SLR ADAPTATION FRAMEWORK
PLANNING WITH NATURE:
A demonstration in Marin County

North Bay BAYCAN meeting
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Point Blue
Conservation science for a healthy planet.
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Introduction

- Challenge of transitioning from vulnerability assessments to adaptation solutions
- Lots of interest in nature-based options, where are they appropriate?
- **Goal:** Develop a *framework process and set of tools* to support the transition from vulnerability assessment to adaptation strategies at a useful scale
Sea level rise will not stop at city boundaries.
Traditional jurisdictions

- 9 counties
- 101 cities
- Multiple special districts
- Regulatory jurisdictions
- Frontline communities in low-lying areas
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**
- **Evaluate tradeoffs** between the choices we need to make
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
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
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Geomorphologic unit types

1. Headlands & small valleys
2. Alluvial fans & plains
3. Wide alluvial valleys
Data inputs

- Defined by geomorphic units & bathymetry
- Characterized by
  - Physical and ecological factors
  - Built environment patterns
  - Key vulnerabilities
How can this be used?

- As a toolkit to bring together stakeholders around a given shoreline unit (BCDC)
- A resource to assist environmental review and permitting (BCDC, RB2)
- Guidance for developers and project applicants
- Local, regional planners, and communities creating adaptation plans and policies
  - Cities, local visions
FRAMEWORK

STEP 1: Assess vulnerability
- what assets are vulnerable & where;
- what is the source of vulnerability

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

STEP 3: Envision desired future(s)
- what are desired outcomes?
- Develop visions/themes

STEP 4: Develop adaptation strategies
- Strategy = a combination of “measures”;
- Develop for each desired future or theme

STEP 5: Evaluate and prioritize
- assess benefits and tradeoffs among strategies

Planning within nature’s boundaries
Assess vulnerability
STEP 1 Assess vulnerability (what assets are vulnerable & where; what is the source of vulnerability)

Sources of vulnerability
• Combined flooding
• Subsided lands behind levees
• Eroding shorelines
• Infrastructure

Assets
• Less developed, in public ownership
• Topography, sediment
Identify adaptation measures

Nature-based measures

- Nearshore reefs
- SAV (eelgrass)
- Beaches
- Tidal marsh
- Polder management
- Ecotone levees
- Migration space preparation
- Creek-to-bayland reconnections
- Green stormwater infrastructure
For each adaptation measure:

- **Landscape configuration and process guidelines**
- **Ecosystem functions**
- **Coastal risks managed**
- **Ecosystem services**
- **Policy considerations**
- **Examples**
Marsh restoration

Methods:

- Identify areas currently at the right elevation to potentially support tidal marshes using $z^*$ (~MSL and ~HAT)
- Assess width of marsh needed to knock 100-year waves down to ~1 ft (0.3 m)
Novato OLU: Suitable nature-based measures

- Tidal marsh
Novato OLU: Suitable nature-based measures

- Tidal marsh
- Polder management

A polder (the site of Hamilton Airfield) before and after being opened to tidal action. (Photo courtesy Google Earth)
Novato OLU: Suitable nature-based measures

- Tidal marsh
- Polder management
- Ecotone levee
Novato OLU: Suitable nature-based measures

- Tidal marsh
- Polder management
- Ecotone levee
- Migration space preparation (unprotected and protected)

### Selected Measures

<table>
<thead>
<tr>
<th>Nature-Based Measures</th>
<th>Suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nearshore reefs</td>
<td>⬜</td>
</tr>
<tr>
<td>Submerged aquatic vegetation</td>
<td>⬜</td>
</tr>
<tr>
<td>Beaches</td>
<td>⬜</td>
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<tr>
<td>Tidal marshes</td>
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<tr>
<td>Polder management</td>
<td>⬜ ⬜ ⬜</td>
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<tr>
<td>Ecotone levees</td>
<td>⬜ ⬜ ⬜</td>
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<tr>
<td>Migration space preparation</td>
<td>⬜ ⬜ ⬜ ⬜</td>
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Legend:
- Black circle: High suitability
- Gray circle: Limited suitability
- White circle: Some suitability
Envision desired futures

(What are desired outcomes? Articulate visions/themes for the future)

- A “strategy” combines adaptation measures within an OLU
- A distinguishing goal/theme and criteria are needed to develop strategies
- Strategy themes should be developed with stakeholders
Example Theme #1
“Hold the line”

• Build up existing defenses
• Employ nature-based adaptation options bayward of existing first line of defense
Example Theme #1  
“Hold the line”

• Build up existing defenses
• Employ nature-based adaptation options bayward of existing first line of defense
Example
Theme #2: “Buffer w/ public open space”

- Existing people and infrastructure remain protected in place
- Retreat first line of defense only on public open space
- Retreat allows more space for additional nature-based options
Example Theme #3: “Maximize habitat”

- Maximize opportunities for habitat enhancement
- Existing people/homes remain in place
- Key infrastructure may need to be re-aligned/re-designed
Timing
Matters

How might objectives change with SLR?

- **2010**: Initial state
- **2030**: Restoration in progress
- **2050**: Development of marshes
- **2070**: Mudflats develop
- **2100**: Low marsh formed

Legend:
- Subtidal
- Mudflat
- Low Marsh
- Mid Marsh
- High Marsh
- Upland
Evaluate and Prioritize Strategies

- Identify benefits / services important to stakeholders
- Identify “benefit-relevant indicators” that can be measured (quantitative or qualitative)
- Assess trade-offs among strategies

**Examples of indicators**
- Amount of fill needed
- Distance of existing shoreline protection to be raised/maintained
- Area of vegetated marsh habitat projected in Year 2050
- Total miles of trails
- Indicators defined by the community

<table>
<thead>
<tr>
<th>Cost Considerations</th>
<th>Cultural/Social Services</th>
<th>Regulating Services</th>
<th>Provisioning Services</th>
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</thead>
<tbody>
<tr>
<td>Low cost construction/maintenance</td>
<td>Recreation</td>
<td>Coastal hazard reduction</td>
<td>Food (e.g., sportfish)</td>
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<tr>
<td>Ease of permitting</td>
<td>Education</td>
<td>Carbon sequestration and storage</td>
<td>Raw materials</td>
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<tr>
<td>Political/community acceptability</td>
<td>Aesthetic</td>
<td>Water filtration (improved water quality)</td>
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<td>Supporting Services</td>
<td>Spiritual/Sense of place</td>
<td>Services to disadvantaged communities/vulnerable populations</td>
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<td>Biodiversity support (habitat, species)</td>
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<td>Nutrient cycling</td>
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**NOTE:** only need to quantify benefits that differ among strategies. For example, if coastal hazard reduction is equivalent across strategies (inherent in the designs)
Evaluate and Prioritize Strategies

- Higher values mean “more benefit”
- **Compare total benefits** of strategies, while still seeing the tradeoffs
- Can **weight** certain benefits more than others
- Supports an **informed choice**
- May lead to developing **alternative strategies**
There is no one-size-fits-all approach for SLR adaptation.

- Some places there are a lot of options for nature-based measures and some places there aren’t.
- Options change with SLR. Developing pathways is important. Timing matters.
- Needs to be done with and led by stakeholders and communities.
Next Steps

- Developing “User’s Guide” of the framework with case study examples
- Initial feedback via existing planning process
- Piloting approach in partnership with the County
THANK YOU

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