REPORT

Bate Bay Coastal Management Program

Bate Bay CMP

Client: Sutherland Shire Council

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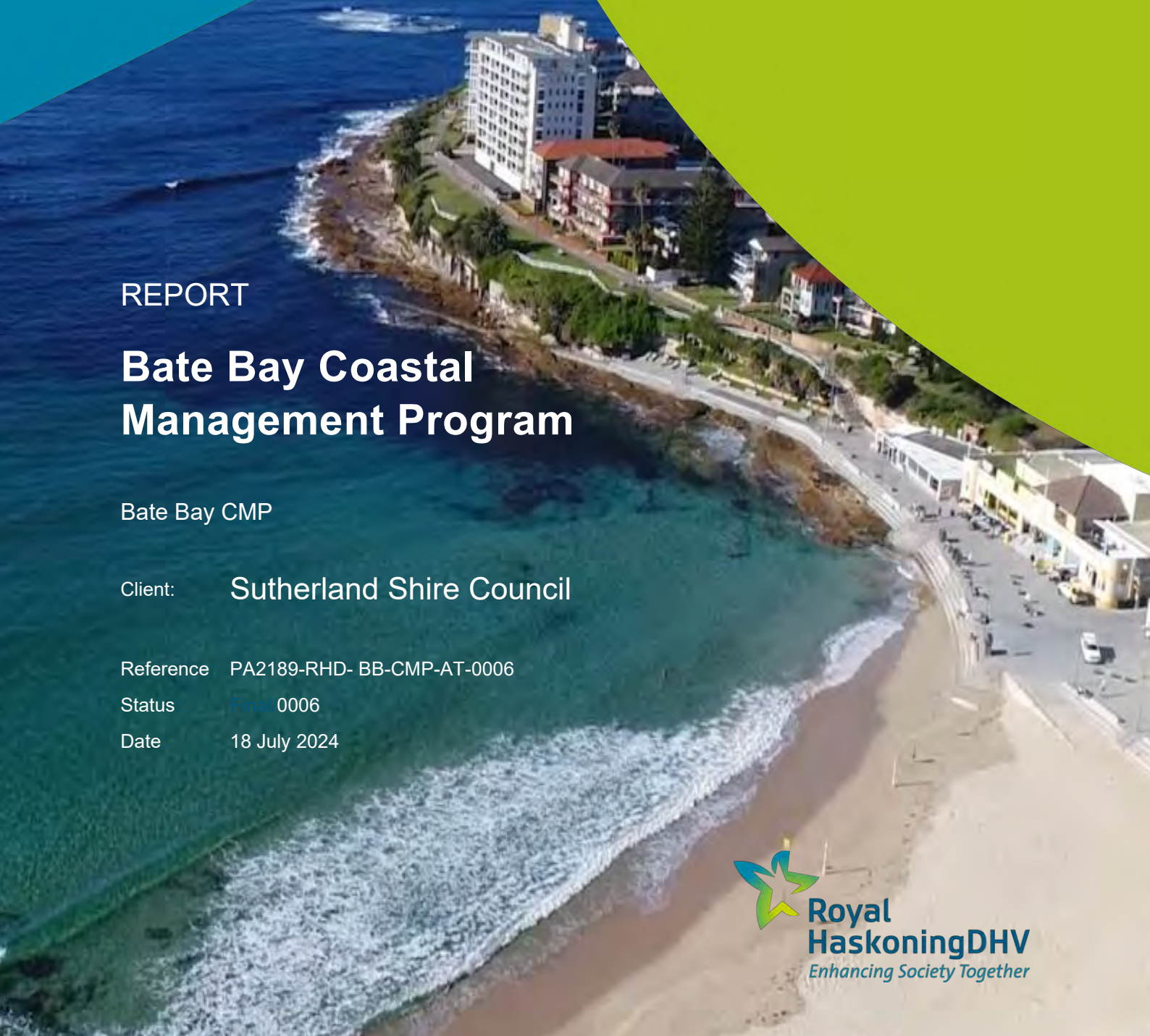

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The Bate Bay Coastal Management Program has been prepared with financial assistance from the NSW Government through its Coastal and Estuary Grants Program. This document does not necessarily represent the opinions of the NSW Government or the Department of Climate Change, Energy, the Environment and Water – Biodiversity, Conservation & Science.

Revision history

Revision	Date	Description
0001	17 August 2021	Initial Draft Bate Bay CMP for Sutherland Shire Council and DCCEEW - BCS review
0002	31 October 2021	Draft Bate Bay CMP approved by Council for Public Exhibition
0003	30 March 2022	Amended Bate Bay CMP adopted by Council and submitted to NSW Government for peer review and final comment
0004	14 February 2023	Amended Bate Bay CMP peer reviewed by NSW Government, additional information requested
0005	17 April 2023	Revised Final Bate Bay Coastal Management Program for approval by Council, and submission to the Minister responsible for managing the *Coastal Management Act 2016* for certification
0006	18 July 2024	Revised management actions for stakeholder agency responsibility

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C. Bate Bay CMP – Coastal Risk and Vulnerability Assessment Report (Royal HaskoningDHV, 2021)
D. North Cronulla to Cronulla Esplanade Renewal – Concept Design Report (Sutherland Shire Council, 2021)
E. Economic Assessment – Bate Bay Coastline Management Plan (Gillespie Economics, 2021)
F. Advice on Management of Prince Street Seawall (Royal HaskoningDHV, 2021)
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Sutherland Shire Council Acknowledgement of Country

Sutherland Shire Council acknowledges the Dharawal speaking people who are the Traditional Custodians of the land of Sutherland Shire.

Council pays respect to the Elders past and present of the Dharawal nation and extends that respect to other Aboriginal people visiting this site.

1 Executive Summary

The Bate Bay coastline is one of Sutherland Shire's most important natural assets and is highly valued for the quality of its beaches, surf, marine and terrestrial ecology, coastal vegetation and overall recreational and scenic amenity. The coastline attracts millions of visitors each year, and forms a significant part of the social, environmental and economic fabric of the Shire. Like all areas of open coast, however, the Bate Bay coastline is affected by pressures of development, contradictory land-uses, changing climate, as well as coastal hazards, particularly short term coastal erosion and long term beach recession.

The Bate Bay Coastal Management Program (Bate Bay CMP) presents a long-term plan that reflects the objectives of Sutherland Shire Council (Council), the community, and the *Coastal Management Act 2016* (CM Act), seeking to deliver sustained benefits of amenity and coastal protection, managing the coastal environment of Bate Bay in a manner consistent with the principles of ecologically sustainable development for the social, cultural and economic well-being of the people of Sutherland Shire and NSW.

The Bate Bay CMP has been prepared by Royal HaskoningDHV (RHDHV) on behalf of Council, and with the support and collaboration of the Department of Climate Change, Energy, the Environment and Water – Biodiversity, Conservation & Science (DCCEEW – BCS). The Bate Bay CMP outlines the strategic aims that guide the management, preservation, improvement, promotion, and rehabilitation of the Bate Bay coastal area from Bass and Flinders Point at the southern limit, to Potter Point at the northern limit (which is also the northern limit of the Boat Harbour Aquatic Reserve).

A geotechnical assessment has been undertaken of the foreshore cliff faces and soil slopes between Bass and Flinders Point and Potter Point, excluding the sandy embayment between the Prince Street seawall and Boat Harbour. Although some areas of instability were identified, the associated risk was deemed to be mainly acceptable and occasionally tolerable. Recommended management actions include ongoing monitoring, especially after significant rain events.

A probabilistic coastal hazard assessment of the sandy beaches has been undertaken utilising a range of inputs including sediment (sand) transport within Bate Bay, long term recession and progradation of the shoreline, storm surge, wave set-up and wave run-up, as well as projected sea level rise. Climate change, including specific consideration of associated sea level rise implications, are addressed within **Supporting Document C** – Bate Bay CMP – Coastal Risk and Vulnerability Assessment Report.

This assessment concluded that assets within the study area, such as Dunningham Park and the Prince Street seawall, are currently at high risk, with public assets at immediate threat requiring protection and rectification (respectively). This information has formed the basis for the development of a number of actions within the coastal management strategy and the Bate Bay CMP.

The coastal management strategy within the Bate Bay CMP has been developed using current scientific and economic investigations, providing an iterative program of specific actions to mitigate identified threats and issues that are to be implemented over the next ten years, 2022-2032 (as per the Section 18 of the CM Act), that are considered feasible, viable and acceptable for Council and the community. While many of the initiatives and actions directly address opportunities to maintain and enhance the natural and cultural assets and attributes within Bate Bay, there are a number of core physical / public assets that require action to address short- to medium-term risks.

Management Actions for Key Locations

The Bate Bay CMP Coastal Vulnerability Assessment identified four Key Locations requiring management actions, being The Esplanade between Cronulla and North Cronulla Beaches, Dunningham Park and North Cronulla Beach, Prince Street Seawall, and the City and Surfing Beaches.
Widening of The Esplanade between Cronulla and North Cronulla is proposed to address deterioration of the current structure, improve public access, and reduce wave overtopping. As well as seeking to increase flow and reduce congestion, improved access to the rock platform, main rock pool and Cronulla Beach from The Esplanade is proposed through incorporating all-access ramps and stepped seating “bleachers”.

The endorsed action for The Esplanade - Option 3: Improved longitudinal and lateral access i.e. The Esplanade widening with access via ramps and bleachers to the rock platform and pools, is described in Section 5.

Dunningham Park and North Cronulla Beach have a well-documented history of being impacted by coastal hazards, including relocation of the North Cronulla Surf Life Saving Club following a storm in the 1950’s. The 2003 Coastline Management Plan recommended construction of a seawall at North Cronulla Beach fronting Dunningham Park, however this seawall has not yet been constructed.

Noting that projected coastal hazard lines extend significantly landward of the existing dunes and public assets, a seawall is proposed for North Cronulla Beach to provide permanent protection from coastal erosion. This involves replacing the existing informal non-continuous rock wall with an engineered structure that comprises a combination of rock revetment, vertical wall and concrete bleachers. Conceptual seawall designs have been provided as options for consideration that would provide for improved public beach access, retention of dune vegetation and usable beach following a coastal erosion event.

The endorsed action for Dunningham Park - Option 4: Combination vertical wall with bleachers and access ramp, and rock revetment, is described in Section 6.

The Prince Street seawall has ongoing structural issues that are likely to lead to further failures and significant ongoing repair unless an effective asset management plan is actioned. The Prince Street seawall requires restorative works to address the loss of sand from beneath the seawall face and thereby minimise the risk of localised subsidence. An asset management plan has been prepared to address short- and medium-term issues, to prolong the effective useful life of the structure. Replacement of the seawall has been noted as a long-term requirement. Various approaches have been considered with detailed investigations to continue following the completion of the Bate Bay CMP.

The endorsed action for remediation of the Prince Street seawall is described in Section 7.

Sand nourishment is proposed for the City Beaches, which will also benefit the Surfing Beaches as the sand is distributed alongshore through natural coastal processes. Continuing the historic practice of nourishing with 60-80,000 m^3 of sand every five to seven years would help maintain the beach profile observed over the past two decades, as well as help maintain surf quality. A lesser rate of nourishment would likely not halt long term recession while a greater rate of nourishment could potentially infill the rock pools and create an undesirably wide beach. Sand would likely be sourced from the periodic dredging of the Port Hacking main navigation channels, however, alternative sources of sand should also be considered if available.

The endorsed action for sand nourishment of the City Beaches, which will also benefit the Surfing Beaches, is described in Section 8.

Management Actions within the Bate Bay Area following Community Consultation

Through widespread community and stakeholder engagement undertaken during Stages 1, 2 and 3 of the CMP process, Council sought to develop a greater understanding of the community's values, issues and aspirations for the wider Bate Bay coastal area. As well as online community consultation, a range of workshops were held with key stakeholder groups including (but not limited to) Surf Life Saving Clubs, representatives of the surfing community, and Bushcare Volunteers.

Responses were distilled into five key themes, being:

Green spaces:
Maintenance of green spaces and restrictions on further development;
Dune and vegetation management:
The requirement for dune protection and vegetation management;
Better information and control on the actions and behaviours:
Observed and/or experienced within Bate Bay;
Restoration:
Of the beaches; and
Zoning:
The need to clearly distinguish between areas for wildlife (reserves), walking, biking, dogs, swimming, surfing, fishing/spearfishing, snorkelling/diving and boating.

Discussion of the outcomes of consultation process and endorsed management actions for the wider Bate Bay coastal area are described in Section 9, with a snapshot of initiatives outlined below;

Opportunities to improve the recreational and environmental amenity of The Esplanade south of Cronulla Beach (along the Cronulla Peninsular) include installation of additional stormwater quality improvement devices in key locations, increasing the extent and connectivity of native coastal vegetation, and path widening at select locations. It is recommended that Council prepare a Masterplan to explore these opportunities in more detail to achieve an appropriate balance between public access improvements, public safety and maintenance of natural amenity.

Management measures for Wanda dunes include a recommendation that Council and NSW Department of Planning, Housing & Infrastructure – Crown Lands (DPHI - Crown Lands) to continue to collaborate to maximise the effectiveness of ongoing dune restoration works to maintain and enhance the environmental and amenity attributes of the area. DPHI - Crown Lands has provided funding assistance up to $400,000 ex GST over three years (2021 - 2023) for management of this site, to allow for the transition to a funding model that is consistent with other councils across the state and aligned with departmental policy.

Council to continue to recognise and promote Aboriginal heritage and ongoing role as custodians of land and water, acknowledging post-settlement heritage of the area, and collaborating to maintain and enhance the significant environmental and cultural attributes and assets within Bate Bay. With coastal areas being historically and currently important to the Aboriginal community, the La Perouse Local Aboriginal Land Council (LALC) are working to reconnect people to the land through property acquisition, and collaboration with the Gamay Rangers program.

The marine and coastal environment of Bate Bay is highly valued by many aspects of society and is a significant drawcard and economic driver for residents and tourists. Recognised as a World Surfing Reserve with many notable breaks, Bate Bay provides opportunities for recreational fishing and spearfishing in and around the rocky reefs, as well as snorkelling and scuba diving within the Boat Harbour Aquatic Reserve. The sand dunes have been made famous through a number of movies and tv programmes, as well as providing construction materials for Sydney's building boom of the 1960's and 1970's.

In order to adequately address the range of concerns and opportunities raised during the consultation process, from small scale to large infrastructure projects, ***the complete range of management actions are included within the Business Plan in Section 14,*** grouped as endorsed actions to address:

- Coastal Hazards Management **Table 14-1**
- Coastal Environment Management **Table 14-2**
- Foreshore Access Management **Table 14-3**
- Coastal Amenity Management **Table 14-4**
- Culture and Safety **Table 14-5**

While a Coastal Vulnerability Area has not been formally mapped for Bate Bay (further information provided in **Section 2.3.1** and **Section 10.9**), an opportunity was recognised to provide guidance and direction to Council and other emergency services in response to coastal storm events.

Supporting the Bate Bay CMP, a Bate Bay Coastal Zone Emergency Action Subplan (BBCZEAS) has been prepared in accordance with NSW Government guidelines, which outlines actions required by Council and combat agencies (including the NSW SES and Police) before, during and following an emergency coastal storm event. The BBCZEAS sits within the NSW emergency management framework established by the *State Emergency and Rescue Management Act 1989*, as a Sub Plan to the Sutherland Shire Local Emergency Management Plan and a Supporting Plan to the Sutherland Shire Flood Emergency Sub Plan.

Key actions are generally in line with Council's current incident management practices, and include beach closure, closure of The Esplanade between Cronulla and North Cronulla Beaches, managing access to public spaces and Surf Life Saving Club buildings until surrounding areas are made safe, as well as potential emergency sand nourishment and top-up of rock protection.

2 Introduction

Following the introduction of the *Coastal Management Act 2016* (CM Act), local governments across NSW are preparing Coastal Management Programs to outline the long-term strategy for managing the coastal zone, in line with State Government guidance and legislative requirements. Management of the coastal zone presents various and significant challenges, including increasing development pressure and use of the coastal zone, increased impacts from urban pollution on coastal and oceanic environments and the effects of a changing climate on both beach areas and adjoining urban areas.

Bate Bay is a large coastal embayment encompassing a number of different coastal landscapes, including cliffs with adjacent residential areas, sandy beaches with foreshore reserve and public domains, seawall structures, long sweeping beach areas backed by heritage listed dunes, rocky reefs protected as aquatic reserve and rocky cliffs adjacent to a National Park. The Bate Bay foreshore is one of Sutherland Shire's most important natural assets and is of significant social, historic, environmental and economic value.

Sutherland Shire Council (Council) has for many decades proactively managed the coastline to enhance these values and protect against coastal hazards. This has included constructing coastal protection works, improving access to and along the foreshore, sand nourishment of beaches, ongoing coastal dune management and supporting the designation of the beaches as a national surfing reserve. A Coastline Management Plan was also prepared for Bate Bay in 2003.

The sand hills of Kurnell possess historical, cultural, scientific and natural significance as a place of early European contact with the Gweagal people. The site has significant Aboriginal signs of habitation, from carvings, ceremonial sites, middens and sites of flaked sharpening stones (Sutherland Shire Environment Centre, 2018). The site is of significant interest to the Aboriginal community, as many of the other hills and dunes that were inhabited by their ancestors have now disappeared. As the dunes move or drift, most of the sites once occupied by the Aboriginal people have been covered and preserved (Australian Wildlife Society, 2007).

The original inhabitants on the Kurnell Peninsula were the Gweagal people, a clan of the Tharawal (or Dharawal) tribe who occupied the region for thousands of years. Their tribe spanned the areas between the Cooks and Georges Rivers from the shores of Botany Bay and westwards towards Liverpool. According to a Gweagal elder, "Dharawal is similar to a state and Gweagal is similar to a shire within the state, Cunnel (Kurnell) is a family village within the shire" (Sutherland Shire Environment Centre, 2018).

It is recognised that Bate Bay held, and still holds, significant Aboriginal cultural, environmental and heritage importance, and that the La Perouse LALC are seeking to reconnect people with the land through a variety of mechanisms. It is understood that LALC may seek to include whole of Boat Harbour Aquatic Reserve within the indigenous protected area, in order to provide greater level of protection, and that there may be potential for LALC rangers to assist in fisheries enforcement, while still encouraging recreational activities.

Extending from Bass and Flinders Point in Cronulla to Boat Harbour at Kurnell, the foreshore encompasses the Shire's iconic surfing beaches, vegetated coastal dunes and the popular Esplanade pedestrian path. The coastal area to the south of Bate Bay comprises Port Hacking, which is primarily an estuarine environment. The coastal areas to the north of Bate Bay include the rocky cliffs within Kamay Botany Bay National Park and the shoreline areas within Botany Bay. The management of coastal areas within Port Hacking and Botany Bay will be documented in separate Coastal Management Programs.

Cronulla has been a tourist destination for more than 100 years with its beach as the main attraction even in the 1880s. Although there are no reports of surfing at Cronulla until early in the 20th century, by 1904 the popular seaside village had become known as 'the Manly of the southern side of Sydney' (surfingreserves.org, online).

Within the regional context, in 2017 the Sutherland Shire Council Local Government Area had a population of 229,017, with a population growth since 2011 of 3% compared to the Greater Sydney area which has grown by 8.5%. The community is predominantly family based with 38% couple family households with children and 10% single parent family households, though with an aging population compared to greater Sydney. There is a high car ownership with 57% of households owning two cars or more (44% in Greater Sydney) and 18% owning three or more cars; over 60% of people travel to work in our cars. Perhaps most relevant for the Bate Bay CMP, Sutherland Shire has the lowest rate of resident departures of any council area in Sydney - only 4.3% of the Sutherland Shire residents moved out of the area in 2013/14 - half the average departure rate across Greater Sydney (Community Strategic Plan, Council 2017).

Specifically for the Cronulla area, the 2016 Australian Bureau of Statistics (ABS) data recorded a resident population of 18,070; representing 6% growth from 2011, which is significantly higher than the New South Wales (NSW) average of around 1%. The population of Cronulla (including Greenhills Beach) is forecast to grow to 24,608 by 2036 and the associated implied dwelling demand is an additional 2,500 homes. When annualised, this represents a long term population growth trend of approximately 1.5% per year over 20 years (Australian Bureau of Statistics, 2016).

Within the Bate Bay Scoping Study area, the main employment zones are the Cronulla Town Centre (2,884 jobs) and the Kurnell Peninsula (1,275 jobs). These precincts represent 4.3% and 1.9% of the overall employment across the LGA. The precincts with the greatest number of jobs within the LGA are Miranda, Taren Point and Sutherland (Australian Bureau of Statistics, 2016).

A number of businesses in the LGA rely upon beach visitation and associated expenditure for their commercial viability. These would include both businesses within the Cronulla CBD, premises along the beachfront, and personal trainers and surf schools that use foreshore reserve areas and the water for their fitness and recreational business activities. It is estimated that visits to Sydney beaches were associated with approximately $260 million in travel costs and around $220 million[1] in retail expenditure on items such as food and drinks (SCCG, 2013).

The Cronulla Beaches National Surfing Reserve (NSR) was declared in September 2008 and is one of southern Sydney's' premier surf spots. Cronulla is home to former world champion surfers as well as other important figures in the development of Australian surfing and surf lifesaving. One of the largest NSR in Australia, the 'Nulla' is proudly preserved by a strong surfing community from an area better known as the 'Shire' (surfingreserves.org, online).

Recognising the importance of having a formalised coastal management framework, Council adopted the Bate Bay Coastline Management Plan in 2003 and the objectives, strategies and actions contained within that document have been used as the basis for the management of coastal areas within Bate Bay up to the present time.

[1] [1]*Estimates are in 2009 $ and derived from case studies at Collaroy-Narrabeen Beach and Manly Ocean Beach.*

With the introduction of the Coastal Management Act 2016, the State Environmental Planning Policy (Coastal Management) 2018[2], and the NSW Coastal Management Manual, Council engaged Royal HaskoningDHV (RHDHV) to deliver Stage 1 of the new Coastal Management Program (CMP) process, the preparation of a CMP Scoping Study, in 2018. The Bate Bay CMP Scoping Study built on existing knowledge, lessons learnt from the implementation of management actions, and awareness of current and future coastal management issues, constraints and opportunities, to refine and define the scope of the following Stages 2-4 of the Bate Bay CMP.

Council, with support from the NSW Department of Climate Change, Energy, the Environment & Water – Biodiversity, Conservation & Science (DCCEEW - BCS), subsequently engaged RHDHV to prepare a Coastal Management Program for the whole of Bate Bay (Bate Bay CMP), including the foreshore and headlands from Bass and Flinders Point at the southern limit to Potter Point at the northern limit. At the initiation of this project, a set of broad principles were established to guide the preparation of the Bate Bay CMP. These principles envisaged a coastline that was attractive, accessible, ecologically healthy and resilient.

The Bate Bay CMP seeks to build on the positive work undertaken over many decades by Council, the community and stakeholders, while taking greater account of the complexity of this dynamic stretch of coastline by incorporating updated technical understanding of coastal processes, and reflecting current community interests and legislative requirements. The Bate Bay CMP provides a set of prioritised, coordinated and cost-effective actions that, when progressively implemented, will help to ensure that Bate Bay is ecologically healthy, resilient, attractive and accessible for current and future generations.

