Working with Nature – a work in progress

(in an age of “encroaching humans” and “encroaching seas”)

Jim Dahm
Eco Nomos Ltd

Outline of Presentation

Brief overview of the fundamental issue – Coastal Squeeze

Brief overview of changing management emphasis

Examples of working with nature using coastal restoration:

- Beaches & dunes
- Estuaries

1. Coastal Dynamics and Coastal Squeeze

(with focus on sandy beaches – but issue is common to all developed coasts)

Coastal Erosion

For management purposes useful to subdivide erosion on beaches into:

- "Short term" or dynamic shoreline changes
    - Temporary erosion over management timeframes (50-100 years) - associated with shoreline fluctuations
    - This erosion can sometimes extend over periods of many years or even decades but involves no permanent net shoreline advance or retreat over long periods of time
    - Presently the most common form of erosion on sandy beaches
- Long term erosion
    - Permanent erosion (at least over management timeframes of 50-100 years)
    - Presently rare on sandy beaches but will become very common and increasingly significant with future sea level rise

In terms of coastal erosion – we're currently living in the "easy management" days!! Its going to get a lot tougher in the future

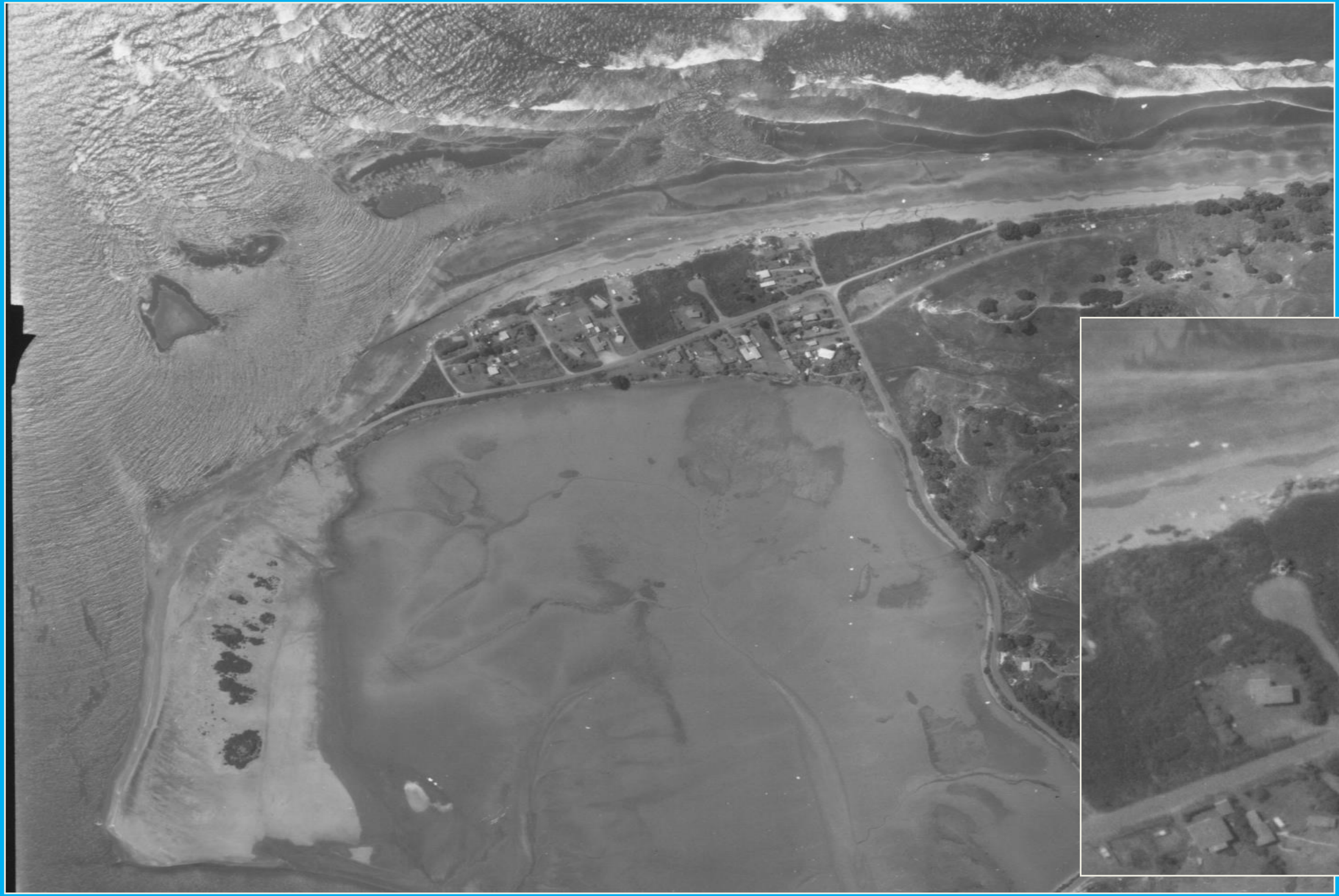
Accreted Condition


Eroded conditions
focus
resource management group

focus
resource management group

focus
resource management group

Ohwa Spit 4/2/1977



Ohwa Spit 4/8/2013

Coastal Development: Before

Pauanui Spit – 1940's

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Coastal Development: After

Pauanui Spit 1990's

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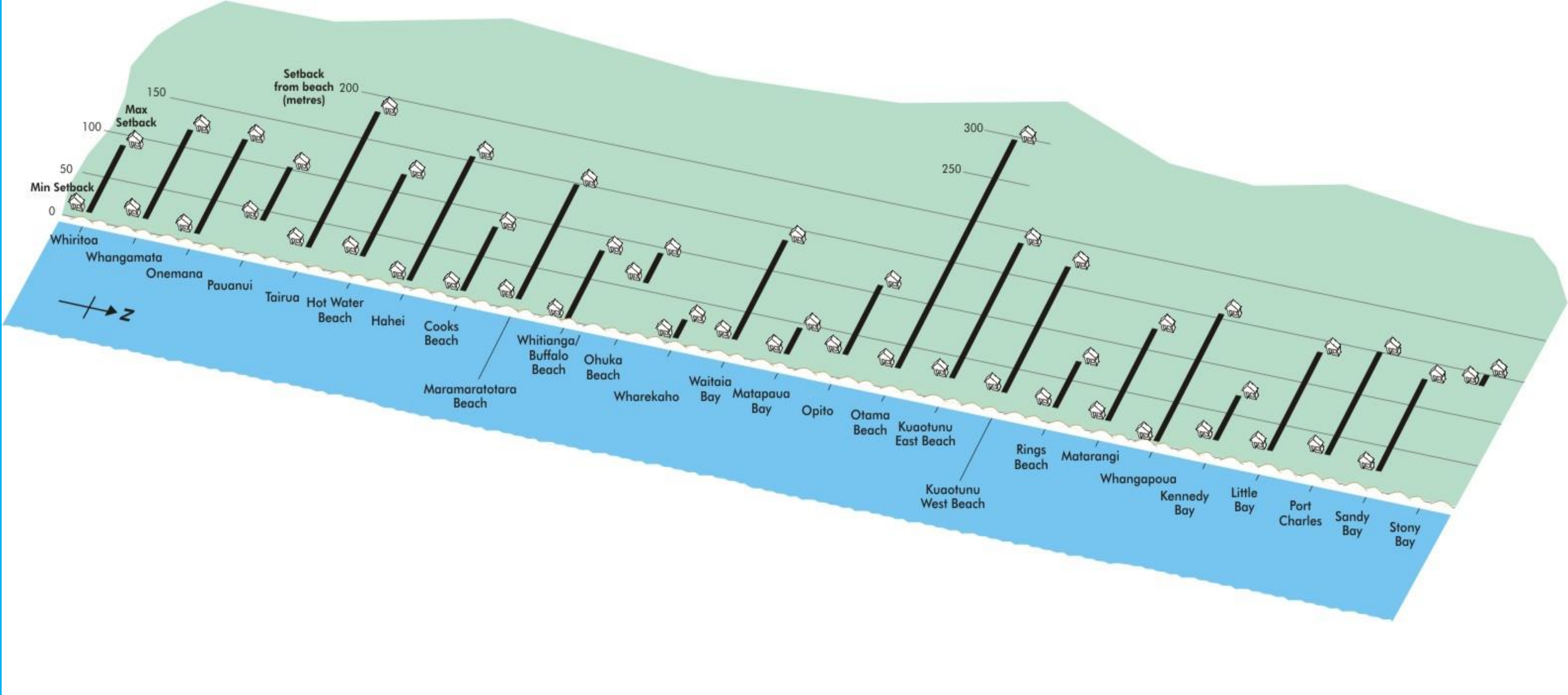
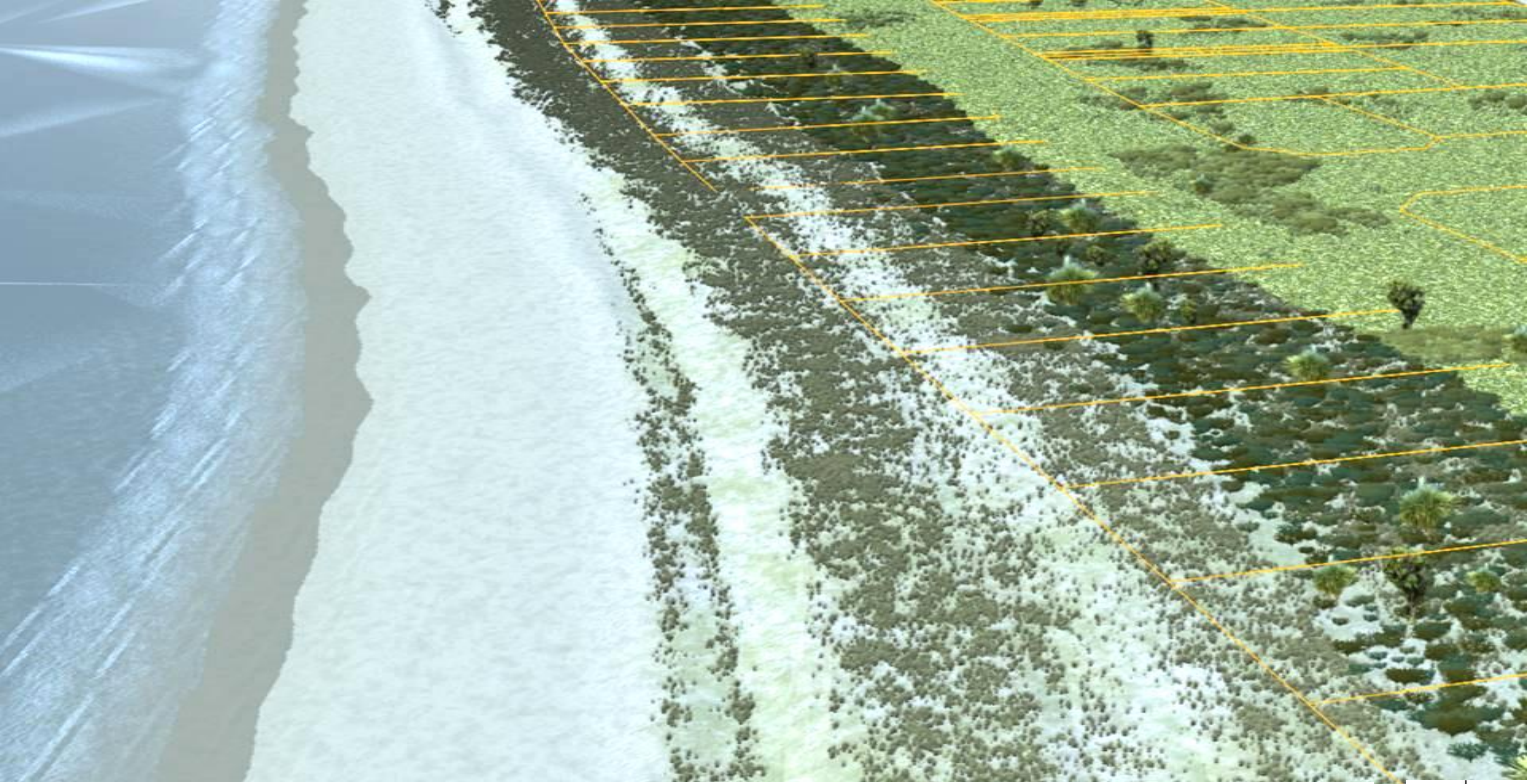
Proximity of Development to the Sea

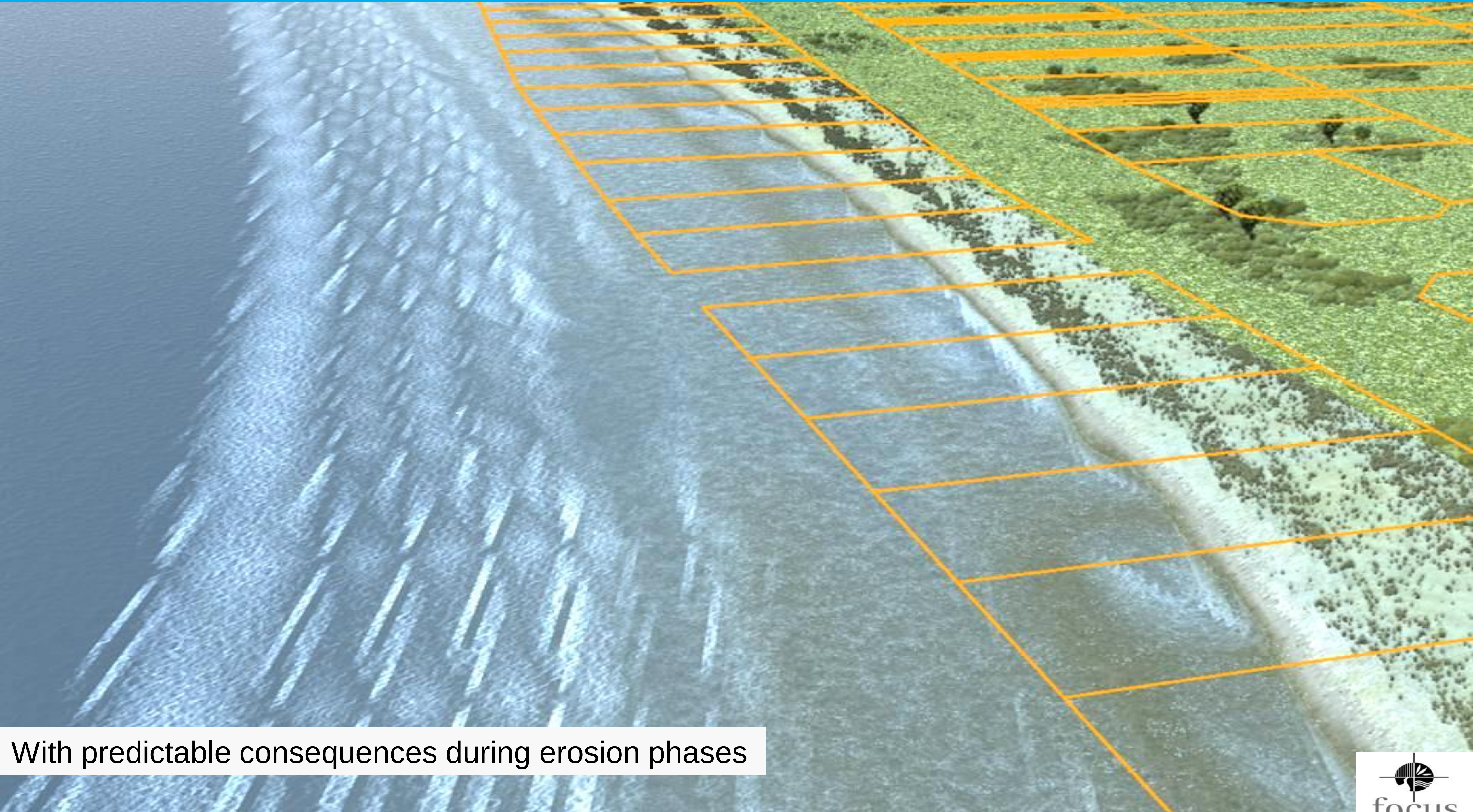


Eco Nomos



e.g. Subdivision often occurred with little or no understaning of coastal dynamics

focus
resource management group



With predictable consequences during erosion phases

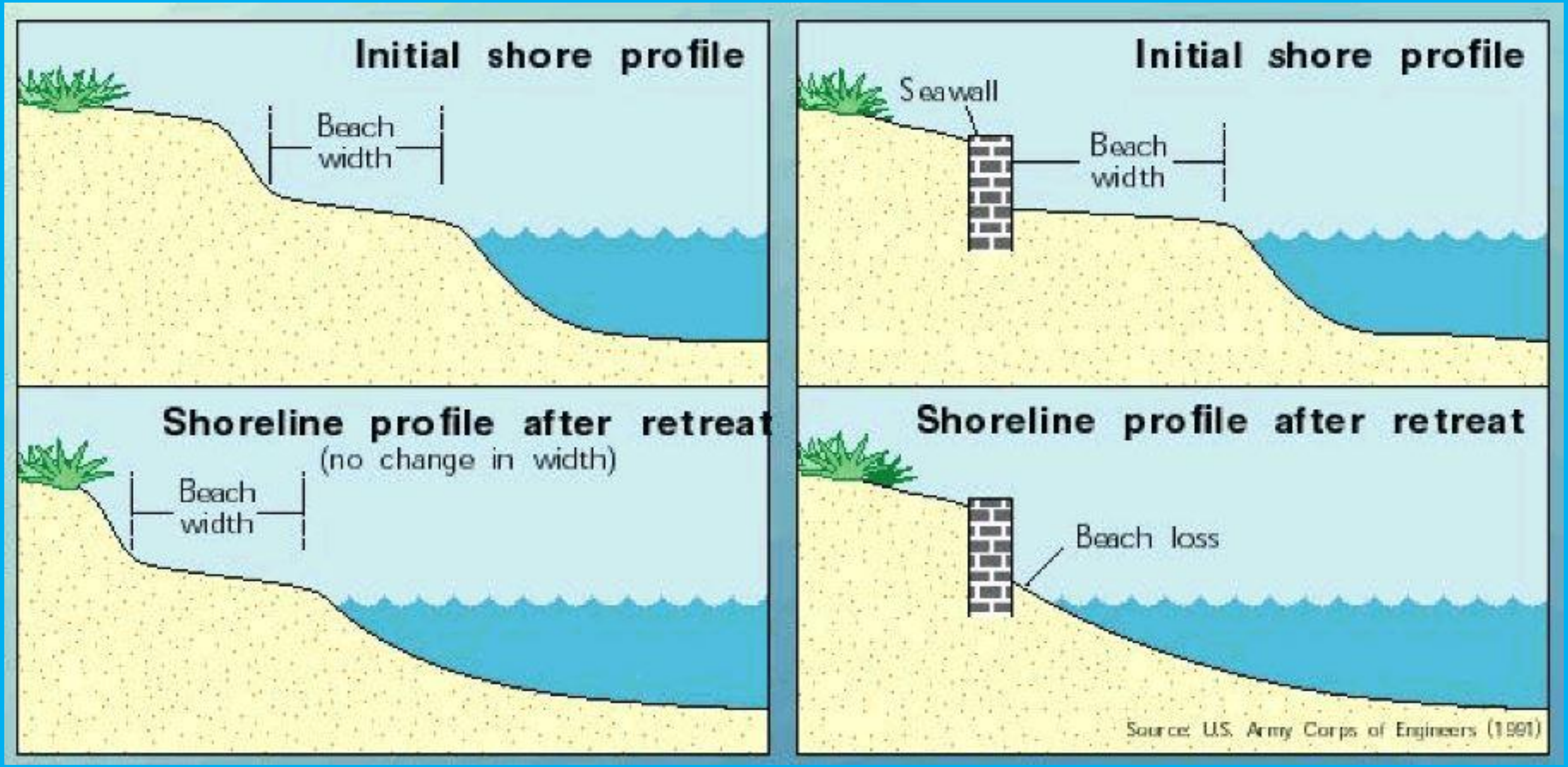
"Coastal Erosion" Problems

Cooks Beach 1978

Coastal Squeeze Vs Natural Shoreline
(beach example)

Natural Shoreline

Coastal Squeeze



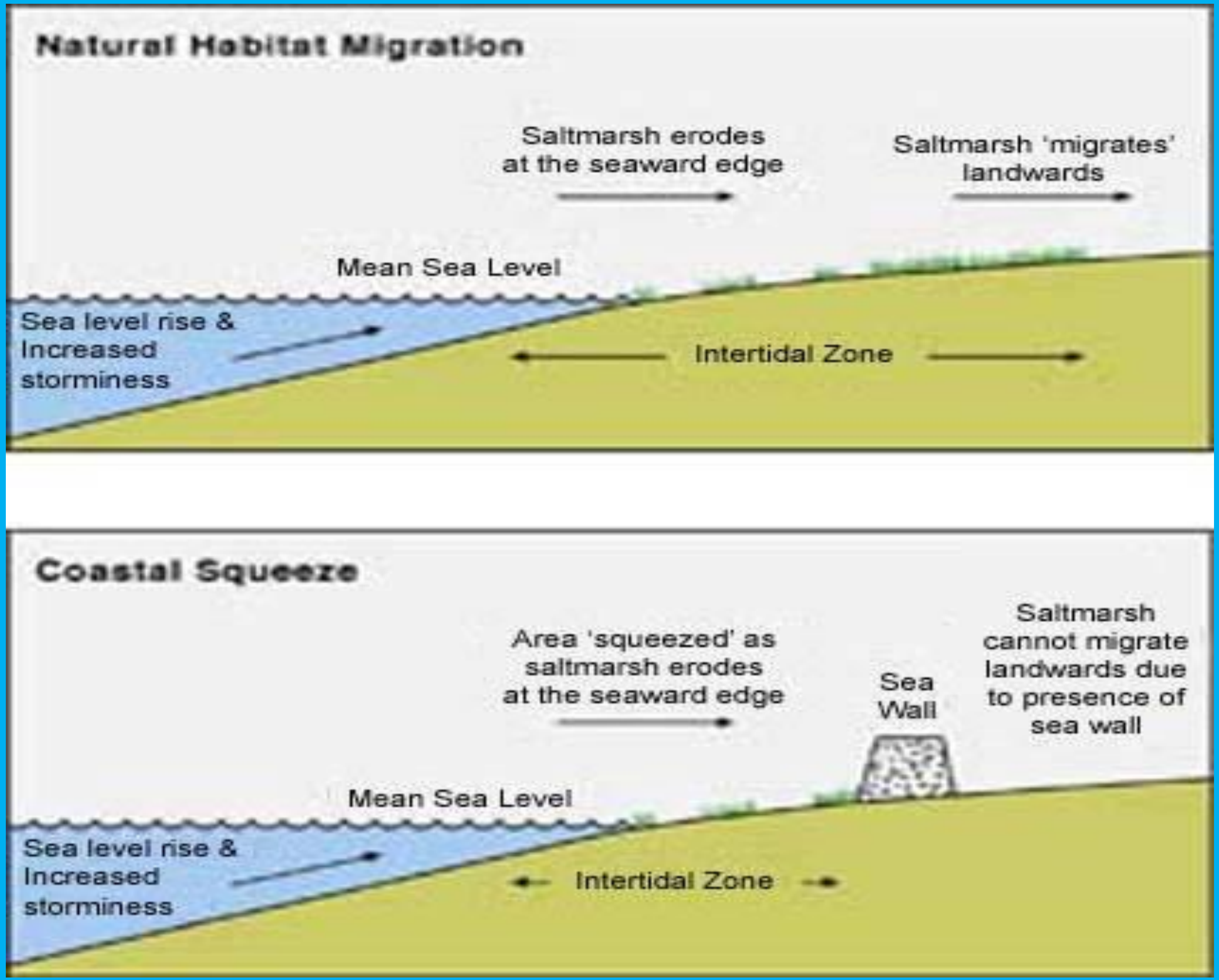
Estuarine Margins

- Estuarine margins have suffered a very similar fate to beaches
- Humans have encroached well seaward of the natural harbour margins around most estuaries in NZ
- Particularly significant activities include drainage and bunding (eliminating hydrological connections to the sea) for pastoral use and reclamation
- This human encroachment has markedly coastal margin ecosystems, particularly riparian margins and salt marsh
- Very significant ecosystems for a wide variety of ecological reasons
- Similar occurrence in most parts of the world

