

COASTAL  
BOULEVARD

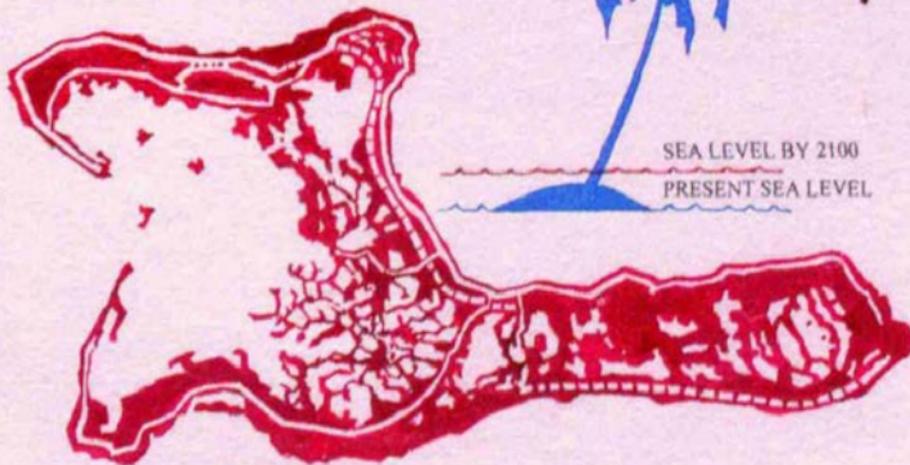
AUSTRALIA  
TERACE

GOVERNMENT  
TERRACE

**ADAPTING TO  
SEA LEVEL RISE**

**KIRIBATI**

**75c**



*Greenhouse Effect on  
Kiritimati Island*

**GREENHOUSE EFFECT**

# INTRODUCTION

## SEA LEVEL RISE IN THE PACIFIC

On March 9, 2012, the Sydney Morning Herald announced that “The Pacific nation of Kiribati is negotiating to buy land in Fiji so it can move islanders under threat from rising sea levels, in what could be the first climate-induced relocation of a country.”

The Pacific Islands are the most endangered places on the globe under the threat of sea-level rise caused by Climate Change. Some islands are

so low-lying, like Kiribati, that they are about to be submerged, while other islands’ primary cities and infrastructures, such as ports, airports, tourist resorts, and roads are at risk.

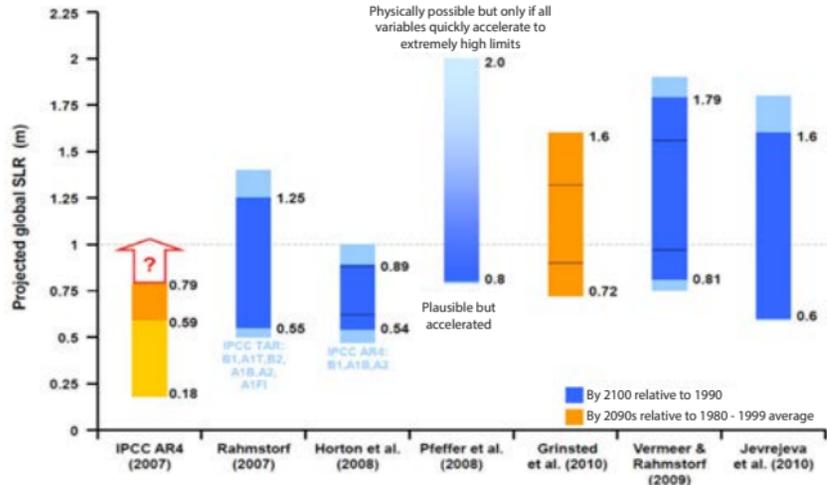
This booklet introduces new measures that help to increase resilience to sea-level rise and tsunamis. We suggest soft interventions that also boost lifestyle and improve the coastal environment.

