ADAPTATION PLANNING USING NATURE’S BOUNDARIES

ICARP TAC Meeting: June 28, 2019

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SF Bay Regional Water Quality Control Board
The Bay and shoreline are heterogeneous and dynamic.

There is no one-size-fits-all approach for SLR adaptation.

Natural infrastructure (such as beaches and wetlands), in conjunction with levees, can lessen flood risk.

Natural infrastructure provides other benefits, such as habitat, recreation, carbon sequestration, aesthetics.
Eleven years to save San Francisco Bay

By Laura Tam and Julie Beagle | June 21, 2019
A science-based framework is essential to identify effective adaptation strategies...

...that are appropriate for their particular settings and that take advantage of natural processes.
Addressing this challenge by:

- Dividing up the Bay into manageable units that respond to the **physical and ecological processes**
- Mapping **suitability for nature-based adaptation measures**
- **Integrating across the land-water divide**, and connecting bayside measures with landside measures
STEP 1
Plan using nature’s boundaries (instead of traditional boundaries)

STEP 2
Identify adaptation measures that could work well in a given place (and use nature as much as you can)

STEP 3
Use when bringing stakeholders together to envision a resilient future
Physical processes that govern the shoreline happen at the Bay scale.

Too large and complex for individual projects.
Traditional jurisdictions

- 9 counties
- 101 cities
- Multiple special districts
- Regulatory jurisdictions
- Frontline communities in low-lying areas
Sea level rise will not stop at city boundaries.
What is a useful scale?

Operational Landscape Units

Areas with shared geophysical and land use characteristics suited for a particular suite of nature-based measures

- Bigger than a project
- Bigger than a City
- Smaller than a County
Geomorphic Unit Types

1. Headlands & small valleys
2. Alluvial fans & plains
3. Wide alluvial valleys
Housing density

Although most high-density residential areas are set back from the shoreline, many places where job centers are located near the Bay shore and are potentially at risk from future sea level rise. In addition to protecting these areas by relocating workplaces, the region is aiming to invest in resilient infrastructure by converting parks, rail, and transportation methods to reduce reliance on the Bay shore—driving home the need for climate planning.

Source: U.S. Census Bureau (2017a)

Job density

Although most high-density residential areas are set back from the shoreline, many places where job centers are located near the Bay shore and are potentially at risk from future sea level rise. In addition to protecting these areas by relocating workplaces, the region is aiming to invest in resilient infrastructure by converting parks, rail, and transportation methods to reduce reliance on the Bay shore—driving home the need for climate planning.

Source: U.S. Census Bureau (2017a)
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7.12 ft NAVD - King Tide, 2019
Crab Cove Alameda

Photo: King Tides Initiative
### Adaptation measures

**Nature-based measures**
- Nearshore reefs
- Submerged aquatic vegetation (eelgrass)
- Beaches (sand, cobble, shell)
- Tidal marshes
- Polder management
- Ecotone levees
- Migration space preparation
- Creek-to-bayland reconnections
- Green stormwater infrastructure

**Regulatory, financial, policy tools**
- Zoning and overlay zones
- Setbacks, buffers, and clustering
- Building codes and building retrofits
- Rebuilding and redevelopment restrictions
- Conservation easements
- Tax incentives and special assessments
- Geologic Hazard Abatement District
- Transfer of Development Rights
- Buyouts
Submerged vegetation restoration

Nearshore reefs

Submerged aquatic vegetation (eelgrass)

Beaches

Tidal marshes

Polder management

Ecotone levees

Migration space preparation
Suitability of nature-based measures

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Flood-proofing buildings and retrofits

Elevating roadways

Perimeter Protection

Beaches

Eel grass

Oysters

Polder management

Nature-based Adaptation Measures

Selected Measures

Suitability

Neighborhood Scale

Submerged aquatic vegetation

Beaches

Tidal marshes

Polder management

Eel grass

Oysters

Polder management

Flood-proofing buildings and retrofits

Elevating roadways

Perimeter Protection

Other Adaptation Opportunities

This OLU has a diverse mix of place types including office parks, industrial buildings and small areas on the north (Hunters Point) and south side of the OLU, which are home to office parks and commercial redevelopment areas. Adaptation opportunities include redeveloping land along the polder management, completing and elevating roadways, perimeter protection with grey infrastructure or hybrid grey/green systems, and flood-proofing buildings and retrofits.
Acquiring migration space