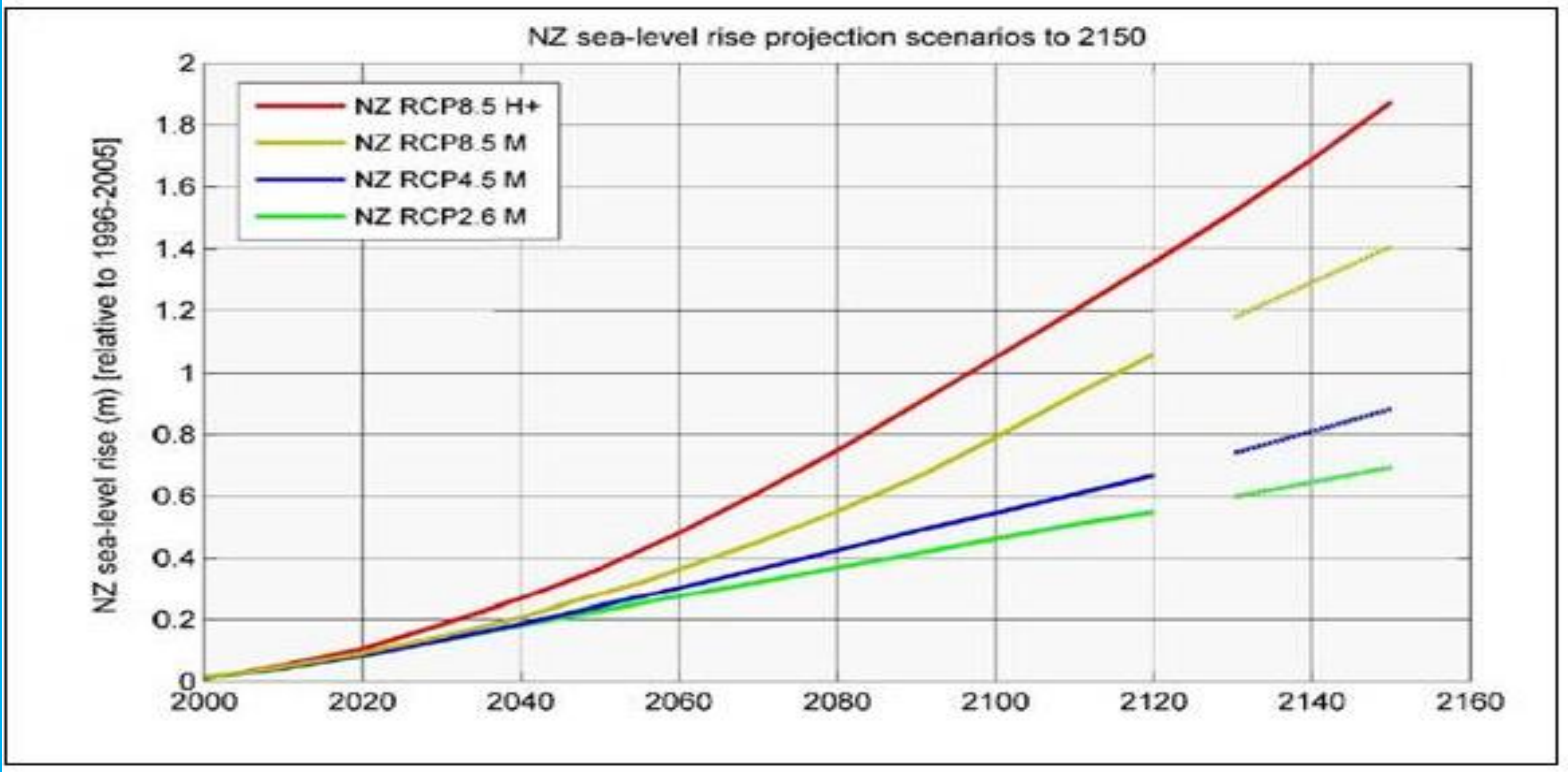
Coastal Squeeze: Estuarine Margins Example

Natural Shoreline →

Coastal Squeeze →



NZ Sea-Level Rise Projection Scenarios to 2150

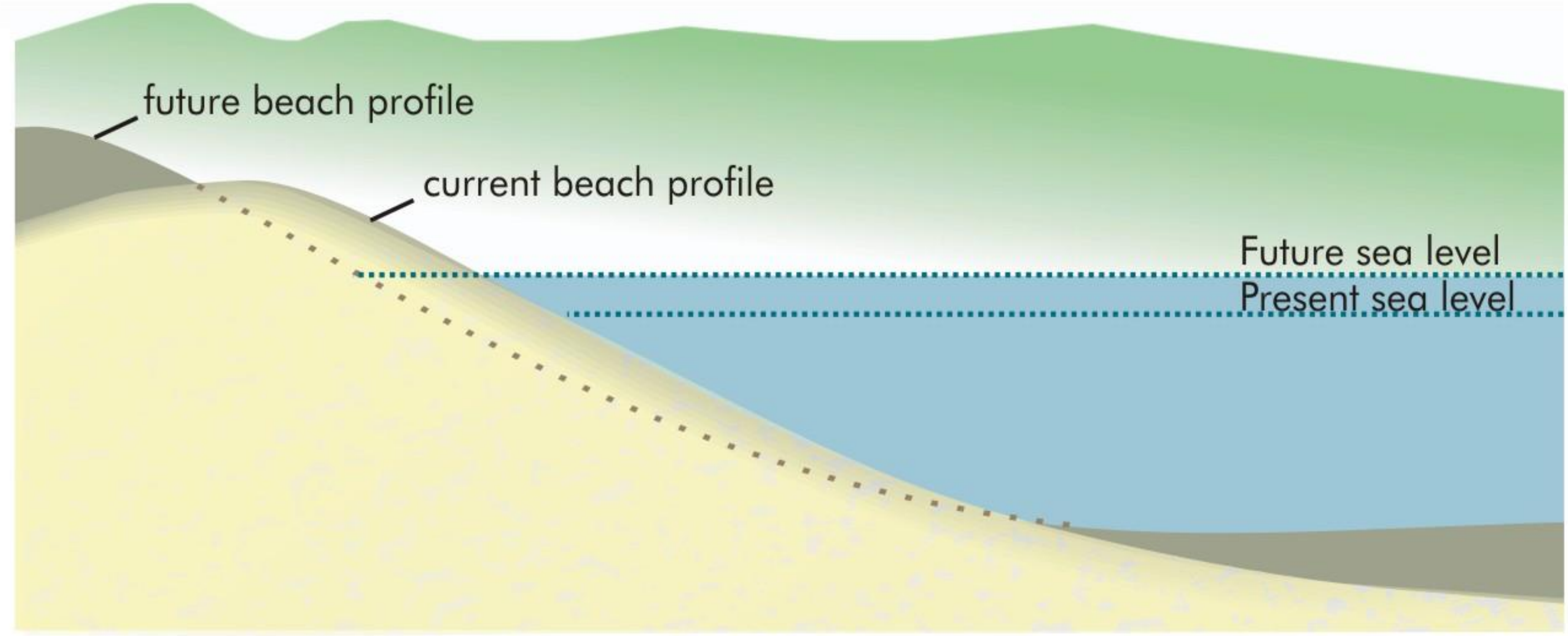


Sea Level Rise – National Guidance

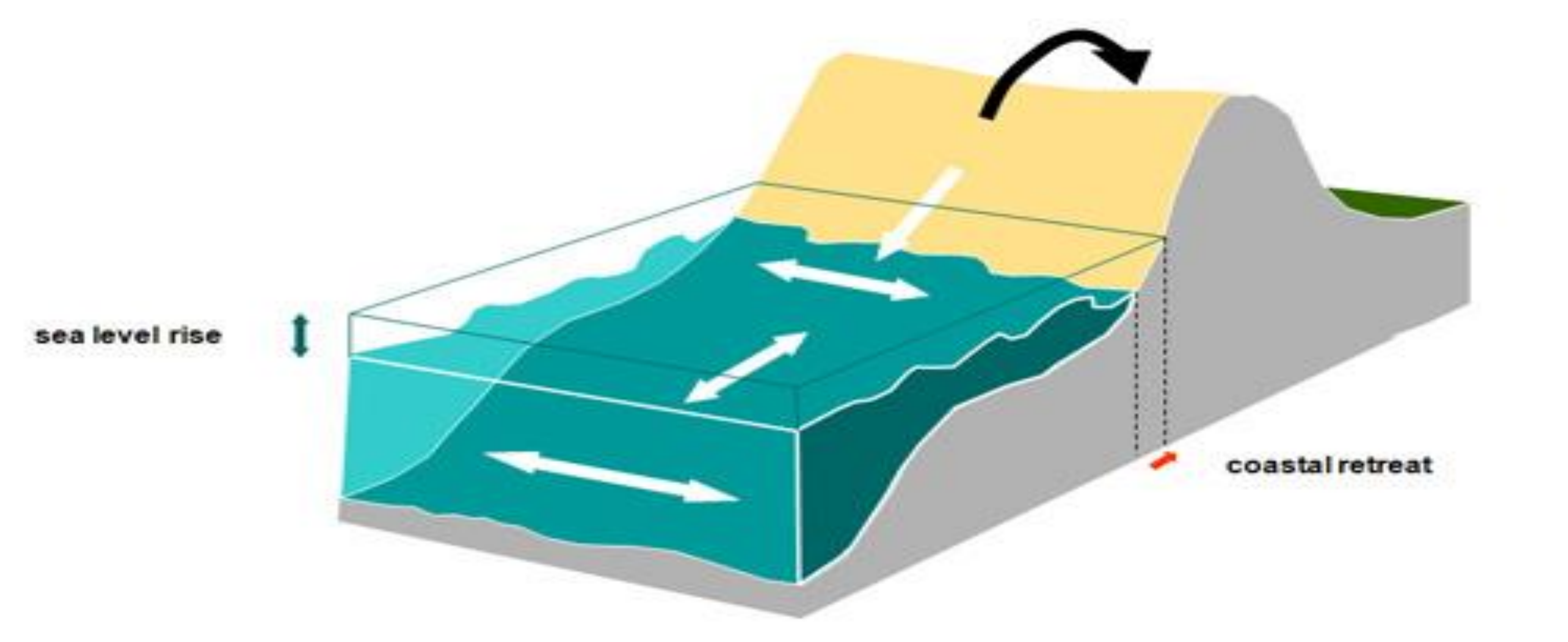
- **National Policy - must plan for 100-150 years**
- **MfE advise 1.6-1.7 m of SLR is inevitable, not if – but WHEN.**
- **Huge uncertainty over rate of change over next 100-150 years**
  - **Must use "plausible scenarios"**
  - **IPCC emissions scenarios (Representative Concentration Pathways or "RCPs")**

Scenario	2070	2120
Low (RCP 2.6) Lower bound "surprise"	0.32 m	0.55 m
Intermediate (RCP 4.5)	0.36 m	0.67 m
High+ (RCP8.5) (85^{th} percentile)	0.61 m	1.36 m

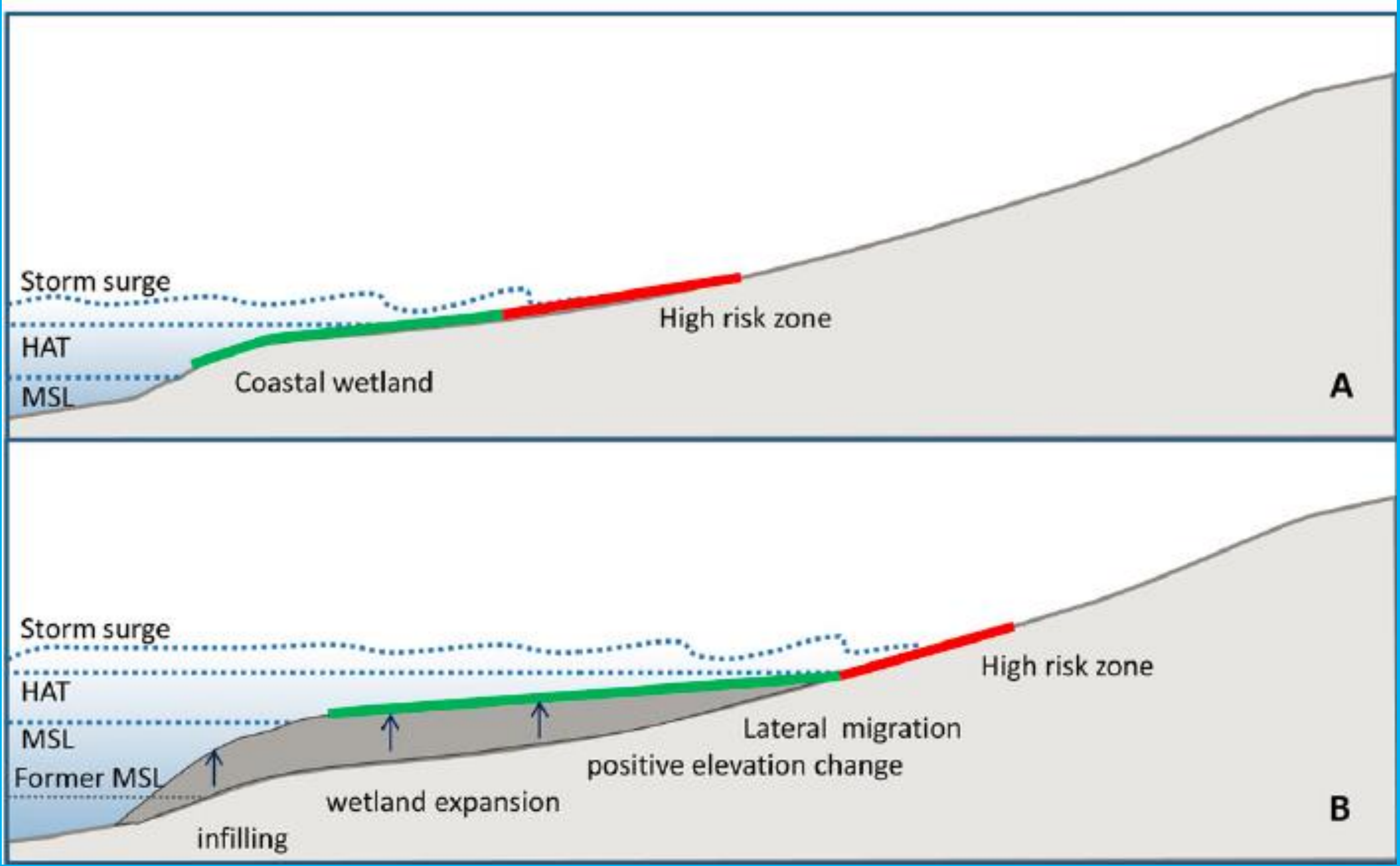
Sandy Beaches Effect of Sea Level Rise



Gravel Beaches Effect of Sea Level Rise



Response of Coastal Wetlands to Sea Level Rise

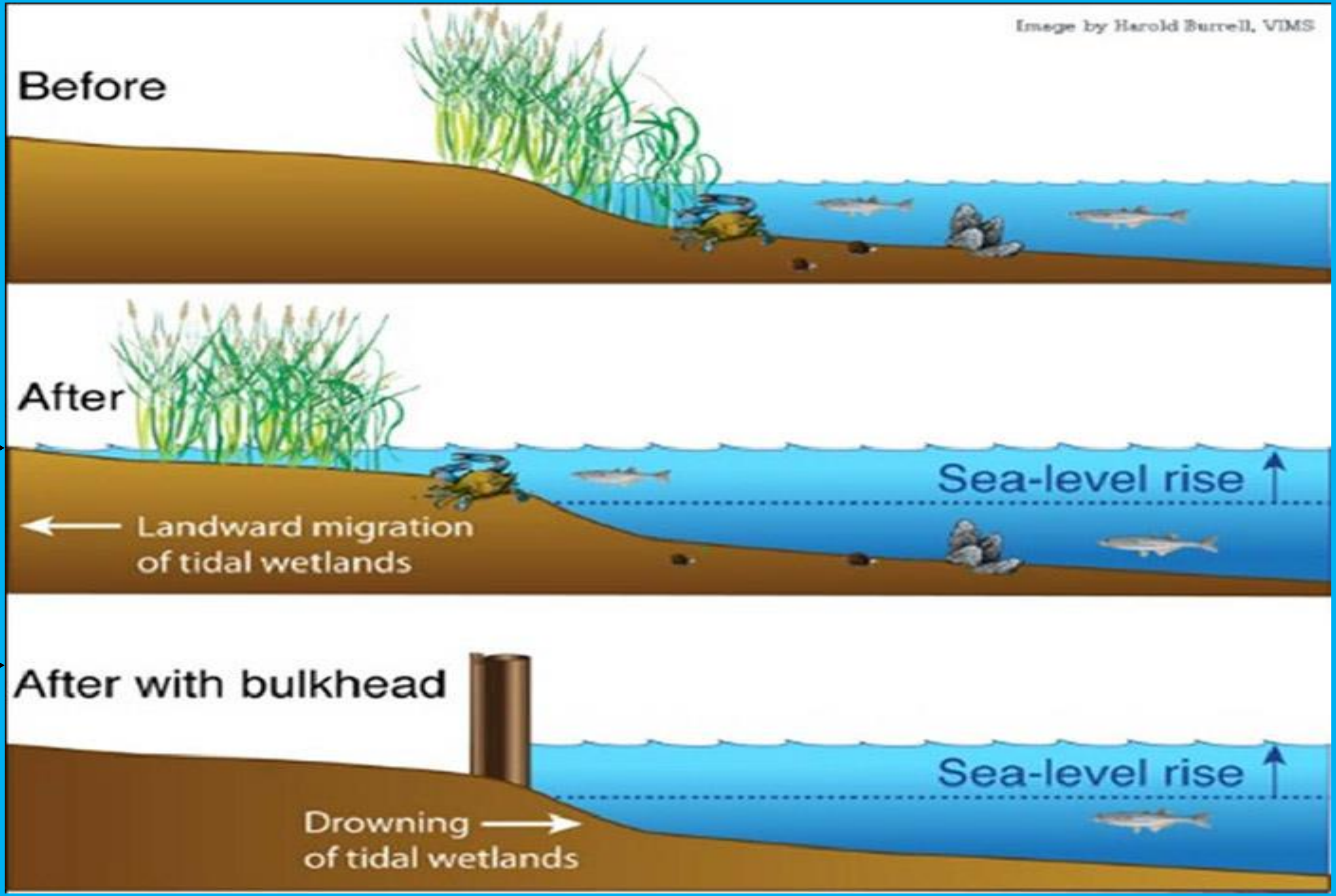


Coastal Squeeze Vs Natural Shoreline

(estuarine margin example)

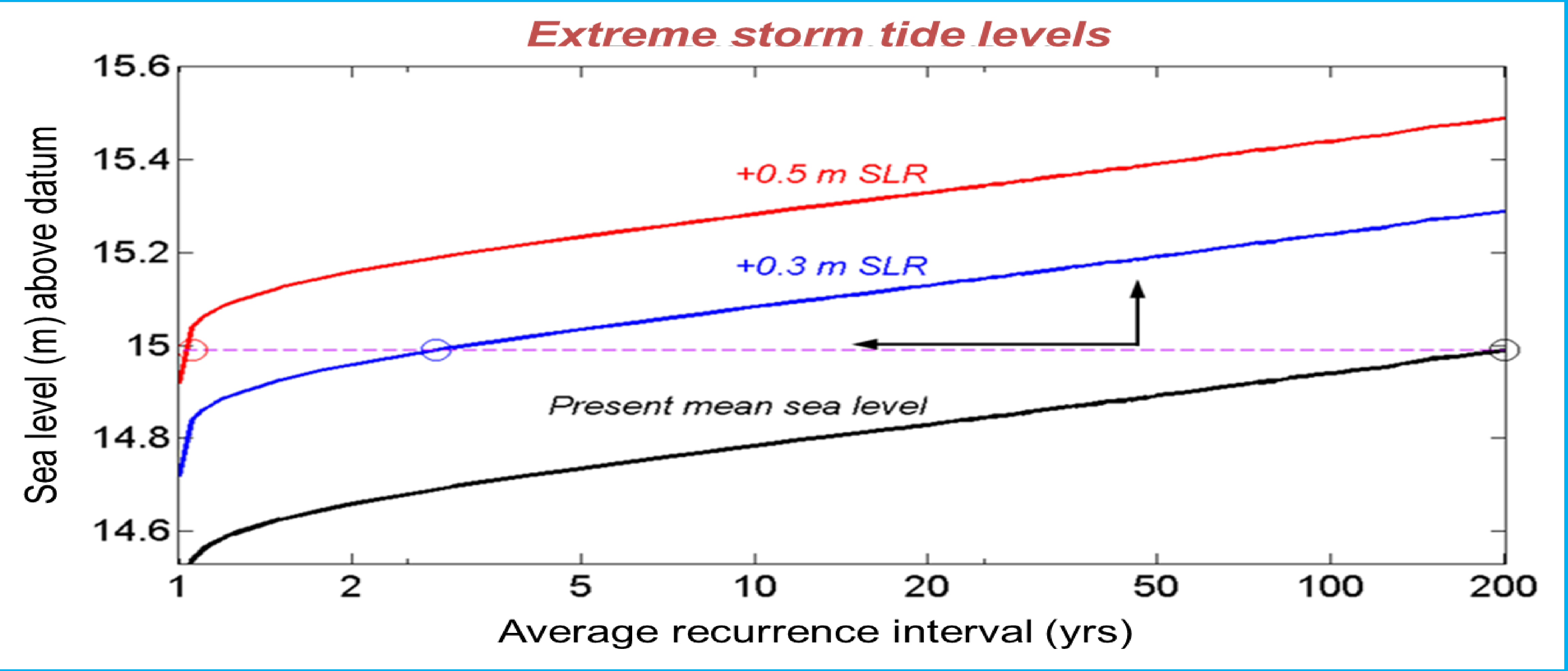
Natural Shoreline →

Coastal Squeeze →



More frequent storm-tides … the next big issue

(NIWA slide – Dr Rob Bell)



Does not consider climate change effects on wave height & surge , wave direction & period, storm frequency

Coastal flooding: 1% AEP → annual event (NIWA slide)

2.9 m spring-tide range

SLR	Auckland
0cm	Every 100 years
10cm	Every 35 years
20cm	Every 12 years
30cm	Every 4 years
40cm	Every 2 years
50cm	Every 6 months
60cm	Every 2 months
70cm	Every month
80cm	Every week
90cm	Twice a week
100cm	Every day

1.4 m spring-tide range

SLR	Wellington
0cm	Every 100 years
10cm	Every 20 years
20cm	Every 4 years
30cm	Once a year
40cm	Every 2 months
50cm	Twice a month
60cm	3 times a week
70cm	Every tide
80cm	Every tide
90cm	Every tide
100cm	Every tide

PCE (2015); NIWA (2015)

Thresholds: 30 cm SLR for Christchurch; 35 cm SLR for Dunedin

Coastal Squeeze - Summary

- **"Encroaching humans" (past & present)**: Seaward encroachment by humans has led worldwide to:
  - Degradation of beaches and dunes, wide range of coastal hazard issues & extensive lengths of shoreline armouring
  - Significant and ongoing loss & degradation of coastal margin ecosystems, particularly riparian and salt marsh ecosystems
- **"Encroaching seas" (mostly future):** Projected sea-level rise over the next few decades and centuries will lead to aggravation of coastal erosion and landward migration of estuarine ecosystems
- Natural coasts and coastal ecosystems being squeezed out and replaced by armoured shorelines
- Encroaching humans + Encroaching seas = **"Coastal Squeeze"**

2. Changing Management Paradigms

Management Paradigm: Historical

Historically, management of coastal erosion/retreat has been dominated by the "coastal engineering" or "protection" paradigm

This paradigm emphasizes adjustment of natural coastal behaviour rather than human behaviour

Characterised by "holding the line" using shoreline armouring or other engineering methods

Under this paradigm, successful management = "stopping erosion"

Reflects the fact that the major objective was protection of property and infrastructure

May also reflect deeper battles in the human psyche??