[2] *Now State Environmental Management Policy (Resilience and Hazards) 2021.*

2.1 Purpose, Vision and Objectives of the CMP

2.1.1 Purpose of the Bate Bay Coastal Management Program

The overarching driver for the Bate Bay CMP is to set the long term strategy for the coordinated management of land within the coastal zone at Bate Bay. The CMP seeks to achieve the objects of the *Coastal Management Act 2016* through a program to identify coastal management issues, pressures, risks and opportunities; actions to be taken; and commitments to implementation, funding and financing.

The purpose of the Bate Bay CMP is to provide an adaptive, integrated and long-term approach to coastal management to address identified risks and ensure developing opportunities can be taken, assessed on their merit and be implemented if advantageous.

The Sutherland Shire Council Community Strategic Plan (Council, 2017) established a set of principles to guide the ongoing decision-making in planning for the Sutherland Shire community's future; which are:

- *Principle 1: We recognise and respect Sutherland Shire is on Aboriginal Land.*
- *Principle 2: We recognise the importance of social justice principles in Sutherland Shire.*
- *Principle 3: We understand the need for ecologically sustainable development.*
- *Principle 4: We want a resilient Sutherland Shire.*

These Principles share many commonalities with the objects of the *Coastal Management Act 2016*, "to manage the coastal environment of New South Wales in a manner consistent with the principles of ecologically sustainable development for the social, cultural and economic well-being of the people of the State".

The direction of these guiding documents has been considered during development of the Bate Bay CMP which aims to protect and enhance the coastal zone while balancing the diversity of needs of the community. The Bate Bay CMP is intended to be subject to regular review to assess the effectiveness of endorsed actions.

2.1.2 Vision for the Bate Bay Coastal Management Program

Through consultation with the wider community, as well as a variety of community stakeholder groups, a shared vision for the Bate Bay coastline has been developed that reflects the Objectives of the Bate Bay CMP, being:

> ***"To preserve and maintain the natural beauty, marine life and largely unspoilt nature of Bate Bay as a high quality and ecologically sustainable area, while providing for a variety of different uses and users of the bay."***

2.1.3 Objectives of the Bate Bay Coastal Management Program

Through consultation with the wider community, as well as a variety of community stakeholder groups, specific objectives to achieve the shared Vision for balanced and achievable management of the coastline have been developed for the Bate Bay CMP.

The management objectives for the Bate Bay CMP are to:

- ***Protect valuable public assets;***
- ***Maintain a wide beach profile and surf quality;***
- ***Improve public access to and shared use of the coastal foreshore;***
- ***Protect and enhance the natural coastal environment; and,***
- ***Protect and celebrate the cultural heritage of Bate Bay.***

It is recognised that achieving these objectives is the shared responsibility of everyone in the community.

Potential actions for inclusion within the Bate Bay CMP have been considered and evaluated through workshops, consultation and consideration of expert opinion as to their effectiveness and suitability for inclusion, and have been further assessed and validated through public exhibition of the draft CMP, with amendments to actions made as needed to address issues raised.

The Bate Bay CMP Business Plan includes a range of actions that address each of the management objectives of the Bate Bay CMP, as well as the Management Objects of the CM Act. The relationship between Bate Bay CMP Management Objectives and relevant Objects of the CM Act, along with links to the full set of action tables and specific examples, are presented in **Table 2-1**.

Table 2-1: Examples of actions to address management objectives of the Bate Bay CMP and relevant Objects of the CM Act

Bate Bay CMP management objectives	Relevant CM Act Management Objects	Example Actions
Protect valuable public assets;	**(f) to mitigate current and future risks from coastal hazards, taking into account the effects of climate change** **(i) to encourage and promote plans and strategies to improve the resilience of coastal assets to the impacts of an uncertain climate future including impacts of extreme storm events**	**Table 14-1: Management actions to address Coastal Hazards**, including: CH7 • Construction of coastal protection works (as defined by the *Coastal Management Act 2016*), to protect public assets at Dunningham Park / North Cronulla Beach. Includes reinstatement of dunes over (buried) rock revetment, revegetation of dune bays, re-establishment of controlled accessways, and reinstatement of Lifeguard tower.
Maintain a wide beach profile and surf quality;	**(g) to recognise that the local and regional scale effects of coastal processes, and the inherently ambulatory and dynamic nature of the shoreline, may result in the loss of coastal land to the sea (including estuaries and other arms of the sea), and to manage coastal use and development accordingly** **(j) to ensure co-ordination of the policies and activities of government and public authorities relating to the coastal zone and to facilitate the proper integration of their management activities**	**Table 14-1: Management actions to address Coastal Hazards**, including CH14 • Investigation, design and documentation of beach nourishment campaign, with beneficial re-use of dredged material (sand) from Port Hacking navigation maintenance placed nearshore to Cronulla and/or North Cronulla beaches for natural redistribution northwards within Bate Bay. *Note*: actions that address beach width and surf quality are also included within **Table 14-2: Management actions to address Coastal Environment** and **Table 14-3: Management actions to address Foreshore Access**.
Improve public access to and shared use of the	**(b) to support the social and cultural values of the coastal zone and maintain public**	**Table 14-1: Management actions to address Coastal Hazards**, including CH5

Bate Bay CMP management objectives	Relevant CM Act Management Objects	Example Actions
coastal foreshore;	**access, amenity, use and safety** **(k) to support public participation in coastal management and planning and greater public awareness, education and understanding of coastal processes and management actions,**	• Investigation, design and documentation of coastal protection works (as defined by the *Coastal Management Act 2016)* at Dunningham Park / North Cronulla Beach, including consideration of use of "sand" coloured concrete to reduce the visual impact of coastal protection works; ensure appropriate slope of access ramp (likely 1:20 V:H), vehicle loading and width requirements, traffic management etc. Consider design of bleachers / access ramp and related / complimentary management actions with respect to beach safety including consultation with relevant stakeholders, i.e. whether built form 'guides' beach users towards known hazards / rips (e.g. the Alley). *Note*: actions that address public access to and shared use of the coastal foreshore are also included within **Table 14-2: Management actions to address Coastal Environment** and **Table 14-3: Management actions to address Foreshore Access**.
Protect and enhance the natural coastal environment; and	**(a) to protect and enhance natural coastal processes and coastal environmental values including natural character, scenic value, biological diversity and ecosystem integrity and resilience**	**Table 14-2: Management actions to address Coastal Environment**, including: CE7 • Development and implementation of a coordinated revegetation strategy for improved connectivity between all reserves and public open spaces within the CMP study area, reflective of Council's Greenweb program, Environment Strategy, and Chapter 38 of Council's DCP2015, with prioritisation of native vegetation in keeping with Council's Open Space Strategy and Implementation Plan.
Protect and celebrate the cultural heritage of Bate Bay	**(b) to support the social and cultural values of the coastal zone and maintain public access, amenity, use and safety,**	**Table 14-5: Management actions to address Culture and Safety**, including: CS1 • Council and the community collaborate to continue promotion of the Cronulla National Surfing Reserve, local events and local business development

Bate Bay CMP management objectives	Relevant CM Act Management Objects	Example Actions
	(d) to recognise the coastal zone as a vital economic zone and to support sustainable coastal economies, and	

Similarly, the Bate Bay CMP Business Plan includes a range of actions that address management objectives of the Coastal Management Areas (as defined by the CM Act), with links to the full set of action tables and specific examples presented in **Table 2-2**.

Table 2-2: Actions to address management objectives of the Coastal Management Areas (as defined by the CM Act)

Coastal Management Area	Example Management Objectives	Example Actions
Coastal Wetlands and Littoral Rainforests Area	(e) to promote the objectives of State policies and programs for wetlands or littoral rainforest management	*Note: While the spatial area of the Bate Bay CMP does not include Coastal Wetlands and Littoral Rainforests, actions that support the intent of the objects of this Coastal Management Area are included.* **Table 14-2: Management actions to address Coastal Environment**, including: • Development and implementation of a coordinated revegetation strategy for improved connectivity between all reserves and public open spaces within the CMP study area, reflective of Council's Greenweb program, Environment Strategy, and Chapter 38 of Council's DCP2015, with prioritisation of native vegetation in keeping with Council's Open Space Strategy and Implementation Plan.
Coastal Vulnerability Area	(f) to adopt coastal management strategies that reduce exposure to coastal hazards— (i) in the first instance and wherever possible, by restoring or enhancing natural defences including coastal dunes, vegetation and wetlands, and (ii) if that is not sufficient, by taking other action to reduce exposure to those coastal hazards	**Table 14-1: Management actions to address Coastal Hazards**, including: CH7 Construction of coastal protection works (as defined by the Coastal *Management Act 2016*), to protect public assets at Dunningham Park / North Cronulla Beach. Includes reinstatement of dunes over (buried) rock revetment, revegetation of dune bays, re-establishment of controlled accessways, and reinstatement of Lifeguard tower.

Coastal Management Area	Example Management Objectives	Example Actions
Coastal Environment Area	(f) to maintain and, where practicable, improve public access, amenity and use of beaches, foreshores, headlands and rock platforms.	**Table 14-3: Management actions to address Foreshore Access**, including: FA10: • Subject to resolution of the Besmaw Pty Ltd land planning proposal, extension of the public reserve for the full length of the beach frontage to increase public access. Recommend that width of the reserve is to be based on providing adequate spatial extent for the foredune and public access during the 100 year future planning period, in keeping with Council's Open Space Strategy and Implementation Plan. **Table 14-1: Management actions to address Coastal Hazards**, including: CH5 • Investigation, design and documentation of coastal protection works (as defined by the *Coastal Management Act 2016)* at Dunningham Park / North Cronulla Beach, including consideration of use of "sand" coloured concrete to reduce the visual impact of coastal protection works; ensure appropriate slope of access ramp (likely 1:20 V:H), vehicle loading and width requirements, traffic management etc. Consider design of bleachers / access ramp and related / complimentary management actions with respect to beach safety including consultation with relevant stakeholders, i.e. whether built form 'guides' beach users towards known hazards / rips (e.g. the Alley).
Coastal Use Area	(a) (v) the use of the surf zone is considered,	**Table 14-4: Management actions to address Coastal Amenity** are also addressed by actions within Tables 14-1, 14-2, 14-3 and 14-5), including: CA4 • Investigation, design and documentation of beach nourishment campaign, with beneficial re-use of dredged material (sand) from Port Hacking navigation maintenance, placed nearshore to Cronulla and/or North Cronulla beaches for natural redistribution northwards within Bate Bay.

Coastal Management Area	Example Management Objectives	Example Actions
		Table 14-5: Management actions to address Culture and Safety, including: CS1 • Council and the community collaborate to continue promotion of the Cronulla National Surfing Reserve, local events and local business development **Note:** objectives of the Coastal Use Area are also addressed by actions within Tables 14-1, 14-2 and 14-3.

2.2 NSW Coastal Management Framework

Local councils and public authorities are required to manage their coastal areas and activities in accordance with relevant state legislation, policies and plans.

The framework for managing the NSW coast as shown in **Figure 2-1** includes:

- *Coastal Management Act 2016* (CM Act);
- State Environmental Planning Policy (Resilience and Hazards) 2021 (Resilience and Hazards SEPP) [3]; and
- Coastal Management Programs (CMPs) prepared in accordance with the NSW Coastal Management Manual.

Other NSW legislation is relevant to the management of the environmental, social and economic values of the Bate Bay coastal zone, including:

- *Environmental Planning and Assessment Act 1979 (EP&A Act);*
- *Local Government Act 1993 (LG Act);*
- *Crown Lands Act 1989;*
- *Crown Land Management Act 2016;*
- *Aboriginal Land Rights Act 1983;*
- *State Environmental Planning Policy (Precincts—Central River City) 2021*[4]*;*

[3] ***Please note**:*
As of 1 March 2022:
- *the State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP) was consolidated within State Environmental Planning Policy (Resilience and Hazards) 2021. All references in Supporting Documents to State Environmental Planning Policy (Coastal Management) and CM SEPP are deemed to be equivalent to references to State Environmental Planning Policy (Resilience and Hazards) 2021.*

[4] ***Please note**:*
As of 1 March 2022:

- *Sutherland Shire Local Environmental Plan 2015 (SSSLEP2015)*
- *Sutherland Shire Local Environmental Plan 2006*
- *Heritage Act 1977;*
- *National Parks and Wildlife Act 1974;*
- *Fisheries Management Act 1994;*
- *Marine Estate Management Act 2014;*
- *Local Land Services Act 2013; and*
- *Biodiversity Conservation Act 2016.*

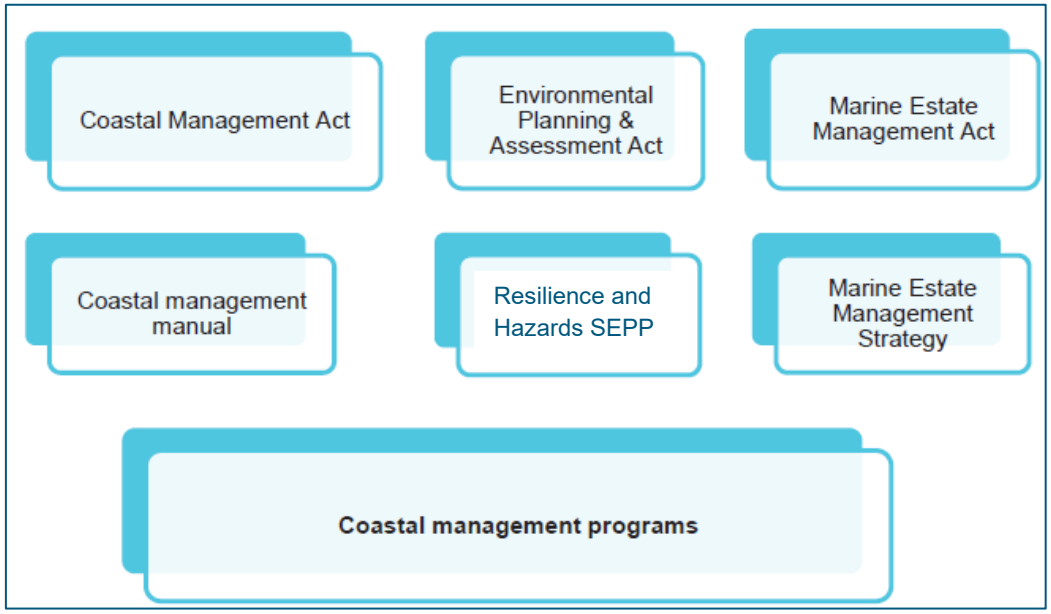

Figure 2-1: NSW Coastal Management Framework

To reduce social conflict and improve effective management of coastal and marine resources beyond existing marine parks, the NSW Government introduced the *Marine Estate Management Act 2014* (MEM Act). The MEM Act provides for strategic and integrated management of the whole marine estate. The marine estate includes all marine waters, estuaries and coastal areas. The NSW Government also established a new advisory Marine Estate Management Authority (MEMA).

MEMA has undertaken a statewide Threat and Risk Assessment (TARA) to consider and prioritise the social, economic and environmental threats to community benefits of the marine estate. The Marine Estate Management Strategy has been prepared to allow a holistic approach to dealing with the cumulative threats to the marine estate. Consistency between the Marine Estate Management Strategy and CMPs is an essential element listed in the Coastal Management Manual (OEH, 2018). Although the statewide MEMA threat and risk assessment was undertaken at a much broader scale than Bate Bay,

- *the State Environmental Planning Policy (Kurnell Peninsula) 1989 was consolidated within the State Environmental Planning Policy (Precincts—Central River City) 2021. All references in Supporting Documents to State Environmental Planning Policy (Kurnell Peninsula) 1989 are deemed to be equivalent to references to State Environmental Planning Policy (Precincts—Central River City) 2021.*

information from the MEMA background reports has been considered during development of the actions within the Bate Bay CMP.

The Bate Bay CMP Scoping Study (**Supporting Document A**) provides clear description of the linkages between state legislation, policies and plans listed above and provided guidance as to how the key principles of these documents have been incorporated into the Bate Bay CMP.

The *Crown Lands Act 1989* provides, under section 87, for the Minister to reserve land, by notification in the Government Gazette. The capabilities of the land and the proposed uses of the land need to be assessed prior to reservation. Such a reservation does not affect any other reservation which may also apply to the land.

Of particular note to a number of community representatives, a National Surfing Reserve was declared at Cronulla in September 2008. It comprises all of the Bate Bay beaches and surf breaks. National Surfing Reserves mark iconic places recognised by the NSR Australia and the local community for the quality and consistency of its surf and its long-term and continuing relationship between the surf and surfers. National Surfing Reserves are created under the *Crown Lands Act 1989* to recognise the importance of the site and raise awareness regarding the environmental, cultural and historic connections to surf culture.

The Bate Bay CMP has been prepared in accordance with the requirements under Division 2 of the CM Act, the provisions of the State Environmental Planning Policy (Resilience and Hazards) 2021 (Resilience and Hazards SEPP). and the NSW Coastal Management Manual Part A (The Manual) (OEH, 2018).

Part A of the Manual recommends that councils follow a five-stage risk management process for preparation and implementation of a CMP as shown in **Figure 2-2**.

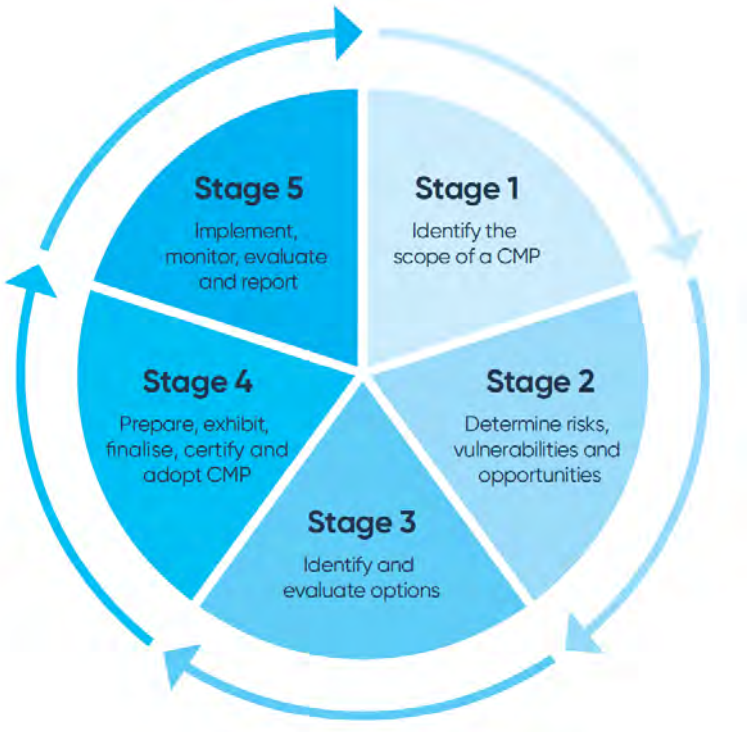

Figure 2-2: Stages for preparation of a Coastal Management Program (NSW Coastal Management Manual Part A)

During 2018, following the guidance of the *NSW Coastal Management Manual Part B: Stage 1 – Identify the scope of a coastal management program*, Council engaged RHDHV to develop a Scoping Study for

Bate Bay, which is included as **Supporting Document A**. The Bate Bay CMP draws heavily on the relevant information provided within the Bate Bay CMP Scoping Study.

2.3 Spatial Extent of the Bate Bay Coastal Management Plan

Section 13(2) of the CM Act provides *that a coastal management program may be made in relation to the whole, or any part, of the area included within the coastal zone.* The Coastal Management Manual further requires that a CMP must include the rationale for selecting the area to be covered by the CMP.

The Bate Bay CMP Scoping Study (**Supporting Document A**) considered a wide range of relevant matters including geomorphological, sedimentary, social, political, land use and jurisdiction over the coastal areas contained within the Sutherland Shire Local Government Area (LGA), prior to defining the spatial extent for the Bate Bay CMP as the open coast between Bass and Flinders Point to the south (near the entrance to Port Hacking) and Potter Point in the north, near Boat Harbour.

The CMP study area has been divided into four (4) precincts based on the relative homogeneity of the natural and cultural values and settings within each precinct (also in keeping with the 2003 Bate Bay Coastline Management Plan), as shown in **Figure 2-3**.

These precincts comprise:

- Precinct 1: The Esplanade – (a.k.a. 'The Cliff-top Walk'), Bass and Flinders Point, Oak Park, Shelly Park, Shelly and Blackwoods Beaches.
- Precinct 2: The City Beaches – Cronulla Beach to North Cronulla Beach.
- Precinct 3: The Surf Beaches – Prince Street Seawall, Elouera Beach to Wanda Reserve.
- Precinct 4: The Beach Reserve – Green Hills, Boat Harbour, Potter Point.

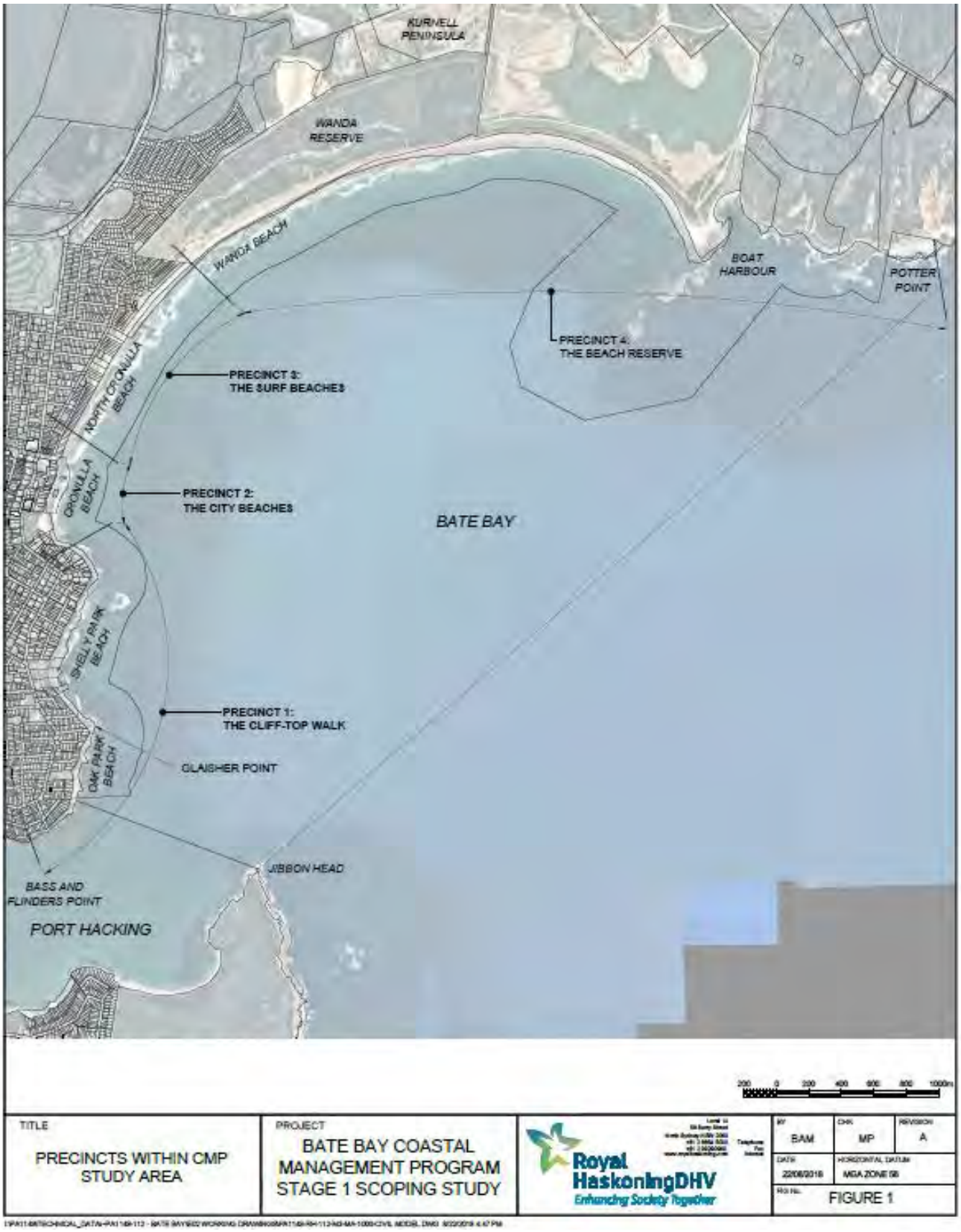

Figure 2-3: Bate Bay CMP Study Area

Australia's coastline has been mapped as compartments based on landforms and patterns of sediment (sand and other beach material) movement. There are three main levels of compartments, each suitable for different types of decision making:

- primary level sediment compartment - based on the influence of large landforms and offshore processes, suitable for regional planning or large-scale engineering such as ports;
- secondary level sediment compartment - based on medium landforms and regional sediment processes, useful for smaller engineering or local planning decisions; and
- tertiary level sediment compartment - based on individual beaches, suitable for very small projects unlikely to restrict sediment movement, such as deciding the exact location of a groyne or seawall within a broader management plan (DAWE, 2021).

