Cocos (Keeling) Islands CHRMAP Review

Prepared for the Shire of Cocos Keeling Islands

14 July 2026

Project Number: TE26019

Version	Description	Date	Author	Reviewer	Approver
1.0	First External Issue (Draft Only)	10/04/2026	RM/EP	AM	AM
2.0	Second External Issue (Draft Only)	12/05/2026	RM/EP	AM	AM
3.0	Third External Issue (Draft Only)	05/06/2026	EP	RM	EP
4.0	Issued for Release	14/07/2026	EP	SM	EP

Executive Summary

The Cocos (Keeling) Islands (CKI) are a remote coral atoll territory of Australia in the eastern Indian Ocean, consisting of 27 low-lying islands, with permanent populations on Home Island and West Island. The Cocos Malay community on Home Island has a long-established cultural identity dating back to the 1820s. In response to coastal hazards, the Australian Government commissioned a Coastal Hazard Risk Management and Adaptation Plan (CHRMAP), first drafted in 2024 and finalised in March 2026. Talis Consultants Pty Ltd, engaged by the Shire, conducted an independent review assessing the validity of the CHRMAP's technical basis and conclusions.

The review found that the CHRMAP uses conservative methodologies for atoll environments, particularly in its coastal vulnerability and risk assessments, which depart in some areas from established Western Australian guidelines and potentially overstates risk levels. The findings suggest that key analytical components, including erosion modelling, risk evaluation, and adaptation option appraisal requires additional work for medium and long-term planning horizons. Economic, environmental, and funding considerations are not fully addressed, and key analyses such as cost-benefit assessments and comprehensive environmental impact evaluations need further detail to be of better use as a long-term planning tool. As a result, major recommendations, particularly long-term retreat, are not yet supported by the analyses presented in the CHRMAP. Additional analysis, including the investigations identified in this review, would strengthen the basis for any long-term adaptation decisions. Talis concludes that the CHRMAP would benefit from further technical work before its recommendations can be relied upon for long-term planning decisions on CKI.

The final CHRMAP, released in March 2026, represents a meaningful shift from the draft. It defers any recommendation for permanent off-island retreat, prioritises further technical investigations, and positions long-term adaptation as contingent on community engagement and study outcomes. Talis acknowledges these changes as improvements. The investigations identified in this review would directly support that further technical work and strengthen the basis for future adaptation decisions.

Council Summary

In response to coastal hazards, the Australian Commonwealth Government commissioned a CHRMAP, first drafted in 2024 and finalised in March 2026. The draft plan recommended long-term managed retreat from Home Island and a mix of protection and retreat for West Island. The final CHRMAP softened these positions, emphasising the need for further technical studies before committing to long-term strategies. Talis Consultants, engaged by the Shire, conducted an independent review assessing the validity of the CHRMAP's technical basis and conclusions.

The CHRMAP Review found that the current coastal hazard plan for the CKI applies methods designed for mainland coastlines rather than coral atoll environments. The modelling assumptions are conservative and, in some cases, inconsistent. The plan may present a more severe picture of future impacts than the available evidence supports. This has implications for major decisions, including long-term retreat from the islands. The review also identified gaps in how risks and options were assessed.

Several analyses, including the comparison of different adaptation options, were incomplete or applied inconsistently, with some practical solutions excluded or not fully evaluated. No cost benefit analysis or long-term multi-criteria analysis was completed, meaning there is currently no clear understanding of the long-term costs, benefits, and trade-offs of options such as protection, adaptation, or relocation. Economic, cultural, and strategic considerations, including the importance of the islands to the Cocos Malay community and nationally significant infrastructure, were not fully factored into the assessment.

Environmental and planning information is also incomplete, including baseline environmental data, formal impact assessments, and consideration of biodiversity and ecosystem health. There are gaps in planning for contaminated sites, freshwater resources, and long-term funding pathways. These limitations mean that further detailed studies and stronger community engagement are needed before major long-term decisions can be made. The review supports a cautious, staged approach, focused on improving the evidence base and protecting existing assets in the short term. Longer-term pathways should be determined through community engagement.

As a result, major recommendations, particularly long-term retreat, are not yet supported by the analyses presented in the CHRMAP. Talis concludes that the CHRMAP requires further technical work before its recommendations can be relied upon for long-term planning decisions on CKI.

Table of Contents

Tables

Figures

1 Introduction

The CKI is a remote Australian territory located in the eastern Indian Ocean at approximately 12°10'S, 96°50'E. The archipelago consists of 27 low-lying coral islands arranged across two atoll formations, with a total land area of roughly 14 km² and a maximum elevation of approximately eight metres above mean sea level. Only Home Island and West Island support permanent communities. These islands form the operational and planning focus for the CKI Coastal Hazards Risk Management and Adaptation Plan (CHRMAP). The CHRMAP is intended to provide a structured framework to evaluate adaptation pathways, including avoidance, retreat, accommodation, and protection, with the aim of supporting long-term, evidence-based land-use and infrastructure planning.

The purpose of this report is to provide a third-party review of the CHRMAP document(March 2026). This includes reviewing the assessments conducted and referenced by the CHRMAP, the completeness of the CHRMAP, and its recommendations and proposed next steps.

This report has found that the methodology and a range of data, details and conclusions within the CHRMAP contain limitations and assumptions that would benefit from further examination and validation. This includes what Talis considers to be too much conservatism in the Coastal Vulnerability Assessment (CVA)[1], assessments and analyses that appear to overstate the risk and pre-assume the "retreat" recommendation, opportunities to strengthen community consultation, and areas that would benefit from additional consideration such as the unique environmental, cultural, and strategic aspects of the locality.

CKI represents one of the most intact tropical island systems in the region, supporting high biodiversity values including seabird colonies, marine turtles, and species-rich coral reef communities. The northern atoll, North Keeling Island, together with its surrounding 1.5-km marine buffer, is protected as Pulu Keeling National Park, Australia's most remote Commonwealth national park. The environmental benefits of maintaining and protecting the islands do not appear to have been considered by the CHRMAP.

The CKI also hold substantial cultural and strategic significance. The Cocos Malay people have inhabited the CKI since the 1820s, which is roughly the same time as when the Swan River Colony was established in Perth. Their unique culture is centred on their connection to the islands. This loss of connection to land has also not been considered by the CHRMAP.

The islands also support Australian Defence Force maritime surveillance operations and are undergoing upgrades to enable deployment of advanced aircraft, strengthening Australia's presence in the Indian Ocean region. Broader geopolitical interest, including from the United States, demonstrates CKI's importance within evolving Indo-Pacific security dynamics. How this is contemplated, particularly in relation to the incongruities between the investment and recommendations within the CHRMAP, is not detailed within the document.

1 The final CHRMAP refers to this document as the Coastal Vulnerability Study (CVS). This review uses CVA, consistent with the term used in the source document.

This report indicates that aspects of the CKI CHRMAP's technical analyses and supporting qualitative assessments would benefit from further development in order to fully address the matters outlined above. Additional targeted analyses and investigations are recommended to strengthen the evidence base and improve the technical basis of the CHRMAP. Incorporating the outcomes of this further work would provide an opportunity to refine and update the document to better support defensible and well-informed coastal hazard risk management and adaptation decision-making.

1.1 Abbreviations

The below abbreviations are used in this report:

Table 1-1: Abbreviations

Abbreviation	Description
AEP	Annual Exceedance Probability
AIDR	Australian Institute for Disaster Resilience
ARI	Annual Recurrence Interval
BC Act	Biodiversity and Conservation Act
BDA	Benefit Distribution Analysis
BOM	Bureau of Meteorology
BTB	Berm Top Barrier
CBA	Cost Benefit Analysis
CHRMAP	*The Cocos (Keeling) Island Coastal Hazard* Management and Adaptation Plan (March 2026)
CKI	Cocos (Keeling) Islands — the most-used abbreviation in the report
cm	centimetres
CVA	Cocos (Keeling) Islands Coastal Vulnerability Study Assessment Report (Volumes 1 & 2). August 2022.
DoD	Department of Defence
DITRDCA	Department of Infrastructure, Transport, Regional Development, Communications, Sport and the Arts
DPLH	Department of Planning, Lands and Heritage
DRF	Disaster Ready Fund
DWER	Department of Water and Environmental Regulation
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPA Act	Environmental Protection Act
EPBC Act	Environmental Protection and Biodiversity Act
ERF	Emergency Response Fund
ESIA	Environmental and Social Impact Assessment

ESMP	Environmental and Social Management Plan
GBV	Gender-Based Violence
GCF	Green Climate Fund
GSC	geotextile-sand-container
GST	Goods and Services Tax
LGA Act	Local Government Act 1995
m	meters
MCA	Multi Criteria Analysis
mm	millimetres
MNES	Matters of National Significance
NEMA	National Emergency Management Agency
NSW	New South Wales
RAAF	Royal Australian Air Force
RFQ	Request for Quotation
RHDHV	Royal Haskoning DHV
SEPP	State Environmental Planning Policy (NSW)
SPP	State Planning Policy
SPP2.0	State Planning Policy 2.0: Environment and Natural Resources Policy
SPP 2.6	State Planning Policy 2.6: State Coastal Planning Policy
TCAP	Tuvalu Coastal Adaptation Project
TSIRC	Torres Strait Island Regional Council
TSRA	Torres Strait Regional Authority
UNDP	United Nations Development Programme
UXO	Unexploded Ordnance
WA	Western Australia
WAPC	Western Australian Planning Commission

2 Project Background

2.1 CHRMAP Background

In 2019, the Australian Government commenced development of a CHRMAP for the CKI. The technical basis of the CHRMAP is the CVA completed by Royal Haskoning DHV (RHDHV) and published in 2022. The goal of the CVA is to evaluate the coastal hazard exposure for Home Island and West Island, by assessing the susceptibility of natural and built assets to erosion and inundation under present-day conditions and projected sea-level rise. Using planning benchmarks of +0.4 meters (m) sea-level rise by 2068 and +0.9 m by 2118, the assessment modelled 1:500 ARI inundation events and 1:100 ARI erosion. As noted by the CVA itself in its executive summary, “the approach [is] overly conservative and does not provide useful information for planning of island atolls.” Section 3 of this report provides further information in this regard.

The CVA was used with a risk and vulnerability assessment that was conducted within Section 4 of the CHRMAP to define the risk levels for the islands’ assets. A separate MCA was then conducted to qualitatively assess possible options seen in Section 6.2 of the CHRMAP. A BDA was also conducted. The BDA’s executive summary states as a founding assumption that the community will eventually be relocated, a position not established by prior analysis. It also did not include key infrastructure such as the airport and the Department of Defence’s investment into it. No cost-benefit analysis was undertaken to compare the economic cost and benefit of each option within Section 6.5 of the CHRMAP.

Based on the documentation reviewed, the superseded draft CHRMAP recommended a protect adaptation pathway for Home Island in the short term, transitioning to planned and managed retreat in the medium term, and ultimately off-island relocation in the long term. For West Island, a combined protect and retreat approach was proposed across the short, medium, and long-term planning horizons, with continued protection of critical infrastructure, including the airport and fuel facilities beyond 2068. The draft CHRMAP identified managed retreat as the primary long-term adaptation pathway for both islands and notes that complete retreat from Home Island was likely to be required due to increasing risks associated with coastal inundation and erosion.

In contrast, the final CHRMAP revises this long-term position by deferring any recommendation for permanent off-island retreat. Instead, it prioritises the completion of further technical investigations to inform future management decisions, positioning long-term settlement outcomes as contingent on the results of these studies. The final CHRMAP appears to be a more considered approach to management and recognises that no recommendations can be made until additional data and studies can be provided.

2.2 Legislation & Policy

The CKI are an Australian external territory (the Territory) administered under the authority of the Cocos (Keeling) Islands Act 1955 and the LGA Act (The Department of Infrastructure Transport Regional Development Communications Sport and the Arts, 2026b). Although the Territory sits within Commonwealth jurisdiction, most legislative powers applied on CKI are founded within the WA legal system. As a result, the Government of Western Australia delivers a wide range of services to CKI under formal agreements with the Australian Government. The Shire of CKI functions under the same legislative provisions as local governments on mainland WA, aligning its planning and service delivery responsibilities with standard Western Australian local government legislation (Shire of Cocos (Keeling) Islands, 2026).

Coastal planning and management for CKI are informed by the Western Australian Planning Commission (WAPC) through State Planning Policy 2.6 (DPLH, 2006). As CKI is generally regulated through Western Australian legislation, SPP 2.6 is the principal policy framework guiding coastal hazard assessment, adaptation planning, and development decision-making across the Territory. The policy establishes recommendations for identifying, evaluating, and managing coastal hazards and mandates the application of risk-based planning (DPLH, 2006).

SPP 2.6 recommends that management authorities develop a CHRMAP in accordance with the WAPC Coastal Hazard Risk Management and Adaptation Planning Guidelines (2019). These guidelines provide a structured approach for assessing vulnerability, determining risk tolerance, and identifying suitable adaptation pathways.

For the CHRMAP to be feasible and implementable, it should consider the statutory requirements of the following:

- *Biodiversity Conservation Act 2016 (BC Act);*
- *Contaminated Sites Act 2003;*
- *Environment Protection Biodiversity Conservation Act 1999 (EPBC Act);*
- *Environment Protection Biodiversity Conservation (Indian Ocean Territories Marine Parks) Proclamation 2022 (EPBC Act);*
- *Environmental Protection Act 1986 (EPA Act);*
- *Cocos (Keeling) Islands Act 1955 (CKI Act); and*
- *Local Government Act 1995 (LGA Act).*

Policies and documents that can be used as a guiding framework for the CHRMAP include (typically 'due regard' documentation within the realms of planning in WA):

- Australian Disaster Resilience Handbook Collection Handbook 7 Managing the Floodplain, A Guide to Best Practice in Flood Risk Management in Australia;
- Conservation Action Plan for the southern atoll of the Cocos (Keeling) Islands, Australian Government Parks Australia & Australian Marine Parks;
- State Planning Policy 2.6: Western Australian Government;
- State Planning Policy Environment and Natural Resources Policy (SPP2.0), Western Australian Government; and
- WA Coastal Zone Strategy, Western Australian Government.

2.3 History & Heritage

A significant proportion of the current CKI community descends from the families originally brought to the islands to work on the coconut plantations. Due to the Territory's geographic isolation, a distinct cultural identity has developed, shaped by Malay traditions and the Islamic faith. This unique cultural identity includes language, customary practices, spiritual beliefs, traditional ecological knowledge, places of cultural significance, objects, stories, and oral histories that are maintained within the community (Shire of Cocos Keeling Islands, 2026).

The CKI hold cultural importance for the Cocos Malay community. A notable example is the Kolam (blue hole) system including 142 individually named blue holes within the lagoon, each associated with specific species and embedded with cultural meaning through the Cocos Malay language and traditional knowledge (DoITRDCSA, 2026a).

On 6 April 1984, the CKI community participated in a United Nations supervised Act of Self-Determination, voting overwhelmingly in favour of integration with Australia. At that time, the Australian Government committed to improving services and living standards to levels comparable with mainland Australia within a decade. The Commonwealth Grants Commission was appointed as the independent body responsible for monitoring and assessing progress toward this commitment (The Department of Infrastructure Transport Regional Development Communications Sport and the Arts (DoITRDCSA), 2026a).

Following the Commission's 1986 report and consultation with the Cocos community and its legal representatives, the Australian Government endorsed measures to bring local standards of living, governance, and infrastructure into alignment with national benchmarks. This process culminated on 7 March 1991 with the signing of a Memorandum of Understanding between the Prime Minister and representatives of the CKI community (DoITRDCSA, 2026a).

The Australian Government's 1984 commitment to achieving living conditions comparable to mainland Australia forms part of the policy context within which the CHRMAP's primary long-term recommendation of off-island relocation should be assessed (DoITRDCSA, 2026a).

2.4 Environmental Setting

Natural coastal protection on CKI is strongly influenced by the atoll's reef–island system, which provides wave attenuation, sediment generation and sediment transport processes essential for coastline stability and long-term geomorphic stability.

The CKI Marine Park, declared in 2022, protects approximately 467,054 km² of diverse marine habitats, including coral reefs, lagoons, deep-sea seamounts, plains and ridgelines. The islands and surrounding marine park support a wide range of migratory, threatened and endemic species. CKI itself formed atop an extinct volcanic seamount rising from seafloor depths of ~5,000 m and represents a late stage in reef-island evolution, transitioning from fringing reefs to barrier reefs and ultimately to coral atolls as the volcanic core subsided (Department of Infrastructure, Department of Planning and Shire of Cocos Keeling Islands, 2024). A continuous fringing reef encloses the lagoon except for two deep entrances. The lagoon bathymetry is shallow at the southern areas where natural deposition occurs and deepens towards the main lagoon entrances in the northwest (Department of Infrastructure, Department of Planning and Shire of Cocos Keeling Islands, 2024).

Coastal landforms reflect the contrasting hydrodynamic regimes of the atoll. Ocean-facing shorelines comprise coarse sands and coral gravel and boulders. This is due to their exposure to oceanic waves, particularly where the reef crest lies close to shore. In contrast, the lagoon shorelines are narrow, sheltered beaches composed of fine white sand deposited under low-energy conditions. Ocean-derived sediments are relatively young and produced by ongoing reef processes, whereas lagoon sands are more weathered, having undergone progressive transport and breakdown as sand eroded from the ocean sides of the islands moves into the lagoon (Department of Infrastructure, Department of Planning and Shire of Cocos Keeling Islands, 2024).

2.5 CKI Biodiversity

2.5.1 Matters of National Environmental Significance

Twenty-three EPBC Act referrals have been lodged for coastal works, infrastructure development, and marine installations within the region. A Matters of National Environmental Significance (MNES) search identified multiple environmental protections relevant to the CKI under the EPBC Act and

indicated that the assessment area intersects a Commonwealth Marine Area and supports protected fauna. The search identified 15 listed threatened species, including vulnerable or endangered birds, several species of marine turtles, and whales. A further 29 listed migratory species including seabirds, shorebirds, whales, and dolphins were recorded in the area. The CKI Marine Park also includes national park and habitat protection zones including critical Green Turtle habitat (Department of Climate Change Energy the Environment and Water, 2025).

2.5.2 Terrestrial and Aquatic

A search of the WA Department of Biodiversity, Conservation and Attractions (DBCA) biodiversity database (Danjoo) identified several priority flora and migratory fauna species for the CKI, including threatened migratory species protected under the EPBC Act.

Floristic diversity on CKI is low, with only 61 plant species recorded across the atolls and a single endemic taxon, *Pandanus tectorius var. cocosensis*, occurring on Home Island and the southern end of West Island. Vegetation of the southern atoll has been substantially modified by more than 160 years of coconut plantation clearing (DBCA, 2025).

North Keeling Island is the only seabird breeding site within a 900-km radius and the sole refuge of the archipelago's only endemic bird, the Cocos Buff-banded Rail.

The only publicly available biological surveys for CKI are project-specific investigations conducted by GHD (2021–22) for the Department of Defence, covering a small portion of Direction Island and part of West Island. The limited survey coverage across the broader CHRMAP assessment area represents a data gap relevant to evaluating the environmental feasibility of coastal adaptation works.

2.5.3 Marine

The reef system surrounding the southern atoll comprising the outer reef flat, reef crest, reef slope, and mesophotic reef supports a high diversity of marine species, including both hybrid and endemic coral-reef fauna. The system provides habitat for a range of megafauna such as bottlenose and spinner dolphins (popas), reef sharks (cucut), manta rays (pareh), and a variety of benthic invertebrates including sponges. The reef at Belakang Batu-Karang (Trannies Beach) is particularly species-rich and is recognised as an area of high conservation value (Australian Government Director of National Parks and Australian Marine Parks (DNPAMP), 2025).

The outer reef also supports several species targeted by local and recreational fishers, including reef and pelagic species of commercial and cultural value. Multiple hybrid and endemic coral-reef fish species occur nowhere else on Earth, a product of the islands' biogeographic position at the interface of the Indian and Pacific Ocean marine provinces, where species assemblages from both regions overlap and intermix. Documented hybrid and endemic species include the Cocos angelfish and lemonpeel angelfish hybrids. To date, six hybrid reef-fish varieties and two endemic species have been recorded (DNPAMP, 2025).

The Kolam (blue holes) represent ecologically significant habitats within the southern atoll lagoon. Distributed across sandy lagoonal substrates, these features are characterised by deeper, more structurally complex environments encircled by coral, often with coral rubble accumulations at their centres. They support a range of species including cucut (sharks), gong gong (spider conch), gelek burik (coral trout), dongol (bumphead parrotfish), and ikan hijau (humphead Māori wrasse) (DNPAMP, 2025). The cultural significance of the Kolam to the Cocos Malay community is discussed in Section 2.3 of this report.

3 Review of Coastal Hazards

The primary coastal hazards that the CHRMAP aims to address are erosion and inundation. Accurate calculation of both hazards is essential for sound assessment. Underestimating the hazards (or being unconservative) means that the future reality may be worse than anticipated, while overstating the hazards (or being conservative) means that the future reality may be better than anticipated. While being “conservative” may be seen as being safe, multiple conservative assumptions can compound to lead to unrealistic outcomes decisions being made on inaccurate information. The risk analysis should be as accurate as reasonably practical (neither conservative nor unconservative) so that the future risk can be understood as accurately as possible and decision-making can be based on the most relevant and accurate information.

The following sections examine whether the CHRMAP's erosion and inundation calculations meet this standard.

3.1 Erosion Risk

The CVA calculates erosion risk by summing three erosion allowance factors and an uncertainty factor:

- S1 is the allowance for the current risk of storm erosion;
- S2 is the allowance for historic shoreline movement trends extrapolated to the future;
- S3 is the allowance for erosion caused by future sea level rise; and
- An uncertainty factor, taken as a uniform 0.2m per year allowance.

The 100-year erosion allowances presented in both the CHRMAP documents (CHRMAP Table 12 p. 103) and calculated in the CVA Table 30 and Table 31 are shown in Figure 3-1 below. The negative S2 value for the West Island Scout Park/Kite Beach location reflects the natural deposition of sand at that location.