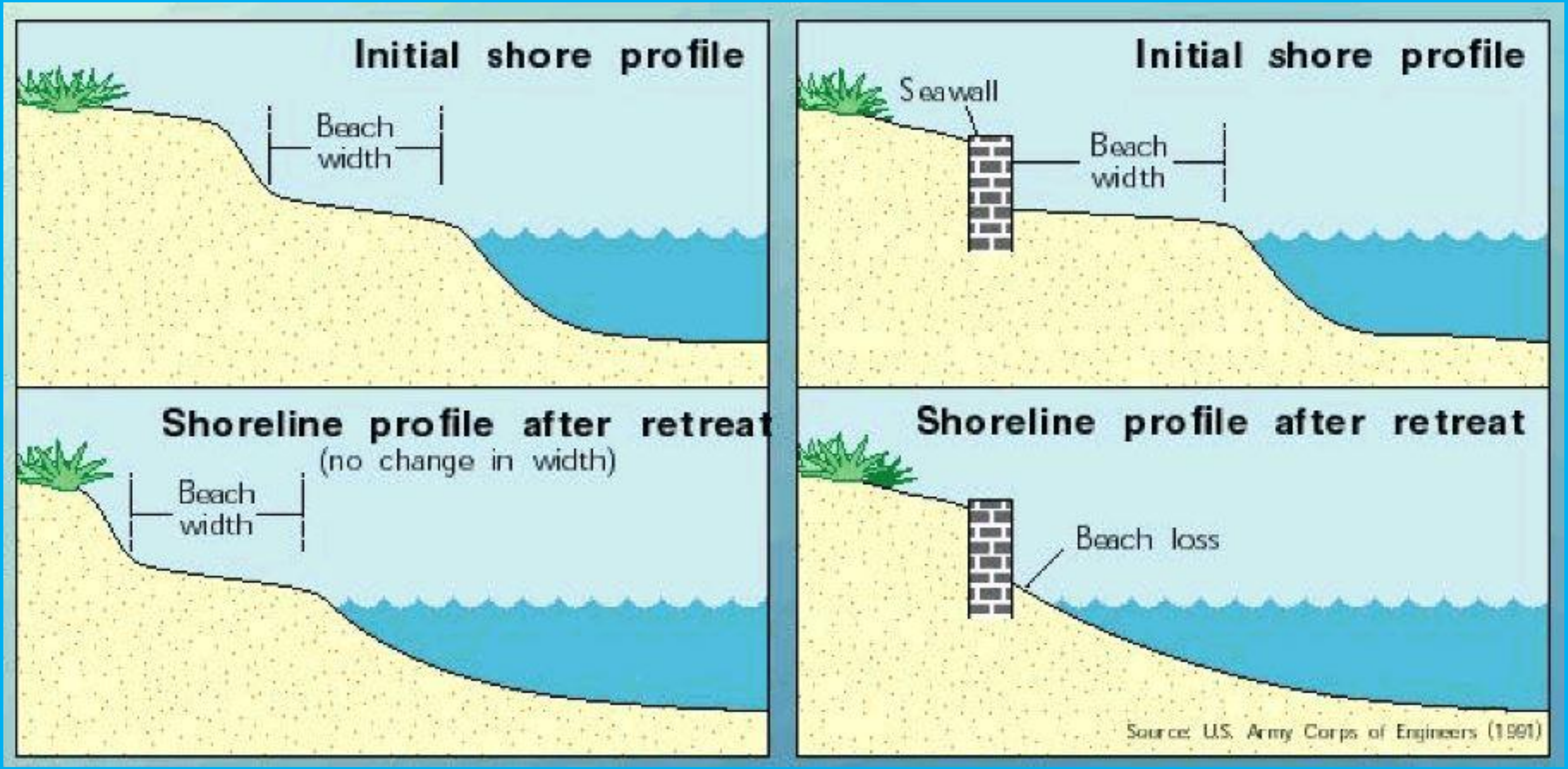
This paradigm goes to the bone of modern human society

Challenges to Engineering Paradigm

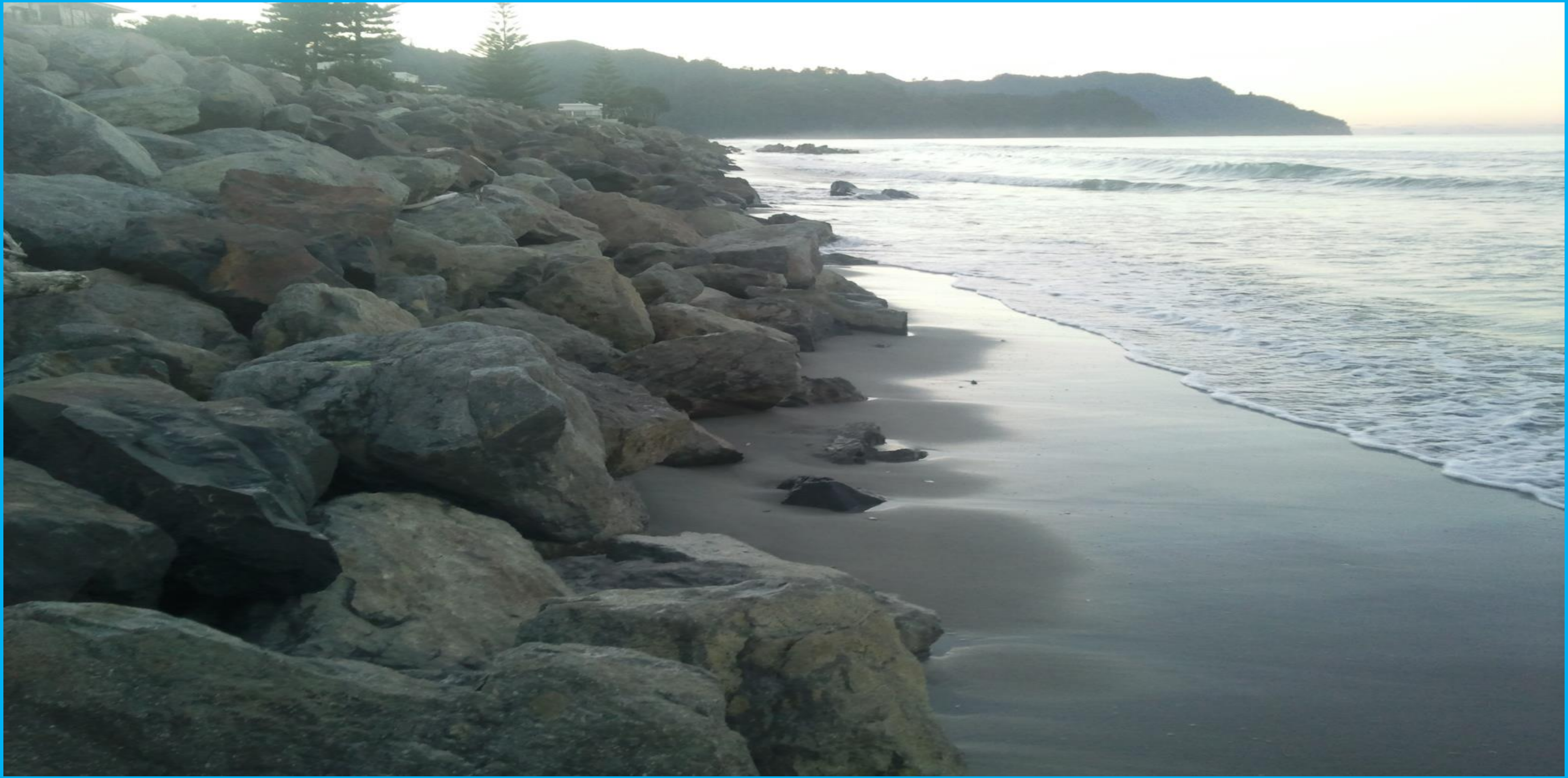
In recent years, various factors have challenged the sustainability of the traditional "coastal engineering" paradigm, including:

- Serious adverse environmental effects of engineering structures
- Exacerbation of erosion hazard
- Increased emphasis on sustainability and multiple objectives
- Equity issues
- Potential for future aggravation of coastal erosion and associated issues by projected climate change
- Concerns about resilience (of coastal communities, the natural and amenity values of the coast, and natural coastal features and ecosystems)

Effect of Seawalls on Retreating Beaches



Beach Loss




Modern Management

The present paradigm for the management of coastal hazards emphasizes sustainability and resilience and is characterised by:

- **A wide range of social and environmental objectives (safeguarding all the values important to communities).**
- **Nearshore property and infrastructure remain important considerations, but not the only considerations**
- **Risk avoidance and risk reduction are given emphasis**
- **Restoration of natural coastal ecosystems and buffers**
- **Living with natural coastal processes as far as practical**
- **Being proactive and strategic – rather than reactive**
- **Seeking equitable solutions for all stakeholders**
- **The development of resilient coastal communities & coastal ecosystems**

Management Options and Philosophy:
National Policy (NZCPS 2010)

Decreasing preference

- **Risk avoidance** - Managing land use in hazard risk areas to avoid risk. Landward relocation of assets to a safe location
- **Risk reduction** - Managing land use and development to reduce existing risk exposure over time
- **Living with coastal processes** – accepting
- **Mitigation of coastal hazards** through protection and restoration of natural buffers (e.g. beaches, dunes, wetlands)
- **Soft engineering** measures which mitigate erosion **using** natural buffers (e.g. beach nourishment)
- **"Hard" engineering structures**, including new or existing sea walls or rock revetments. Traditional emphasis but now last resort for most areas. Significant challenge

Examples of Changing Paradigm

- Huge emphasis on restoration of coastal margin environments – e.g. Coastcare in NZ
- Recovery of estuarine wetlands via managed realignment started to happen. Particularly UK – but even some useful projects now in NZ (e.g. Maketu Estuary, Project Manukau, etc)
- Managed retreat slowly starting to gain currency (e.g. setback and development controls now standard; some notable retreat projects (e.g. southern Muriwai) and much more discussion of this approach
- Huge emphasis on beach nourishment as opposed to shoreline armouring (e.g. Netherlands, USA)
- Increased focus on adaptive management & long term strategies
- Strong emphasis in policy on protection and restoration of coastal ecosystems
- Dredged sediment increasingly treated as a resource and not as a waste product. Major emphasis in US but even some areas in NZ (e.g. Waikato Region)
- Coastal engineering projects increasingly linked to restoration
  - USACE & Dutch "Working with Nature" and "engineering with nature" programs (some useful restoration outcomes linked to coastal engineering projects)
  - PIANC "Working with Nature" position paper and increased emphasis
- Increasingly significant research focus & publications related to working with nature
- Etc, etc

Discussion

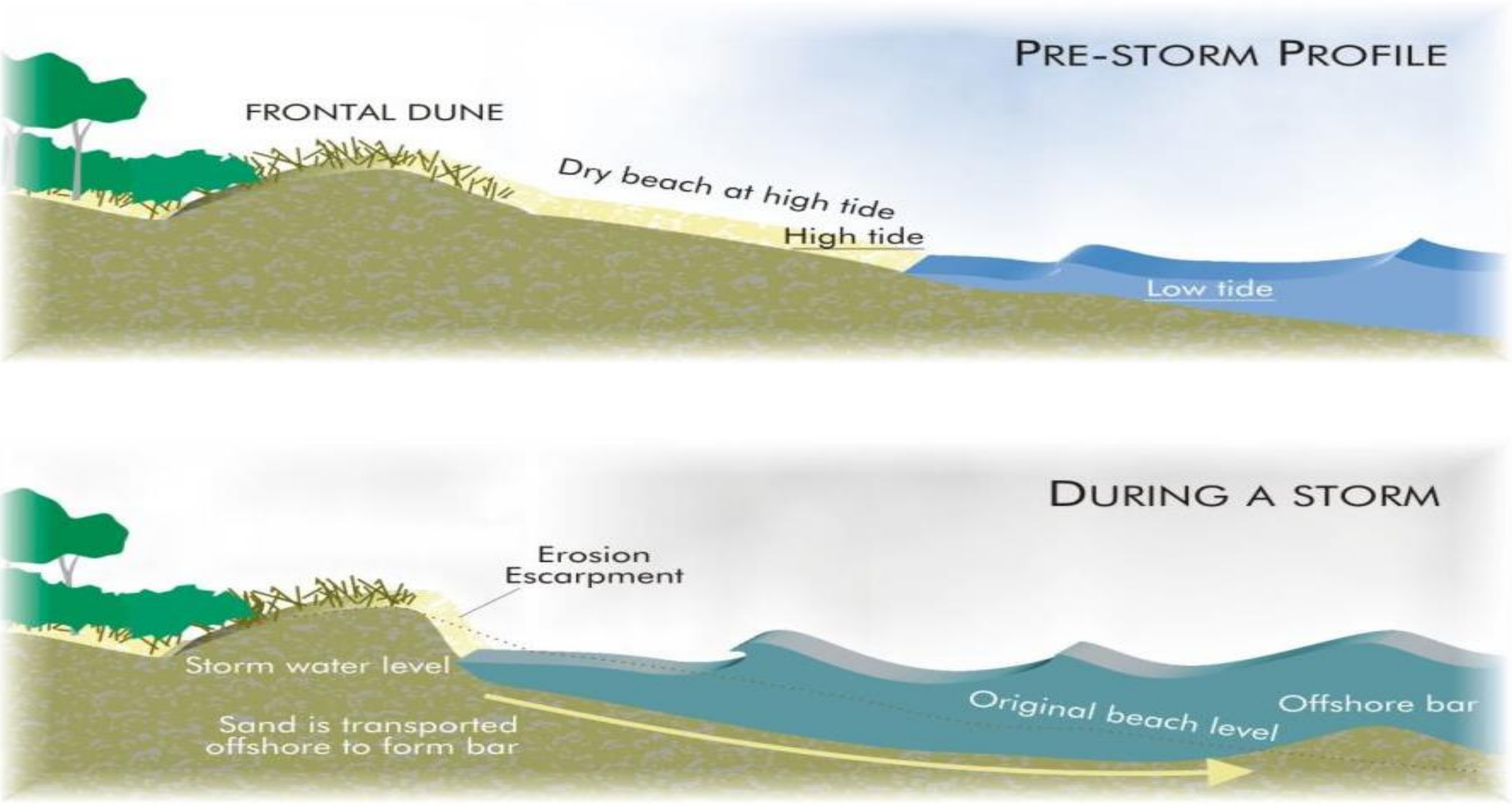
Beaches and Dunes

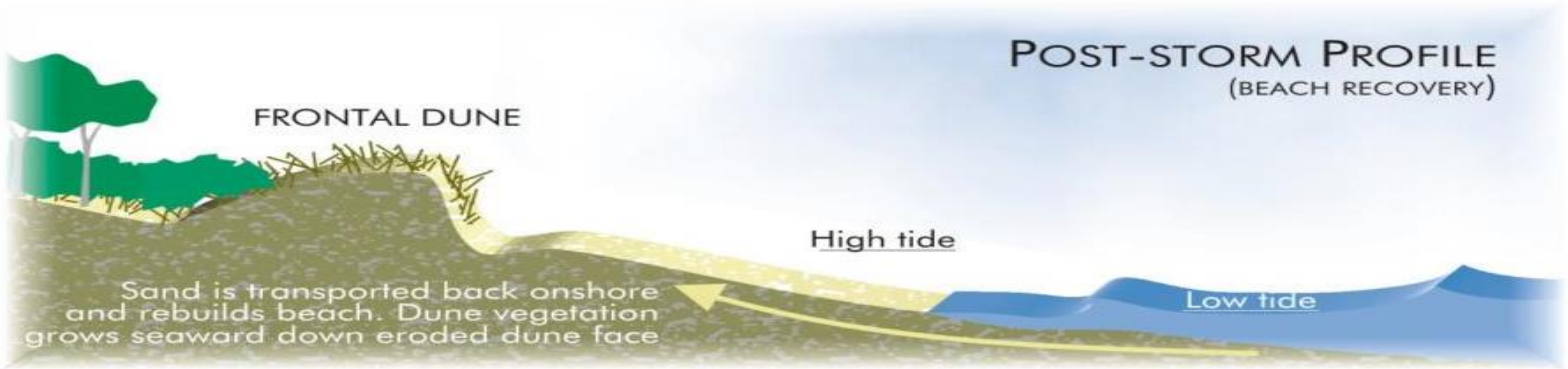
Dune Restoration

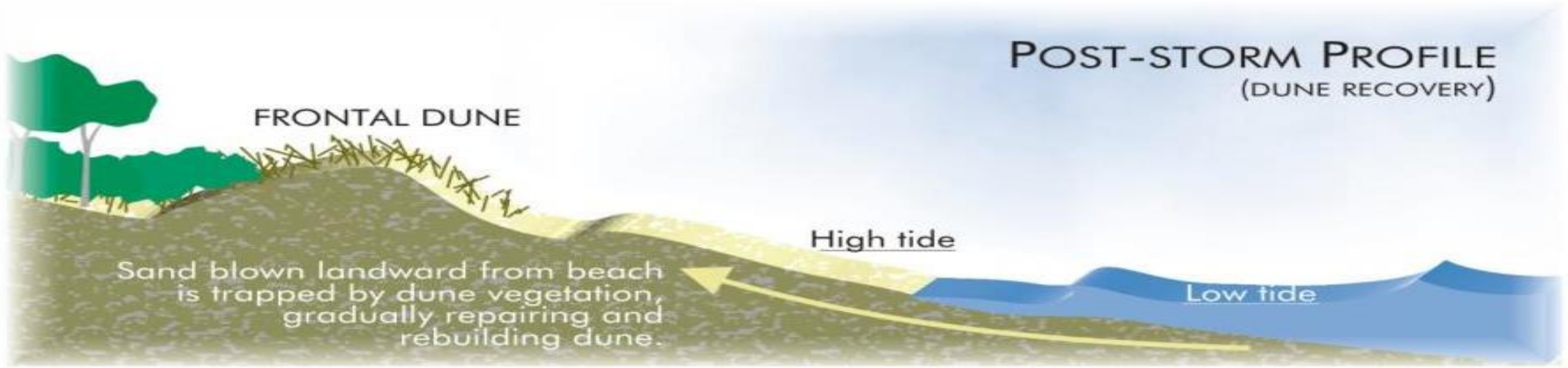
- Sandy shorelines in their natural state often backed by coastal dunes
- These dunes often significantly modified or even totally destroyed by human use and development
- The importance of these coastal dunes to coastal values and coastal functioning now much better understood
- A number of councils in NZ now operate dune restoration programmes
- This restoration work is done for a number of reasons, including ecological values, natural character, management of coastal hazards & community information/capacity building

Dunes & Coastal Processes

- Sandy shorelines often fluctuate over time – so dunes experience periods of erosion and periods of natural shoreline recovery
- Dunes are an integral part of the total beach – sand exchanges between the dune and the beach. Dunes can be viewed as a beach's "savings account"
- The width of dune is also a useful measure of the resilience of the beach to future change (including climate change)
- Particular native sand trapping vegetation (spinifex and pingao) play a critical role in natural dune repair after erosion.
- So, on fluctuating shorelines, dunes provide a natural self-repairing barrier against coastal hazards (inundation and erosion)
- BUT it is not about "stopping erosion" – the dunes come and go; need adequate space for a sustainable dune


PRE-STORM PROFILE
FRONTAL DUNE
Dry beach at high tide
High tide
Low tide
DURING A STORM
Erosion
Escarpment
Storm water level
Sand is transported
offshore to form bar
Original beach level
Offshore bar


POST-STORM PROFILE
(BEACH RECOVERY)
FRONTAL DUNE
High tide
Low tide
Sand is transported back onshore and rebuilds beach. Dune vegetation grows seaward down eroded dune face


POST-STORM PROFILE
(DUNE RECOVERY)
FRONTAL DUNE
High tide
Low tide
Sand blown landward from beach is trapped by dune vegetation, gradually repairing and rebuilding dune.

