

POTENTIAL COASTAL ADAPTATION STRATEGIES



Sea Wall/Revetment

Description

A seawall or revetment is a hard engineering shore-based structure which protects the coast (and abutting properties) from erosion, at least in the short term. Sloping concrete or basalt stone structures are commonly used in Hawaii.

Pros

- Protects property behind the shoreline
- Hard engineered solution that is tried-and-tested

Cons

- Leads to beach loss along eroding coasts
- Causes environmental problems including loss of natural habitat
- Disrupts sediment movement and transport, causing long-term erosion
- High construction cost
- Diminishes public access



Riprap Rock Armor

Description

"Riprap" is man-placed rock or other loose material used to armor shorelines, pilings and other shoreline structures against scour, storm surges, and water erosion (usually constructed with large basalt boulders in Hawai'i).

Pros

- Cost roughly same as sea wall
- Requires little taking of land property
- Requires minimal maintenance once installed

Cons

- Not appropriate for many beaches.
- Not as effective for storm surge
- Impacts on an eroding beach are generally the same as a seawall (beach loss) without other mitigation (e.g., beach nourishment)
- Has a large footprint into public trust submerged lands



Natural or Living Shoreline

Description

A protected, stabilized coastal edge made of natural materials like plants, sand dunes, and/or rock. Unlike a concrete structure, which impedes the growth of plants and animals, living shorelines grow over time. Often referred to as 'soft armoring.' Not usually compatible with most sandy beach environments.

Pros

- Allows coexistence with erosion and sea level rise over the long term
- Avoids most of the issues that arise from hard armoring

Cons

- Not typically used on beaches on the open ocean
- Relatively new and untested strategy in Hawaii; used extensively in places like Chesapeake Bay
- Requires taking in-land area



Sand Nourishment

Description

The practice of adding large quantities of sand or sediment to beaches to combat erosion and increase beach width. A "soft armoring" technique, but impermanent.

Pros

- Protects valuable beaches; preserves maximum beach area
- Avoids most issues caused by walls/revetments

Cons

- Requires significant dredging of sand
- Potential environmental risks to the nearshore marine ecosystem
- Repeat nourishment needed on a chronically eroding beach



POTENTIAL IN-LAND ADAPTATION STRATEGIES



Restrict New Development

Description

The City would set physical benchmarks (i.e. number/frequency of flooding events or percentage of property lost) that trigger increased development restrictions, if adaptation solutions and/or regional drainage plans have not been applied.



Pros

- Reduces long-term loss of property
- Reduces risk to private and public structures and infrastructure
- Reduces City and County liability

Cons

- Curtails economic growth
- May seem overly punitive or harsh
- Less new development means less new investment and community benefits



Require District Drainage

Description

In the most severely impacted SLR-XA areas, require property owners to join together to create and administer a regional/district program in order to plan for needed capital improvements and drainage solutions.



Pros

- Will help address impacts that cut across ownership/property lines
- Collaborative strategy that operates at a larger scale than individual buildings
- Leverages private sector funding

Cons

- Requires all businesses to partner
- Requires serious, on-going financial commitments
- Will necessitate coordination with public agencies



Raise Roads and Pipes

Description

An intensive and complex public or private effort where new fill is added to raise roads by 3 to 6 feet (or more), along with nearby water and sewer pipes/lines. New drainage and green infrastructure features are usually added, to maximize co-benefits.



Pros

- Allows existing infrastructure to be salvaged and made resilient.
- Essential for intensively developed areas to adapt in place

Cons

- Extreme cost
- Disruptive and complicated
- Requires intense coordination
- Necessitates redesign on the part of adjacent development



Raise/Abandon/Repurpose 1st Floor

Description

As flooding occurs more and more frequently, private businesses will need to renovate, re-purpose, elevate, or abandon ground floors. Ground floors can also be redesigned as parking, storage, or other nonhabitable space. Mechanical and electric facilities will need to be hardened and/or relocated.



Pros

- Salvages buildings in areas that experience frequent flooding
- Allows continued use of existing businesses and apartments

Cons

- Very costly and may be infeasible
- Requires new connections and walkways to access street level
- Doesn't address street level flooding or impacts underground



Rapid Retreat (phased over 30 years)

Description

Allows an area that was not previously exposed to flooding by the sea to become flooded by removing coastal protection. Timeframe is 20 to 30 years for buildings to become unoccupiable. Might require buy-out of impacted properties.