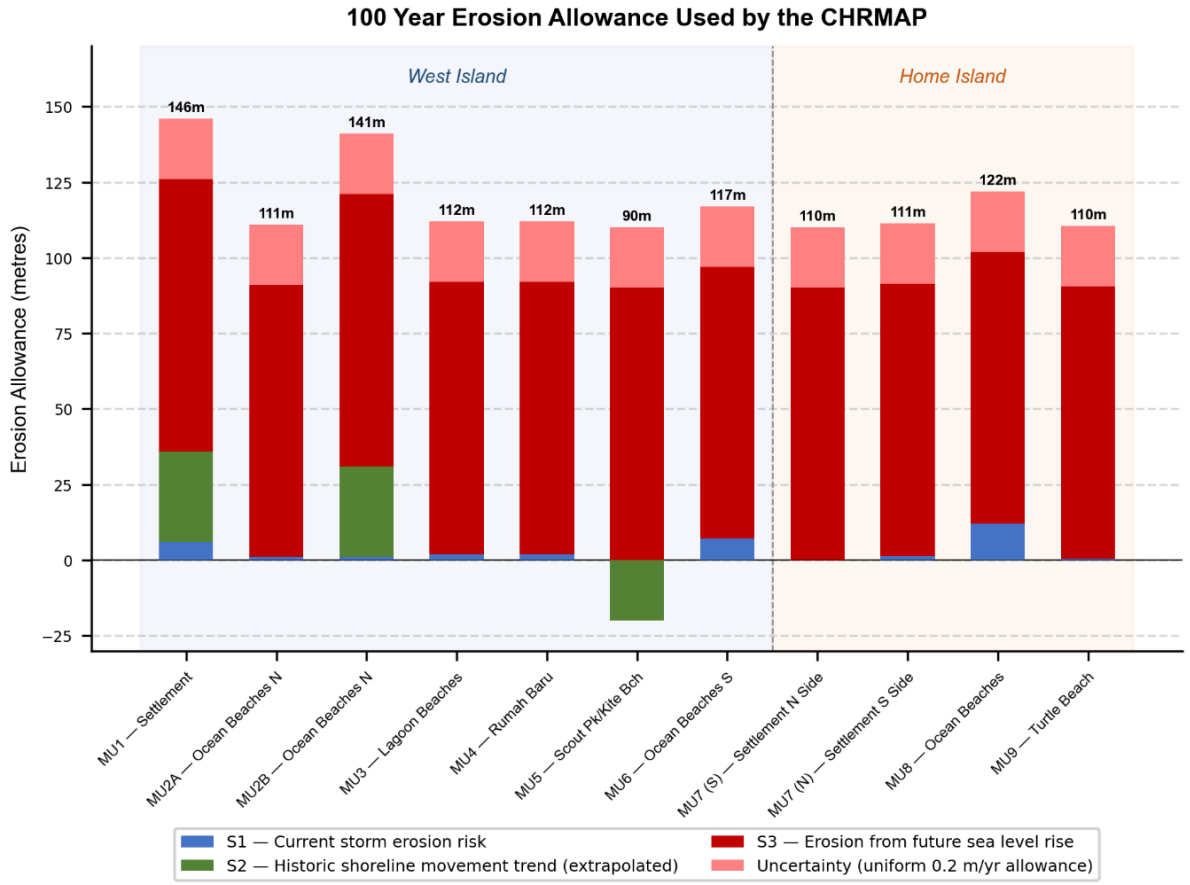

Figure 3-1: 100 Year Erosion Allowance Used by the CHRMAP

As shown in Figure 3-1, the erosion allowance used by the CHRMAP is dominated by two factors:

- The S3 allowance (erosion caused by future sea level rise) accounts for on average 78% of the erosion allowance used by the CHRMAP; and
- The uncertainty factor accounts for on average 17% of the erosion allowance used by the CHRMAP.

These two factors combined account for 96% of the erosion allowance used by the CHRMAP.

The S1 allowance (current risk of storm erosion) and S2 allowance (historic shoreline movement trends) account for an average of 2% each of the erosion allowance.

As shown below, both the S3 and uncertainty factors adopt a precautionary approach. The erosion hazard presented by the CHRMAP may therefore overstate future erosion risk relative to what the evidence supports. This is a matter that refined atoll-specific modelling could resolve.

3.1.1 S3 Erosion Allowance

The CVA is the technical basis for the CHRMAP. Page v of the CVA states:

> "A key limitation to this [erosion] mapping is the application of the S3 allowance for erosion due to sea level rise. While the application follows SPP 2.6, the approach [is] overly conservative and does not provide useful information for planning of island atolls."

As such, the CVA itself states that the erosion allowance used by the CHRMAP is overly conservative and does not provide useful information for planning purposes on CKI.

While the CVA applies SPP 2.6 Schedule 1 Section 4.4, Schedule 1 Section 4.9 in fact states:

> "4.9 Allowance for Erosion on Islands:
>
> Acknowledging that for most islands the allowance would preclude development, variation should be considered on a case-by-case basis."

The CVA applies SPP 2.6 Schedule 1 Section 4.4, which is for sandy coasts, instead of Section 4.9 for islands. S3 for sandy coasts is given as uniform 90m of erosion in a 100-year timeframe. As SPP 2.6 Schedule 1 Section 4.9 states, this method of calculating S3 is not suitable for use on islands.

3.1.2 Uncertainty Factor

The uncertainty factor (accounting for 17% of the total erosion allowance used by the CHRMAP) is also derived from SPP 2.6 Schedule 1 Section 4.4 Allowance for Erosion on Sandy Coasts. This section applies a uniform 0.2 m per year (20m in 100 years). As described above, Schedule 1 Section 4.9 states that erosion on islands should be considered on a case-by-case basis, and as such, Schedule 1 Section 4.4 is not applicable.

It should also be noted that the uncertainty factor in SPP 2.6 is inherently conservative as it assumes additional erosion beyond that otherwise calculated. Erosion values are equally likely to be less than calculated. As such, a more accurate approach would be a probability-based sensitivity analysis.

As noted in Section 3 above, accurate representation of erosion risk is essential for planning purposes. 96% of the erosion allowance comes from general allowances intended to be used for sandy beaches in Western Australia and not applied to coral atoll conditions without site-specific calibration. As the CVA states, the erosion allowance used by both CHRMAP documents is "overly conservative" and "does not provide useful information for planning purposes".

3.2 Inundation Risk

3.2.1 Overly Conservative Annual Exceedance Probability

Both CHRMAP documents use a conservative 0.2% Annual Exceedance Probability (AEP) storm event (equivalent to a 1-in-500-year ARI event to determine the inundation risk for CKI. This value has been used based on SPP 2.6 Schedule 1 Section 5, which as noted in Section 3.4 below, was developed conservatively for the mainland WA coastline.

The probability of a 1-in-500 ARI event occurring within various timeframes is:

- A 10% chance that the event will occur within 50 years;
- An 18% chance that the event will occur within 100 years (the planning horizon of the CHRMAP);
- A 33% chance that the event will occur within 200 years;
- A 45% chance that the event will occur within 300 years;
- A 55% chance that the event will occur within 400 years; and
- A 63% chance that the event will occur within 500 years.

As such, the CHRMAP inundation modelling is conservatively based on an event has an 18% chance of occurring within the CHRMAP's 100-year planning duration, and an event that will most likely not occur within the next 300 years.

The 1:500 ARI design event is not the standard benchmark for land use planning in Australian coastal hazard practice. Across Australian jurisdictions, the 1% AEP (1:100 ARI) event is the primary design event used to define hazard extents for planning and development controls:

- The Australian Institute for Disaster Resilience Handbook 7, Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIDR, 2017), defines the standard risk management framework using the 1% AEP (1:100 ARI) as the primary planning event. Higher ARI events (1:500) are used for emergency planning and assessment of critical infrastructure such as cyclone shelters or post-disaster hospitals, not for land use planning decisions;
- NSW Coastal Management SEPP 2018 applies the 1% AEP (1:100 ARI) storm event as the primary planning benchmark for coastal hazard mapping and development controls (NSW Government, 2018); and
- Queensland Coastal Protection and Management Act 1995 and associated guidelines similarly use the 1% AEP (1:100 ARI) for coastal hazard assessment and setback determination.

The Queensland Department of Environment and Heritage Protection document Coastal Hazard Technical Guide: Determining Coastal Hazard Areas (2013) provides further guidance, as summarised in Table 3-1 below.

Table 3-1: Queensland Recommended Storm-Tide Event Levels

Typical Usage	1% AEP	1:100 ARI
Emergency Service Facilities	0.2% AEP	1:500 ARI
Hospitals and Associated Facilities	0.2% AEP	1:500 ARI
Major Switch Yards and Substations	0.5% AEP	1:200 ARI
Police Facilities	0.5% AEP	1:200 ARI
Power Stations	0.2% AEP	1:500 ARI
Sewerage Treatment Plants	0.5% AEP	1:200 ARI
School Facilities	0.5% AEP	1:200 ARI
Stores of Valuable Records or Items of Historic or Cultural Significance (e.g. galleries and libraries)	0.5% AEP	1:200 ARI
Water Treatment Plants	0.5% AEP	1:200 ARI

The erosion assessment within the CHRMAP itself uses the 1% AEP (1:100 ARI) event, as stated in Section 3.2.3: "The coastal erosion hazards assessment has been completed for a 100-year ARI event in accordance with SPP 2.6 requirements (i.e. a 1% probability of occurring each year)" (CHRMAP, 2026). This creates an internal inconsistency within the CHRMAP's risk framework: erosion hazard is mapped to the 1:100 ARI event, while inundation hazard is mapped to the 1:500 ARI event. This is a fivefold difference in design probability.

The CHRMAP applies a 1:500 ARI inundation standard that is five times more conservative than the national benchmark and is inconsistent with the CVA erosion assessment.

3.2.2 Lack of Probabilistic Risk Based Approach

In Talis' view, a 1:100 ARI is conservative for typical planning purposes, with just a 50% chance the event would occur within 69 years, or a 63% chance it would occur within the next 100 years.

Given the unique situation of the CKI, Talis recommends a probabilistic risk-based approach to better quantify the inundation hazard on CKI. For example, subject to agreed criteria, the islands could be considered resilient to inundation if they are found to:

- Remain self-sufficient and largely unaffected during common storm events (1:2 ARI, or 50% chance of occurring within 1 year);
- Require some external assistance for less frequent events such as a 1:20 ARI (50% chance of occurring within 13 years); and
- Require significant external assistance for rare events such as a 1:100 ARI (50% chance of occurring in 69 years).

Modelling multiple scenarios and assessing their likelihood and consequences is necessary to accurately characterise the inundation risk. If the risk is found to be unacceptable, engineering controls should be considered to reduce the risk to an acceptable level.

3.3 CVA Recommendations Not Followed

The CVA also recommends that the limitations of SPP 2.6 be considered and states that misunderstanding the natural resilience of CKI will lead to maladaptation. As the further studies recommended by the CVA do not appear to have been completed, the CHRMAP may not fully account for the CVA's own qualifications and limitations.

> "SPP 2.6, section 4.9 states "Acknowledging that for most islands the allowance would preclude development, variation should be considered on a case-by-case basis." This will need to be further considered at later stages of the CHRMAP and should be based on the latest available science and understanding of the natural resilience of atolls and specifically the Cocos (Keeling) Islands. Misunderstanding of the natural resilience will lead to maladaptation and possibly to rendering the islands uninhabitable by the middle of this century."
>
> – CVA page 162.

> "This study [the CVA] has followed the requirements of SPP 2.6 in relation to applying the S3 allowance for erosion due to sea level rise. As per the discussion in Section 6.6.6, this is unlikely to be a useful way to characterise risk and vulnerability of an atoll. It is recommended that future stages consider a refined approach to determining S3."
>
> – CVA page 162.

> "As part of the CHRMAP process the next steps should include … Re-evaluate the need for a more suitable approach to the determination of S3 and considered the impact that would have on the vulnerability assessment presented herein."
>
> – CVA page 163.

The CHRMAP did not implement the CVA's recommendation to refine the S3 approach for atoll conditions. The CVA stated explicitly that misunderstanding the natural resilience of atolls will lead to maladaptation. The further investigations identified in the CVA, particularly a refined approach to S3, remain outstanding and represent a priority for future CHRMAP review work.

3.4 Applicability and Suitability of State Planning Policy 2.6

In addition to the application of SPP 2.6 methodology discussed in Sections 3 and 3.2 above, the applicability of SPP 2.6 to the CKI is not established.

As noted in SPP 2.6 Section 3, "This Policy applies to the coast throughout Western Australia, including… all islands within the state lying seawards of the mainland." As the CKI are not "within the state", SPP 2.6 is not applicable. This is also illustrated by SPP 2.6 Figure 1 (reproduced in Figure 3-2 below), which does not include the CKI (located at 96°E) on the figure defining coastal areas. As such, it appears that SPP 2.6 was not produced while considering the Cocos (Keeling) Islands and may not be suitable for this location.

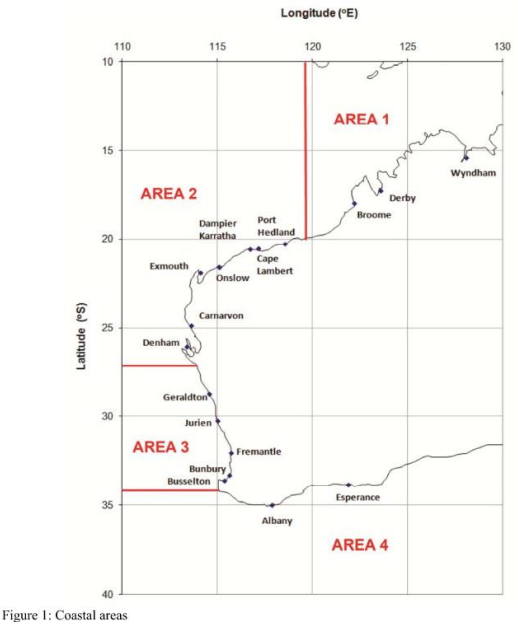

Figure 1: Coastal areas

Figure 3-2: Coastal Areas as defined by SPP 2.6

The CHRMAP notes this limitation on page 71, stating:

> "However, the inability of SPP 2.6 to account specifically for atoll biomorphology on CKI, and in particular to predict future robustness of coral growth, is a gap in knowledge on CKI that is recognised in this study."

Although this limitation is recognised in the CHRMAP, it is not accounted for in the CHRMAP's methodology. The S3 erosion allowance and the following risk assessment, MCA pre-screening, and the adaptation hierarchy are all applied without adjustment for atoll conditions.

As noted in SPP 2.6 Section 5.5 and in Section 5.1 of the CHRMAP, a hierarchy of recommendations is adopted prior to any analysis of the location, with Avoid and Retreat being preferred over Accommodate and Protect, with the CHRMAP stating "with the CHRMAP guidelines indicating a clear preference against the adoption of Protect as a long-term adaptation pathway.". The Avoid and Retreat options are illustrated in the WAPC Guidelines, with an example reproduced in Figure 3-3

below. While this approach is reasonable on mainland Australia where retreating means moving a short distance, the same cannot apply in the same way to the CKI where the long-term recommendation of "retreat away from the islands" means moving residents thousands of kilometres.

Figure 5: Illustrates a typical foreshore reserve on a sandy coast

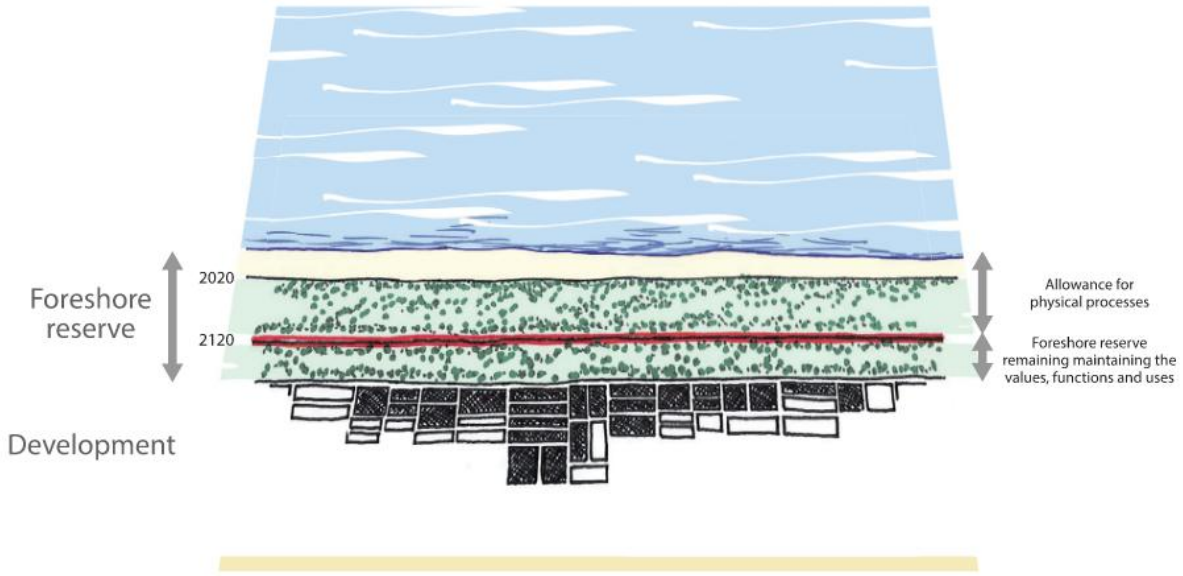

Figure 3-3: An Example Coastal Buffer Showing Retreat or Avoid Options on Mainland Western Australia as per the WAPC State Coastal Planning Policy Guidelines (2020)

SPP 2.6 Schedule 1 Section 4.9 states that the intent of SPP 2.6 is not to prevent development on islands but to recognise that unique locations such as the CKI should be considered on a case-by-case basis. Given the cultural and strategic importance of the CKI, each option should be considered on its merits without the prior assumption that Avoid and Retreat are the preferred options.

The CHRMAP is required to apply SPP 2.6 and has done so. The concern raised here is not that the CHRMAP has failed to follow SPP 2.6, but that SPP 2.6 itself may not be the appropriate planning instrument for a coral atoll environment. Future review of the CHRMAP should consider whether a more appropriate framework, developed specifically for island and atoll territories, should be adopted.

Key Findings — Coastal Hazards

- The erosion model applies mainland sandy coast formulas that have not been calibrated for coral atoll conditions. The 100-year erosion allowance is likely overstated as a result. Atoll-specific modelling is the first investigation required before any long-term planning decision is made.
- The inundation benchmark (1:500 ARI) is more conservative than AIDR and interstate planning standards (1:100 ARI). This is not consistent with the erosion benchmark (1:100 ARI), creating an internal inconsistency in the hazard framework.

4 Review of Risk and Vulnerability Assessment

The CVA and CHRMAP assess coastal risk and vulnerability using a qualitative process as summarised in Figure 4-1. This process is informed by, but does not strictly follow, the Western Australian Coastal Hazard Risk Management and Adaptation Planning Guidelines (The Government of Western Australia, 2022).

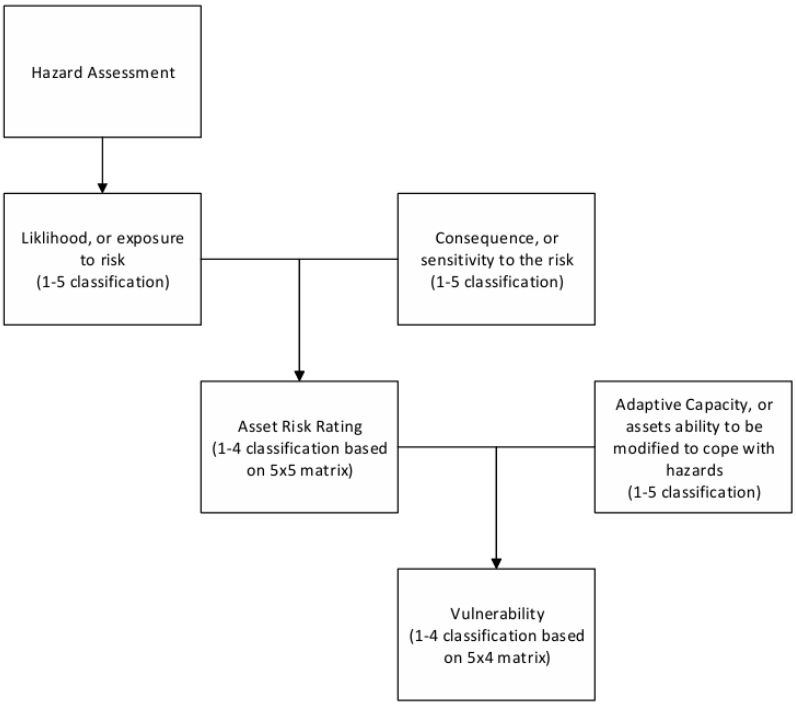

Figure 4-1: Summary of the Vulnerability Assessment Process

4.1 Hazard Assessment

As noted in Section 3 above, the hazard assessment underpinning the CHRMAP is overly conservative. In particular, the CVA states (page v) that the S3 erosion allowance "… does not provide useful information for planning of island atolls."

This overly conservative assessment is the basis of the risk ratings and vulnerability assessment, which as shown below, leads to overly conservative results throughout the entire process.

4.2 Likelihood

The likelihood ratings as used by the CVA are shown in Table 4-1 below. These likelihood criteria do not align with the WAPC guidelines (Table 4-2) or the National Emergency Risk Assessment Guidelines (Australian Institute for Disaster Resilience (AIDR), 2020)(Table 4-3).

Table 4-1: Likelihood Criteria as per the CVA

Table 34: Adopted likelihood rating for risk assessment (source: WAPC, 2019).