# FACTS & ESTIMATES

## SEA LEVEL RISE

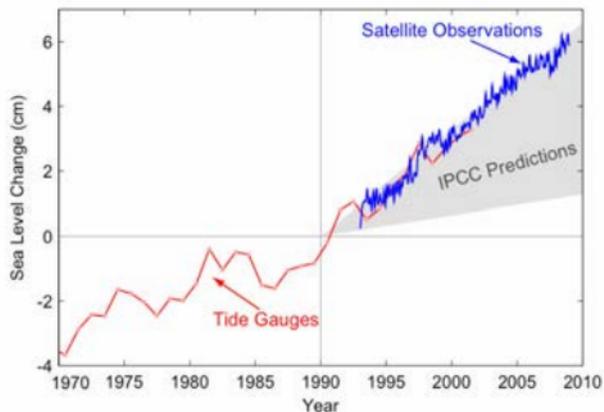
The surface of our planet is constantly changing. 20,000 years ago, the sea level was 120m lower than the the present. Global warming is causing both the thermal expansion of the oceans and the melting of Antarctic ice shelves, resulting in a rise of water levels. In addition to this, tectonic shifts and movement of plates lead to earthquakes and tsunamis.

Estimates on sea-level rise are derived from algorithmic modelling. The results differ due to a lack of knowledge about the complexity of the environment. The trend, however, is clear: the level of the

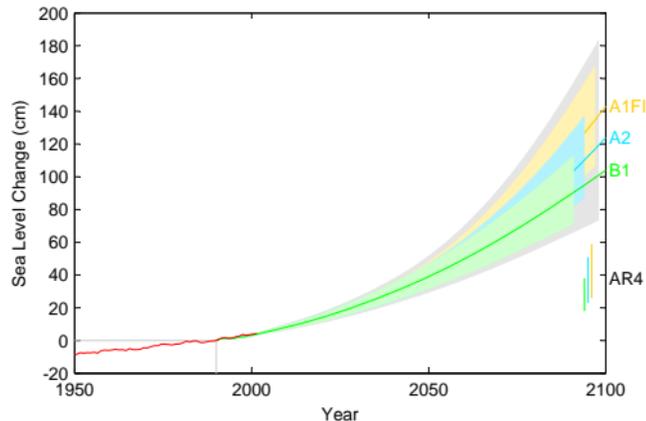


ocean in *the west Pacific is rising at a significant pace and increase 0.8m - 2m by the end of this century* (not including storm-surge).

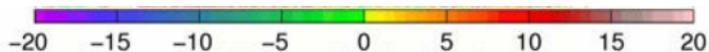
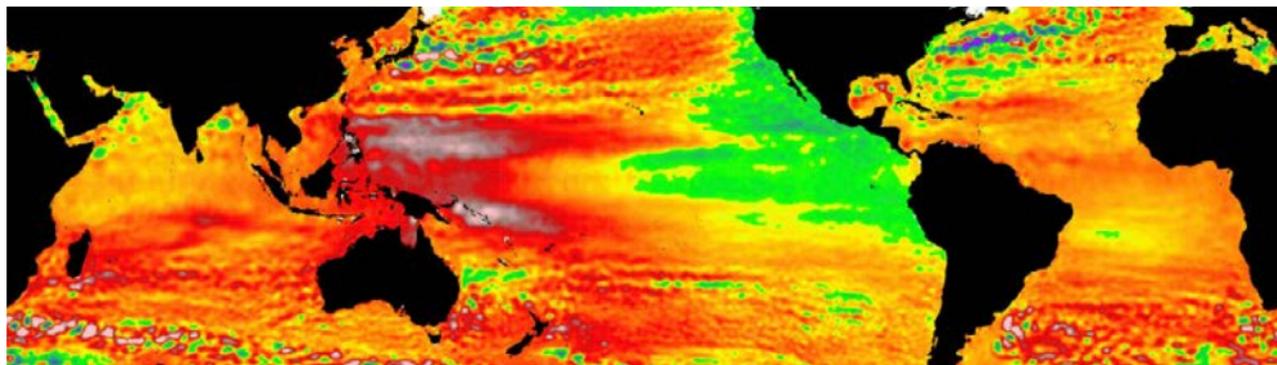
Given these facts and estimates, the uncertainty of science, and the limited timeframe, *we should start to take action now.*



^ Relatively conservative estimates of the rate of sea level rise by the Intergovernmental Panel on Climate Change (IPCC).