Pros

- Provides new natural areas to absorb rising seas and storm surges
- Potential to address sea level rise aggressively, if buy-outs or other incentives are used

Cons

- Infeasible for high-density areas
- Politically difficult
- Severe impacts on particular parcels
- Potentially extreme costs to purchase private waterfront property



Slow Retreat (phased over 60 years)

Description

Allows an area that was not previously exposed to flooding by the sea to become flooded by removing coastal protection. Timeframe is 50 to 60 years for buildings to become unoccupiable - the longer timeframe allows for advance planning and interim adaptation measures.



Pros

- Provides new natural areas to absorb rising seas and storm surges
- Slower timeframe allows owners/businesses to plan for future retreat

Cons

- Not very feasible in areas with existing high density development
- Politically difficult
- Flooding impacts may come earlier than anticipated/predicted



Adaptive Design Requirements

Description

New design standards for impacted areas; may include guidance for ground floor design, mandatory pumps, elevated mechanical equipment, and other adaptation-related improvements. Structures may also be subject to limits on armoring and rebuilding.



Pros

- Ensures new buildings will be resilient to future decades of flooding impacts
- Allows new development in impacted areas

Cons

- Raises cost of new buildings
- Introduces another level of complexity in project review



Floodable Park

Description

Designed to absorb stormwater/floodwater and decrease run-off and flooding by storing excess water and releasing it slowly. These parks will flood periodically during extreme rainfall events, hurricanes, and some King Tides.



Pros

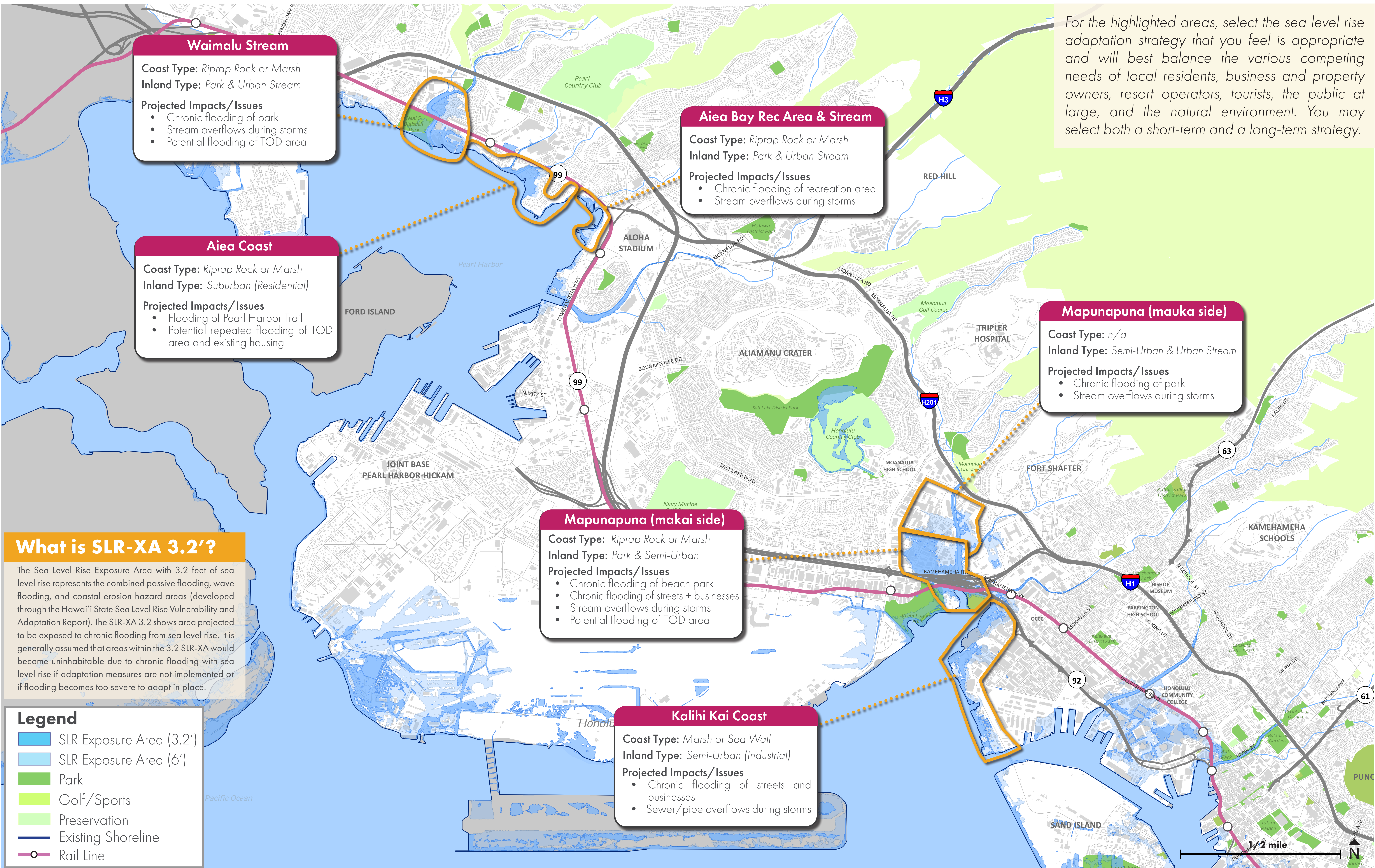
- Leverages existing open space
- Combined amenity, resilience, and biodiversity benefits