Likelihood rating		Planning period		
		2018	2068	2118
Hazard line	2018	Possible	Likely	Very likely
	2068	Unlikely	Possible	Likely
	2118	Rare	Unlikely	Possible

Table 4-2: WAPC Time Dependent Likelihood Scale (WAPC p. 47)

Table 5: Example of timeframe dependant likelihood (Exposure) scale

	Rating	Almost certain	Likely	Possible	Unlikely	Rare
	Likelihood (Exposure)	It is likely that the hazard will impact the asset during the timeframe	It is moderately likely that the hazard will impact the asset during the timeframe	It is likely as not that the hazard will impact the asset during the timeframe	It is moderately unlikely that the hazard will impact the asset during the timeframe	It is unlikely that the hazard will impact the asset during the timeframe
100-year timeframe	Occurring Probability	82-100%	63-82%	37-63%	18-37%	<18%
	Average Recurrence Interval	less than 60 years	60-100 year	100-220 years	220-500 years	more than 500 years
10-year timeframe	Occurring Probability	90-100%	63-90%	25-63%	10-25%	<10%
	Average Recurrence Interval	less than 4.5 years	4.5-10 years	10-35 years	35-100 year	more than 100 years
1-year timeframe	Occurring Probability	95-100%	63-95%	20-63%	5-20%	<5%
	Average Recurrence Interval	Less than 0.3 year	0.3 -1 year	1-5 years	5-20 years	more than 20 years

Table 4-3: Likelihood Levels as Defined by the National Emergency Risk Assessment Guidelines

Likelihood	Annual Exceedance Probability (AEP)	Average Recurrence Interval (ARI) (Indicative)	Frequency (Indicative)
Almost Certain	63% per year or more	Less than 1 year	Once or more per year
Likely	10% to <63% per year	1 to <10 years	Once per 10 years
Unlikely	1% to 10% per year	10 to <100 years	Once per 100 years
Rare	0.1% to <1% per year	100 to <1000 years	Once per 1000 years
Very Rare	0.01% to <0.1% per year	1000 to <10,000 years	Once per 10,000 years
Extremely Rare	Less than 0.01% per year	10,000 years or more	Once per 100,000 years

For example, as shown in CVA Map 1, parts of the Home Island residential area would be inundated for the 1-in-500 design event if it were to occur in 2018.

- As per the CVA likelihood criteria (Table 4-1), those areas of Home Island would have a "Possible" likelihood classification for the 2018 planning period;
- Under the WAPC likelihood criteria (Table 4-2), a 1-in-500-year design event is considered to be "Rare" if it occurs during any of the 1-year, 10-year, or 100-year timeframes; and

- Under the National Emergency Risk Assessment Guidelines (Table 4-3), the 1-in-500-year inundation event would have a “Rare” likelihood level.

While the WAPC and National Emergency Risk Assessment Guidelines recommend modelling design events with different likelihood of occurring to better understand the risk, the CVA and CHRMAP risk assessment only models a 1-in-500-year inundation event and a 1-in-100 ARI erosion event for the three timeframes and then uses these single events to infer the likelihood.

As discussed in Section 3.2.2 and shown by the WAPC guidelines and National Emergency Risk Assessment Guidelines above, the correct way to assess likelihood is to model a range of ARI events to determine the quantitative probability that the asset is affected by the design event in any given year. This approach produced quantitative outputs suited to further analysis and aligns with the WAPC guidelines and National Emergency Risk Assessment Guidelines.

The CVA and CHRMAP apply conservative assumptions at both the hazard assessment and likelihood stages. This compounding conservatism produces final risk ratings that are very conservative.

CHRMAP Section 4.1 states that an AEP-based probability scale was adopted as shown in Table 4-4 below. This appears inconsistent with the CVA, which only modelled 0.5% AEP inundation events (“Rare” as per the CHRMAP’s rating description) and overly conservative 1% AEP erosion events (“Unlikely” as per the CHRMAP’s rating description). The likelihood ratings used in the CHRMAP are only based on Table 4-1, not Table 4-4.

Table 4-4: CHRMAP Likelihood Rating Descriptions

Table 15: Exposure/Likelihood rating description for erosion and inundation

LIKELIHOOD RATING	DESCRIPTION	ANNUAL EXCEEDANCE PROBABILITY
Almost Certain	Expected to occur in most circumstances	>90%
Likely	Impact to asset for a given planning timeframe is likely	50-90%
Possible	Impact to asset for a given planning timeframe is possible	10-50%
Unlikely	Impact to asset for a given planning timeframe is unlikely	1-10%
Rare	May occur in exceptional circumstances	<1%

4.3 Consequence

The CVA considers three criteria for consequence assessment as shown in Table 4-5 below, while the final CHRMAP adopts four criteria in Table 17 (p.129). Neither fully aligns with the WAPC guidelines, which also consider Infrastructure and Safety consequences as distinct categories.

Table 4-5: Consequence Ratings as per CVA Table 37

Table 37: Consequence scale for each impact category (after WAPC, 2019).

Rating	Environment (including heritage)	Social	Economic
Insignificant	Minimal damage to local environmental assets; recovery may take less than six months	Minimal short-term inconveniences to services, employment, wellbeing, finances or culture (e.g. < 5% of community affected), neighbourhood loss, many alternative sites exist.	Permanent loss or damage to property, plant and equipment, finances < $10,000, or 2% of annual operating budget.
Minor	Environmental damage to local environmental asset that could be reversed or offset, local alternate habitat exists.	Small to medium disruption to services, employment wellbeing, finances or culture (e.g. < 10% of community affected), local loss, many suitable alternative sites exist.	Permanent loss or damage to property, plant and equipment, finances > $10,000 - $100,000, or 2 - 5% of annual operating budget.
Moderate	Environmental damage to local environmental asset that could be reversed or offset, no alternate habitats exist.	Minor injury. Major short-term or minor long-term disruption to services, employment wellbeing, finances or culture (e.g. < 25% of community affected), regional loss, limited suitable alternative sites exist.	Permanent loss or damage to property, plant and equipment, finances > $100,000 - $2 million, or 5 - 10% of annual operating budget.
Major	Irreversible damage to local environmental asset that would compromise its viability, local alternate habitat exists.	Serious injury. Medium term disruption to services, employment wellbeing, finances or culture (e.g. < 50% of community affected), national loss, very limited suitable alternative sites exist.	Permanent loss or damage to property, plant and equipment, finances > $2 - $5 million, or 10 - 20% of annual operating budget.
Catastrophic	Irreversible damage to local environmental asset that would compromise its viability, no alternate habitats exist.	Loss of life and serious injury. Large long-term or permanent loss of services, employment wellbeing, finances or culture (e.g. > 75% of community affected), international loss, no suitable alternative sites exist.	Permanent loss or damage to property, plant and equipment, finances > $5 million, or > 20% of annual operating budget.

It should also be noted that the consequences defined in the CVA do not align with the consequences used in the CHRMAP (CHRMAP p. 128). This discrepancy between the CHRMAP and its underlying technical basis is a methodological inconsistency that should be resolved.

While many of the consequence ratings in the CVA match the WAPC example ratings, there are some exceptions as shown in Table 4-6.

Table 4-6: Comparison of CVA & CHRMAP Consequences to WAPC Guidelines Consequences

Asset & Coastal Hazard	CVA Consequence	CHRMAP Consequence	WAPC Guidelines Consequence	Comments
Foreshore Amenity (Erosion)	Moderate	Major	Moderate	As noted in the WAPC: "These areas will remain functional even if reduced in size by erosion. They also serve as a buffer to allow roll back and therefore retention of the beach amenity. There may be some financial and social costs associated with specific facilities within foreshore reserves (e.g. BBQs, shelters, paths, etc) that make impacts of greater consequence to community.
Existing Residences (Erosion)	Major	Major	Moderate	While the CVA is correct that replacing houses on CKI is expensive, replacing houses in mainland coastal areas is also expensive. The CVA also states that "losses in relation to erosion are irreversible". Beach nourishment and land reclamation demonstrate that such losses can be reversed.
Existing Residences (Inundation)	Major	Major	Moderate	As noted in the WAPC: "For the public, other community assets would be rated more highly. For the individual owner, this asset is of very high importance. The economic impact from inundation of private residential property could potentially be substantial. However, damages are repairable."
Hospitals (Inundation)	Catastrophic	Catastrophic	Major	As noted in the WAPC: "Such facilities are socially vital, while the building is typically highly financially costly to build and fit out, making relocation of the physical asset difficult. During periodic inundation events, damages or loss of services from this asset is of

Asset & Coastal Hazard	CVA Consequence	CHRMAP Consequence	WAPC Guidelines Consequence	Comments
				significant impact to the community."
School, Club House, Mosque/Church (Erosion)	Major	Catastrophic	Moderate	As noted in the WAPC, "Such facilities are highly important to the community; however, the grounds and buildings can be relocated / replaced."
School, Club House, Mosque/Church (Inundation)	Catastrophic	Catastrophic	Moderate	As noted in the WAPC, "Such facilities are highly important to the community; however, the grounds and buildings can be relocated / replaced."
Roads, Boat Ramps (Erosion)	Major	Major	Minor	As noted in the WAPC on roads: "The permanent loss of local roads is of lesser importance to the functioning of the greater community." As noted in the WAPC on boat ramps and recreational maritime structures: "These features typically service few community members, compared with other transport infrastructure (and they can be raised or relocated easily)."
Roads (Inundation)	Major	Major	Moderate	As noted in the WAPC: "Inundation across major traffic routes may have impacts upon the safety and access for the community particularly during storms where access is important."
Boat Ramps (Inundation)	Major	Major	Minor	As noted in the WAPC on boat ramps and recreational maritime structures: "These features typically service few community members, compared with other transport infrastructure (and they can be raised or relocated easily)."

As shown, the consequence ratings in the CVA and CHRMAP are more conservative than those in the WAPC guidelines.

4.4 Asset Risk Rating

The asset risk rating used by the CVA and CHRMAP (Table 4-7) differs from that recommended by the WAPC Guidelines (Table 4-8). No justification is provided for this departure from the WAPC guidelines.

Table 4-7: Asset Risk Rating as per CVA Table 40 and CHRMAP Table 19

Table 40: Risk matrix adopted to assess asset vulnerability.

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	L	M	H	E	E
Likely	L	M	M	H	E
Possible	L	L	M	H	E
Unlikely	L	L	M	M	H
Rare	L	L	L	M	M

L= low, M=medium, H=high and E=extreme

Table 4-8: WAPC Guidelines Risk Level Matrix (Reordered to match the CHRMAP table)

		Consequences				
		Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood	Almost Certain	High	High	Extreme	Extreme	Extreme
	Likely	Medium	High	High	Extreme	Extreme
	Possible	Low	Medium	High	Extreme	Extreme
	Unlikely	Low	Low	Medium	High	Extreme
	Rare	Low	Low	Medium	High	High

The risk definitions used by the CHRMAP (Table 4-9) also differ from those used by the WAPC guidelines (Table 4-10) with no stated justification. The WAPC guidelines classify any risk below Extreme is considered to be Tolerable or Acceptable.

Table 4-9: CHRMAP Risk Level Definition

Table 20: Risk Level definition

RISK LEVEL (POTENTIAL IMPACT)	DESCRIPTION
Low	Acceptable risk. A level of risk that is low and manageable without intervention outside routine asset maintenance.
Medium	A level of risk that may require intervention to mitigate, such as changes to design standards or asset maintenance. Short to medium term action required.
High	A level of risk requiring significant intervention to mitigate in the immediate to short term.
Extreme	Immediate action required to reduce risk to acceptable levels

Table 4-10: WAPC Guidelines Risk Level Definition

Table 8: Example of a risk tolerance scale

Risk level	Action required	Acceptance/tolerance
Extreme	Immediate action required to eliminate or reduce risk to acceptable levels	Intolerable
High	Immediate to short-term action required to eliminate or reduce risk to acceptable levels	Tolerable
Medium	Short to medium term action to reduce risk to acceptable levels, or accept risk	Tolerable/Acceptable
Low	Accept risk	Acceptable

(Adapted from BMT WBM 2017)

The CHRMAP also notes that High risks require “significant intervention”, whereas no such distinction is used in the WAPC. This presupposes the level of complexity of the response required.

Using the example of the inundation of residential housing on Home Island, the cumulative differences between the CHRMAP and CVA risk ratings and WAPC guidelines can be demonstrated.

Table 4-11: Comparison between Risk Methodologies for the Inundation for Home Island Residences in 2018

Item	CHRMAP & CVA	WAPC
Likelihood based on the modelled 1-in-500-year design event	Possible	Rare
Consequence	Major	Moderate
Asset Risk Rating	High	Medium based on WAPC table
		Low based on CHRMAP table
Risk Level Description	"A level of risk requiring significant intervention to mitigate in the immediate to short term"	Based on the more onerous WAPC rating: Description: "Short to medium term action to reduce risk to acceptable levels, or accept risk" Acceptance: "Tolerable/Acceptable"

Note that in the WAPC Asset Risk Rating, the Medium risk is based on the WAPC risk matrix (Table 4-8) while the Low risk is based on the CHRMAP risk matrix (Table 4-7).

The final CHRMAP indicates that, prior to consideration of adaptive capacity, the CHRMAP and CVA assess the 2018 inundation risk to residences on Home Island as high and requiring significant intervention. In comparison, application of the WAPC framework classifies the same level of risk as medium, suggesting that it may be mitigated to acceptable levels or, in some cases, considered tolerable or acceptable. This discrepancy should be considered and addressed within the document.

4.5 Adaptive Capacity

The adaptive capacity definition in the CVA (Table 4-12) matches the WAPC guidelines, however, the CHRMAP definitions (Table 4-13) differ from those in the CVA and WAPC even though the CHRMAP claims this scale has been adopted from the CVA and WAPC. As shown, the CHRMAP has changed the wording used by the CVA and WAPC and removed the "No Adaptation Required" category. In doing so, the CHRMAP relies on the CVA for technical credibility while modifying the definitions and outcomes of the CVA analysis.

Table 4-12: CVA Adaptive Capacity Scale (which matches the WAPC guidelines)

Table 43: Adaptive capacity scale adopted for the CKI vulnerability assessment.

Adaptive capacity scale	Description
No adaptation required	Potential impact has insignificant effect on asset. Controls are re-established naturally or with ease before more damage would likely occur.
Very high	Good adaptive capacity. Functionality restored easily. Adaptive systems restored at a relatively low cost or naturally over time.
High	Decent adaptive capacity. Functionality can be restored, although additional adaptive measures should still be considered. Natural adaptive capacity restored slowly over time under average conditions.
Moderate	Small amount of adaptive capacity. Difficult but possible to restore functionality through repair and redesign.
Low	Little or no adaptive capacity. Potential impact would destroy all functionality. Redesign required.

Table 4-13: CHRMAP Adaptive Capacity Scale

Table 21: Adaptive capacity scale

ADAPTIVE CAPACITY	DESCRIPTION
Very High (can adapt easily)	Impact of coastal hazard will cause minimal or no reduction in asset's function or performance
High (can adapt)	Impact of coastal hazard will cause short-term or localised reduction in asset's function or performance. Minor modifications may be required but could be undertaken as part of routine maintenance. Early renewal of 10-20% of infrastructure may be required.
Moderate (may adapt)	Impact of coastal hazard will cause medium-term or moderate reduction in asset's function or performance. Minor modifications will be required. Early renewal of 20-50% of infrastructure may be required.
Low (difficulty adapting)	Impact of coastal hazard will cause long-term or significant reduction in asset's function or performance. Major modifications will be required. Early renewal of 50-90% of infrastructure may be required.
Very Low (challenging to adapt)	Impact of coastal hazard will cause complete loss of asset's function or performance. Asset will require redesign, rebuilding and/or relocating. Early renewal of more than 90% of infrastructure may be required.

4.6 Vulnerability

The vulnerability matrices used by the CHRMAP (Table 4-14) and CVA (Table 4-15) differ as shown below, with the CHRMAP matrix more closely aligned with the WAPC matrix.

Table 4-14: CHRMAP Vulnerability Matrix

Table 22: Vulnerability matrix

RISK LEVEL (POTENTIAL IMPACT)	ADAPTIVE CAPACITY				
	Very High Can adapt easily	High Can adapt	Moderate May adapt	Low Difficulty adapting	Very Low Challenging to adapt
Low	Low	Low	Low	Medium	High
Medium	Low	Low	Medium	High	Very High
High	Low	Medium	High	Very High	Very High
Extreme	Medium	High	Very High	Very High	Very High

Table 4-15: CVA Vulnerability Matrix

Table 45: Coastal vulnerability matrix adopted for the Cocos (Keeling) Islands assessment.

Adaptive capacity	Risk rating			
	Low	Moderate	High	Extreme
Low	M	H	E	E
Moderate	L	M	H	E
High	L	L	M	H
Very high	L	L	L	M
No adaptation required	L	L	L	M

L= low, M=medium, H=high and E=extreme

Although the CHRMAP matrix is better aligned with the WAPC matrix, the CHRMAP (Table 4-16) has used different definitions from the WAPC (Table 4-17) and CVA (Figure 4-2). Whereas the CHRMAP defines a high vulnerability asset as requiring urgent action, the WAPC defines the same high rating as tolerable. Similar to the change in the definition of risk as discussed in Section 4.4 above, this change in definition materially changes the outcome of the qualitative vulnerability assessment.

While both the final CHRMAP (p. 130) and the CVA (p. 152) claim to follow the WAPC's vulnerability assessment methodology, as shown below, neither does so without modifications that affect the outcome of the qualitative analysis.

Table 4-16: CHRMAP Vulnerability Level Definitions

Table 23: Vulnerability tolerance scale

VULNERABILITY LEVEL	PRIORITISATION	TOLERANCE LEVEL
Low	Asset has high resilience, it is able to cope with the impacts of coastal hazards without additional support. No immediate action required. Likely to be adequately managed by routine procedures.	Acceptable
Medium	Asset has some ability to cope with the impacts of coastal hazards. However short to medium term actions are likely to be required to reduce risk to acceptable levels. Observing, assessing and improving current controls and procedures is likely to be required.	Monitor
High	Asset has limited ability to cope with the impacts of coastal hazards. Immediate to short-term adaptation is likely to be required to reduce risk to acceptable levels. Establishment and implementation of controls is likely to be required.	Urgent action is required
Very High	Asset has minimal ability to cope with the impacts of coastal hazards without additional support. Adaptation will need to be considered as a priority. Establishment and implementation of controls is likely to be required.	Unacceptable

Table 4-17: WAPC Vulnerability Level Definitions

Table 13: Example of a vulnerability tolerance scale

Risk level	Action required	Acceptance/tolerance
Very High (VH)	Asset has minimal ability to cope with the impacts of coastal hazards without additional support. Adaptation will need to be considered as a priority.	Intolerable
High (H)	Asset has limited ability to cope with the impacts of coastal hazards. Immediate to short-term adaptation is likely to be required to reduce risk to acceptable levels.	Tolerable
Medium (M)	Asset has some ability to cope with the impacts of coastal hazards. However short to medium term actions are likely to be required to reduce risk to acceptable levels.	Tolerable/Acceptable
Low (L)	Asset has high resilience; it is able to cope with the impacts of coastal hazards without additional support. No immediate action required.	Acceptable

(Adapted from Evocoast 2017)

Figure 4-2: CVA Vulnerability Level Definitions

- Extreme – Asset has minimal to no ability to adapt to impacts of coastal hazards without additional support. Significant further adaptation required to ensure asset not lost. Reconsideration of design required if vulnerability cannot be reduced. Risk management measures will need to be a priority.
- High – Asset has limited ability to adapt to impacts of coastal hazards. Immediate to short-term risk management measures required.
- Medium – Asset has some ability to adapt to impacts of coastal hazards. Short-term to medium-term risk management measures required.
- Low – Asset has high resilience and can adapt to impacts of coastal hazards without additional support. No immediate risk management measures required other than monitoring.

4.6.1 Worked Example

Continuing with the example of the inundation of residential housing on Home Island, the differences in vulnerability ratings between the final CHRMAP, CVA and WAPC guidelines are shown in the following comparison.

Table 4-18: Comparison between Vulnerability Methodologies for the Inundation for Home Island Residences in 2018

Item	CHRMAP	CVA	WAPC
Asset Risk Rating	High	High	Medium
Adaptive Capacity	Low	Low	Low
Vulnerability Rating	Very High	Extreme	High
Vulnerability Rating Description	"Asset has minimal ability to cope with the impacts of coastal hazards without additional support. Adaptation will need to be considered as a priority. Establishment and implementation controls is likely to be required."	"Asset has minimal to no ability to adapt to impacts of coastal hazards without additional support. Significant further adaptation required to ensure asset not lost. Reconsideration of design required if vulnerability cannot be reduced. Risk management measures will need to be a priority."	"Asset has limited ability to cope with impacts of coastal hazards. Immediate to short-term adaptation is likely to be required to reduce risk to acceptable levels."
Tolerance Level	**Unacceptable**	None provided	**Tolerable**

The differences in Table 4-18 show that the same design event produces an unacceptable rating under the final CHRMAP and a tolerable rating under the WAPC approach. While the CHRMAP states that the immediate risk of inundation of Home Island residences is unacceptable based on the CVA's conservative 1-in-500-year design event, applying the WAPC methodology produces a tolerable rating even when the same conservative 1-in-500-year design event is used. As with other discrepancies between methodologies, a review and assessment should be conducted and summarised within the document.

4.7 Risk and Vulnerability Assessment Summary

The risk and vulnerability assessment adds conservatism at each stage.

- The hazard assessment uses erosion allowances that the CVA describes as overly conservative and not suitable for atoll planning;
- The likelihood criteria are more conservative than both the WAPC guidelines and the National Emergency Risk Assessment Guidelines, classifying low-probability events as more likely than established frameworks would;
- The consequence ratings exceed the WAPC benchmark for most asset categories;
- The risk matrix and vulnerability definitions have been modified from the WAPC guidelines in ways that produce higher risk and vulnerability ratings without explanation; and
- The adaptive capacity scale removes the "No Adaptation Required" category present in both the CVA and WAPC, skewing results toward intervention.

Applied in sequence, these decisions produce an assessment that adopts a precautionary approach at each stage, with the result that risk ratings are more conservative than the WAPC guidelines would produce. The practical consequence is that assets that the WAPC framework would classify as tolerable or medium risk are rated in the CHRMAP as unacceptable or of extreme vulnerability requiring urgent action. The assessment does not acknowledge this divergence from the WAPC framework or explain why a more conservative approach is warranted for the CKI specifically. Until the hazard assessment, likelihood criteria, consequence ratings, and vulnerability definitions are reconciled with the WAPC guidelines, the risk and vulnerability ratings in the CHRMAP should be treated with caution when informing adaptation decisions. This reconciliation is recommended as a priority action in the next CHRMAP review.

