Adaptation Pathways Planning Framework

Dolan Eversole- University of Hawaii Sea Grant Program

LAC NDE FORUM 2026 - Session 5: System Transformation

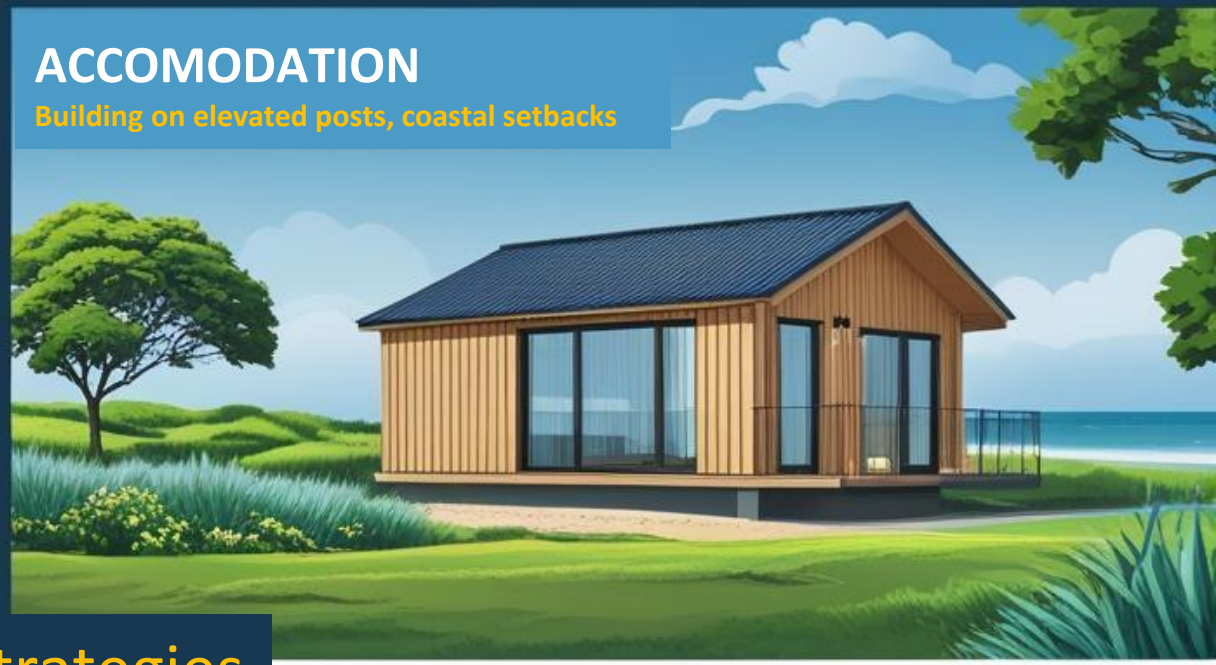
Adaptation Strategies

PROTECTION

Hard Armoring to protect critical infrastructure

ACCOMODATION

Building on elevated posts, coastal setbacks



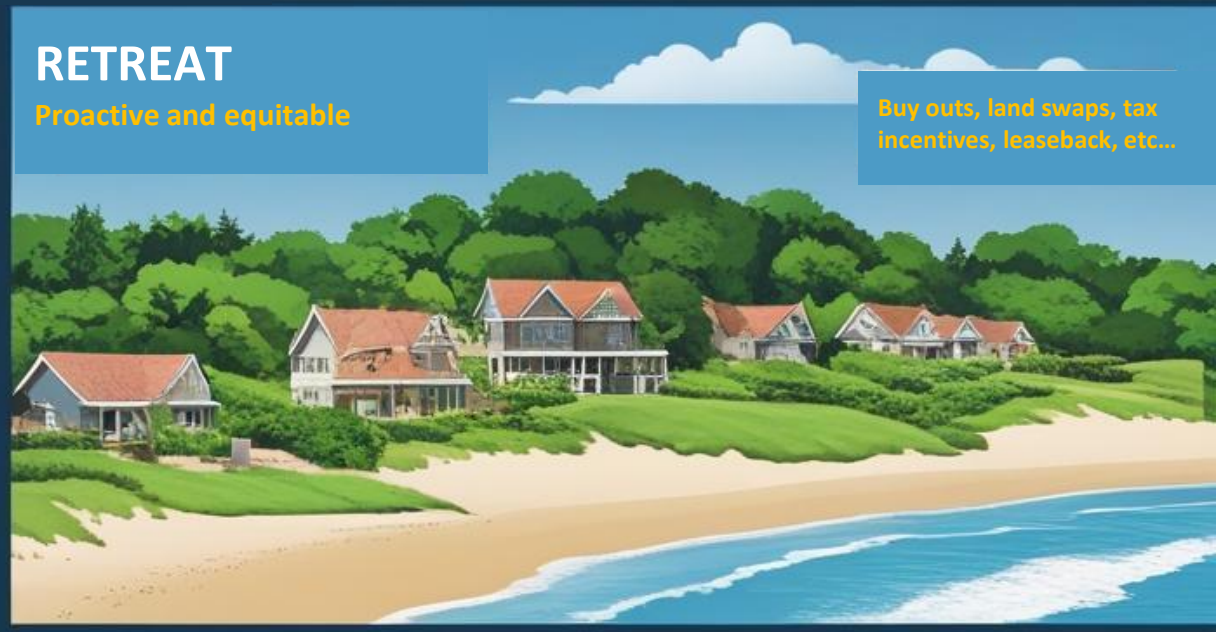
RESTORATION

Restoring natural ecosystems and processes

RETREAT

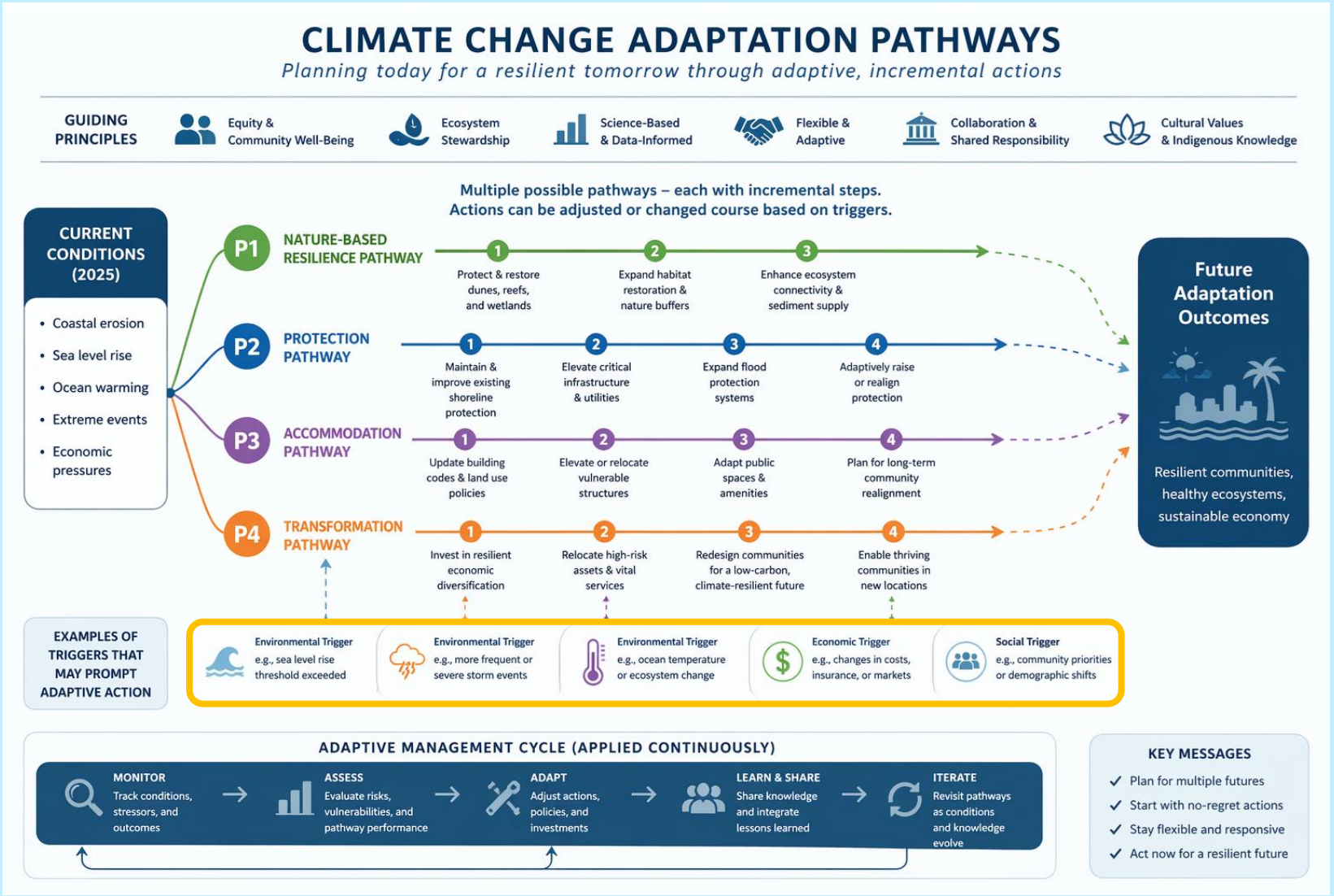
Proactive and equitable

Buy outs, land swaps, tax incentives, leaseback, etc...

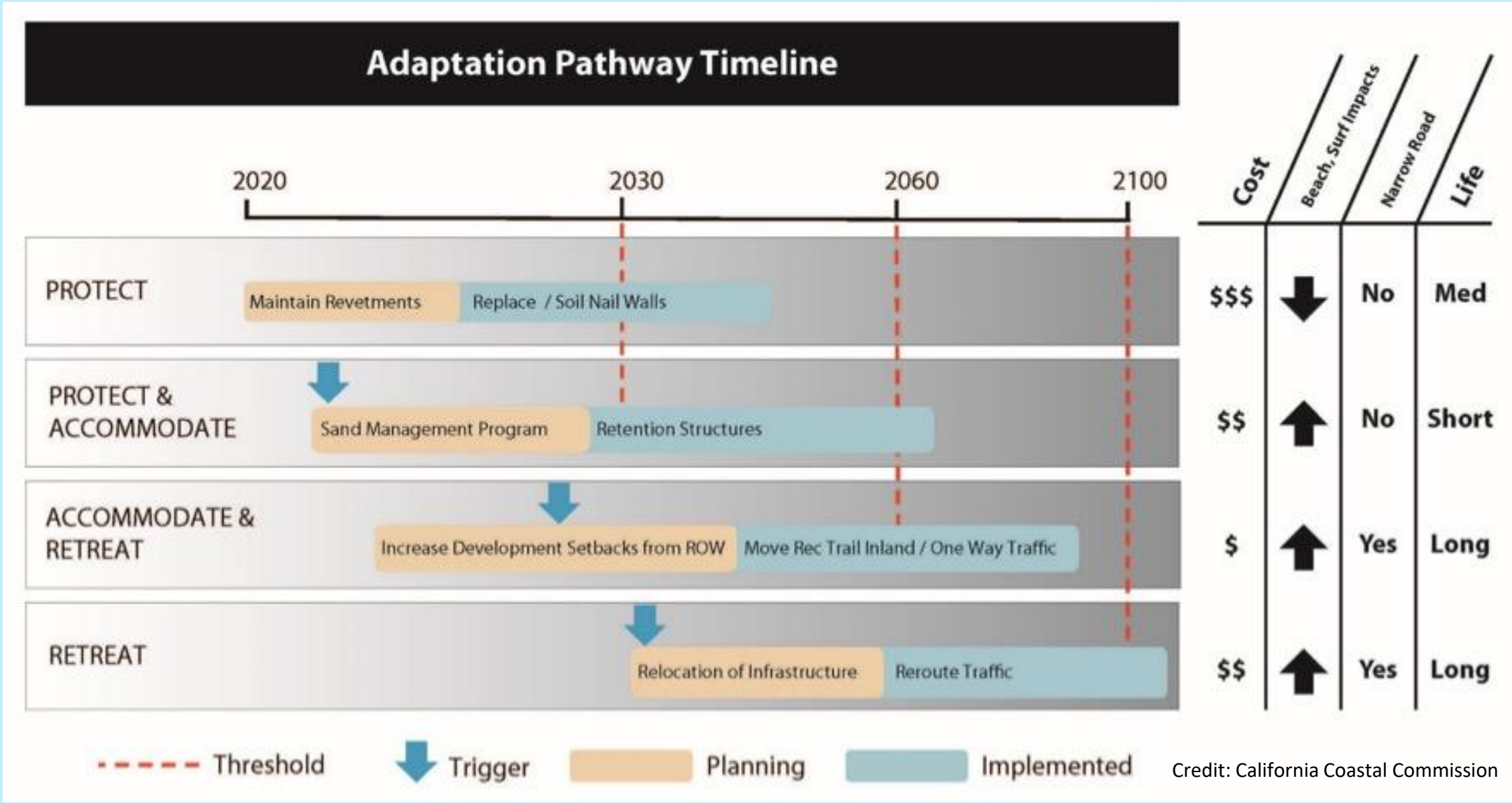


Adaptation Pathways Framework

Focus on sea level rise adaptation/accommodation



Adaptation Pathways and Triggers



Credit: California Coastal Commission

Waikīkī Resilience and SLR Adaptation Project

PROJECT WEBSITE

https://www.uhcdc.manoa.hawaii.edu/work/wrap

Sea Grant
UNIVERSITY OF HAWAI'I

UHCDC
UNIVERSITY OF HAWAI'I
COMMUNITY DESIGN CENTER

STATE OF HAWAI'I
OFFICE OF PLANNING AND
SUSTAINABLE DEVELOPMENT

Hawaii CZM Program
Coastal Zone Management

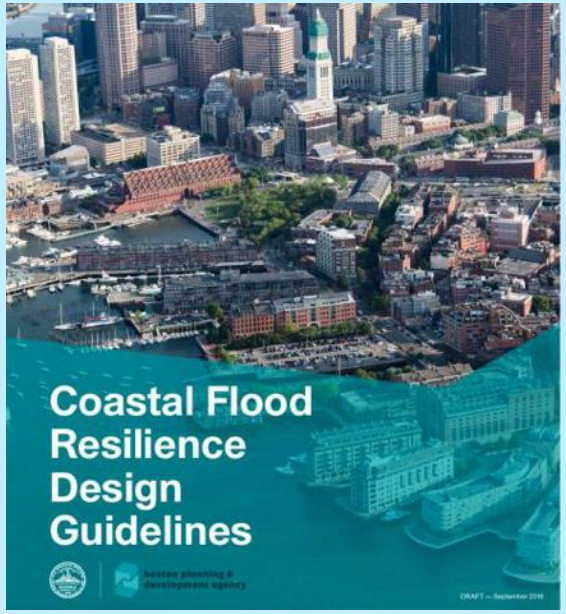
- Interdisciplinary
- Science-Driven
- Climate Change Focus
- 50-100 year timeframe
- Model framework

Adaptation Planning Precedents

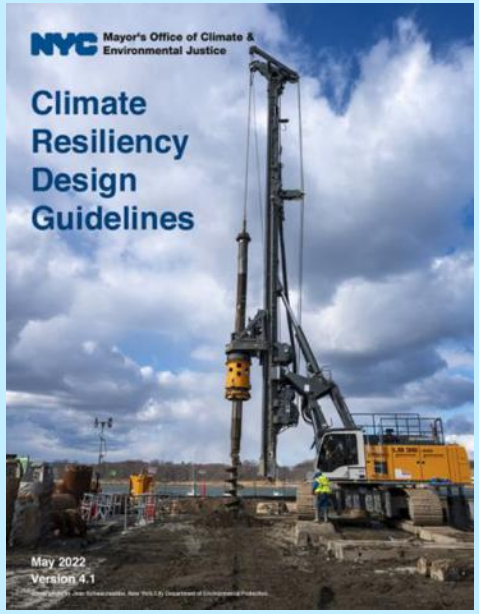
Focus on sea level rise projections and adaptation through accommodation

Adaptation planning efforts in Waikīkī benefit from the precedents in other coastal communities that have implemented innovative and holistic adaptation strategies.