Although the entirety of the Bate Bay CMP study area lies wholly within the Sutherland Shire Local Government Area, it also lies within the Sydney primary sediment compartment as shown in **Figure 2-4**, and the 'Botany Bay, Bate Bay and Port Hacking' secondary coastal sediment compartment listed within Schedule 1 of the CM Act, as shown in **Figure 2-5**.

The Australian Government funded National Climate Change Adaptation Research Facility (NCCARF) describe the dominant regional processes of the 'Botany Bay, Bate Bay and Port Hacking' secondary coastal sediment compartment influencing coastal geomorphology in this region as the humid warm to cool temperate climate, micro-tides, south-easterly Tasman Sea swells, easterly seas, dominantly quartz (terrigenous) sediments with northerly longshore transport in the northern part, and the El Nino Southern Oscillation (driving beach erosion/accretion cycles, cyclone frequency). Regional hazards or processes driving large scale rapid coastal changes include: East Coast Lows (extra-tropical cyclones), mid-latitude cyclones (depressions), and storm surges (NCCARF, 2005).

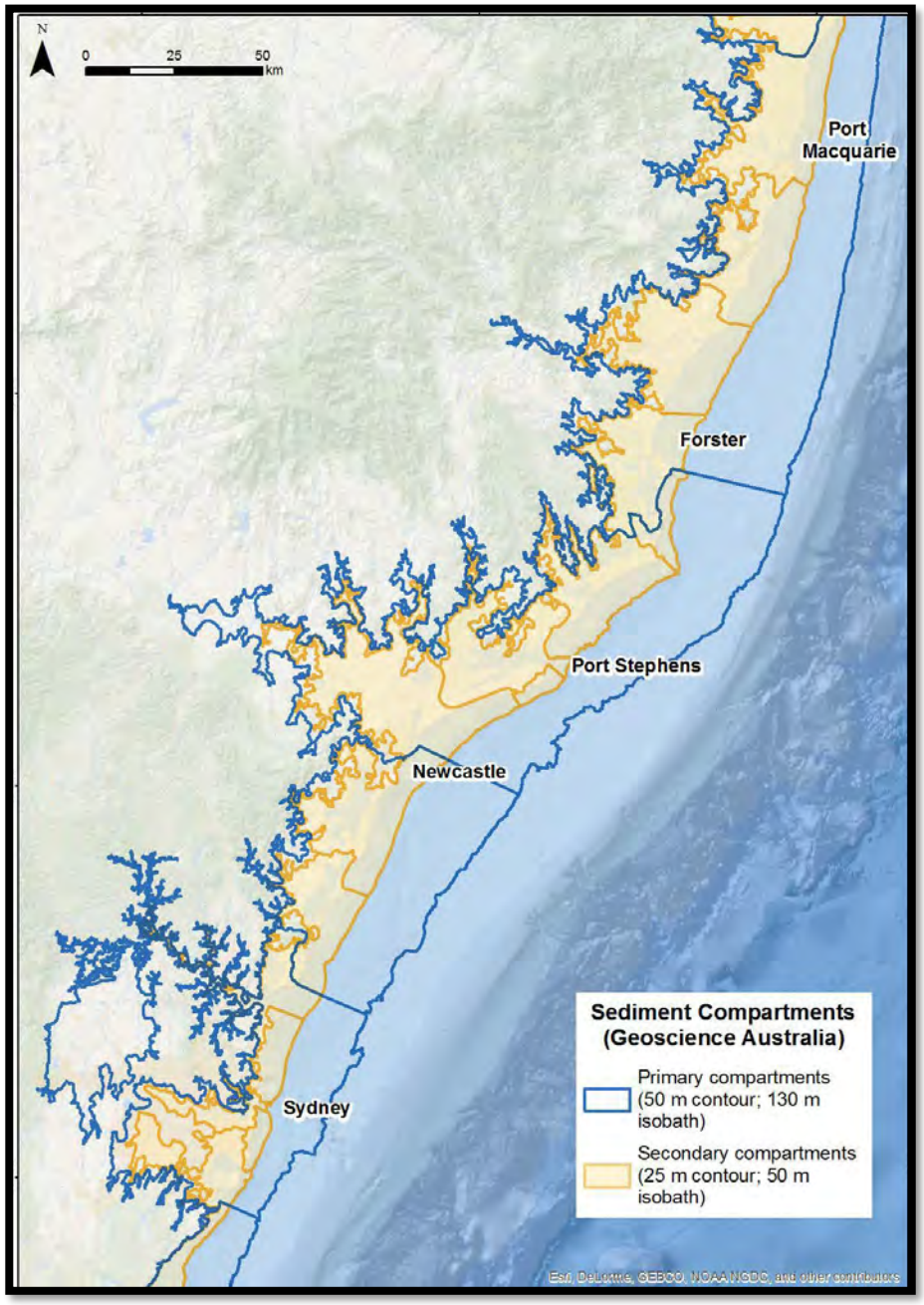

Figure 2-4: Primary and secondary coastal sediment compartments and local government area boundaries (source: NSW Coastal Management Manual Part B: Stage 2)

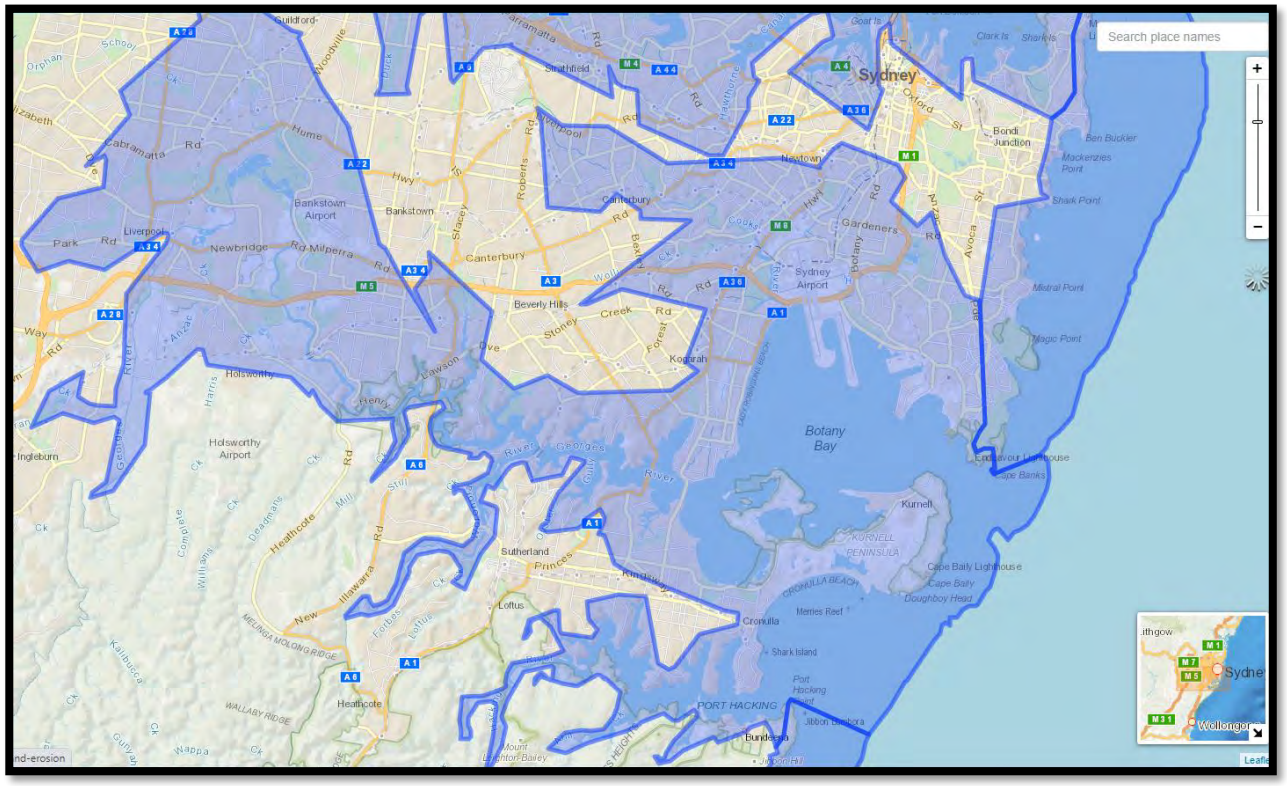

Figure 2-5: Sydney Southern Beaches secondary coastal sediment compartment (source: National Climate Change Adaptation Research Facility (NCCARF))

In accordance with Section 16 (1) (b) of the CM Act, consultation on the CMP with other local councils within this sediment compartment as shown in **Table 2-3** (i.e. Georges River Council, Bayside Council and Randwick City Council) is required before the CMP is adopted. It is however recognised that Bate Bay is identified as a "closed" embayment, meaning that coastal processes do not transport sediment outside of Bate Bay, therefore consultation with adjoining councils is not required.

Table 2-3: Secondary coastal sediment compartment description

Coastal sediment compartment	Extent of compartment (along coastline)	Local government areas* (with land in sediment compartment)	Geomorphology summary
Botany Bay, Bate Bay and Port Hacking	From Cape Banks to Port Hacking Point	Georges River Council, Bayside Council and Randwick City Council	Sandstone headlands, embayed beaches, pocket beaches, transgressive dunes, drowned river valleys, Botany Bay and Georges River estuary, Port Hacking estuary.

2.3.1 Coastal Management Areas within Bate Bay

The following Coastal Management Areas (CMA) as defined under the CM Act and mapped within the Resilience and Hazards SEPP are contained within the Bate Bay CMP study area:

- Coastal Environment Area (refer **Figure 2-6**); and
- Coastal Use Area (refer **Figure 2-7**)

It is noted that a Coastal Vulnerability Area (CVA) is yet to be mapped, however due to the existence of known coastal hazards associated with beach erosion, shoreline recession and coastal inundation, a CVA is identified as a likely management area to be applicable to the CMP study area.

Coastal Wetlands and Littoral Rainforests have not been identified in the relevant mapping under the Resilience and Hazards SEPP for the area within the Bate Bay study area. Coastal wetlands exist predominantly on the Botany Bay side of the Kurnell Peninsula, in areas such as Woolooware Bay, which is outside the study area.

Figure 2-6: Coastal Environment Area (blue shading) as mapped within Resilience and Hazards SEPP (2021)

Figure 2-7: Coastal Use Area (pink shading) as mapped within Resilience and Hazards SEPP (2021)

The Resilience and Hazards SEPP specifies that a number of matters need to be considered by the consent authority before development consent is granted to development of land that is within these CMAs.

Division 2 of Chapter 2 of the Resilience and Hazards SEPP states the following in relation to development consent within a Coastal Vulnerability Area:

12 Development on land within the coastal vulnerability area

Development consent must not be granted to development on land that is within the area identified as "coastal vulnerability area" on the Coastal Vulnerability Area Map unless the consent authority is satisfied that:

(a) if the proposed development comprises the erection of a building or works—the building or works are engineered to withstand current and projected coastal hazards for the design life of the building or works, and

(b) the proposed development:

(i) is not likely to alter coastal processes to the detriment of the natural environment or other land, and

(ii) is not likely to reduce the public amenity, access to and use of any beach, foreshore, rock platform or headland adjacent to the proposed development, and

(iii) incorporates appropriate measures to manage risk to life and public safety from coastal hazards, and

(c) measures are in place to ensure that there are appropriate responses to, and management of, anticipated coastal processes and current and future coastal hazards.

Division 3 of Chapter 2 of the Resilience and Hazards SEPP states the following in relation to development consent within a Coastal Environment Area:

13 Development on land within the coastal environment area

(1) Development consent must not be granted to development on land that is within the coastal environment area unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on the following:

(a) the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment,

(b) coastal environmental values and natural coastal processes,

(c) the water quality of the marine estate (within the meaning of the Marine Estate Management Act 2014), in particular, the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1,

(d) marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms,

(e) existing public open space and safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,

(f) Aboriginal cultural heritage, practices and places,

(g) the use of the surf zone.

(2) Development consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that:

(a) the development is designed, sited and will be managed to avoid an adverse impact referred to in subclause (1), or

(b) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or

(c) if that impact cannot be minimised—the development will be managed to mitigate that impact.

Division 4 of Chapter 2 of the Resilience and Hazards SEPP states the following in relation to development consent within a Coastal Use Area:

14 Development on land within the coastal use area

(1) Development consent must not be granted to development on land that is within the coastal use area unless the consent authority:

(a) has considered whether the proposed development is likely to cause an adverse impact on the following:

(i) existing, safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,

(ii) overshadowing, wind funnelling and the loss of views from public places to foreshores,

(iii) the visual amenity and scenic qualities of the coast, including coastal headlands,

(iv) Aboriginal cultural heritage, practices and places,

(v) cultural and built environment heritage, and

(b) is satisfied that:

(i) the development is designed, sited and will be managed to avoid an adverse impact referred to in paragraph (a), or

(ii) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or

(iii) if that impact cannot be minimised—the development will be managed to mitigate that impact, and

(c) has taken into account the surrounding coastal and built environment, and the bulk, scale and size of the proposed development.

2.3.2 Overview of Community and Stakeholder Engagement

Responses received from stakeholders during each formal engagement opportunity, as well as feedback provided throughout preparation of the draft CMP, have been considered during development and refinement of proposed management actions.

2.3.2.1 Engagement during development of Stages 2 & 3

Broad scale community and stakeholder engagement has been undertaken as part of the preparation of the Bate Bay CMP. Engagement commenced in mid-2020 utilising Council's Join the Conversation (JTC) website and flyers were sent to residents and businesses located within the study area.

The community was asked about their values, issues and aspirations for the Bate Bay coastline. Some 162 people responded giving 421 comments. The key themes that emerged were the importance of green space, the need to manage the dunes and foreshore use, the need for good information, and the desirability of beach restoration.

Council liaised with NSW Government agencies including DPHI - Crown Lands, Sydney Water, DPIRD - Fisheries , National Parks & Wildlife Service (NPWS) and TfNSW - Maritime, as well as local stakeholders including Marine Rescue NSW and the Hungry Point Reserve Land Manager.

Presentations on the CMP were given in late 2020 to Council's community reference group, Council's access committee, the Sutherland Shire Economic Development Committee, Cronulla-Sutherland District Council of Surf Life Saving, the Cronulla Chamber of Commerce and representatives of the surfing community. Informal conversations were held with local groups including Besmaw Pty Ltd, the La Perouse Local Aboriginal Land Council and local Bushcare volunteers.

These discussions helped in further understanding the key values, issues and aspirations for the coastline, and were directly applied during development of the range of management actions which are discussed further in **Section 9**.

2.3.2.2 Engagement during development of Stage 4

As key actions and initiatives were considered and developed, key stakeholders were identified for targeted engagement. Presentations on issue and/or site specific proposed management measures were given in September and October 2021 to interest bodies including the Cronulla Sutherland District Council of Surf Life Saving, the local surfing community and local Bushcare volunteers.

The draft Bate Bay CMP was placed on public exhibition for 7 weeks from 1 December 2021 until 17 January 2022. The draft CMP report body and separate Management Actions report were uploaded to the JTC website together with photographs, frequently asked questions, a summary brochure and list of survey questions. The survey questions were designed to gauge the community's perceptions and acceptance of (or otherwise) the Bate Bay CMP broadly, and specifically sought feedback regarding the proposed key and general management actions.

Council utilised social media outlets to distribute information to residents and other interested parties within the Bate Bay CMP study area as well as across the LGA, advising of the public exhibition and inviting feedback. NSW government agencies and local stakeholder groups were formally invited to comment on the CMP. Presentations to a range of key stakeholder groups were offered to discuss the CMP and particular concerns / objectives in more detail.

Discussion of submissions received during public exhibition, and subsequent amendment of the CMP, is provided in **Section 13**. The Communication Engagement Strategy along with associated consultation and submission reports are included as **Supporting Documents** to the CMP.

2.3.2.3 Engagement following submission of the adopted CMP to the NSW Government

As noted in **Section 2.3.2.1** and **Section 2.3.2.2**, during Stages 2, 3 and 4 of the CMP, Council actively engaged with key stakeholders and NSW Agencies when developing actions for inclusion within the Business Plan, in order to address Division 2 s.15(4)(b) of the CM Act:

> *(4) A coastal management program must not include the following:*
> *(b) Proposed actions or activities to be carried out by any public authority or relating to any land or other assets owned or managed by a public authority, unless the public authority has agreed to the inclusion of those proposed actions or activities in the program.*

Feedback was sought and received from the majority of identified stakeholders, including key public authorities which have active management roles relating to lands and water within the spatial extent of the Bate Bay CMP, being:

- Department of Climate Change, Energy, the Environment & Water – Biodiversity, Conservation & Science (DCCEEW – BCS)

Department of Planning, Housing & Infrastructure – Crown Lands (DPHI - Crown Lands) Department of Primary Industries & Regional Development – Fisheries (DPIRD - Fisheries)
Following adoption at the Council Meeting of 26 April 2022, the Bate Bay Coastal Management Program (dated 30 March 2022), was submitted to DCCEEW – BCS for final review and assessment against the DCCEEW – BCS "Coastal Management Program Checklist" (included as **Supporting Document K** to the Bate Bay CMP.

In addition, recognising the number of agencies with an interest in the management of Bate Bay, Council requested a letter of agreement for actions in the CMP (as per Section 15(4)(b) of the CM Act) from key stakeholders, including:

- DCCEEW – BCS DPHI - Crown Lands DPIRD - FisheriesTransport for NSW
- NPWS
- Sydney Water

Responses were received from key stakeholders:

DCCEEW – BCS DPHI - Crown Lands DPIRD - Fisheries
Responses from the agencies above included agreement and/or absence of disagreement with actions relating to their land or assets. The agencies requested minor amendments to wording within the CMP, including reference to updated Agency names, additional descriptors and/or examples of relevant actions, discussion about potential funding mechanisms, and/or clarification of inclusion of the respective agency within actions as "primary responsibility" or "key stakeholder".

The requested amendments have been reviewed and actioned as appropriate. These communiques, as well as a table detailing the comment/request and subsequent amendment to the CMP (when required) are included as **Supporting Document L** – Post-Adoption Agency Consultation and Amendment Report.

Council's position is that the correspondence received meets the requirement for agreement (as per Section 15(4)(b) of the CM Act) from these key agencies for actions within the Bate Bay CMP that pertain to land or assets. The three Agency responses clarify responsibilities and suggest minor amendments, while tacitly or implicitly agreeing with numerous actions.

Lack of response from other Agencies is considered neither an endorsement of, nor an objection to, the proposed Actions included within the Bate Bay CMP Business Plan. Included Actions are considered high level and indicative in nature, subject to appropriate engagement with relevant stakeholders, including appropriate assessment and approvals, prior to delivery.

In addition, Division 2 s.16 of the CM Act outlines requirements for Consultation on the CMP, including s.16.1(c) with regard to consultation with other public authorities, stating that:

> *(1) Before adopting a coastal management program, a local council must consult on the draft program with -*
> *(c) other public authorities if the coastal management program -*
> *(i) proposes actions or activities to be carried out by that public authority, or*
> *(ii) proposes specific emergency actions or activities to be carried out by a public authority under the coastal zone emergency action subplan, or*
> *(iii) relates to, affects or impacts on any land or assets owned or managed by that public authority.*

While receiving a letter of agreement from public authorities for relevant actions within the CMP is preferred, it is noted that Division 2, s. 16(3) states that:

> *(3) "A failure to comply with this section does not invalidate a coastal management program".*

As a final opportunity for clarification of the non-binding intent of including agencies and representative groups as Key Stakeholders, the footnote accompanying each action table states:

> *"Key Stakeholders include government agencies (some with statutory responsibilities), stakeholders with ownership of land and/or with an interest in the proposed management action, and will be consulted from the time of project initiation. Key stakeholders may or may not be financial contributors to the proposed management action. Inclusion as a Key Stakeholder does not indicate pre-emptive approval of identified actions, which may be subject to relevant authorisations and approvals as appropriate."*

These matters were discussed by Council with DCCEEW – BCS representatives on 27 January 2023, and agreed in principle, enabling Council to progress in seeking certification of the Bate Bay CMP with the correspondence received up to that date included within **Supporting Document L** – Post-Adoption Agency Consultation and Amendment Report.

Council has confirmed with DCCEEW – BCS that the requested amendments are of a minor nature, and do not constitute a substantive change to the Bate Bay CMP as adopted by Council (dated 30 March 2022), and as such, the amended Bate Bay CMP (dated 30 January 2023) does not require formal adoption by Council prior to submission for certification.

Once finalised by Council, the Bate Bay CMP will be submitted to the Minister responsible for the management of the CM Act requesting formal certification of the CMP, prior to Council publishing the CMP in the NSW Government Gazette, pursuant to s17 of the CM Act, which reads as follows:

17 Adoption, certification and gazettal of coastal management program

(1) A local council may adopt a draft coastal management program and submit it to the Minister for certification under this section.

(2) The Minister may certify, or refuse to certify, that the draft coastal management program submitted to the Minister has been prepared in accordance with the requirements of this Part and the coastal management manual.

(3) The local council, after the coastal management program has been certified by the Minister, must publish it in the Gazette.

(4) A coastal management program takes effect on the date on which it is published in the Gazette or, if a later date is specified in the program for its commencement, on the later date so specified.

2.4 Timeframes covered by the Bate Bay CMP

The Bate Bay CMP considers a range of timeframes and planning horizons both in completing the risk assessment for known threats, and in terms of the management actions to address these threats both now and into the future.