Dune Restoration

- Natural dunes manage themselves, dune restoration is essentially about repairing human damage
- Primarily aims to restore natural dune features, processes and patterns (including vegetation and fauna)
- Invariably has to be integrated with a wide range of other objectives, particularly at urban & popular amenity beaches
- At most sites, there are a wide variety of constraints you have to work within (funding, views, available space, other uses and values, etc)

Common Elements in Dune Restoration

Wide range of activities can be required – varies with site:

1) Community involvement and information (critical)
2) Management of human use to prevent vegetation damage (accessways, management of vehicles/stock, etc)
3) Weed and animal pest control
4) Earthworks to restore natural dune shape and clean loose sands, remove fill, etc
5) Planting of appropriate native vegetation
6) Monitoring and maintenance

Dune Management: Examples from Practice

Whangamata

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Whangamata Sites

Whangamata


Esplanade & Surf Club
Pipi Road and Island View
Peninsula Rd
Harbour View Rd
Leighton Rd
Tuck Rd
Hunt Rd
Ranfurly Rd
Rutherford Rd
Barbara Ave
Esplanade Dr
Beverley Terrace
Ocean Rd
Mary Rd
Sylvia Rd
Island View Rd
Pipi Rd
Tangaroa Rd
Rangi Ave
Given Ave
Hauturu St
Papanui Rd
Bellona Rd
Philomel Rd
Leander Rd
Exeter Rd
Whangamata
Lincoln Rd
Beach Rd
Cement Rd
Aickin Rd
Lindsay Rd
Wattie Pl
Chartwell Ave
Lorraine Pl
Mayfair Ave
Sharyn Pl
Hampton Rd
Ajax Rd
Kiwi Rd
Tui Rd
Williamson Rd
Otahu Rd
Brook Pl
Patuwai Dr
Wareka Pl

Pipi Road and Island View

(approx 500m x 20-30m)

Pipi Road - Before

Pipi Road - Before

Pipi Road – After Spraying

Pipi Road - Earthworks

Pipi Road - Earthworks

Pipi Road - Earthworks

Pipi Road - Planting

Pipi Road – 5 Months After Planting

Pipi Road – 17 Months After Planting


Before


After

Whangamata Esplanade 1978

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Whangamata Esplanade 2000

2 Years After Planting (2002)

2004

2011

2014

Examples

2. Pauanui Ocean Beach

Coastal Development: After

Pauanui Spit 1990's

Modification of Frontal Dune
(bulldozed and capped)

Pauanui 2000


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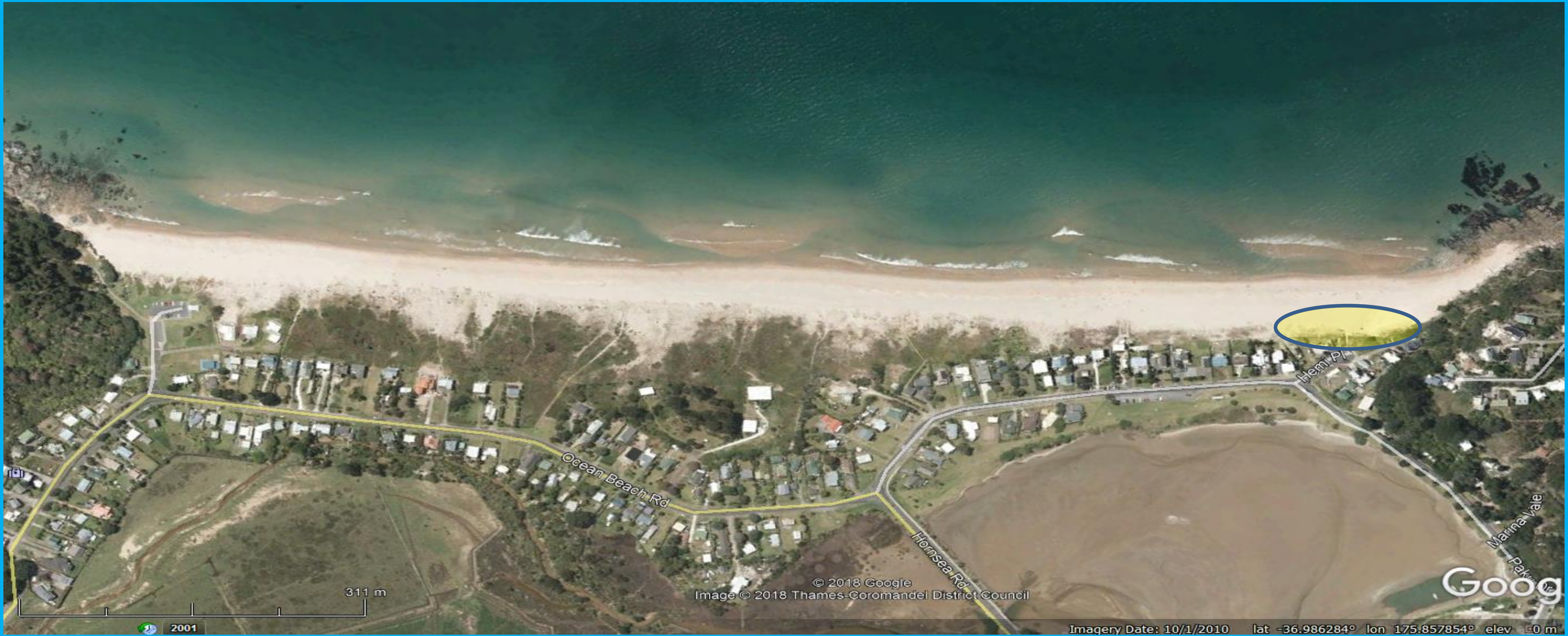
:

Example

3. Tairua Ocean Beach

Tairua Ocean Beach

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Tairua Surf Club South 2010

December 2019

Examples

4. Cooks Beach

Cooks Beach: Demonstration Area: Before

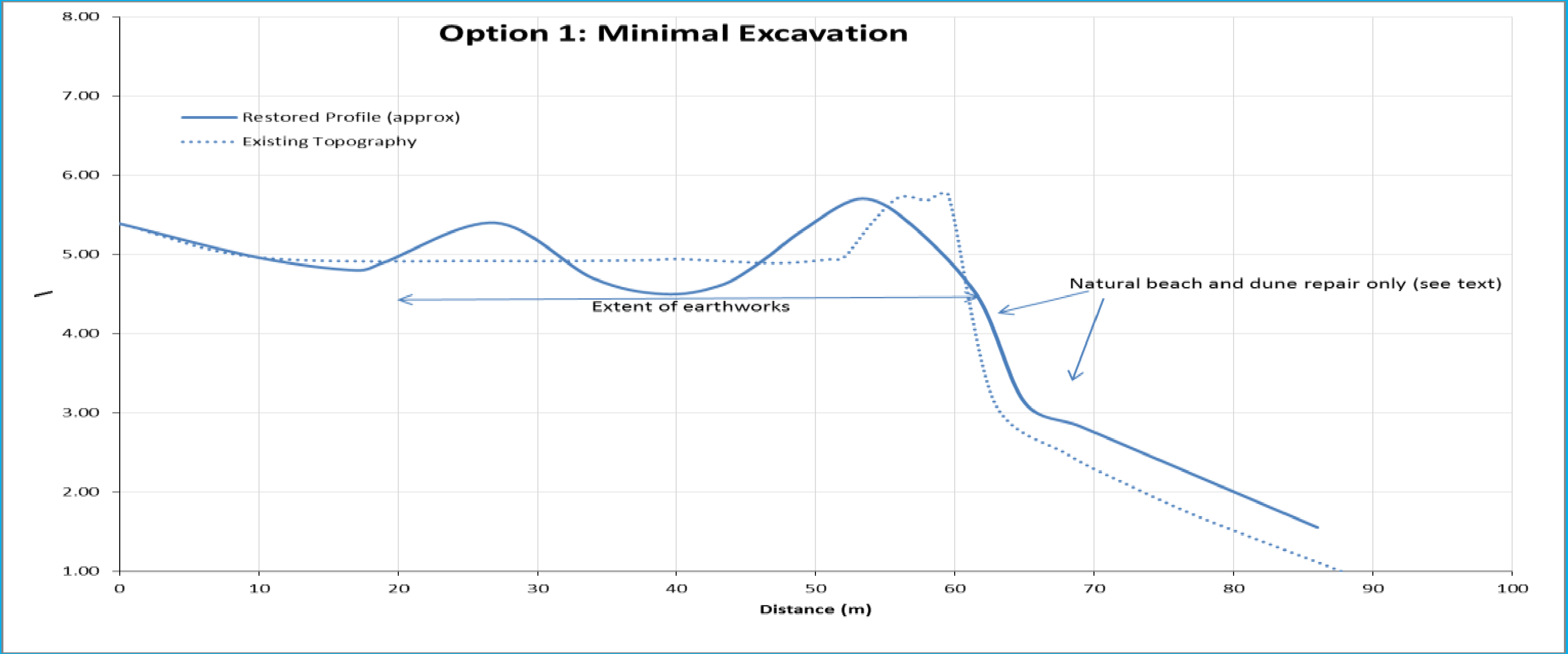
Cooks Beach: Demonstration Area: After

Location West Coast Sites

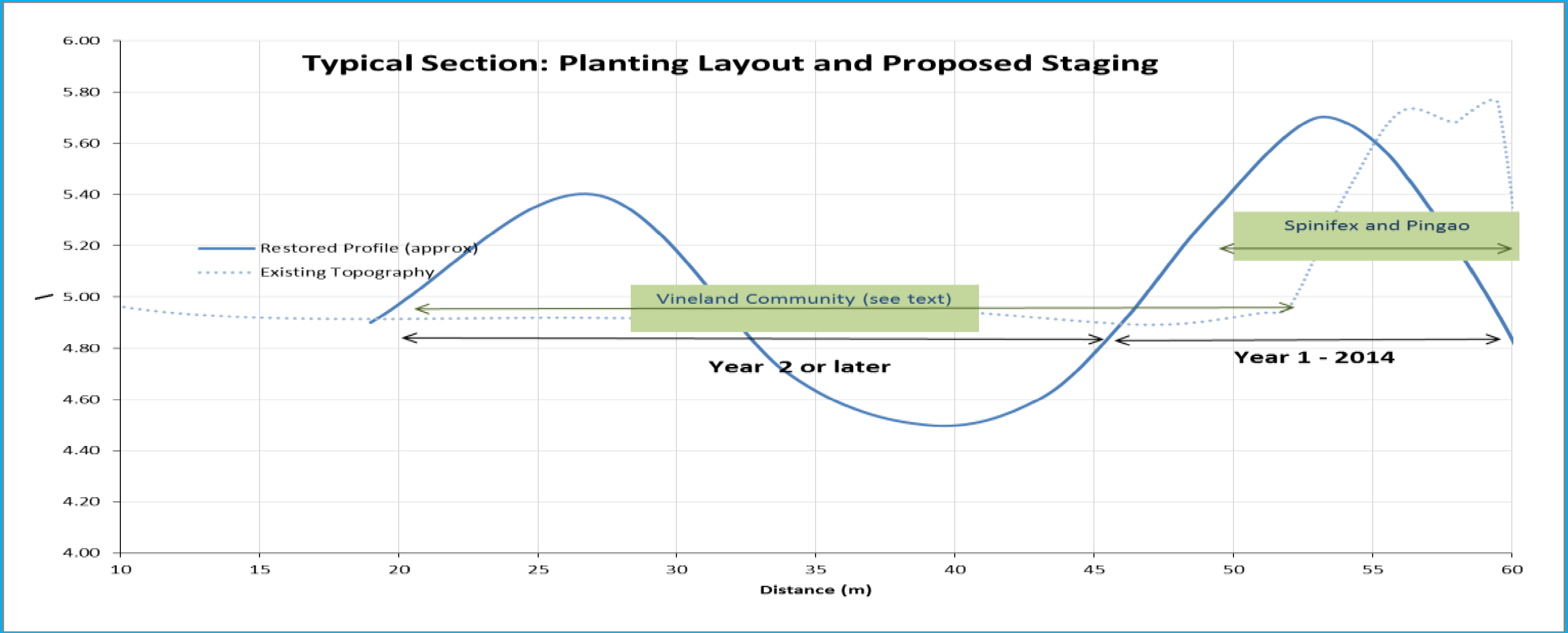
Seaview Motor Camp
West Coast North Island

Seaview Motor Camp Site

Seaview Motor Camp



Seaview Motor Camp



Before

Seaview - Earthworks

Seaview - Earthworks

Excavation

Excavation

Immediately after Planting

3 months after Planting

4 months after Planting!

7 months after Planting

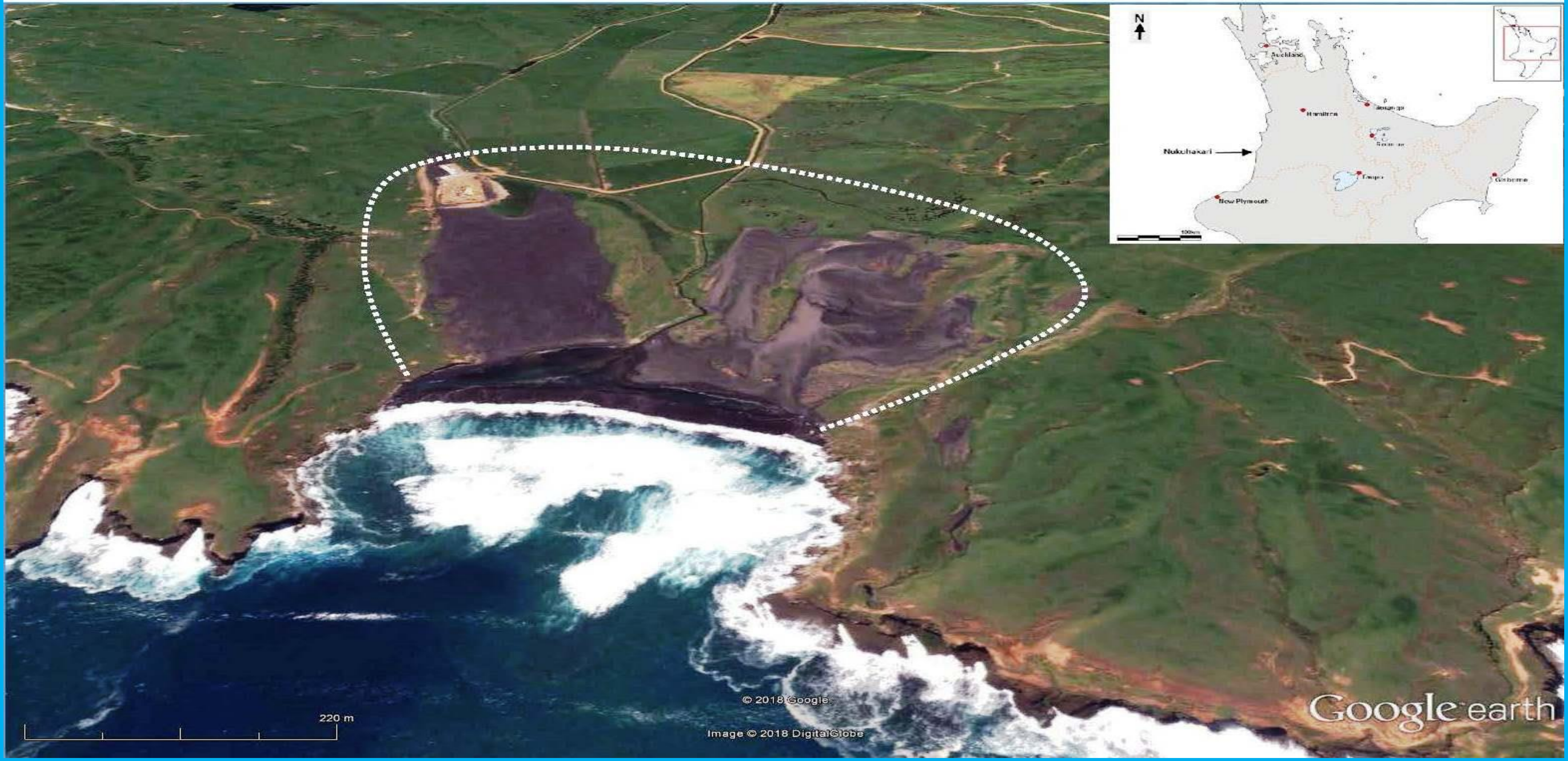
12 months after Planting

3 Years after Planting


Nukuhakari Station

West Coast – North Island

Nukuhakaru Station – Restoration Site



Nukuhakaru Station – Wind Erosion

Nukuhakaru Station – Wind Erosion

Nukuhakari - Restoration Strategy

- Management of vegetation disturbance (fencing out of stock) (At many similar sites offroad vehicles also an issue – but not here)
- Planting to establish dune at seaward end – cut off sand supply from beach to inland migrating dunes
  - Focus on pioneer sand trapping plants initially (largely spinifex but also some pingao)
  - Minimum 15m wide planting width (0.7-1m plant spacing)
  - Started at most seaward edge practicable (but some constraints at this site)
- Aided by natural re-establishment of *Carex pumila* further seaward, which expanded after stock exclusion

Nukuhakari - Restoration Constraints

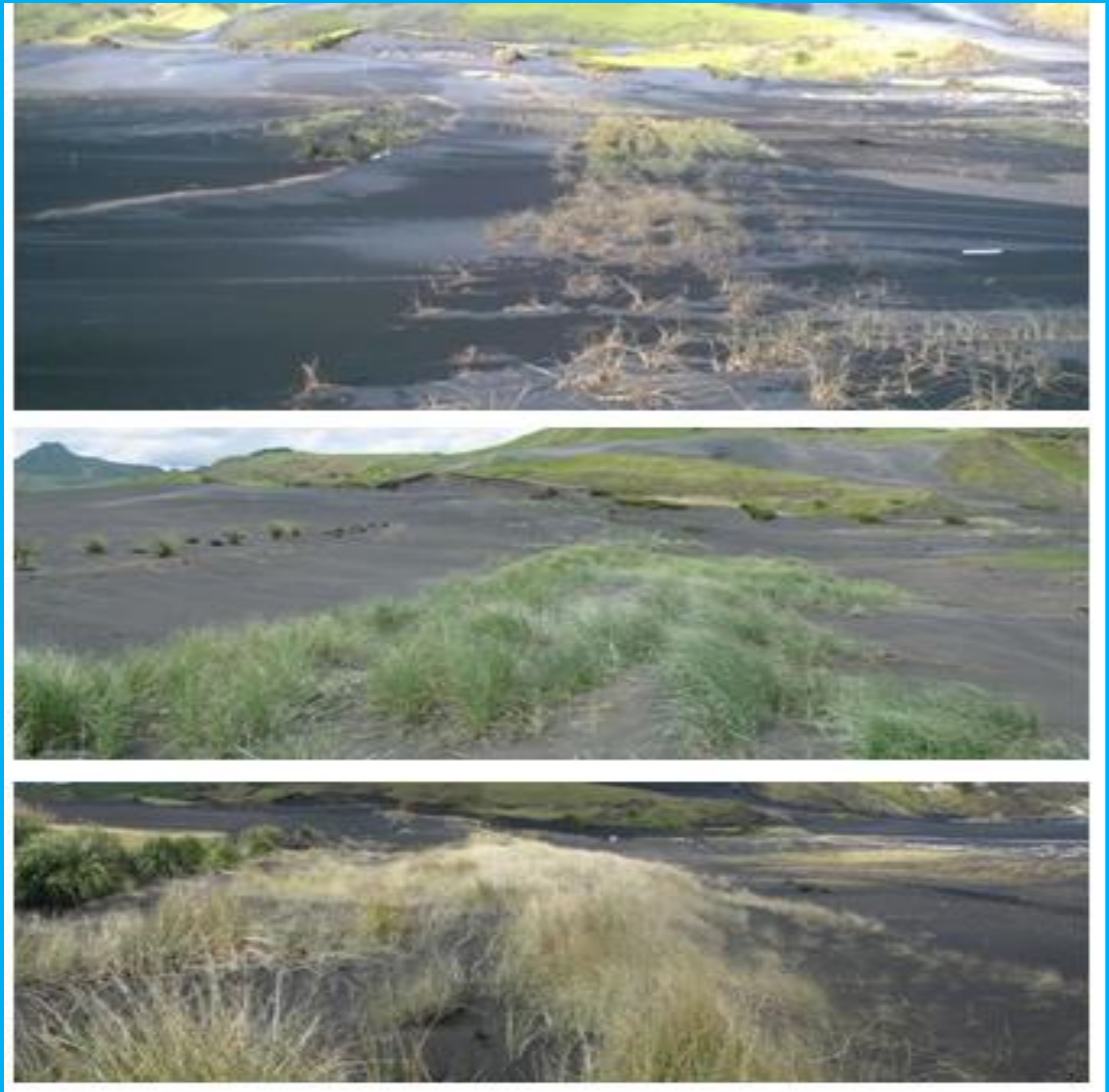
- Very limited plant budget – only able to do 2-4000 plants per year (so incremental approach required over many years)
- No significant funds for animal pest control or management
- Not practicable to mitigate wind erosion (e.g. wind break or sand trapping fences) to assist plant establishment

Planting to Re-establish Frontal Dune

Planting to Re-establish Frontal Dune

Overall – Year 1

Overall – Year 4 (2017)



BUT .. hard slow win!!

Indicator Paddock (new - 2013)

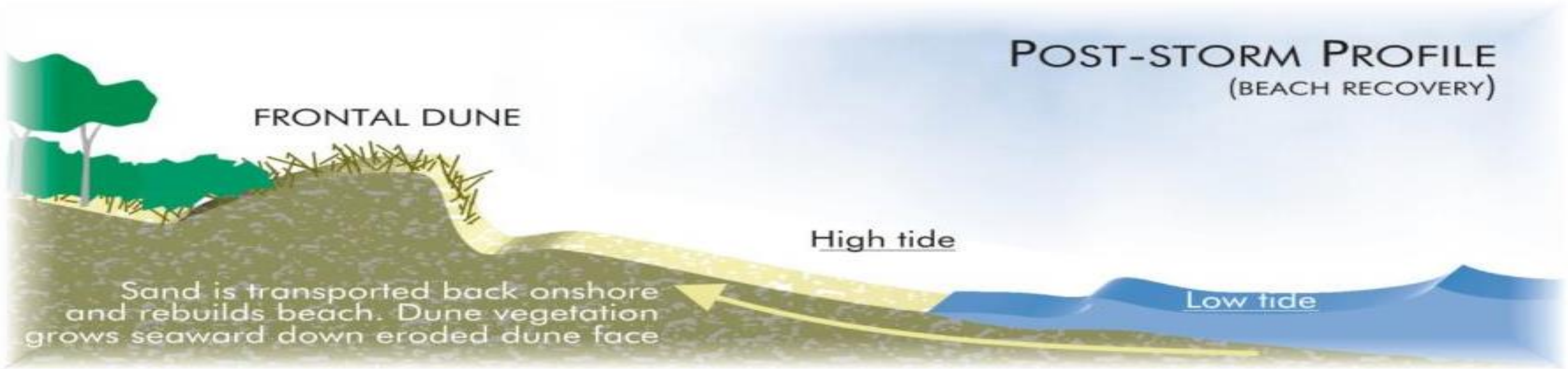
Indicator Paddock – buried!!

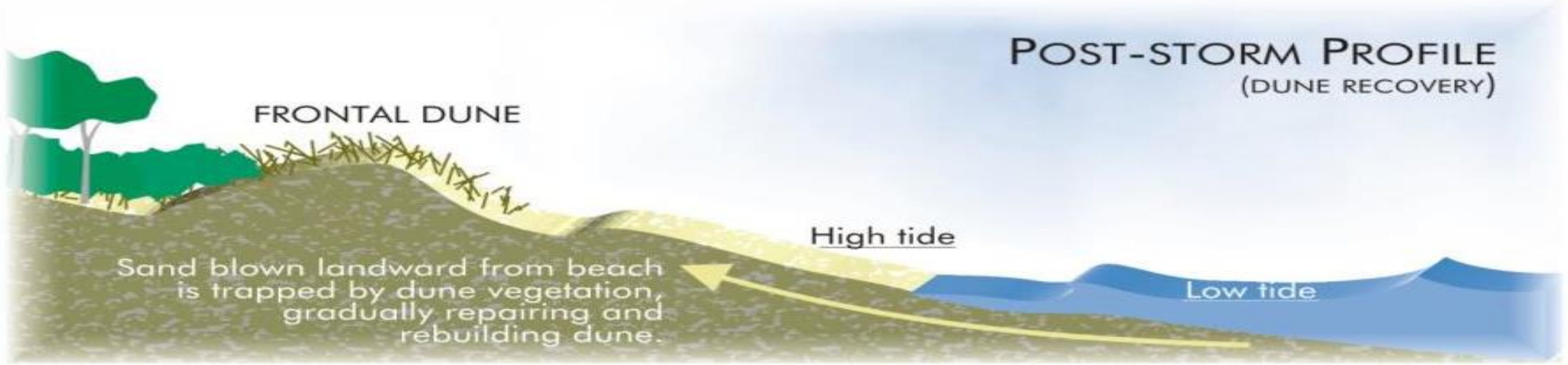
Indicator Paddock 2017

Tairua Ocean Beach – Southern End

Tairua South End 2003

Tairua South: Coastal Erosion Setbacks


POST-STORM PROFILE
(BEACH RECOVERY)
FRONTAL DUNE
High tide
Low tide
Sand is transported back onshore and rebuilds beach. Dune vegetation grows seaward down eroded dune face


POST-STORM PROFILE
(DUNE RECOVERY)
FRONTAL DUNE
High tide
Low tide
Sand blown landward from beach is trapped by dune vegetation, gradually repairing and rebuilding dune.