^ Other models, incorporating the melting of polar ice and permafrost, predict higher levels



^ 1993 to 2008 Change in Sea Level (in centimetres)

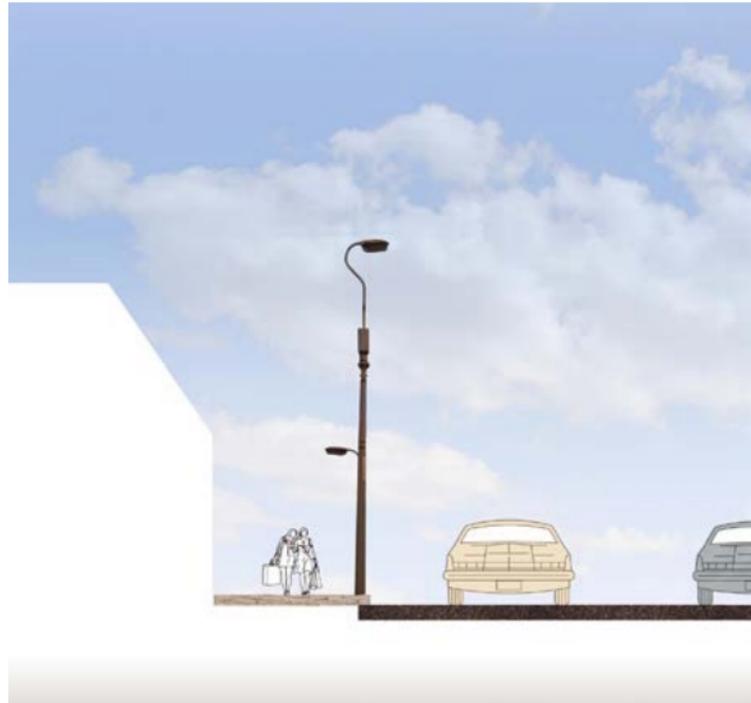
# RESPONSE OPTIONS

## RESILIENCE: SOFT ENGINEERING

Over the past few centuries the typical responses to sea level rise have used “hard” engineering approaches. These include the use of sea-walls, which are both unattractive and costly.

There are better options. In 2010, the School of Architecture at Princeton University in the United States presented a study on how to boost the resilience of New York City against sea-level rise. These lab-tested measures can be implemented into the coastal landscape as a variety of *“soft” geo-engineering interventions that align with nature rather than fighting it.*

One advantage of this soft approach is that it can start with small interventions, monitored and optimised in performance. Over time, with moderate subsequent investments, an array of protective measures can be put in place, which increase accessibility to the water and improve the atmosphere of the waterfront.