For certain threats that are likely to change over time, the following future timeframes (which reflect the time period when the modelling was completed in 2020, while implementation of the CMP is expected to begin in 2022) were considered:

- 2070, where 50 years from “present” (date of coastal hazard modelling) is a regularly applied planning timeframe, and 2070 is and was a commonly applied timeframe for strategic planning purposes;
- 2120, where 100 years from “present” (date of coastal hazard modelling) is a commonly applied timeframe for strategic planning purposes. Consideration of timeframes beyond 2100 is also provided because processes such as sea level rise is projected to continue for many hundreds of years regardless of climate change mitigation actions.

Assessment of coastal vulnerability to processes such as storm events, coastal erosion, and long term shoreline recession were based on probabilistic models with set timeframes, providing revised hazard lines for the immediate (2020), 2070 and 2120 planning periods, as shown in the Bate Bay CMP – Coastal Risk and Vulnerability Assessment Report (**Supporting Document C**) and Bate Bay CMP maps in **Section 17**.

Management actions were developed as a priority for threats considered to be high or extreme at the present timeframe. Management actions were also developed for future high to extreme threats where the future threat is well accepted and requires planning intervention now in order to adequately manage the future threat.

The CM Act requires Coastal Management Programs to be reviewed at least once every ten years, in accordance with the coastal management manual. However, a coastal management program may, at any time, be amended (in whole or in part) by another coastal management program, for example should the actions within the existing CMP be assessed as ineffective, or should there be significant changes in the land use or physical characteristics of the location that significantly affect delivery of actions within the Bate Bay CMP.

As a result, key actions within the Bate Bay CMP and the Business Plan in **Section 14** have been prepared for a 10-year period from 2022 to 2032 (with the anticipation that the Bate Bay CMP will be adopted, endorsed and Gazetted in 2022), with ongoing maintenance activities after that time.

2.5 Good faith and liability

Section 733 (2) of the Local Government Act 1993 provides that a local council does not incur any liability in respect of:

- any advice furnished in good faith by the council relating to the likelihood of any land in the coastal zone being affected by a coastline hazard (as described in the coastal management manual) or the nature or extent of any such hazard, or
- anything done or omitted to be done in good faith by the council in so far as it relates to the likelihood of land being so affected.

Also, section 733 (4) (b) relevantly provides that a council is, unless the contrary is proved, taken to have acted in good faith for the purposes of section 733 if the advice was furnished, or the thing was done or omitted to be done substantially in accordance with the principles and mandatory requirements set out in the coastal management manual.

3 A Snapshot of Issues

As previously noted, the study area has been divided into four (4) precincts based on the relative homogeneity of the natural and cultural values and settings within each zone, and encompass:

- Precinct 1: The Esplanade – (a.k.a. 'The Cliff-top Walk'), Bass and Flinders Point, Oak Park, Shelly Park, Shelly and Blackwoods Beaches.
- Precinct 2: The City Beaches – Cronulla Beach to North Cronulla Beach.
- Precinct 3: The Surf Beaches – Prince Street Seawall, Elouera Beach to Wanda Reserve.
- Precinct 4: The Beach Reserve – Green Hills, Boat Harbour, Potter Point.

All other parts of the coastline within the scope of the CMP were then considered as a further general precinct with common issues and proposed management actions.

As noted previously, a set of broad principles was established early on to guide the preparation of the CMP, which envisaged a coastline that was attractive, accessible, ecologically healthy and resilient.

3.1 Population Growth and Demographic Changes

By 2026 the Sutherland Shire population is projected to grow by over 21,000 people to 250,269, with a corresponding increase in the number of dwellings which is forecast to grow from 83,709 in 2011 to 96,009 in 2026. During this period, the average household size is projected to fall. Currently there is an average of 2.69 people living in each home, projected to drop to 2.66 by 2026 because of an ageing population. There will be an increase in the number of couple households without children, including a 45% increase of people old enough to retire, somewhat offset by a 7% increase in the number of people of working age (Community Strategic Plan, Council, 2017)

3.2 Social Drivers and Sustainability

Responding to community concerns and reflecting the community's aspirations and long-term vision for Sutherland Shire that relates to the coastal management of Bate Bay, the Community Strategic Plan (Council, 2017) notes that Council seeks to protect and sustain the natural environment. It is recognised that residents, community groups, schools, Council, and developers all have a role in protecting the environment, and reducing resource consumption, for the benefit of current and future generations.

Council to continue to recognise and promote Aboriginal heritage and ongoing role as custodians of land and water, acknowledging post-settlement heritage of the area, and collaborating to maintain and enhance the significant environmental and cultural attributes and assets within Bate Bay. As shown in **Figure 3-1**, almost the entire Bate Bay CMP study area is noted as being of high Aboriginal Archaeological Sensitivity.

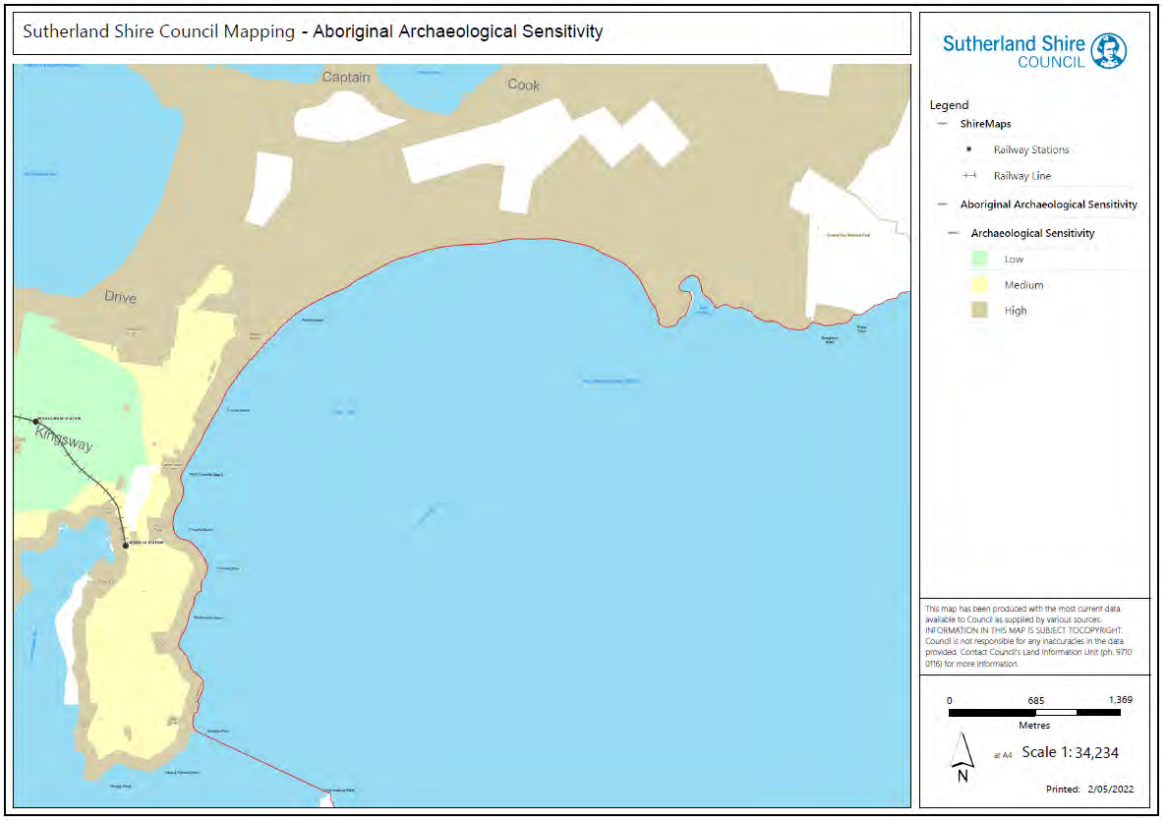

Figure 3-1: Sutherland Shire Council Mapping - Aboriginal Archaeological Sensitivity

With coastal areas being historically and currently important to the Aboriginal community, the La Perouse Local Aboriginal Land Council (LALC) are working to reconnect people to the land through property acquisition, and collaboration with the Gamay Rangers program. Wanting to use and celebrate the land once more, the LALC are seeking to improve relationships between themselves and Council, NPWS and DPIRD - Fisheries in terms of environmental management, as well as development and promotion of cultural events such as the Meeting of Two Cultures and Fire Stories events.

While there are many Aboriginal Heritage sites within the study area, as indicated in **Figure 3-2**, the majority of sites are not advertised due to risk of vandalism. A particular midden at Boat Harbour is very significant and the most significant on the Bate Bay foreshore, and it receives “passive protection” by not being publicised. There are however many opportunities for interpretative signage and local stories.

It is understood that Council will soon have an Aboriginal and Torres Strait Islander committee, which provides an opportunity for ongoing engagement during development and delivery of projects from the Bate Bay CMP, as well as other Council programs. La Perouse LALC an active member of the committee, working closely with the Gujaga Foundation (the peak organisation leading language, cultural and research activities within the La Perouse Aboriginal community) and Gamay Rangers program (Australia's first urban Indigenous ranger group, undertaking natural and cultural resource management caring for Country located on Gamay (Botany Bay).

Figure 3-2: AHIMS search - Bate Bay sites

In the current society, it is noted that the community strongly values access to the special natural environment of Sutherland Shire, especially the beaches and national parks, Council parks and nature reserves. Sutherland Shire has over 1,000 parks and reserves and 3,000 hectares of land containing remnant vegetation (Council, 2017). In addition, the Cronulla beaches within the Bate Bay study area have been proclaimed a National Surfing Reserve and are protected for the public purpose of surfing recreation under the *Crown Lands Act 1989*.

In the north of the embayment, the beaches of Greenhills and Boat Harbour are currently owned by DPHI - Crown Lands up to the lower beach zone, and are then privately owned by Besmaw Pty Ltd, which allows (and regulates) access by 4X4 vehicles, one of the few such locations in Sydney. Immediately offshore is Boat Harbour Aquatic Reserve, which includes the southern part of the Kurnell peninsula, incorporating the whole of Merries Reef and extending east to three green 'Water Board' vents at Potter Point. The seaward boundary is 100 m from the mean low water mark, and it covers an area of approximately 70 hectares, as shown in **Figure 3-3**.

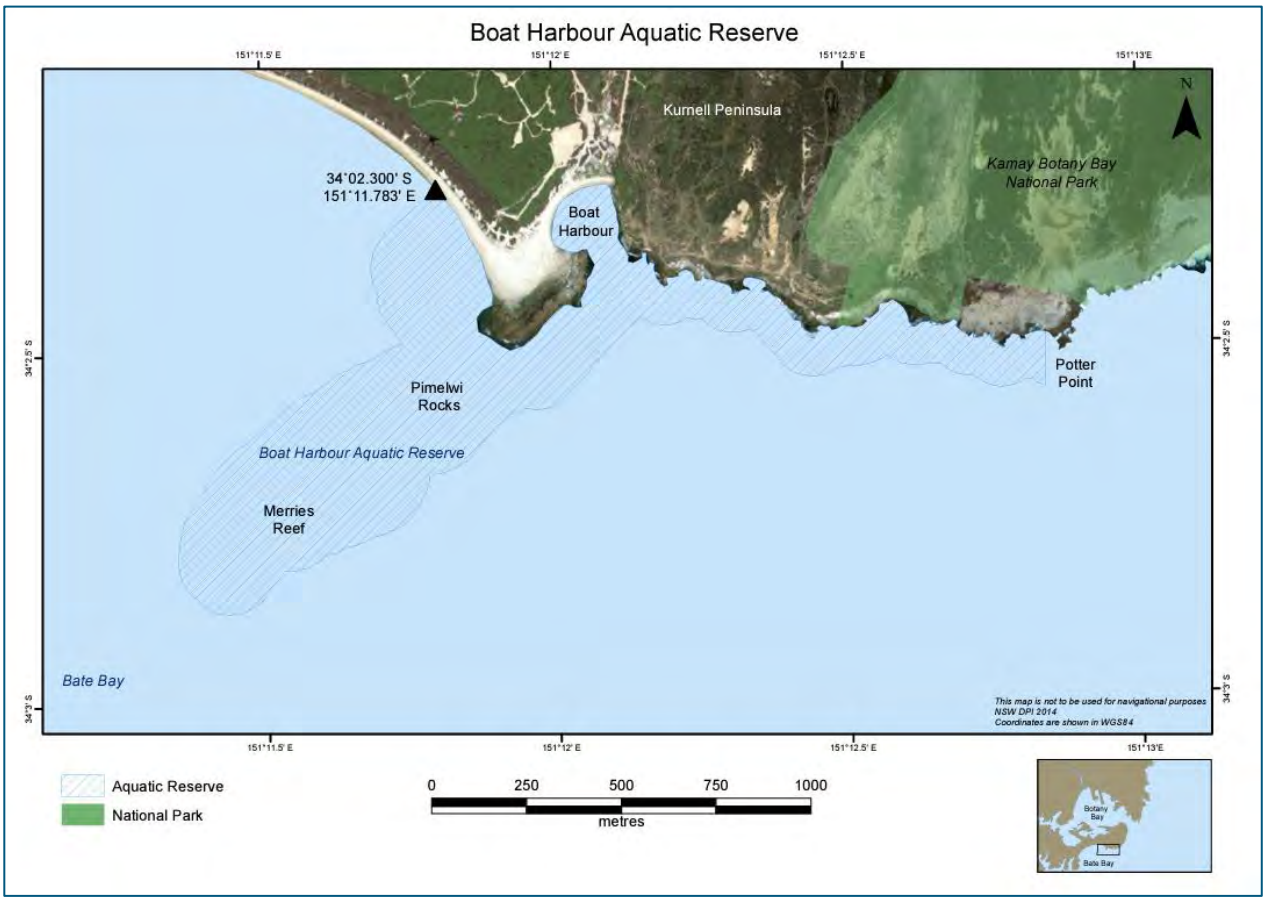

Figure 3-3: Boat Harbour Aquatic Reserve

However, it is recognised that the weather is changing. Sutherland Shire has experienced record-breaking heat trends, and it is noted that the changing climate has the biggest impacts on the most vulnerable members of the community including the ageing population, small children and the economically disadvantaged. Council also reflect the community concerns about the impact of development on beaches, parks and trees, and note the intention to maintain biodiversity, natural resources and access to them (Council, 2017).

As noted in **Section 2.1.3** The Sutherland Shire Council Community Strategic Plan (Council, 2017) established a set of principles to guide the ongoing decision-making in planning for the Sutherland Shire community's future, which many commonalities with the objects of the *Coastal Management Act 2016*, being to manage the coastal environment of New South Wales in a manner consistent with the principles of ecologically sustainable development for the social, cultural and economic well-being of the people of the State.

Having specific association with the intent of the Bate Bay CMP, **Principle 3** (Council, 2017) states that:

> **Principle 3**
> *We understand the need for ecologically sustainable development.*
>
> *To sustain our community socially and environmentally, decision-making for our community should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations as follows:*

The Precautionary Principle: *if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.*

Inter-generational equity: *that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.*

Biological diversity and ecological integrity: *the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.*

Environmental costs need to be considered: *that improved valuation, pricing and incentive mechanisms should be promoted – in assessing the costs and benefits of our actions, the costs to the environment need to be included.*

We will embed the principles of ecologically sustainable development into Our Community Plan to ensure Sutherland Shire can be enjoyed by current and future generations.

In order to achieve the goals described above, Council has adopted a range of Strategies to be implemented.

Having specific association with the objectives of the Bate Bay CMP, **Strategy 2.4** (Council, 2017) provides direction for Council to ensure that:

Strategy 2.4 Environment and climate risks and impacts are understood and managed.

2.4.1 Plan for and respond to long-term climate related changes.
2.4.2 Monitor and manage the environment to minimise the impacts of natural disasters.
2.4.3 Build community resilience to respond and adapt to environment and climate risks.

These community drivers and adopted direction of Council provide direction that support the delivery of actions within the Bate Bay CMP.

3.3 Potential Development

In addition to incremental development of the Cronulla and Bate Bay area across a range of private and public landowners, it is noted that a large site on the northern end of Bate Bay/Kurnell known as the “Holt Estate” (as shown in **Figure 3-4**, referred to within as “Besmaw Pty Ltd land”) has been privately owned and managed since 1861, and is stated as remaining 100% owned by the descendants of Thomas Holt. In the early 2000’s 11 hectares of the original land purchased were dedicated to the NSW State Government as regional open space and were incorporated into Towra Nature Reserve (source: https://www.holtestate.com.au/history).

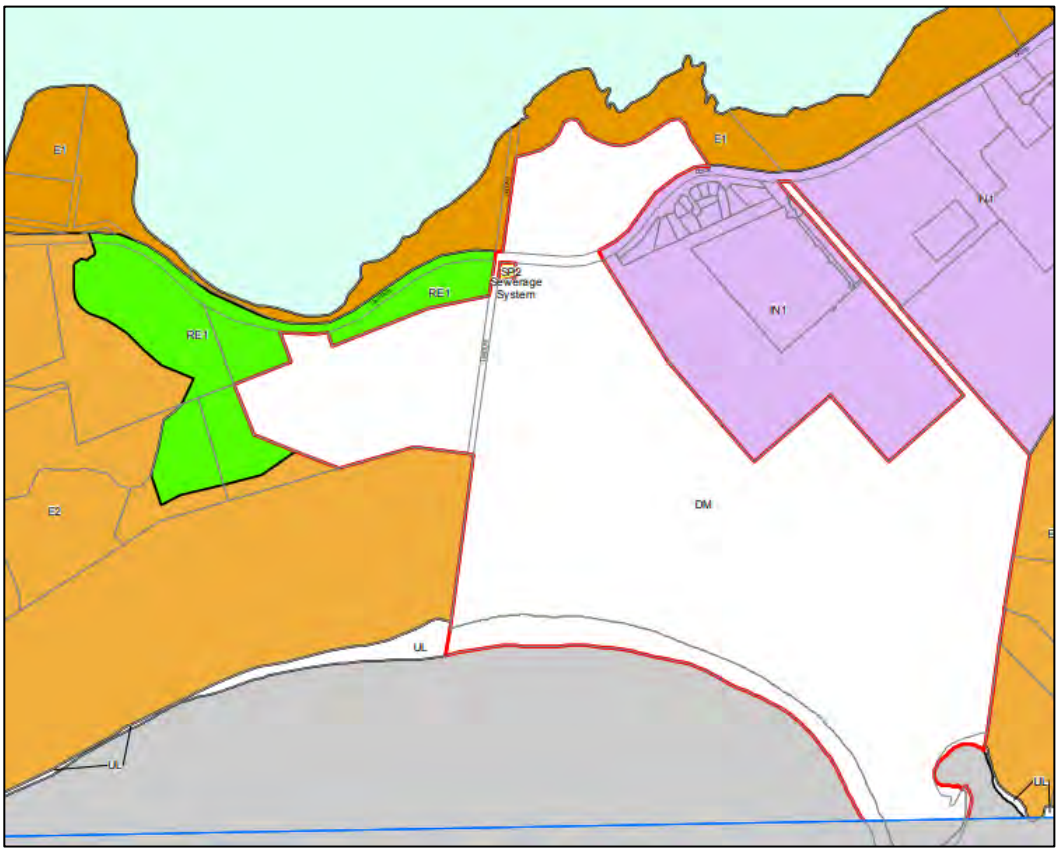

Figure 3-4: Location of the "Holt Estate" shown in white, identified as 'deferred matter' under SSLEP2015

The remaining Besmaw Pty Ltd land is used in a number of ways, with the section north of Captain Cook Drive (Lot 2 North) used for horse riding, equestrian activities and stables; the land south of Captain Cook Drive (Lot 2 South) used for sand extraction and rehabilitation; further south, Bate Bay foreshore is a recreation park, while Boat Harbour houses waterfront holiday cabins (source: https://www.holtestate.com.au/history).

Besmaw Pty Ltd is the family company that controls the business on behalf of five different family groups. In recent years, Besmaw Pty Ltd have been in talks with the NSW Department of Planning, Housing & Infrastructure – Planning and Sutherland Shire Council about planning for the future to deliver a sustainable future for the site (source: https://www.holtestate.com.au/history).

In comparison to the already developed southern section of Bate Bay, the potential for development of the Besmaw Pty Ltd land has not yet been determined, and as such the potential impacts and benefits of future development, as well as the interaction of development with the CMP, is not known at this stage. Further discussion on planning matters within the CMP spatial area is provided within **Section 10**.

3.4 Coastal Hazards and Vulnerability

Recognising the long history of coastal erosion and related management issues within the study area, detailed investigations were undertaken to review and update the understanding of coastal processes and hazards within Bate Bay. This included consideration of notable storms that drive sediment transport and shoreline change, cause damage to coastal infrastructure and can lead to variable shoreline recession rates across the Bay. The investigations employed increased datasets, improved modelling techniques

and increased computational power to provide probabilistic coastal hazard assessments that included consideration of sea level rise implications.

The CM Act (section 7) provides for a Coastal Vulnerability Area to include land subject to coastal hazards. The Definitions within the CM Act indicate that coastal hazard means:

> *(a) beach erosion,*
> *(b) shoreline recession,*
> *(c) coastal lake or watercourse entrance instability,*
> *(d) coastal inundation,*
> *(e) coastal cliff or slope instability,*
> *(f) tidal inundation,*
> *(g) erosion and inundation of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters.*

Noting that the CM Act (section 15(1)) provides for a CMP to deal with *issues affecting the areas to which the program is to apply*, it is open for the CMP to address only the relevant hazards rather than seek to address hazards which are not present or not sufficiently present to be considered an issue affecting the subject area.

For the Bate Bay CMP, the following hazards are considered relevant:

> *(a) beach erosion,*
> *(b) shoreline recession,*
> *(d) coastal inundation,*
> *(e) coastal cliff or slope instability,*

Other hazards are not an issue at this location and thus are not relevant for this assessment.

The Bate Bay CMP – Coastal Risk and Vulnerability Assessment Report (CVA Report) (**Supporting Document C**) provides an initial overview of historical developments that have occurred in the region, describes the range and effect of coastal processes within the study area, and reports on numerous and varied coastal protection and coastal management works, including seawalls, beach nourishment, dune rehabilitation and coastal management operations that have been delivered within the Bate Bay coastal area.

The CVA Report provides a synopsis of the spatial extent, methodology, findings and recommendations of the foreshore geotechnical hazard investigation, undertaken by JK Geotechnics (JKG, 2020). The CVA Report also describes the process, methodology and outcomes of the probabilistic coastal hazard assessment that was undertaken to assess the impacts of the respective coastal hazards on the sandy portions of Bate Bay over a range of planning timeframes, before discussing the short-, medium-, and long-term implications of coastal processes on the beach and associated assets.

Utilising existing records and professional experience to determine priority locations, the study area for the Bate Bay CMP was initially divided into four areas for further investigation, covering the northern beach reserve (Green Hills, Boat Harbour, Potter Point), the surfing beaches (Prince Street Seawall, Elouera Beach to Wanda Reserve), the city beaches (Cronulla Beach to North Cronulla Beach, including a 350m section of The Esplanade), and the rocky foreshore/headland of Cronulla peninsula (featuring Oak Park, Shelly Park, Shelly and Blackwoods Beaches, The Esplanade and Bass and Flinders Point).