Key Findings — Risk and Vulnerability Assessment

- The risk framework departs from WAPC guidelines at four stages: likelihood criteria, consequence ratings, risk matrix, and vulnerability definitions. Each departure increases the risk rating beyond what the guidelines would produce. The departures are not documented or justified in the CHRMAP.
- Until the risk framework is reconciled with the WAPC guidelines, the risk ratings should be treated with caution when informing adaptation decisions. Reconciliation is recommended as a priority action in the next CHRMAP review.

5 Review of Risk Treatment Options

5.1 Multi-Criteria Analysis

5.1.1 Gaps in the Multi-Criteria Analysis

MCA Only Considers Short-Term Timeframe

The MCA in Appendix E of both CHRMAP documents evaluates only short-term adaptation options for Home Island and West Island. Medium-term and long-term options are not scored or compared in the MCA at any point. The CHRMAP identified managed retreat as the long-term pathway for Home Island, but this was never subjected to MCA scoring against the other options. Without a complete and comparative MCA across all planning horizons, there is no documented basis for concluding that the recommended short-term protect pathway is compatible with the medium and long-term pathways identified elsewhere in the CHRMAP.

Legal and Political Dimensions Not Considered in the MCA Criteria

The MCA uses eight criteria:

- Implementation;
- Environmental Impact;
- Social Impact (Property);
- Social Impact (Way of Life);
- Economic Impact;
- Flexibility;
- Effectiveness; and
- Financial.

None of these criteria appear to capture political feasibility, Commonwealth obligations, or legal constraints at either the Local, State or Commonwealth level.

Cultural Heritage Not Considered in MCA Criteria

The Cocos Malay community's connection to Home Island is also a cultural heritage matter, not just a "way of life" consideration. As defined under Section 5 of the Western Australian Heritage Act 2018, cultural heritage significance refers to aesthetic, historic, scientific, social or spiritual value for individuals or groups. Cultural heritage criteria typically assess irreversibility of loss, significance to identity, and connection to place. These are distinct from the Social Impact (Way of Life) criterion, which addresses day-to-day disruption to lifestyle. An option that physically removes the community from Home Island scores very differently under a cultural heritage criterion than under a general social impact criterion.

Strategic Value Not Considered in MCA Criteria

The location of the CKI is strategically significant in the eastern Indian Ocean. The West Island airport operates as a RAAF facility supporting maritime surveillance and patrol operations, and the islands are located near shipping lanes connecting the Indian Ocean to the Pacific (Figure 5-1). The Commonwealth has invested in defence infrastructure on the islands on this basis. No MCA criterion assesses whether an adaptation option maintains or compromises this strategic utility. An option that reduces the habitability of West Island, or that defers protection of the airport precinct, carries a strategic cost that is not captured in any of the eight criteria. Conversely, options that protect critical infrastructure and maintain year-round operational access provide a strategic benefit that the MCA

does not credit. The omission means the MCA is evaluating adaptation options for what is, in part, a strategic Commonwealth asset using criteria designed for a standard residential coastal settlement.

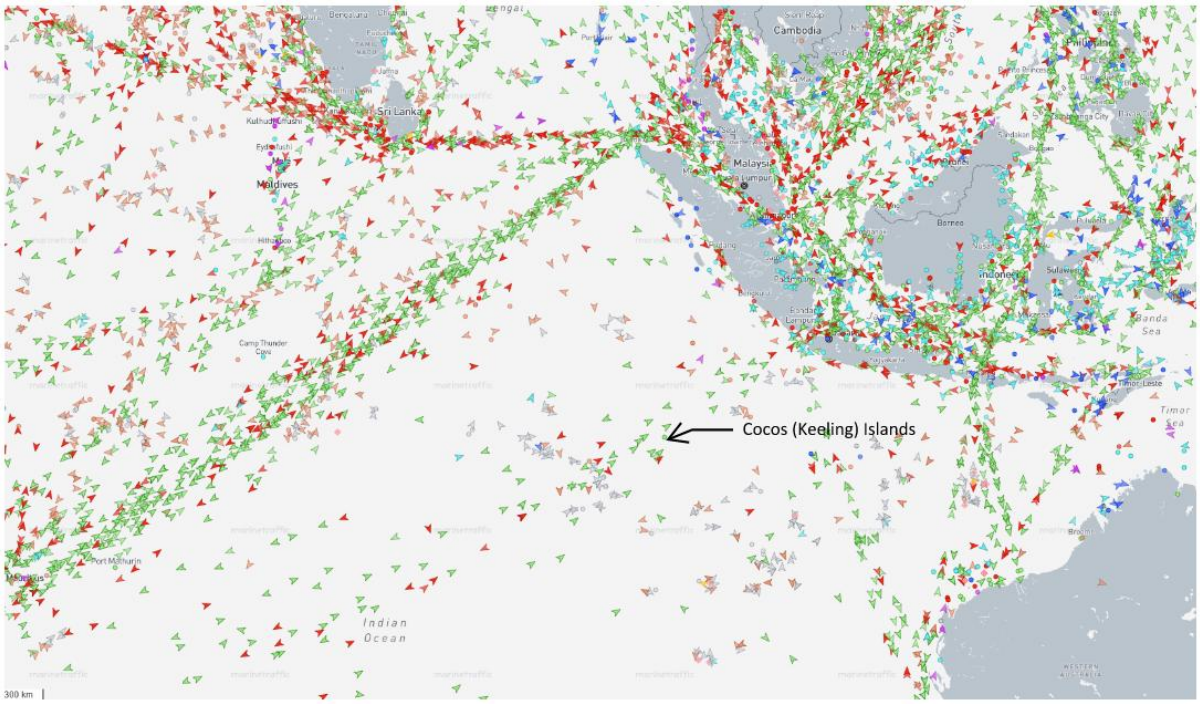

Figure 5-1: Location of the Cocos (Keeling) Islands in Relation to Shipping Lanes [Source: Marine Traffic.com]

5.1.2 Pre-Screening

P1 Large Beach Nourishment Campaign Excluded During Erosion Pre-Screening

Option P1, a large-scale beach nourishment campaign, is excluded at the pre-screening stage on the grounds that it would smother nearshore coral reefs (CHRMAP Appendix E). No site-specific analysis supports this conclusion. The pre-screening does not identify which reef areas would be affected, what volume of material would need to be placed in proximity to reef habitat, or whether the placement locations proposed for nourishment would interact with the reef at all. The assertion is unqualified and applied without reference to the actual coastal geometry of West Island or Home Island.

Beyond the lack of justification, the pre-screening process is not the correct stage at which to resolve this question. Pre-screening is designed to remove options that are technically incapable of addressing the hazard. P1 is rated as effective at countering erosion in the same pre-screening table. An option that is technically capable but carries environmental risk should be taken to the scoring stage so the trade-off can be considered. The Environmental Impact criterion exists to capture this trade-off. Excluding P1 at pre-screening on environmental grounds removes it from comparison before the MCA can assess whether its environmental cost is outweighed by its technical performance, and before any site-specific investigation has established what the environmental impact is.

As shown in Section 10 of this report, large-scale sandscaping projects distribute sediment through natural coastal processes rather than direct placement at the target beach. International experience from projects including the Dutch Sand Motor (Section 10.3) and the Bacton to Walcott Sandscaping Scheme (Section 10.4) indicates that this approach produces less direct disturbance to nearshore habitat than conventional nourishment. Ruling out P1 at pre-screening without distinguishing between direct placement nourishment and offshore sandscaping variants conflates two approaches with materially different environmental profiles. The pre-screening conclusion that beach nourishment will smother nearshore coral reefs does not address whether a sandscaping approach,

placed at a distance from reef habitat and reliant on wave energy to redistribute sediment, would carry the same risk.

P3 & P4 Offshore Structures and P5 Groynes Excluded During Erosion Pre-Screening

Options P3 and P4 (offshore structures) and P5 (groynes) are also excluded at the pre-screening stage on the grounds that they are not effective at countering cross-shore erosion (CHRMAP Appendix E). This reasoning would benefit from being revisited. Groynes and offshore structures are designed to interrupt longshore sediment transport as they retain sediment that would otherwise be carried along the shoreline by wave-driven currents, and they are not intended to address cross-shore profile changes driven by normal wave action. The relevant question is not whether groynes address cross-shore erosion, but whether the dominant erosion mechanism at the Cocos Islands is cross-shore or longshore.

Section 6.6.4 of the CVA identifies longshore sediment transport as the primary driver of shoreline change on the West Island ocean shoreline. Excluding groynes and offshore structures because they do not address cross-shore erosion should be revisited as the CVA identifies longshore erosion as the dominant form of erosion. These options warrant evaluation against the actual erosion process identified in the CVA in the next review cycle.

P8 Storm Surge Barrier Excluded During Inundation Pre-Screening

Option P8, the storm surge barrier, was excluded at the pre-screening stage for inundation. The pre-screening treats it as a standalone alternative to other inundation protection options. This is not how storm surge barriers function in practice. A storm surge barrier is not a freestanding structure: it is a gate built into a levee or seawall that remains open under normal tidal and sea conditions and closes when a storm surge or inundation event is forecast. The barrier and the levee are components of the same system.

Excluding P8 from the MCA while retaining P9 (levees) means the scored options do not include the most functional form of levee design. A levee with integrated storm surge barriers would provide passive ocean access during normal conditions, retain the ability to seal the settlement against inundation events, and avoid the permanent disconnection from the shoreline that a solid levee wall creates. By separating P8 from P9 at the pre-screening stage, the MCA evaluates a levee without gates against an accommodation option and a nourishment option, and concludes the levee is preferred. It does not evaluate the most capable version of the levee option.

P10 Land Raising Excluded During Inundation Pre-Screening

Option P10, land reclamation, is excluded at the pre-screening stage on the grounds that it is not effective at countering erosion (CHRMAP Appendix E). This reasoning does not align with how land reclamation functions and would benefit from clarification. Land reclamation places fill material seaward of the existing shoreline to create new land area. By definition, it replaces land lost to erosion and repositions the shoreline further seaward, directly countering the effect of coastal recession.

Excluding an option because it does not perform a function it was not designed to perform is an inconsistency worth revisiting. It removes from the MCA an option that is widely used in low-lying island and coastal settings where erosion and inundation risk is the primary planning challenge.

5.1.3 Scoring

Options Not Considered

As noted above, multiple options have been excluded from the MCA, with just four options making it through to the final scoring stage. These four options are:

- PMR2: Structural – Design Assets to Withstand Hazards. This is also noted as AC1 in the West Island table;

- P9 + P2: Levees with Ongoing Nourishment;
- P9 + P6: Levees with GSC Seawalls; and
- P9 + P7: Levees with Concrete SeaBee Seawalls.

Notable omissions include:

- P1: Large Beach Nourishment Campaign;
- P3 & P4: Offshore Structures;
- P5: Groynes;
- P8: Storm Surge Barrier; and
- P10: Land Reclamation and Land Raising. These two options should also be considered separately as they are fundamentally different things, although they are screened together in the CHRMAP.

The broader omission in the MCA is that managed retreat is excluded during pre-screening, and yet it is the CHRMAP's recommended medium to long-term pathway for Home Island.

Scoring Discrepancies

Even though the same four options are considered on West Island and Home Island, there are significant differences and discrepancies in how the options are scored between the two islands (Table 5-1).

No justification is provided for the financial criterion even though it is scored for each option.

Table 5-1: MCA Scoring Discrepancies

Criterion	MCA West Island Reason	MCA Home Island Reason	MCA West Island Score	MCA Home Island Score	Comments
AC1 / PRM2: Structural – Design Assets to Withstand Hazards					
Social Impact – Property	High impact – potential loss of multiple properties (approximately 30) due to erosion. Daily impact to residents accessing properties, as stairs are required for stilted housing.	High impact – potential loss of multiple properties (approximately 30) due to erosion. Daily impact to residents accessing properties, as stairs are required for stilted housing.	2	4	Same reason provided for West Island and Home Island, yet scored lower on West Island than Home Island. The CHRMAP does not account for the fact that most of the residences on West Island are already on stilts with stairs to access them without significant social impact.
Flexibility	Houses built on stilts can be raised in future if built as kit homes that can be dismantled and lifted with cranes.	Difficult to reverse or adapt, as houses built on stilts can't be easily raised.	4	2	Different flexibilities provided even though it is the same adaptation. The CHRMAP does not account for the fact that buildings are typically raised by jacking them upwards and splicing in longer piles beneath the buildings, rather than dismantling the buildings entirely.
Effectiveness	Partially effective in medium term. Raising houses on stilts is effective at countering inundation in medium tern but not effective at counting	Partially effective in medium term. Raising houses on stilts is effective at countering inundation in medium tern but not effective at counting	2	4	Same reason provided for West Island and Home Island, yet scored lower on West Island than Home Island.

Criterion	MCA West Island Reason	MCA Home Island Reason	MCA West Island Score	MCA Home Island Score	Comments
	erosion. Option would have to be combined with a protect pathway (nourishment or seawall option) to increase erosion effectiveness.	erosion. Option would have to be combined with a protect pathway (nourishment or seawall option) to increase erosion effectiveness.			Also states that combined options should be considered but are not.
P9 + P2: Levees with Ongoing Nourishment					
Financial	No reason provided for Financial criterion	No reason provided for Financial criterion	1	2	Option is scored lower on the West Island than the Home Island with no explanation provided in the CHRMAP.
P9 + P6: Levees with GSC Walls					
Social Impact – Way of Life	Loss of access to certain assets, as levee separates community from Settlement beaches and views. Seawalls cause erosion of Settlement beaches.	Will definitely affect key values of area, as levee separates community from Settlement beaches and views. Seawalls cause erosion of Settlement beaches.	2	1	Provides different scores for the same justification. The assessment also states that seawalls cause erosion of Settlement beaches, though this does not align with the purpose of seawalls, which would be to prevent erosion of the Settlement beaches.
Financial	No reason provided for Financial criterion	No reason provided for Financial criterion	2	5	Given a significantly better score on Home Island than West Island even though it is the same adaptation.
P9 + P7: Levees with Concrete SeaBee Seawalls					

Criterion	MCA West Island Reason	MCA Home Island Reason	MCA West Island Score	MCA Home Island Score	Comments
Social Impact – Way of Life	Loss of access to certain assets, as levee separates community from Settlement beaches and views. Seawalls cause erosion of Settlement beaches.	Will definitely affect key values of area, as levee separates community from Settlement beaches and views. Seawalls cause erosion of Settlement beaches.	2	1	Provides different scores for the same justification. The statement that seawalls cause erosion of Settlement beaches would benefit from review, as the purpose of a seawall would be to prevent such erosion.
Financial	No reason provided for Financial criterion	No reason provided for Financial criterion	2	4	Given a significantly better score on Home Island than West Island even though it is the same adaptation.

Other Issues

- Combined systems not included in the MCA, including:
    - AC1 (Structural) + P6/P7 (Seawalls) to raise building to:
        - Protect from inundation; and
        - Provide walls to protect from erosion.
    - AC1 (Structural) + P1/P2 (Nourishment) to:
        - Raise building to protect from inundation; and
        - Conduct beach nourishment to prevent erosion and replenish beaches.
    - AC1 (Structural) + P1/P2 (Nourishment) + P6/P7 (Seawalls):
        - Protect from inundation;
        - Provide walls to protect buildings critical infrastructure from erosion; and
        - Conduct beach nourishment to prevent erosion and replenish beaches in less critical areas.

  It is expected that the optimal overall solutions would include a range of all available options, as each asset has different vulnerabilities and different needs. Therefore, the coastal defence system should consider a combination of all options.
- AC1 / PRM2: Structural – Designing Assets to Withstand Hazards
    - Financial score of 1 on both the West Island and Home Island, even though many of the West Island residences are already raised off the ground stilts;

      The Home Island residential houses will also eventually need to be replaced, which provides a financial opportunity to build more resilient housing;
    - Home Island table cites the potential loss of the Cocos Island Beach Resort due to ongoing erosion as justification for an Economic Impact score of 1 even though the resort is on the West Island; and
    - The stated number of residences potentially affected by erosion on West Island and Home Island is stated as the same figure for both islands, which warrants clarification.
- P9 Levees are assumed to be constructed with imported clay. Other types of levees are possible, including partially permeable levees with integrated drainage systems and pumps (electric or wind powered).
- Only two types of seawalls considered.
    - P7 SeaBee seawalls have a financially better score on Home Island than the GSC walls even though GSC walls can be constructed with local material and labour.
    - P7 SeaBee seawalls for Flexibility provides a score of 2 and states that “additional concrete layers could not be added.” This appears to be a factual error. SeaBee seawalls can accommodate additional layers, and the scoring should be revisited accordingly.

5.1.4 Weightings

Weightings Not Used in MCA

The MCA scoring tables in Appendix E of the CHRMAP present total scores as the simple sum of eight criteria, each scored out of five, giving a maximum of 40 points. Each criterion contributes equally at 12.5% of the total. No differential weighting is applied.

Section 6.1 of the CHRMAP states that MCA workshops were held to "confirm the criteria, approach to weighting," but the scoring tables contain no record of what weighting the community endorsed, or whether equal weighting was an explicit community decision rather than a default.

Equal weighting is itself a weighting decision that can drastically change the MCA outcome. Using equal weighting, Effectiveness, the criterion that assesses how well an option reduces erosion or inundation, carries the same weight as Implementation, Financial, and Economic criteria. An option that scores poorly on Effectiveness but well across the remaining seven criteria can outscore a technically superior option.

The CHRMAP does not acknowledge or test whether a different weighting scheme, one that assigns greater weight to technical effectiveness, would change the recommendation. Without a sensitivity analysis, the MCA cannot demonstrate that the recommended option is robustly preferred rather than the result of one particular weighting assumption.

5.1.5 CHRMAP Commentary Not Justified by MCA

In the superseded draft CHRMAP Section 6.3 MCA Result and Options Summary, the CHRMAP makes statements about long-term recommendations:

- In Section 6.3.1 on the Home Island: “In the long term, managed retreat away from the Island may be the only viable and feasible option.”
- In Section 6.3.2 on the West Island: “In the long term, planned and managed retreat may be the only viable and feasible option to prevent unacceptable impacts by coastal hazards on vulnerable development, land uses and populations.”

These statements were not based on findings from the MCA which does not include long-term options. The MCA evaluates only short and medium-term options for both settlements. Drawing long-term conclusions from an analysis that was not designed to support them goes beyond what the MCA can demonstrate. The long-term pathway recommendations require a separate and explicit analysis before they can be presented as findings of the MCA process.

The final CHRMAP reevaluates the MCA recommendations in Section 6.3.1 and 6.3.2 stating that “Long Term Settlement Planning will need to be undertaken in partnership with the community as soon as possible to establish longer term pathways. Whilst all options will be considered, including resilience measures (revegetation/sand nourishment) and protect options, relocation may also be viable and feasible. Medium-to-long-term options are presented to indicate subsequent costing involved in further options assessment.”

5.1.6 MCA Summary

The MCA would need to be substantially revised before it could support and inform long-term decisions. A revised MCA should form part of the next CHRMAP review cycle.

- The criteria set is incomplete, omitting legal and political feasibility, cultural heritage, and strategic value considerations that are directly relevant to CKI's context.;
- The pre-screening stage has removed options on technical grounds that are not fully supported by the available evidence, leaving only four options to be scored when at least eight warranted consideration;
- The scoring tables contain internal inconsistencies, including identical justifications producing different scores between islands, criteria scored without explanation, and at least one factual error attributing an asset to the wrong island;
- Combined adaptation approaches, which are likely to represent the most practical solutions given the range of asset types and vulnerabilities across the two settlements, are not evaluated at all;
- The adaptation pathway the CHRMAP for long term, managed retreat from Home Island, is excluded from the MCA entirely; and
- No differential weighting has been applied to the criteria and no sensitivity analysis has been conducted, meaning the scoring outcome cannot be shown to be robust to different assumptions about what matters most.

Taken together, the MCA appendices would benefit from further development before they can provide a robust basis for the recommendations made. A revised MCA should extend the timeframe of analysis, correct the pre-screening, apply transparent and community-endorsed weightings, evaluate combined options, and include managed retreat as a scored pathway, if this is a consideration or future implication.

These issues in the MCA have a material bearing on the outcomes of the report. The long-term recommendations for the West Island (Section 6.2.4.1) and the Home Island (Section 6.2.4.2) both previously referenced the MCA as their justification, even though no long-term MCA was presented in the CHRMAP. Going forward, the MCA would need to consider all possible outcomes to be used as justification for decision making in the future.

5.2 Benefit Distribution Analysis

5.2.1 Overview

The BDA is provided in Appendix G of the CHRMAP. The BDA was commissioned to apply the user-pays principle established under SPP 2.6, which provides that the beneficiaries of coastal adaptation interventions should contribute to their cost in proportion to the benefit they receive.

The BDA executive summary states the following assumption before any analysis is presented:

> "West Island's and Home Island's risk of inundation and erosion is so great that potential interventions other than relocation have been assessed as cost prohibitive and will likely be ineffective against the combination of erosion and inundation. As such, this report makes the assumption that the CKI communities will eventually be relocated."

The BDA is therefore not a tool for evaluating whether relocation is the appropriate long-term pathway. It assumes that outcome from the outset.

The BDA estimates the economic value of assets that would be protected by coastal interventions and apportions that value as a percentage across different owner groups: private landowners, the CKI Lands Trust, the Australian Government, and the broader community. It defines benefit as "the

continued existence and operation of an asset, at its existing full functionality, landholding, service, or economic/commercial outcome as at the time of the BDA."

The BDA finds that approximately $190 million of economic value is at risk from erosion and inundation by 2068, with the replacement cost of non-essential infrastructure exceeding $100 million. Of the total benefit that would be preserved by protection interventions, 94.3% is attributed to private interests, predominantly the Cocos (Keeling) Islands Lands Trust. The Trust is administered by the Shire and has no material capacity to fund adaptation works. The BDA acknowledges this directly, noting that the user-pays principle cannot be straightforwardly applied in the Cocos (Keeling) Islands context and that a more sophisticated approach to funding will be required.