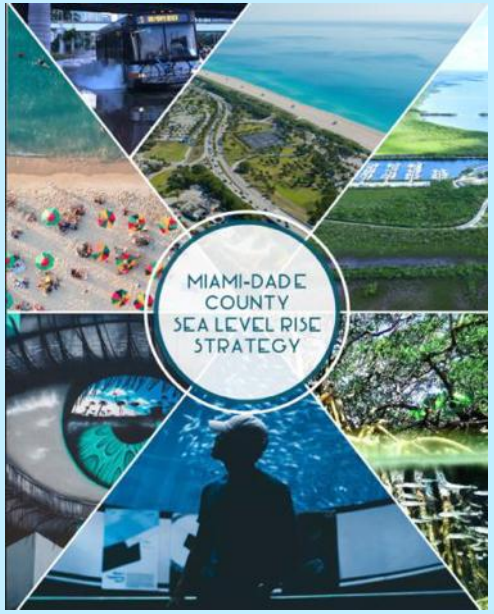
Boston



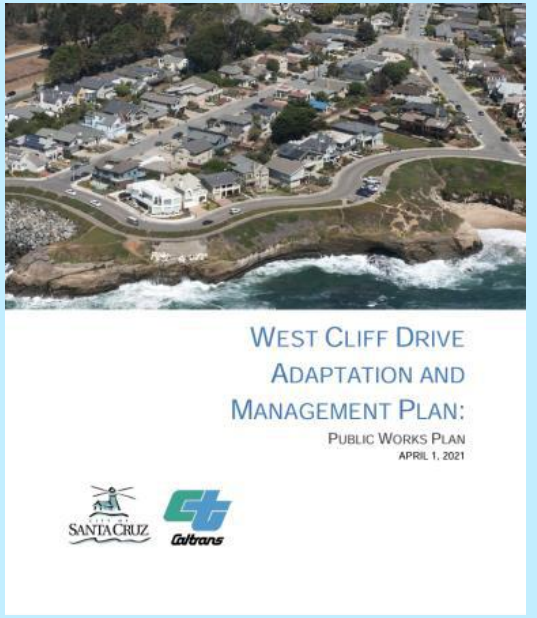
New York



Miami

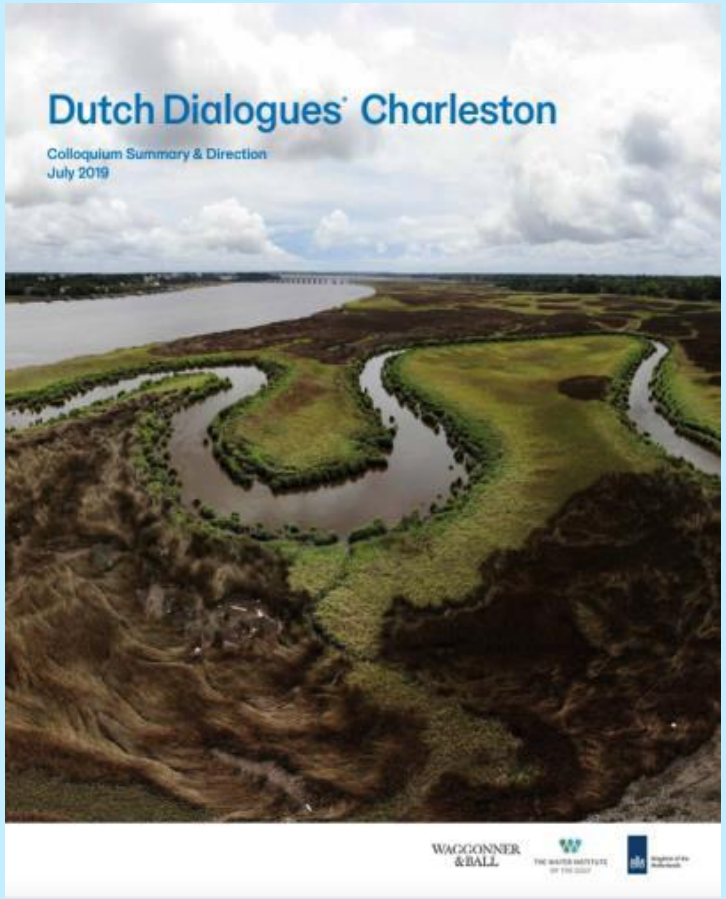


California

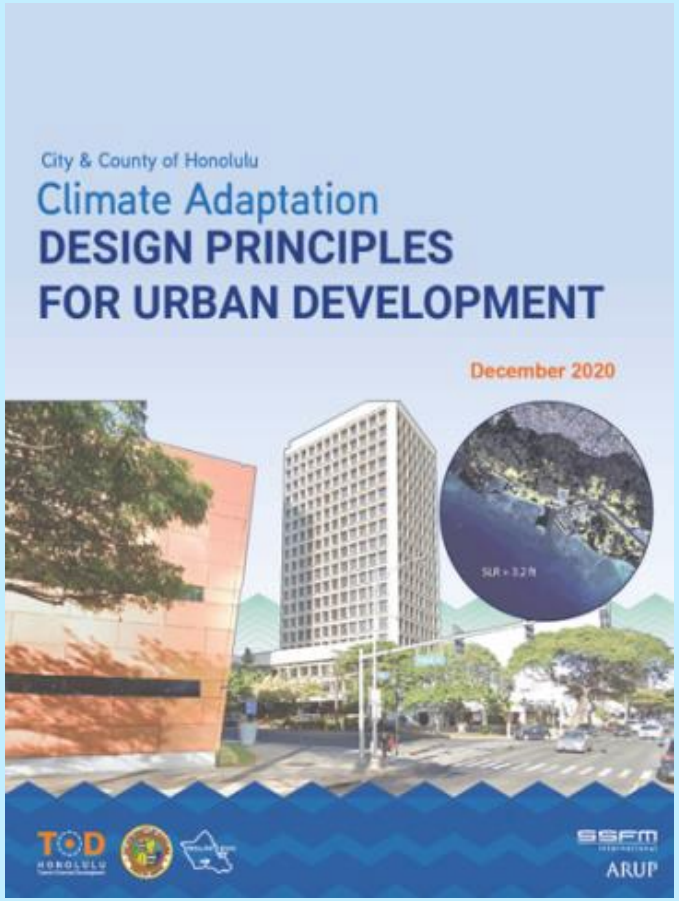


Adaptation Planning Precedents

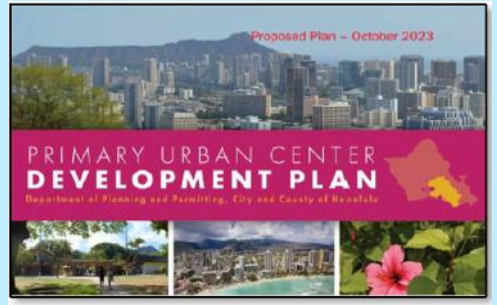
Charleston, South Carolina

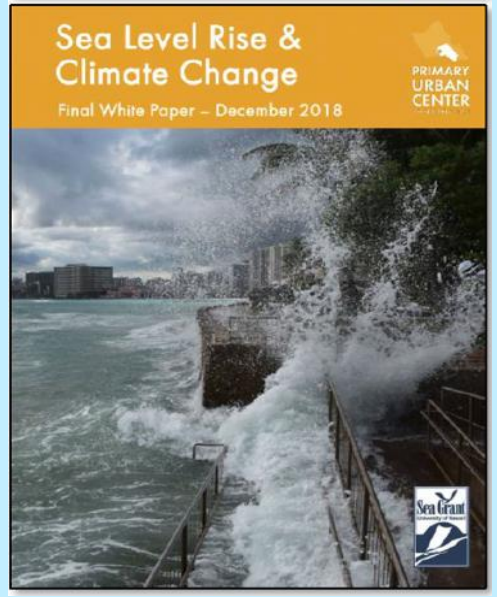


Honolulu, Hawaii

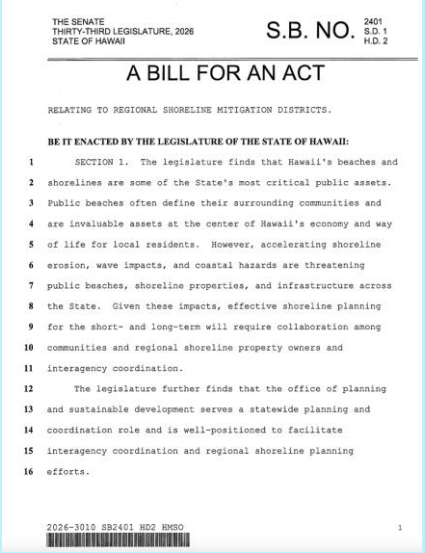


Honolulu
Primary Urban Center





Hawaii State Legislature
Senate Bill 2401
(May, 2026)



THE SENATE
THIRTY-THIRD LEGISLATURE, 2026
STATE OF HAWAII

S.B. NO. 2401 S.D. 1 H.D. 2

A BILL FOR AN ACT

RELATING TO REGIONAL SHORELINE MITIGATION DISTRICTS.

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF HAWAII:

SECTION 1. The legislature finds that Hawaii's beaches and shorelines are some of the State's most critical public assets. Public beaches often define their surrounding communities and are invaluable assets at the center of Hawaii's economy and way of life for local residents. However, accelerating shoreline erosion, wave impacts, and coastal hazards are threatening public beaches, shoreline properties, and infrastructure across the State. Given these impacts, effective shoreline planning for the short- and long-term will require collaboration among communities and regional shoreline property owners and interagency coordination.

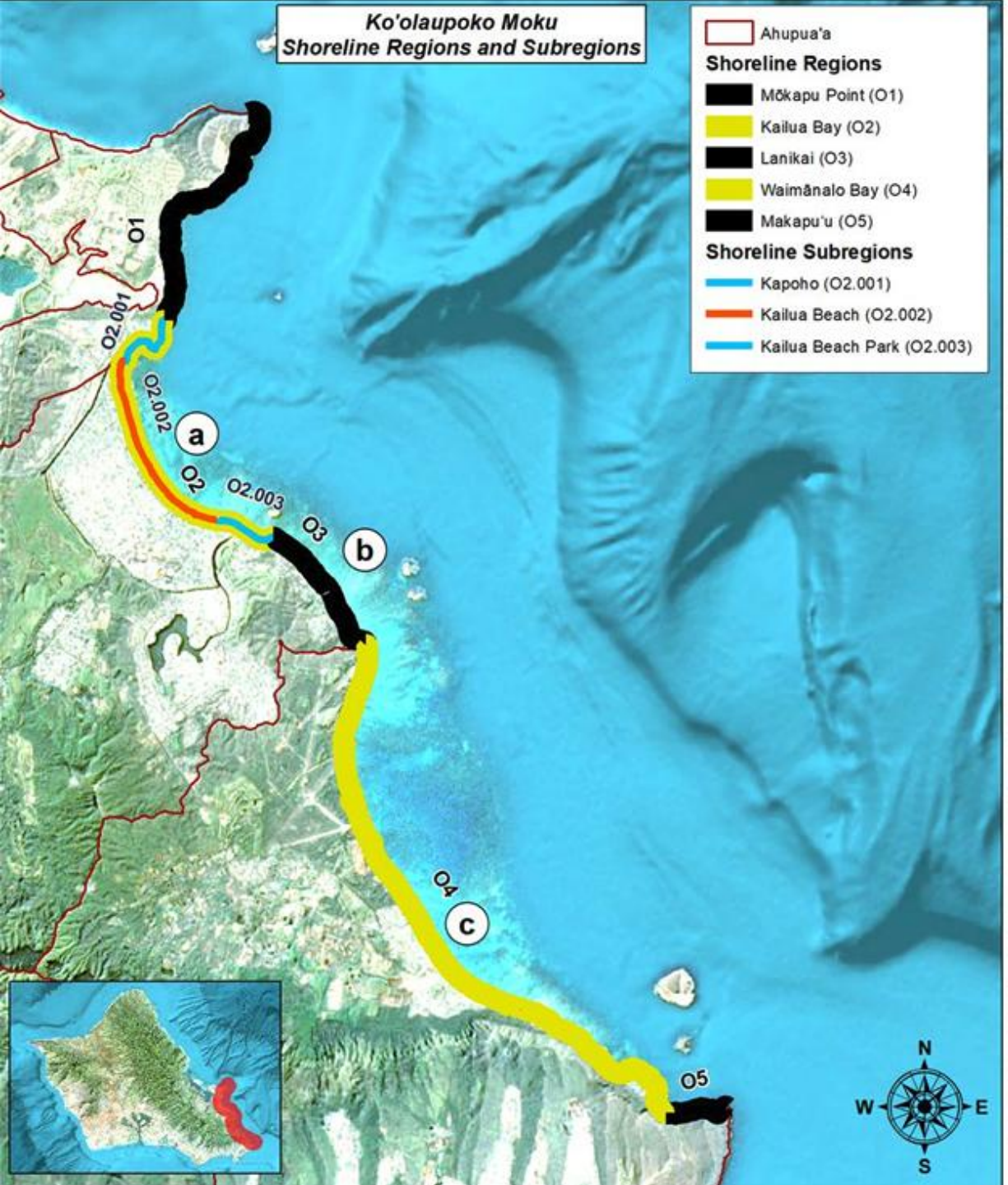
The legislature further finds that the office of planning and sustainable development serves a statewide planning and coordination role and is well-positioned to facilitate interagency coordination and regional shoreline planning efforts.