The key focus areas for the CMP were identified as:

- North Cronulla Beach and Dunningham Park;

- The Surfing Beaches;
- Prince Street Seawall; and,
- The Esplanade between Cronulla and North Cronulla beaches.

An abbreviated selection of the CVA Report, including further discussion of the relevant impact of coastal processes on these locations, as well as potential management measures, is provided below.

3.5 Sediment Transport

Coastal hazards are initially considered in the context of broad sand movement. The embayment is relatively unique in that, unlike much of the NSW coastline, Bate Bay is described as a “closed” sediment system with negligible transfer of sediment into or out of the Bay in the north and south directions and beyond a water depth of about 12 m (Patterson Britton, 2001). The only possible significant losses of sediment are due to windblown losses that occur in the north-east of the embayment.

There is however a general longshore movement of existing sand within the embayment from the city beaches northwards towards the beach reserve opposite Merries Reef. **Figure 3-5** provides a visual representation of sediment movement within this closed sediment system by displaying in yellow arrows and text the onshore and offshore movement of sand, while the red arrows and text provide descriptions of the average annual volume and direction of sand movement at selected locations.

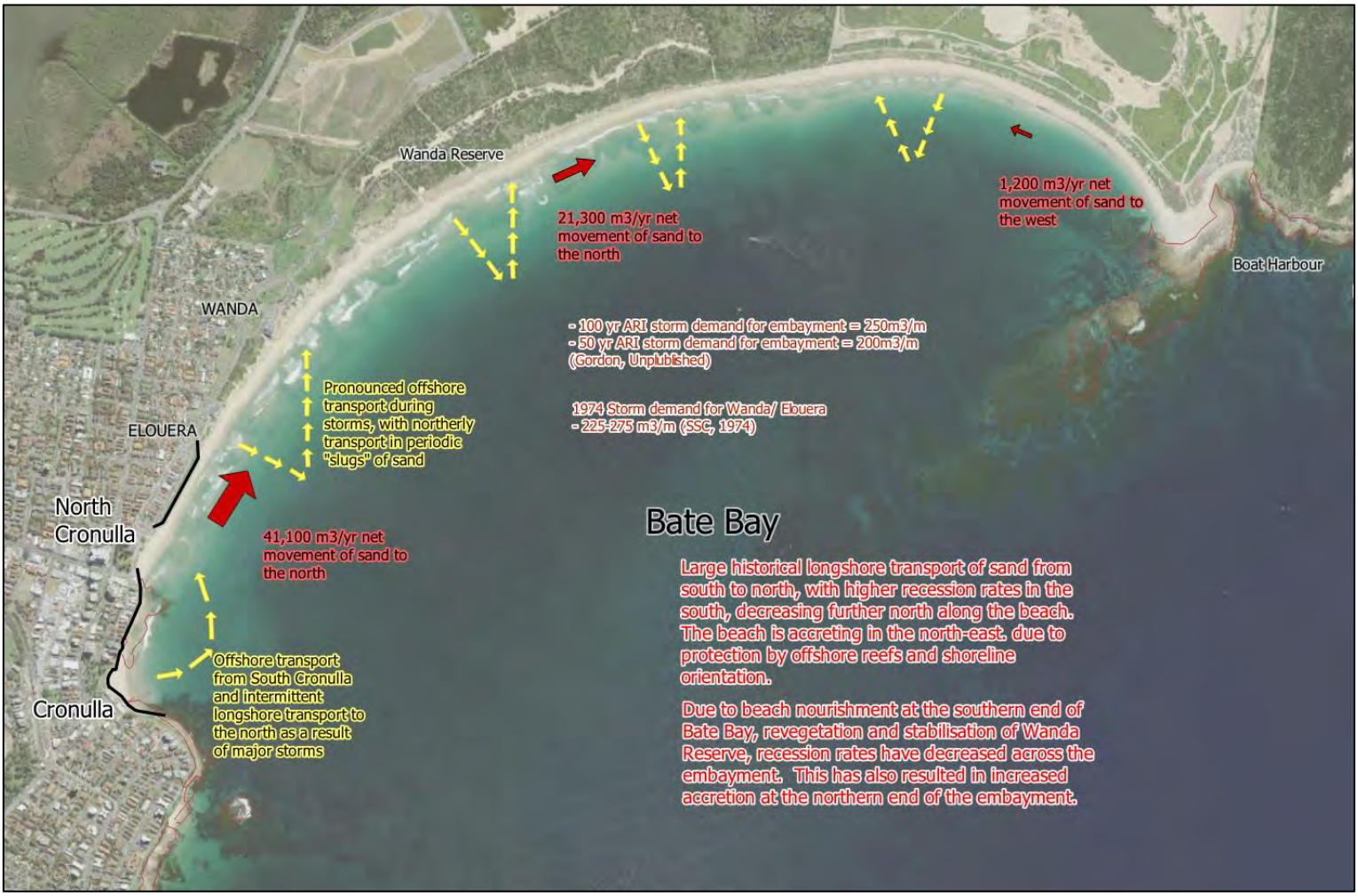

Figure 3-5: Sediment Transport within Bate Bay

3.6 Shoreline Recession / Progradation Rates

The NSW Government has extensive aerial records of the State's beaches, dating as far back as the 1930s. By using stereo-photogrammetric techniques, these photographs have been processed into profiles along the NSW coast. At each beach, data has been extracted at representative transects, typically at a spacing of 20 – 200 m, with transect location kept constant across each air photo date. These profiles are grouped into "Blocks" of relative parallel sets of profiles, as shown in **Figure 3-6**.

Average shoreline recession or progradation rates are determined by the analysis of available beach profiles within each Block (sourced from DCCEEW - BCS NSW Beach Profile Database).

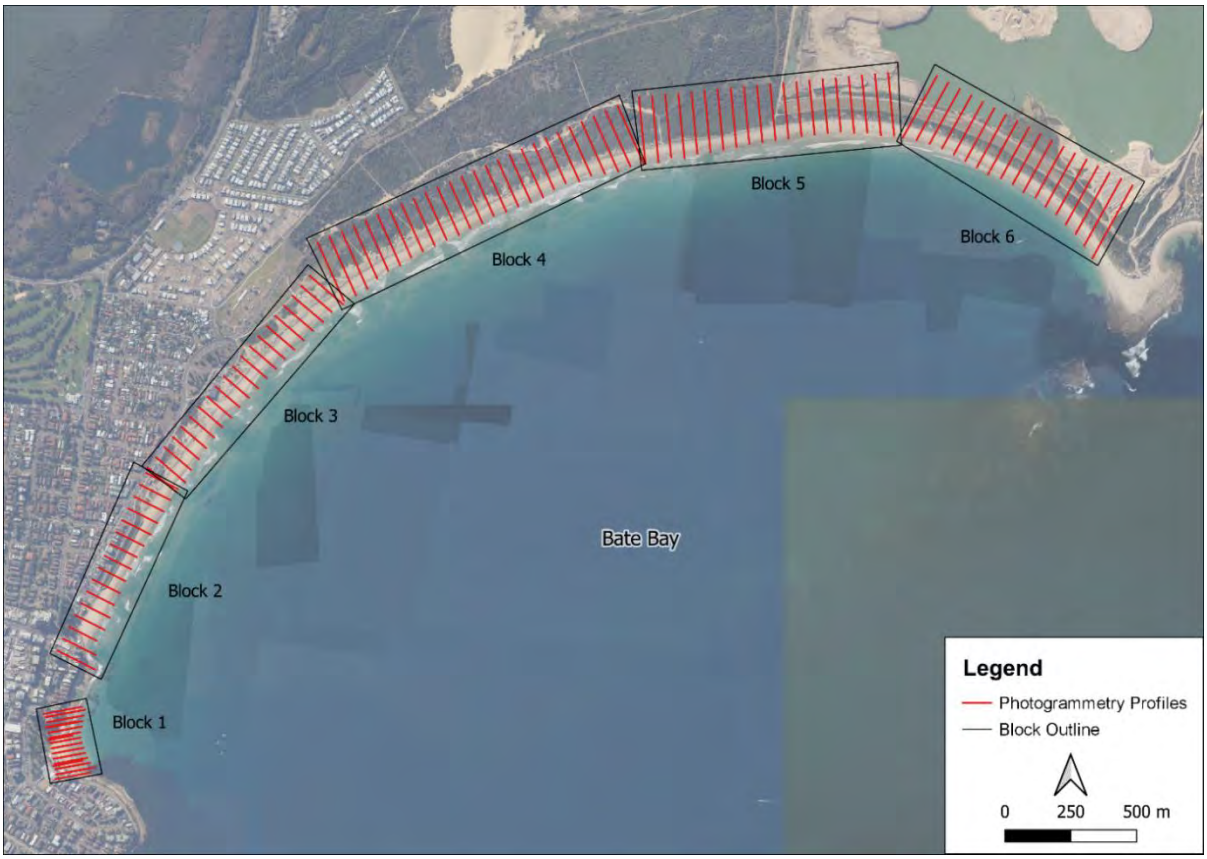

Figure 3-6: Apportioning of Blocks and associated Photogrammetric Beach Profile Locations (data source: DCCEEW - BCS)

Based on analysis of the beach profiles between 1930 to 2018, the adopted block average recession or progradation rates were able to be determined. The years analysed for each of the blocks are set out in **Figure 3-7** as well as the summarised average shoreline movement rates. It is important to note that minus values indicate a landward trend (recession) and positive values indicate a seaward trend (progradation), as shown in **Figure 3-7**.

Analysis of available beach profile data collected from the 1930s found that because of the longshore sand movement, the city beaches were slowly receding but much of the northern beach reserve was accreting (prograding), as shown in **Table 3-1**. The estimated rates of recession would likely have been greater if not for the beach nourishment undertaken in 1977/78 and again on four occasions between 1999 and 2012.

Table 3-1: Average Shoreline Recession Rates

Block	Average Shoreline Recession Rates (m/year)	Years Analysed
1	-0.2	1930-2018
2	-0.25	1930-2018
3	-0.13	1930-2018
4	+0.12	1930-2018
5	-0.05	1951-2016
6	+0.42	1961-2016

Figure 3-7: Rates of Recession and Progradation within Bate Bay, including time period of assessed data (data source: DCCEEW - BCS)

3.7 Sea Level Rise

Global mean sea level rise projections are provided in IPCC (2013b) for four (4) representative concentration pathways (RCP) scenarios, namely RCP2.6, RCP4.5, RCP6.0 and RCP8.5. For each scenario a median sea level rise value is provided along with a likely range, corresponding to the 5% to 95% percentile values, for future years up to 2100. Global plots of percentage deviation from the global

mean sea level rise are also provided and indicate that the local variation along the east coast of Australia is up to 10% higher than the global mean.

Council has adopted its own Sea Level Rise Policy (Sutherland Shire Council, 2016) which is based on the IPCC (2013b) RCP6.0 (high) scenario. Review of the adopted sea level rise values relative to 2015 (refer **Table 3-2**) indicates that the published IPCC (2013b) values have been increased by Council by 10% to account for local variation in sea level rise relative to the global mean. These sea level rise projected values have been utilised within the probabilistic coastal hazard assessment of Bate Bay to predict the probability of future coastal hazards impacting a range of locations.

Table 3-2: Sutherland Shire Council Adopted Sea Level Rise Projections (Sutherland Shire Council, 2016)

Year	Sea Level Rise (m)
2015	0.00
2020	0.03
2030	0.10
2040	0.15
2050	0.23
2060	0.30
2070	0.39
2080	0.50
2090	0.61
2100	0.72

3.8 Qualitative Assessment of Risk to Life and Risk to Property from Cliff and Foreshore Instability

JK Geotechnics (JKG) were engaged by RHDHV to undertake a geotechnical assessment of the foreshore cliff faces and soil slopes between Bass and Flinders Point and Potter Point, excluding the sandy embayment between the Prince Street seawall and Boat Harbour. Although some areas of instability were identified, the associated risk was deemed to be mainly acceptable and occasionally tolerable.

JKG carried out a qualitative risk assessment of both risk to life and risk to property in accordance with the Australian Geomechanics Society (AGS) (2007) risk classification (JKG, 2020).

3.8.1 Assessment of Risk to Life

JKG used the indicative probabilities associated with the assessed likelihood of instability to calculate the risk to life. The temporal, vulnerability, spatial and evacuation factors that have been adopted are provided within the CVA Report (**Supporting Document C**) together with the resulting risk calculation. JKG considered people walking along the coastal path, people walking along the base of the wave cut platform, people stationary on the wave cut platform or beach, people stationary in the rear yards of private properties, people within the houses at the eastern end of the Besmaw Pty Ltd land (Precinct 4 only), and Council bush regeneration staff working on foreshore slopes.

JKG assessed that the risk to life for the person most at risk within the study area with no stabilisation measures ranges between about 10^{-5} and 10^{-12}. These levels would be considered to be 'acceptable' in relation to the criteria given in AGS 2007.

Elsewhere across the study area, the risk to life was 10^{-6} or less. Risk to life of 10^{-5} or less is considered 'Acceptable' in accordance with AGS 2007.

3.8.2 Assessment of Risk to Property

The results of the risk assessment have identified that the risk to property within the study area was either 'Very Low' or 'Low', with the exception of the following features that were assessed to be at 'Moderate Risk':

- The loosely stacked sandstone masonry retaining wall opposite No. 88 and No. 87 The Esplanade. It is noted that this wall was also identified in the geotechnical report undertaken by Jeffery & Katauskas (2005) to inform the *Bate Bay Assessment of Shoreline Protection Works* (Patterson Britton, 2006);
- The foreshore soil slopes above the crest of the cliff line between 25 Elizabeth Place and 12 Arthur Avenue; and,
- The concrete/sandstone block/rendered seawall supporting the seaward side of The Esplanade at the northern end of Cronulla Beach.

'Very Low' and 'Low' risk is considered 'Acceptable' in accordance with AGS 2007, and 'Moderate Risk' is considered tolerable. Further details are provided within the CVA Report (**Supporting Document C**), while mapping of geotechnical hazard zones are included in **Section 16**. Management actions to be implemented by Council, including periodic and event-based monitoring, are included within the action tables of the Bate Bay CMP.

3.9 Structural Integrity and Wave Overtopping of a section of The Esplanade

The Esplanade forms part of the Cronulla Coastal Walkway, which is primarily a 5km concrete and bitumen pathway that loops around the foreshore of Bate Bay and the Cronulla peninsula, from Wanda Beach in the north to Salmon Haul Bay in the south. Identified as being at risk is a low-lying 350 metre long (approximately) section of pedestrian and bicycle thoroughfare from Cronulla Park and Cronulla Beach in the south to Peryman Square in the north, as shown in **Figure 3-8**.

Figure 3-8: Aerial photograph showing extent of The Esplanade considered to be at risk

The existing Esplanade pathway varies in width between 2.5 and 4 metres. The Esplanade is paved with concrete which exhibits abrasion at the surface, partially exposing coarse aggregates. Three (3) rows of brick pavers separate the concrete pathway slab panels at regular spacings. A 1.5 to 2m high vertical concrete seawall retains the fill material under the pathway and appears to be founded on the adjacent rock platform. The existing concrete components exhibit cracking, indicating differential movement. An aluminium balustrade is bolted to the crest of the seawall.

A portion of the seawall has been displaced, and is currently supported by steel circular hollow section props that are bolted into the rock platform. This propped section was identified as 'high risk' by Patterson Britton & Partners in their *Assessment of Shoreline Protection Works* (April 2006). The props exhibit moderate surface corrosion and are unsightly, as shown in **Figure 3-9**.

Figure 3-9: Displaced section of The Esplanade stabilised though use of props

Seawall crest levels along The Esplanade vary along its length from a relatively elevated level at around 4.5m AHD where it links with Peryman Square at its northern end, to the lowest crest levels at 2.6-2.7m AHD behind the North Cronulla Rock Pool. Seawall crest levels increase to the south to around 3-3.3m AHD behind the Cronulla Beach Rock Pool. At the southern end of the subject site, seawall crest levels are at around 3.5-3.6m AHD. As such, the most vulnerable areas for wave overtopping exist in the vicinity of the North Cronulla Rock Pool, where the seawall crest is low and the adjacent rock platform level is also relatively low.

Review of the average overtopping discharges for present day conditions indicates that for relatively frequent events that may occur once a year, overtopping in the lowest sections of the seawall may be dangerous for pedestrians. For events with a recurrence interval greater than 10 years, overtopping may be unsafe for vehicle transit at any speed, which would be problematic for emergency response along The Esplanade (e.g. ambulance service).

However, this assessment should only be considered to be a rough indication given the simplification of complex wave breaking processes, subjectivity of tolerable overtopping limits, and local geometry of the rock platform, rock pools and seawall which could produce variation in overtopping discharges by orders of magnitude. Notwithstanding, this finding is generally consistent with anecdotal evidence from Council that suggests that overtopping is an issue along The Esplanade and is currently managed by closure of the pathway in adverse sea conditions.

Estimated average overtopping discharges reported within the CVA Report (**Supporting Document C**) indicates that the inclusion of sea level rise at the end of a nominal 50-year design life (2070) significantly increases overtopping rates. Increasing the height of The Esplanade by a typical pavement thickness of say 200mm would provide a minor reduction in overtopping. An increase in elevation of several metres is required to reduce overtopping to tolerable levels for vehicle and pedestrian access for relatively frequent events (1 year ARI) under future sea level rise.

It is considered impracticable to increase the height of the Esplanade to limit overtopping to acceptable levels and frequency over the design life of the structure. A more effective method may be to introduce wave deflecting parapets and recurve fixtures to the crest of the seawall, in addition to continuation of periodic closures.

3.10 Probabilistic Coastal Hazard Assessment for Sandy Beaches and Public Assets

There are a number of ways in which coastline hazard lines can be defined, including:

- for various planning periods, such as Immediate, year 2050, 50 years from present (year 2070 at date of investigation), year 2100, and/or 100 years from present (year 2120 at date of investigation); and
- at various locations, such as at the landward edge of the Zone of Wave Impact (ZWI), Zone of Slope Adjustment (ZSA), or Zone of Reduced Foundation Capacity (ZRFC), refer to **Figure 3-10**, modified from Nielsen et al (1992).

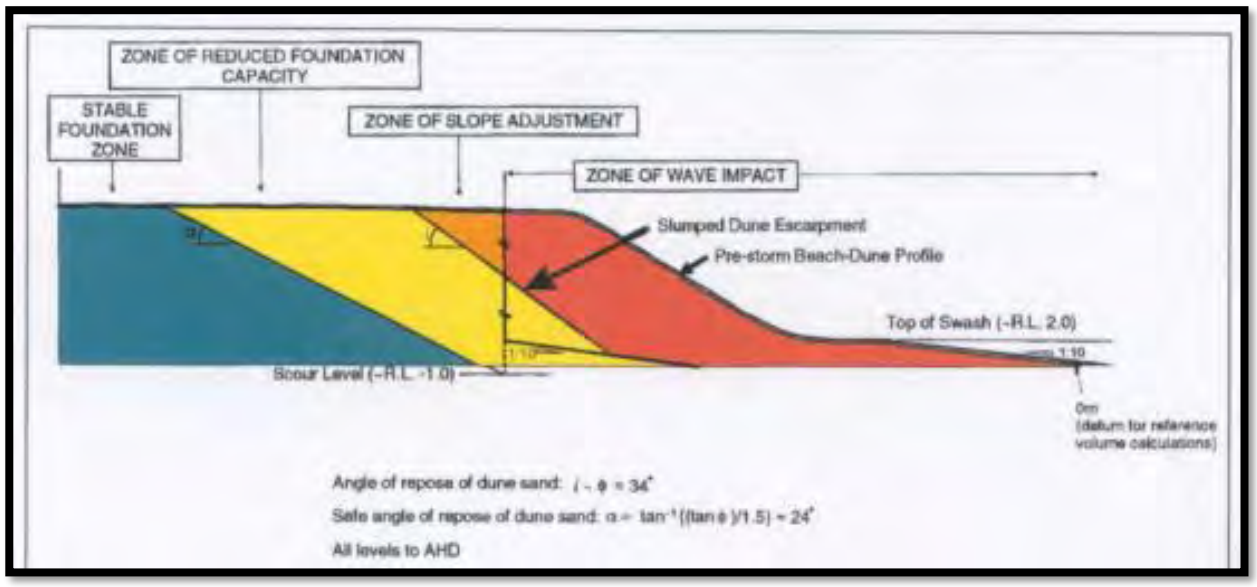

Figure 3-10: Schematic representation of dune erosion hazard (after Nielsen et al, 1992)

The Cronulla Surf Life Saving Club (SLSC) is positioned landward of a terminal revetment (seawall) and is not considered at risk from coastal erosion, however it may be impacted by wave run-up and overtopping. The North Cronulla SLSC is positioned within Dunningham Park. Dunningham Park and the North Cronulla SLSC are noted as being impacted by historical coastal erosion events such as the 1974 storm event (refer **Figure 3-11**), and is projected to continue to be impacted unless coastal protection works are constructed at this location.

Probabilistic modelling was carried out to estimate the extent of existing and future coastal erosion. It was predicted that by 2070 there would be a 95% chance that erosion during a coastal storm would extend into Dunningham Park and to the SLSC buildings at North Cronulla, Elouera and Wanda Beaches.

Figure 3-11: 1974 Storm Erosion at North Cronulla Beach

The end points or headlands of the Dunningham Park embayment are assumed to be fixed in position. The Peryman Square roadhead rock works to the south, and Prince Street Seabee seawall with its upgraded toe to the north, are expected to remain in place and be serviceable for at least the next 30 years. The Coastline Management Program probabilistic current and future ZSA coastal hazard lines for 2020 and 2070, as shown in **Figure 3-12** and **Figure 3-13** assume no management intervention in the form of a seawall at North Cronulla Beach fronting Dunningham Park.

Information provided by Council show that the Elouera and Wanda Surf Life Saving Clubs (SLSCs) have been constructed on deep piles to address known coastal erosion hazards, and are therefore considered not at risk of impact/loss as a built asset. However, it is expected that during and for a period of time after a coastal erosion event access to and from the Cronulla, North Cronulla, Elouera and Wanda SLSCs and adjoining facilities will be impacted.

The probabilistic coastal hazard assessment described in the CVA Report (**Supporting Document C**) provides updated erosion / recession probability lines for the ZSA and ZRFC for 2020, 2070 and 2120, which are provided as maps in **Section 17**.

These probabilistic coastal hazard lines have been considered when undertaking the vulnerability assessment of assets between Cronulla Beach and Boat Harbour (described in **Section 3.11**) and have been utilised when developing options for management actions.

Figure 3-12: Dunningham Park - Zone of Slope Adjustment 2020

Figure 3-13: Dunningham Park - Zone of Slope Adjustment 2070

It is noted that the probabilistic current and future ZSA coastal hazard lines (refer to **Figure 3-10**) for 2020 and 2070, as shown in **Figure 3-14** and **Figure 3-15** are projected to impact on the beach and vegetated sand dunes along the “surf beaches” and Wanda Reserve during an erosion event.

