QCoast$_{2100}$ Guidelines

Phase 6: Identify Potential Adaptation Options

Rodger Tomlinson

CHAS guidelines - phases

PHASE 1: Stakeholder communication and engagement plan

PHASE 2: Scoping coastal hazard issues

PHASE 3: Hazard mapping

PHASE 4: Stocktaking of assets

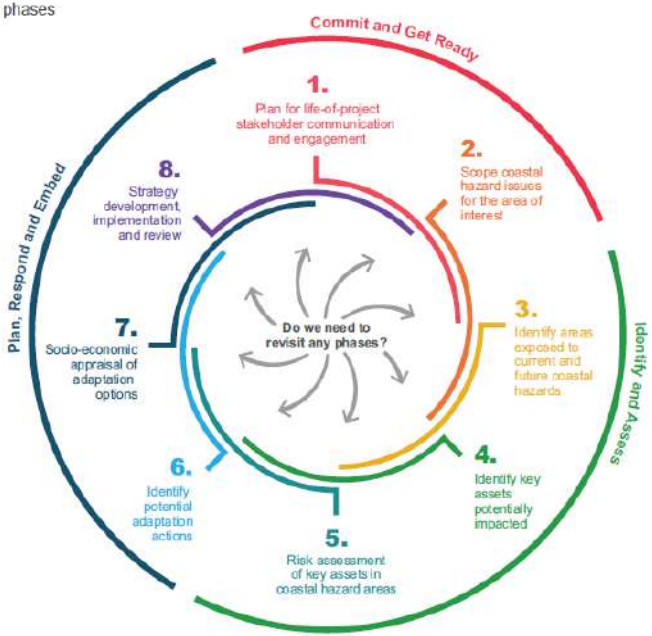
PHASE 5: Risk assessment

PHASE 6: Adaptation options

PHASE 7: MCA/CBA

PHASE 8: implementation and review

Figure 1. Project phases



Phase 6
Identify potential adaptation options

Overarching Principles

- Plan over multiple time horizons or scenarios, and adopt flexible management options that are adjusted over time

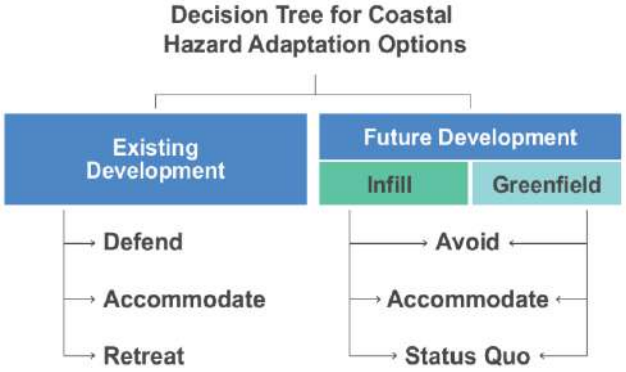
Purpose

- Identify and evaluate potential adaptation options to reduce or eliminate risk identified in Phase 5

Minimum requirements

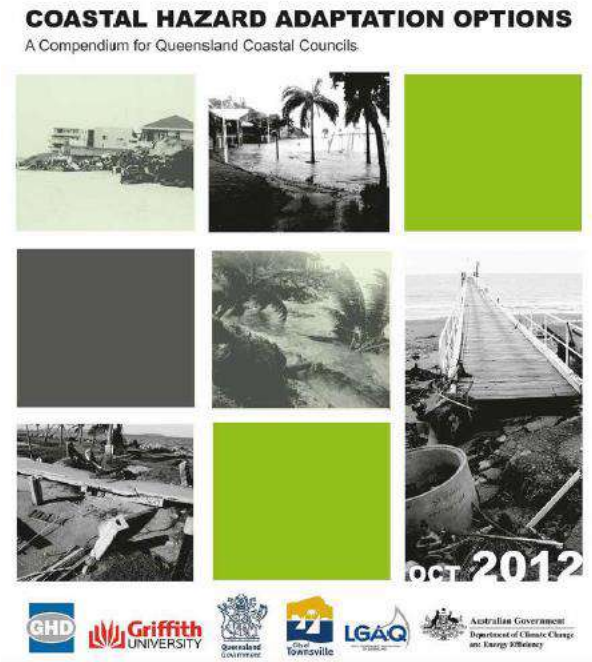
- Identify range of options
  - Avoid – develop in low risk areas
  - Retreat – relocate, building setbacks
  - Accommodate – retrofit buildings
  - Defend – increase buffers, increase awareness

Staging adaptation responses



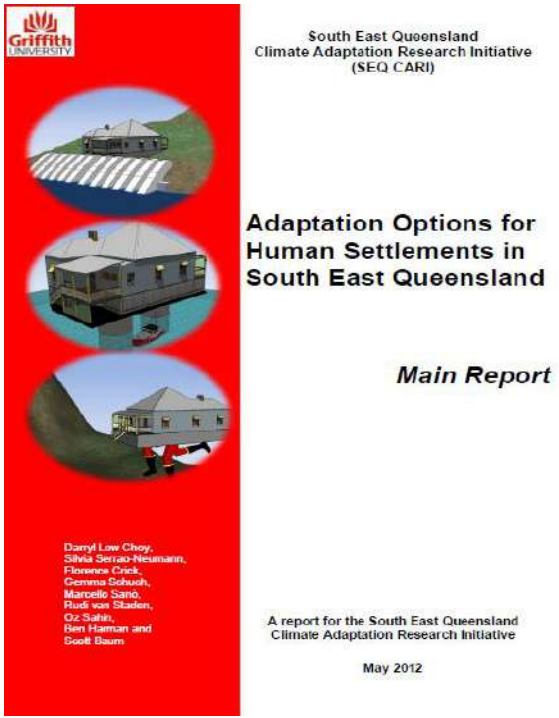
Minimum requirements

- Hold a workshop of key stakeholders to:
  - identify existing policies, procedures and management measures
  - identify resulting changes to risk to current assets
  - provide input to practical application, acceptability and appropriateness



Minimum requirements

- Select adaptation options from *The Compendium* or other source
- Adopt a screening methodology using a minimum assessment criteria of:
  - Benefits
  - feasibility and legality
  - Costs
  - adverse impacts (environmental, social and economic).



Minimum requirements

- Prepare adaptation options document which:
  - identifies broad categories for each locality and/ or key asset
  - informs more detailed stakeholder-driven socio- economic appraisal
    - a description of the selected adaptation options for each location and/or asset, including estimated high level costs
    - a photo or diagram of the option at work
    - assessment of its effectiveness in dealing with coastal hazards
    - interaction with other adaptation options and risk of unintended consequences

Leading practice

Prioritise selection of options according to this hierarchy:

1. Avoid placing new assets into hazard areas
2. Build resilience by protecting/restoring natural coastal ecosystems
3. Build community resilience
4. Adapt existing and future assets to accommodate identified coastal risks
5. Defend existing assets to the impacts of a defined event/s.

Leading practice

The Compendium has been prepared specifically to provide guidance. It includes:

- a technical description of the options
- positives and negatives of each option
- failure risks
- estimated costs (in 2012 monetary value) and other considerations

The Compendium groups coastal hazard adaptation options into 4 themes to assist in identifying and evaluating potential response options.

Need to consider "adaptation pathway" approach.

Table 6. List of adaptation options of the compendium

Category	Option
Regenerative options	Beach nourishment Dune construction and regeneration Riparian corridors restoration and generation Wetland restoration
Coastal engineering options	Artificial reefs Detached breakwaters Groynes and artificial headlands Sea dykes or levees Seawalls Storm surge barriers
Coastal settlement design options	Building retrofitting and improved design Flood resilient public infrastructure Raise land and floor levels
Planning options	Development setbacks Land buy-back Land swap Land-use planning

Source: Griffith Centre for Coastal Management and GHD 2012.

Leading practice

- Not all options are covered in *The Compendium*
- The internal workshop and the output document should identify other types of options to address:
  - Risk to services, natural resources and values
  - Education and awareness programs or other social programs
  - The resilience of essential services
  - Planning instruments that avoid increasing future risk - avoidance will generally be the most cost-effective long term response in undeveloped or rural areas.

Leading practice

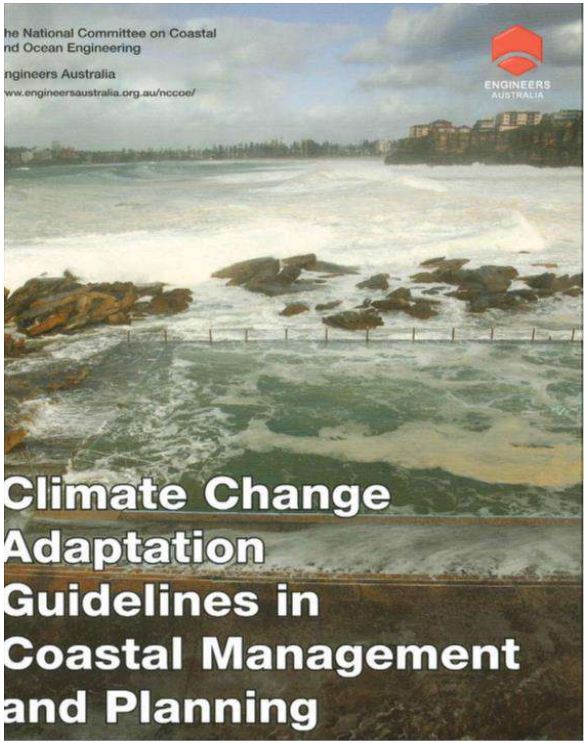
Limitations:

- more detailed information is needed to provide a meaningful assessment
- care is needed to reject only those options which could not possibly work at the site and rely on the more detailed option analysis
- screening will require expert opinions including from coastal engineers and planners
- a workshop environment is required to properly discuss and integrate the opinions

Leading practice

For coastal engineering options, the Engineers Australia (2012a) guidelines provide a useful structured framework for the selection of options:

- identify range of suitable adaptation options
- planning and/or protection/amelioration options
- prepare a schedule for implementation of adaptation options, particularly if a staged development is being considered including preliminary short-term works
- undertake sensitivity analysis for key climate/process changes for each preferred option
- select preferred option/suite of options.



A conceptual design process is recommended

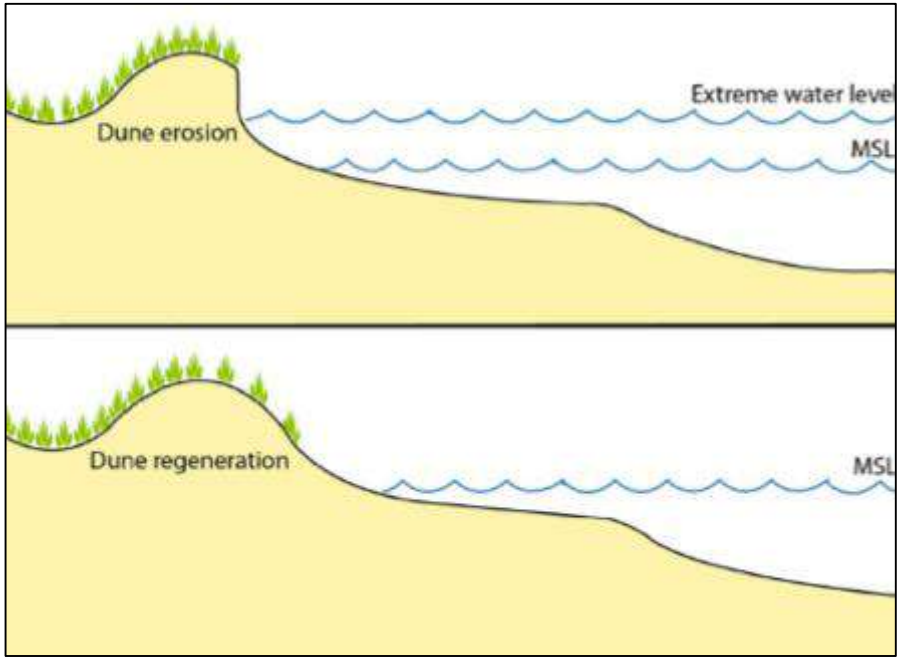
Leading practice

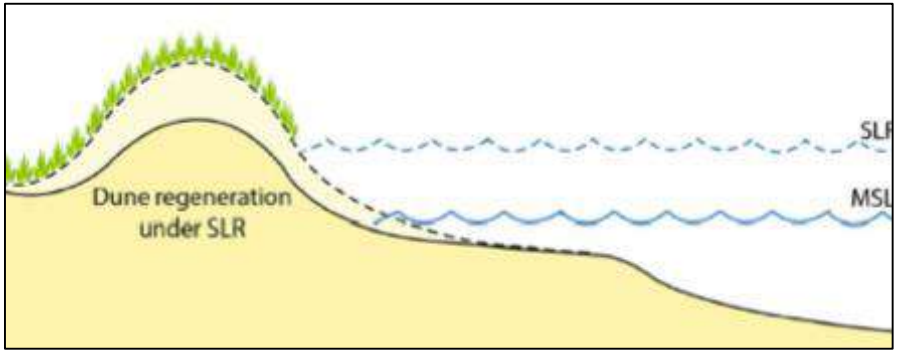
The identification and selection of adaptation options should be mindful of the risks of maladaptation, where the social and environmental costs of the adaptation are higher than the actual benefits. In particular, adaptation options should:

- take into account the level of uncertainty of the hazard they are designed to address
- consider the system as a whole and possible negative unintended consequences of adaptation action for the overall system.