2026-3010 SB2401 HD2 RMSO 1

RELATING TO REGIONAL SHORELINE MITIGATION DISTRICTS

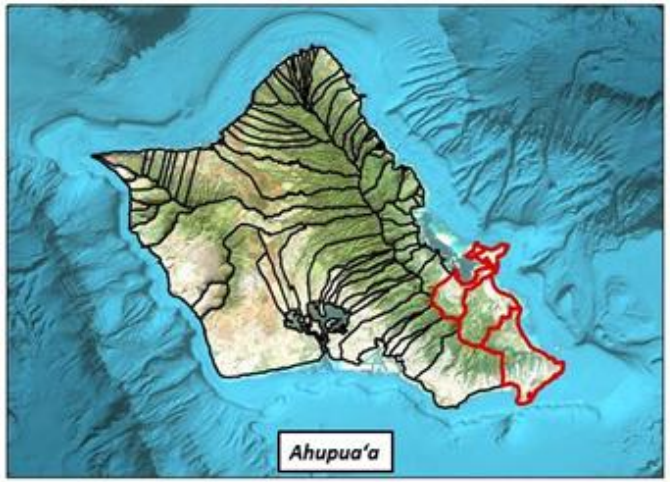
Requires the State Office of Planning and Sustainable Development to plan and serve in a coordinating role to **develop shoreline adaptation pathways plans for regional shoreline mitigation districts.**

https://www.capitol.hawaii.gov/session/measure_indiv.aspx?billtype=SB&billnumber=2401&year=2026


Ko'olaupoko Moku
Shoreline Regions and Subregions
Ahupua'a
Shoreline Regions
Mōkapu Point (O1)
Kailua Bay (O2)
Lanikai (O3)
Waimānalo Bay (O4)
Makapu'u (O5)
Shoreline Subregions
Kapoho (O2.001)
Kailua Beach (O2.002)
Kailua Beach Park (O2.003)
O1
O2.001
O2.002
O2
O2.003
O3
O4
O5
a
b
c
N
W
E
S

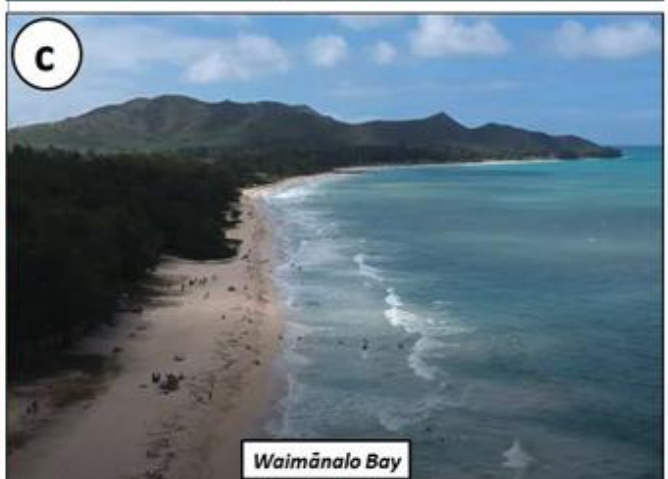

Moku


a
Kailua Bay


Ahupua'a


b
Lanikai


Ko'olaupoko Sustainable Community Plan Area


c
Waimānalo Bay

Adaptation options for sea level rise

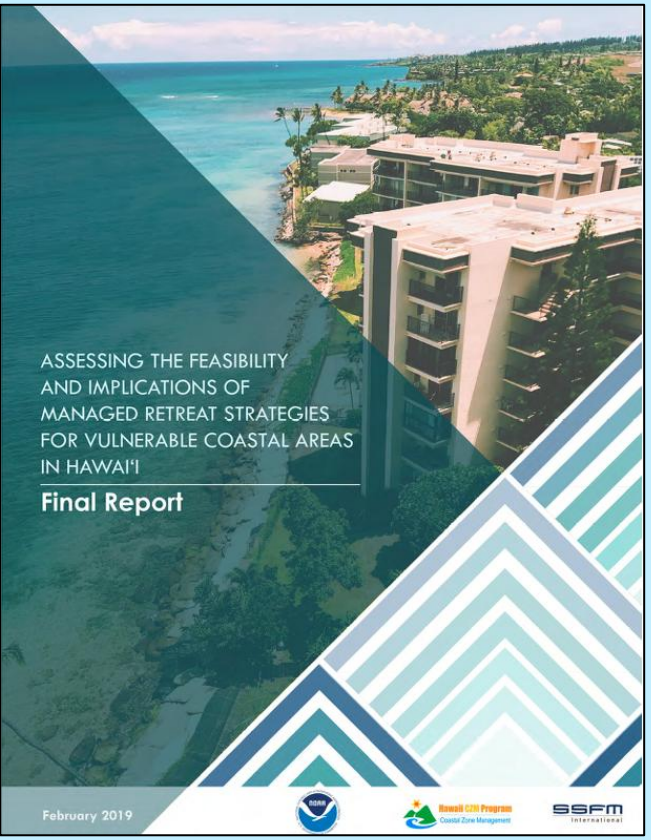
Coastal Adaptation Policies

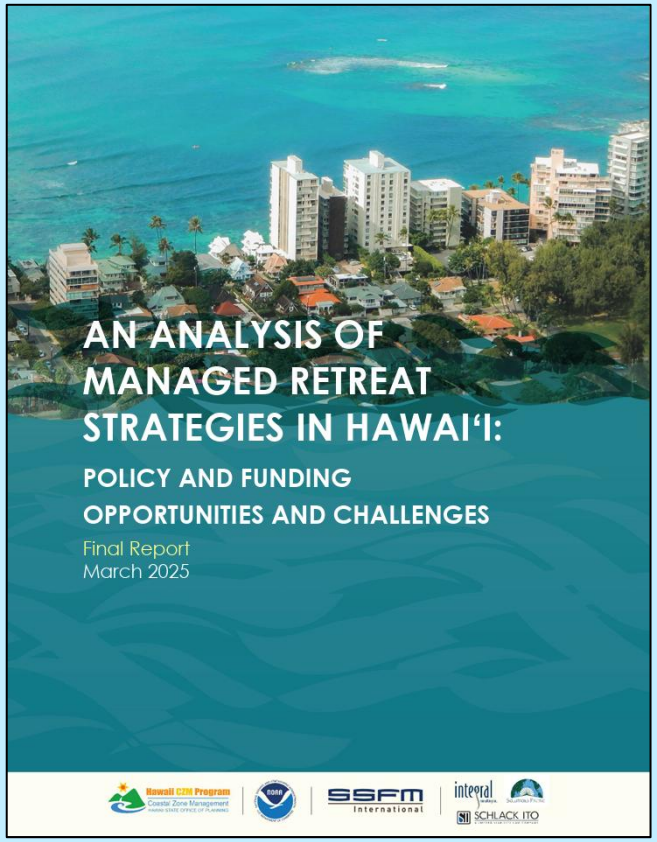
Accommodation

(Relocation- Managed Retreat)

STATE REPORTS ON MANAGED RETREAT

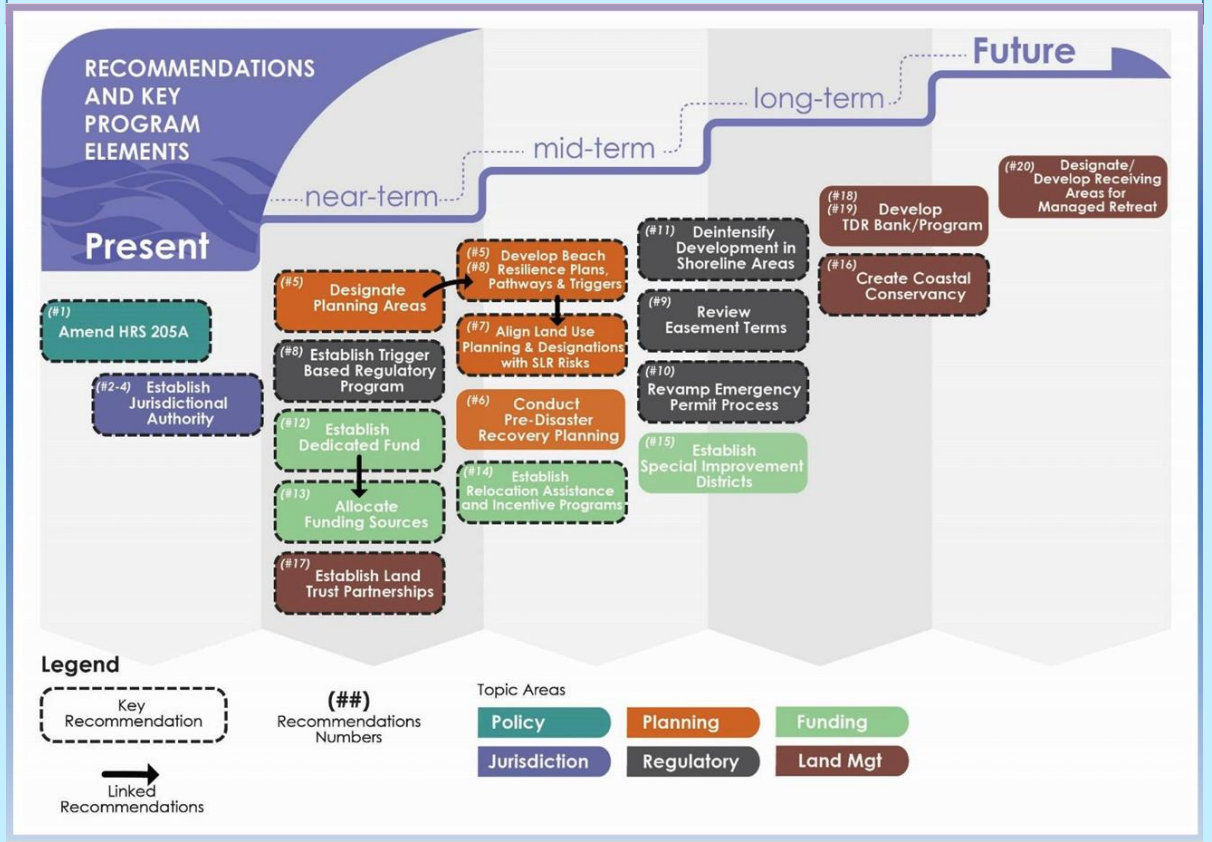
(2019 & 2025)





Selected Policy Recommendations- Managed Retreat

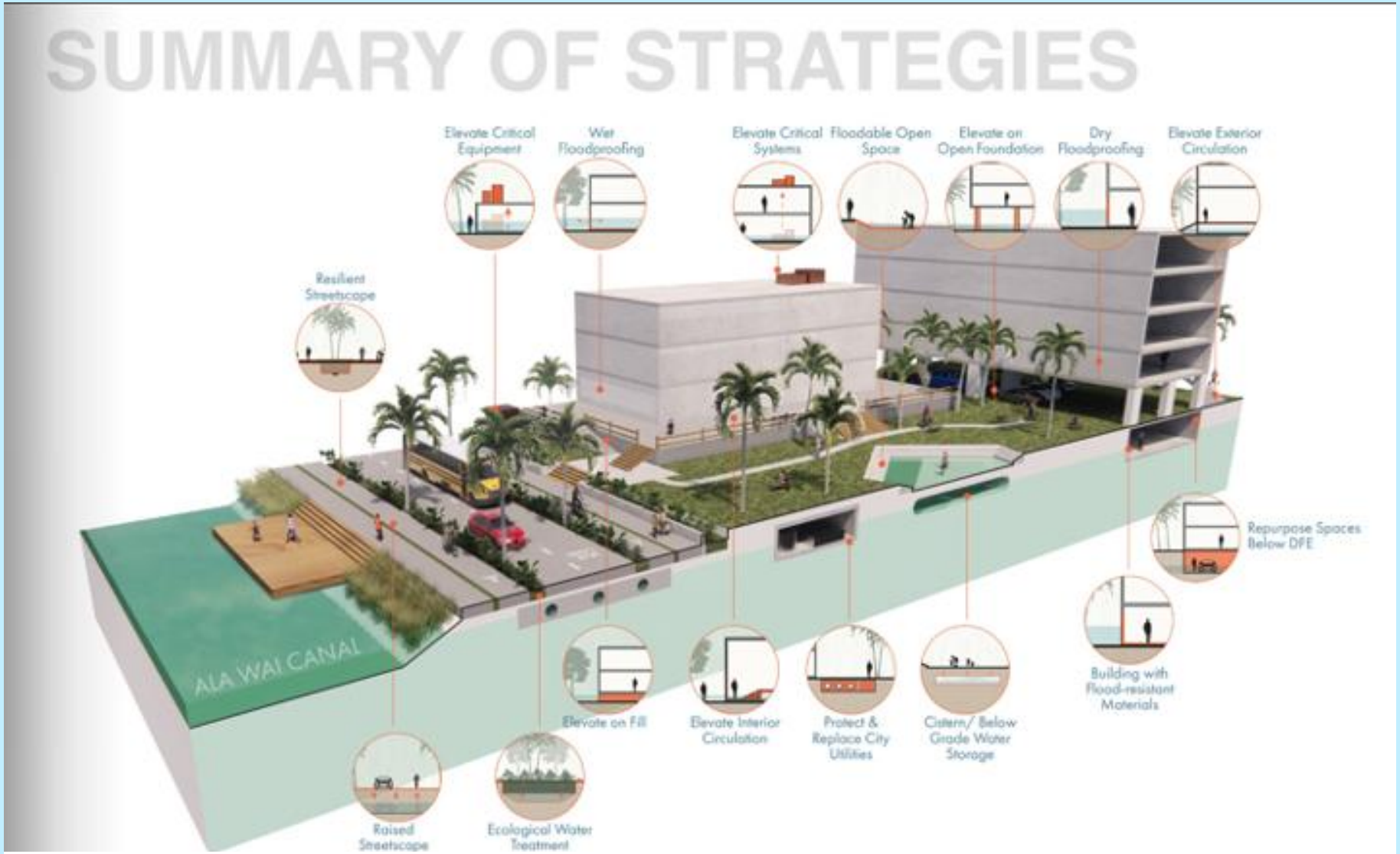
1. Need for a Proactive, Holistic, and Equitable Approach
2. Creation of a Beach Resilience Program (BRP) Using Adaptation Pathways.
3. Importance of Traditional Ecological Knowledge (TEK) and Community Engagement
4. Legal and Policy Foundations Support Managed Retreat, but Gaps Remain.
5. Funding, Incentives, and Land Management Mechanisms Are Essential.