5.2.2 Scope Limitations

No Evaluation of Retreat and Accommodation Pathways

The BDA evaluates the benefit distribution of protection interventions only. Retreat and accommodation pathways are not given equivalent treatment. For a document intended to inform adaptation decisions across the full SPP 2.6 hierarchy, this is a significant gap. A community considering whether to protect or retreat cannot use the BDA to compare who benefits and by how much under each pathway.

No Cost Distribution Analysis Conduced

The BDA explicitly states that cost distribution is out of scope. The document therefore answers the question of who benefits from adaptation but not how costs should be allocated between those parties. The user-pays principle under SPP 2.6 requires both pieces of information. Without a cost distribution analysis, the BDA cannot fulfil the purpose for which it was commissioned.

Essential Services Infrastructure Excluded

Essential services infrastructure, estimated at $1.5 billion, is excluded from the BDA on the basis that its benefit accrues equally to all community members. This figure represents the single largest cost item on the islands and the most consequential for any adaptation funding decision. The $1.5 billion figure is provided by the Australian Government and is not independently verified or itemised in the BDA. Excluding it from the benefit distribution means the BDA does not address the dominant funding question facing the Commonwealth.

Strategic Value Not Considered

The BDA does not attribute economic value to the strategic utility of the CKI. As noted in Section 5.1.1, the West Island airport operates as a RAAF facility and the islands occupy a position of strategic significance in the eastern Indian Ocean. The Commonwealth's recognition of this value is demonstrated concretely by the CKI Airfield Upgrade Project, for which the Department of Defence has submitted an estimated capital cost of $567.6 million (excluding GST) to the Parliamentary Standing Committee on Public Works (Australian Government Defence (AGD), 2026).

This single infrastructure project costs three times the BDA's total assessed economic value of all non-essential assets across the island group ($190 million). The BDA excludes the airport within the essential services category and estimates essential services infrastructure separately at $1.5 billion. However, the Commonwealth is committing over half a billion dollars to a single asset on West Island on strategic grounds, which demonstrates that the value of the islands to Australia extends well beyond the non-essential private and community assets the BDA captures.

The BDA should treat the CKI as a strategic defence asset and account for the Commonwealth's existing and planned investment in that asset, rather than exclude it from scope.

5.2.3 Methodology Issues

Retreat Assumption is Basis of Analysis

The retreat assumption is embedded in the analysis before it runs. The BDA executive summary states that "potential interventions other than relocation have been assessed as cost prohibitive and will likely be ineffective against the combination of erosion and inundation" and that "this report makes the assumption that the CKI communities will eventually be relocated."

A benefit distribution analysis is a tool for informing adaptation decisions, not for confirming decisions already made. By assuming relocation from the outset, the BDA cannot provide an objective basis for evaluating whether relocation is the appropriate pathway, or for comparing the benefit distribution of protection against retreat. The assumption also contradicts the short-term protection works the CHRMAP recommends, which are justified on the basis that they extend the life of the settlements.

BDA Calculates Asset Value for Perpetuity

The BDA defines benefit as the continued existence of assets in perpetuity, but acknowledges that this outcome is "highly unlikely to be achieved for all stakeholders on CKI." Applying a perpetuity assumption to calculate the benefit of works the CHRMAP itself describes as sacrificial in the long term is inconsistent. If the protection works will not preserve assets permanently, the benefit attributed to those works in the BDA may be overstated relative to what the works will deliver.

For Home Island specifically, the BDA acknowledges that the standard BDA methodology is not suitable because assets will not be preserved in perpetuity. This is a significant methodological concession. It is noted in the body of the BDA but is not clearly flagged in the CHRMAP's summary of BDA findings, which presents the results without qualification.

No Sensitivity Analysis

No sensitivity analysis is presented on the benefit distribution percentages. The 94.3% private benefit figure is presented as a fixed output. No testing is provided of how the distribution changes under different assumptions about asset values, planning horizon, or intervention effectiveness.

5.2.4 Limitations of “User Pays” Findings

The central finding of the BDA is that 94.3% of the benefit of coastal adaptation on CKI accrues to private interests, predominantly the CKI Lands Trust. Under the SPP 2.6 user-pays principle, this would imply that the Trust should contribute 94.3% of the cost of adaptation works. The BDA acknowledges that this conclusion is not actionable.

The Trust holds most of the private land on CKI and is the landlord for the majority of residents on both islands. It is administered by the Shire of CKI, which has no meaningful rate base or independent capital capacity. The Trust's ability to raise capital through land transactions is directly affected by the coastal hazard risk the BDA is assessing. The BDA therefore identifies the Trust as the primary financial beneficiary of adaptation while simultaneously acknowledging that the Trust cannot fund it.

The BDA notes that "most of the benefit ultimately flows to the Trust and Australian Government interests" and that "a more sophisticated response to funding" will be required. It does not develop what that response would look like. The user-pays analysis produces a percentage attribution that

leads directly back to Commonwealth funding in every scenario, without providing a framework for how Commonwealth funding should be structured, conditioned, or recovered.

The practical consequence is that the BDA fulfils the technical requirement to conduct a benefit distribution analysis without producing findings that can be acted upon. The SPP 2.6 user-pays principle was designed for contexts where private beneficiaries have the capacity to contribute. On CKI, where land ownership is concentrated in an entity that cannot pay and where the Commonwealth is the default funder of last resort, the user-pays framework does not provide useful guidance for funding decisions without substantial further development.

5.2.5 Relationship to the Cost-Benefit Analysis

The BDA was designed as the precursor to a cost-benefit analysis. The RFQ for the CHRMAP (as per the BDA attachment on PDF p. 316) specified that "… adaptation options receiving a positive score in the MCA would proceed to the CBA", which would assess the timing of interventions, compare the cost of each option against the value of damages avoided, and calculate benefit-cost ratios to determine which options provide the greatest return relative to their cost. The BDA establishes who benefits; the CBA was intended to establish whether the benefits outweigh the costs and when intervention is warranted.

The CBA was not completed. The advice provided to Shape Urban by FAR Lane concluded that a formal CBA was not required for most assets because "the best time to implement the required interventions is the present." This creates a sequencing issue: the CBA is the tool for determining the best time to act, yet the conclusion was reached before the CBA was conducted. The only assets identified as warranting CBA consideration were the Home Island cemetery and Sydney Highway, neither of which represents the primary adaptation decision facing the islands.

Without the CBA, the BDA findings cannot support funding decisions. The BDA establishes that 94.3% of the benefit of protection flows to private interests, but without a completed CBA there is no assessed cost against which that benefit can be compared, no benefit-cost ratio for any of the recommended options, and no quantitative basis for determining whether the short-term protect pathway is economically justified relative to retreat or accommodation alternatives. The two analyses were designed to work together. Presenting the BDA findings without the CBA removes the cost context that gives the benefit distribution figures their practical meaning.

5.2.6 BDA Conclusion

The BDA is open about what it cannot demonstrate. It states that "caution should be applied in applying user pays principles on CKI," that the perpetuity assumption is "highly unlikely to be achieved for all stakeholders," and that "in the long term, BDA is not suitable for considering the preserved benefits of Home Island." The CHRMAP does not carry these qualifications through to its summary of BDA findings.

In Talis' view, the conclusions drawn in the final CHRMAP from the BDA findings are not fully supported by the BDA's own qualifications and scope limitations. CHRMAP Section 6.4.2 states that "Home Island's vulnerability to the combination of erosion and inundation is so great that potential interventions will be cost prohibitive over the long-term." This conclusion is attributed to the BDA even though the CHRMAP itself notes that "in the long term, BDA is not suitable for considering the preserved benefits of Home Island."

The final CHRMAP has been refined compared to the superseded draft and now states "Long-term adaptation requires a more sophisticated response to funding, including consideration of how best to

effect long-term relocation of vulnerable private assets through negotiated agreements when impacts on those private assets become unacceptable."

Section 6.4.7 of the CHRMAP states that the Trust "should be obliged to contribute to protection measures," using the word "obliged" for a party the BDA identifies as having rental income "entirely insufficient for the hazard management requirements of the CHRMAP." The same section describes the likelihood of erosion and inundation becoming unacceptable as "extreme", a characterisation that is not supported by the hazard assessment evidence reviewed in Section 3 of this report.

There is a notable difference between the BDA's findings and the way they are summarised in the CHRMAP. The BDA was designed to inform adaptation decisions. As structured, it assumes the primary long-term outcome before the analysis, excludes the dominant cost items from the benefit distribution, and produces a user-pays result that cannot be acted upon. The CHRMAP would be strengthened by carrying through the qualifications the BDA's authors attached to them.

5.3 Cost-Benefit Analysis

5.3.1 Scope and Completeness

Section 6.5 of the CHRMAP is one page and is not reflective of the CBA assessment and associated findings. The CHRMAP's own definition of cost-benefit analysis states that it "assists in the decision of when is the best time to implement adaptation, as well as which interventions against sea level rise provide the greatest benefit relative to costs." Section 6.5 does not fulfil either purpose.

The section identifies only two assets for which a CBA might inform timing: the Home Island cemetery and Sydney Highway. Both are then dismissed. The cemetery is deferred pending a Cultural Heritage Assessment. Sydney Highway is dismissed on the basis that "given the immediacy of the need for interventions, there is also little need for a CBA." For the fuel jetty and Rumah Baru, the CHRMAP concludes that "a CBA is therefore not required to analyse investment timing for these assets" as they are recommended to be protected in the short-term. The protect versus retreat decision for Home Island, which is the single most consequential decision in the CHRMAP, does not appear in Section 6.5 at all.

Section 6.5 concludes with a single line: "A note regarding CBA is detailed in Appendix F." Appendix F contains a letter of advice from FAR Lane and an extract from the project RFQ. The RFQ specifies that a detailed cost-benefit analysis was outside the project scope. This explains why no CBA was conducted, but the CHRMAP does not state this in Section 6.5. The scope limitation is disclosed only in an appendix, and only by reference to a procurement document rather than as an acknowledged gap in the analysis.

Section 6.5 describes why a comprehensive cost-benefit analysis was not completed, rather than presenting the results of one. This should be read as a gap in the analytical basis, not as a completed assessment. The final CHRMAP itself identifies a CBA as a priority future action, and Talis supports this position.

5.3.2 Home Island Protect vs. Retreat Decision

The CHRMAP recommends levees and seawalls as the short-term protect pathway for Home Island and identifies managed retreat as a potential medium-to-long-term pathway. However, no cost comparison between the two pathways has been completed.

Action 2 (CHRMAP Section 7.1, p.181) lists "cost benefit analysis comparing costs of short to medium term options against implementation of longer-term adaptation" as a future investigation, to be undertaken as part of a terrestrial flood and groundwater study. The CHRMAP identifies the CBA needed to support its primary Home Island recommendation as outstanding and makes the recommendations ahead of the studies identified as being needed to support them.

The long-term cost estimates in CHRMAP Table 35 (p.170) indicate that a reclamation and protect pathway for Home Island would cost more than $500 million. No equivalent cost estimate for a managed retreat pathway is presented. The BDA is the only completed economic analysis in the document. However, the BDA explicitly states that it "is not suitable for considering the preserved benefits of Home Island" in the long term. The long-term retreat pathway for Home Island is therefore recommended without a completed cost-benefit analysis and without a comparable cost estimate for protect.

SPP 2.6 requires that adaptation options be assessed against each other before a preferred pathway is identified. Recommending protect now and deferring the CBA to a future investigation does not satisfy this requirement. The protect versus retreat decision will determine the long-term future of the Cocos Malay community on Home Island. If a plan proposing long-term retreat is going to be considered, it would be better supported once the CBA has been completed.

5.3.3 No Cost-Benefit Analysis Completed

Section 6.5 states that CBA "involves forecasting future cash flows associated with each measure (both the cost of implementing a measure, and the flow of future benefits) and discounting based on an assumed time period." The CHRMAP does not apply this methodology in the document.

The cost estimates in Tables 34 and 35 (pp.169-170) are presented as order-of-magnitude brackets. Short-term levee options for West Island are costed at "$1 million to $10 million." Long-term reclamation options for Home Island are costed at "more than $500 million." These brackets span a factor of ten in some cases. They are not a basis for comparing options, and the CHRMAP does not use them as one.

No lifecycle cost analysis is presented for any option. The short-term protect pathway requires ongoing maintenance of seawalls and levees. No estimate of maintenance cost over 10, 30, or 50 years is provided. No comparison is made between the lifecycle cost of the protect pathway and the lifecycle cost of an accommodate or retreat pathway over the same period.

No sensitivity analysis is presented on the cost estimates. Construction costs on the CKI are subject to significant uncertainty. Supply chain, logistics, and materials availability present much more significant challenges than remote mainland construction projects. The CHRMAP acknowledges this throughout but applies no range or confidence interval to any cost figure.

The CHRMAP also does not assess what happens if the protect pathway is pursued and subsequently abandoned. Short-term seawall construction is described in Section 6.4.2 as likely to be "sacrificial in the long term." No analysis estimates the sunk cost of protection works that are later lost to coastal hazards, or how that cost should be weighed against alternative pathways.

Key Findings — Risk Treatment Options

- The MCA pre-screening excluded several protection options without demonstrating they were technically incapable of addressing the hazard. Some exclusion grounds do not appear

to be technically supported. The pre-screening methodology needs revision before the MCA can support any long-term planning recommendation.

- No cost-benefit analysis was completed. The final CHRMAP identifies a CBA as a priority future action. Without it, no long-term adaptation decision has an economic basis.

6 Review of CHRMAP Recommendations

6.1 Summary of CHRMAP Recommendations

The key recommendations of the CHRMAP (Table 6-1) are presented below for both the Home Island and West Island.

Table 6-1: Final CHRMAP Recommendations

Timing	Home Island	West Island
Short Term (0-10 years)	• Consider management and adaptation planning options relevant to all assets, including strategic planning, statutory planning, and policy or governance interventions. • All options require further investigation and detailed design, and ongoing engagement with stakeholders and community. • Intensification or expansion of new permanent residential development and other vulnerable land uses (including associated infrastructure) should be prohibited within areas impacted by coastal hazards. • Commence Long-Term Settlement Planning in partnership with the community as soon as possible for vulnerable areas, including land use planning and potential implementation mechanisms. • Relocate minor assets and service infrastructure – areas outside of the settlement areas, with the exception of critical service infrastructure assets that cannot be located. • Protect key infrastructure in the Settlement Area, Lagoon, Runway, Rumah Baru, fuel station, power station, potable water and wastewater infrastructure, including the Kampong and cemetery, with a combination of seawalls and levees.	• Consider management and adaptation planning options relevant to all assets, including strategic planning, statutory planning, and policy or governance interventions. • All options require further investigation and detailed design, and ongoing engagement with stakeholders and community. • Intensification or expansion of new permanent residential development and other vulnerable land uses (including associated infrastructure) should be prohibited within areas impacted by coastal hazards. • Commence Long-Term Settlement Planning in partnership with the community as soon as possible for vulnerable areas, including land use planning and potential implementation mechanisms. • Relocate minor assets and service infrastructure – areas outside of the settlement areas, with the exception of critical service infrastructure assets that cannot be located. • Protect key community infrastructure through a combination of reinforcing existing, and building new, seawalls and levees. • Minor Asset Relocation and Services Relocation for at risk assets that can be moved to a lower risk area (i.e. Sydney Highway requires immediate relocation further inland, and will

Timing	Home Island	West Island
		require levees and seawalls for protection).
Medium Term (10-50 years)	• Land use planning instruments to facilitate progressive relocation of minor and service infrastructure assets out of the hazard zone. • In collaboration with the community, progress Long-term Settlement actions as developed in the short-term, noting that there is limited available land of adequate size on Home Island that does not suffer the same issues as the Kampong. • For areas outside of the settlement, move minor and service infrastructure assets that are identified as being within the hazard area.	• Assessment of protect measures and investment in reinforcements (i.e. replacing seawalls and sandbags at the Settlement Area and Runway). • Replace seawalls and other protect measures at the end of the relevant structure design life. • For areas outside of the settlement, move minor and service infrastructure assets that are identified as being within the hazard area in the Northern and Lagoon beaches, and Rumah Baru.
Long Term (50+ years)	• Long-term adaptation pathways are limited for both West and Home Island. Long-Term Settlement Planning in the Short and Medium-term will confirm the most suitable option to protect lives in a socially, economically and environmentally respectful way in this time frame. • All options will be considered, including resilience measures (revegetation/sand nourishment) and protect options, as well as settlement relocation which may be necessary due to the significant health and safety risks posed by coastal inundation and erosion, and associated flooding.	• Protect essential infrastructure beyond 2068: Continue a protect pathway for the settlement areas and critical service infrastructure assets outside the Settlement Area that can't be easily relocated (Fuel Station, Rumah Baru). • Planned and managed retreat: using land use planning instruments to progressively move assets out of the hazard zone for all non-critical service infrastructure assets. • Protect essential airport infrastructure beyond 2068; further raise the pavement height to reduce risk of runway flooding.

The CHRMAP also makes the key disclaimer that "Long term planning and development is contingent on the results of further analysis and scenario planning to determine the level of investment required to support a permanent civilian population on CKI." The CHRMAP nonetheless contains long-term recommendations, made before the further analysis the disclaimer identifies as a prerequisite.

The final CHRMAP represents a shift from the draft's retreat-led strategy to a more adaptive, staged risk-management approach. In the short term, the final plan prioritises targeted protection of high-value assets through engineered measures (e.g. seawalls, levees) aimed to be supported by detailed design, monitoring, and planning controls, rather than assuming early retreat. In the medium term, the recommendation is a hybrid pathway, whereby critical infrastructure is protected while non-critical assets are progressively relocated, reflecting a more nuanced, risk-based allocation of

adaptation measures, however these works still appear to be recommended without a risk assessment or environmental impact assessment. In the long term, the final plan replaces the draft's assumption of island-wide retreat with a scenario-based framework, where continued protection, versus managed retreat are contingent on triggers such as hazard thresholds, funding, and community decision-making of which was not considered in the draft. Overall, this transition demonstrates a move toward adaptive pathways model under uncertainty, integrating engineering, planning, and socio-economic considerations rather than prescribing a single deterministic trajectory.

6.2 CHRMAP Justifications for Recommendations

The long-term recommendations presented in Section 8.3 of the CHRMAP reference CHRMAP Section 6.2.4, which in turn references the MCA even though the MCA in CHRMAP Appendix E considers only short and medium-term adaptation pathways.

CHRMAP Section 6.2.4.2 states that the "viable long-term options that achieved a positive score in the MCA" for the long-term on the Home Island are PMR2, PMR3, and PMR4 (planned and managed retreat – relocation and/or demolition and removal of assets) and P5b & P7 (Protect – Seawalls & Land Raising / Reclamation). Neither of these options are included in the MCA presented within the CHRMAP.

It is unclear whether an additional MCA was completed that is not in the CHRMAP, or if the above reference draws from the short-term MCA. If the former is true, the shortcomings of the MCA identified in Section 5.1 of this report would still need to be addressed before it could provide any useful data. The MCA should also be used as a tool to compare options only, not as justification for making the final decision.

If both the MR2 and P5b/P7 options scored well, it is unclear why the MR2 option is selected as the recommendation where a viable alternative option exists.

After reviewing both the Draft (2024) and Final (2026) CHRMAPs, the MCA applied in the draft and final versions of the CKI CHRMAP remains consistent in methodology, including the same criteria, scoring framework, planning horizons and somewhat aligned with SPP 2.6 and the CHRMAP Guidelines. No substantive changes were made to the MCA structure or assessment approach between documents. However, the interpretation and application of MCA outcomes differ. The draft CHRMAP presents MCA results alongside more explicit long-term conclusions, particularly indicating managed retreat for Home Island. In contrast, the final CHRMAP more clearly positions the MCA as a decision-support tool, emphasising short-term protection, staged decision-making, and the need for further analysis, particularly highlighting a full CBA be completed before confirming long-term adaptation pathways.

6.3 Areas of Alignment with the Final CHRMAP

The final CHRMAP, released in March 2026, takes positions on several matters consistent with this review's findings.

First, the final CHRMAP defers any recommendation for permanent off-island retreat pending further technical investigations and community consultation. This is consistent with this review's finding that the analytical basis for a long-term retreat recommendation was not established in the CHRMAP.

Second, the CHRMAP identifies a cost-benefit analysis comparing protect and retreat pathways as a priority future investigation (Action 2, Section 7.1). This review reaches the same conclusion. The CBA

is the central analytical step required before any long-term adaptation decision can be made for Home Island.

Third, the final CHRMAP commits to a five-year review cycle. This provides a structured pathway through which the investigations identified in this review, including erosion modelling, environmental baseline studies, groundwater assessment, and engineering feasibility, can be completed and incorporated into a strengthened evidence base before adaptation decisions are finalised.

Talis acknowledges these as improvements over the draft CHRMAP.

Key Findings — CHRMAP Recommendations

- The draft CHRMAP recommended long-term off-island retreat for Home Island. The final CHRMAP defers this pending further technical investigation and community engagement.
- Long-term recommendations in final CHRMAP are contingent on investigations that have not been completed. The required investigations are identified in Section 11 of this report.

7 Environmental CHRMAP Gaps and Limitations

Biodiversity & Ecosystem Function

Significant gaps exist within the CHRMAP regarding biodiversity, ecosystem function, and the environmental values of the CKI. Although the document states that it considers marine environments, beaches, foreshore vegetation, land uses, and natural assets, it does not meaningfully describe the biodiversity, ecological processes, or habitat values that underpin these systems. Critical terrestrial environments, including native rainforests are largely omitted, despite their ecological importance, cultural significance to Cocos-Malay elders, and potential to support MNES protected under the EPBC Act and threatened and priority species under the BC Act. The retreat option proposed within the CHRMAP further highlights these gaps, as it would require vegetation clearing and habitat disruption, presenting direct risks to MNES-listed species and exacerbating erosion. Yet the document does not acknowledge these ecological consequences nor provide baseline information on existing fauna, habitat condition, or threatened species likely to be impacted.

These omissions extend into the risk assessment process and asset classification within the CHRMAP. Environmental values are treated primarily as social or amenity assets rather than ecological systems essential for shoreline stability, erosion mitigation, and long-term community resilience. In the CHRMAP Table 18 illustrates this inconsistency by rating erosion impacts to environmental assets as “major” while rating inundation impacts as “insignificant”. The latter contradicts the former given inundation contributes to erosion, displaces flora and fauna, and directly affects the community. This has also been researched by Masselink et al stating “episodic high-volume overtopping can flatten islands and increase hazard exposure.”.