Adaptation Options

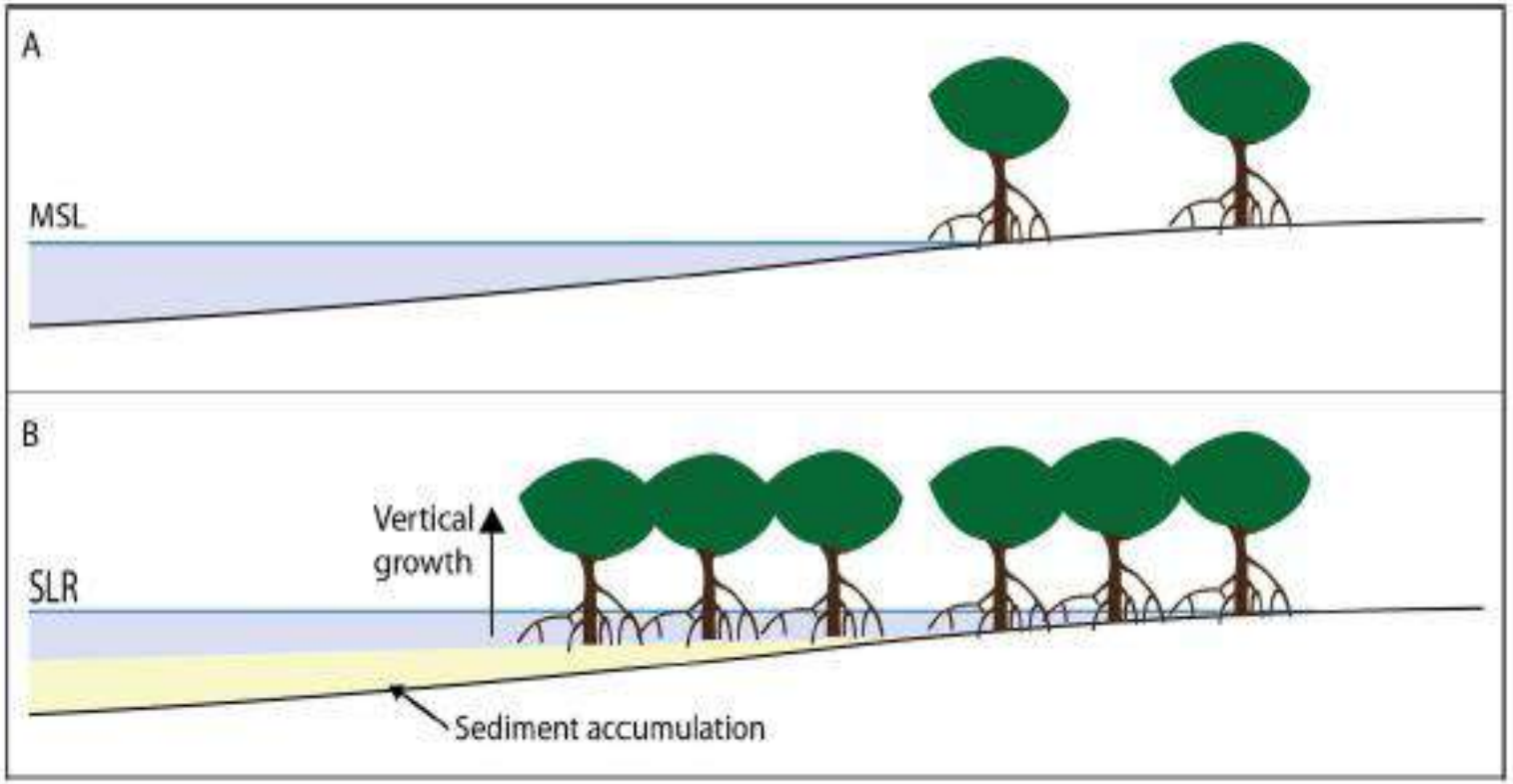
Dune construction and regeneration



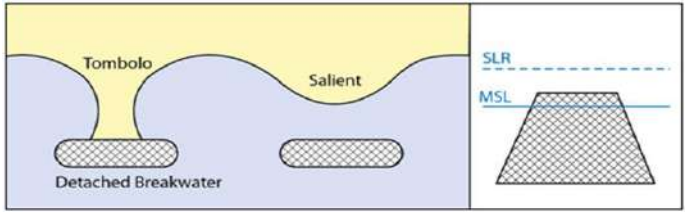


- Wind fences;
- Vegetation;
- Management of beach access; and
- Reconstruction and/or reinforcement.