https://planning.hawaii.gov/czm/ormp/ormp-action-team-project-on-the-feasibility-of-managed-retreat-for-hawaii/

Accommodation

(On-site Design Interventions)



Envisioning *In Situ* Sea Level Rise Adaptation Strategies for a Densely Developed Coastal Community, Waikīkī. April 2022.
https://seagrant.soest.hawaii.edu/meguro-adapting-waikiki/#2022-mid-design

Accommodation

(Land Use Design Interventions)

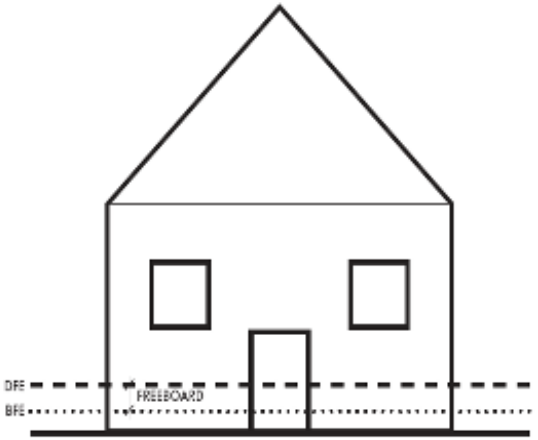
Terms & Definitions

Base Flood Elevation: The elevation of the base flood relative to the datum specified on a community's Flood Insurance Rate Map (FIRM). In any given year, there is a one-percent chance that the base flood will be equaled or exceeded. The BFE is the NFIP's minimum elevation used for design and construction of buildings. Areas affected by the base flood are shown as Special Flood Hazard Area (SFHAs) or FIRMs.

Design Flood Elevation: The elevation of the design flood relative to the datum specified on a community's flood hazard map. This elevation is the higher of the base flood or the value designated for a flood hazard area on a community flood map or otherwise designated.

Freeboard: An added margin of safety expressed in feet above a specific flood elevation, usually the BFE. Some States, Tribes, and many community regulations require freeboard. Freeboard can account for unknown factors, future development and floods higher than the base flood.

Source: FEMA Protecting Building Utility Systems from Flood Damage



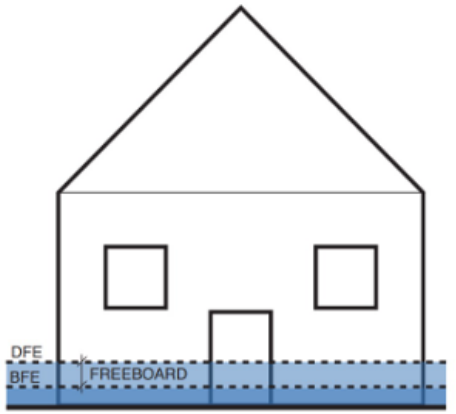
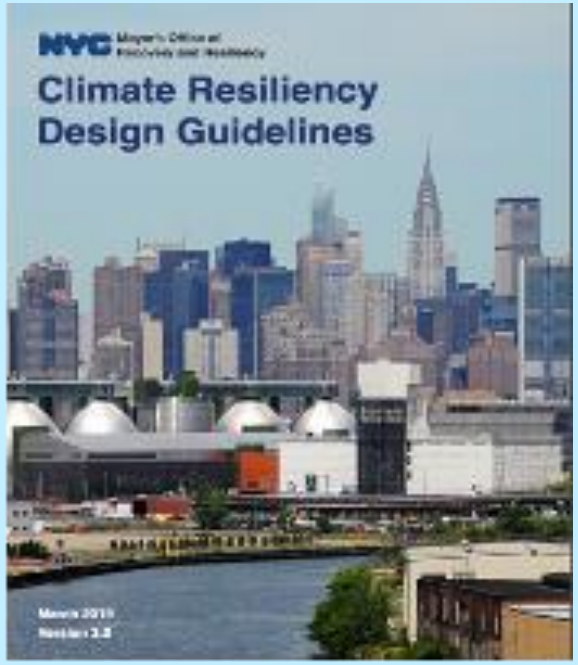


Figure 8. Graphic showing relationship of BFE, DFE & Freeboard

Design Elevations (all MHHW, Honolulu Tide Station)[1]				
NOAA RSLR Scenario	Intermediate		Intermediate High	
Year	2050	2100	2050	2100
MHHW[2]	45 cm	131 cm	62 cm	205 cm
King Tide[3]	19 cm	26 cm	19 cm	26 cm
Water Table[4]	60.1 cm	60.1 cm	60.1 cm	60.1 cm
TOTAL	124.1 cm, **4.1 ft**	217.1 cm, **7.1 ft**	141.1 cm, **4.6 ft**	291.1 cm, **9.6 ft**

[1] Sweet et al. (2017) give three versions of each scenario corresponding to the 17th (low), 50th (medium), and 83rd (high) percentile of the climate-related sea level projections consistent with the GMSL scenario. We use the 83rd percentile due to low risk tolerance of community design.
[2] Relative to the year 2000.
[3] 12 exceedances per yr
[4] Water table, 2 ft clearance to provide some dry depth.

Table 2. Estimated sea level rise and king tide scenarios for Honolulu Tide Station at NOAA Intermediate & Intermediate-High scenarios.



The historical response to erosion has been to armor the shoreline, which has led to beach loss and impacts to neighboring property.

Avoidance: Coastal Setbacks

Adaptation

Miami Beach, Florida

Miami Dade County Sea-level Rise Strategy

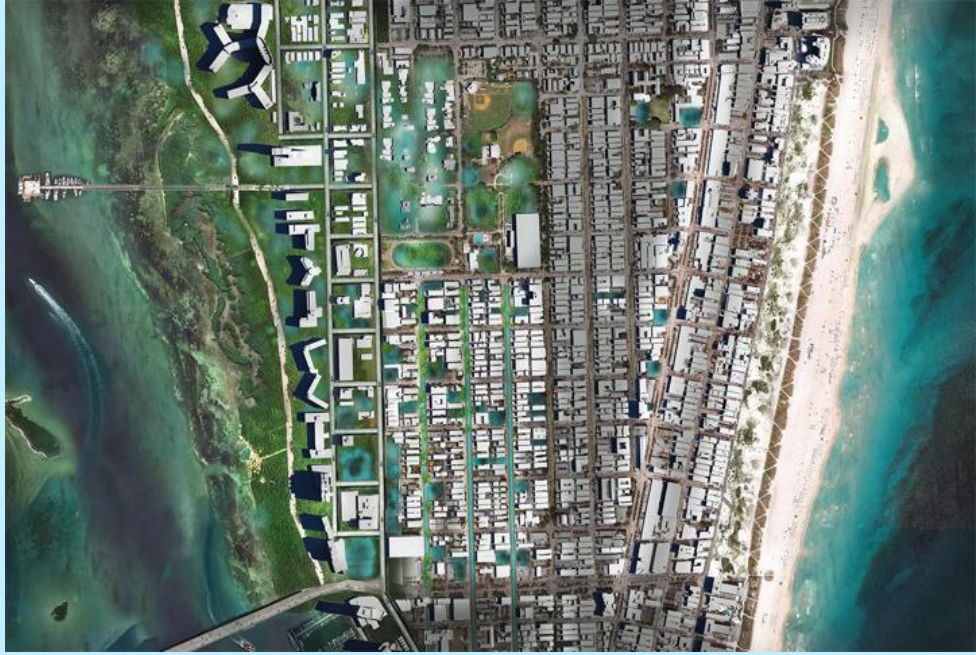
Florida's Resilient Coastlines Program conceptual adaptation four-step planning process. Image Credit: FDEP, 2018.

https://miami-dade-county-sea-level-rise-strategy-draft-mdc.hub.arcgis.com/

Accommodation

Miami Beach, Florida

MIAMI DROWNING
(Isaac Stein, University of Miami, 2015)



https://www.vanityfair.com/news/photos/2015/11/miami-beach-rising-sea-levels-plan

- Restored mangroves
- Raised walkways through mangroves
- Recreational waterways
- High rise towers sacrifice lower floors
- Raised roads
- Re-introduced trams
- Reduced reliance on automobiles

Adaptation Examples

Santa Cruz, California

West Cliff Drive

RESILIENT COAST SANTA CRUZ
BUILDING RESILIENCE TO SEA LEVEL RISE

Adaptation Strategies Considered

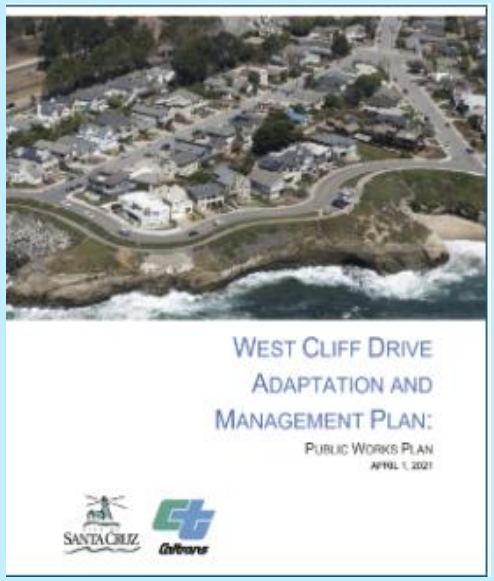
- Emergency Armoring
- Coastal Recreation and Sand Backpass
- Protection Focused
- Managed Retreat

https://storymaps.arcgis.com/collections/1ecc423b4af54d28aae59db0be0e99a9?item=8

Accommodation Triggers

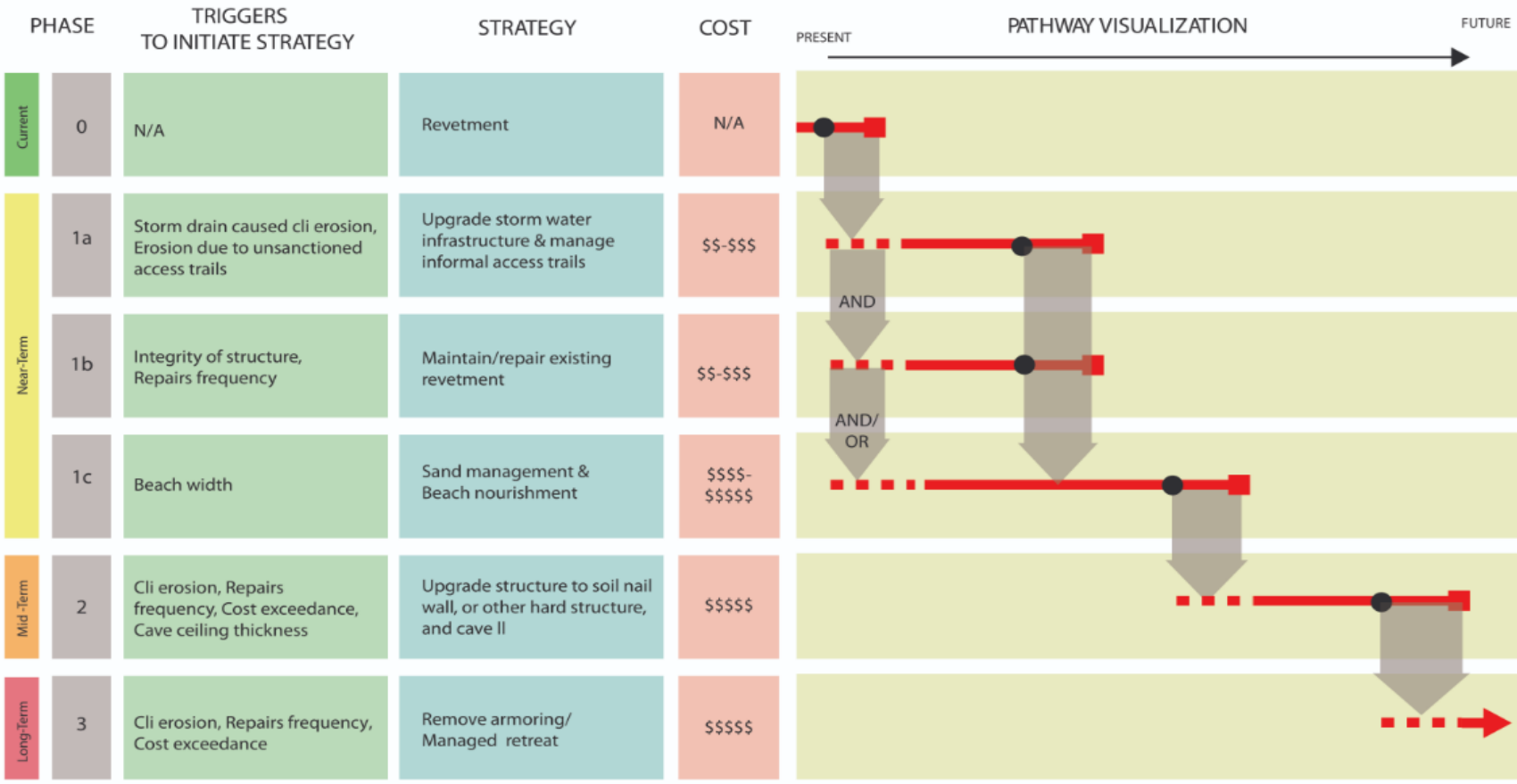
Santa Cruz, California

West Cliff Drive



WCD 1 Pyramid Beach

	PHASE	TRIGGERS TO INITIATE STRATEGY	STRATEGY	COST
Current	0	N/A	Revetment	N/A
Near-Term	1a	Storm drain caused cli erosion, Erosion due to unsanctioned access trails	Upgrade storm water infrastructure & manage informal access trails	$$-$$$
Near-Term	1b	Integrity of structure, Repairs frequency	Maintain/repair existing revetment	$$-$$$
Near-Term	1c	Beach width	Sand management & Beach nourishment	$$$$-$$$$$
Mid-Term	2	Cli erosion, Repairs frequency, Cost exceedance, Cave ceiling thickness	Upgrade structure to soil nail wall, or other hard structure, and cave II	$$$$$
Long-Term	3	Cli erosion, Repairs frequency, Cost exceedance	Remove armoring/ Managed retreat	$$$$$