Tairua South End

Tairua South End – After Planting

One Year after Planting

Six Years after Planting

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Tairua Ocean Beach 2003

Tairua Ocean Beach 2004

Tairua Ocean Beach 2007

Tairua South End - Summary

- Property periodically subject to severe storm erosion
- Reasonable use not practical while avoiding erosion
- House designed to withstand severe dune erosion – founded on rock at depth
- Natural dune protection reinstated by removal of debris, push-up and planting
- Dune **will** periodically erode and during severe storms deck may even be lost - but house secure
- After storms, dune can be reinstated

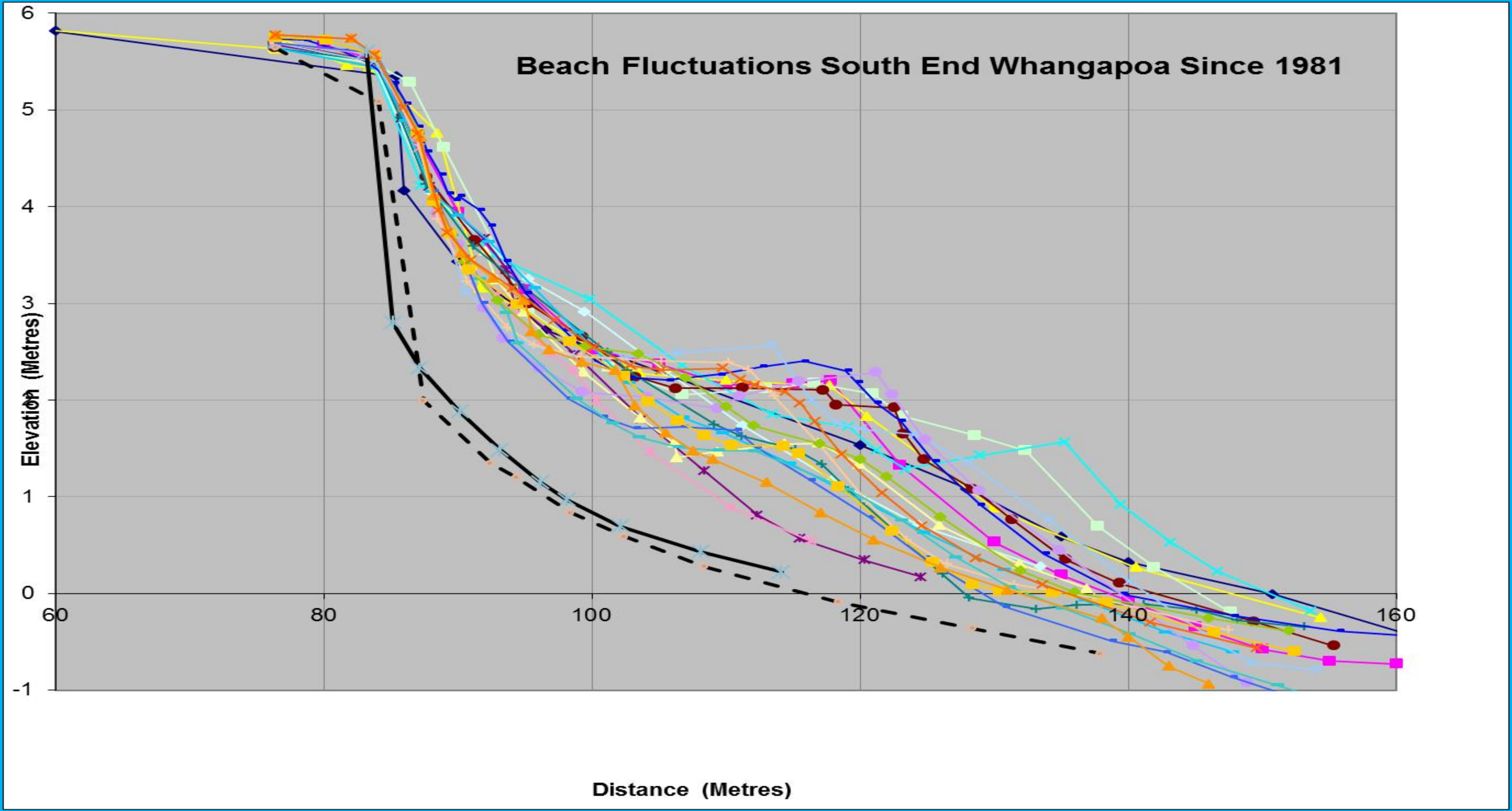
Living with Erosion – Working with Nature using Sand Push-ups

Example – Southern Whangapoua Beach

Sand Push-Ups

- Useful transition tool
- Involves pushing up of sand after major storms to more quickly repair/reinstate natural protection (e.g. dunes)
- A short-medium term approach used to “hold” situation while longer term solutions (e.g. setbacks) take effect
- Not often required but can be very useful tool
- With careful design, can be very effectively used to mitigate erosion while longer term solutions are implemented (i.e. managing transitions – not a permanent solution)

Whangapoua Erosion Hazard Lines: South End



Beach Fluctuations South End Whangapoa Since 1981
Elevation (Metres)
Distance (Metres)
6
5
4
3
2
1
0
-1
60
80
100
120
140
160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Sand Pushups

- Needs to be used judiciously and with expert input/design
- But can be very useful tool for short-medium term management
- Thames Coromandel District Council has obtained consent for beach scraping at most of its east coast beaches
  - Provides for major beach scraping at a few key sites
  - Provides for minor beach scraping at other sites
- Plan likely to provide for facilitation of this approach with appropriate guidelines and controls
- Useful model for other councils

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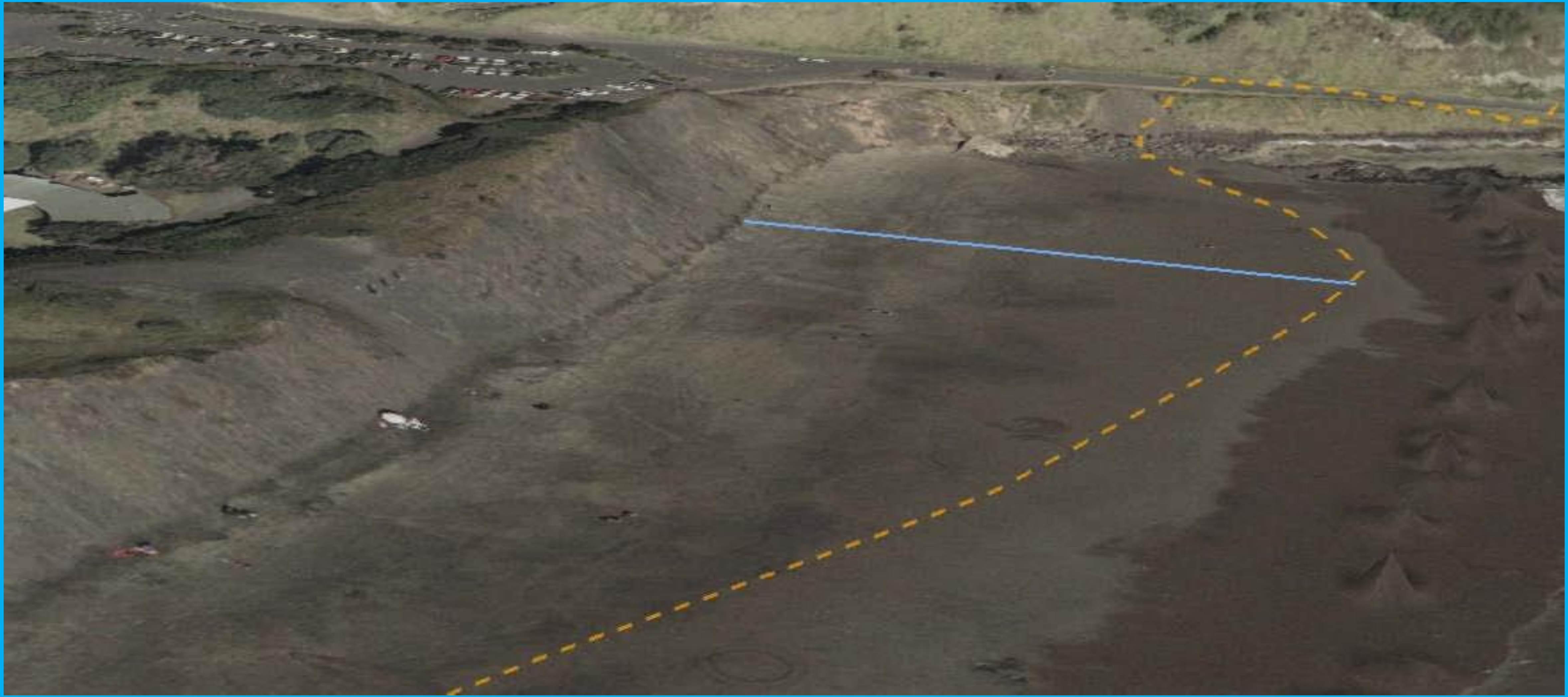
Managing Erosion with Managed Retreat Example - Muriwai Beach, Auckland West Coast

Muriwai: Erosion 1960's to 2007

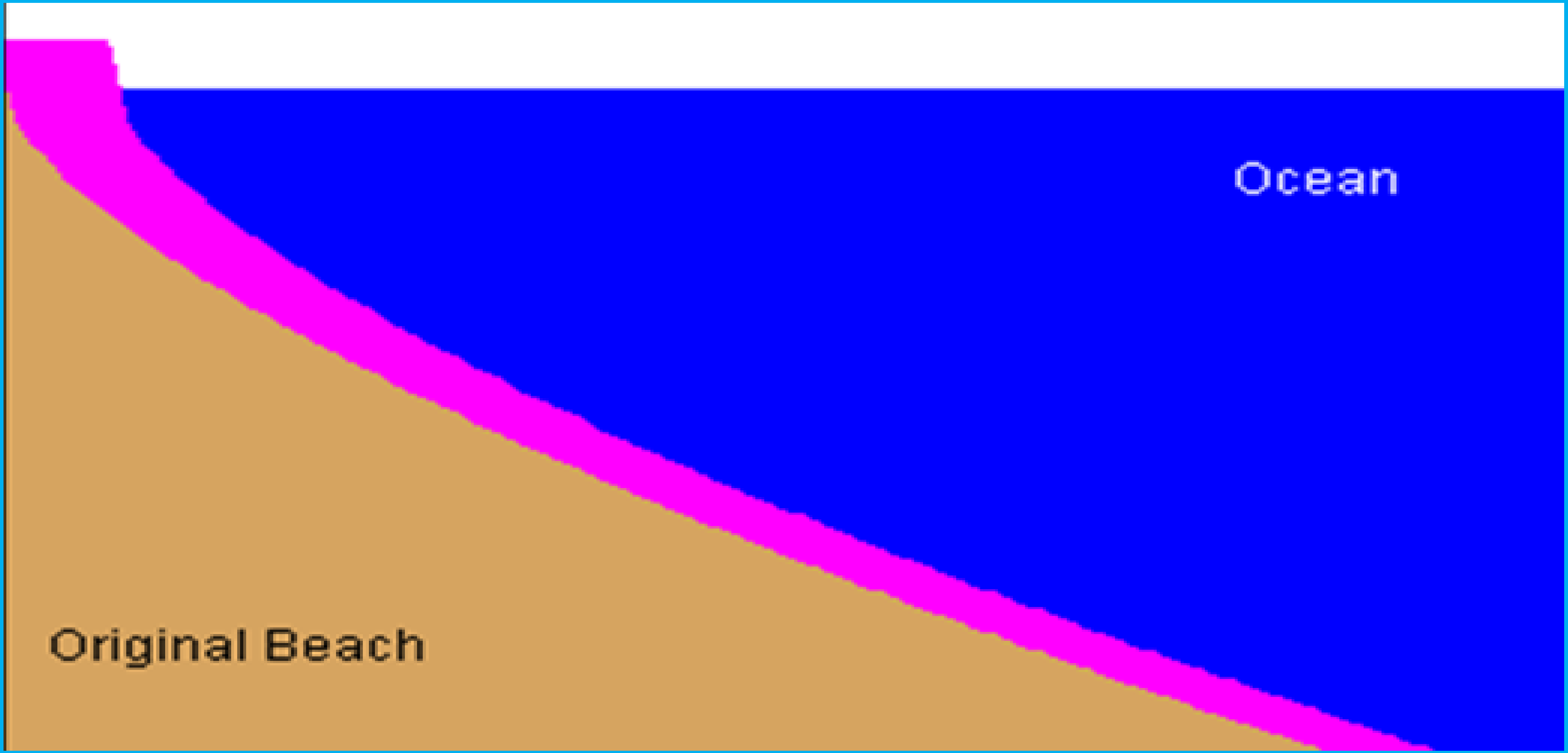



DANGER
CONSTRUCTION
SITE

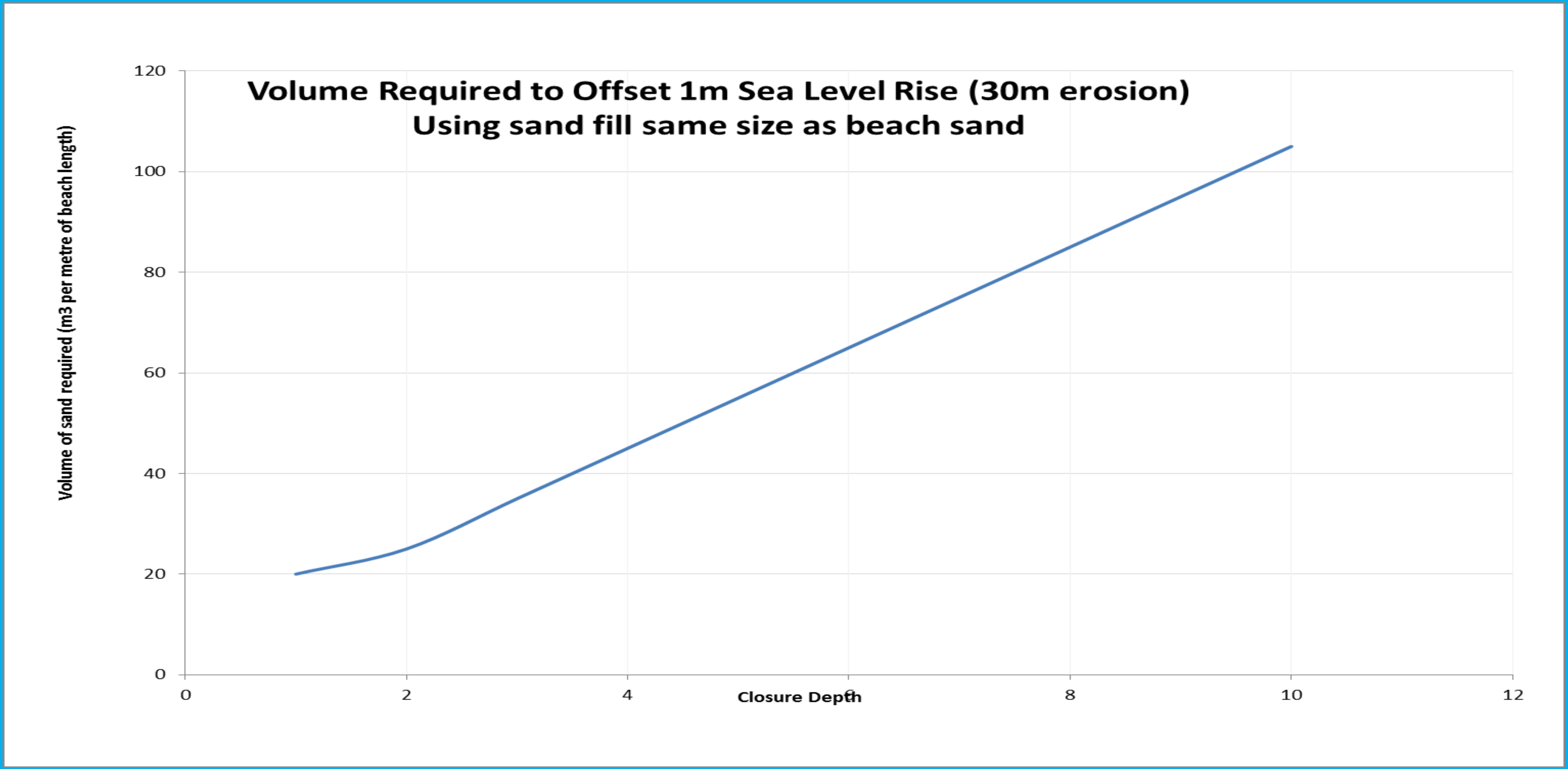
"Soft Engineering" – Beach Nourishment

- Very widely used to manage erosion in some countries (e.g. Holland, US)
- In NZ has so far only proved cost-effective in relatively low energy environments – often as part of sediment conservation measures requiring clean dredged sands or gravels to be returned to coast
- Higher energy open coast environments require very large sand volumes and can also have significant maintenance requirements
- Has also been used to enhance urban recreational beaches (e.g. Oriental Bay, Wellington; Mission Bay and Kohimarama, Auckland) where expense often justified

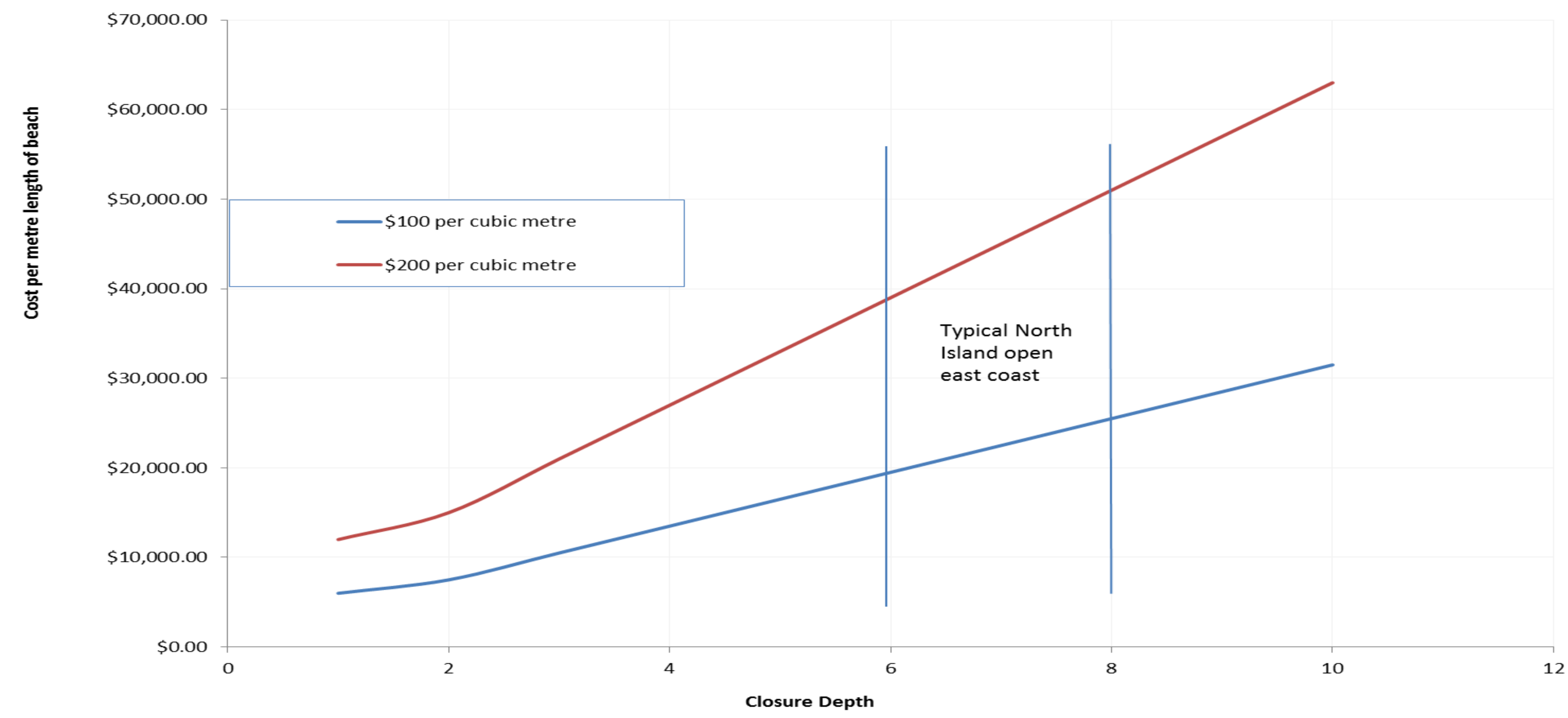
Beach Nourishment – Open Coast



Beach Nourishment – Indicative Example showing increasing volumes required as Closure Depth Increases