Easements, buyouts in open/protected areas

Elevating roadways

Polder management

Marsh Restoration

Migration Space

Creek connections

Napa – Sonoma

Nature-based Adaptation Measures

In the Napa-Sonoma OLU there has been significant landscape-scale management of migration space. Funds and flexible opportunities to restore large connective patches of tidal marsh in the neighborhood of roads and rail corridors that are vulnerable to tidal flooding provide a window of opportunity to connect the existing levees and existing levees to reduce flooding. Shifting, tidal creek crossings are narrow, and the tidal marsh that exists in the transition zone. All of the existing tidal marsh and reed beds in the Sonoma Creek basin are preparing migration space for through to maintain or move through. The majority of these areas should be connected to or one of the existing tidal marshes being mined for vineyards. Acquiring and protecting these areas will be key to creating marsh restoration pathways. Much of the existing tidal marsh is adjacent to the creeks and is disconected from undeveloped migration space by large and deep polders such as Skaggs Island. If raised to tidal elevations, these polders could be converted to tidal marsh. However, the amount of sediment needed is considerable and raising the shoreline may be more feasible. Significant opportunities exist to improve the delivery of freshwater, nutrients, and sediment from Sonoma Creek and the Napa River to build better elevation capital to upland in these sub-basins and to reduce flooding issues. There are also opportunities for widening the bridge crossings at Sonoma Creek and Toll Creak if Highway 37 is raised on some combination of embankments and pilings. Ecotone levee creation is less critical in this OLU due to limited presence of development in need of protection, but ecotone levees could be incorporated into the design of embankments to raise Highway 37 or the railroad.

Other Adaptation Opportunities

Like Petaluma, the very large Napa-Sonoma OLU has the benefit of large migration space, providing opportunities for large and flexible candidate floodwaters. The large areas that allow flooding to occur and that are large enough to support recreational and agricultural uses to habitat or ecological uses over time, through restoration work, transition to tidal marsh, and other good planning. The tools to do this are ready and at the disposal of the various public and private sector solutions. A key will be to strike a balance of conservation easements or voluntary buyouts. For the suburban areas of the OLU where conversion may go on further in the future, but the tools to support these opportunities will be ready and at the disposal of the various public and private sector solutions. Balancing on what the community prefers to invest in. Elevating Highway 37 to slow tidal action northward toward formerly diked wetlands would significantly support the large areas of restoration possible in this OLU.
Adaptation pathways

Conceptual phasing of measures triggered by sea-level rise, rather than a chronological timeline (adapted from Goals Project 2015).

KEY

- Threshold
- Decision point
- Lead time required to implement
- Timing of actions to be effective

Sea Level Rise

0ft 1ft 2ft 3ft 4ft 5ft

Existing marsh
Add beaches, sediment, recharge, channels
Acquire, restore, and create transition zone
Realign levees and/or adjust land use
**STEP 1**
Plan using nature’s boundaries (instead of traditional boundaries)

**STEP 2**
Identify adaptation measures that could work well in a given place (and use nature as much as you can)

**STEP 3**
Use when bringing stakeholders together to envision a resilient future
How can this be used?

- As a toolkit to bring together stakeholders around a given shoreline unit
- A resource to assist environmental review and permitting
- Guidance for developers and project applicants
- Local, regional planners, and communities creating adaptation plans and policies
THANK YOU

Contact: julieb@sfei.org

Thanks to our team: Jeremy Lowe, Sam Safran, Katie McKnight, Letitia Grenier, SFEI
Laura Tam and Sarah Jo Szambelan, SPUR

For more info: adaptationatlas.sfei.org