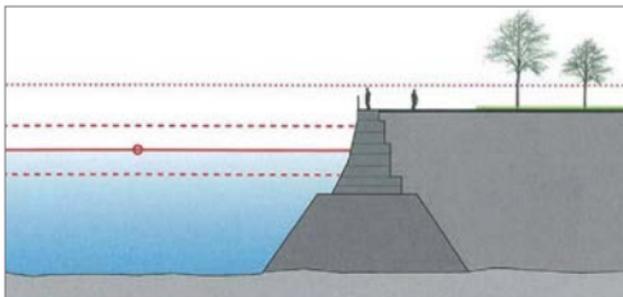


Apia's current seawall >  
Potential coastal boulevard for Apia v

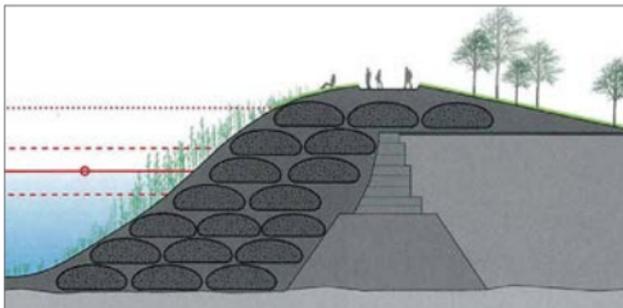


# RESILIENCE

## SOFTENED COASTLINE

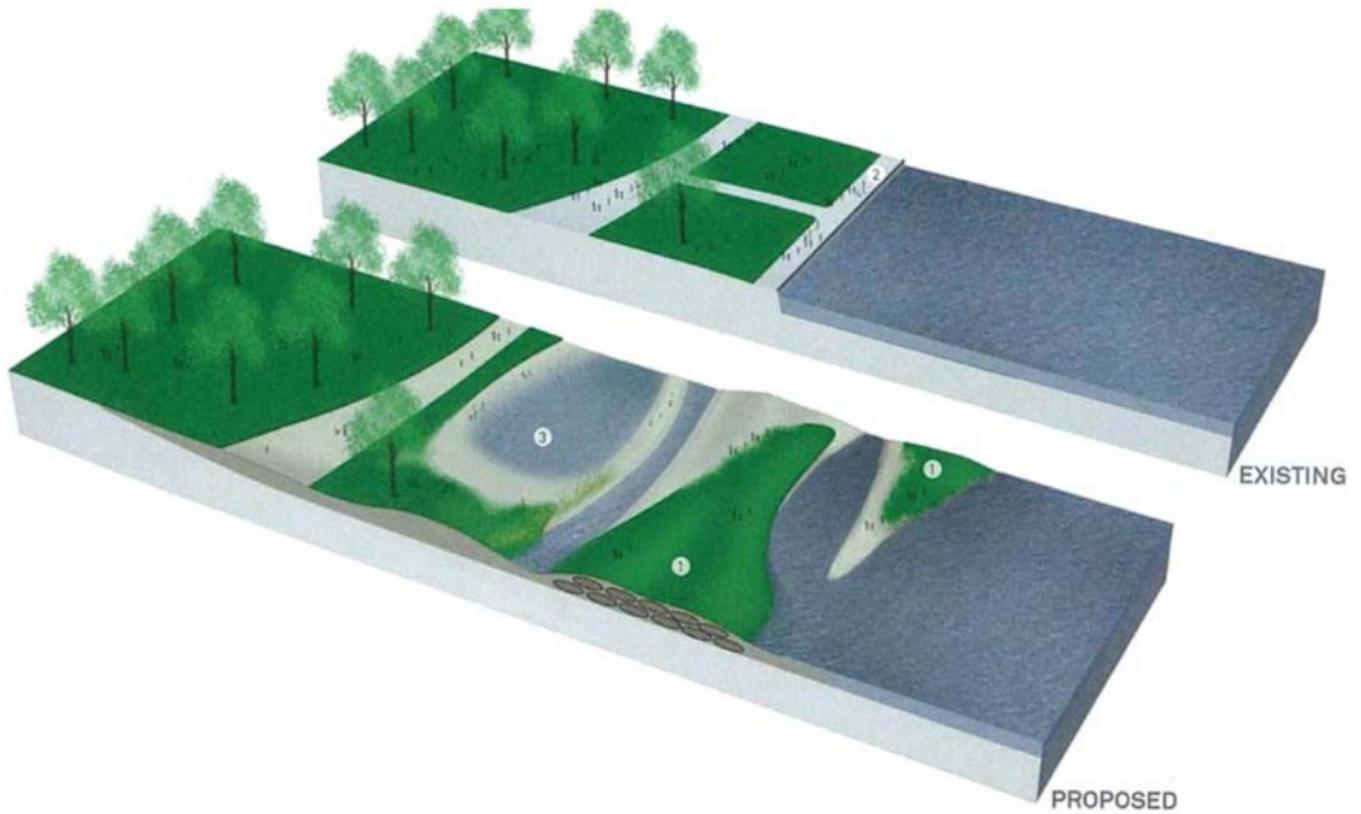


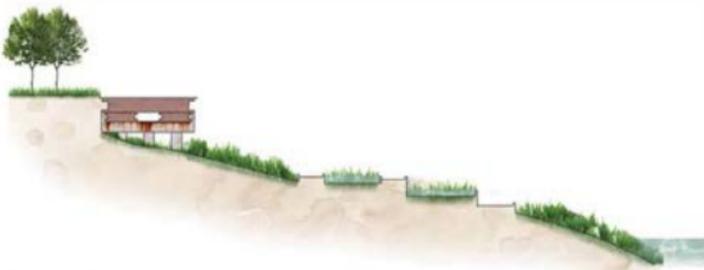
In the central parts of towns and cities, coastlines are usually comprised of hard quay walls, often no longer in use because of the relocation of the cities' ports. The opportunity exists to soften these walls by building a wide base within the water and creating a softly moulded coastline above the existing height. These would absorb most of the energy from storm surges, mitigating the effect of sea level rise.