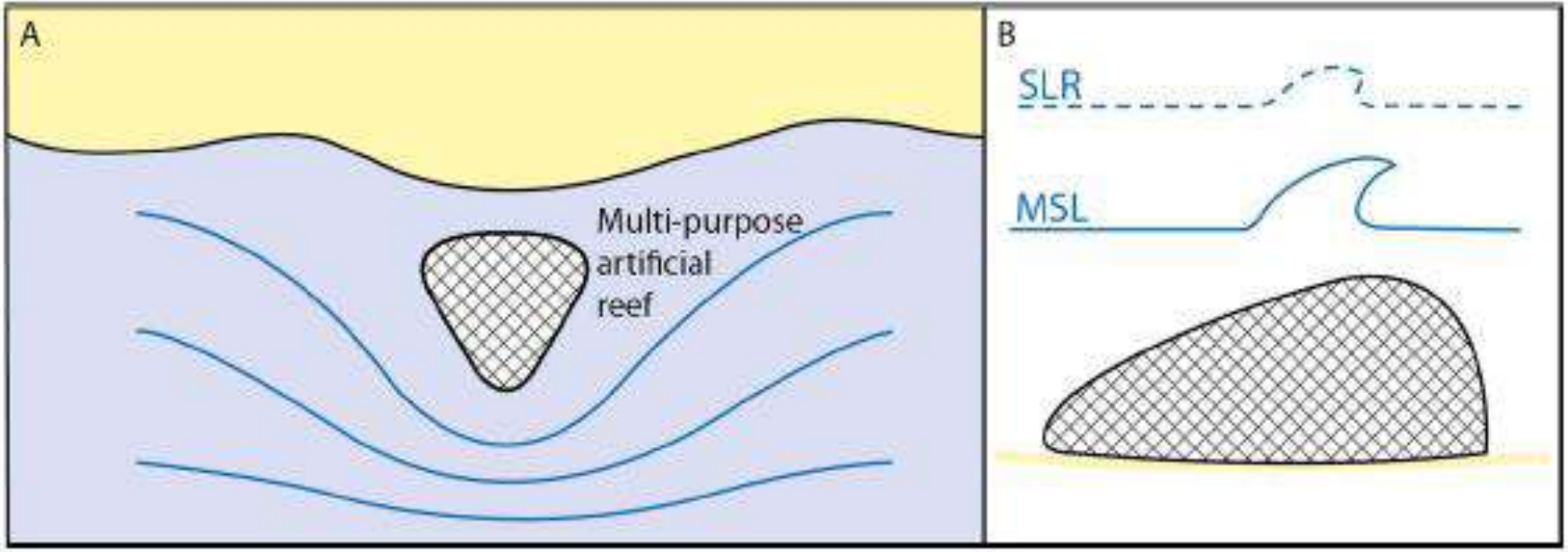
Wetland restoration



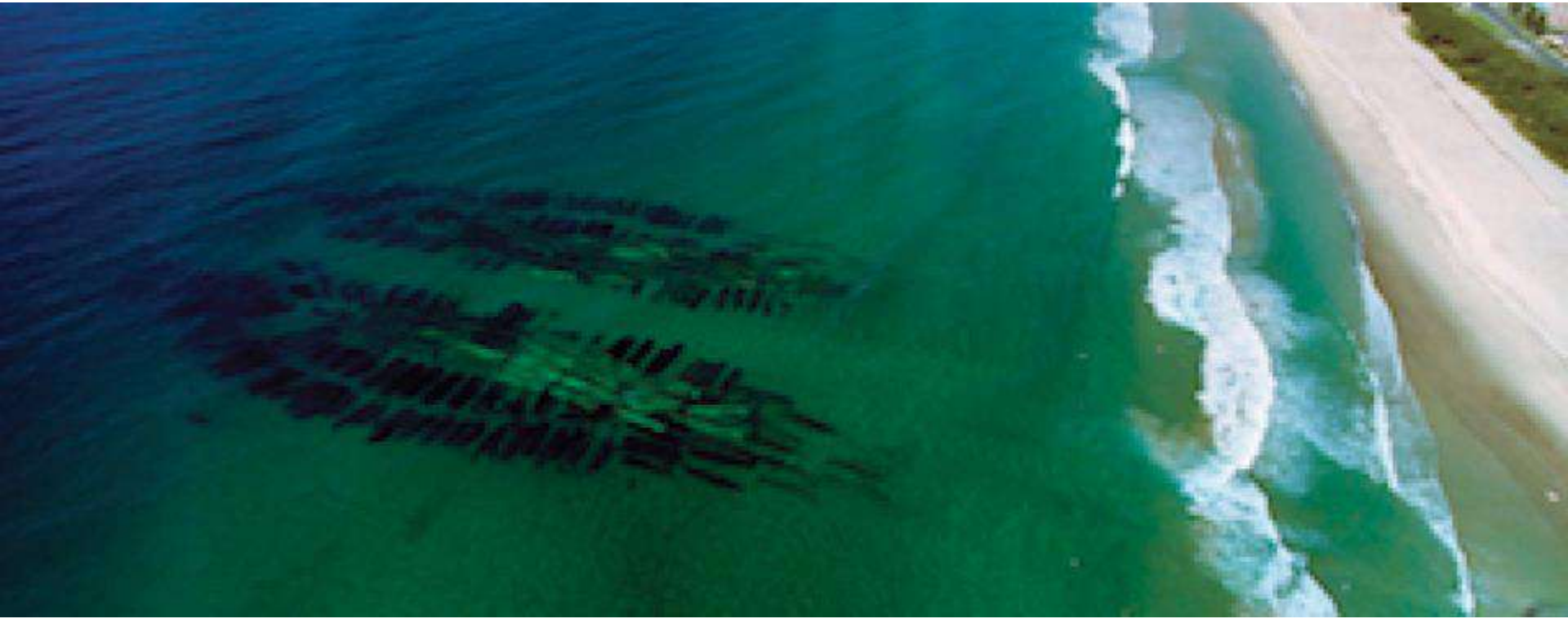
Breakwaters



Artificial reefs



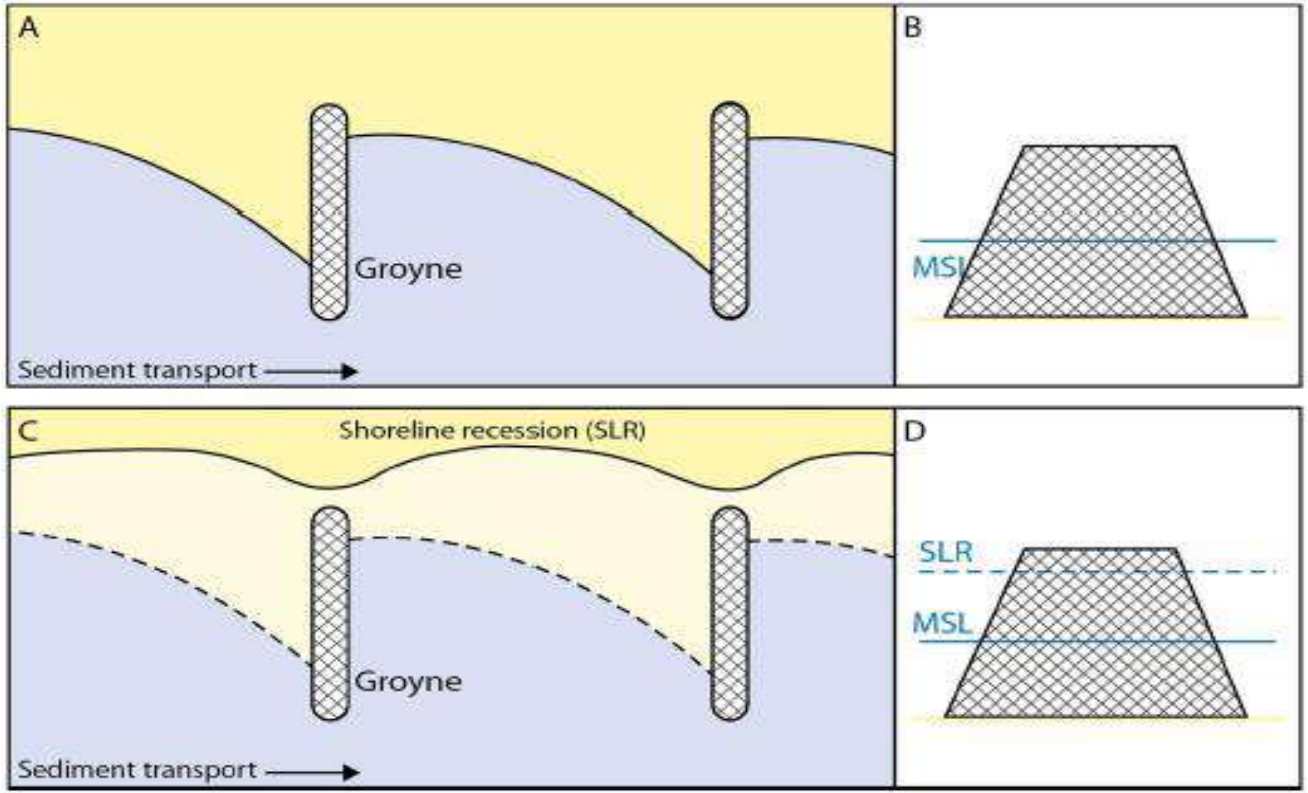
Artificial reefs



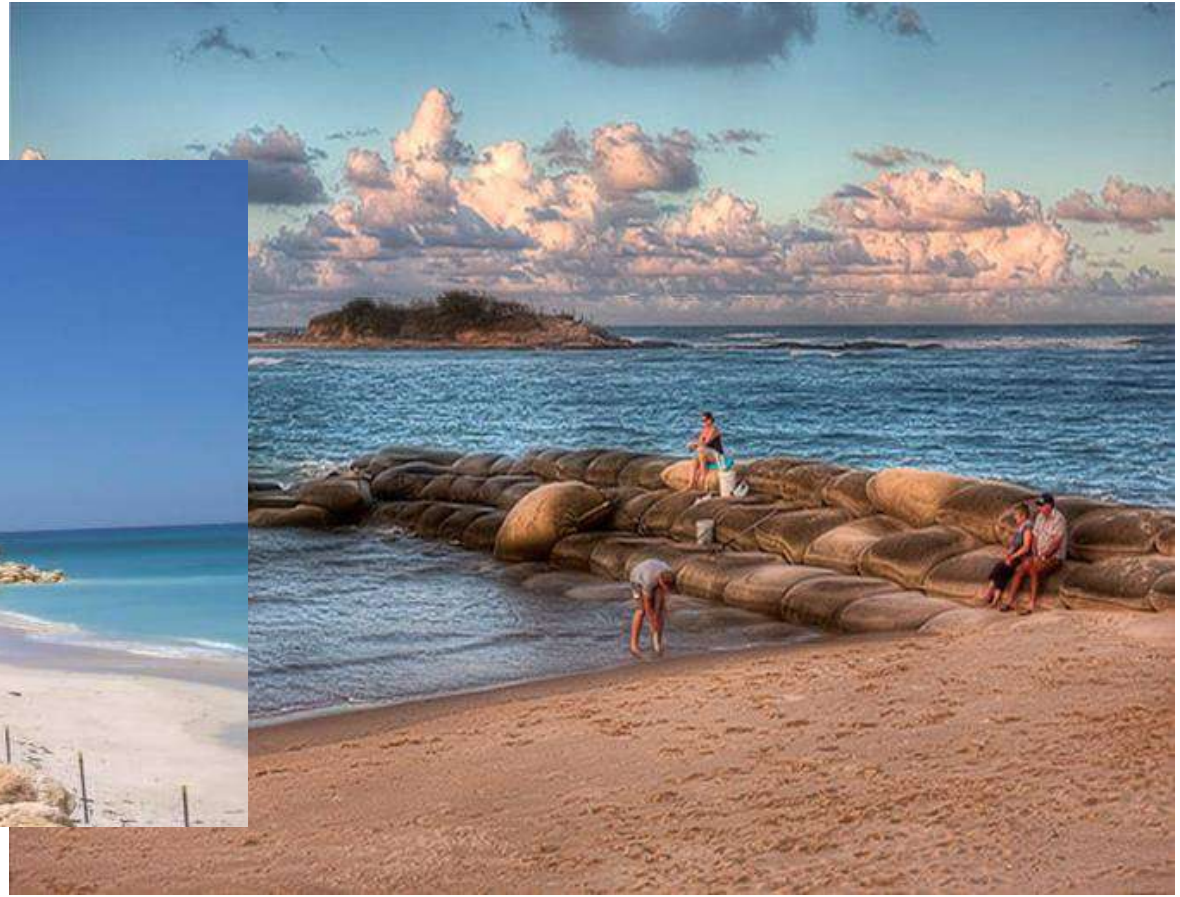
Effectiveness for Climate Change Adaptation

- Need for retro-fitting existing breakwaters
- Climate change may alter the role in beach and shoreline stabilisation
- Crest freeboard
- New armour stability
- Cost of upgrades