Cons

- Makes parks unusable for recreation during storms/floods
- Expensive for larger parks

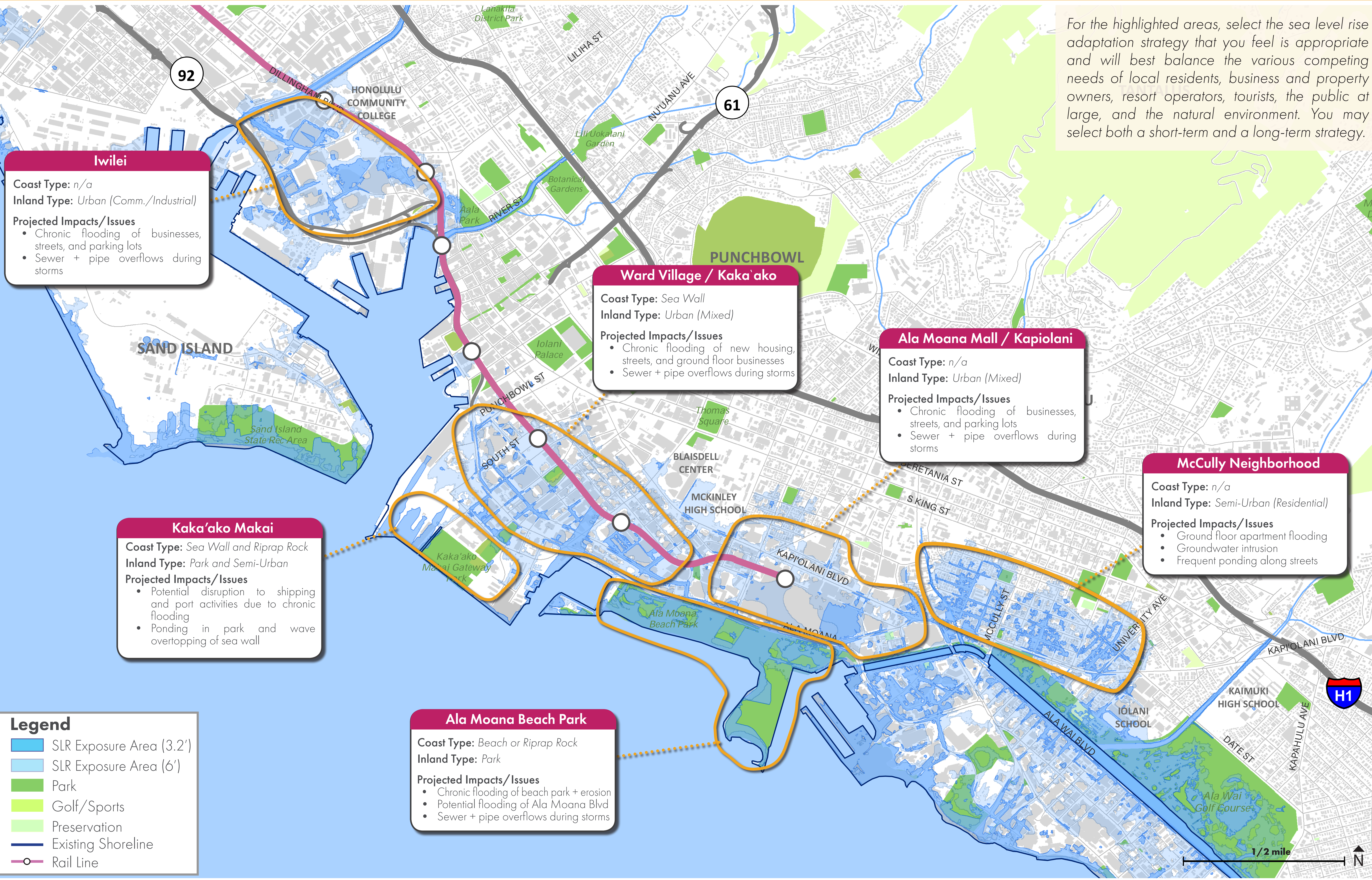
HOW DO WE RESPOND TO SEA LEVEL RISE?