The environment is not listed as a vulnerable asset in Section 4.6.1 of the CHRMAP, despite being defined as such in the CHRMAP guidelines and repeatedly identified by the community as highly valued. The existing environment section focuses almost exclusively on the marine park and does not address terrestrial ecosystems, including no mention of fauna surveys, habitat mapping, or searches for protected matters. As a result, Section 3.3.2 does not accurately classify environmental assets. The engagement findings note the community’s strong desire to protect natural landscapes and vegetation, but this is not reflected in the assessment or planning outcomes. These gaps collectively limit the CHRMAP’s ability to appropriately evaluate environmental risk or design actions that protect biodiversity and ecosystem function on CKI.

Environmental health, contaminated sites

There are critical gaps in the CHRMAP’s treatment of environmental health and contaminated-site risks, particularly in relation to baseline data and known or potential sources of contamination.

Without conducting baseline assessments on soil, groundwater, and marine sediment, the CHRMAP cannot adequately assess the potential impacts of coastal erosion and inundation on the federally listed marine park, threatened and priority species, MNES and community. Lack of foundational data severely limits the ability to predict contaminant mobilisation, ecological harm, or risks to human health. Furthermore, despite the presence of facilities and land uses on the CKI that commonly require contamination assessment programs, such as a fuel station and a cemetery, there are currently no contaminating features listed in the Department of Water and Environmental Regulation (DWER) contaminated sites register (DWER, 2023). This absence suggests further investigation of potential contamination sources may be warranted.

Without systematically identifying, assessing, and planning for contaminants that may be exposed or mobilised by coastal hazards, the CHRMAP does not fully address environmental-health risks, regulatory obligations, or long-term risk management needs.

Legislative, Regulatory and Policy considerations

There are omissions within the CHRMAP regarding the legislative frameworks that should guide environmental protection and risk-based decision making. While Section 2.6.3 of the CHRMAP outlines relevant planning frameworks, it does not incorporate key environmental legislation that directly governs the protection of biodiversity, land, and coastal environments. Critical Acts, such as the EPBC Act, BC Act, Contaminated Sites Act, and the EPA Act are not referenced, despite their clear relevance to any works or decisions that could affect MNES values, native vegetation, fauna habitat, or land and water quality. The absence of these legislative considerations creates a significant gap, particularly given that proposed adaptation options, including retreat and shoreline modification, may trigger regulatory obligations under these Acts.

Although the CHRMAP is a policy document, it must be guided by the legislation under which local government operates, particularly where proposed actions have the potential to affect protected matters or cause environmental harm. Without explicitly acknowledging and integrating these legislative requirements, the CHRMAP cannot effectively inform decision-making or ensure compliance with statutory obligations. As a result, the document risks recommending adaptation pathways that may not be feasible, environmentally responsible, or aligned with Commonwealth and State regulatory frameworks. This would strengthen the robustness and credibility of its recommendations.

The guiding State policy documents intended to inform the development and implementation of the CHRMAP do not appear to have been adequately addressed within the reviewed document. Notably, SPP 2.6 specifies that works resulting in significant and permanent negative environmental impacts, whether occurring on- or off-site, should not be undertaken. Additional critical policy requirements articulated in Section 5.11 of SPP 2.6 include the principle that “where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason to postpone measures to prevent” such harm, and that “the onus is on any proponent to show that development does not pose any likelihood of serious or irreversible harm to the environment.”

On this basis, the recommendations presented and scored within the CHRMAP matrix cannot be used to justify environmental degradation resulting from proposed works undertaken without supporting biological studies or an EIA. Section 5.11 further stipulates that “if the proponent cannot demonstrate there is not a likelihood of such harm, the onus is on the development proponent to show that the harm can be managed.” Therefore, absence of adequate environmental assessment cannot be used to dismiss or downplay risks of ecological harm. Additional key environmental considerations derived from SPP 2.6 are listed below:

- Section 2.6 of SPP 2.6 states that “Planning for coastal zone land is about balancing these often-competing needs and desires in a way that takes into account the values of the coastal zone, which include its scenic, aesthetic and ecological qualities”
- Section 2.2 - “The Strategy sets out the guidance for achieving the state goals of generating wealth and prosperity; preserving and enhancing the environment”, in addition it is stated that the “State Planning Policy No. 2: Environment and Natural Resources Policy (SPP2) sets out the broad environment and resource management policies for sustainable development.”
- Section 5.2 explains that “Proposed major urban development outside existing settlements will only be supported where a genuine community need has been demonstrated and the environmental capability has been properly assessed.” And most notably also explicitly states development and settlement should “Avoid significant and permanent negative impacts on the environment, either on or off site.”

- Section 5.3 water resources and management requirements under policy means “treating all urban water flows as potential resources, and giving consideration to all water users, including the community, industry and the environment.” And that “Development on or near the coast should not discharge any waste or stormwater that could significantly degrade the coastal environment, including the coastal foreshore reserve, coastal waters and marine ecosystems.”
- Section 5.7 Coastal Protection works explains that “Coastal protection works should only be supported where it is demonstrated there are no significant negative impacts on the adjacent environment within the sediment cell”

It is also noted that the accompanying document SPP2.0 is not referenced in the CHRMAP, though this document clearly stipulates that “The purpose of this policy is to inform local governments and the Town Planning Appeals Tribunal of those aspects of State-level planning policy concerning the environment and natural resources which should be taken into account in planning decision making, while acknowledging the inherent difficulties of balancing conflicting needs. Local governments and State agencies will need to take account of these policy measures to ensure integrated decision making and, in the planning, and management of the environment and natural resources.” Not including these policies risks them being overlooked throughout the life of the project.

Environmental Impact Assessment

Significant gaps exist in the CHRMAP regarding the role of Environmental Impact Assessment (EIA) as a guiding document for environmental decision making. Although the CHRMAP notes that groynes were previously removed for environmental reasons, it does not include an explanation or supporting evidence for why these structures were deemed unsuitable, nor does it outline environmentally responsible alternatives. Without clear documentation of impacts, trade-offs, or lessons learned, the rationale for removing or avoiding certain coastal protection measures remains unclear. This omission limits transparency and prevents informed comparison of potential adaptation options, especially those involving physical works that may have long-term effects on coastal processes and ecological systems.

The CHRMAP does not present adequate environmental information to support its findings or recommendations. Critical documents typically required to assess and manage environmental impacts, such as an EIA, Environmental Management Plan (EMP), or baseline flora and fauna surveys are entirely absent. This severely limits the CHRMAP’s ability to assess how proposed actions may exacerbate or mitigate coastal erosion, inundation, or ecological disturbance. The document itself acknowledges challenges around protecting the natural environment and preventing activities that worsen erosion; however, determining whether proposed management actions will exacerbate or reduce impacts requires a formal EIA. Without this, the CHRMAP lacks the evidence base needed to evaluate environmental consequences or design low-impact, ecologically sustainable adaptation pathways.

The reliance on stakeholder consultation, economic considerations, and broad environmental principles outlined in Section 2.7 of the CHRMAP is insufficient without an EIA or Environmental and Social Impact Assessment (ESIA) to establish realistic and measurable success criteria. Similarly, Section 5.3 addresses the need to balance balancing community, economic, environmental, and cultural needs in long-term coastal development. Yet meaningful balance cannot be achieved without appropriate baseline data, impact prediction, and assessment of alternatives. Technical reports and modelled data, while valuable for forecasting, cannot replace field-based surveys or regulatory-grade environmental assessments required to understand ecological sensitivity or risk.

These gaps affect the reliability of the MCA scoring presented in the CHRMAP within Section 6.2.2. Environmental scores cannot be accurately assigned without first identifying the environmental assets present, understanding their condition, or assessing the consequences of each proposed option through an EIA process. Likewise, Table 28 within the CHRMAP, which evaluates the suitability of risk treatment options, becomes largely subjective and inconclusive without supporting impact assessments. Without an EIA, these rankings are better characterised as qualitative judgements rather than evidence-based evaluations. Overall, the absence of environmental impact assessment processes significantly weakens the CHRMAP's capacity to assess risk, justify decisions, comply with environmental legislation, or protect ecological values of the CKI.

Financial Provisioning

There are substantial gaps in the CHRMAP's financial provisioning, particularly regarding the long-term costs associated with environmental risk, land loss, and community resilience. The CBA does not account for the financial implications of decommissioning contaminating features on the island prior to land loss, despite this being a foreseeable and potentially high-cost obligation. Similarly, the CHRMAP omits any consideration of the cost of remediating contaminated sites, which may be necessary to prevent environmental harm or comply with legislative requirements should coastal hazards expose or mobilise contaminants. These omissions significantly underestimate the true cost of proposed adaptation pathways. The socioeconomic implications of relocating communities whether internally within the CKI, Indonesia or to mainland WA have not been explored or costed. Relocation would involve substantial financial, cultural, social, and logistical impacts, yet these are absent from the CBA and risk assessments. Without incorporating these critical financial considerations, the CHRMAP does not present an accurate picture of long-term costs or provide decision makers with the information needed to plan for financially and socially sustainable adaptation.

Section 5.7 of SPP 2.6 states that "coastal protection works should only be supported in conjunction with appropriate funding arrangements for the construction and ongoing care, control and maintenance being put in place." Although various works have been proposed for CKI, the CHRMAP does not appear to have considered potential funding sources or long-term financial commitments nor the financial or staffing resourcing capabilities of the CKI Shire. This omission is notable given that multiple government grants have been made available to Local Government authorities to address similar coastal management challenges across WA. Funding pathways utilised by Australian Local Government have been explored in Section 8 of this report.

Scoring Matrix & Viability

There are several inconsistencies and methodological gaps in the CHRMAP's scoring matrix that affect the reliability of the assessment and its capacity to guide defensible decision-making. Despite the inherently multidisciplinary nature of developing a CHRMAP for the CKI, the document does not appear to have fully incorporated specialist recommendations contained within key technical appendices attached as part of the CHRMAP. It is not clear whether the document incorporated the full suite of ecological, cultural, engineering, and community-based expertise required for a project of this complexity.

These issues extend into the structure of the scoring matrices themselves. For example, Table 17 in the CHRMAP has a description of consequences to "flora, fauna or land-form" followed by the statement "scenic, naturalness of the environment unchanged" is unclear and appears to focus only on visual amenity rather than ecological condition or environmental function. The environmental criteria listed in Table 31 are not scientifically accurate or consistent with regulatory practice. Public health considerations such as dust, noise, and odour are categorised under amenity rather than environmental health, where they typically belong, and the environmental factors fail to account for

risks to the CKI Marine Park, MNES values, or broader ecosystem health. Without grounding these criteria in sound ecological science, legislative requirements, or established impact-assessment methods, the scoring risks are subjective and would benefit from stronger grounding in ecological science and establishment impact-assessment methods.

These gaps are compounded by the absence of an EIA, which means that environmental factors cannot be reliably scored in the assessment matrix or evaluate the true implications of proposed coastal works. Statements regarding viability for example, that long-term costs may exceed environmental or social benefits lack weight without a full understanding of environmental impacts, cumulative risks, and the consequences of inaction. Similarly, references to "environmental health regulations" in relation to triggers for transitioning pathways are unclear, as environmental health is a public-health discipline, not an environmental-protection framework. It is therefore ambiguous whether the CHRMAP refers to risks to human health, ecological health, or both. Practical recommendations such as raising Air Force Road also lacks clarity, particularly around whether responsibility lies with the Shire or with Defence, and whether environmental impacts have been evaluated. Together, these issues indicate that the viability assessment and scoring matrix are not currently evidence-based, which undermines the CHRMAP's ability to meet its own success criteria or provide a credible foundation for future decision making.

Key Findings — Environmental Gaps

- The environment is not included as a primary asset category in the CHRMAP's vulnerability assessment. Coastal vegetation, reef systems, and beach habitat are not evaluated as assets requiring protection alongside built infrastructure.
- No environmental baseline has been established for CKI. Any adaptation option affecting the CKI Marine Park, EPBC-listed species, or coastal vegetation will require regulatory approvals that cannot be progressed without this baseline. Establishing it is a prerequisite for implementation.

8 CHRMAP Impacts

8.1 Community

The prospect of long-term managed retreat from the CKI, a pathway considered in the CHRMAP for Home Island, would have substantial social, cultural and economic implications for the local community. The Cocos Malay people maintain deep ancestral, cultural and spiritual connections to Home Island. Relocation would sever long-standing physical and cultural ties to place, fundamentally disrupting established patterns of life, community relationships and culturally embedded practices. Such displacement carries a high risk of eroding cultural identity, weakening community cohesion, and undermining CKI-based traditions that are intrinsically linked to the island environment.

Concerns have also been raised regarding the prospect of involuntary or perceived forced relocation, particularly where priority is given to long-term protection of strategic and military infrastructure on West Island while placing less emphasis on the preservation of established community settlements. This asymmetry risks creating perceptions of inequitable treatment, potentially exacerbating community mistrust in government-led planning and decision-making processes.

In addition, uncertainty surrounding housing security, continuity of services, and long-term community viability contributes to heightened social stress. While the Australian Government has committed to further consultation and emergency preparedness funding, significant anxiety persists within the community regarding the future of their island home and the broader implications of managed retreat.

The final CHRMAP released in March 2026 adopts a cautious position, recommending that further technical investigations be undertaken before any permanent retreat pathway is confirmed. As a standalone recommendation, this staged approach is appropriate and consistent with adaptive planning principles. However, the effectiveness and legitimacy of these technical studies depend on their design and implementation. To meaningfully inform decision-making, future investigations should systematically incorporate local knowledge, community values, and cultural context alongside technical and economic analyses.

Without effective project management, timely delivery, and genuine community participation, there remains a risk that prolonged investigation phases may themselves perpetuate uncertainty and social impact, even in the absence of a formal retreat decision.

8.2 Environment

Modelling from the CVA shows that shorelines across the CKI are highly sensitive to erosion driven by wave energy, reduced sediment supply, and rising sea levels. The CVA predicts that these hazards will intensify, resulting in irreversible long-term loss of natural landforms, particularly on low-lying Home Island.

Coastal hazards are projected to degrade ecological systems through several pathways:

- Progressive shoreline recession along lagoon and ocean-facing coasts, with altered sediment transport reshaping shorelines and disrupting seagrass habitats, reef-derived sediment cycles, and marine connectivity;
- Increased inundation and saltwater intrusion, causing changes in vegetation composition, die back of freshwater-dependent species providing structural integrity to land systems, and loss of beach and dune habitats;

- Declining coral reef health under climate-driven stress, reducing carbonate sediment supply and increasing erosion risk; and
- Visible erosion is already occurring at significant sites such as Pulu Gangsa cemetery, lagoon beaches, and parts of West Island.
- Freshwater lenses on Home and West Islands, already thin and vulnerable, are expected to deteriorate further.
- Rising sea levels will increase groundwater salinity, reduce freshwater availability and alter soil moisture regimes critical for vegetation; and
- High tides and storm surges will elevate groundwater tables, reducing infiltration capacity, prolonging ponding, and limiting natural recharge.

These changes threaten native vegetation, soil quality, and long-term water security, and will exacerbate erosion.

Foreshore ecosystems, including dunes, beach-ridge vegetation, and coconut palm forests, function as protective barriers. As erosion and inundation progress:

- Storm overwash will damage dune vegetation and weaken root structures. This will also accelerate coastal erosion;
- Persistent inundation will convert vegetated areas into saline flats or open water, shrinking terrestrial habitats and isolating fauna in addition to flattening topography;
- Coastal species will face increased exposure to storm impacts and saltwater intrusion; and
- Loss of culturally significant sites such as Pulu Gangsa cemetery and traditional resource areas is likely.

These impacts undermine the ecological function of the atoll and the viability of species dependent on low-lying habitats. Climate-driven coastal changes will ultimately compromise the islands' ability to sustain both natural ecosystems and human settlement.

9 Funding

Effective coastal hazard management in Western Australia is supported by a suite of targeted grant programs designed to help Local Governments plan for, assess, and mitigate the risks posed by coastal erosion, inundation, and long-term shoreline change. These funding pathways delivered through State initiatives such as CoastWA and SPP 2.6 coastal planning grants and complemented by Commonwealth resilience funding streams provide essential resources for developing evidence-based CHRMAPs, implementing on-ground protection works, and strengthening local capacity to respond to increasing climate-related coastal pressures. Together, these grants form a critical investment framework that enables Western Australian communities to build long-term resilience in the face of accelerating coastal hazards, however they do not fund the costs of retreat or include retreat-specific provisions.

Funding Pathways for Coastal Hazard Management in WA include:

CoastWA Program (Western Australian State Government)

Primary State-led program supporting Local Governments to plan for, assess, and adapt to coastal hazards.

Key Features:

- Provides strategic guidance for long-term sustainable coastal land-use planning;
- Supports development and implementation of coastal hazard management and adaptation options; and
- Strengthens partnerships between State and Local Governments, especially for smaller or under-resourced LGAs.

Funding:

- $33.5 million (2021–2026) State Government investment; and
- Supports planning, technical assessments, and implementation of hazard-mitigation actions.

State Planning Policy 2.6 (SPP 2.6) – Coastal Planning Grants

To support rigorous coastal hazard risk assessment and strategic adaptation planning in line with SPP 2.6 requirements. Supports local governments in meeting regulatory obligations for evidence-based coastal planning.

Funding Available - Grants up to $200,000 for:

- CHRMAP;
- Hazard assessments;
- CHRMAP components or updates;
- Implementation of CHRMAP actions;
- Coastal strategies (new or reviewed); and/or
- Foreshore management plans (new or reviewed).

WA Coastal Grants Program (Former McGowan Government)

To fund on-ground coastal management and protection works.

Funding:

- $4 million allocated for coastal projects; and
- Supported mitigation efforts in coastal hotspots across WA (e.g., Rottnest Island).

Notes:

- Designed to complement CoastWA by enabling implementation of site-specific hazard-mitigation works; and
- Uptake varied across local governments.

Commonwealth Funding Pathways NEMA Emergency Response Fund (ERF) – *Now Terminated*

Operation Period: 2019–30 June 2023.

Funding Mechanisms:

- Up to $50 million/year for disaster-preparedness or risk-reduction projects; and
- Up to $150 million/year for recovery or resilience-building after a disaster.

Relevance to Coastal Hazards: Supported coastal infrastructure resilience, flood mitigation, and other preparatory works. Status:

- Terminated 30 June 2023; and
- Continues to honour previous commitments.

Disaster Ready Fund (DRF) – *Current Commonwealth Program*

Commencement:
1 July 2023, replacing the ERF.

Focus:

- Nationally significant disaster-risk-reduction projects; and
- Supports resilience investments including those targeting erosion, inundation, coastal flooding, and climate-related hazards.

Eligible uses:

- Coastal protection works;
- Coastal monitoring, modelling and hazard assessments;
- Climate adaptation planning; and
- Resilient infrastructure upgrades.

Table 9-1: Funded Coastal Hazards Projects

Recipient	Year	Project	Description	Grant	Source
City of Greater Geraldton	2022/2023	Sunset Beach – Groynes and Sand Nourishment	Construction of four 70m Geotextile Sand Container groynes plus sand nourishment	$750,000	
City of Fremantle	2022/2023	Port Beach Sand Nourishment – Phase 2 Dune Creation & Stabilisation	Rebuilding sand dunes and upper beach at Port Beach hotspot	$500,000	
City of Albany	2021/2022	Emu Point – Groyne Field Design Optimisation	Optimisation design work for groynes at Emu Point hotspot	$230,000	
City of Albany	2021/2022	Emu Point Groyne	Completion of modelling and finalisation of preliminary & detailed design	$230,000	
City of Stirling	2021/2022	Mettams Pool – Sand Nourishment	Sand nourishment to address erosion at Mettams Pool	$190,000	
City of Mandurah	2025/2026	Town Beach Seawall Upgrade	Upgrade of Town Beach seawall to better protect against coastal erosion plus improvements to public safety, landscaping to support native seedling growth, and protecting Seashells as an important tourism node.	$1.32 million	Hotspot Coastal Adaptation and Protection Grants

Recipient	Year	Project	Description	Grant	Source
City of Wanneroo	2025/2026	Offshore Sand Investigations - Assessment of Placement Methodology and Nearshore Impacts & Quinns Beach and Yanchep Lagoon Renourishment	Assess placement methodologies and nearshore environmental impacts for beach renourishment using offshore sources. Undertake beach renourishment works adjacent to Quinns Beach Carpark, Quinns Dog Beach and Yanchep Lagoon for coastal protection and beach accessibility.	$258,113	Hotspot Coastal Adaptation and Protection Grants
City of Stirling	2025/2026	Mettams Pool Beach - Sand Nourishment year 4	Nourishment year 4 Undertake annual beach nourishment Mettams Pool to protect assets.	$150,000	Hotspot Coastal Adaptation and Protection Grants
Rottnest Island Authority	2021/2022	South Thomson Bay – Revetment Design & Construction	Design and construction of coastal protection structure at South Thomson Bay	$1.77million	McGowan Government
Rottnest Island Authority	2019	Thomson Bay seawall	Highest priority hotspot in WA (per 2019 assessment); seawall protects chalets	$1.77 million	McGowan Government
Shire of Esperance	2022/2023	Esperance Bay – Castletown Sand BackPassing Infrastructure	Installation of a 3.5 km buried pipeline between Bandy Creek	$2.06 million	NEMA - Emergency

Recipient	Year	Project	Description	Grant	Source
			Boat Harbour and Castletown Beach		Response Fund projects
City of Busselton		West Busselton Coastal Stabilisation	Provides longer-term coastal protection to mitigate coastal hazards.	$1.07 million	NEMA - Emergency Response Fund projects
City of Busselton		Vincent Street Seawall Refurbishment	Refurbishes the existing 400m seawall structure for coastal protection.	$1.636 million	NEMA - Emergency Response Fund projects
Shire of Shark Bay		Upgraded revetment for Denham Foreshore and Town Centre	Upgrades the existing foreshore revetment for increased protection from coastal hazards, including inundation.	$1.609 million	NEMA - Emergency Response Fund projects
City of Cockburn	2021/2022	C.Y. O'Connor Beach – Engineered Fringing Reef	Installation of engineered reef modules as a coastal management trial	$600,000	NEMA - Emergency Response Fund projects
Torre Strait Island	2023/2024	Poruma Seawall builds climate resilience	Stage 2: The one-kilometre-long seawall is among completed works to mitigate coastal inundation and erosion on low-lying coral cay island community, north of Cairns.	$5 million	Seawall package co-funded by the Albanese Labor Government and the Queensland Government.

