



California's
Coastal Zoning

Social and Legal Considerations for
Coastal Adaptation

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COASTAL ADAPTATION: CHALLENGES AND QUESTIONS

What solutions are possible? Where? To what extent?

- COASTAL ADAPTATION: CHALLENGES AND QUESTIONS

- Changing climate → increased inundation and erosion in coastal areas



Winter storm and coastal flooding
Capitola, Santa Cruz County
March 2014



Erosion and coastal squeeze
Surfer's Beach, San Mateo County
January 2017

● COASTAL ADAPTATION: CHALLENGES AND QUESTIONS

- Two spatially dependent lenses:
 1. What strategies are feasible in a given location?
 2. Where can a given strategy be implemented?

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INTEGRATING COASTAL VULNERABILITY INTO LAND USE PLANNING

Natural Capital Project InVEST model

InVEST

integrated valuation of
ecosystem services
and tradeoffs

● INTEGRATING COASTAL VULNERABILITY INTO LAND USE PLANNING

InVEST model



Coastal exposure

Protective services of natural infrastructure

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LEGAL CONTEXT: ZONING

Linking existing legal structure to model outputs



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LEGAL CONTEXT: ZONING

Linking existing legal structure to model outputs

Jesse Reiblich, Lisa M. Wedding, & Eric H. Hartge. *Enabling and Limiting Conditions of Coastal Adaptation: Local Governments, Land Uses, and Legal Challenges*. 22 *Ocean & Coastal Law Journal* 156 (2017).

● LEGAL CONTEXT: ZONING

- Acquire geospatial data

- Sort zoning designations from local ordinances into generalized categories

- Merge local datasets into statewide layer

LEGAL CONTEXT: ZONING



- Statewide zoning designation layer to complement model outputs
 - 93% coverage of coastal zone

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USE BY LOCAL PLANNERS

Connecting biophysical and legal data to real-time decisions

USE BY LOCAL PLANNERS

The screenshot displays the web application interface for REIP (Resilient Ecosystems and Infrastructure Planning). The browser address bar shows the URL geointerest.frih.org/REIP/. The main map area shows a dark-themed map of California with a yellow highlighted coastal region. The sidebar on the left contains map controls and layers:

- Scale: 50 km / 50 mi
- Map Style: dark, imagery, elevation, terrain
- Layers: photos, habitats, population, zoning

The right sidebar is titled "CLIMATE ADAPTATION STRATEGIES" and includes a "Map a category:" section with three categories:

- ENGINEERED: **Dune Restoration Project:** Engineered project to enhance or restore vulnerable or eroded dune systems
- FINANCIAL:
- LEGAL / REG:

Below this, the "ENGINEERED STRATEGIES" section lists various options:

- Beach Nourishment
- Cliff Stabilization
- Dune Restoration Project
- Living Shorelines
- Riprap
- Seawalls
- Elevation of Structures
- Wetland Restoration

A yellow hexagonal icon with a bulldozer symbol is positioned to the right of the "Dune Restoration Project" option. The interface also includes a top navigation bar with "REPORTS", "EXPOSURE", "STRATEGIES", and "KEY" tabs, and a bottom right corner with a "CART" icon and a page number "3".

USE BY LOCAL PLANNERS

The screenshot displays the web application interface for local planners. The browser address bar shows the URL `geointerest.frih.org/REIP/`. The main map area shows a coastal region with various colored overlays. A legend on the left allows users to toggle map layers: `dark`, `imagery` (selected), `elevation`, `terrain`, `photos`, `habitats` (checked), `population` (checked), and `zoning`. A scale bar indicates 3 km and 1 mi. A regional map inset shows the location within Southern California, highlighting San Bernardino, Riverside, Palm Springs, Oceanside, San Diego, National City, and Tijuana.

A central menu titled "CLIMATE ADAPTATION STRATEGIES" is open, listing strategies under three categories:

ENGINEERED	FINANCIAL	LEGAL/ REGULATORY
Beach Nourishment	Buyout Program	Development Moratoria
Living Shorelines	Conservation Easements	Overlay Zones
Riprap	Geologic Hazard Abatement Districts (GHADs)	Redevelopment Restrictions
Seawall	Transfer of Development Rights	Trigger Language
Elevation of Structures		
Wetland Restoration		

On the right, a control panel titled "CLIMATE ADAPTATION STRATEGIES" allows users to filter the map by category:

- Map a category:
 - 1. ENGINEERED
 - 2. FINANCIAL
 - 3. LEGAL / REG
- LEG / REG STRATEGIES:
 - Development Moratoria
 - Overlay Zones
 - Redevelopment Restrictions
 - Trigger Language

The interface includes navigation controls (back, forward, home, refresh) and a search bar at the top. A "KEY" button is visible in the top right of the application area.

USE BY LOCAL PLANNERS

The screenshot shows a web application interface for climate adaptation strategies. At the top, there are tabs for 'REPORTS', 'EXPOSURE', 'STRATEGIES', and 'KEY'. The 'STRATEGIES' tab is active. Below the tabs, there is a map showing a coastal area with a hexagonal grid overlay. A legend on the left side of the map includes options for 'dark', 'imagery', 'elevation', 'terrain', 'photos', 'habitats', 'population', and 'zoning'. The 'imagery' option is selected. A scale bar indicates 3 km and 1 mi. A detailed information panel is open over the map, showing three categories: 'ENGINEERED', 'FINANCIAL', and 'LEGAL/ REGULATORY'. The 'LEGAL/ REGULATORY' category is selected, and a detailed information panel for 'Development Moratoria' is open. This panel includes a description, tradeoffs, considerations, and examples.

CLIMATE ADAPTATION STRATEGIES

Map a category:

- ENGINEERED
- FINANCIAL
- LEGAL / REG

ENGINEERED

- [Beach Nourishment](#)
- [Living Shorelines](#)
- [Riprap](#)
- [Seawall](#)
- [Elevation of Structures](#)
- [Wetland Restoration](#)

FINANCIAL

- [Buyout Program](#)
- [Conservation Easements](#)
- [Geologic Hazard Abatement Districts \(GHADs\)](#)
- [Transfer of Development Rights](#)

LEGAL/ REGULATORY

- [Development Moratoria](#)

Development Moratoria

Temporary development prohibition while planning proceeds

Tradeoffs:

- Only a means to an end; not an end in itself
- Limited in duration and scope
- Maintains status quo

Considerations:

- If determined to be invalid, may constitute temporary taking
- California imposes two-year limit on moratoria
- Only suitable during planning or study process

Examples: Stinson Beach (Marin County), Redondo Beach (LA County)

● USE BY LOCAL PLANNERS

- Methodology is flexible and applicable nationwide
 - Arkema et al. (2013) Nature paper provides framework for coastal vulnerability analysis at scale
- Hurricanes Harvey and Irma highlight importance of integrated analysis



Thanks!

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