In recent decades urban waterfronts have come into focus. A softened coast line will upgrade the look and feel of these waterfront areas while also creating opportunities to enhance biodiversity with coastal estuaries or wetlands.

This option can be modified with terraces providing seating and coastal boulevards to embellish the harbourfront and allow access to the water for residents and visitors.





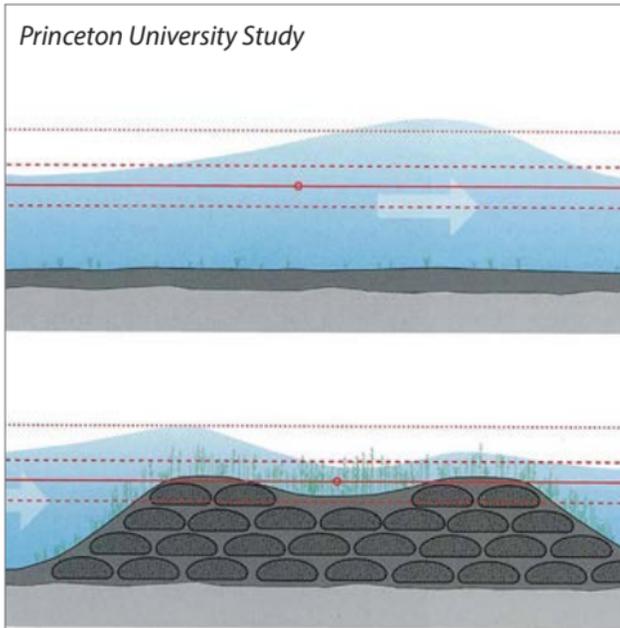
^ Soft, landscaped coastlines comprise a variety of access and and amphibious natural environments (image by Mitchell Round, University of Auckland)



*In cities, softened coastlines can be integrated into park-like arrangements or urban farming (image by Gabrielle Free, University of Auckland)*