Beach Nourishment

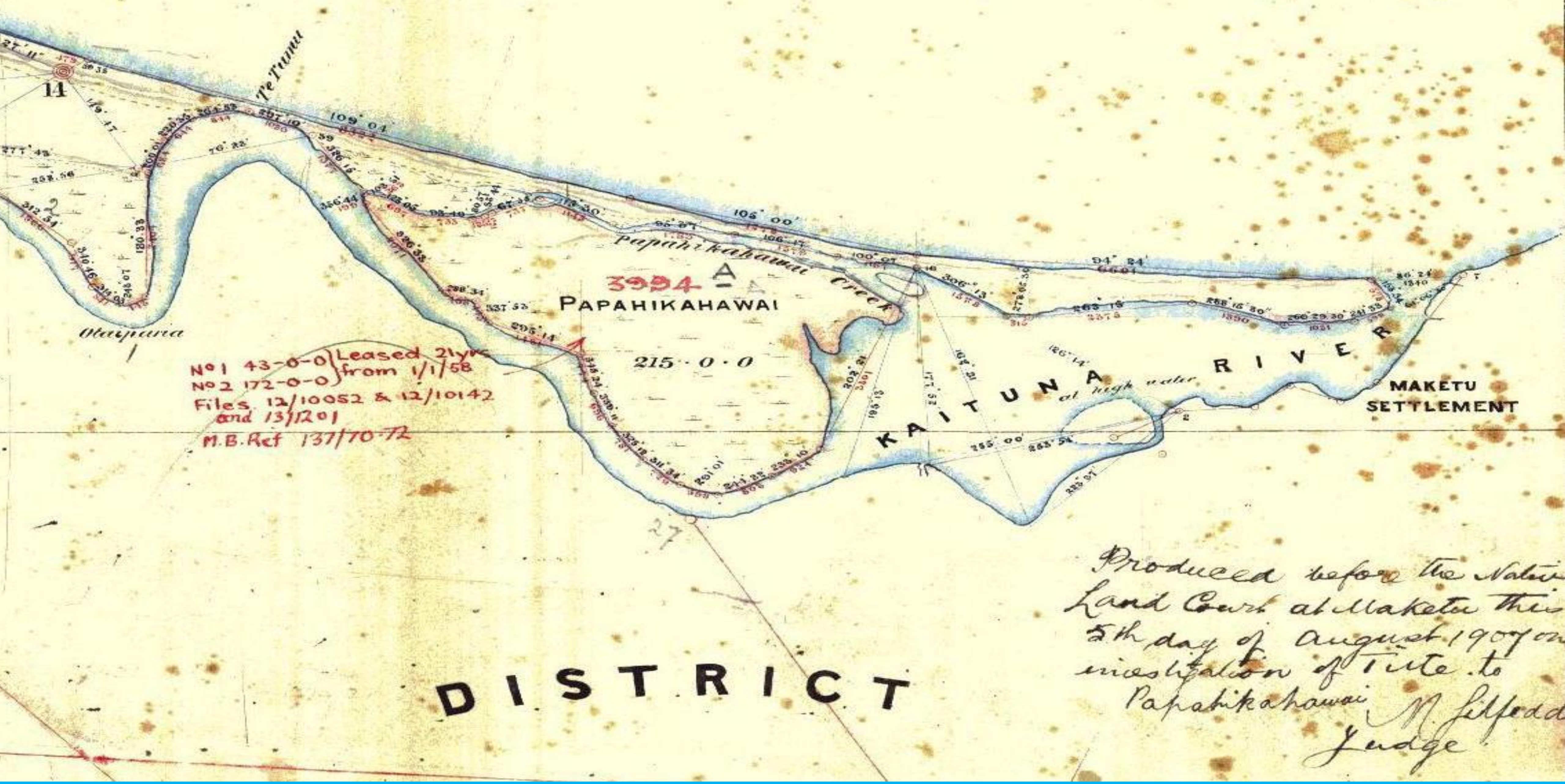


Estuaries

Longer Term – Integrated Estuarine Restoration

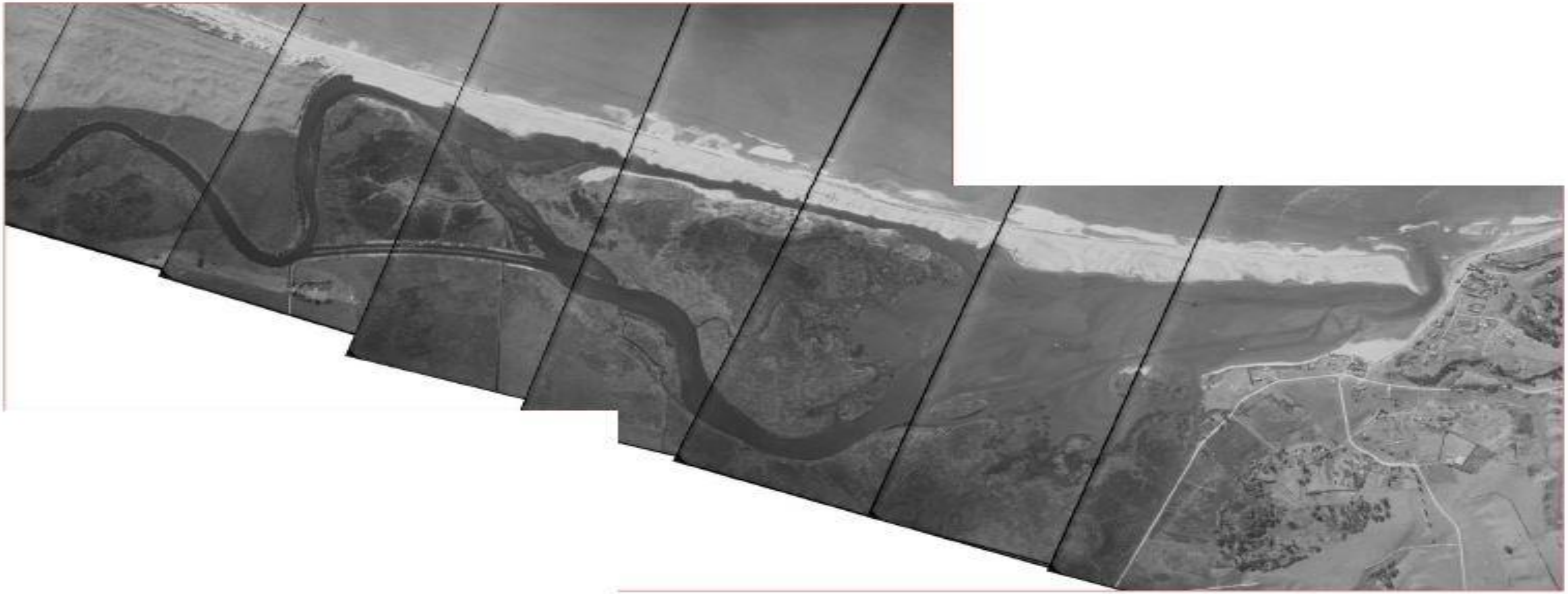
Example: Maketu Estuary

Kaituna River Re-diversion and Te Awa o Ngātoroirangi / Maketū Estuary Enhancement Project



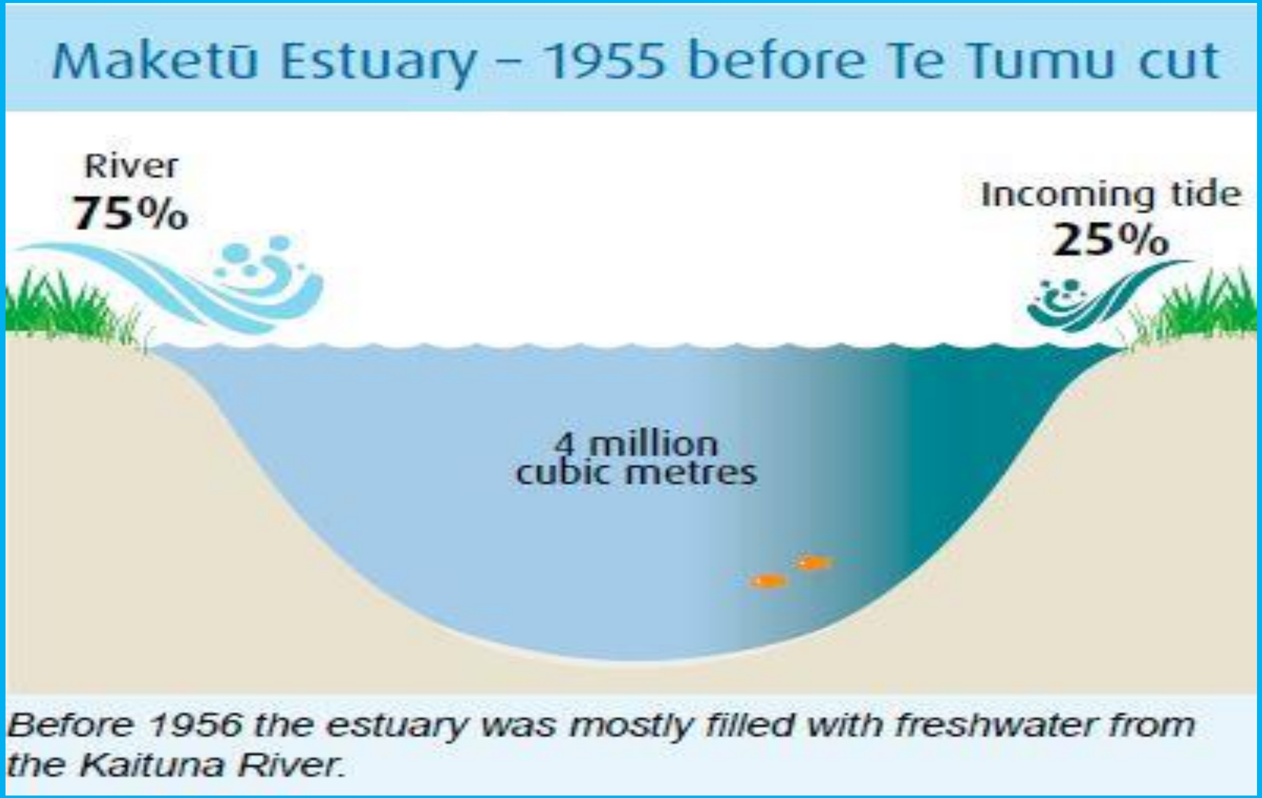
Te Tumu
14
Papahikahawai Creek
3994
PAPAHIKAHAWAI
215 · 0 · 0
No 1 43-0-0 Leased 21yrs
No 2 172-0-0 from 1/1/58
Files 12/10052 & 12/10142
and 13/1201
M.B. Ref 137/70-72
KAITUNA RIVER
at high water
MAKETU
SETTLEMENT
DISTRICT
Produced before the Native
Land Court at Maketu this
5th day of August 1907 on
investigation of Title to
Papahikahawai
Judge

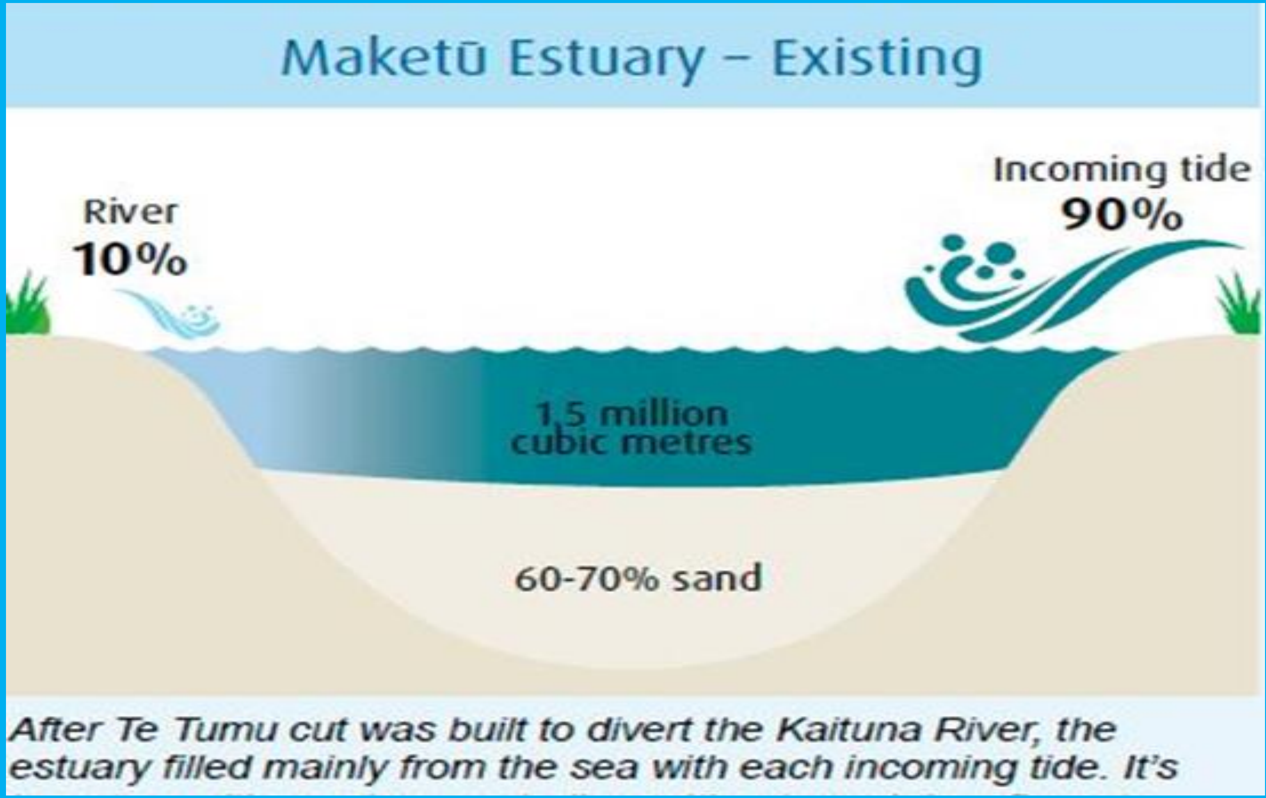
Maketu Estuary – Pre Diversion



Maketu Estuary – Recent View

Effects on Estuary Hydrology





Maketu Estuary – Adverse Effects of 1956 Kaituna Diversion

- Became totally saline estuary – upper reaches used to be freshwater wetland which quickly died out
- Major expansion of flood tide delta in lower estuary reducing tidal prism and causing shoreline erosion
- Reductions in kaimoana and other life
- Significant adverse cultural effects
- Extensive loss of intertidal wetlands (particularly rushland) and sea grass beds
- Markedly reduced circulation and flushing in the upper estuary and increased nutrient loads from land leading to problematic algal growths and anoxic sediment
- Reduced the natural flushing of sand and mud

Project overview

Project goal

To significantly increase the volume of water (particularly fresh water) flowing from the Kaituna River into Ongatoro/Maketū Estuary by 2018 in a way that maximises the ecological and cultural benefits (particularly wetlands and kaimoana) while limiting the economic cost and adverse environmental effects to acceptable levels.

20% Kaituna flow re-diverted through estuary (currently 5%)

Creation of 22 ha (i.e. 55 acres) of wetlands

Project resources

- $6.2M over ten years 2012-22
- Skilled project team

1939 (prior to diversion)

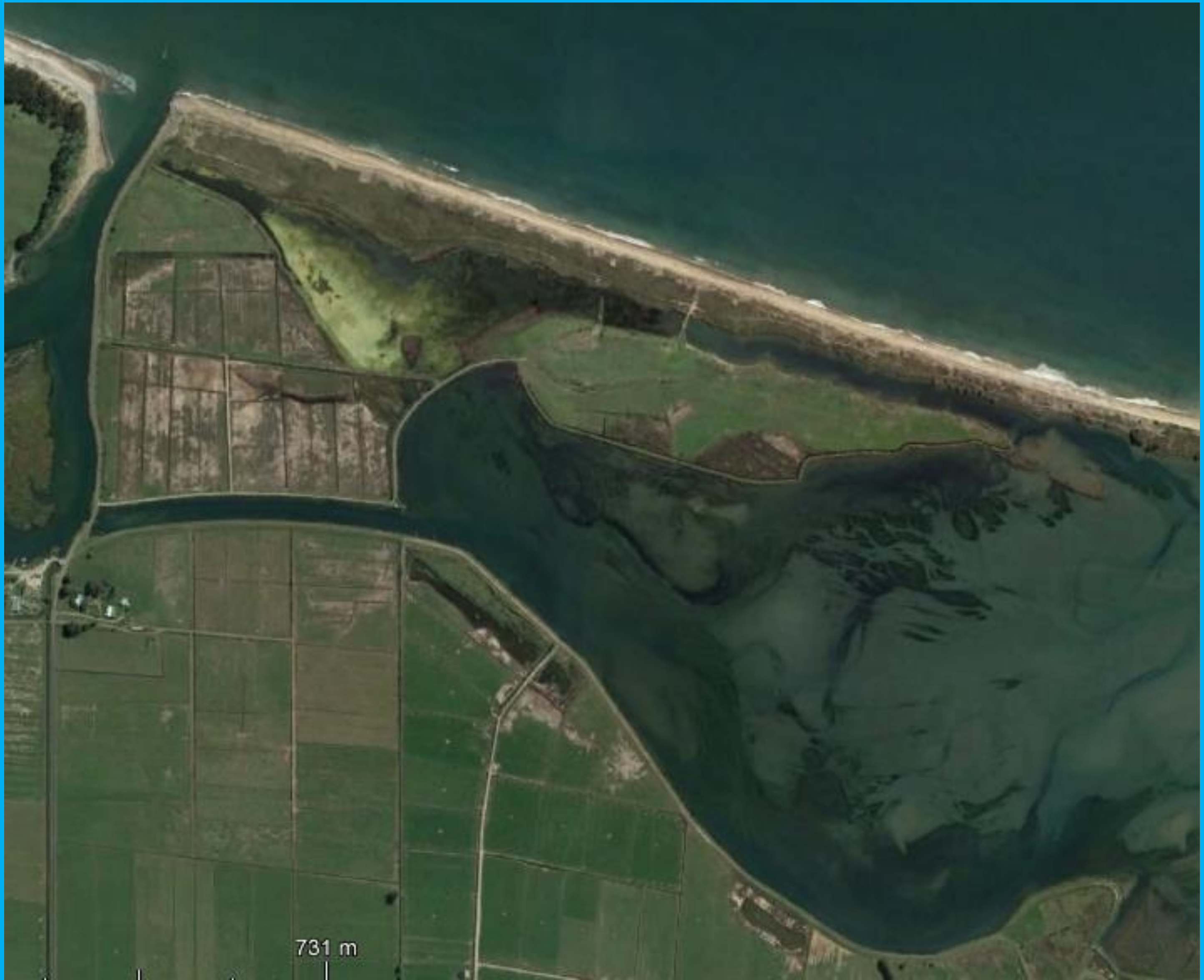
1959 (shortly after diversion)

1989

1979 (spit breach)

Upper Estuary Wetlands (before diversion)

Upper Estuary Wetlands (2016 – before re-diversion)



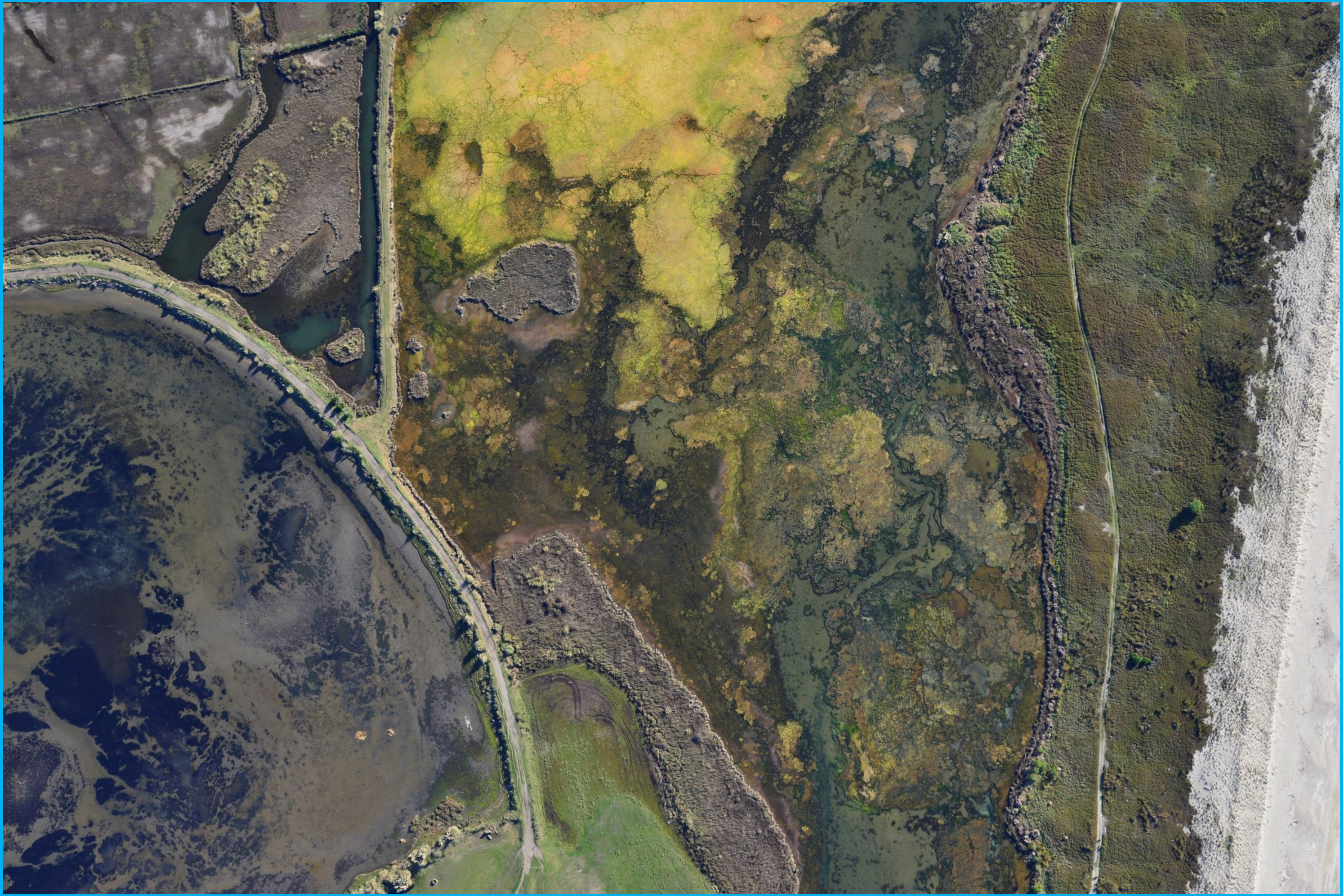
Maketu - Problematic Algal Growths

- Concentrations of nutrients such as phosphorus and nitrogen are high in the upper estuary
- Nutrients stimulate growth of algae, such as sea lettuce, Gracilaria and benthic cyanobacteria.
- Prolific algae growths in the mid and upper estuary
- Also cause large fluctuations in dissolved oxygen levels, with daily minimum dissolved oxygen levels too low to support healthy fish.