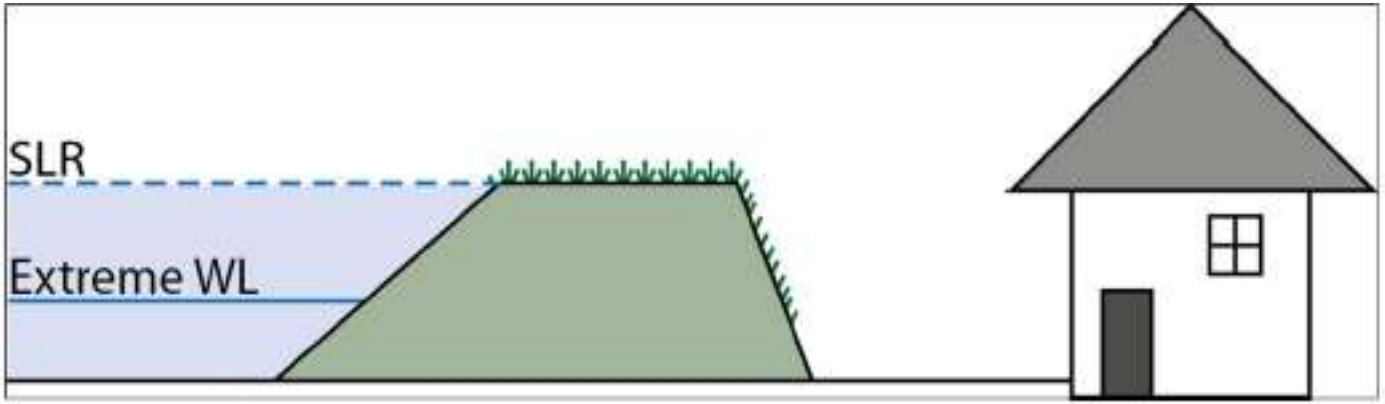
Groynes and artificial headlands



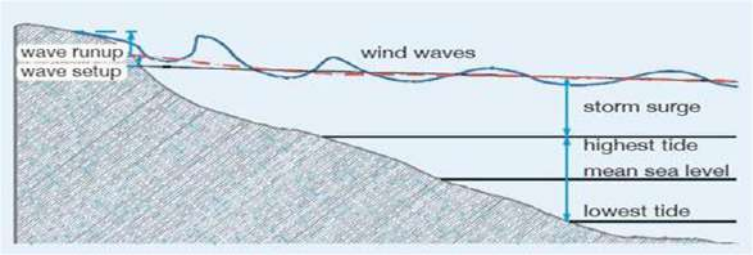
Groynes



Sea dykes and levees

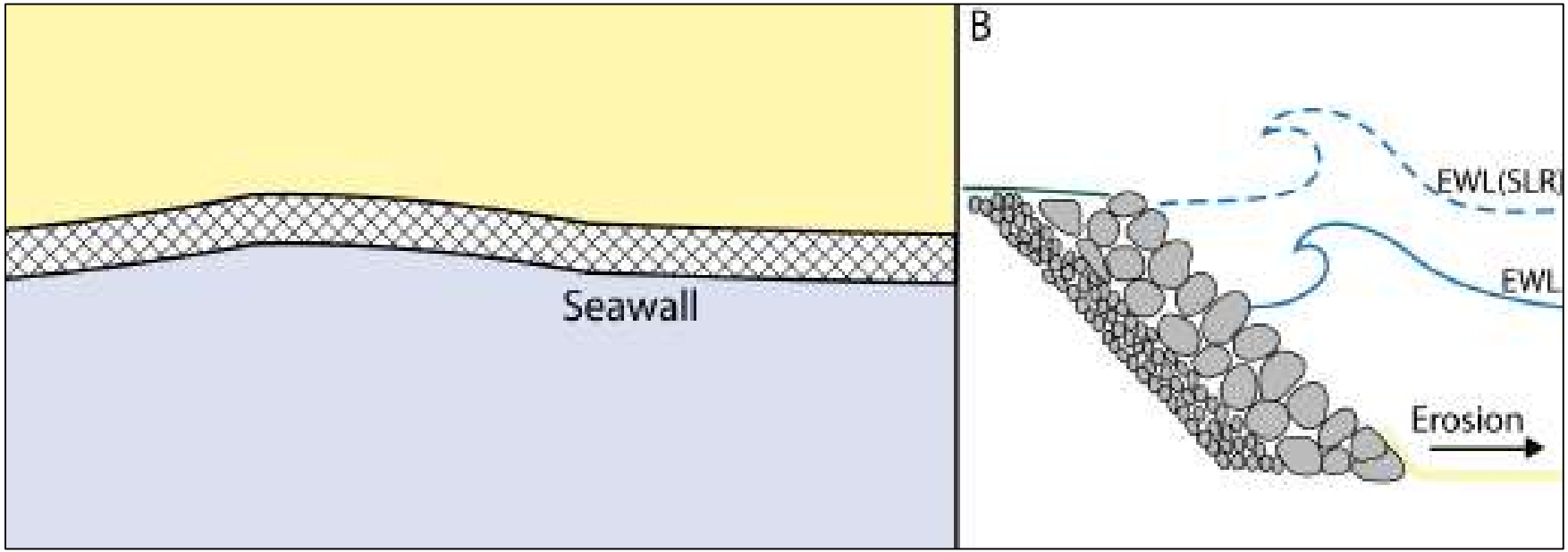


Coastal Flooding & Overtopping

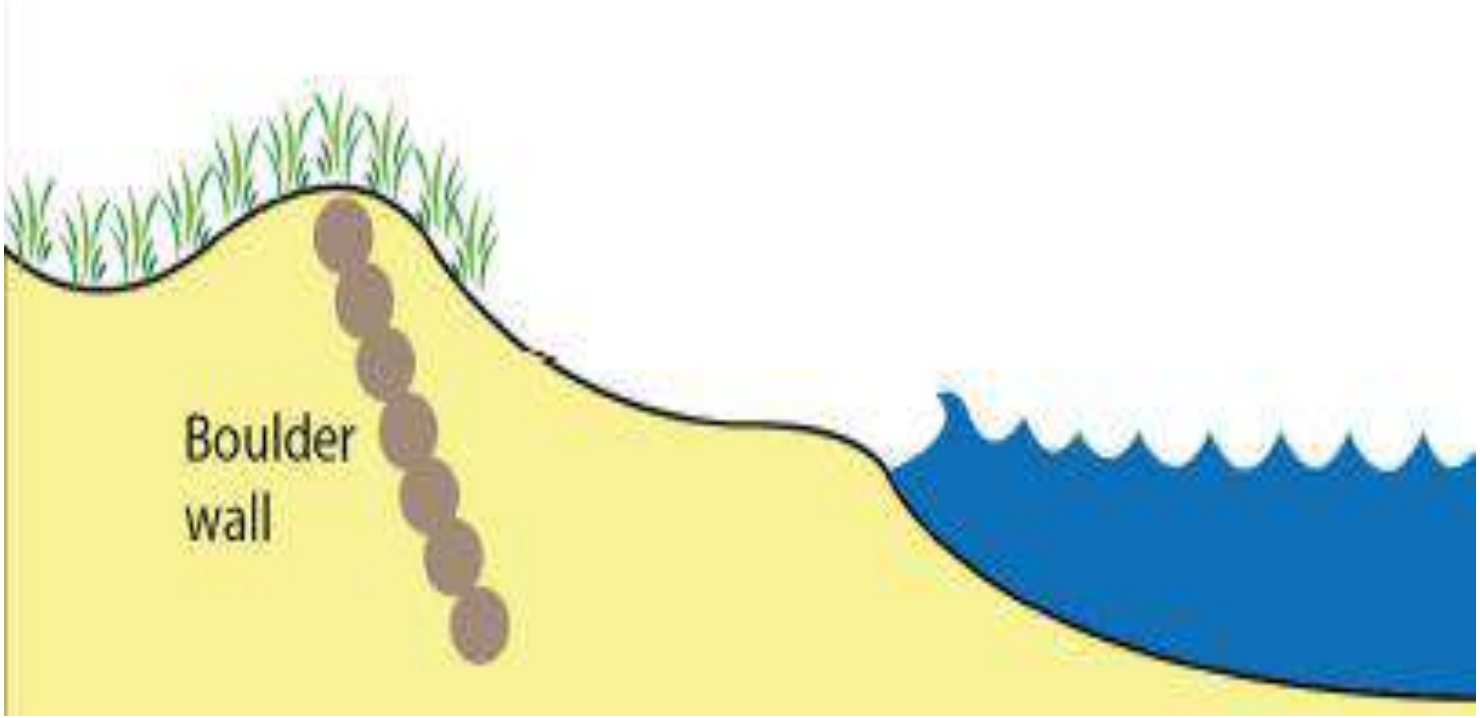


- Levees or flood barriers
- Raising development level over time
- Resilient and adaptive buildings

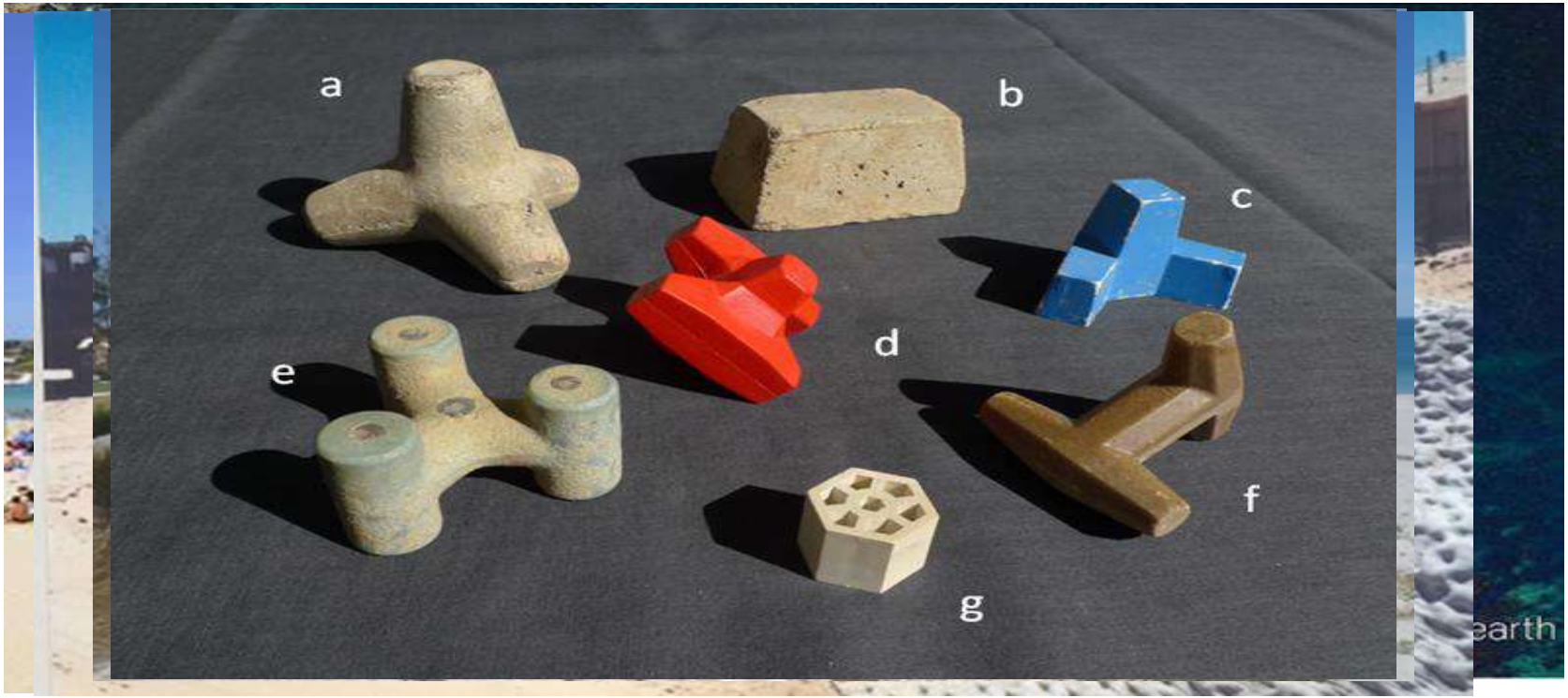
Seawalls



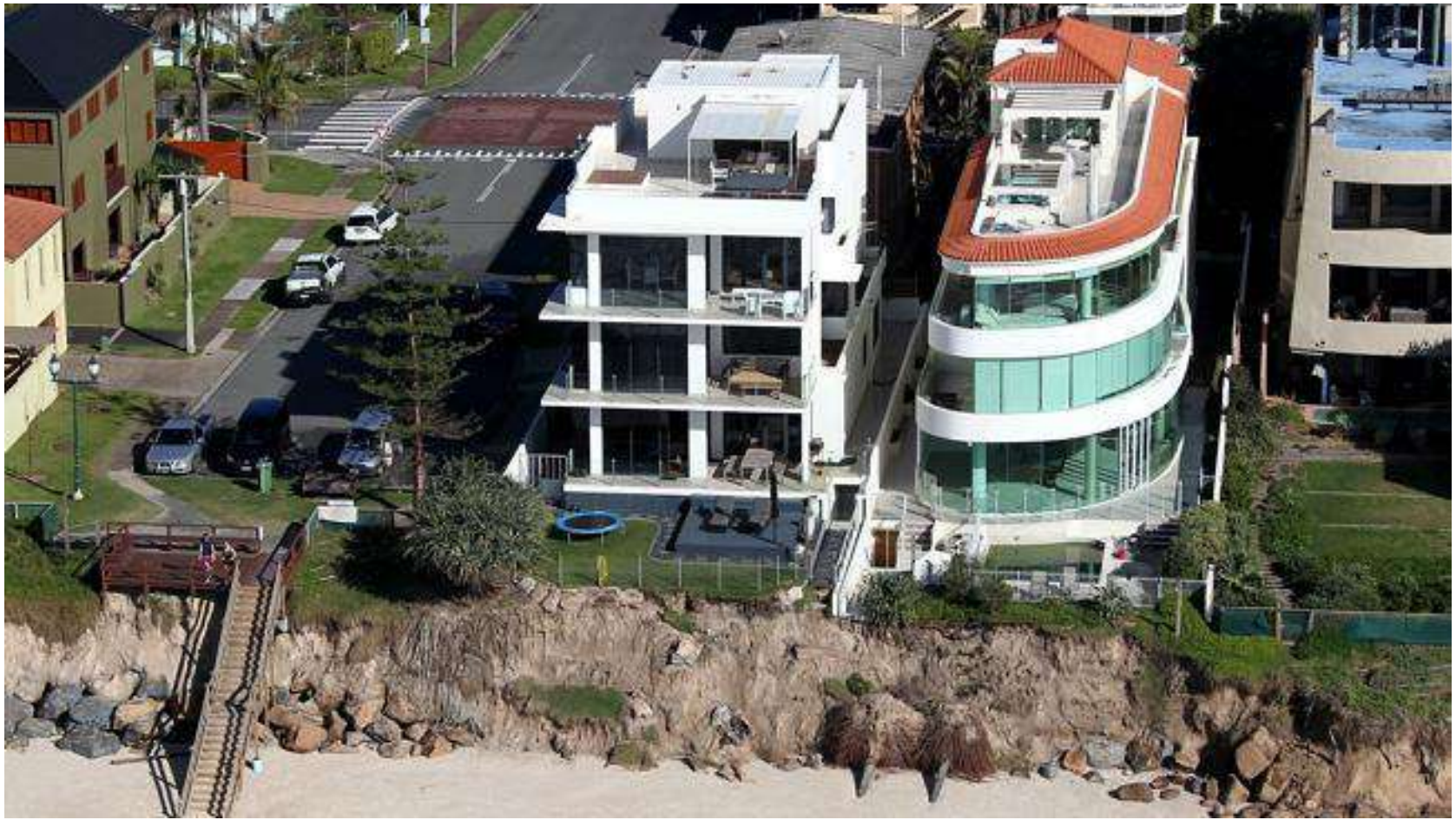
Seawalls



Seawalls



Buried seawall beneath sacrificial dune Dixon Park - eroded and protected

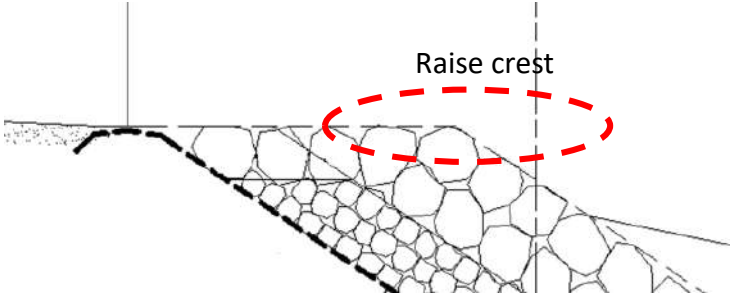


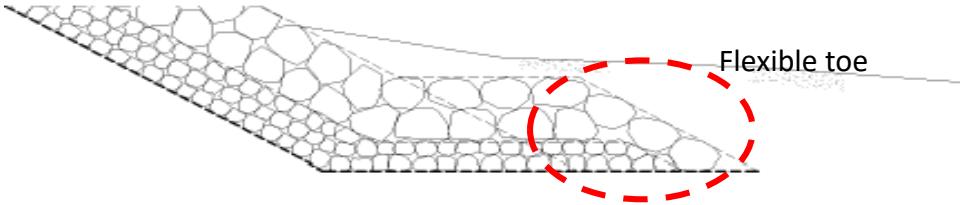
Possible Seawall Responses to Climate Change

- Retreat / Allow erosion to occur
- Reduce exposure by increasing upper beach volume (i.e. nourishment and other coastal protection works)
- Accommodate higher level of damage over time and ensure maintenance occurs
- Adapt existing seawall design
- Re-construct seawall

Adapting existing seawall design

- Place additional layer of large armour units on face of seawall, enhancing stability of armour units
- Place additional rock at the crest to increase crest level or crest width, reducing overtopping damage
- Place additional rock as a flexible toe to accommodate additional scour. Include placement of secondary armour and filter layers as part of the toe to reduce potential for liquefaction.