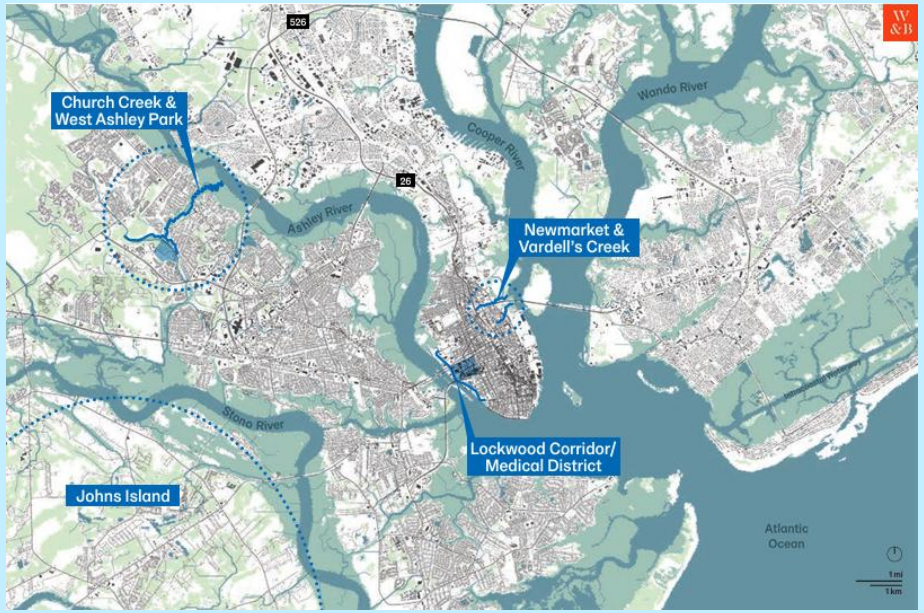
Adaptation Examples
Community Engagement

Charleston,

South Carolina

“Dutch Dialogues”

https://www.historiccharleston.org/dutch-dialogues/



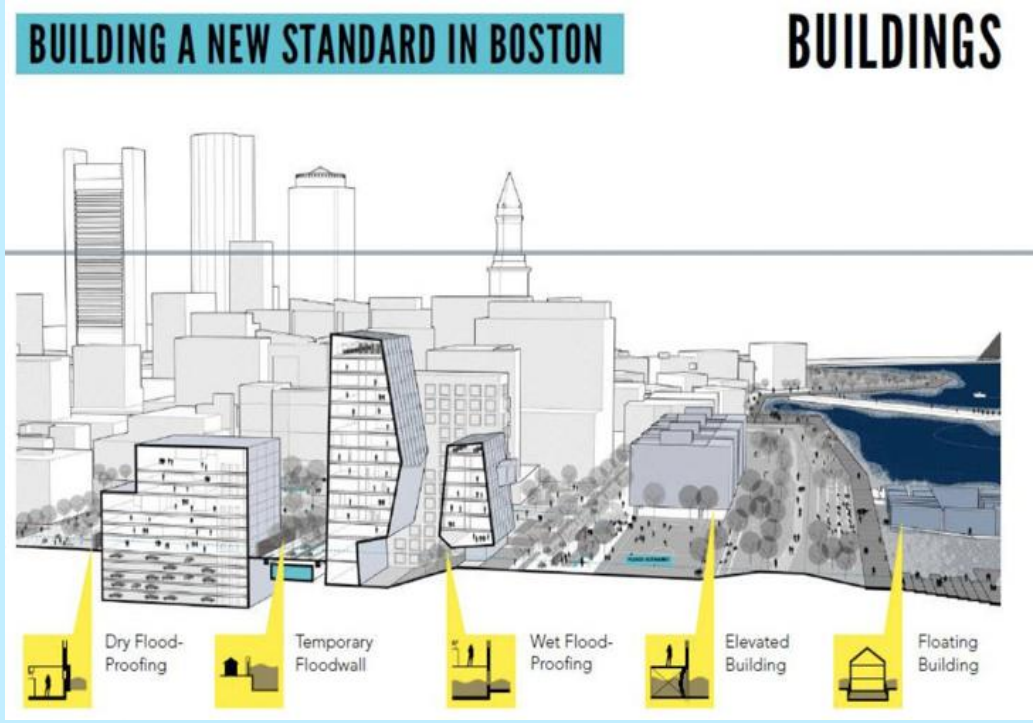
The Charleston, SC “Dutch Dialogues” were a collaborative, multi-disciplinary effort in 2019 by local experts, government and community members to develop an integrated flood and stormwater management plan that incorporates key concepts of resiliency and economic vitality.

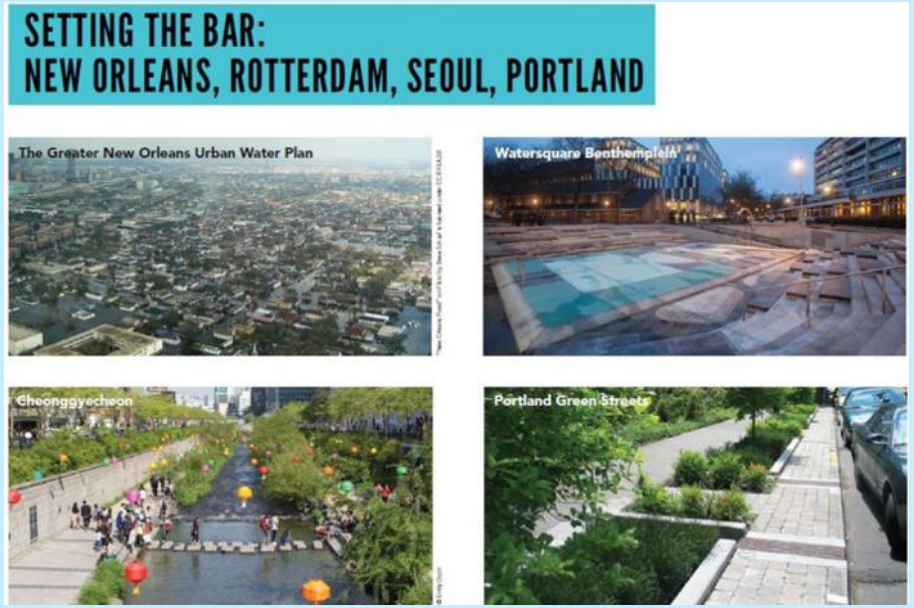
Accommodation

Boston, Massachusetts

Coastal Flood Resilience Design Guidelines

Figure 2. An example photo of a “Repurpose or Reuse Ground Floor Use” solution. Source: Boston Coastal Flood Resilience Design Guidelines.

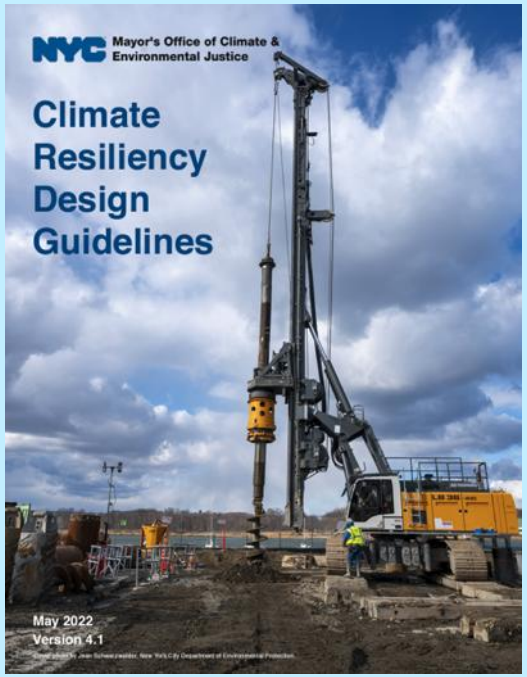




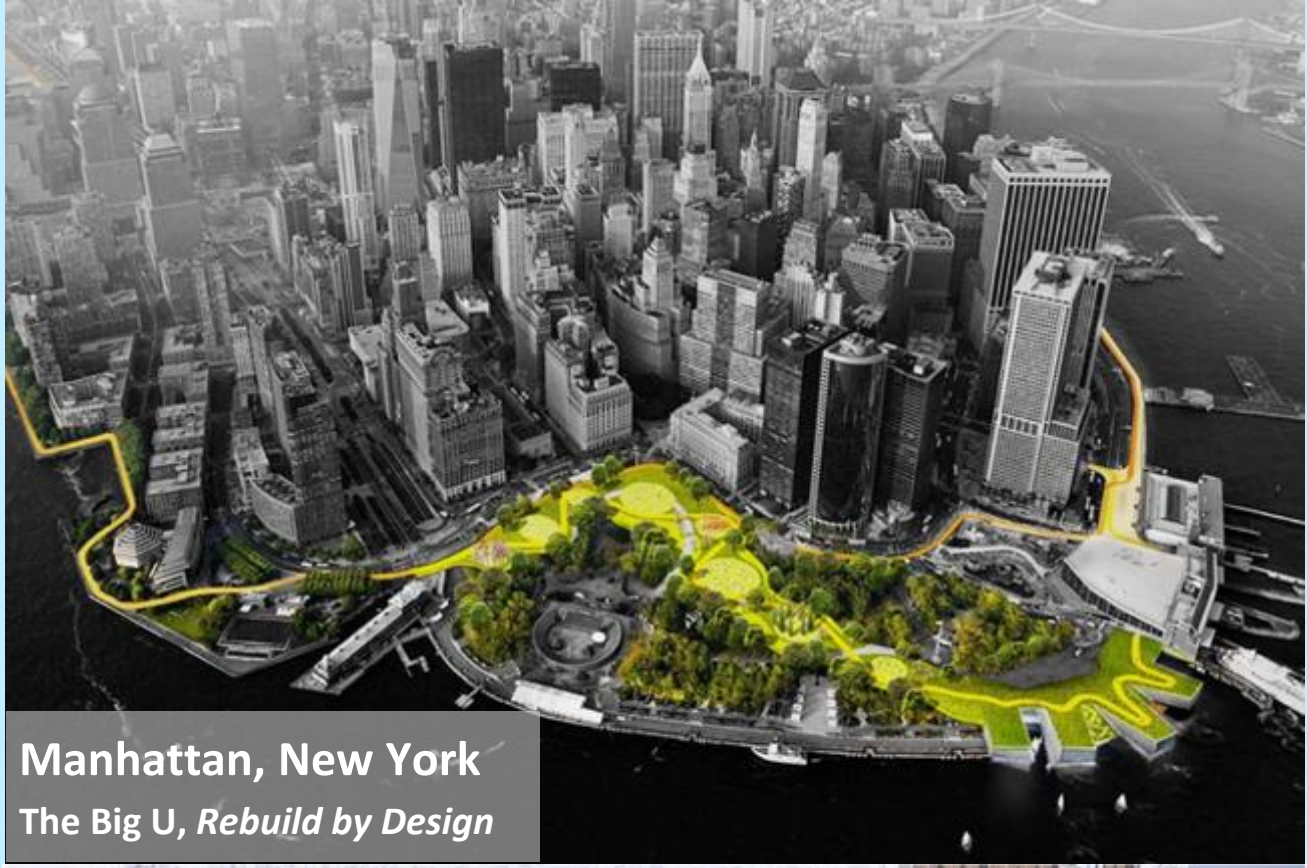
Case studies in Netherlands, Korean, Portland, and New Orleans for public space resiliency. Source: Sasaki Associates, Inc, 2014

Protection & Accommodation

New York



"If you wage war with water, you will lose."

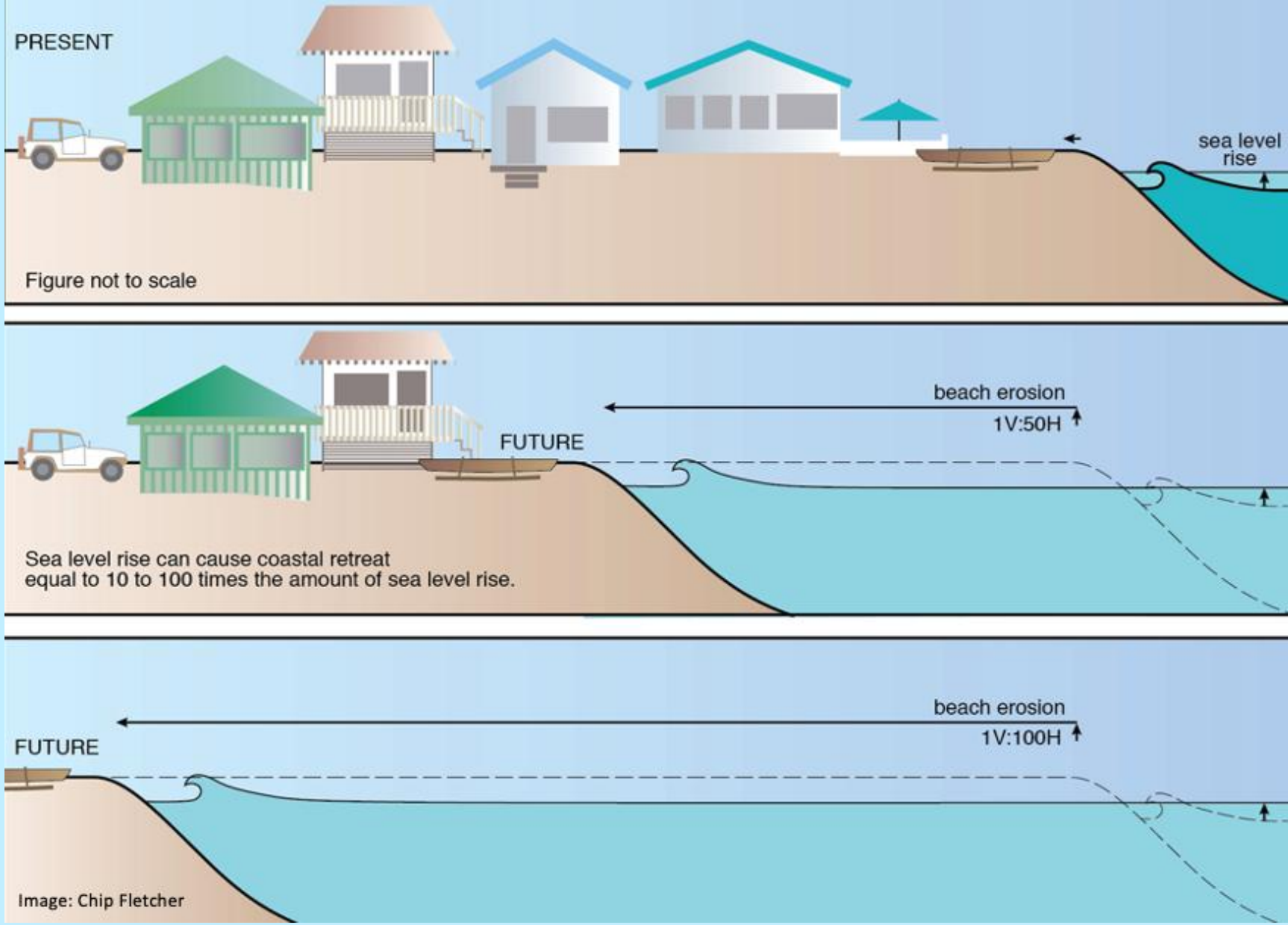


Aloha and Mahalo

Dolan Eversole-
University of Hawaii Sea Grant Program
eversole@hawaii.edu

Adaptive Relocation

(Managed Retreat)