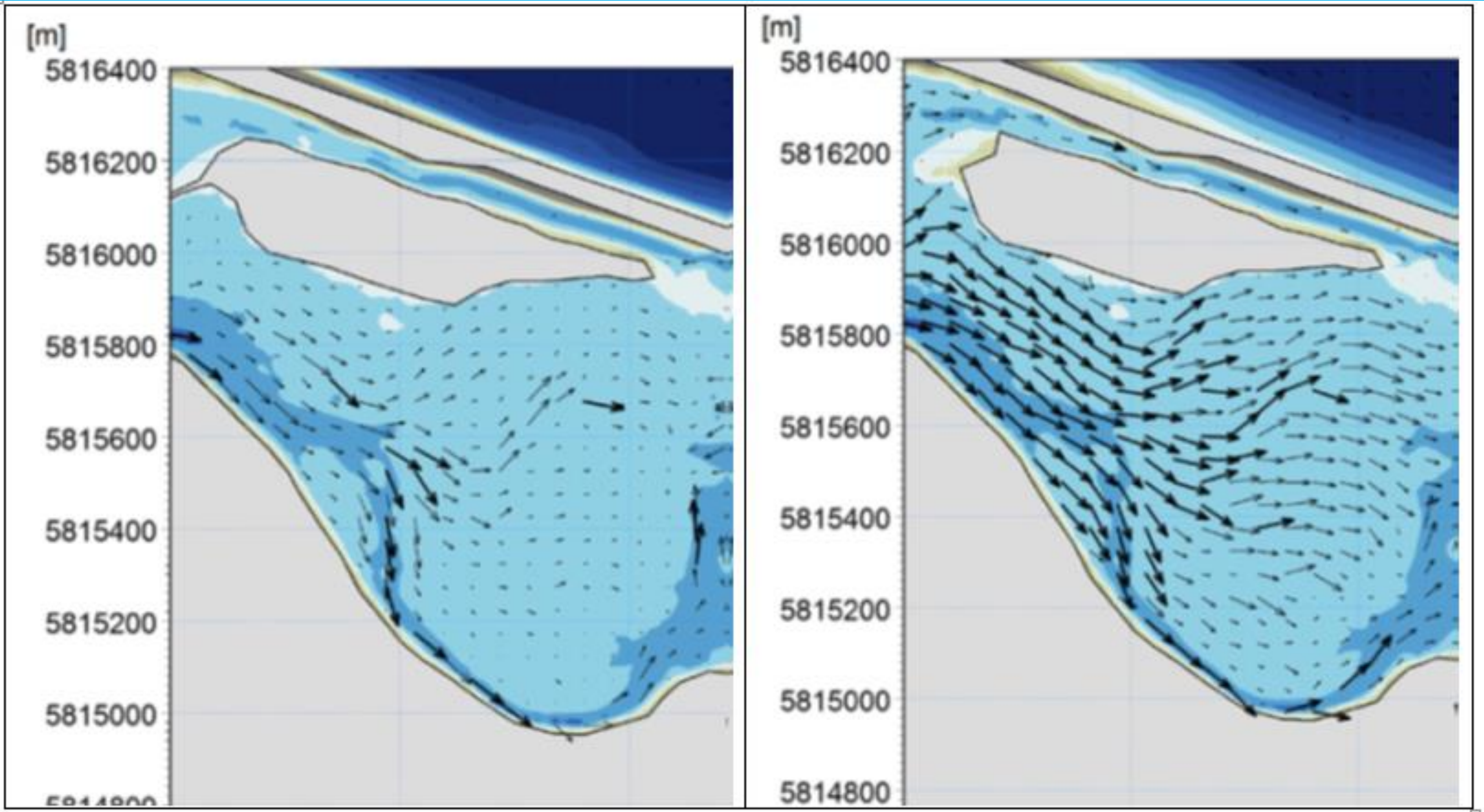
Maketu - Problematic Algal Growths

Lingbya and *Ulva flexuosa* algae at Papahikahawai

Maketu - Problematic Algal Growths




Stopbanks to be removed
Papahikahawai Island
Papahikahawai Creek
Te Tumu
Proposed wetland
Stop bank
Ford's Cut
Channel filled
Inlet structure
Ford Island
Ford Road
Upgraded public boat ramp + carpark
Kaituna Road
Kaituna River
Proposed re-diversion channel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April 2003

April 2019


April 2003

Stopbank

July 2017 – Lowering Stopbank and Removing Pampas

July 2017 Chenier Construction

January 2018

April 2019

December 2017

December 2017

Chenier

Constructed Chenier & Island - Maketu Estuary


Stopbanks to be removed
Papahikahawai Island
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Kaituna Road
Kaituna River
Proposed re-diversion channel


Te Pā Ika
shaping and planting
Flyover video

Constructed Wetland - St Annes - Manukau Harbour

Managed Realignment UK

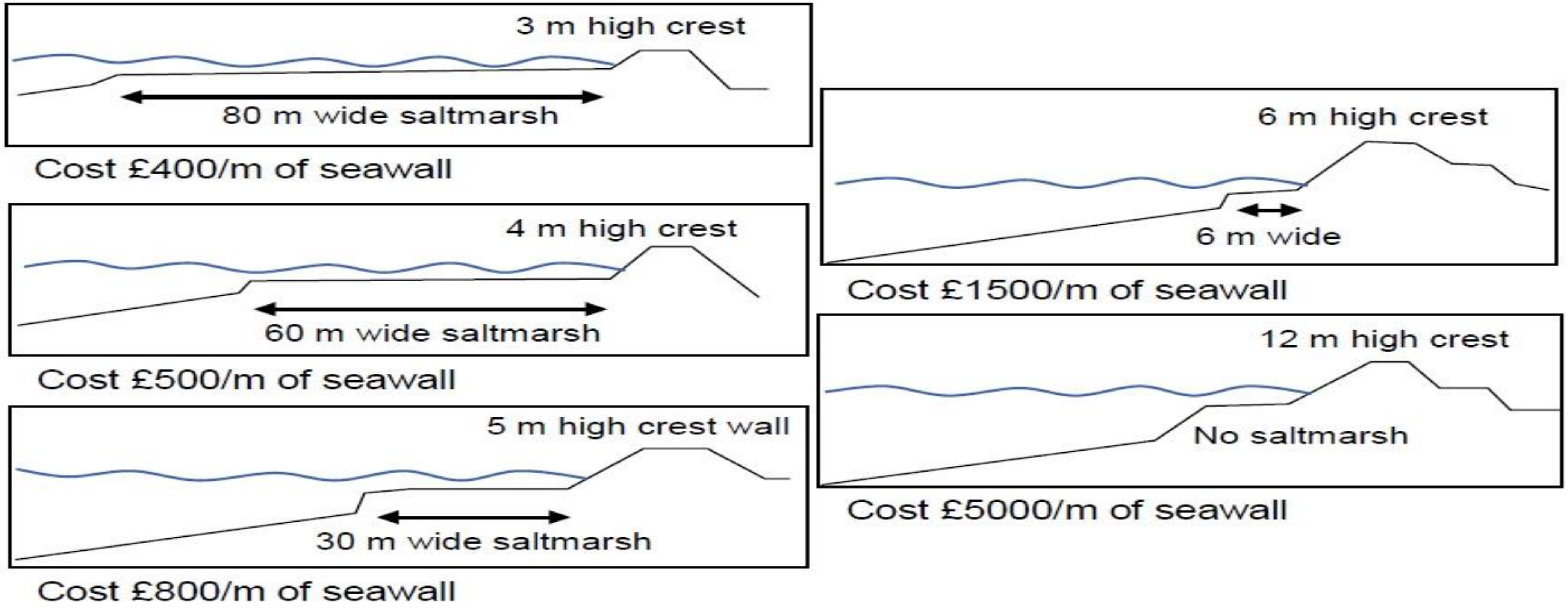
- Involves landward retreat of coastal defences to restore (recover) intertidal wetlands
- Enables restoration of significant areas of formerly lost intertidal wetland
- Significantly reduces the costs of coastal protection and in the UK that has been used as one of the major drivers
- Only just starting to be used (mostly UK and some isolated examples elsewhere)

Managed Realignment UK

Saltmarsh as Coastal Protection

- Studies on saltmarsh indicate they are capable of attenuating up to 97% of incoming wave energy – depending on marsh width
- I.e. Waves reaching shoreline are much smaller and less powerful
- So, restoration of intertidal habitats can have highly beneficial implications for coastal protection:
  - Costs of defences are markedly reduced
  - In some cases, coastal defences may no longer even be required

Sea Defence Costs with Differing Widths of Saltmarsh (south east UK - early 1990's)



Indicative costs and heights of sea defences with different widths of saltmarsh fronting. Costs presented in early 1990s prices. Information drawn from south east England

Managed Realignment - Obstacles

- **Requires land to be yielded to the sea**.
  - Of course, this land was formerly wetland
  - Nonetheless present land uses have to be abandoned
  - There are issues and costs that have to be worked through

- **For this reason, the managed realignment option is often of high political and social controversy**.
  - The schemes frequently suffer from a lack of public acceptance
  - So, difficulties of achieving should not be under-estimated
  - Has to be managed carefully to progress

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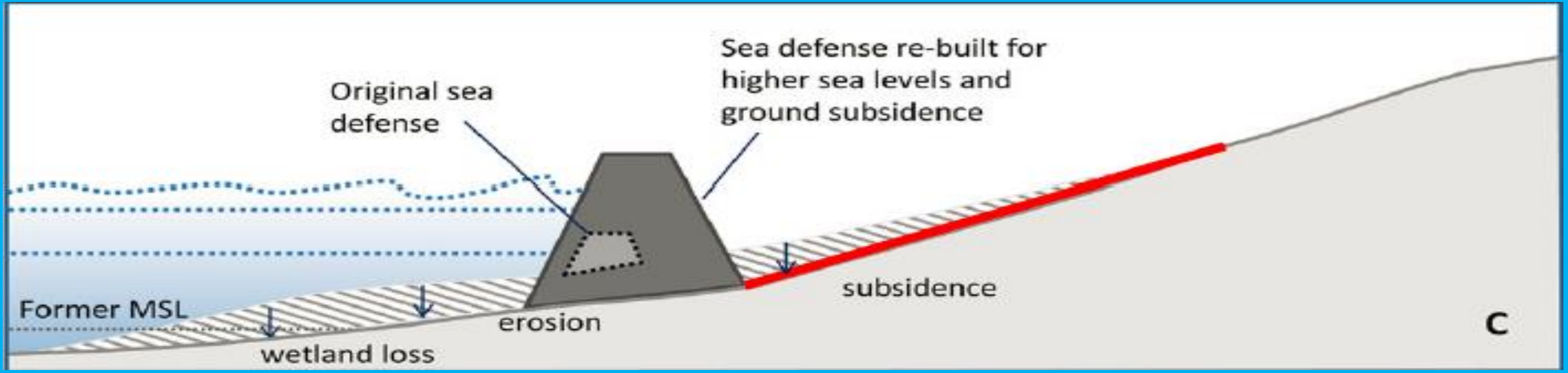
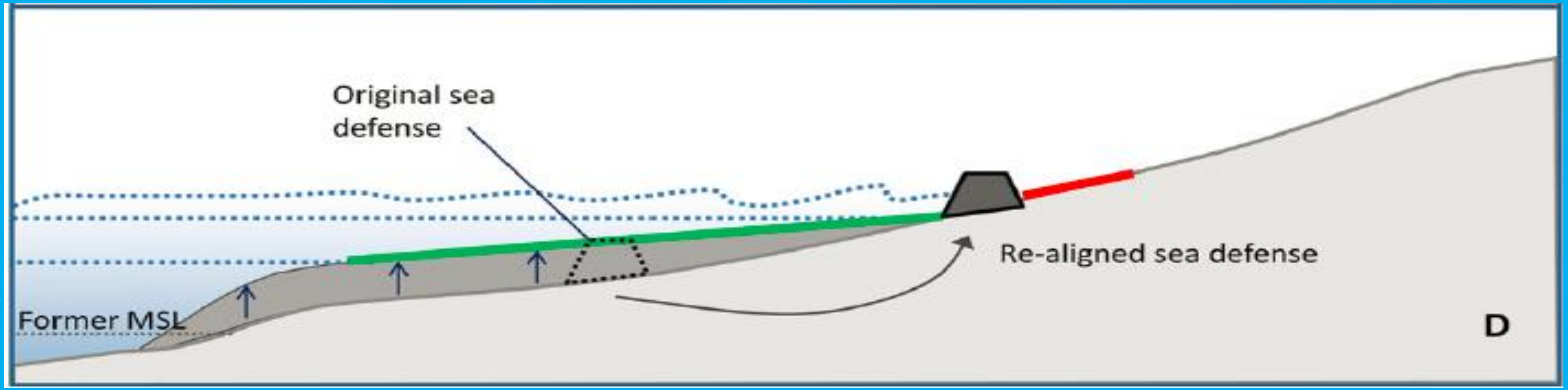
Longer Term ? Managed Realignment





Managed Realignment UK

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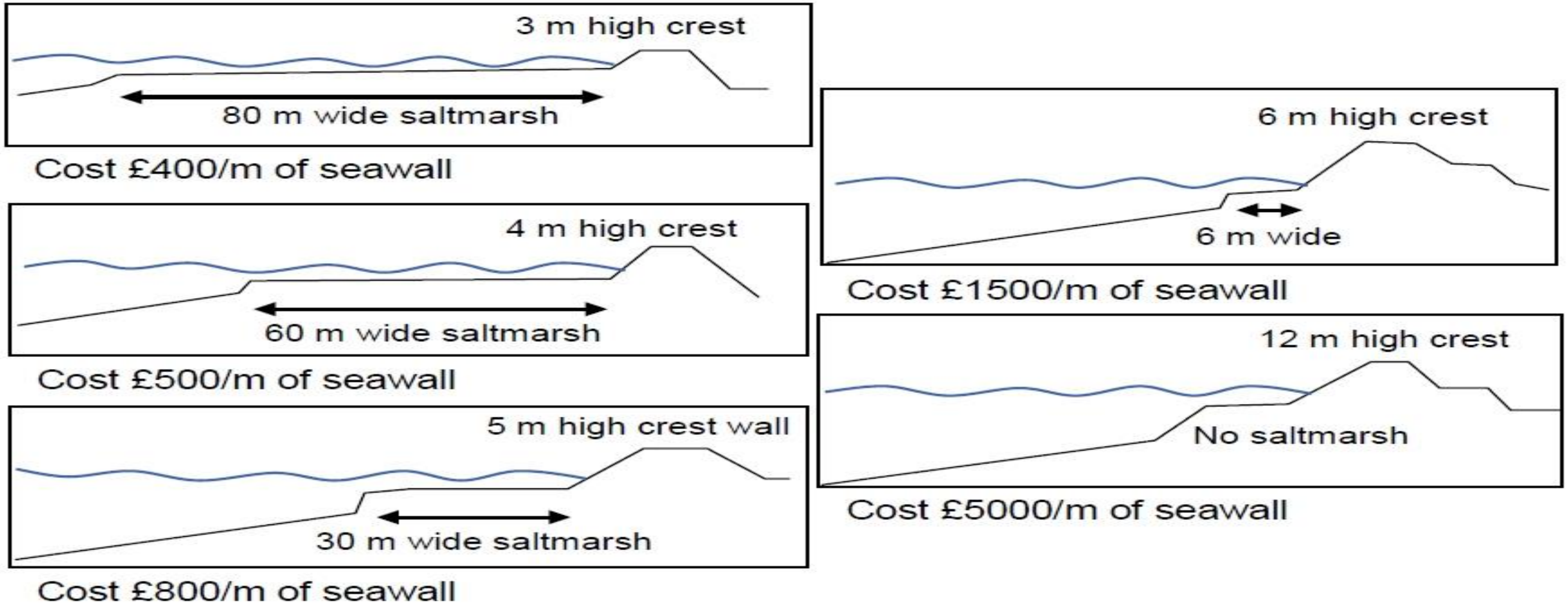

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Restoration of In-Harbour Ecosystems

Estuarine Beach formed by Nourishment

(Tairua Harbour, Coromandel)

Constructed Wetland - St Annes - Manukau Harbour

Natural Chenier and Wetland Protection

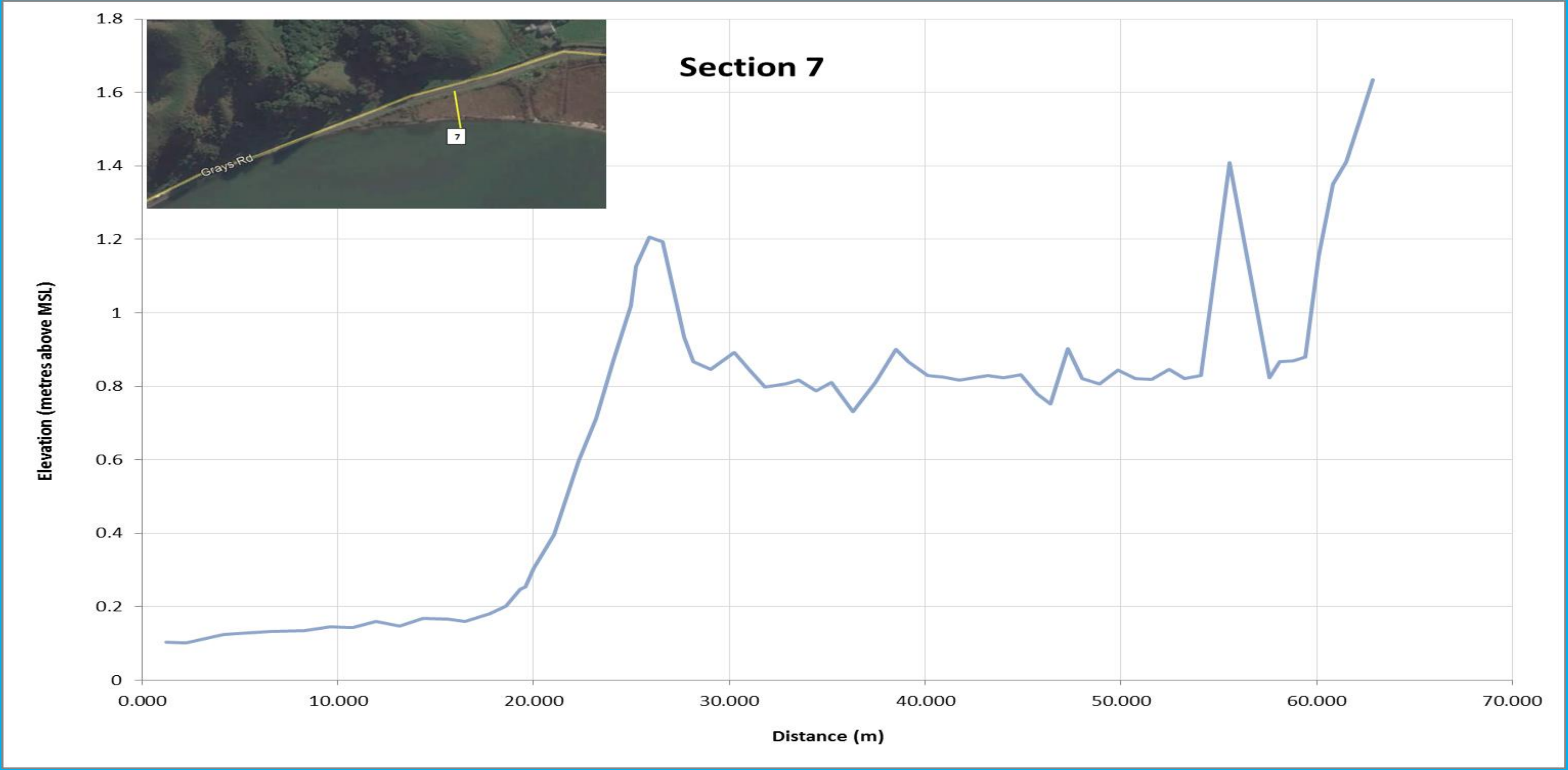
(Example Pauatahanui Inlet)

Shoreline protected by coastal wetland (in this case freshwater wetland) which is in turn protected by a chenier

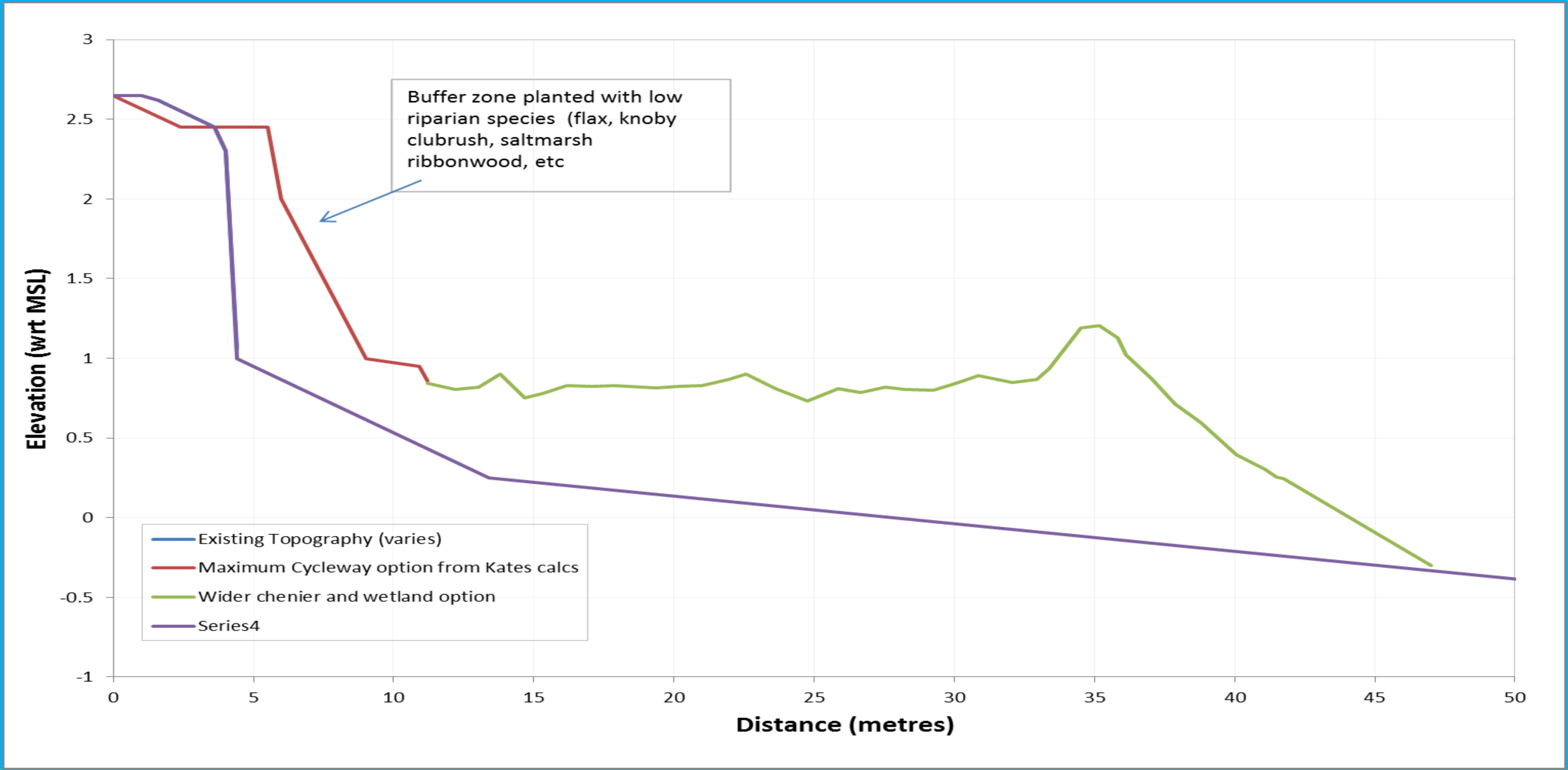
Chenier (natural) along seaward edge of wetland