The investigations identified in this review, including erosion and inundation modelling, environmental baseline assessments, engineering feasibility studies, and groundwater studies, are consistent with the types of work eligible for support under the programs described above.

10 Case Studies

10.1 Tuvalu

The Tuvalu Coastal Adaptation Project (TCAP), financed by the Green Climate Fund (GCF) and implemented by the Government of Tuvalu and UNDP, was approved in June 2016, with implementation commencing on 7 June 2017. The project constitutes one of the largest climate-resilience investments undertaken in Tuvalu and aims to reduce the acute vulnerability of low-lying atoll environments to sea-level rise, storm surges, coastal erosion, and extreme wave events. Three islands Funafuti, Nanumea, and Nanumaga were prioritised based on their exposure to coastal hazards, population concentration, and the value of social and economic assets at risk.

TCAP adopts a climate-informed, engineering-and-ecosystem-based approach tailored to the geomorphological and socio-cultural context of atoll nations. The project's Environmental and Social Management Plan (ESMP) provides the safeguards framework for all coastal-protection works. Developed in alignment with UNDP Social and Environmental Standards (SES) and informed by Environmental and Social Impact Assessments (ESIAs), the ESMP responds to moderate-level environmental and social risks, including impacts to marine and terrestrial habitats, community health and safety, construction-related disturbance, gender and inclusion concerns, and Indigenous Peoples' rights.

The Interim Evaluation found that TCAP's design is underpinned by a strong analytical foundation incorporating hydrodynamic modelling, coastal-process assessments, and economic and financial analysis. The project is assessed as highly relevant to Tuvalu's national adaptation priorities, strengthening long-term resilience to climate-driven coastal hazards.

Funafuti: Large-Scale Reclamation

Funafuti, which hosts the majority of Tuvalu's population and critical national infrastructure, was selected for the most extensive engineering intervention. Feasibility studies recommended large-scale land reclamation as the preferred option for reducing overtopping, shoreline instability, and inundation risk.

The reclamation is designed to:

- Provide a long-term buffer against wave runup and storm-driven flooding;
- Create additional land area for public services and essential infrastructure; and
- Stabilise the lagoon shoreline by reinstating a more continuous, higher-energy foreshore system.

This intervention represents a major physical transformation of Funafuti's hazard-prone coastal zone and is intended to offer multi-decadal protection under projected sea-level-rise scenarios.

Nanumaga: Berm Reinforcement and Access Infrastructure

Nanumaga's selection reflects severe damage caused by Tropical Cyclone Pam (2015), which highlighted the island's exposure to wave overtopping, coastline loss, and infrastructure vulnerability. TCAP's works focus on a 450-m high-value zone on the western coast, where homes, community facilities, and the existing boat harbour are concentrated.

The intervention included:

- Construction of a Berm Top Barrier (BTB) to elevate protective berms and reduce overtopping;
- Extension of a cellular concrete boat ramp, improving marine access while simultaneously strengthening coastal defences. These measures are designed to reduce erosion, safeguard livelihoods, and maintain essential transport functions; and
- Safeguards, Governance, and Social Outcomes.

The ESMP establishes comprehensive management strategies addressing ecology, groundwater, surface water, air quality, noise and vibration, erosion and sedimentation, waste management, unexploded ordnance (UXO), social impacts, cultural heritage, and emergency response. Notable measures include:

- Restrictions on vegetation clearance and light/noise control to protect fauna;
- Groundwater protection through fuel-storage bunding, controlled refuelling, and monitoring;
- Dust suppression, emission controls, and restrictions on work hours to minimise disturbance;
- Site-specific Erosion and Drainage Sediment Control Plans (EDSCPs) to reduce sediment loads in highly erodible atoll soils;
- Waste minimisation guided by the avoid–reduce–reuse–recycle hierarchy and
- Cultural heritage protection via chance-find procedures and ongoing community engagement.

Given the sensitivity of Tuvalu's environmental and cultural landscape, safeguard implementation is central to project delivery. The Interim Evaluation highlighted the need for stronger monitoring, documentation of safeguard processes, and continued attention to gender inclusion, GBV prevention, and community participation.

The evaluation concludes that TCAP is strategically relevant, technically robust, and progressing toward its intended outcomes, but requires improvements in:

- Project management efficiency;
- Safeguards monitoring and documentation; and
- Long-term financial planning for maintenance and sustainability.

Despite these challenges, TCAP is positioned to deliver transformative coastal-adaptation benefits, demonstrating workable, scalable solutions for atoll nations confronting existential climate risks. The project's integration of engineering design, local sediment resources, nature-based principles, and community-driven decision-making provides a model for climate-resilience programming across the Pacific and other small-island developing states.

Figure 10-1: Coastal Hazard Adaption Works on Tuvalu

10.2 Torres Strait Islands

The Torres Strait is a region of exceptional cultural and environmental significance, home to 18 communities across 17 islands and characterised by outstanding marine biodiversity, including the world's largest dugong population, extensive seagrass meadows, diverse coral reefs, and rich mangrove systems. The region faces severe climate-change risks, most critically progressive sea-level rise, coastal erosion, and frequent inundation, which are already affecting infrastructure, cultural heritage, food security, and community wellbeing. Islands across the region exhibit diverse geomorphology continental remnants, coral cays, volcanic islands, and low-lying deltaic mud islands yet most settlements lie in hazard-prone coastal zones. Exacerbating factors include remoteness, high coast-to-land ratios, and widespread Indigenous disadvantage. Communities such as Boigu and Saibai, which sit barely above sea level, experience annual tidal inundation, with flooding entering from both the ocean and swamp systems behind settlements. Consequences include sewage system failures, contamination of drinking water, damage to homes, loss of crops, dispersal of waste, crocodile incursions, and erosion of graves an issue causing considerable distress.

Coral cays such as Poruma face acute shoreline erosion, exacerbated by changes in natural sediment dynamics and infrastructure such as barge ramps. Losses include culturally significant coconut palms and important community land. Traditional systems once allowed for flexible settlement relocation, but modern infrastructure and mapped land boundaries limit mobility. Sea-level rise in the Torres Strait is not only a physical hazard but a cultural existential threat.

Torres Strait Islanders (Ailan Kastom) have deep ancestral ties to their land and sea country; relocation would disrupt identity, cultural continuity, and land-ownership systems. As each island has its own Traditional Owners, relocation to another island would make affected communities' "refugees" on someone else's land. Consequently, adaptation options such as relocation carry profound cultural, political, and social impact The Torres Strait Regional Authority (TSRA), in collaboration with Queensland Government agencies, TSIRC, and researchers, established a long-term program to assess risks and design adaptation strategies. Key milestones include:

- Formation of the Land and Sea Management Unit (2005) to build the evidence base for adaptation and government investment;
- Rapid coastal assessments identifying six high-risk communities (Saibai, Boigu, Warraber, Poruma, Masig, Iama);
- Community-informed sediment transport and coastal process studies by Dr Kevin Parnell, including sea-level rise mapping to identify vulnerable areas; and
- Development of community-endorsed management plans recognising that hard engineering is often the only feasible option, but with potential secondary impacts.

Accurate tidal datums were historically lacking. Early seawall construction (e.g., on Boigu) used incorrect datum values, resulting in walls far too low to protect communities. New tide gauges installed from 2009 onward now supports reliable planning. Sea-level rise in the region is 6–8 mm/year, significantly above the global average of ~3.2 mm/year, adding urgency to adaptation.

An estimated $26 million was needed for initial priority works. Funding was secured through a combination of Commonwealth and Queensland Government investment, catalysed by a $5 million Regional Development Australia grant in 2013. TSIRC manages project delivery supported by a multi-agency governance structure. Major seawall works began at Saibai in 2015.

Long-term options include accommodate, defend, and retreat/relocate, with adaptation pathways developed to map likely transition points, investment requirements, and thresholds for action. Economic models are being developed to compare the long-term costs and benefits of defend versus retreat strategies, incorporating probabilistic water-level modelling.

A Regional Adaptation and Resilience Plan is being developed to guide community conversation and future decision-making, acknowledging both the technical challenges and the deep cultural implications of adaptation.

The case study underscores that the Torres Strait faces some of Australia's most complex and culturally significant climate-change challenges. Adaptation requires:

- Accurate scientific data;
- Culturally grounded planning;
- Long-term investment; and
- Inclusive governance and local agency.

Ultimately, while difficult decisions may lie decades ahead, proactive planning and strong cultural leadership will shape the future resilience of Torres Strait communities.

10.3 Sand Motor, The Netherlands

The Sand Motor (Dutch: Zandmotor) is a coastal nourishment project constructed in 2011 on the coast of the Netherlands in South Holland. Approximately 21.5 million cubic metres of sand as a broad peninsula extending roughly 2.5 km into the North Sea, forming a sediment reservoir from which wind, waves, and tidal currents redistribute material along the adjacent 17 km shoreline over a 20-year design period. The project was developed under the Dutch Building with Nature program as an alternative to repeated small-scale nourishments that had previously been required every several years to arrest chronic shoreline recession on the Delfland coast. Long-term monitoring led by Deltares and TU Delft (Deltares, 2016) has confirmed that sediment redistribution is proceeding broadly in line with modelled predictions, with the original peninsula progressively flattening and beach widths increasing at locations along the coast, as shown in Figure 10-2.

The Sand Motor received the PIANC Outstanding Civil Engineering Achievement Award in 2017. Stive et al. (2013, Journal of Coastal Research) assessed it as a reference case for large-format nourishment replacing multiple smaller interventions at lower whole-of-life cost and with reduced ecological disturbance from construction activity(Stive, 2013).

Figure 10-2: The South Holland Coastline Prior to the Sand Motor (Top, December 2010), After the Construction of the Sand Motor (Middle, July 2013), and Over 10 Years After Construction (Bottom, June 2025) [Source: Google Earth]

A comparable nourishment strategy warrants investigation for the CKI. The CVA coastal morphology analysis identifies nodal points at the southern ends of West Island and Home Island where sediment naturally enters each island system (Figure 10-3 and Figure 10-4). Sand deposited at these nodal points would be redistributed progressively northward along the ocean-facing shorelines by natural wave and current action. Beach widths would increase and wave overtopping frequency would reduce without the construction of hard coastal structures.

Figure 10-3: Conceptual Coastal Processes Model for the West Island (CVA Figure 64)

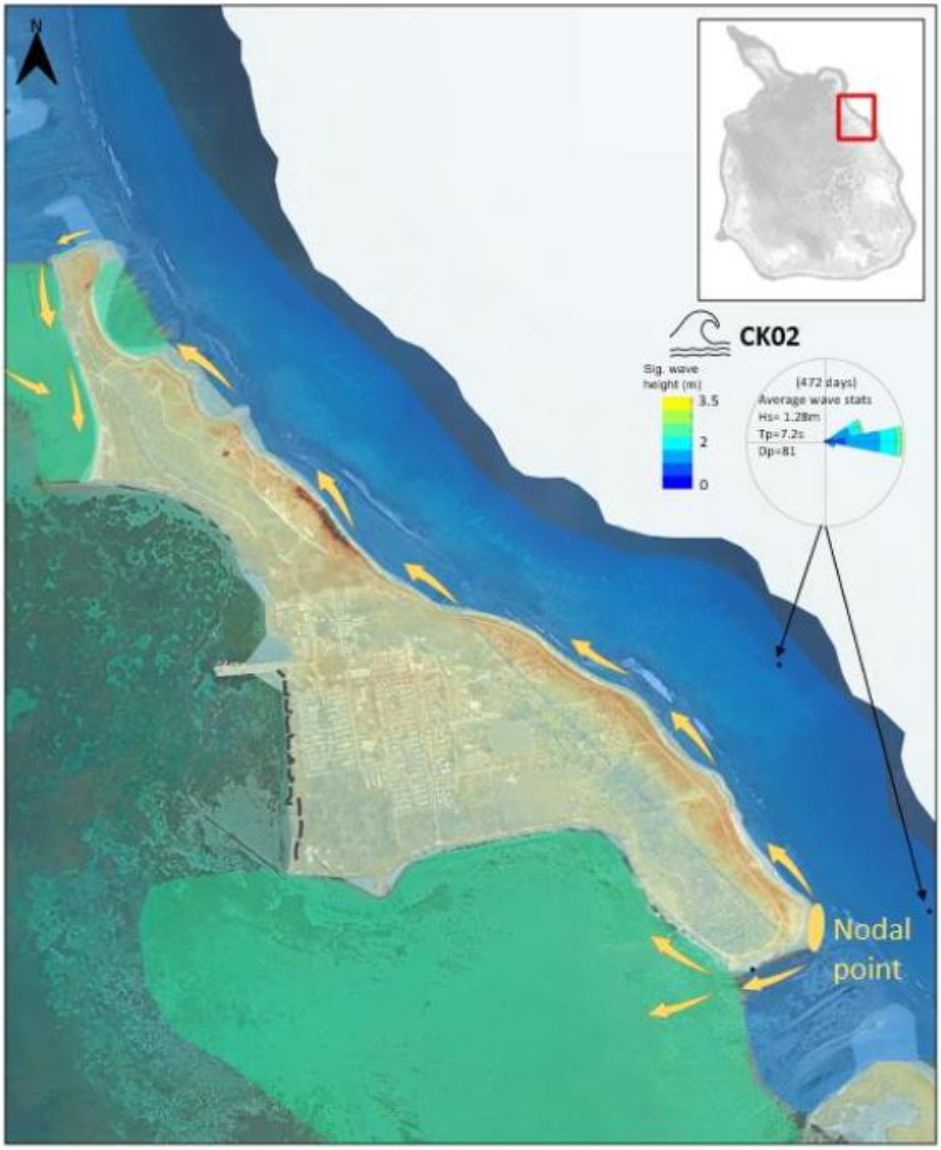

Figure 10-4: Conceptual Coastal Processes Model for the Home Island (CVA Figure 65)

Source material could be dredged from the lagoon floor in areas of natural sand deposition outside the designated marine park boundaries, as shown in Figure 10-5, which confirms that there are suitable dredge zones which do not conflict with protected reef habitats. The nodal areas on West Island and Home Island are also outside of the Marine Park areas. Section 4.3.9.3 of the CKI Marine Park Management Plan 2025 also specifically allows for dredging and the disposal of dredged material within the marine park where it has been assessed as necessary for critical infrastructure and safety.

This beach nourishment approach is consistent with the SPP 2.6 adaptation hierarchy, which prioritises accommodation over protection. The volume of sediment required and the dredge cycle frequency would be determined through detailed coastal process modelling calibrated to CKI conditions to ensure the program is sized with adequate allowance for ongoing shoreline adjustment.

Lagoon dredging for sediment replenishment has been undertaken on Pacific atolls including Funafuti in Tuvalu, establishing that the approach is feasible in low-lying coral island settings with similar reef-flat and lagoon morphology (see Section 10.1 above).

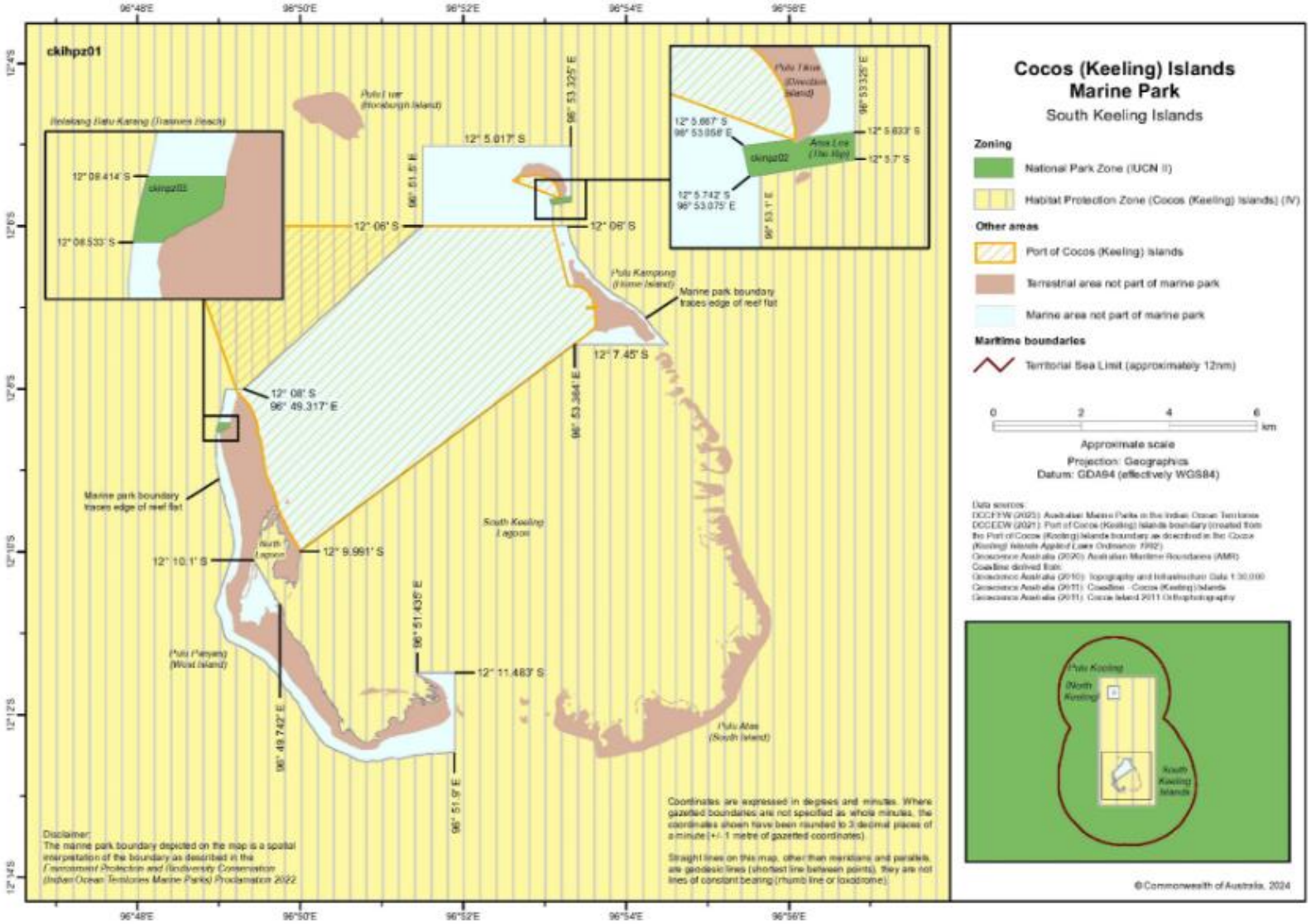

Figure 10-5: Cocos (Keeling) Islands Marine Park and Port Area (Department of National Parks and Australian Marine Parks, 2025)

10.4 Bacton to Walcott and Benin Sandscaping Schemes

The Bacton to Walcott Sandscaping Scheme, completed in 2019, is the first sandscaping project undertaken in the United Kingdom. This project applies the same large-format beach nourishment methodology used by the Sand Motor to the North Norfolk coast. Coastal modelling for the project was undertaken by Royal HaskoningDHV, the same firm that prepared the CKI CVA. The project was delivered by North Norfolk District Council in partnership with Bacton Gas Terminal operators Shell UK Ltd and Perenco UK Ltd, and the Environment Agency, at a total cost of approximately £21 million. Approximately 1.8 million cubic metres of sand was placed on the beach frontage between the gas terminal and the village of Walcott, raising and widening the beach profile to act as a natural buffer against wave attack and erosion of the backing cliffs and coastal defences (Cotton I, 2022).

Post-construction monitoring has confirmed the scheme is performing as designed. In the first six months of operation, the terminal frontage lost approximately 56,000 m^3 of sediment while the village frontages gained approximately 112,000 m^3, confirming the intended down-drift redistribution pathway with no measurable loss of sediment to deep water. By November 2020, waves were breaking further offshore, reducing wave energy reaching the backing cliffs and defences (North Norfolk District Council, 2026). By June 2021, cumulative sediment loss across the project stood at approximately 247,000 m^3, representing around 14% of the 1.8 million cubic metres placed, with overall beach levels remaining above the pre-construction baseline. A quantified benefits assessment four years after construction found that approximately £3.1 million in flood and erosion damages had been prevented (Borsje et al., 2025). Modelled projections indicate the scheme will extend coastal protection for the gas terminal for 15–20 years before significant renourishment is required. The scheme has been assessed in peer-reviewed literature as a replicable model for combining critical infrastructure protection with community coastal adaptation in studies published in Frontiers in Marine Science (Cotton I, 2022) and Regional Environmental Change (Lorenzoni, 2024)

Following the Dutch and English sandscaping schemes described above, the sandscaping concept has since been applied beyond Northern Europe. In May 2023, a sand motor was completed on the coast of Benin in West Africa, constructed by Boskalis with $60 million in World Bank funding as part of a broader $500 million adaptation initiative targeting coastal erosion across the Gulf of Guinea. The project involved the placement of over approximately 6 million cubic metres of sand at roughly one-third the scale of the original Dutch project. Benin's coastline loses up to 45 feet of beach annually in the most severely affected areas, with coastal erosion across the Gulf of Guinea region estimated to eliminate approximately 5% of regional GDP annually if left unaddressed. The Benin project is the first application of the sandscaping methodology outside temperate European conditions and shows the concept is transferable to tropical developing-nation coastlines (Bittle J, 2024).

The three sandscaping projects described above range in scale from 1.8 million to 21.5 million cubic metres. The volume required at CKI would be a fraction of these figures. West Island is approximately 10 km in length and Home Island less than 2 km, and the proposed approach targets only two nodal deposition points on the ocean sides of the islands rather than continuous beach nourishment along the full coastline. Each of these projects involved volumes substantially greater than what the CKI application would require, and each confirms the methodology is viable well beyond the scale that would be needed here.