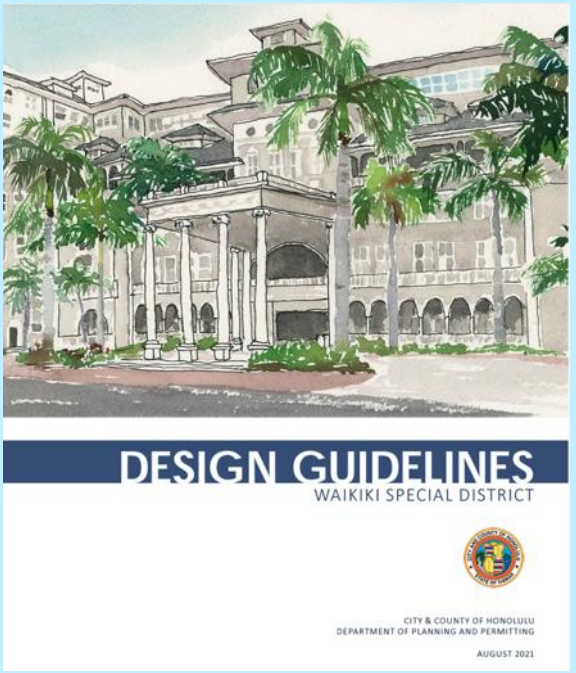
NOAA DEFINITION:

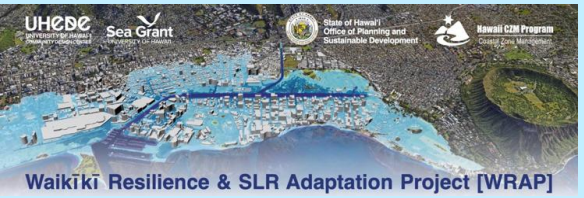
"Managed retreat typically involves establishing thresholds to trigger the demolition or relocation of structures threatened by coastal hazards or sea level rise."

https://web.archive.org/web/20150905055350/http://coastalmanagement.noaa.gov/initiatives/shoreline_ppr_retreat.html

Accommodation (Adapting In-place)

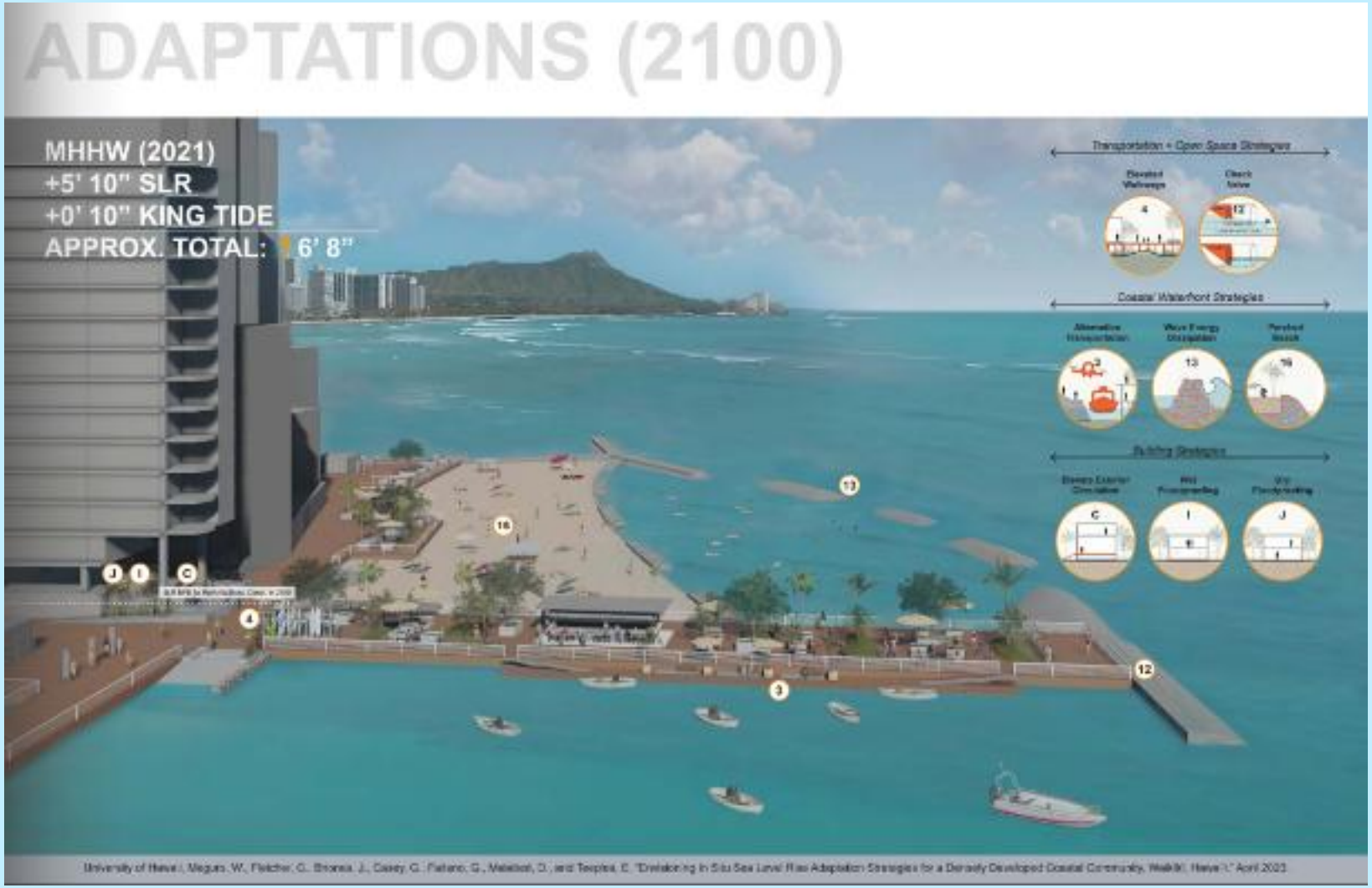
Waikīkī Special District





Accommodation

(Design Interventions)



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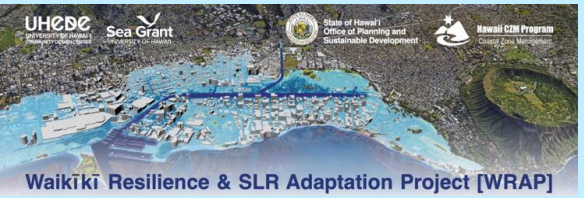
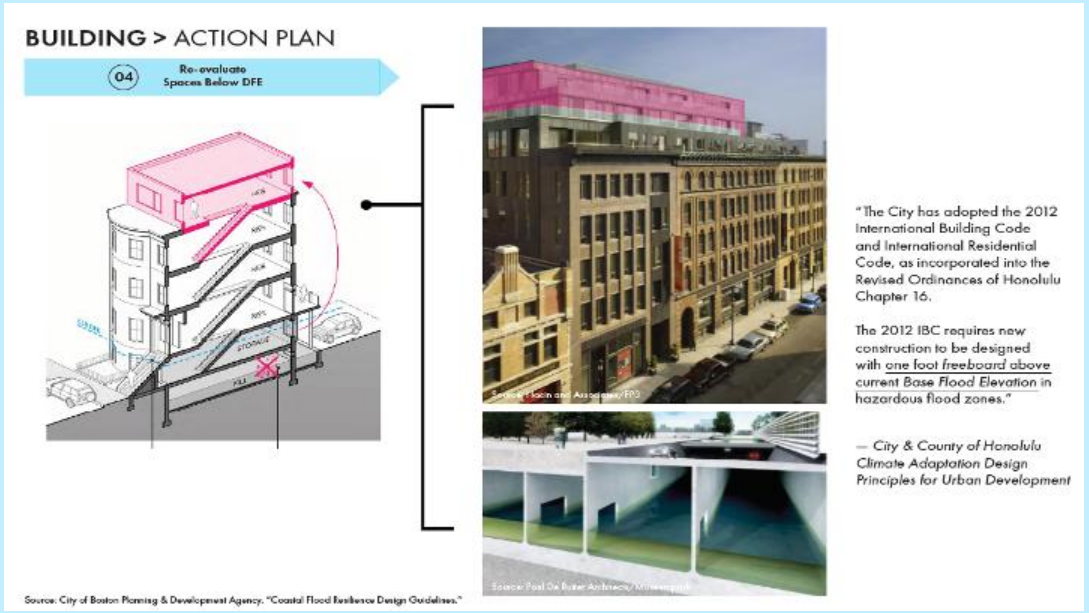
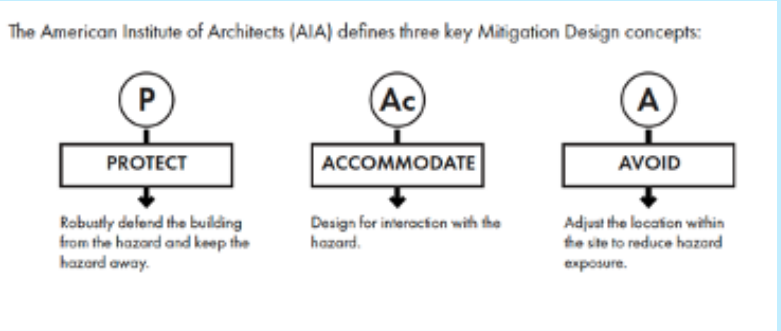
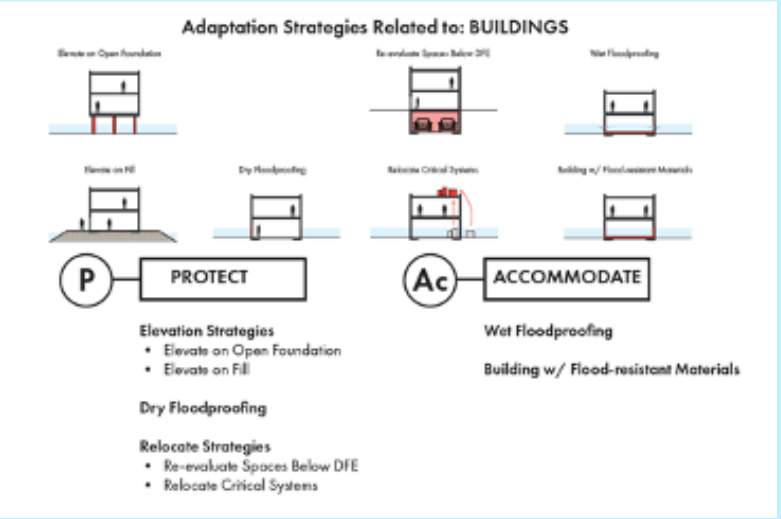


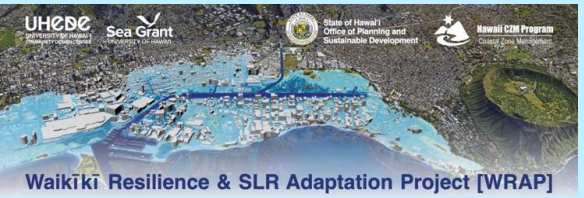
Accommodation

(Design Interventions)









Accommodation

(Design Interventions)

BUILDING

At-grade Occupied Space(s)

Related Strategies:

Prioritize:

01 :Relocate Critical Systems

2a :Dry Floodproofing

OR

2b :Wet Floodproofing

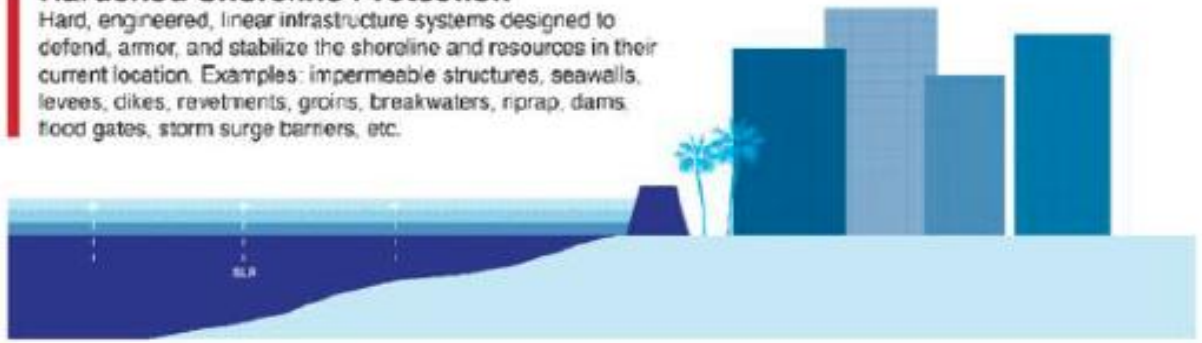
03 :Building w/ Flood-resistant materials

If possible,

04 :Elevate Lowest Interior Floor with Exterior/Interior Access to DFE

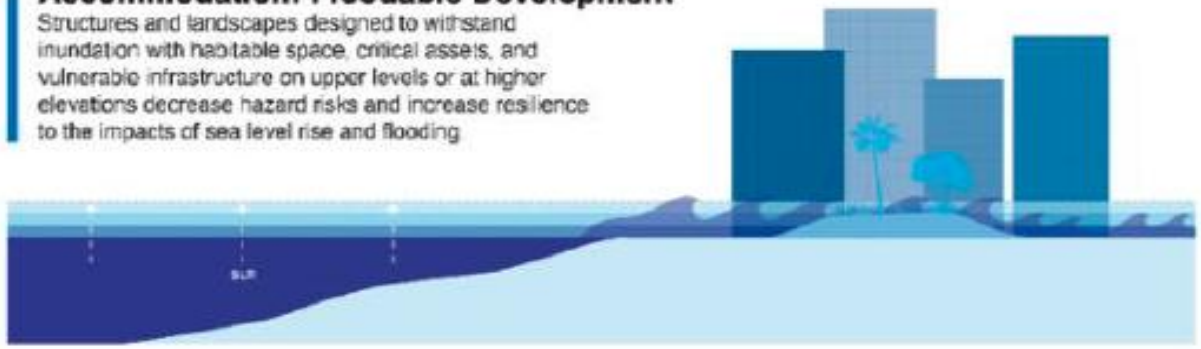
Hardened Shoreline Protection

Hard, engineered, linear infrastructure systems designed to defend, armor, and stabilize the shoreline and resources in their current location. Examples: impermeable structures, seawalls, levees, dikes, revetments, groins, breakwaters, riprap, dams, flood gates, storm surge barriers, etc.