What strategies are appropriate in specific locations?



HOW DO WE RESPOND TO SEA LEVEL RISE?

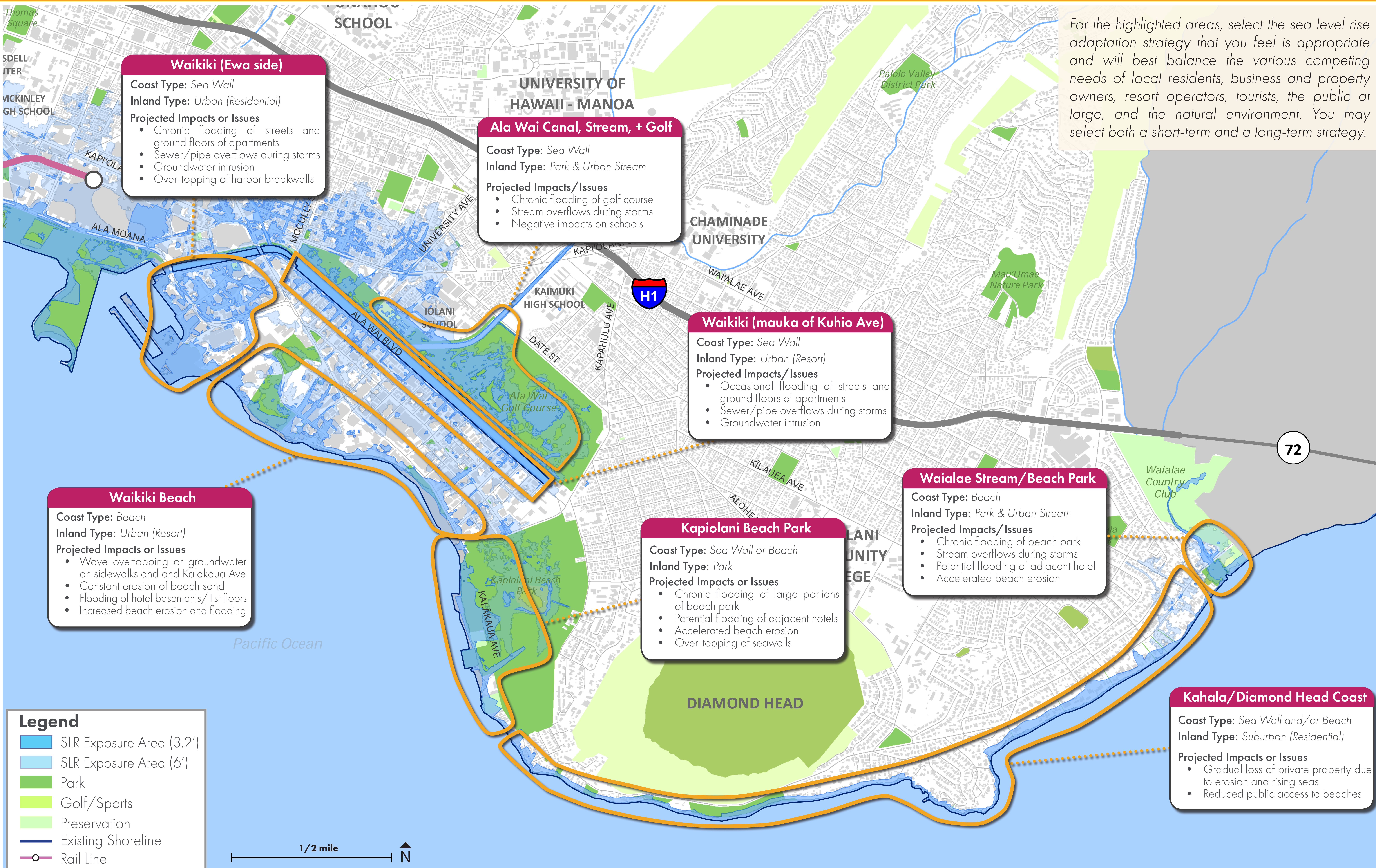
What strategies are appropriate in specific locations?