Figure 10-6: The Bacton to Walcott Coastline Prior to Sandscaping (Top, May 2011), During Sandscaping (Middle, July 2019), and After (Bottom, October 2024) [Source: Google Earth]

11 Recommendations and Next Steps

11.1 Future Review Pathway

The investigations identified in this review form a coordinated program, not individual corrections to the CHRMAP. They can be sequenced across three phases aligned with the final CHRMAP's five-year review cycle.

Phase 1 — Immediate Investigations (0–2 years)

These investigations are ready to proceed and are prerequisites for later phases:

- Cost-benefit analysis comparing protect and retreat pathways for Home Island (identified as Action 2 in the final CHRMAP);
- Groundwater and terrestrial flood study;
- Establishment of environmental and coastal monitoring programs; and
- Sand source and availability investigation.

Phase 2 — Technical Studies (1–3 years)

These studies require Phase 1 outcomes or independent funding:

- Atoll-specific erosion modelling under SPP 2.6 Schedule 1 Section 4.9;
- Environmental baseline investigations (biological surveys, water quality, sediment studies); and
- Engineering feasibility and concept design for protection options.

Phase 3 — CHRMAP Review (3–5 years)

With Phase 1 and Phase 2 outcomes completed, a revised CHRMAP can be prepared on a sound evidence base. This review's findings on the erosion model, the risk framework, the MCA, and the economic analysis provide a checklist for what that revised CHRMAP should address.

11.2 Ongoing Coordination and Collaboration

The investigation program outlined in Section 11.1 will require coordinated effort between the Australian Government and the Shire. The Australian Government holds responsibility for funding major infrastructure on the CKI and has access to technical agencies and funding mechanisms that the Shire cannot access independently. The Shire holds planning authority and community relationships that are essential to ensuring investigations are designed around the needs and values of the CKI community. Investigations designed without this coordination risk producing outputs that are technically sound but difficult to implement, or that do not reflect community priorities. Talis recommends that a formal coordination framework be established between the Australian Government and the Shire to govern the phased investigation program.

11.3 Detailed Recommendations

Based on a review of the documentation, there are a number of gaps, inconsistencies and areas requiring further refinement across several components of the CHRMAP. Collectively, these issues limit the extent to which the document, in its current form, fully achieves its original intent of providing

a robust and well-substantiated framework for Coastal Hazard Risk Management and Adaptation. The following considerations are therefore identified:

- The coastal hazard assessment as presented is overly conservative and applies methods that the CVA itself states are unsuitable for island atoll planning ;
- The risk and vulnerability assessment adds to this conservatism through departures from the WAPC guidelines that are not explained in the document, producing risk ratings more conservative than the WAPC framework would generate;
- The analyses used to evaluate and compare adaptation options appear incomplete;
- The MCA contains scoring errors and covers only short-term options;
- The draft CHRMAP BDA pre-assumed retreat as the only viable long-term outcome without prior analysis establishing this as the only viable pathway. The final CHRMAP explicitly deferred permanent retreat pending the outcomes of further technical studies, however retreat is still considered as a preferred option based on the risk management hierarchy;
- No cost-benefit analysis was completed, but has been recommended within the Final 2026 CHRMAP;
- The environmental values of the CKI, including its biodiversity, ecological function, and legislative obligations across multiple State and Commonwealth Acts, are not adequately addressed and no consideration of EIA has been presented; and
- The CHRMAP does not identify a credible funding pathway for its primary recommendation of managed retreat, while existing State and Commonwealth funding programs are available to support protection works.

Talis recommends that the items identified in this report be addressed in the next CHRMAP review. The recommendations of this report are summarised in Table 11-1.

Table 11-1: Recommendations

Report Section	Recommendation
3.1 Erosion Risk	
3.1	A priority investigation for the next CHRMAP review should be development of atoll-specific erosion modelling under SPP 2.6 Schedule 1 Section 4.9. The current erosion allowance derives 96% of its total from two factors (S3 and uncertainty) that are based on mainland sandy coast formulas and have not been calibrated for coral atoll conditions.
3.1.1	The uniform 90m S3 allowance should be replaced with a site-specific assessment using SPP 2.6 Schedule 1 Section 4.9 (island case-by-case assessment), not Section 4.4 (sandy coasts). This investigation should be completed before any long-term erosion-based adaptation decision is finalised.
3.1.2	The uniform 0.2m/year uncertainty factor should be replaced with a probabilistic sensitivity analysis representing the actual range of erosion outcomes on atoll shorelines.

Report Section	Recommendation
3.2 Inundation Risk	
3.2.1	Adopt the 1% AEP (1:100 ARI) as the planning benchmark for inundation, consistent with AIDR Handbook 7, NSW Coastal Management SEPP, and Queensland coastal guidelines. Reserve the 1:500 ARI for critical infrastructure design only.
3.2.2	Replace the single deterministic design event with a probabilistic scenario-based assessment that characterises the likelihood and consequence of a range of inundation events.
4.3	Complete the further studies recommended by the CVA before drawing any conclusions from the hazard data. The CVA explicitly states that using its results without those further investigations will lead to maladaptation.
3.4	Establish through a formal determination whether SPP 2.6 applies to CKI, and where it is used, apply Section 4.9 (island-specific case-by-case assessment) rather than the mainland coastal formulas.
4 Review of Risk and Vulnerability Assessment	
4.1	Correct the hazard assessment per Section 4 before repeating the risk and vulnerability assessment. All downstream risk ratings are dependent on accurate hazard inputs.
4.2	Adopt the WAPC guidelines likelihood criteria, model the full range of AEP events required by those guidelines, and clarify and align the likelihood methodology in CHRMAP Section 4.1.
4.3	Include all consequence categories required by the WAPC guidelines (Infrastructure and Safety in addition to the existing criteria) and calibrate consequence ratings against the WAPC framework.
4.4	Adopt the WAPC guidelines risk matrix without modification, or document and justify any departures from it.
4.5	Reinstate the "No Adaptation Required" category in the adaptive capacity scale to match both the CVA and the WAPC guidelines.
4.6	Align the vulnerability matrix with the WAPC guidelines matrix and reassess all vulnerability ratings under the corrected framework.
4.7	Redo the full risk and vulnerability assessment using the unmodified WAPC guidelines framework. The current assessment compounds conservatism at multiple stages, which limits its suitability as a basis for defensible adaptation decisions.
5 Review of Risk Treatment Options	
5.1 Multi-Criteria Analysis	
5.1.1	Expand the MCA to cover medium- and long-term timeframes and add criteria for legal obligations, cultural heritage, and strategic value.
5.1.2	Revise the pre-screening methodology. Options should only be excluded if they are technically incapable of reducing the specific hazard they are designed to address, and the basis for each exclusion should be documented.
5.1.3	Address all scoring inconsistencies identified in this section, include options not included in the initial assessment, and document the basis for each score against each criterion.

Report Section	Recommendation
5.1.4	Apply the defined weightings to the MCA and conduct a sensitivity analysis on the weighting scheme to test whether the recommended option is robustly preferred. Weightings should be justified and aligned with all stakeholders through adequate consultation.
5.1.5	Conduct a long-term MCA. The current MCA assessed only short-term options and cannot support long-term recommendations.
5.1.6	Rerun the MCA covering all timeframes before it is used to support any adaptation recommendation. The current MCA requires substantial rework and cannot support the decisions it is being used to justify.
5.2 Benefit Distribution Analysis	
5.2.1	The 94.3% private benefit finding should be referenced alongside its stated limitations. It is based on an analysis that assumes retreat and excludes essential services infrastructure, including the CKI airport and Department of Defence assets.
5.2.2	Expand the BDA to cover all adaptation pathways, include the full cost of retreat, and incorporate the strategic and defence value of CKI infrastructure.
5.2.3	Redo the BDA without a pre-assumed retreat outcome, test a range of NPV assumptions, and include a sensitivity analysis on the benefit distribution percentages.
5.2.4	Do not apply the user-pays principle mechanically where the identified beneficiary (the Trust) has explicitly insufficient financial capacity. Assess alternative funding models. Also consider the disbursed benefits through CKI's strategic location.
5.2.5	Complete the CBA that the BDA was designed to precede. The BDA findings cannot support adaptation decisions without it.
5.2.6	A priority action in the next CHRMAP review is ensuring the BDA's stated limitations are clearly reflected in adaptation decisions. The BDA notes that it is not intended for assessing long-term Home Island options, and this context should be clearly conveyed in the CHRMAP.
5.3 Cost-Benefit Analysis	
5.3.1	A detailed cost-benefit analysis comparing protect versus retreat pathways for Home Island should be prioritised as an immediate investigation. The final CHRMAP identifies this as outstanding. Completing it will provide the economic foundation for all subsequent adaptation decisions.
5.3.2	Complete a cost comparison of both the protect and retreat pathways for Home Island before any long-term recommendation is made. This is the central decision for the CHRMAP.
5.3.3	Complete a full CBA including lifecycle cost estimates, a benefit-cost ratio for each option, and an assessment of the sunk cost risk if a pathway is subsequently abandoned.
6 Review of CHRMAP Recommendations	
6.1	Do not present long-term recommendations while simultaneously acknowledging they are contingent on analysis that has not been completed.

Report Section	Recommendation
6.2	Clarify whether an additional long-term MCA was completed but not included in the CHRMAP. If not, the long-term recommendations lack an analytical basis and should be withdrawn.
7 Environmental CHRMAP Gaps and Limitations	
7.1	Environmental baseline investigations, including biological surveys, water quality sampling, sediment studies, and contaminated sites assessment, should be prioritised as a coordinated package to inform future adaptation planning and any project environmental assessment. These investigations should be completed before any adaptation option requiring EPBC Act or EPA Act approvals is progressed. The environment should be included as a primary asset category in the next CHRMAP risk assessment.
7.2	Conduct contaminated sites investigations on required assets such as fuel farm, petrol stations and cemetery.
7.3	Shire of CKI to create and implement an Environmental Management Plan, in order to inform decision making, prioritise on ground works and protect the natural environment on island.
7.4	Seek funding to have an environmental officer, to incorporate environmental works as business as usual, including restoration and rehabilitative works.
7.5	Incorporate environmental assets into CKI strategic planning, including planning schemes.
7.6	Create and coordinate an environmental monitoring program incorporating rolling impact assessments for programmed works.
7.8	Commission terrestrial and aquatic, biological surveys to better understand the natural environment of CKI and inform decision making.
7.9	Water quality sampling program to understand works required, including sea water quality analysis for impacts to marine park and fresh water for impacts to vegetation and human health concerns.
7.10	Sediment studies for both marine and freshwater ecosystems, to further understand impacts to the environment and works required mitigation purposes.
7.11	Form a community working group with forms of government to protect sensitive community and environmental interests.
8 Funding	
8.1	Identify and use existing programs such as the Disaster Ready Fund and CoastWA program to fund the additional investigations and revised CHRMAP. Existing funding supports protection works but does not cover retreat costs.
10 Case Studies	
10.1 & 10.2	Conduct a full analysis of similar sites in Australia and internationally to ensure that all adaptation pathways are considered.
10.3 & 10.4	Lagoon dredging for sediment replenishment has been established in Pacific atoll settings. sandscaping should be assessed as a long-term protection option for CKI.

Report Section	Recommendation
10.3 & 10.4	Include a preliminary sand volume estimate and feasibility assessment for sandscaping at CKI in the next CHRMAP iteration. Complete conceptual designs for this and other adaptation options to inform a proper Cost-Benefit Analysis.
11 Recommendations and Next Steps	
11	It would be beneficial to scope and fund the additional technical investigations as a coordinated package. Revising and finalising the CHRMAP is best undertaken after these investigations are completed.

To ensure that the CHRMAP effectively supports decision-making and is aligned with both State and Commonwealth legislative frameworks, it is recommended that references to SPP guidance be reviewed and removed where they are not directly applicable to the CKI context. In their place, guidance should be developed specifically for island and atoll territories, ensuring that it is both legislatively compliant and appropriately tailored to the unique environmental, geographic, and governance setting of CKI.

A comprehensive program of targeted on-ground studies and technical assessments should be undertaken prior to the implementation of CHRMAP related works. These investigations should be designed to address identified data gaps and strengthen the scientific and technical evidence base underpinning the plan. This will ensure that proposed management actions are robust, defensible, and capable of meeting relevant regulatory and legislative requirements.

The increased emphasis on community involvement throughout the CHRMAP is acknowledged and strongly supported. To further enhance this approach, it is recommended that an on-island working group be established, comprising local stakeholders and supported by technical specialists. This working group should also include representation from the Shire, either through a dedicated staff member or an appointed representative. This role would facilitate effective communication between Commonwealth agencies and the Shire, provide local context to decision-making processes, and support advocacy on key environmental and community issues.

Given that a number of knowledge gaps have been identified, it is imperative that future efforts prioritise the collection of high-quality baseline data and the improvement of analytical rigour. Strengthening the scientific foundation of the CHRMAP will enhance its utility as a decision-support tool and ensure that management actions are consistent with statutory environmental responsibilities and obligations applicable to the CKI.

It is also recommended that the Shire consider independently funding priority investigations and studies aligned with its strategic objectives. This would enable the Shire to proactively support its position on sensitive or high-priority issues, reduce reliance on Commonwealth timelines, and avoid constraints associated with differing Commonwealth priorities. In doing so, the Shire should also remain cognisant of the Commonwealth's broader obligations under international frameworks such as the Paris Agreement, including responsibilities to address and mitigate the disproportionate impacts of climate change on island environments, which often contribute minimally to global emissions yet experience heightened vulnerability.

12 References

Australian Government Director of National Parks and Australian Marine Parks (2025) *Cocos (Keeling) Islands Marine Park Management Plan*. Available at: https://australianmarineparks.gov.au/static/c3cf256f8e04c46783c7786a8d58e764/amp-ckimp-management-plan-2025.pdf.

Australian Government Defence (2026) *Cocos (Keeling) Islands Airfield Upgrade*. Available at: https://www.defence.gov.au/about/locations-property/infrastructure-projects/cocos-keeling-islands-airfield-upgrade.

Australian Government National Emergency Management Agency (2024) *Coastal and Estuarine Risk Mitigation Program*. Available at: https://www.nema.gov.au/our-work/resilience/coastal-and-estuarine-risk-mitigation-program.

Australian Institute for Disaster Resilience (2020) "National Emergency Risk Assessment Guidelines," Australian Disaster Resilience Handbook Collection [Preprint]. Available at: https://www.aidr.org.au/media/7600/aidr_handbookcollection_nerag_2020-02-05_v10.pdf.

Bittle J (2024) Can the "sand motor" save West Africa's eroding coast?, Engineers Australia . Available at: https://createdigital.org.au/sand-motor-west-africa-eroding-coast/.

Borsje, R. et al. (2025) "BACTON SANDSCAPING: QUANTIFIED BENEFITS 4 YEARS AFTER CONSTRUCTION," Coastal Engineering, 38. Available at: https://icce-ojs-tamu.tdl.org/icce/article/view/13984.

Bureau of Meteorology (2024) *Cocos & Christmas Island Weather*.

Cotton I, F.J.L.I. and T.T. (2022) "Understanding perceived effectiveness of a novel coastal management project: The case of the Bacton-Walcott sandscaping scheme, UK," Frontier in Marine Science: Coastal Ocean Processes, 9. Available at: https://www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2022.1028819/full.

Deltares (2016) Development of the Sand Motor. Available at: https://cms.deltares.nl/assets/common/downloads/Brochure-Ontwikkeling-van-de-Zandmotor_ENG-1_compressed.pdf.

Bureau of Meteorology (2024) *Cocos & Christmas Island Weather*.

The Department of Infrastructure, Transport, Regional Development, Communications, Sport and the Arts, Department of Planning, Lands and Heritage. and Shire of Cocos Keeling Islands (2024) *The Cocos (Keeling) Islands Coastal Hazard Risk Management and Adaptation Plan ACKNOWLEDGEMENTS*.

Department of Water and Environmental Regulation (2023) *Contaminated Sites Database Interactive Map*. Available at: https://www.wa.gov.au/service/environment/environment-information-services/find-known-contaminated-site.

Department of Planning, Lands and Heritage (2006) *State Planning Policy No. 2.6 - State Coastal Planning Policy*. Available at: https://www.wa.gov.au/system/files/2021-07/SPP-CST-SPP2-6_Policy.pdf.

Department of Biodiversity Conservation and Attractions (2025) *Dandjoo Biodiversity Data Repository*. Available at: https://dandjoo.bio.wa.gov.au.

Department of Climate Change Energy the Environment and Water (2025) *Protected Matters Search Tool*. Available at: https://pmst.environment.gov.au/#/map?lng=131.52832031250003&lat=-28.6905876542507&zoom=5&baseLayers=Imagery,ImageryLabels.

https://www.wa.gov.au/system/files/2021-07/SPP-CST-SPP2-6_Policy.pdf.

Falkland, A.C. and Woodroffe, C.D. (2004) "Geology and Hydrogeology of the Cocos (Keeling) Islands," *Developments in Sedimentology*, 54, pp. 885–908. Available at: https://www.sciencedirect.com/science/chapter/bookseries/abs/pii/S0070457104800530.

GHD (2021a) *CPS 10428-1 - Supporting Information - Flora and Fauna Airfield Report*.

GHD (2021b) *Supporting Information - Flora and Fauna Report Airfield*.

GHD (2022a) *CPS 11049-1- Supporting Document - Technical Memorandum*.

GHD (2022b) *Supporting Information-Flora and Fauna Lot 3003*.

GHD (2023) "CPS 10428-1 - Supporting information - Flora and fauna Report Enabling Works Area."

Government of Western Australian Department of Transport and Major Infrastructure (2026) *Coastal Studies* . Available at: https://www.transport.wa.gov.au/marine/projects-coastal-management/coastal-erosion-management/coastal-studies#anchor-link-1.

Intergovernmental Coastal Hazards Working Group (2023) *Towards a National Collaborative Approach to Managing Coastal Hazards in Australia*. Available at: https://www.wa.gov.au/system/files/2024-11/towards-a-national-collaborative-approach.pdf.

Lorenzoni, I., D.S.A., M.M. et al. (2024) "Innovation in coastal governance: management and expectations of the UK's first sandscaping scheme," Regional Environmental Change, 24. Available at: https://link.springer.com/article/10.1007/s10113-024-02248-x.

National Archives of Australia (no date) *The Cocos (Keeling) Islands - Fact Sheet 103*. Available at: https://www.naa.gov.au/sites/default/files/2020-05/fs-103-the-cocos-keeling-islands.pdf.

North Norfolk District Council (no date) Bacton to Walcott Coastal Management. Available at: https://www.north-norfolk.gov.uk/sandscaping.

Royal Haskoning DHV (2021) *Cocos (Keeling) Islands Coastal Vulnerability Study Assessment Report (Volume I)*. Available at: www.dplh.wa.gov.au.

Royal Haskoning DHV and Bluecoast Consulting Engineers (2021) *Cocos (Keeling) Islands Coastal Vulnerability Study Assessment Report (Volume II)*. Available at: www.dplh.wa.gov.au.

Shape Urban, Australian Government Department of Infrastructure, T.R.D.C. and the A. and Western Australian Department of Planning Lands and Heritage (2024) *The Cocos (Keeling) Islands Coastal Hazard Risk Management and Adaptation Plan DRAFT*.

Shire of Cocos (Keeling) Islands (2026) *The Shire* . Available at: https://www.cocoscrc.net/cocos-islands-shire-council.html#:~:text=On%20the%201st%20July%201992%20the%20Territories%20Law,Western%20Australian%20laws%20to%20the%20Cocos%20%28Keeling%29%20Islands.

Stive, M.J.F.; de S.M.A.; L.A.P.; A.S.G.J.; van G.-M.C.; van T. de V.J.S.M.; de V.S.; H.M.M.S., and R.R., (2013) "A New Alternative to Saving Our Beaches from Sea-Level Rise: The Sand Engine," BioOne [Preprint]. Available at: https://bioone.org/journals/journal-of-coastal-research/volume-29/issue-5/JCOASTRES-D-13-00070.1/A-New-Alternative-to-Saving-Our-Beaches-from-Sea-Level/10.2112/JCOASTRES-D-13-00070.1.short.

The Department of Infrastructure Transport Regional Development Communications Sport and the Arts (2026) *Cocos (Keeling) Islands Environment and Heritage*, *2026*. Available at: https://www.infrastructure.gov.au/territories-regions/territories/indian-ocean-territories-christmas-island-and-cocos-keeling-islands/cocos-keeling-islands/cocos-keeling-islands-environment-and-heritage#anc_ff.

The Department of Infrastructure Transport Regional Development Communications Sport and the Arts (2026) *Cocos (Keeling) Islands Governance and Administration*. Available at:

https://www.infrastructure.gov.au/territories-regions-cities/territories/indian-ocean-territories/cocos-keeling-islands/governance-administration.

The Government of Western Australia (2022) *Coastal Hazard Risk Management and Adaptation Planning Guidelines*. Available at: https://www.wa.gov.au/government/document-collections/coastal-hazard-risk-management-and-adaptation-planning-guidelines.

The Shire of Cocos Keeling Islands (2026) "History, Culture & Language." Available at: https://cocoskeelingislands.com.au/about/history-culture-language/.

The Shire of Cocos Keeling Islands (2026) "History, Culture & Language." Available at: https://cocoskeelingislands.com.au/about/history-culture-language/.

Western Australian Planning Commission (1928) *Statement of Planning Policy No. 2 - Environment and Natural Resources Policy*. Available at: https://www.wa.gov.au/system/files/2021-06/SPP_2-0_environment_natural_resources.pdf.

talis consultants

Assets | Engineering | Environment | Noise | Spatial | Waste

HEAD OFFICE
604 Newcastle Street,
Leederville, WA 6007

NSW OFFICES
Nowra
76 Bridge Road,
Nowra, NSW 2541

Newcastle
58 Cleary Street,
Hamilton, NSW 2303

QLD OFFICE
Brisbane
35 Boundary Street,
South Brisbane, QLD 4101

P: 1300 251 070 | E: enquiries@talisconsultants.com.au

ABN 85 967 691 321