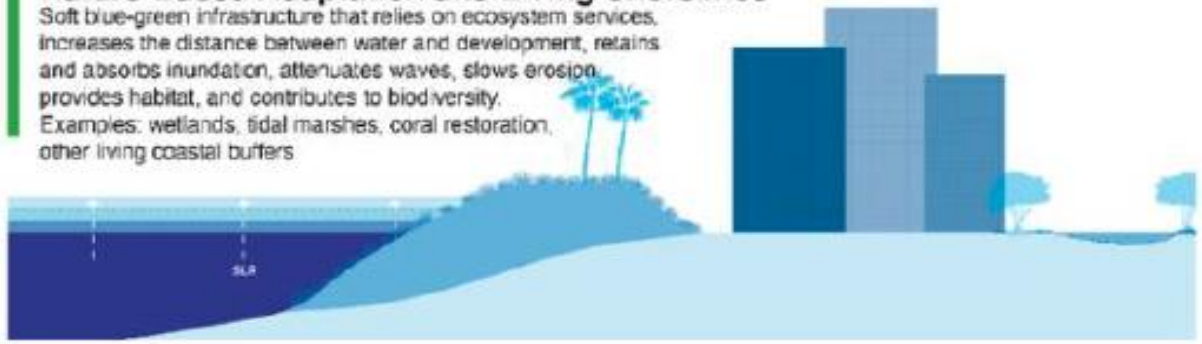
Accommodation: Floodable Development

Structures and landscapes designed to withstand inundation with habitable space, critical assets, and vulnerable infrastructure on upper levels or at higher elevations decrease hazard risks and increase resilience to the impacts of sea level rise and flooding.



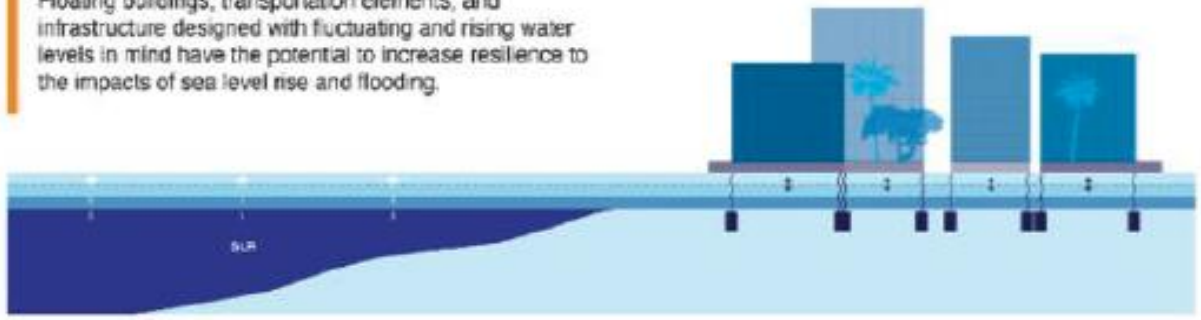
Nature-Based Adaptation and Living Shorelines

Soft blue-green infrastructure that relies on ecosystem services, increases the distance between water and development, retains and absorbs inundation, attenuates waves, slows erosion, provides habitat, and contributes to biodiversity. Examples: wetlands, tidal marshes, coral restoration, other living coastal buffers



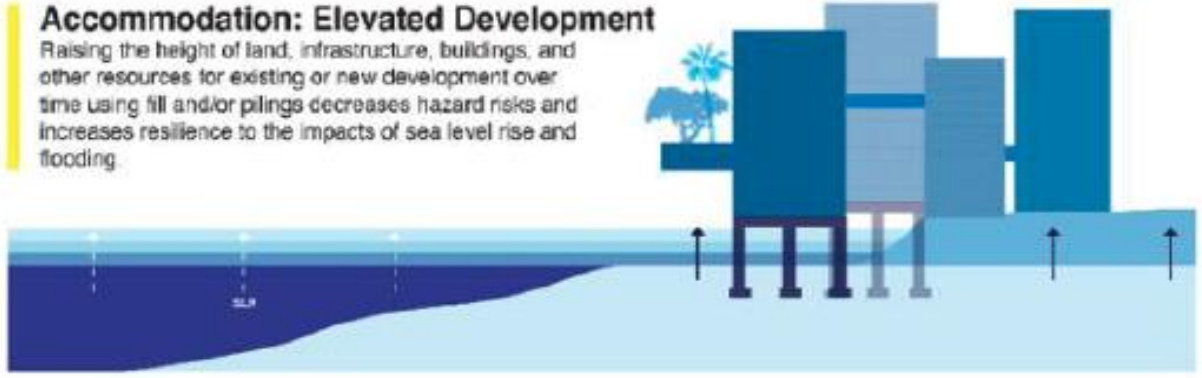
Accommodation: Floating Development

Floating buildings, transportation elements, and infrastructure designed with fluctuating and rising water levels in mind have the potential to increase resilience to the impacts of sea level rise and flooding.



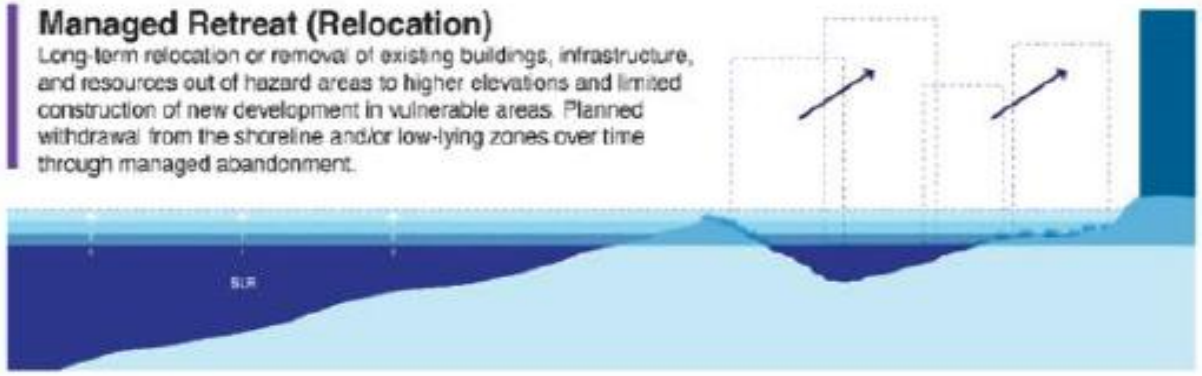
Accommodation: Elevated Development

Raising the height of land, infrastructure, buildings, and other resources for existing or new development over time using fill and/or pilings decreases hazard risks and increases resilience to the impacts of sea level rise and flooding.



Managed Retreat (Relocation)

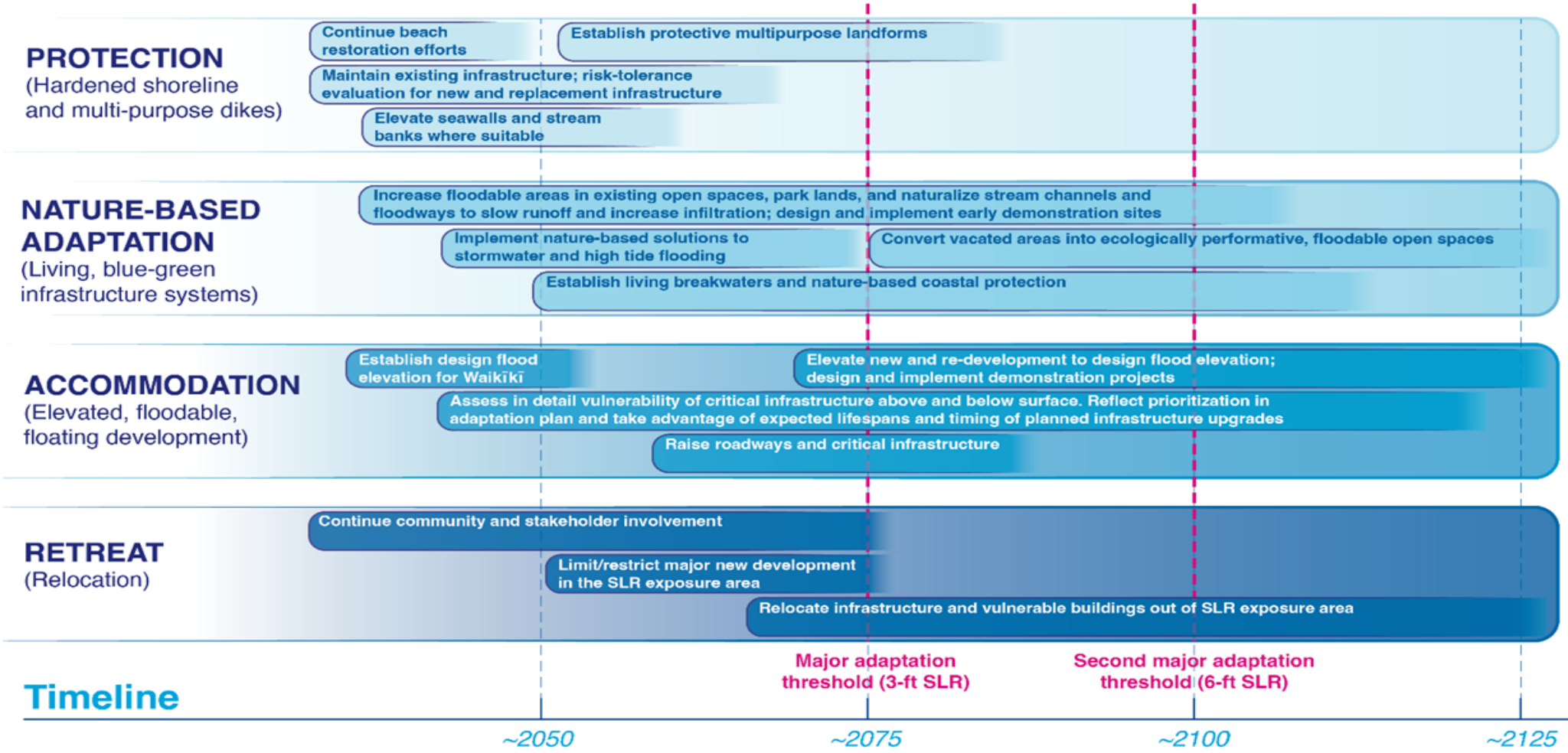
Long-term relocation or removal of existing buildings, infrastructure, and resources out of hazard areas to higher elevations and limited construction of new development in vulnerable areas. Planned withdrawal from the shoreline and/or low-lying zones over time through managed abandonment.



Waikīkī Resilience & Sea-Level Rise Adaptation Project (WRAP)

Preliminary Conceptual Adaptation Roadmap

Adaptation Strategies



Triggers*

Near-term adaptation triggers:
- Subsurface utilities saturation frequency exceeds tolerance levels.
- Damage to subsurface utilities and transportation assets.
- Beach restoration efforts in Waikīkī exceed the acceptable recurrence limits.
- High tide and compound rain/tide flooding
- Etc..

Long-term adaptation triggers:
- Flood frequency intolerable
- Cost of accommodation exceeds relocation
- Flood insurance premium increase
- Disaster triggers (more than x times in x years)
- Etc..

A trigger initiates the process to a new pathway before a harmful adaptation-threshold is reached.

*The triggers listed above are examples. Actual triggers to be determined during a subsequent project phase after adaptation pathways are established.