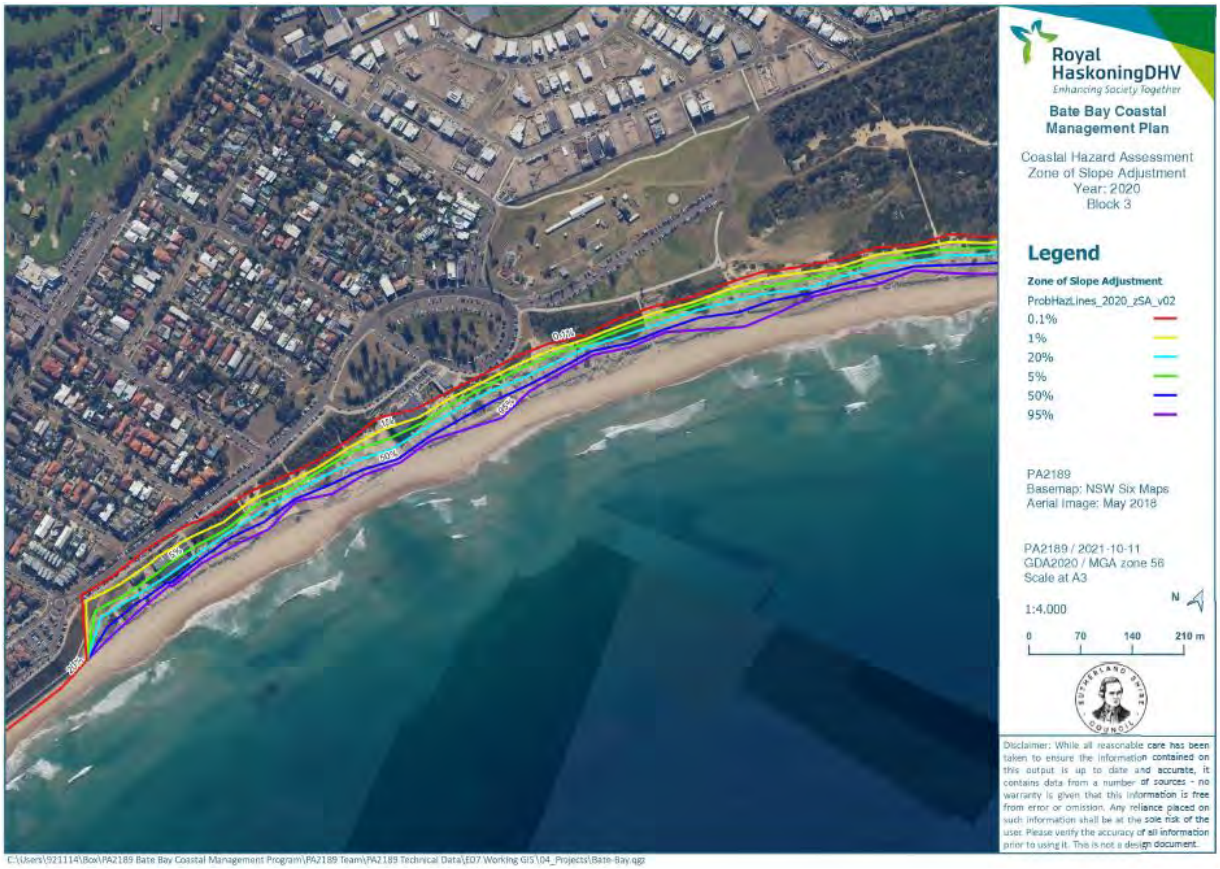

Figure 3-14: Surf Beaches - Zone of Slope Adjustment 2020

Typical hazards relevant to most zones of the beach frontage include:

- unstable vertical dune erosion scarps (that can collapse suddenly creating a hazard to persons/property at crest or near toe of scarp);
- public safety in areas of wave overtopping/inundation;
- unsafe beach accessways due to erosion;
- unsafe access to/from the Cronulla, North Cronulla, Elouera and Wanda SLSCs and adjacent facilities;
- vehicles driving on sealed surfaces e.g., roadway/carpark where founding material has been eroded or undercut;
- vegetation destabilised by erosion; and,
- submerged objects e.g., remnant/displaced stormwater assets or former seawall elements.

Figure 3-15: Surf Beaches - Zone of Slope Adjustment 2070

3.11 Vulnerability Assessment

As noted in the Coastal Management Manual Part B: Stage 2 (OEH, 2018), vulnerability in a coastal context is determined by:

- determining the number, type and location of assets and locations that may be vulnerable to coastal hazards;
- developing an understanding of the exposure and potential impacts of hazards and threats to assets and locations;
- assessing the sensitivity of communities, assets and values to potential impacts; and,
- assessing the capacity to respond and adapt – as influenced by the environmental, socioeconomic and planning context.

Assets and coastal values that have a high exposure and sensitivity to the impacts of coastal hazards, combined with a low capacity to mitigate the impacts or be modified to adapt, are considered to be highly vulnerable. **Figure 3-16** shows schematically how these components of vulnerability interact.

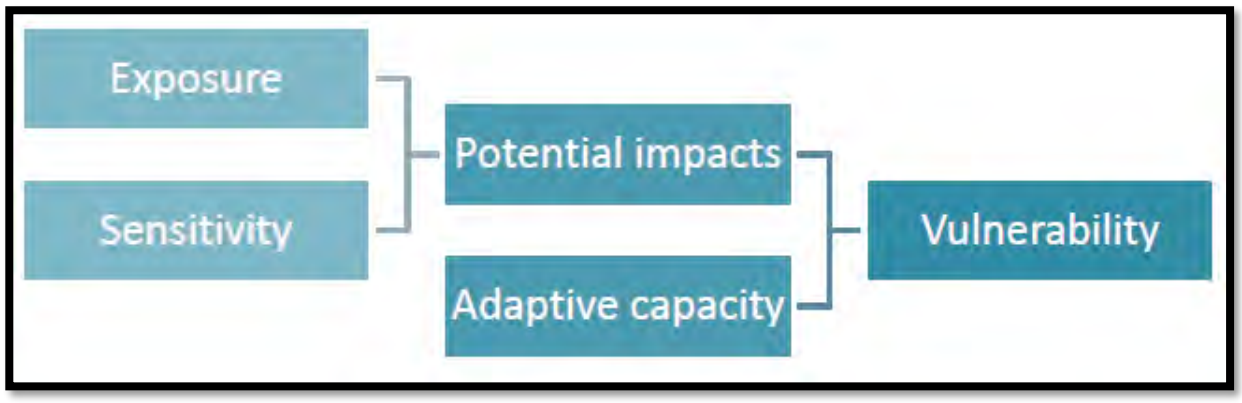

Figure 3-16: Components of vulnerability (Coastal Management Manual Part B: Stage 2; OEH, 2018)

The coastal vulnerability assessment was undertaken for four types of risks, being:

- Public Safety;
- Infrastructure Damage;
- Environmental; and,
- Public Amenity.

Consideration has been given to the range of threats across asset locations, and the potential exposure to hazards or impacts, across current, 20 year, 50 year and 100 year planning horizons.

The capacity to apply adaptive control measure(s) (eliminate, substitute, engineering controls, administrative controls) has been considered, and assuming that potential mitigation actions have been taken to address the identified threats to each asset, an additional assessment of the residual risk and underlying vulnerability has been undertaken. The assets that are considered to have a high residual vulnerability rating are provided in **Table 3-3**.

Notably, the assessment confirmed the vulnerability of Dunningham Park, The Esplanade, Prince Street Seawall and the City Beaches as Key Locations requiring specific management actions.

Table 3-3: Vulnerability assessment of assets with a high residual risk rating

Risk Assessment	Asset	Threat(s)	Exposure to Hazards or Impacts
Public Safety	South and North Cronulla Rock Pools, Esplanade	Wave runup and overtopping	- Injury to public due to inundation caused by high sea level during storm events - Injury to public caused by structures and/or debris mobilising during storm events.
	Prince Street Seawall	Coastal erosion	- Injury to beach users caused by exposure and mobilisation of buried remnants of historic foreshore protection. - Injury to beach users and/or residents caused by structures mobilising during storm events. - Injury to beach users caused by erosion, instability of existing beach accessways.

Risk Assessment	Asset	Threat(s)	Exposure to Hazards or Impacts
		Wave runup and overtopping	- Injury to public due to inundation caused by high sea level during storm events - Injury to public caused by structures and/or debris mobilising during storm events.
Infrastructure Damage	Cronulla Surf Life Saving Club and adjacent buildings, The Esplanade	Wave runup and overtopping	- Damage to public and private infrastructure and property caused by wave runup and overtopping of seawalls during coastal storms.
	South and North Cronulla Rock Pools, The Esplanade	Coastal erosion	- Damage to public infrastructure and property, including Council beach accessways, caused by storm erosion. - Damage to seawalls caused by scour and/or coastal storms.
	Dunningham Park and adjacent buildings	Coastal erosion	- Damage to public and private infrastructure and property, including Council beach accessways, caused by storm erosion. - Damage to seawalls and connected assets (e.g. The Esplanade) caused by scour and/or coastal storms.
		Shoreline recession	- Damage to public and private infrastructure and property, including Council beach accessways, caused by shoreline recession.
		Wave runup and overtopping	- Damage to public and private infrastructure and property caused by wave runup and overtopping of seawalls and dunes during coastal storms.
	Prince Street Seawall	Coastal erosion	- Damage to public infrastructure and property, including Council beach accessways, caused by storm erosion. - Damage to seawalls caused by scour and/or coastal storms.
		Shoreline recession	- Damage to public and private infrastructure and property, including Council beach accessways, caused by shoreline recession.
	Elouera Surf Life Saving Club and adjacent buildings	Coastal erosion	- Damage to public and private infrastructure and property, including Council beach accessways, caused by storm erosion.
		Shoreline recession	- Damage to public and private infrastructure and property, including Council beach accessways, caused by shoreline recession.
		Wave runup and overtopping	- Damage to public and private infrastructure and property caused by wave runup and overtopping of dunes during coastal storms.
	Wanda Surf Life Saving	Coastal erosion	- Damage to public and private infrastructure and property, including Council beach accessways, caused by storm erosion

Risk Assessment	Asset	Threat(s)	Exposure to Hazards or Impacts
	Club and adjacent buildings	Shoreline recession	- Damage to public and private infrastructure and property, including Council beach accessways, caused by shoreline recession.
		Wave runup and overtopping	- Damage to public and private infrastructure and property caused by wave runup and overtopping of dunes during coastal storms.
Environmental	Bate Bay sandy embayment	Population growth & coastal development	- Loss of habitats. - Reduction in the health of ecosystems. - Reduced biodiversity value. - Impact on indigenous and non-indigenous heritage - Loss of migratory waders and shorebirds. - Loss of threatened species - Increased use of the coastal zone from residents and tourists resulting in impacts on the health of ecosystems, biodiversity, habitats, and water quality. - Increased pedestrian, pet and vehicle traffic over rock platforms, dunes, and other sensitive areas resulting in damage to habitats. - Change in land-use impacting water quality of beaches.
		Recreational use of the coastal zone	- Damage to habitats. - Adverse impacts on water quality and aquatic ecology. - Reduced biodiversity value.
Public Amenity	Bate Bay sandy embayment	Coastal erosion	- Reduced beach amenity caused by loss of beach sand during coastal storms resulting in narrow beach widths, erosion scarps, hazardous beach access, exposure of existing emergency foreshore protection and buried remnants of damage from historic events.
		Shoreline recession	- Reduced beach amenity resulting from shoreline recession.
		Population growth; coastal development; & human use of the coastal zone	- Increased visitation from residents and visitors resulting in more crowded beaches, less available parking, conflicts between user groups, increased requirement for maintenance of accessways and other assets etc. - Reduced public amenity due to increased/damaging private coastal development - Impacts on public amenity caused by the occupation of public spaces by people, businesses and private belongings. - Increased pedestrian, pet and vehicle traffic over rock platforms, dunes, and other sensitive areas resulting in damage to habitats.

4 Actions to be implemented by Council and by Public Authorities

A range of management measures to address coastal vulnerabilities and meet the management objectives discussed in **Section 2.1.3** have been identified and assessed as actions for inclusion within the Bate Bay CMP, following community and stakeholder consultation.

4.1 Management Options for Key Locations

The Bate Bay CMP Coastal Vulnerability Assessment identified four Key Locations requiring management actions, being The Esplanade between Cronulla and North Cronulla Beaches, Dunningham Park and North Cronulla Beach, Prince Street Seawall, and the City and Surfing Beaches.

Widening of The Esplanade between Cronulla and North Cronulla Beaches is proposed to address deterioration of the current structure and improve public access. Access to the rock platform and Cronulla Beach from The Esplanade (lateral access) could be improved by incorporating access ramps and bleachers, a range of options have been provided for community consultation and comment.

The endorsed action for The Esplanade - Option 3: Improved longitudinal and lateral access i.e. Esplanade widening with access via ramps and bleachers to the rock platform and pools, is described in Section 5.

Dunningham Park and North Cronulla Beach have a well-documented history of being impacted by coastal hazards, including relocation of the North Cronulla Surf Life Saving Club. Noting that projected coastal hazard lines extend significantly landward of the existing dunes and public assets, a seawall is proposed for North Cronulla Beach to provide permanent protection from coastal erosion. This involves replacing the existing informal non-continuous rock wall with an engineered structure that comprises a combination of rock revetment, vertical wall and concrete bleachers. It is noted that the 2003 Coastline Management Plan recommended construction of a seawall at North Cronulla Beach fronting Dunningham Park, however this seawall has not yet been constructed.

The endorsed action for Dunningham Park - Option 4: Combination vertical wall with bleachers and access ramp, and rock revetment, is described in Section 6.

The Prince Street seawall has ongoing structural issues that are likely to lead to further failures and significant ongoing repair unless an effective asset management plan is actioned. The Prince Street seawall requires restorative works to address the loss of sand from beneath the seawall face and thereby the risk of localised subsidence. An asset management plan has been prepared to address short- and medium-term issues, to prolong the effective useful life of the structure. Replacement of the seawall has been noted as a long-term requirement. Various approaches have been considered with detailed investigations to continue following the completion of the Bate Bay CMP.

The endorsed action for remediation of the Prince Street seawall is described in Section 7.

Sand nourishment is proposed for the City Beaches, which will also benefit the Surfing Beaches as the sand is distributed alongshore through natural coastal processes. Continuing the historic practice of nourishing with 60-80,000 m^3 of sand every five to seven years would help maintain the beach profile observed over the past two decades, as well as help maintain surf quality. A lesser rate of nourishment would likely not halt long term recession while a greater rate of nourishment could potentially infill the rock pools and create an undesirably wide beach. Sand would likely be sourced from the periodic dredging of the Port Hacking main navigation channels, however, alternative sources of sand should also be considered if available.

The endorsed action for sand nourishment of the City Beaches, which will also benefit the Surfing Beaches, is described in Section 8.

Through widespread community and stakeholder engagement undertaken during Stages 1, 2 and 3 of the CMP process, Council sought to develop a greater understanding of the community's values, issues and aspirations for the wider Bate Bay coastal area. As well as online community consultation, a range of workshops were held with key stakeholder groups including (but not limited to) Surf Life Saving Clubs, representatives of the surfing community, and Bushcare Volunteers.

In order to adequately address the range of concerns and opportunities raised during the consultation process, a wide range of actions have been developed and included as endorsed actions to address:

- Coastal Hazards Management
- Coastal Environment Management
- Foreshore Access Management
- Coastal Amenity Management
- Culture and Safety

The consultation process and management actions for the wider Bate Bay coastal area are further described in Section 9.

5 The Esplanade

5.1 Endorsed Action - Esplanade Upgrade Option 3: Widen Path with Bleachers, Access Ramps & Maintain Walkway Alignment

Option 3 was developed during project team workshops and represents a combination of the preferred widening concept (i.e. backfilled concrete seawall) that maintains the existing walkway alignment with the all-ability access ramp add-on. The plan layout for this option is shown in **Figure 5-1, Figure 5-2, Figure 5-3**, typical sections provided **Figure 5-4, Figure 5-5, Figure 5-6, Figure 5-7, Figure 5-8 and Figure 5-9**, with renderings provided in **Figure 5-10, Figure 5-11, Figure 5-12, Figure 5-13, Figure 5-14** and **Figure 5-15**.

During further development of the proposed design, consideration will be given to provision of appropriate access for emergency and maintenance vehicles (e.g. Ambulances, Lifeguard and Surf Club ATV's) along this section of The Esplanade, as well as to the rock shelf and rock pools for e.g. transfer of lifesaving equipment and patients. Consideration will also be given to provision of appropriate lighting and other amenity features.

The southern end of the alignment would comprise a widened 5m walkway formed by a backfilled concrete vertical seawall structure. Existing beach access steps at approximately Chainage (CH) 80 would be demolished and reinstated with new concrete steps.

The widened 5m walkway would continue to the north as a solid vertical faced seawall structure and would widen by a further 2m to incorporate all-ability access ramps to the Cronulla Beach Rock Pool. Concrete ramps would extend from both sides of the pool to a central level landing area. The ramps would have a grade of 1V:20H with 1.2m landings at every 15m ramp length and would include handrails along the seaward side, seeking to provide safe and appropriate access for rock pool users with a range of mobility functions.

To the north of the northern ramp entry to The Esplanade walkway, a width of 7m (5m widened Esplanade plus 2m width for ramp entry) would be maintained to accommodate the new public access stairs positioned adjacent to the North Cronulla Rock Pool at approximately CH 250.

To the north of the new public access stairs the widened walkway would return to a 5m width and continue along its existing alignment. At approximately CH 300 the walkway would grade at 1V:20H up to a 1.5m landing at the location of new public access stairs at approximate CH 320.

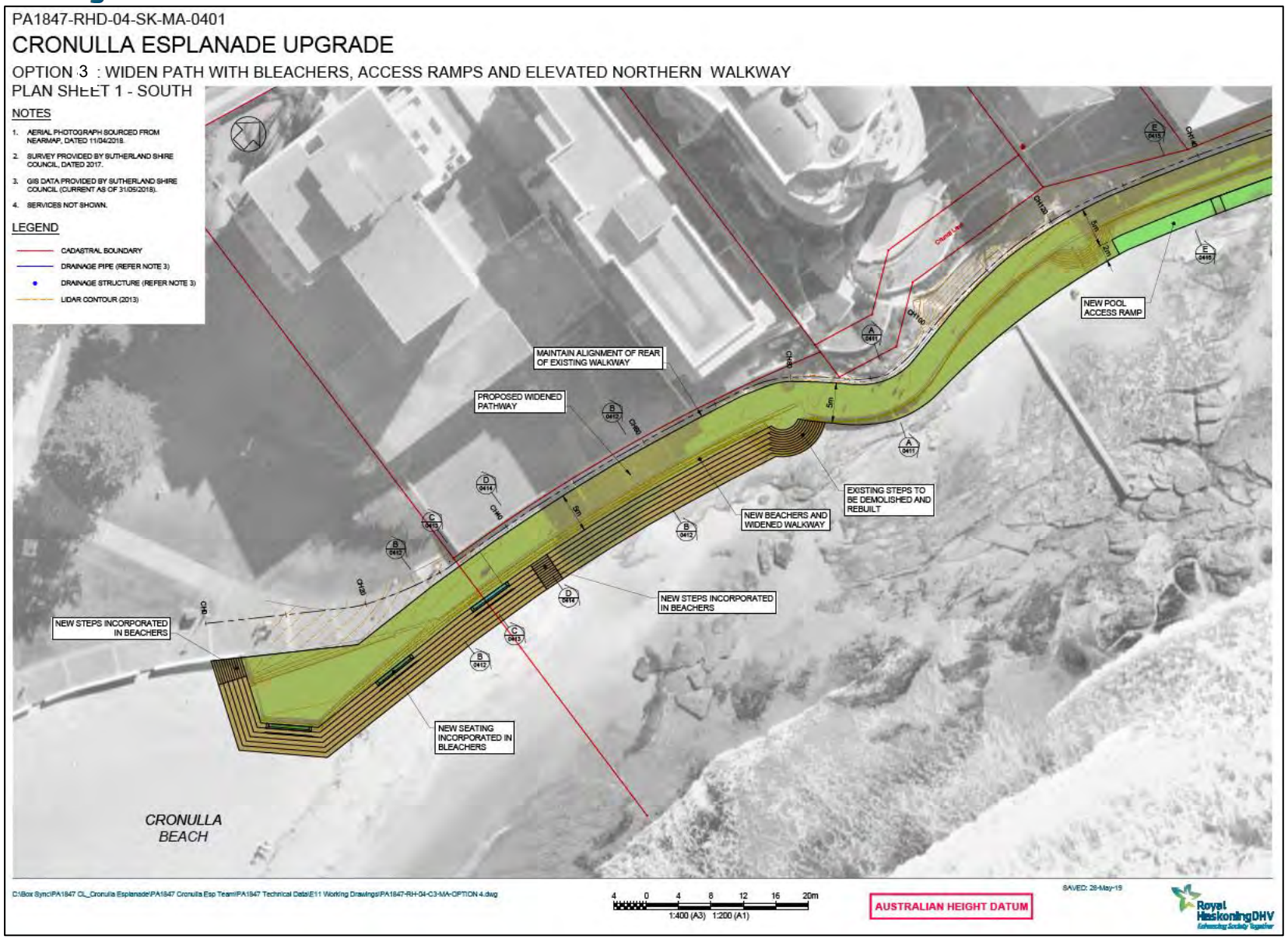

Figure 5-1: Option 3 - Widen Path with Bleachers, Access Ramps & Maintain Walkway Alignment – Southern Section