# RESILIENCE

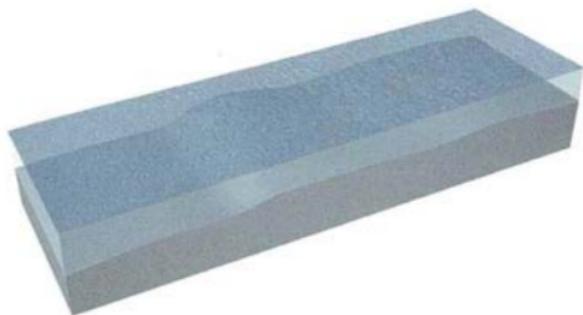
## ARTIFICIAL ISLANDS



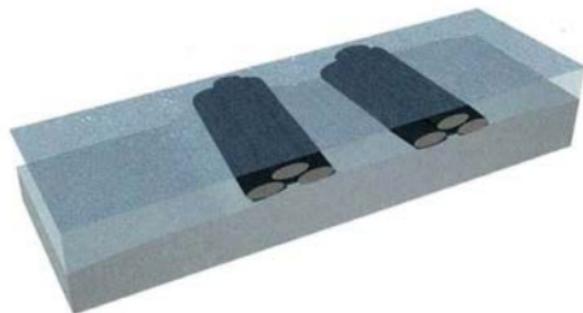
Ports are continuously dredged in order to maintain or deepen shipping channels. The dredged spoil can instead be used to build up artificial islands. As storm surge waves or tsunamis build up over kilometers, massive interventions are necessary to break their energy and protect the land.

The dredged sediment first has to be decontaminated, then filled into geotextile tubes and placed in bundles in appropriate places. The final shape of the island is created by further infill of sediment. All of this can be done without disrupting the coastal mainland.

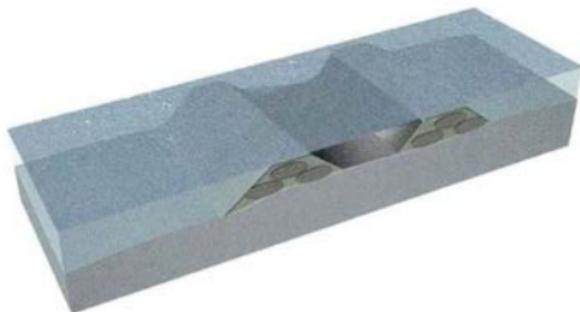
Wave barriers can substantially enrich coastal ecosystems by creating artificial islands.



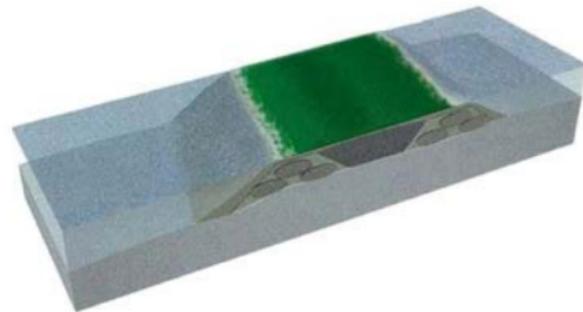
Existing vacant sea bed sites



Positioning of geotextile tubes



Fill / island formation



Recycled rubble / debris as dry island foundation

^ *How an artificial island is built*



^ *Artificial Islands in Apia's harbour could both protect the city against storm surge and also provide opportunities for leisure activities.*

# CONCLUSION

Nobody is certain how quick or disastrous sea level rise will be. We know, however, that the earlier we start taking action, the more potential we have to use these changes to beautify our communities by applying sensitive and adaptive measures.

Cities have always invested heavily in various building schemes - whether in fortifications or urban infrastructure to keep up with sprawl. Now may be the time to invest significant money in the resilience of our coastal areas.

If we consider the situation wisely and make the right decisions early, we will not have a "crisis" on our hands; we will have beautifully adapted, safe cities.

***"Crisis is only  
the perception  
of those who  
refuse to adapt."***



▲ *A vision for Apia's Waterfront*



^ *The Paihia Master Plan (by S&T) focused on delivering a unique sense of place for the town with a contemporary maritime feeling and enhanced connection between the land and sea.*





## ABOUT US

Stephenson&Turner NZ Ltd is a long-standing practice in the Pacific. We specialise in urban design, architecture, and research-based engineering. Bernd Gundermann, Principal, architect and urban designer with S&T is an expert reviewer with the Intergovernmental Panel on Climate Change (IPCC) and incorporates the latest scientific research with urbanism. Adaptive Urbanism, as demonstrated in this booklet.

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