Intermediate high sea-level rise scenario — 3-ft SLR — 6-ft SLR

Adaptation References

U.S. and Abroad

1. ABC Waters, Design Guidelines. (2018). Singapore water Design Guidelines.
2. Boston Coastal Flood Resilience Design Guidelines, (Boston, 2019) *Climate Ready Boston*
3. Miami, 2021. February 2021. Miami Dade County Sea-level Rise Strategy. *Miami Dade County.*
4. New York Climate Resiliency Design Guidelines, (NYORR, 2020) .
5. Resilient Coasts California, Santa Cruz, California
6. Waggoner and Ball, 2019. The Dutch Dialogues, Charleston. City of Charleston

Honolulu

1. City & County of Honolulu Actions to Address Climate Changes and Sea Level Rise. (2018). Mayor's Directive 18-02
2. City & County of Honolulu. Climate Adaptation: Background Research, International Best Practices and Local Initiatives
3. City & County of Honolulu (C&C, 2020b). Climate Adaptation Design Principles for Urban Development. December, 2020. *City and County of Honolulu Transit Oriented Development*.
4. Climate Adaptation: Background Research, International Best Practices and Local Initiatives (2020).
5. O'ahu Resilience Strategy City and County of Honolulu, Office of Climate Change Sustainability and Resiliency. (2019).
6. Climate Change and Sea-Level Rise. *Honolulu Primary Urban Center Development Plan Update*. (2020).
7. City and County of Honolulu Climate Change Commission (2018). Climate Change Brief.
8. 2022 updated Sea Level Rise Guidance from the Honolulu Climate Change Commission

Hawaii

1. HAWAII MANAGED RETREAT STRATEGIES FOR VULNERABLE COASTAL AREAS IN HAWAIʻI (2019)
2. State Regional Shoreline Management Plan

Climate Change References

Hawaii, U.S. and International

1. The Intergovernmental Panel on Climate Change (IPCC) 6th Assessment
2. U.S. Fifth National Climate Assessment
3. U.S. Fifth National Climate Assessment (Hawaii and Pacific Island Chapter)
4. U.S. Interagency Sea Level Rise Scenario Tool
5. U.S. Interagency Global and Regional Sea Level Rise Scenarios (Report)
6. Honolulu Climate Ready Oahu
7. Oahu Climate Action Plan (2020-2025)
8. Hawai‘i Sea Level Rise Vulnerability and Adaptation Report
9. Hawai‘i Sea Level Rise Viewer

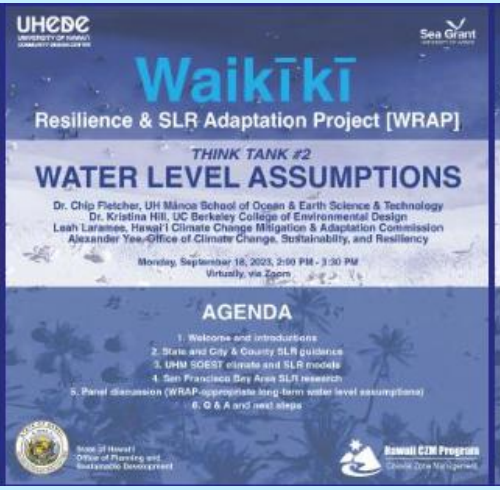
PROJECT WEBSITE

https://www.uhcdc.manoa.hawaii.edu/work/wrap

Keywords: *"Waikiki, Resilience, Adaptation, Project"*

Think Tank Events

As part of the preliminary research and analysis phases of the project, UHCDC hosted a series of "Think Tank" panel discussions aimed at soliciting subject expert input and identifying additional project needs and considerations that will inform subsequent WRAP scope of work items.



https://www.uhcdc.manoa.hawaii.edu/work/wrap

Stakeholder and Community Outreach Events.

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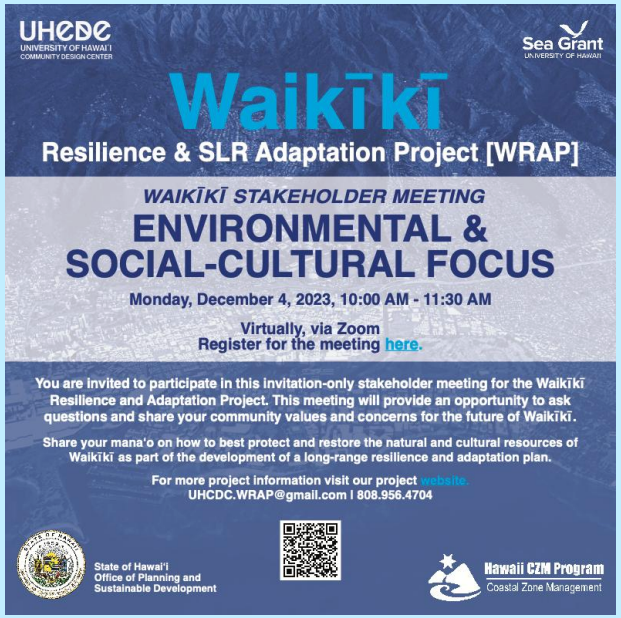

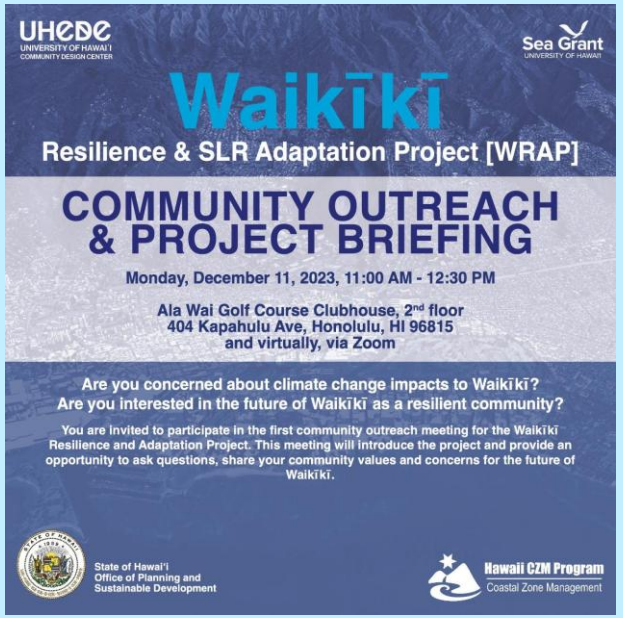

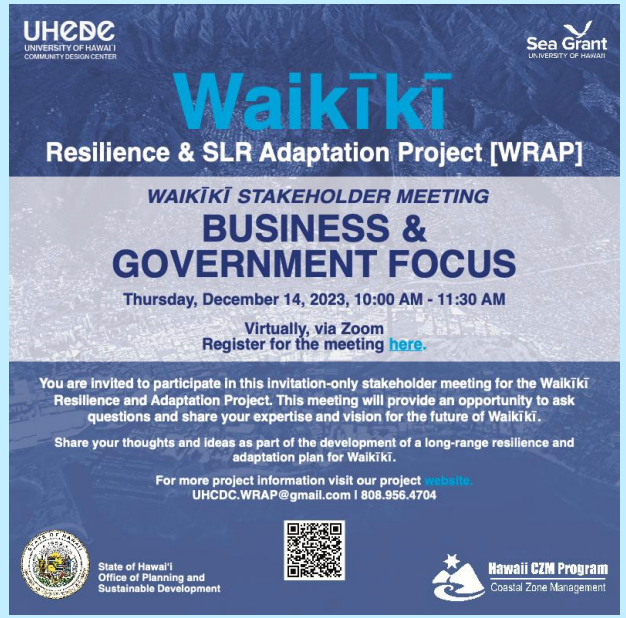

December, 2023

https://www.uhcdc.manoa.hawaii.edu/work/wrap

Participatory Visioning

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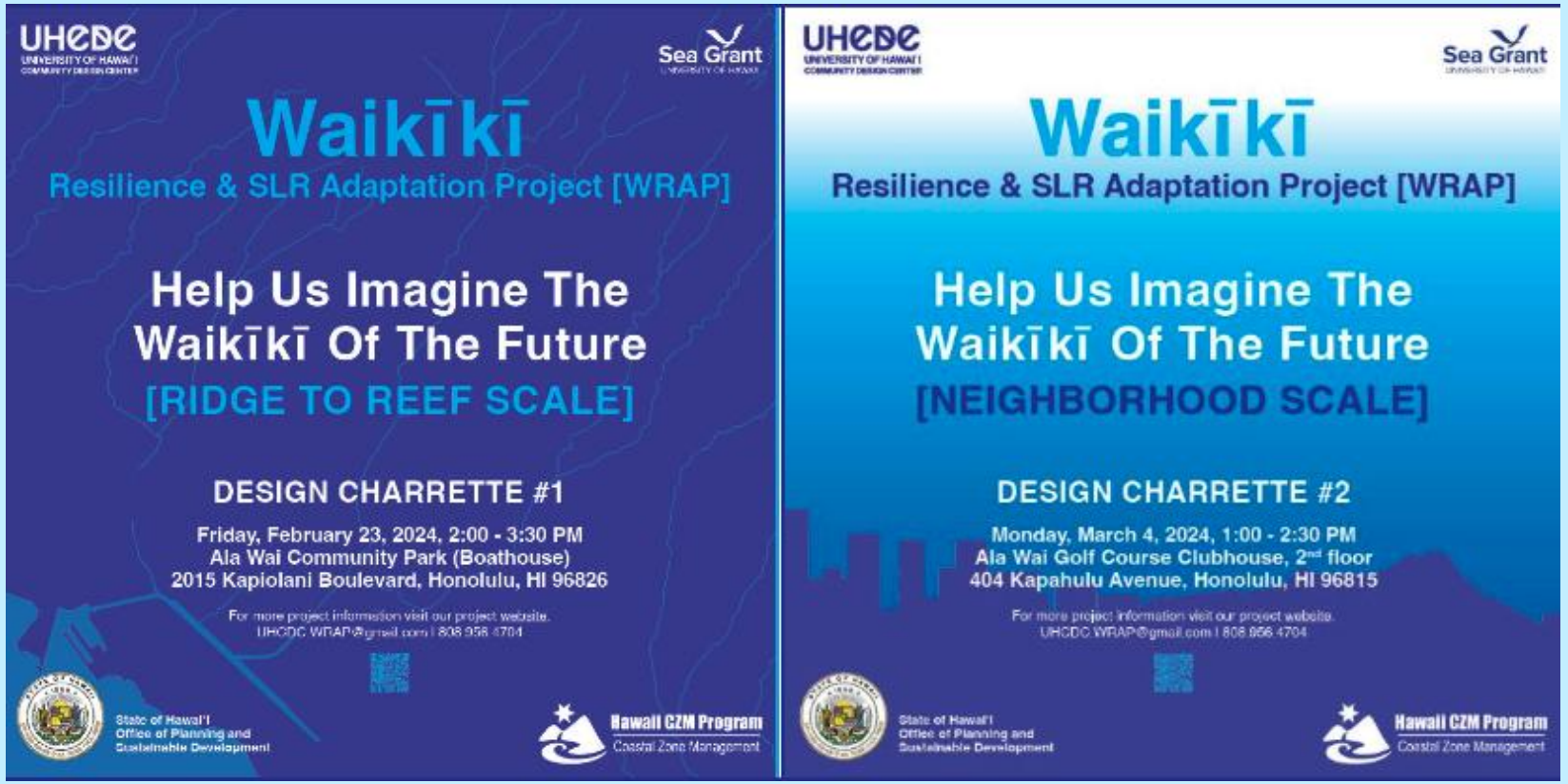
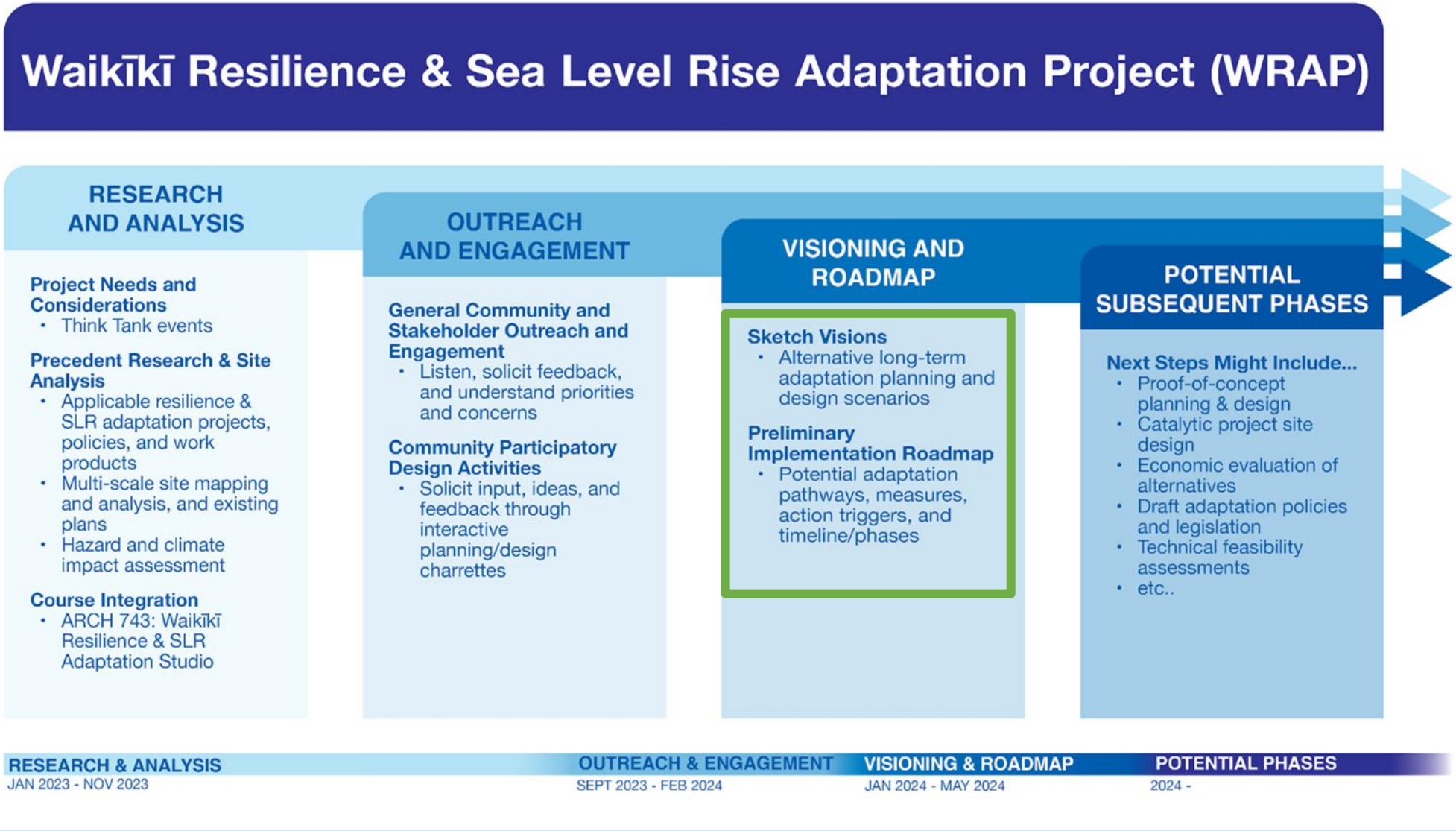


February-March, 2024

https://www.uhcdc.manoa.hawaii.edu/work/wrap

Waikīkī Resilience & SLR Adaptation Project

Community Feedback



Coastal Armoring-Emergency

Sunset Beach, Oahu, Winter 2020

Accommodation vs Chronic Erosion