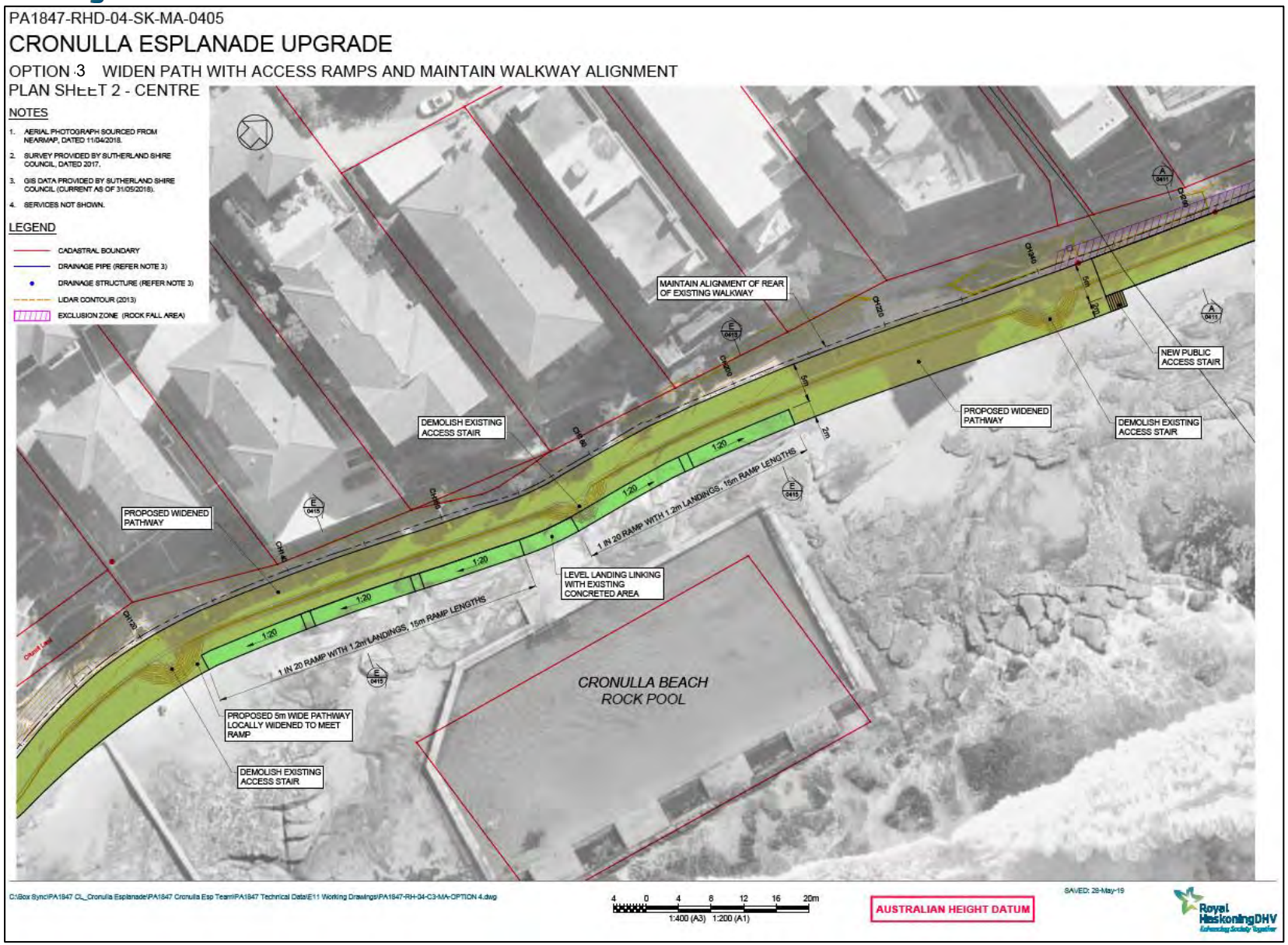

Figure 5-2:Option 3 - Widen Path with Bleachers, Access Ramps & Maintain Walkway Alignment – Central Section

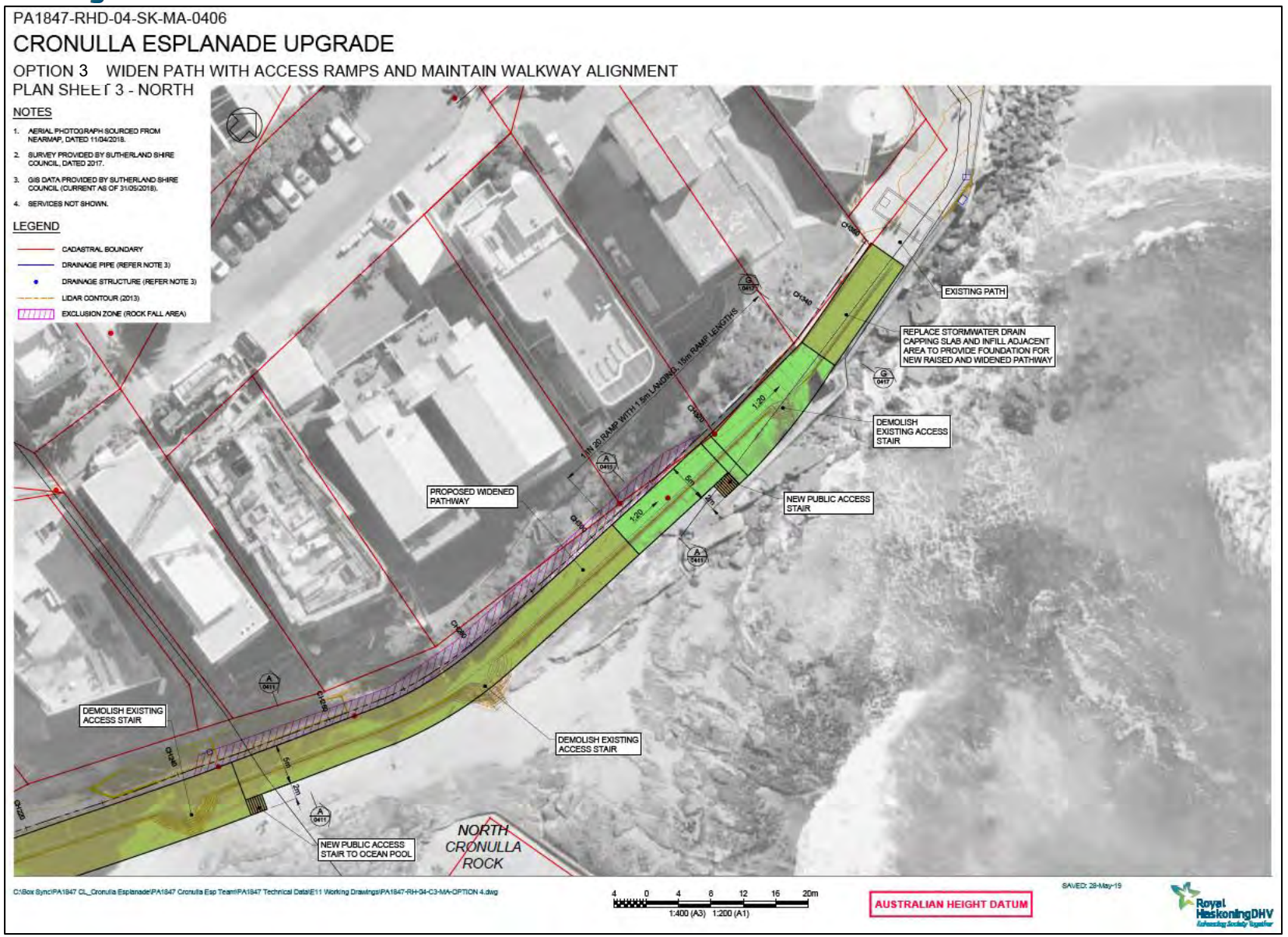

Figure 5-3: Option 3 - Widen Path with Bleachers, Access Ramps & Maintain Walkway Alignment – Northern Section

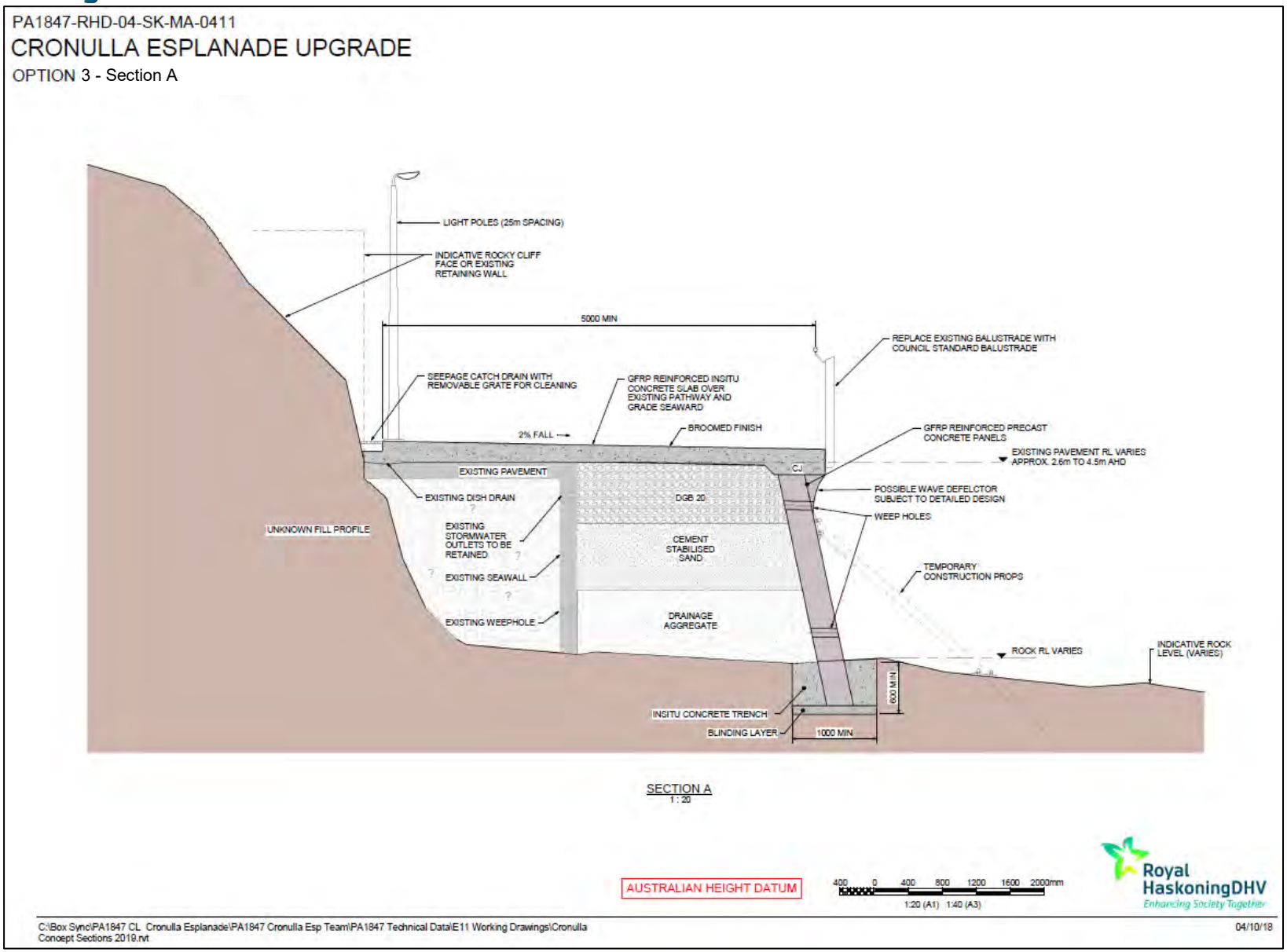

Figure 5-4: Option 3 - Widen Path with Bleachers, Access Ramps & Maintain Walkway Alignment – Section A

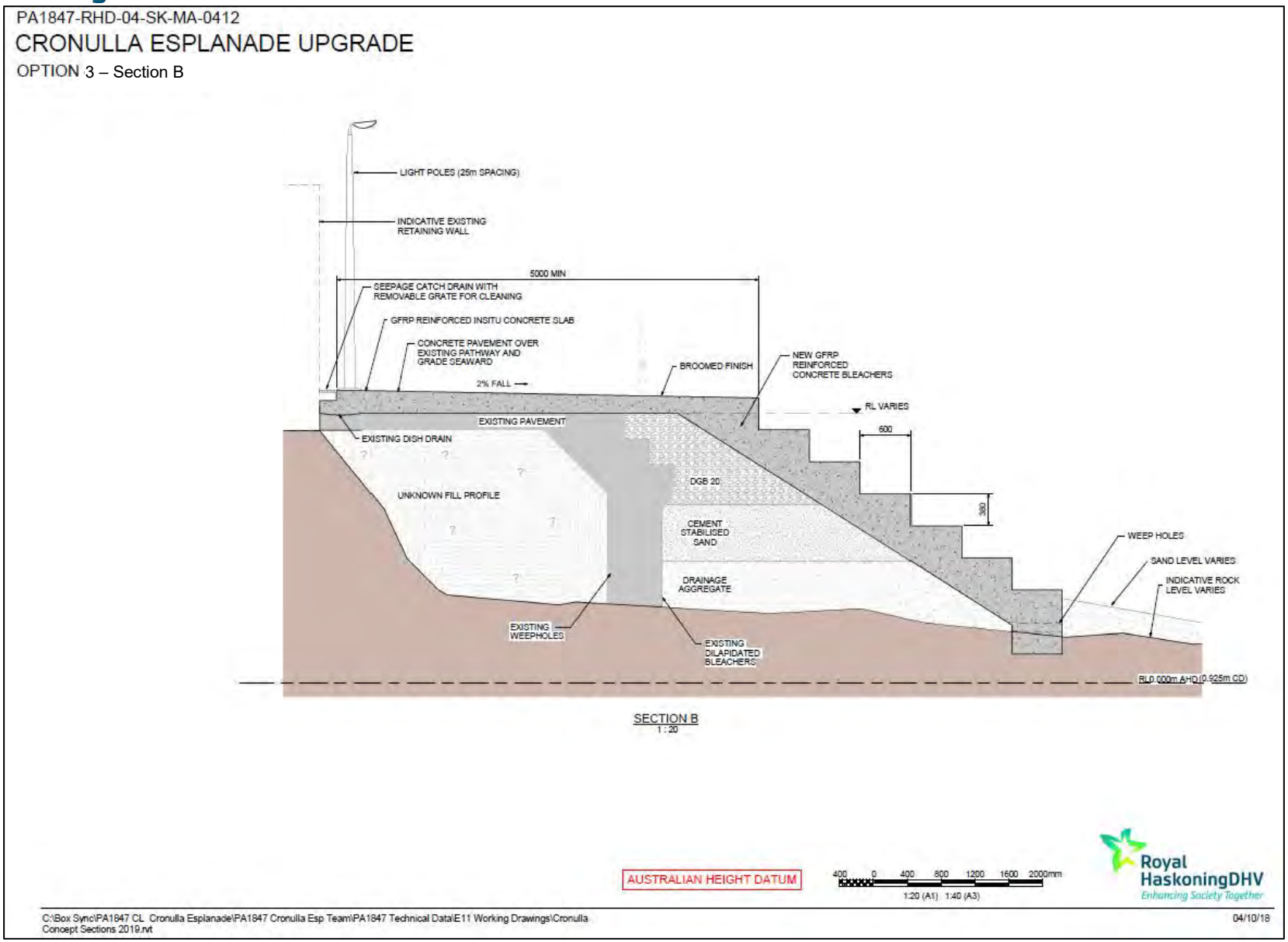

Figure 5-5: : Option 3 - Widen Path with Bleachers, Access Ramps & Maintain Walkway Alignment – Section B

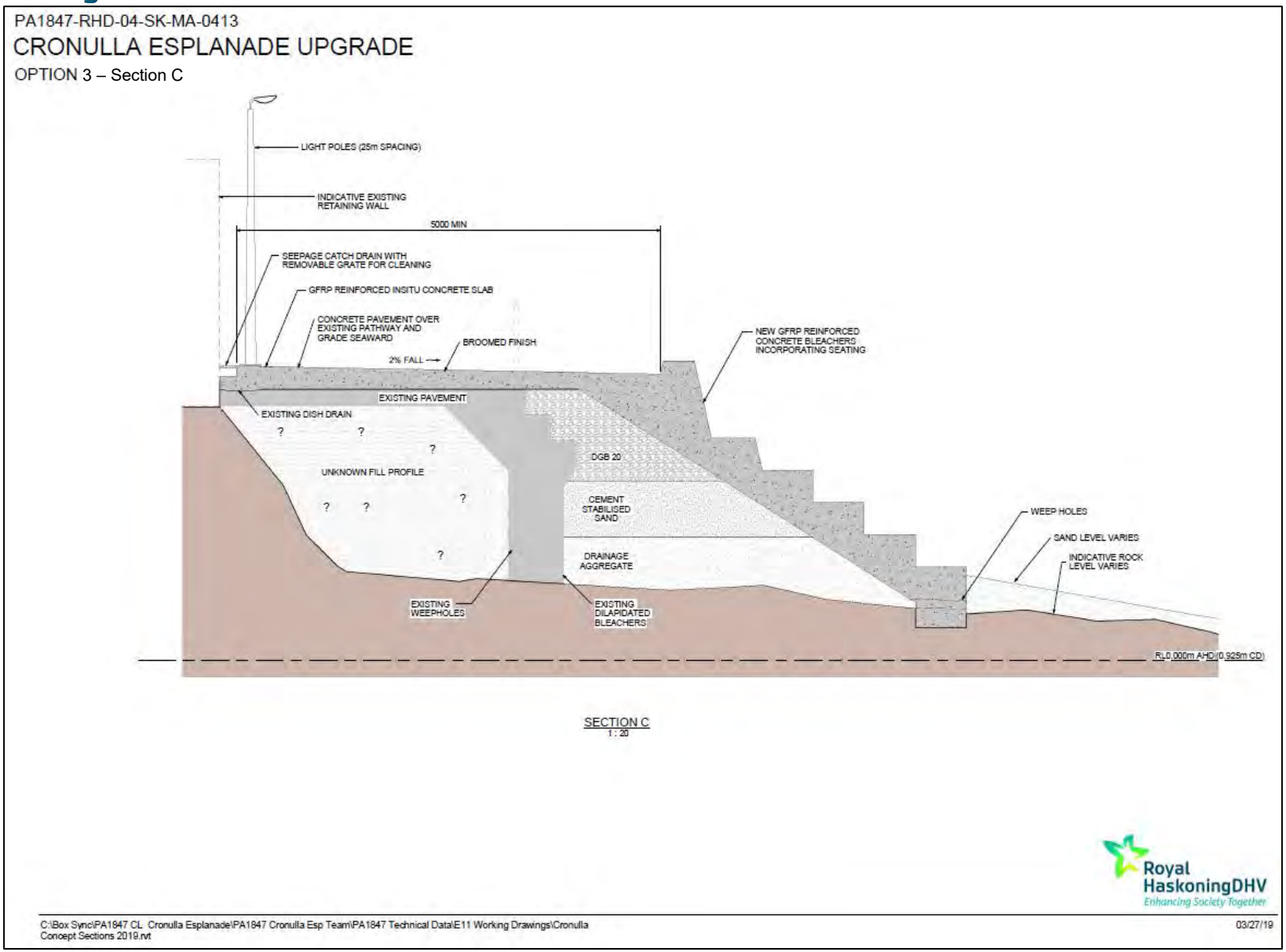

Figure 5-6: Option 3 - Widen Path with Bleachers, Access Ramps & Maintain Walkway Alignment – Section C

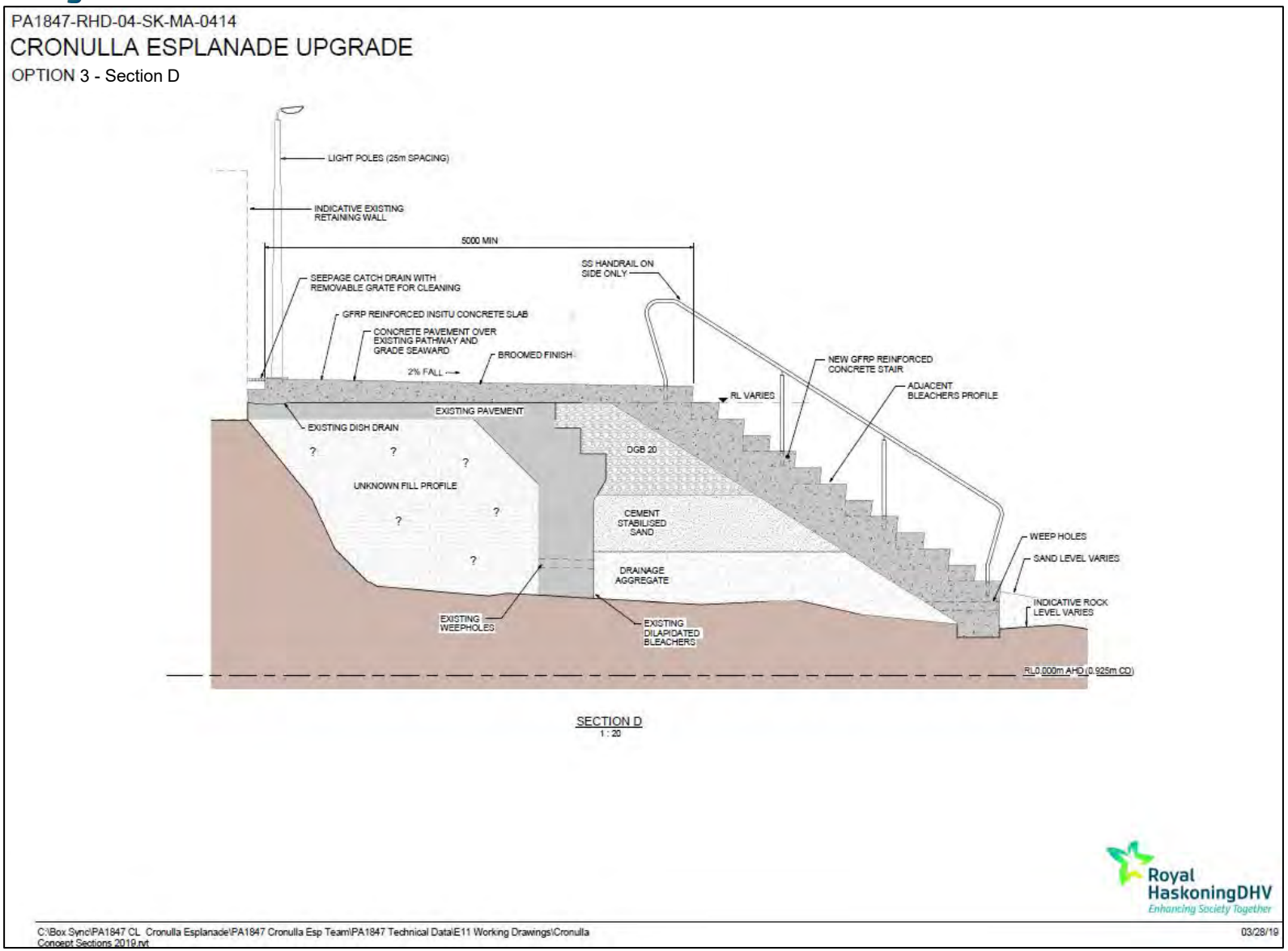

Figure 5-7: Option 3 - Widen Path with Bleachers, Access Ramps & Maintain Walkway Alignment – Section D