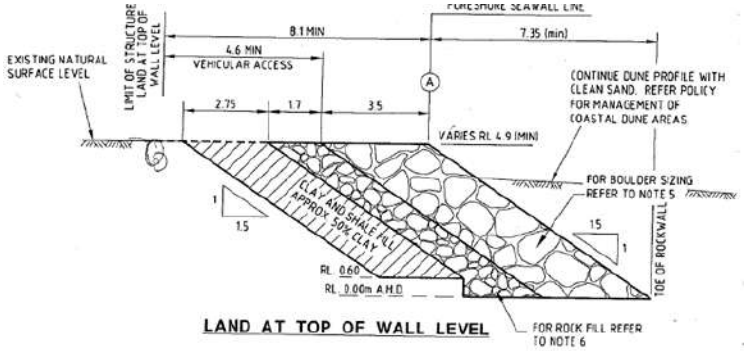
Adapting Seawall Design

- With increased design waves and higher water levels, over-topping of the crest and safety of people and equipment is increasingly important. Raising the crest to compensate may not always be practical, and the use of crest wave deflectors and/or wave absorption devices may need to be considered.
- Overall the costs of modifying or replacing existing structures will be high, with Townend and Burgess (2004) estimating increases in the annual costs of such actions ranging from 150% to 400% depending on the future scenario .

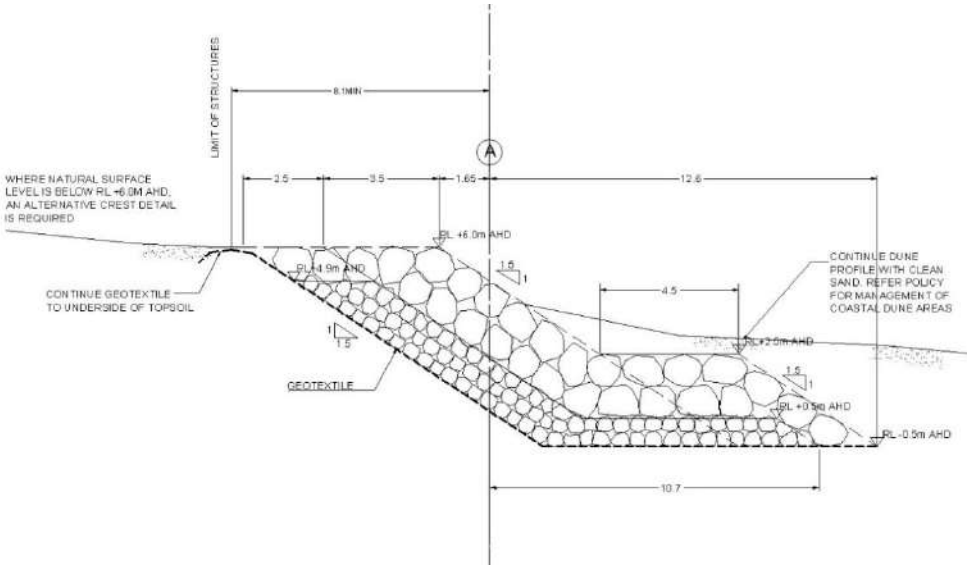
Re-construct seawall

- Utilise best practice design and incorporate elements which allow for future maintenance and design adaptation.
- Use larger primary armour to enhance the stability of armour units.
- Increase notional permeability of seawall by modifying secondary armour and filter layers to enhance the stability of armour units by increasing wave dissipation and reducing reflection.
- Incorporate a higher or wider crest to reduce overtopping damage.
- Found toe to anticipated scour depth or incorporate a flexible toe detail to accommodate additional scour.