HOW DO WE RESPOND TO SEA LEVEL RISE?

What strategies are appropriate in specific locations?

For the highlighted areas, select the sea level rise adaptation strategy that you feel is appropriate and will best balance the various competing needs of local residents, business and property owners, resort operators, tourists, the public at large, and the natural environment. You may select both a short-term and a long-term strategy.



HOW DO WE ADDRESS SEA LEVEL RISE?

What new policies and regulatory approaches should be prioritized?

ZONING CHANGES

Immediately pausing increased density entitlements in the most severe sea level rise exposure areas: In impacted areas, the City & County would pause rezoning for higher density until a detailed adaptation plan is developed by the City or by a district entity (such as a Business Improvement District or Community Facilities District).

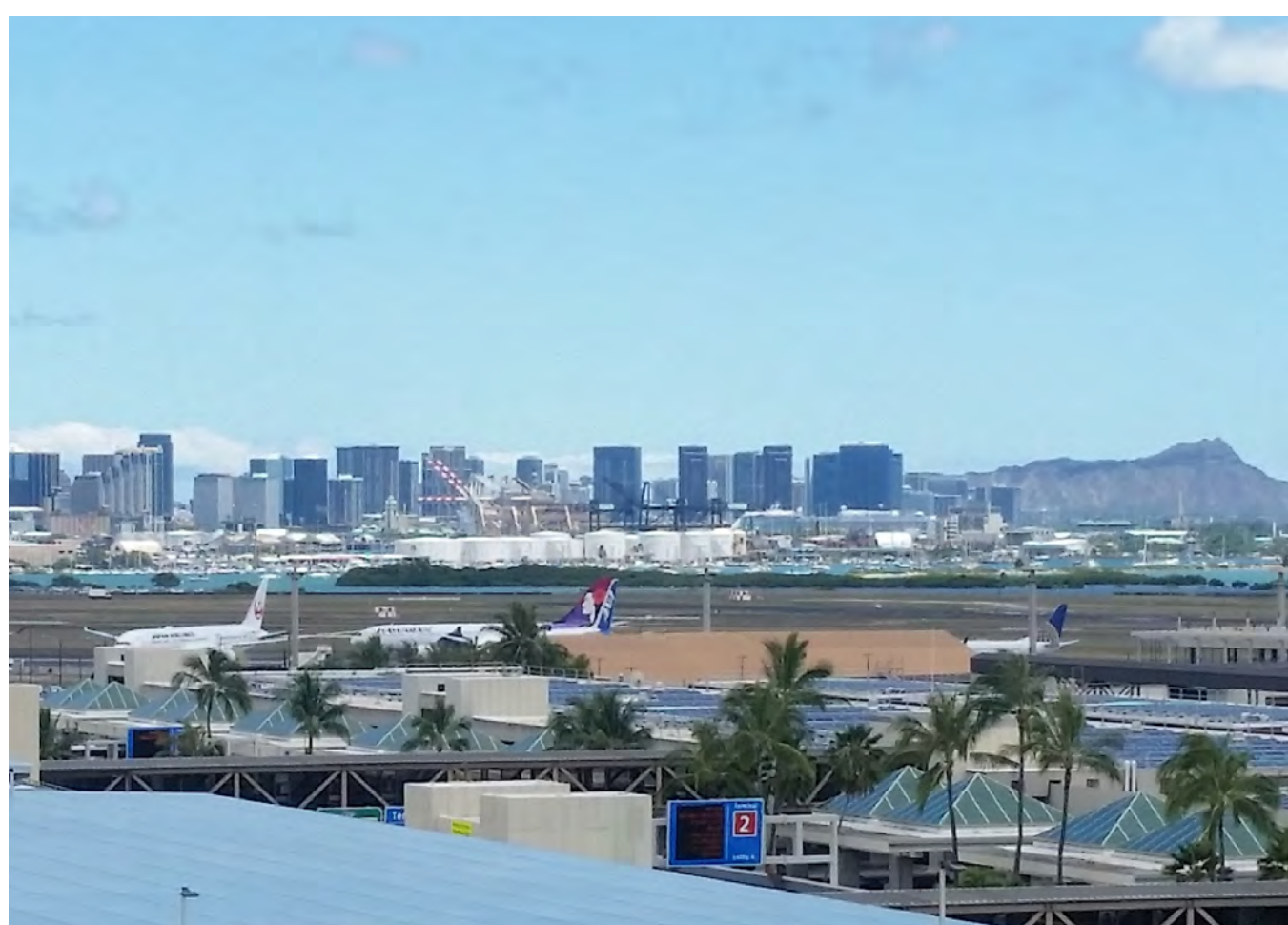


NOT AT ALL

DEFINITELY!

DEVELOPMENT RESTRICTIONS

Gradually restricting new development in the sea level rise impacted areas: The City & County would establish physical benchmarks (i.e. number/frequency of flooding events or percentage of property lost) that trigger escalating development restrictions, if adaptation solutions and/or regional drainage plans have not been applied, and/or are proving ineffective with accelerating sea level rise.



NOT AT ALL

DEFINITELY!

RESILIENT DESIGN STANDARDS

Establishing specific design standards and resiliency requirements for all new construction in SLR-XA areas: For new development and major reconstructions (including post-disaster), the City & County would impose new regulations and design guidelines to ensure buildings can withstand 6 feet of sea level rise.