Natural Chenier and Wetland

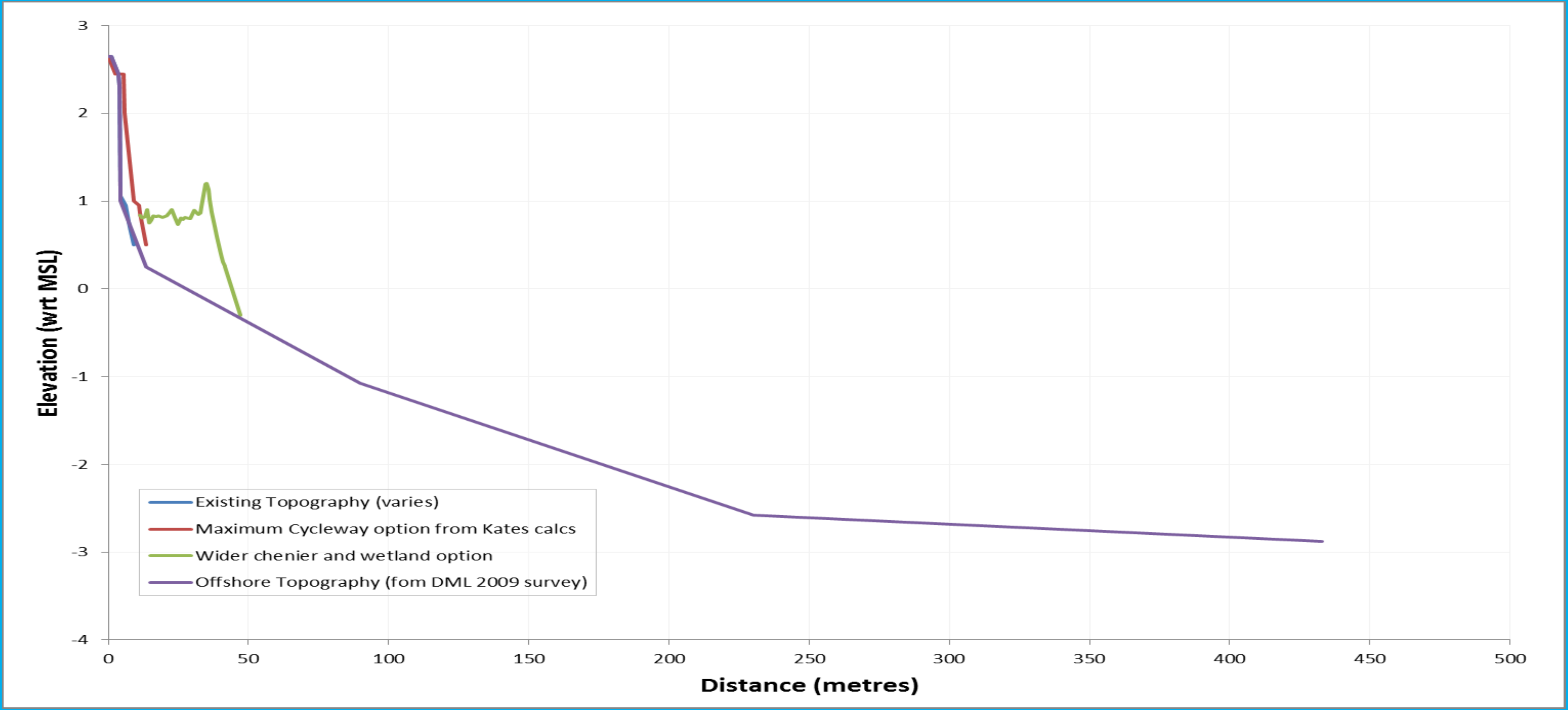
Natural Chenier and Wetland – Grays Road



Maximum width Cycleway & Wetland Option

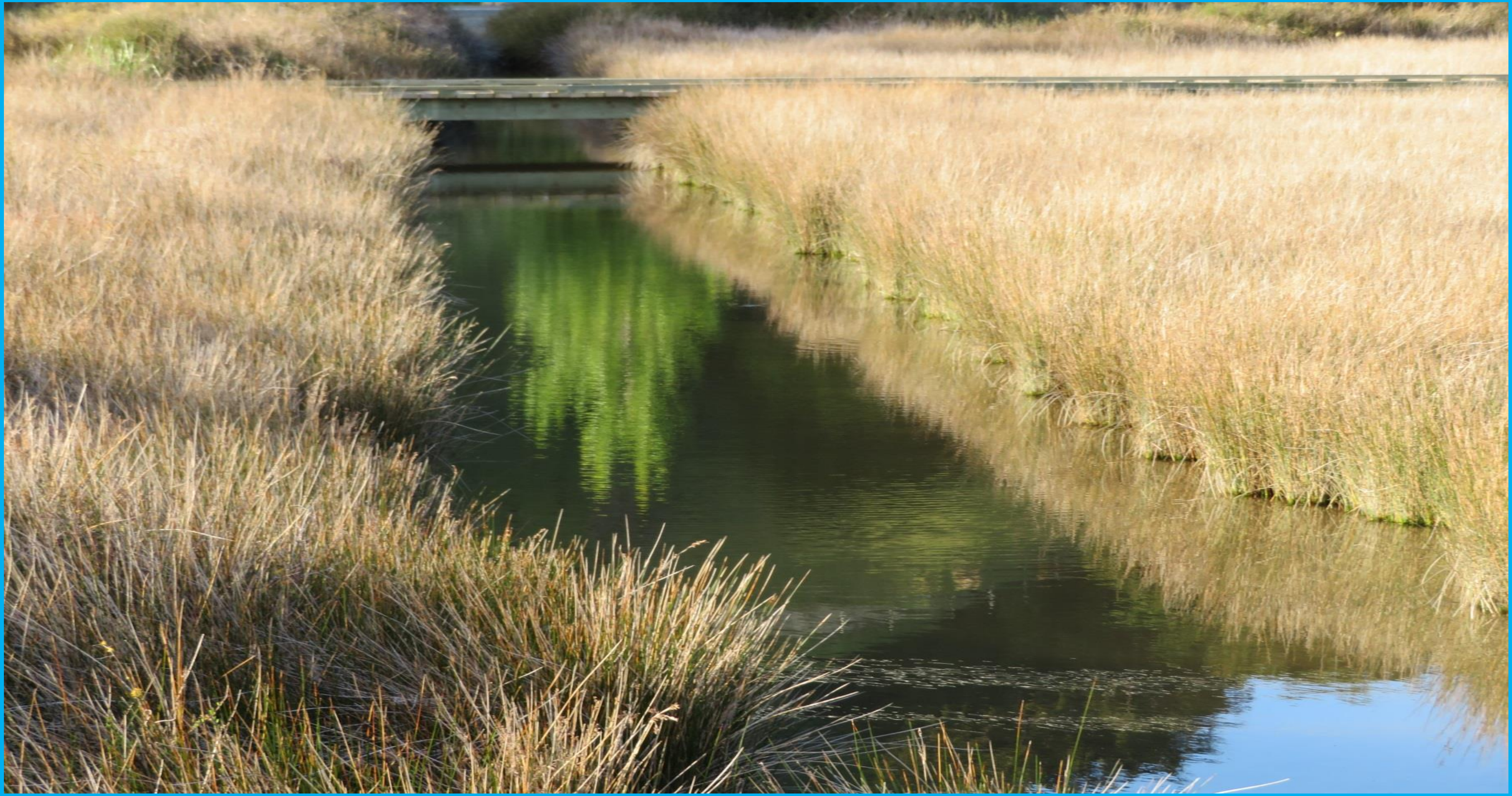


Maximum Width Wetland Option

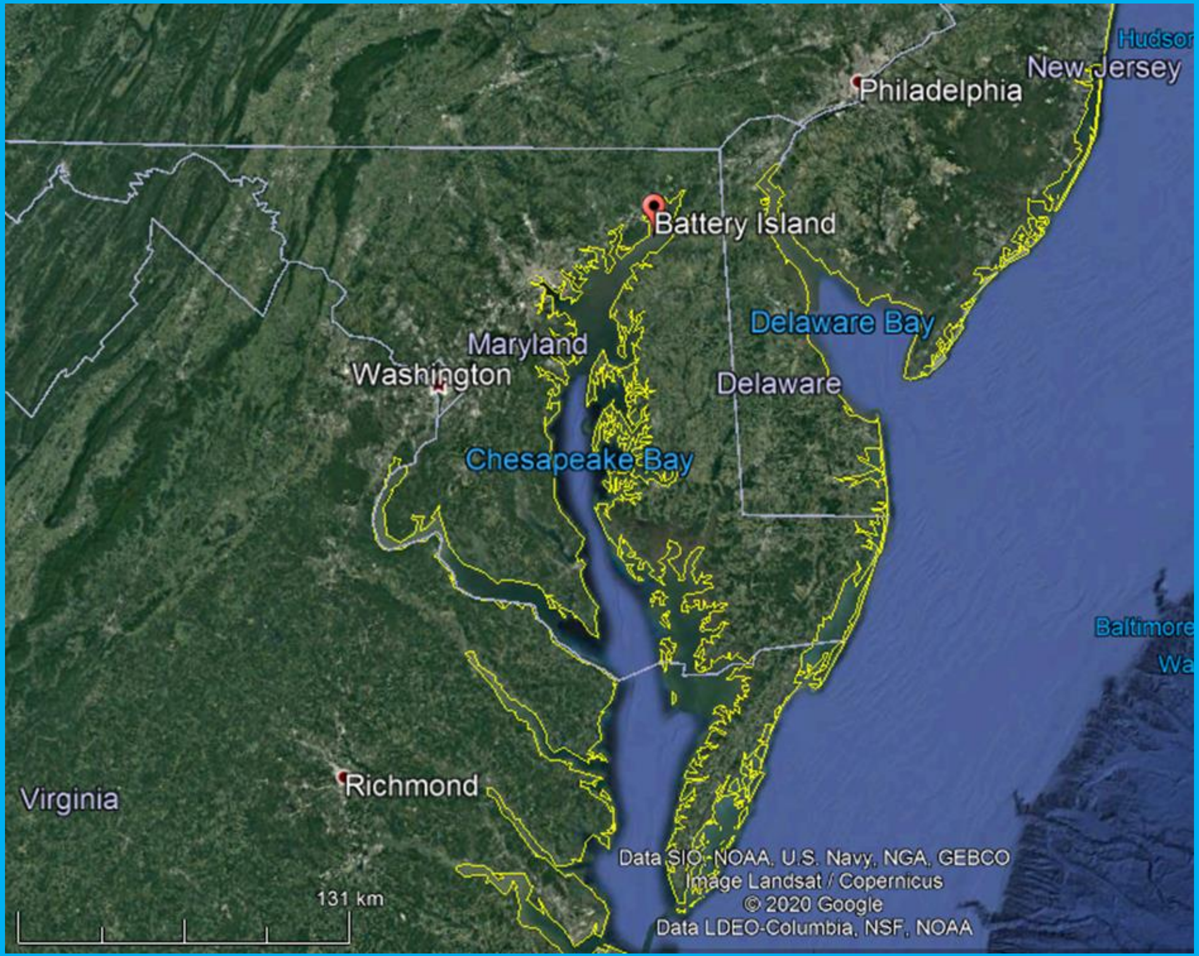


Existing Stream Outlet

Potential to enhance Porirua Harbour stream and stormwater outlets



Battery Island, Chesapeake Bay
Eastern US

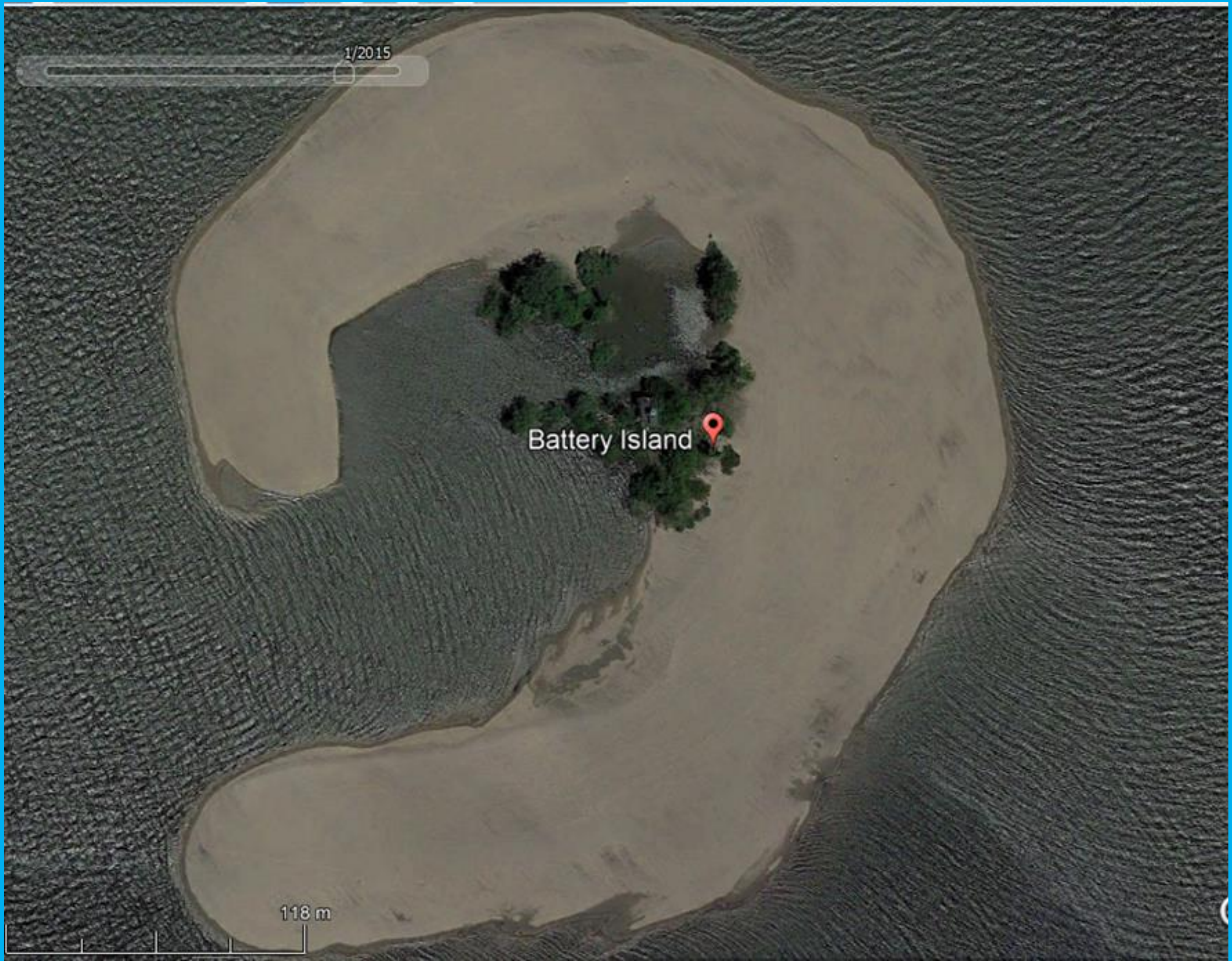


Battery Island Restoration Project, US

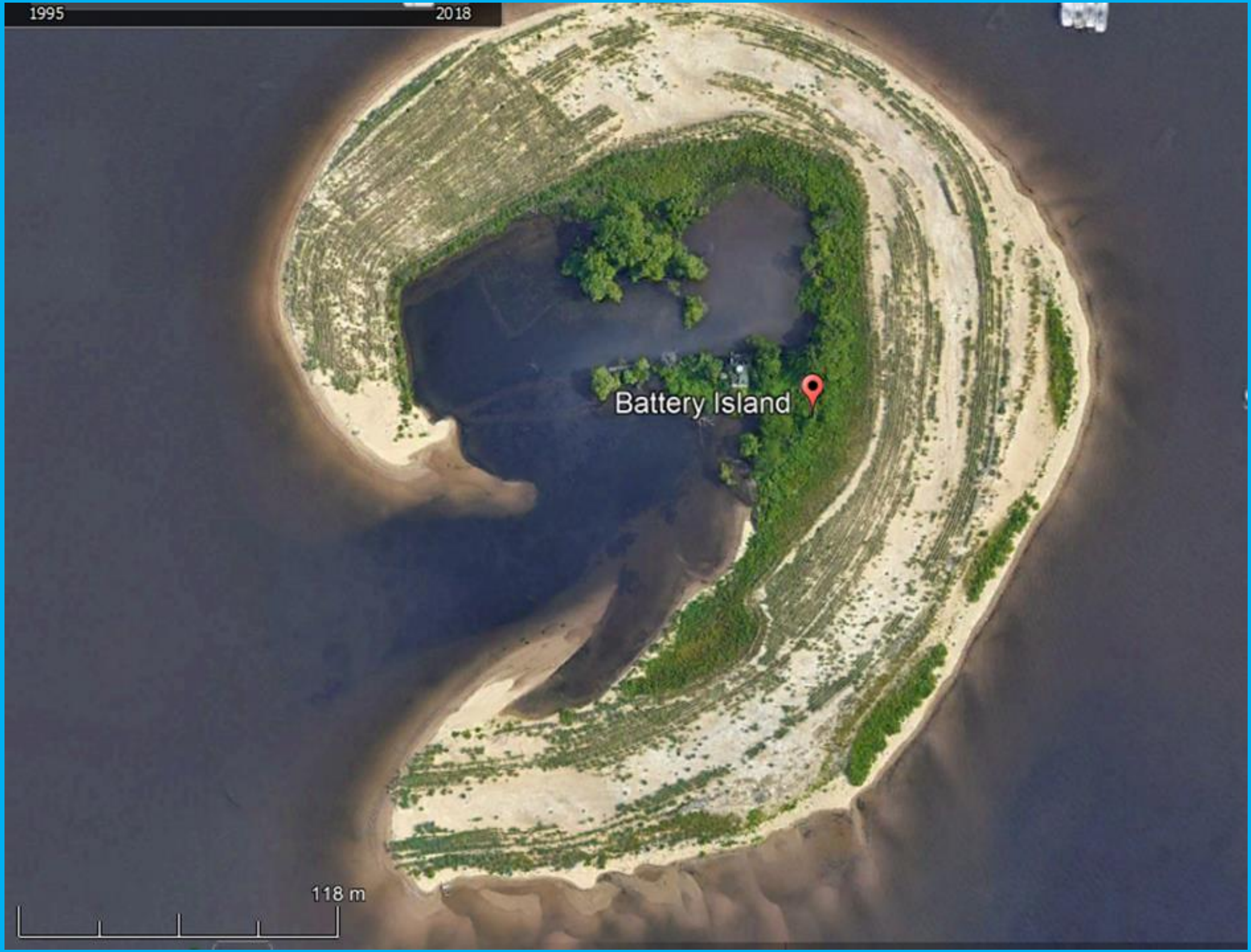
- Primary objective was to beneficially use dredged material to restore an eroded waterfowl nesting site and historic lighthouse in the Susquehanna National Wildlife Refuge, Chesapeake Bay
- Material was dredged from the Susquehanna federal channel at the mouth of the Susquehanna River
- Dredged material was placed hydraulically with a diffuser and distributed by earth moving equipment to create an unconfined horseshoe-shaped island
- This use of dredged material applying working with nature principles was cost-competitive with traditional upland confined placement alternatives.

Battery Island – Before & After

Figure 7. Battery Island before (left; 2011) and after (right; 2013) unconfined placement of dredge material



After (2013)

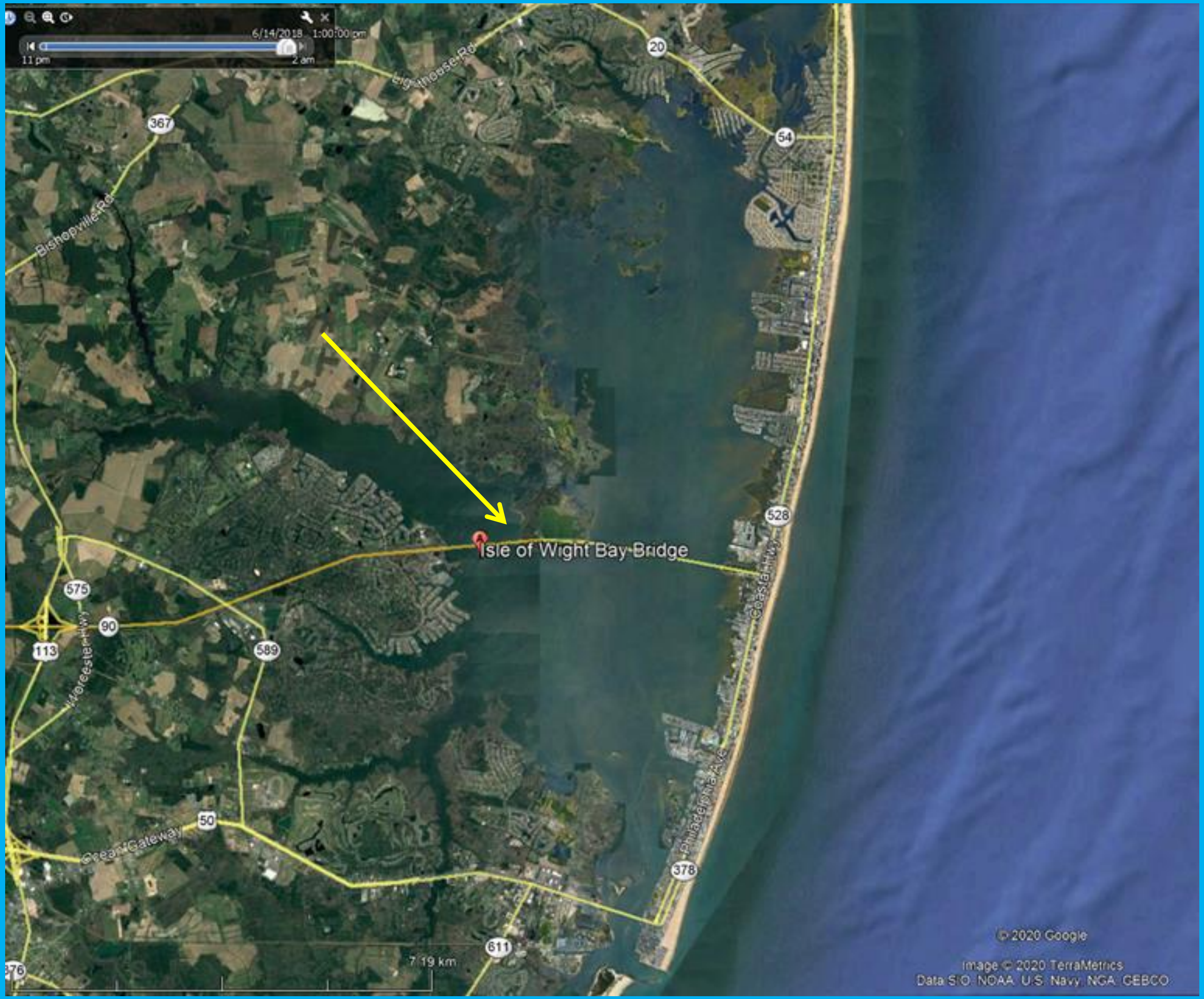


After (2017)

Elvia Island, Galveston Bay, Texas

Birds making use of the 6 acre island constructed of sediment dredged from the Houston Ship Channel

Isle of Wight



Isle of Wight Bay, MD, Eastern US

- Isle of Wight Bay Restoration Project, Worcester County, MD.
- Restoration project involved placement of dredged sediment from the Isle of Wight Federal channel to restore salt marsh habitat
- Rubble protection placed to the restored marsh
- The shoreline had eroded at this location, exposing built infrastructure through the loss of marsh habitat

Isle of Wight Bay Restoration

- The Isle of Wight Federal channel is a three mile navigation channel (2m deep and 25m wide) that extends into the Isle of Wight Bay.
- Dredged material was hydraulically pumped with a diffuser behind breakwaters to create a bayside (lower) and upland (higher) marsh.
- The raised area was planted with native saltmarsh species (Poa pratensi (bluegrass), Festuca rubra (red fescue), and Spartina alterniflora (smooth cordgrass)).
- On the western side of the restored marsh, an opening in the breakwater was created to allow for tidal flows into and out of the marsh. The opening allows for natural water flows that sculpt the marsh
- Additionally, a pier was constructed, providing the public with access and recreational fishing opportunities

Before & After

2017

Figure 2. Wading birds utilize the restored Isle of Wight salt marsh.

Discussion