Gold Coast Seawall

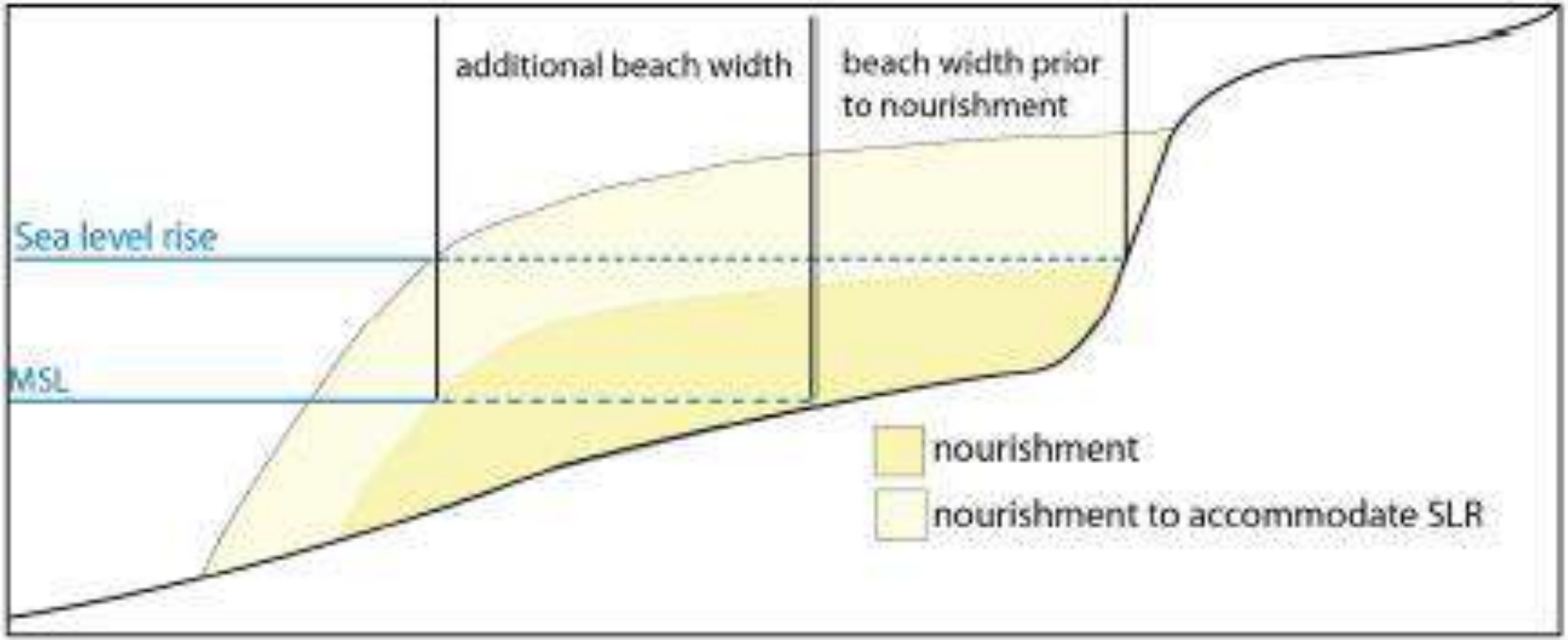


1970 C.O.G. design

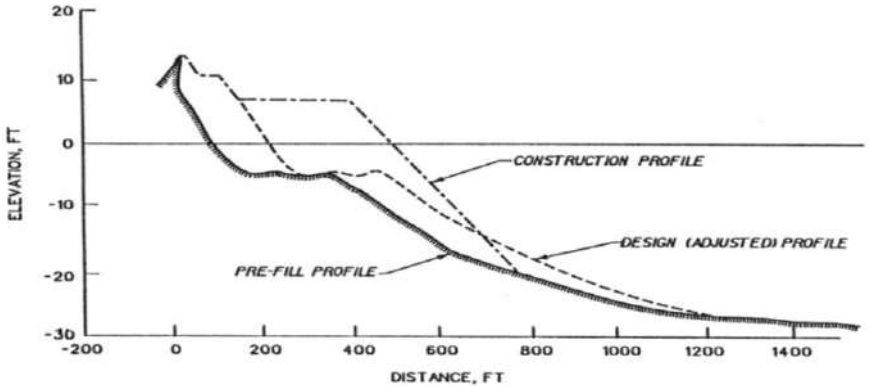


2014 proposed ‘concept’ design

Beach nourishment



Beach Nourishment

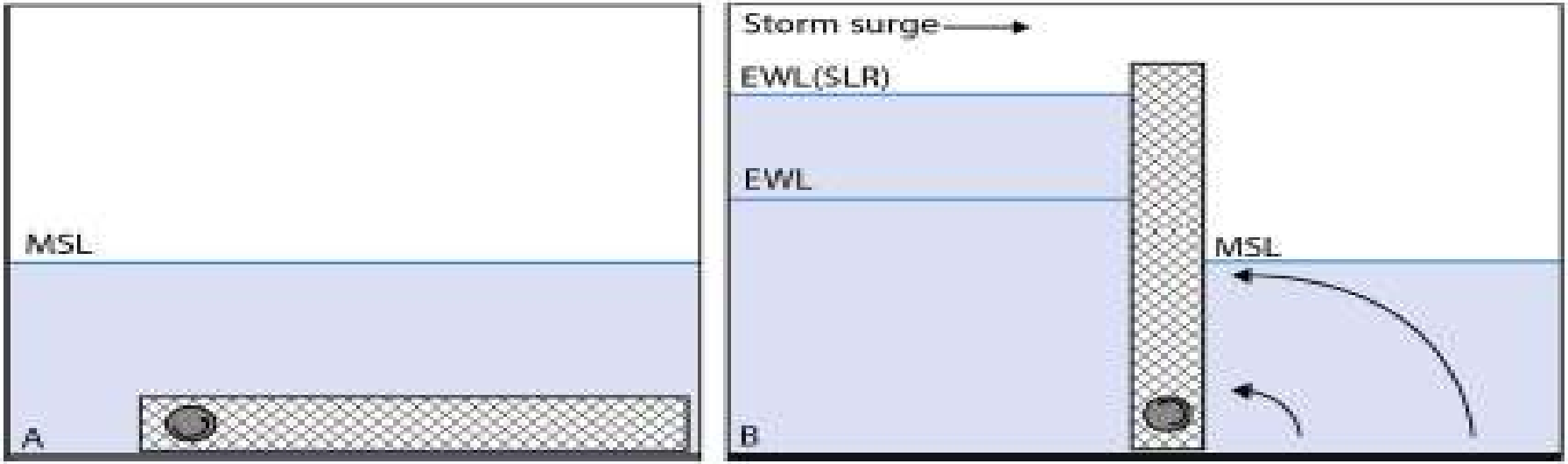


- Gold Coast Strategy = Seawalls + nourishment

Effectiveness for Adaptation

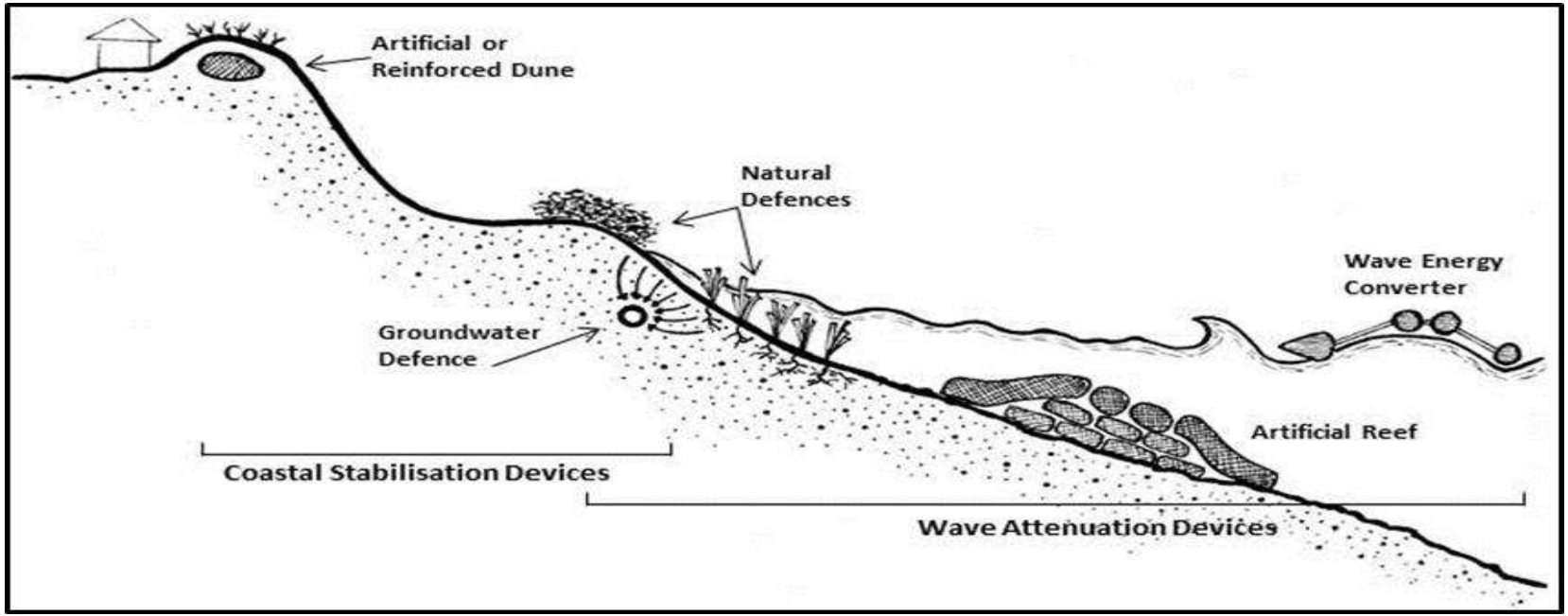
- Most seawalls are upgradable
  - Increased wave climate – larger armour
  - Sea level rise – increase height and width
  - New structures – adequate design
- Nourishment
  - Bruun Rule, longshore transport, wave climate ??
- Groynes
  - Increased structural capacity and dimensions
  - Landward extension
  - Profile response and trapping

Storm surge barriers



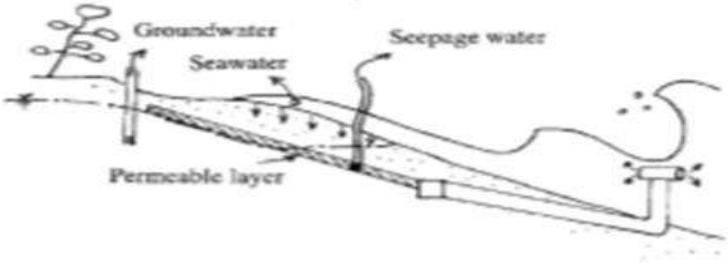

Goolwa
Clayton
HINDMARSH ISLAND
SIR RICHARD PENINSULA
or Harbor
MUNDOO ISLAND
Goolwa Barrage
Vertical slot &
Denil fishways
MURRAY MOUTH
PELICAN POINT
Mundoo Barrage
Boundary Creek Barrage
THE COORONG
Ewe Island Barrage
SOUTHERN OCEAN
Tauwitchere Barrage
Rock ramp &
vertical slot fishways
0
10 km

Emerging Technology and Novel Approaches



Natural Defences

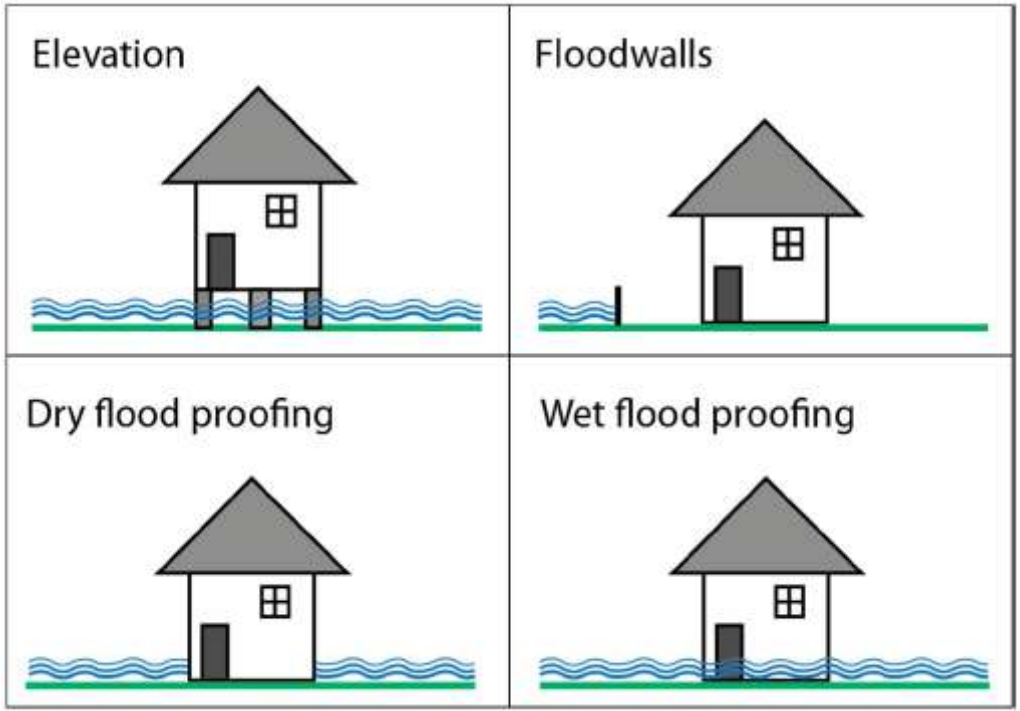
Beach Groundwater Manipulation



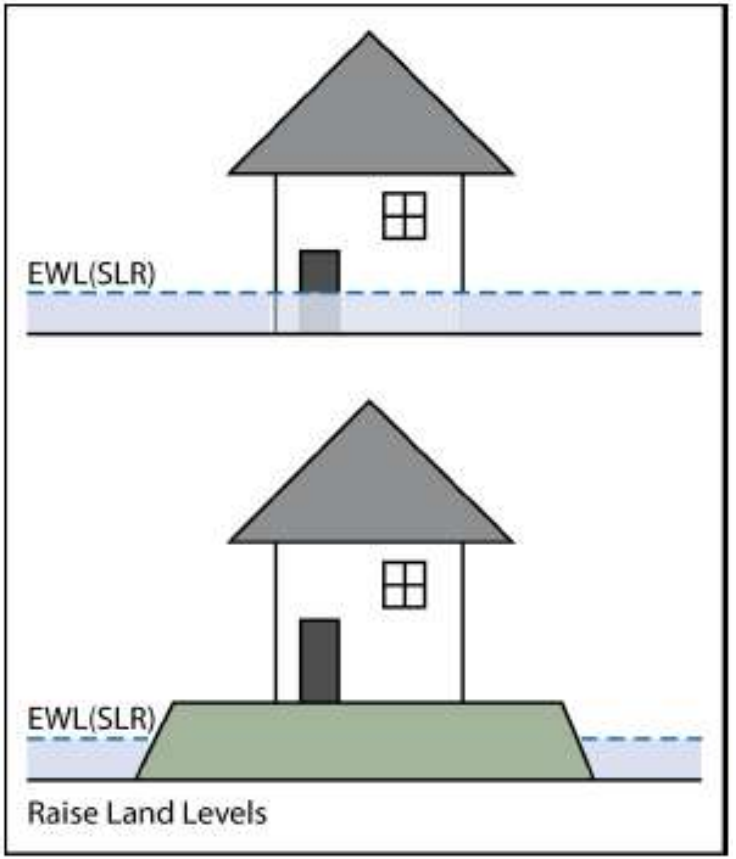
Wave Energy Converters

- Point absorbers;
- Terminators; and
- Attenuators.