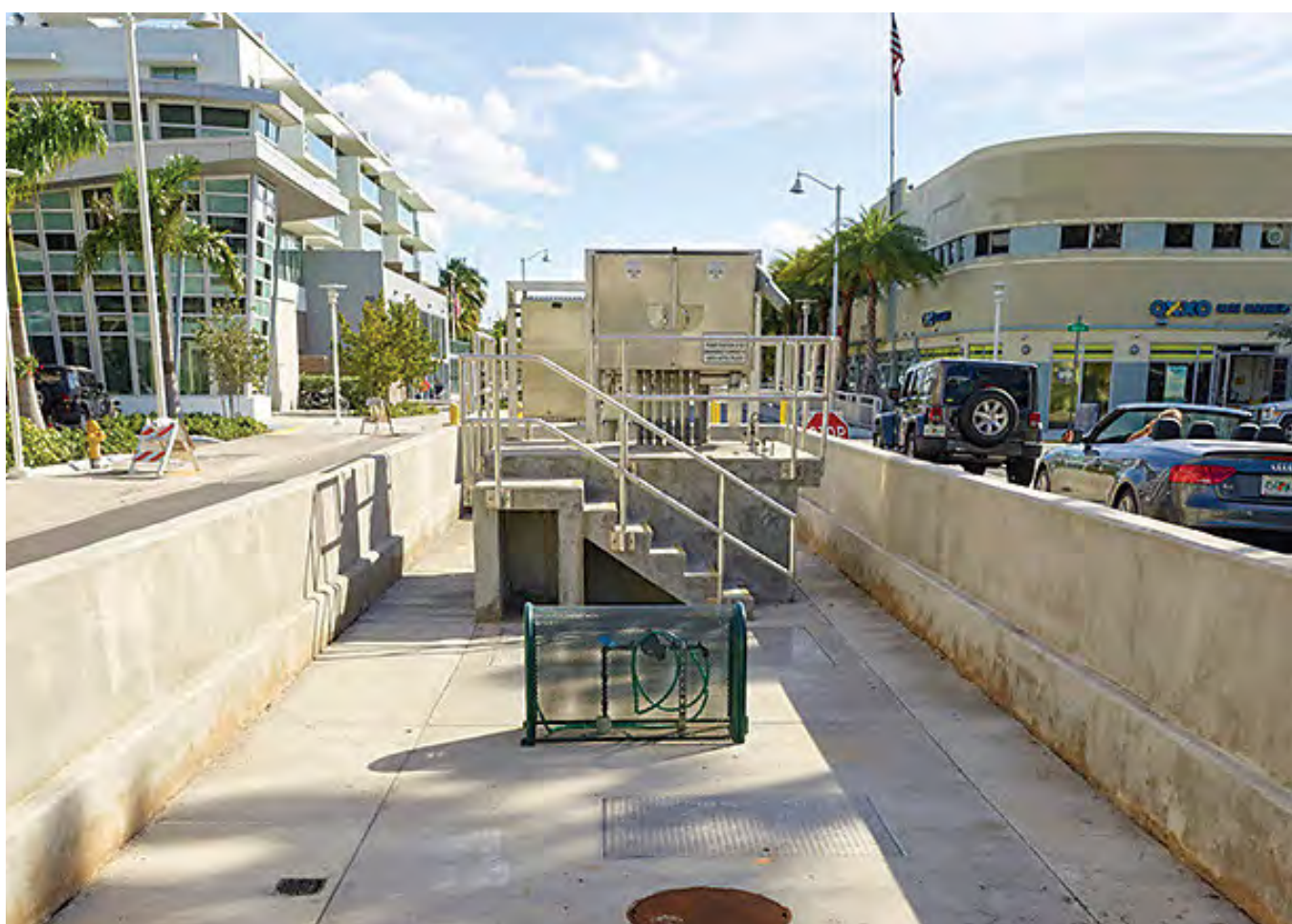


NOT AT ALL

DEFINITELY!

ADAPTATION FUNDING

Raising the cost of public services and utilities in areas chronically impacted by flooding: To account for the greater expense in providing and maintaining pipes, streets, wires, and other public infrastructure in SLR-XA areas, the City & County will increase the price accordingly for these services, and use this revenue to pay for resiliency and adaptation improvements.



NOT AT ALL

DEFINITELY!

HOW DO WE ADDRESS SEA LEVEL RISE?

What new policies and regulatory approaches should be prioritized?

PRIVATE SEA WALLS

Building sea walls to protect private property against sea level rise/flooding, even if it causes erosion: The City & County has traditionally allowed individual owners to build and rebuild concrete sea walls, despite evidence that seawalls lead to beach loss on an eroding shoreline.



NOT AT ALL

DEFINITELY!

LOW IMPACT DEVELOPMENT

Pursuing additional City-maintained Low Impact Development (LID) solutions: The City & County will continue funding and constructing 'green infrastructure' projects, such as bioswales, retention ponds, rain gardens, permeable pavements, green roofs, infiltration planters, and similar.



NOT AT ALL

DEFINITELY!

INCENTIVIZED RETREAT

Encouraging coastal property owners to retreat to higher ground through City programs, incentives, and buy-outs: The City & County would seek to strike deals with private property owners to buy land most threatened by sea level rise, or negotiate rolling easements (properties yield to the public interest by allowing wetlands or beaches to migrate inland gradually over time).



NOT AT ALL

DEFINITELY!

RESILIENT INFRASTRUCTURE

Requiring that sea level risk analysis and vulnerability assessments be regularly conducted by infrastructure agencies: The City & County would work with the various agencies (including those responsible for the water system, sewer system, and stormwater system) to ensure their capital improvement plans reflect the latest sea level rise modeling, adaptation guidance, and planning regulation.



NOT AT ALL

DEFINITELY!