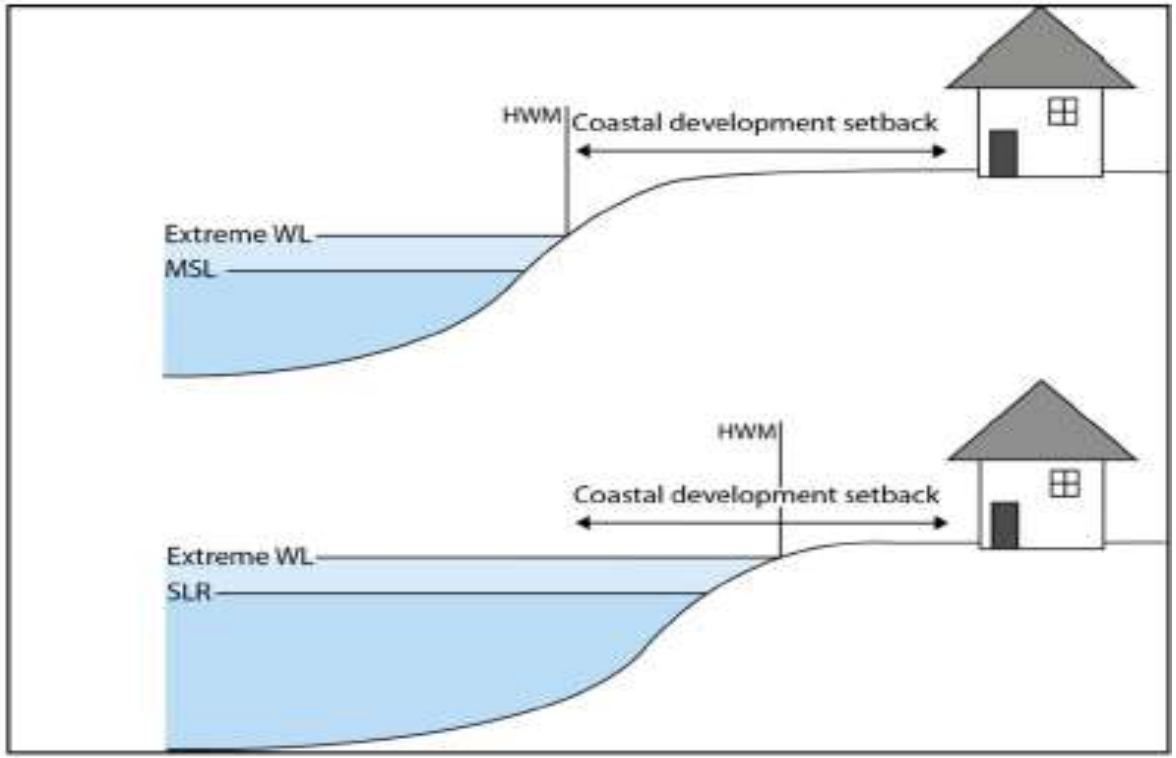
Building retrofitting & design



Raise land levels



Development setbacks/easements



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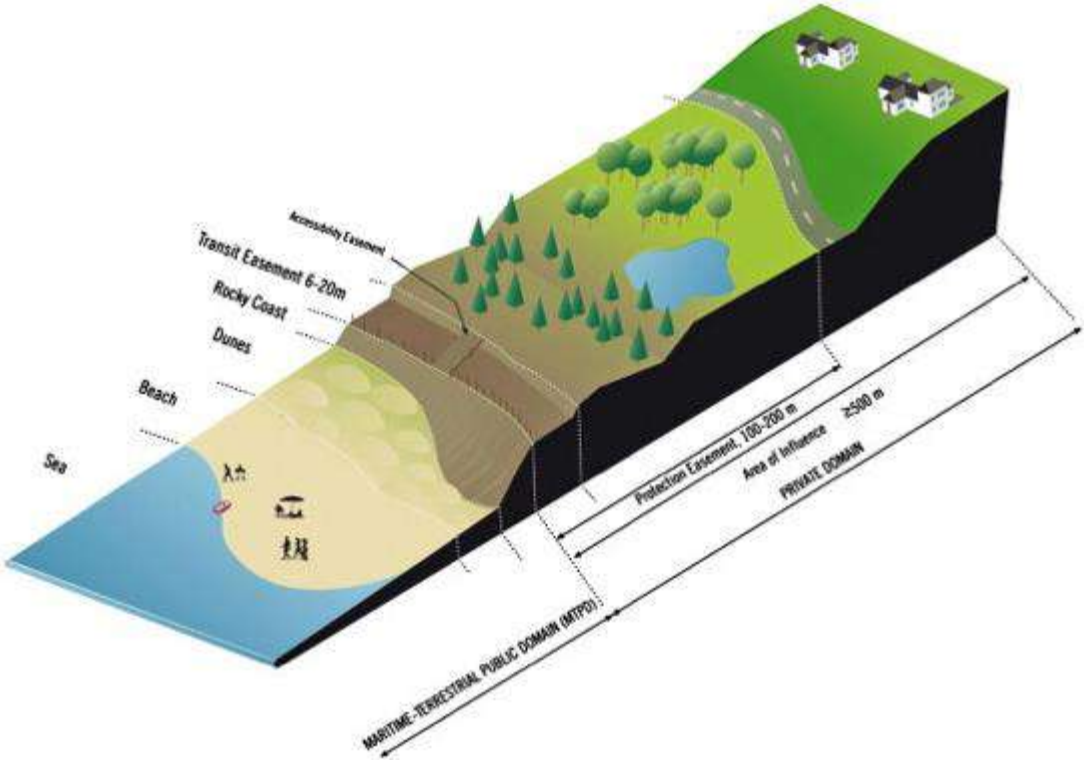
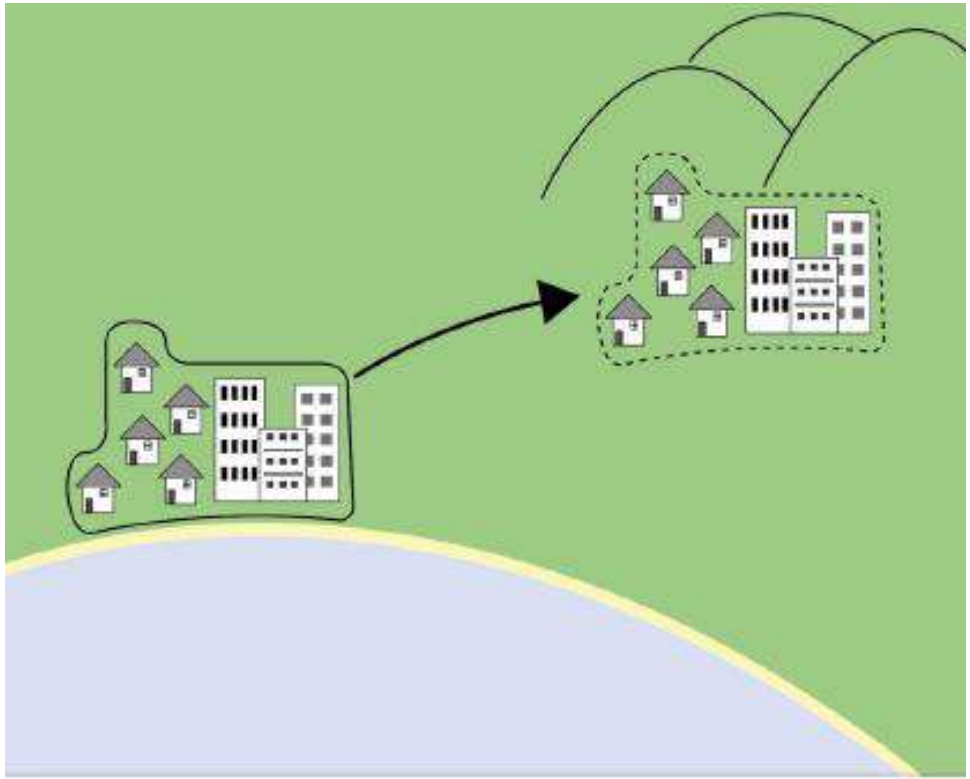
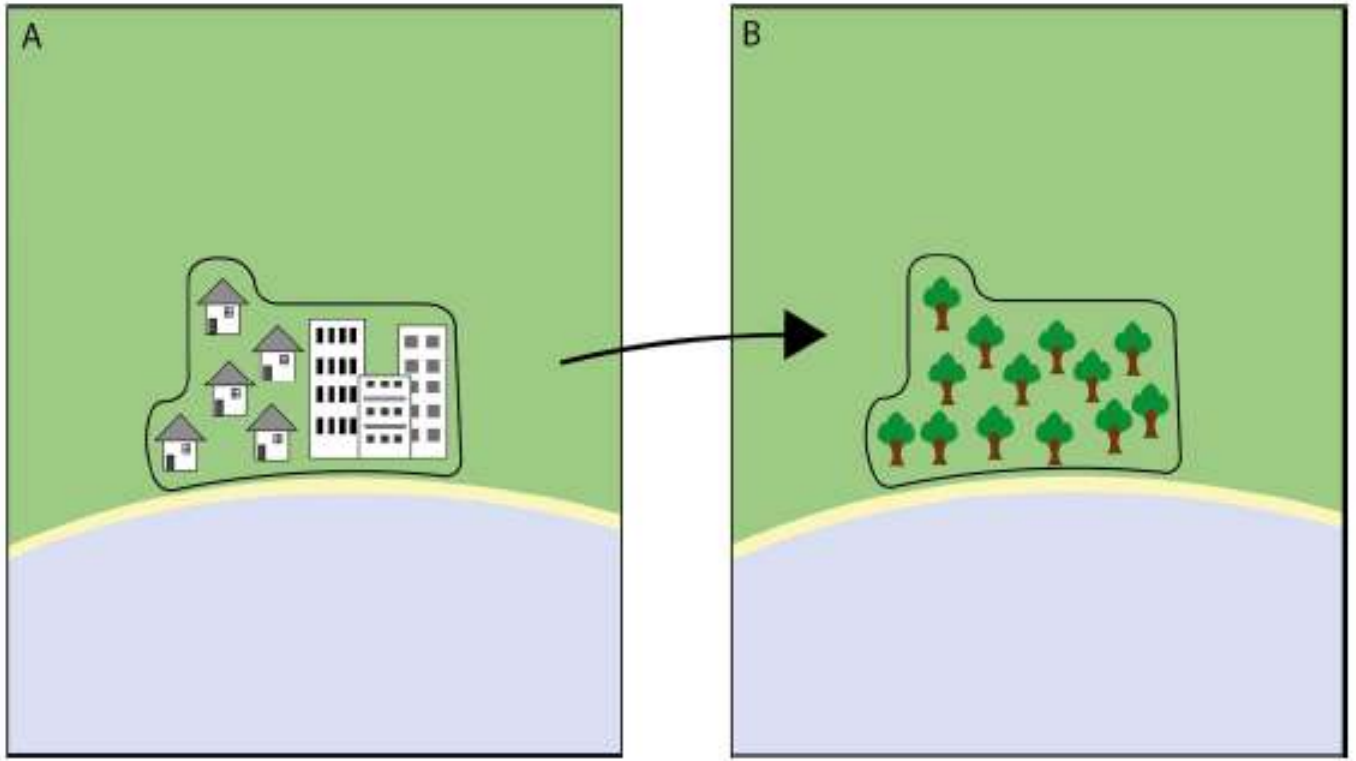


Land purchase or swap

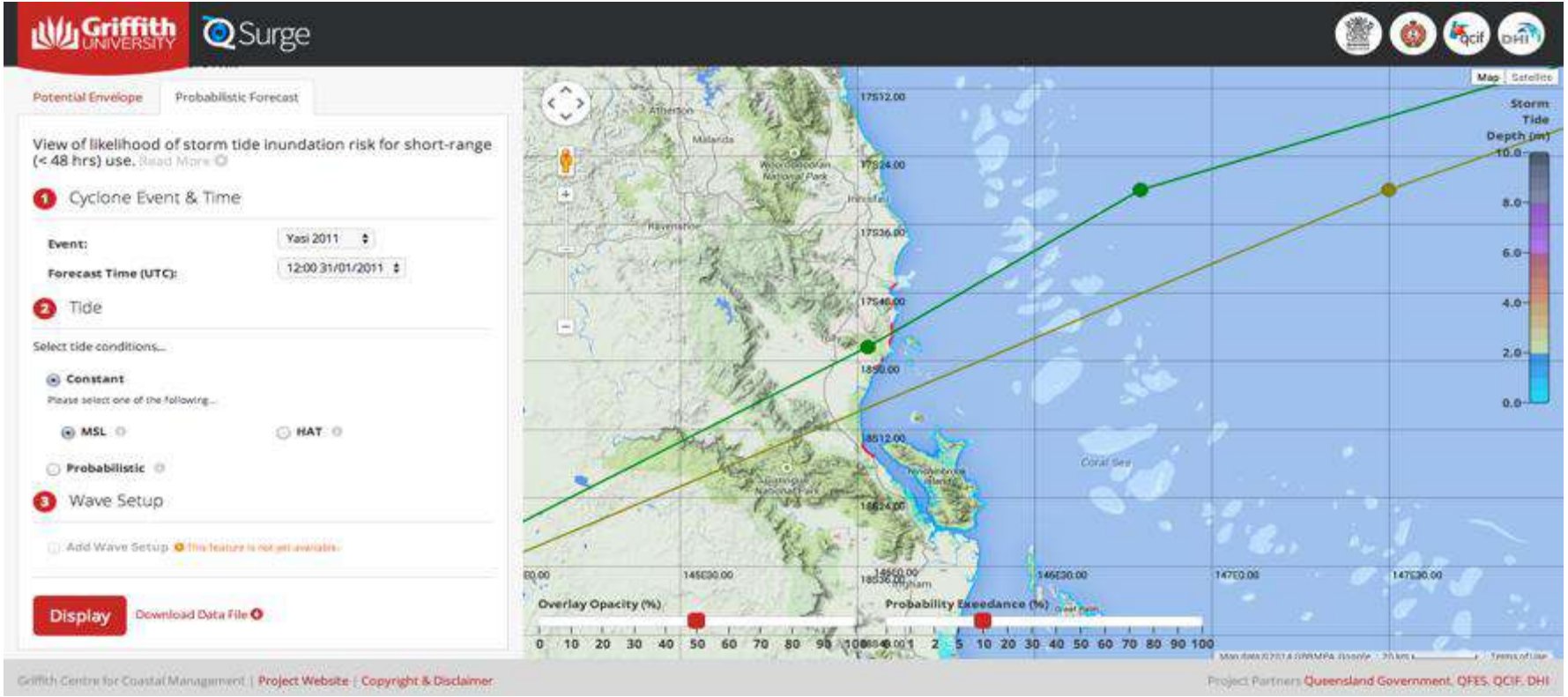


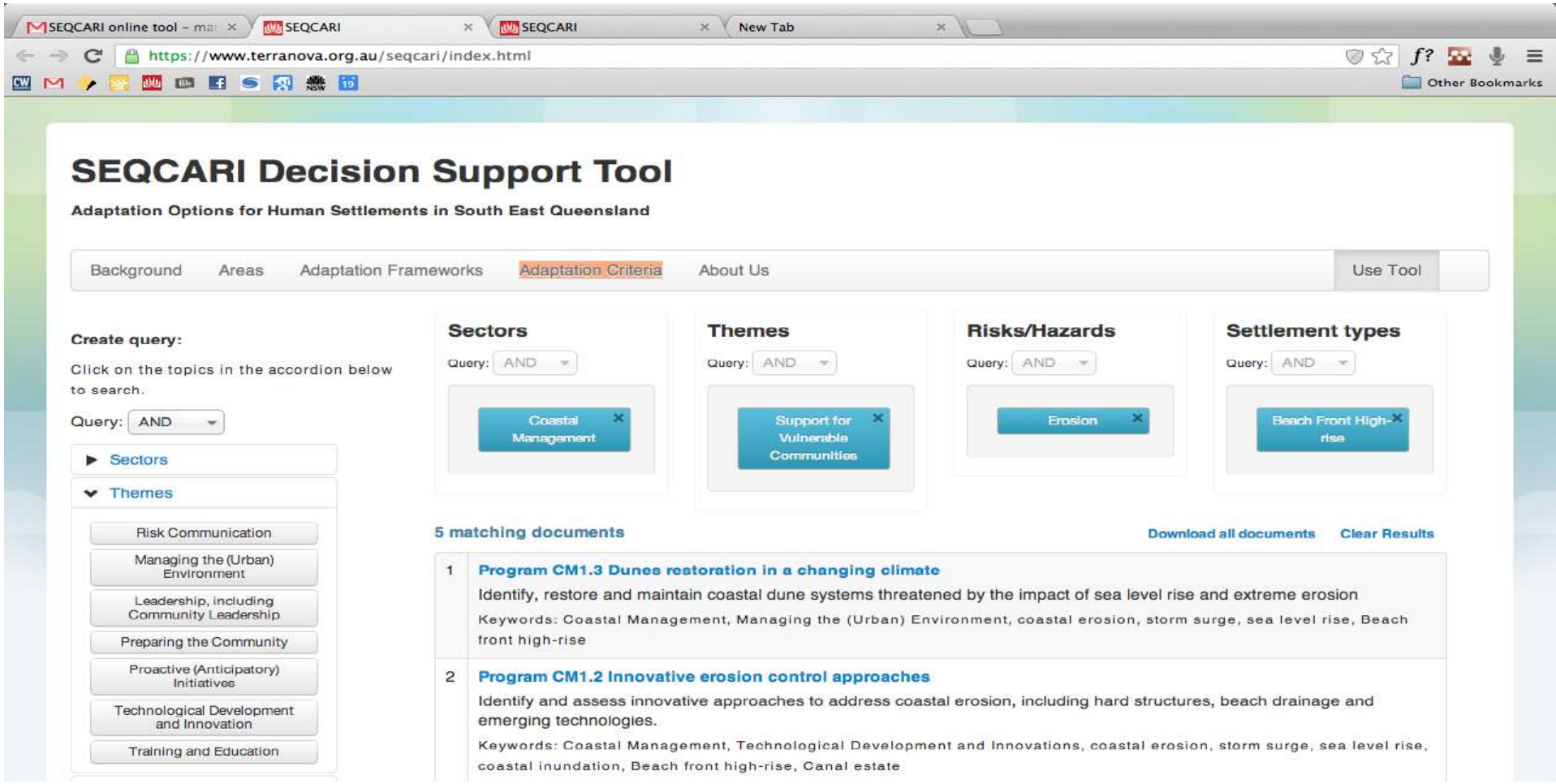
Change land use



Raise awareness

Warning systems/alerts

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New Tab
https://www.terranova.org.au/seqcari/index.html
Other Bookmarks
SEQCARI Decision Support Tool
Adaptation Options for Human Settlements in South East Queensland
Background
Areas
Adaptation Frameworks
Adaptation Criteria
About Us
Use Tool
Create query:
Click on the topics in the accordion below to search.
Query: AND
Sectors
Themes
Risk Communication
Managing the (Urban) Environment
Leadership, including Community Leadership
Preparing the Community
Proactive (Anticipatory) Initiatives
Technological Development and Innovation
Training and Education
Sectors
Query: AND
Coastal Management
Themes
Query: AND
Support for Vulnerable Communities
Risks/Hazards
Query: AND
Erosion
Settlement types
Query: AND
Beach Front High-rise
5 matching documents
Download all documents
Clear Results
1
Program CM1.3 Dunes restoration in a changing climate
Identify, restore and maintain coastal dune systems threatened by the impact of sea level rise and extreme erosion
Keywords: Coastal Management, Managing the (Urban) Environment, coastal erosion, storm surge, sea level rise, Beach front high-rise
2
Program CM1.2 Innovative erosion control approaches
Identify and assess innovative approaches to address coastal erosion, including hard structures, beach drainage and emerging technologies.
Keywords: Coastal Management, Technological Development and Innovations, coastal erosion, storm surge, sea level rise, coastal inundation, Beach front high-rise, Canal estate

Adaptation Options Challenges

Asset anchoring

- Critical infrastructure tends to be expensive and long-lived
- Located near the coast
- Response to extreme events tends to be coastal defence
- None relocated as yet

Acknowledgement: Mark Gibbs

- Prioritise actions according to risk to service, not vulnerability or consequence
  - Don’t focus on the physical scale
  - Value of asset changes with age
- Management actions need to focus on climate change residual risk
  - Existing infrastructure will already be designed for natural hazards – climate change brings marginal increase in risk

Acknowledgement: Mark Gibbs

- One-off solutions tend to be preferred – leading to hard engineering options
  - Seawalls become the most cost-effective option for high economic intensity development
  - Policy lock
  - Active adaptive management requires multiple management practices in parallel

Acknowledgement: Mark Gibbs

- Retreat
  - High economic development – high cost
  - Small settlements – compensation - “Estate planning”

Gold Coast Beach Management

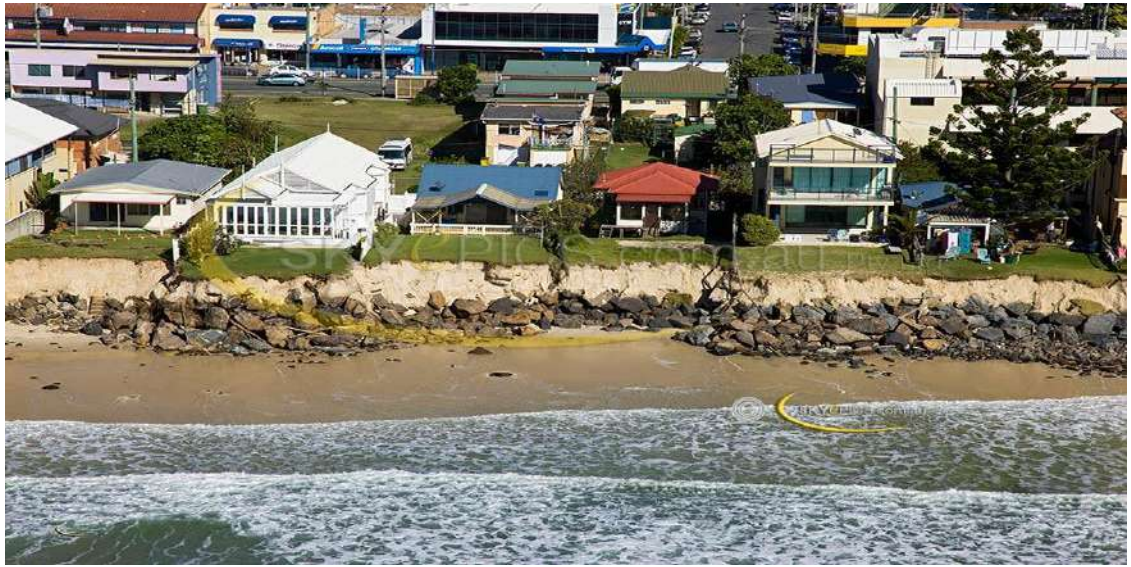
A hazard adaption strategy might includes a combination of:

- Allow erosion to occur naturally in undeveloped areas (no seawalls)
- Undertake beach nourishment (with stabilising coastal structures where required) to continue to provide a usable beach and an adequate sandy buffer seaward of the seawall.
- Adapt existing seawalls (preferred over re-building given length of wall presently completed) to withstand expected conditions with an acceptable damage level. Adapted design to reflect location-specific vulnerability.
- Regular design review to reduce impact of uncertainty on design process.
  - Actual characteristics of future climate & updated predictions
  - Actual changes to protective capacity of the beach over time

Gold Coast

2 main approaches to managing beach erosion

- Last line of defence – Seawall
- Maintain beach width with nourishment



Nourishment

Gold Coast Beach Nourishment Totals

Main Beach to Miami: 6.5 mil m^3

Southern Gold Coast Beaches (Kirra to Durambah): 17.45 mil m^3

Palm Beach: 2.3 mil m^3

Gold Coast - Narrowneck

Northern Gold Coast Beach Protection Strategy

- Award-winning
- Local concept, investigation, design, manufacture, construction, monitoring

- Beach width maintained
- Diverse ecosystem
- Recreational function
- Simple maintenance

Northern Gold Coast Beach Protection Strategy

- Reef construction commenced in August 1999 and concluded in December 2000
- The geo-textile bags were placed with a split-hull hopper dredge
- The reef is 450m long, 205m wide, and in depths of water up to 10m below Lowest Astronomical Tide

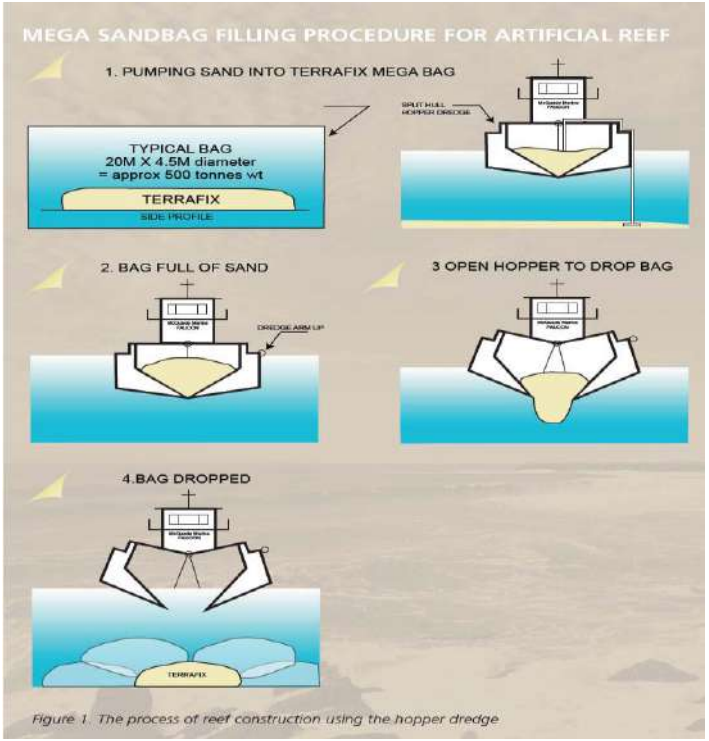


Figure 1. The process of reef construction using the hopper dredge

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