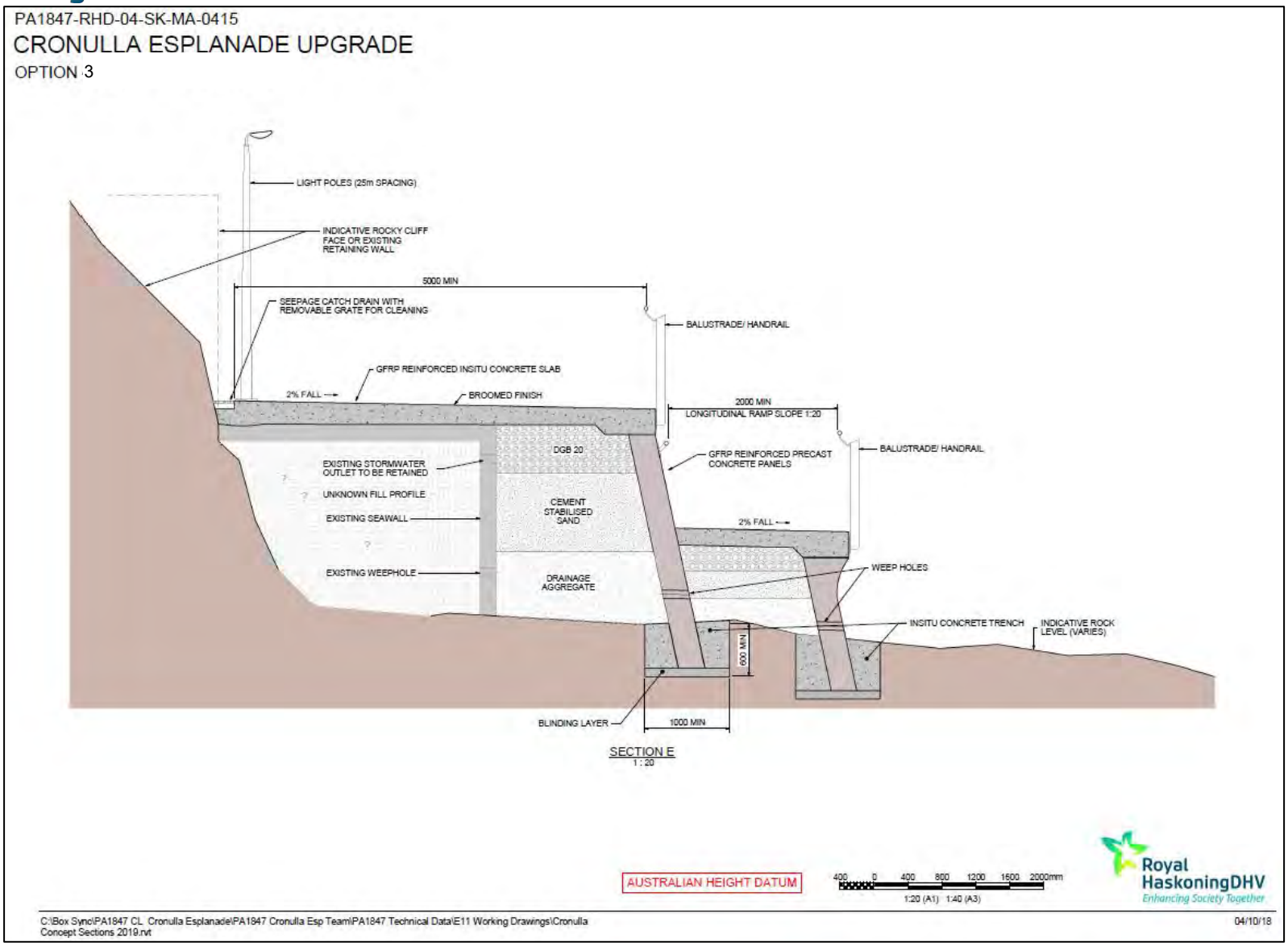

Figure 5-8: Option 3 - Widen Path with Bleachers, Access Ramps & Maintain Walkway Alignment – Section E

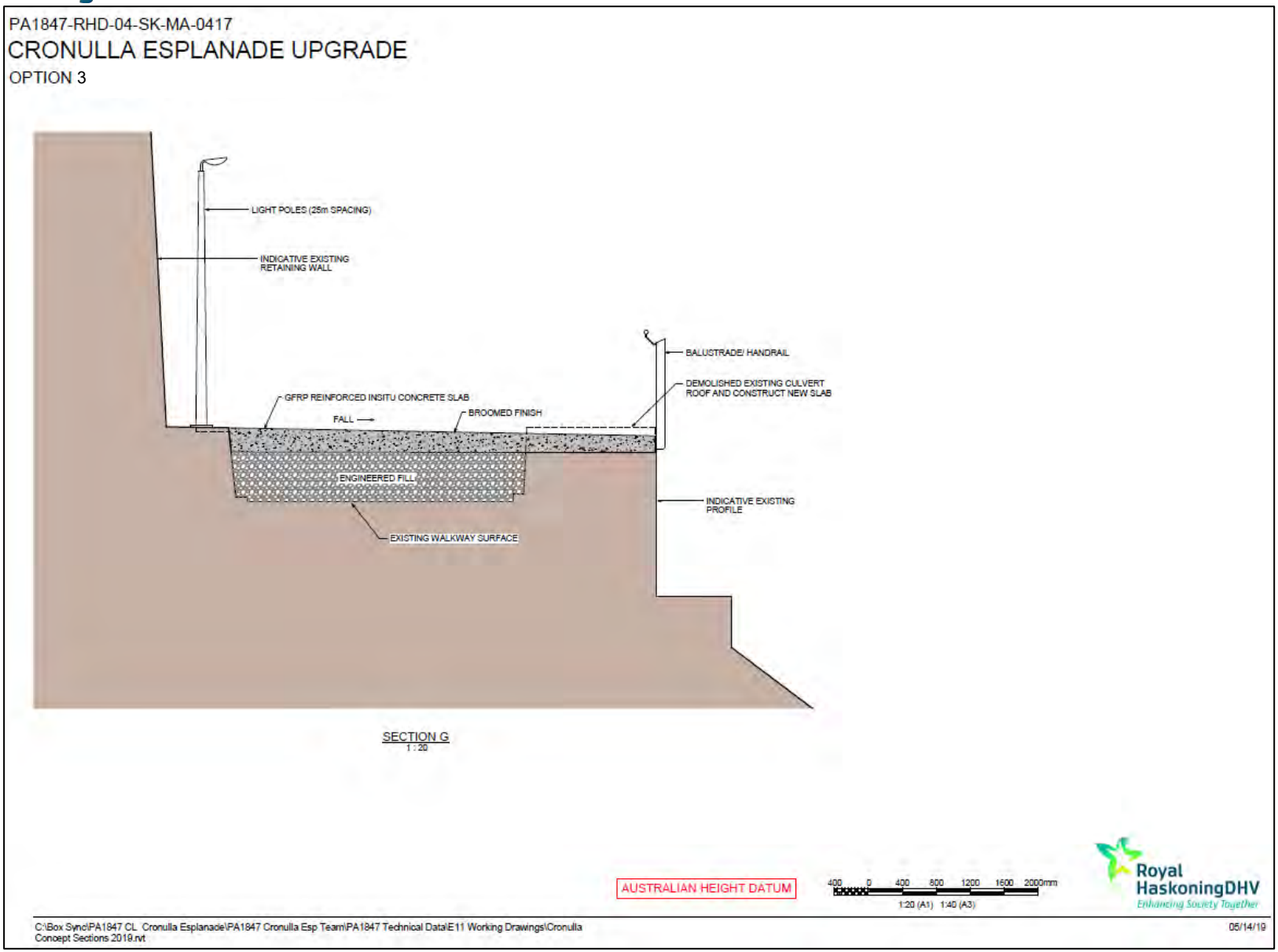

Figure 5-9: Option 3 - Widen Path with Bleachers, Access Ramps & Maintain Walkway Alignment – Section G

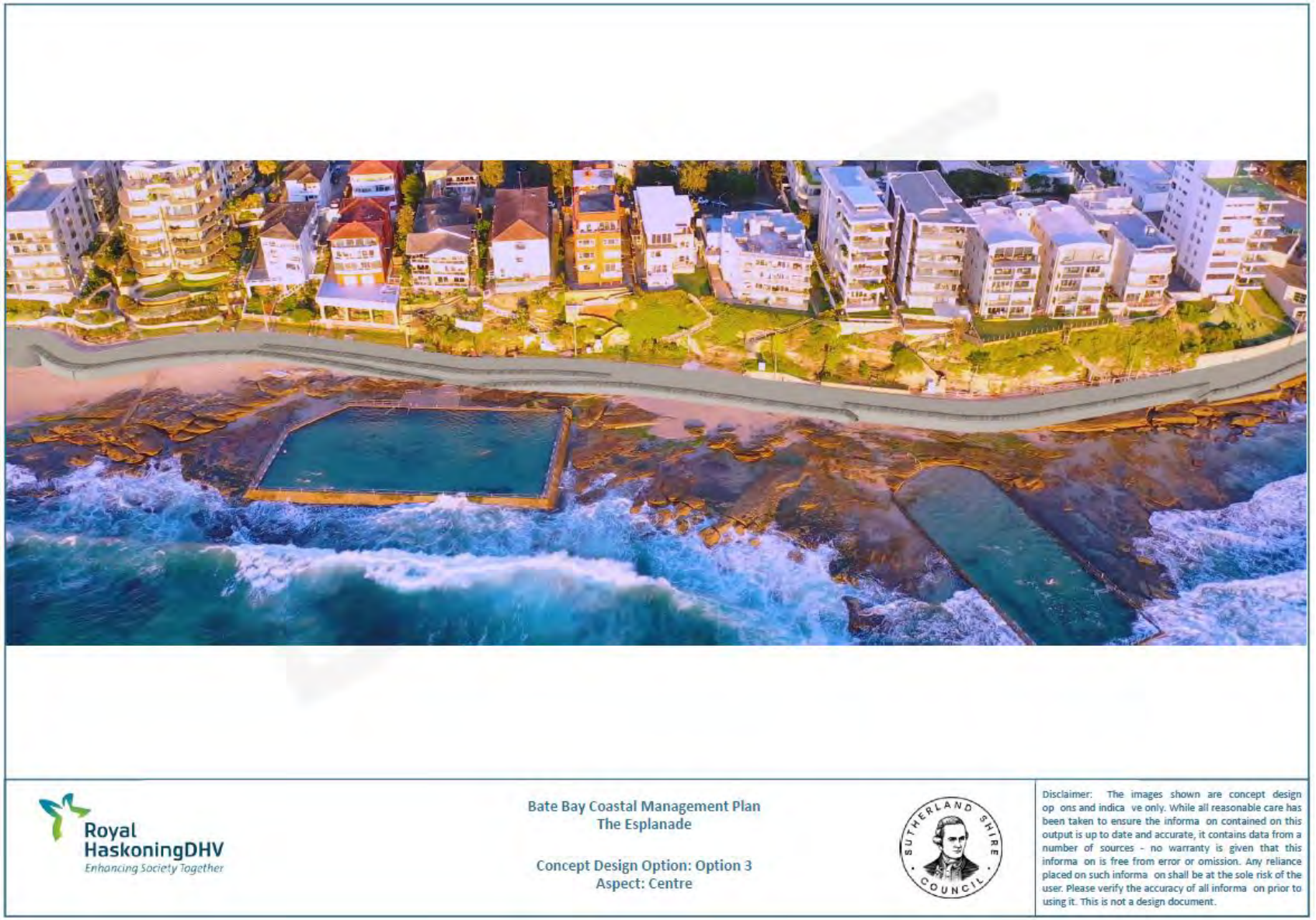

Figure 5-10: Option 3 - Widen Path with Bleachers, Access Ramps & Maintain Walkway Alignment – Centre

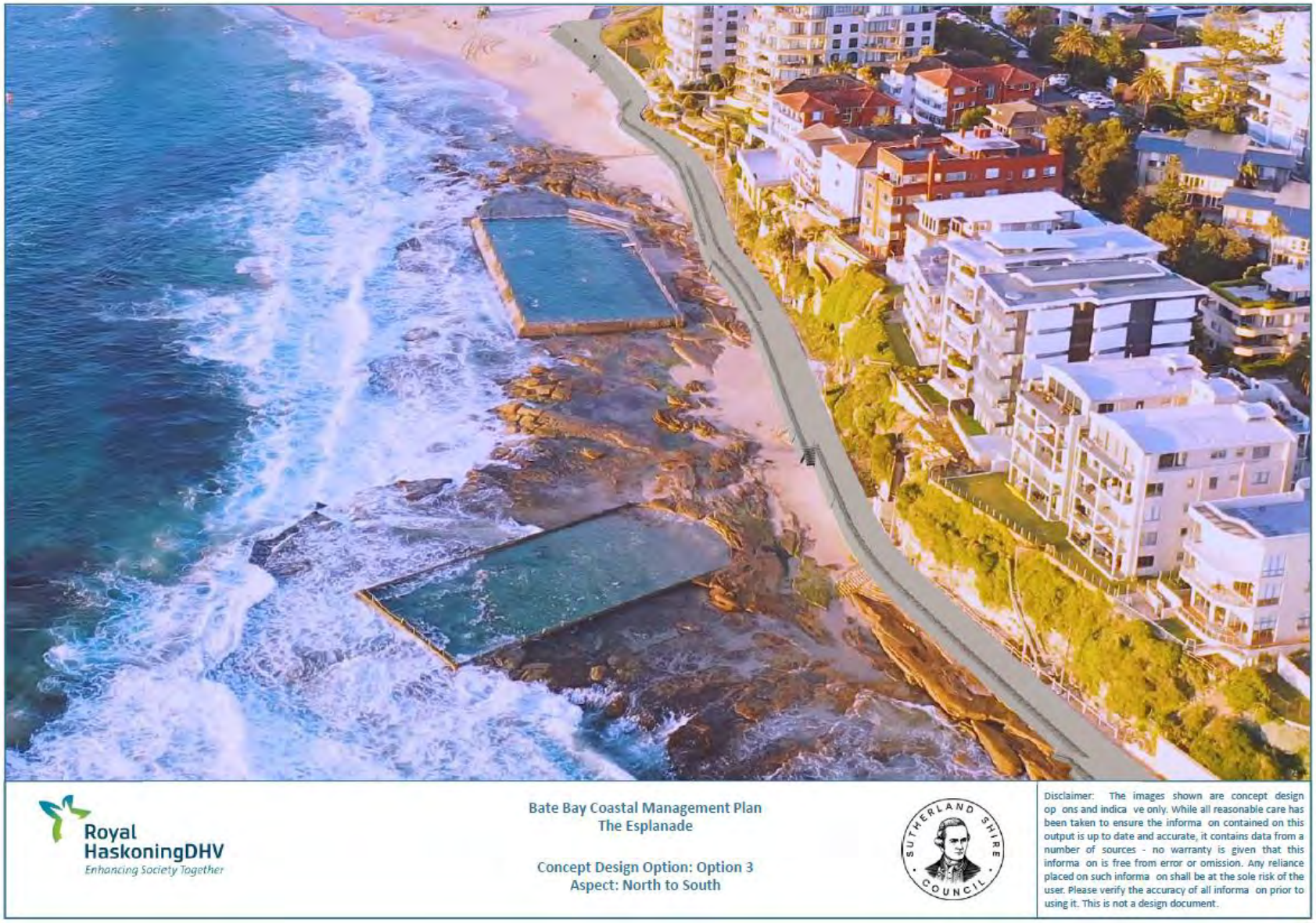

Figure 5-11: Option 3 - Widen Path with Bleachers, Access Ramps & Maintain Walkway Alignment – North to South

Figure 5-12: Option 3 - Widen Path with Bleachers, Access Ramps & Maintain Walkway Alignment – North Low Angle

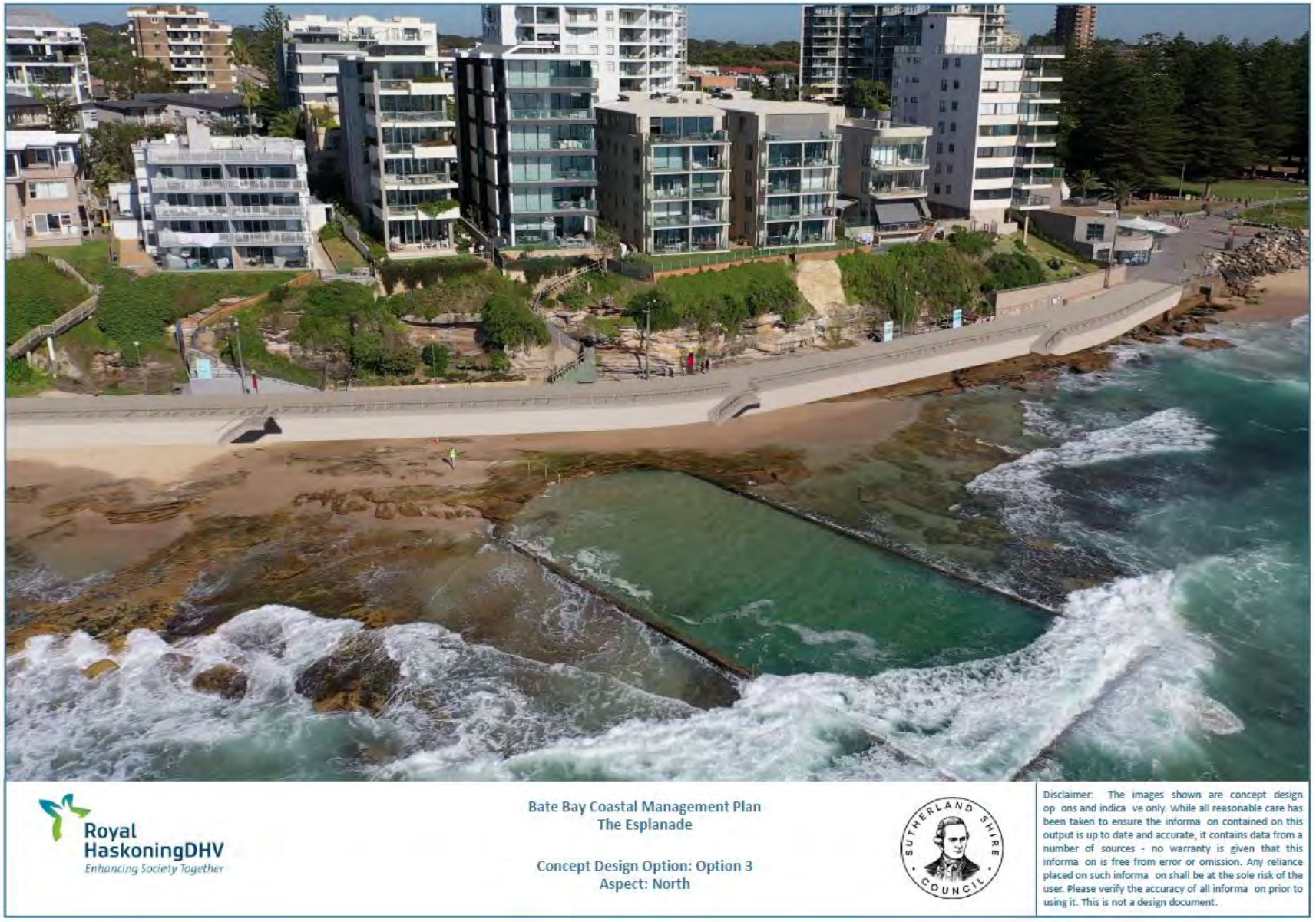

Figure 5-13: Option 3 - Widen Path with Bleachers, Access Ramps & Maintain Walkway Alignment – North

Figure 5-14: Option 3 - Widen Path with Bleachers, Access Ramps & Maintain Walkway Alignment – South Low Angle

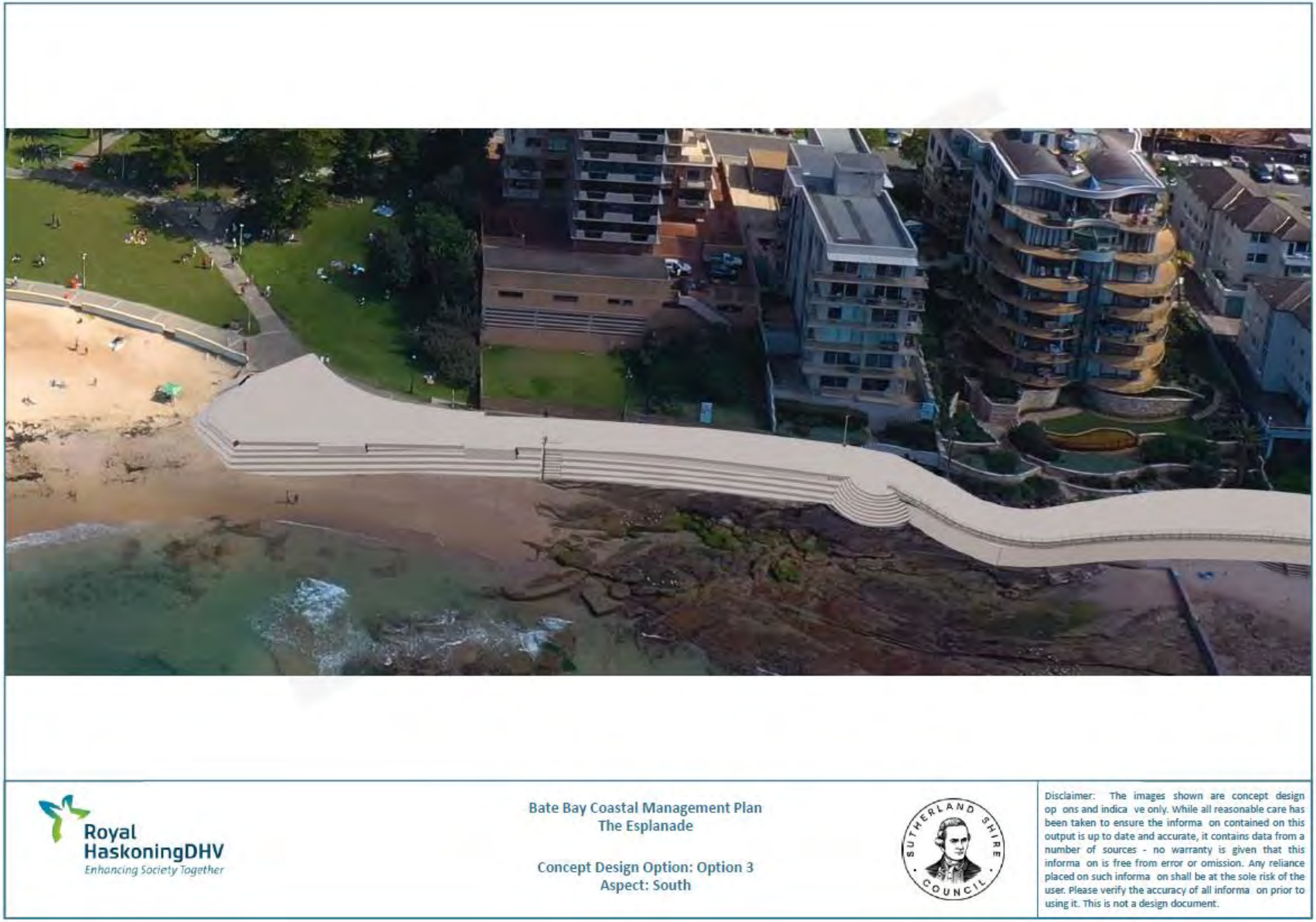

Figure 5-15: Option 3 - Widen Path with Bleachers, Access Ramps & Maintain Walkway Alignment – South

5.2 Esplanade Upgrade Options - Cost Estimates and Summary

The cost estimates (Council, 2021) are based on the works as described to be undertaken with contingencies allowed for the following factors:

i. Extent of detail of current designs i.e. concept only
ii. Access to the site and difficulty of working environment
iii. Potential for damage to site by storm events during construction

A summary of the Options, Costs and relative Advantages and Disadvantages is provided in **Table 5-1**.

Table 5-1

Table 5-1: Esplanade Upgrade Options, Costs, Advantages and Disadvantages

Option	Cost	Advantages	Disadvantages
1 **Status quo i.e. continued maintenance**	**$0**	No immediate capital construction costs.	Only provides for continuing reactive maintenance (potential costs not known). Less than optimal path width is maintained. In the long term the southern part of the seawall is likely to suffer failure to the extent that will require complete rebuild. If this occurs emergency repairs will need to be undertaken. If a full design is not in place these works will likely be at least partially demolished when a full upgrade is undertaken.
2 **Esplanade widening with stair access to the rock platform and pools**	**$4.13M**	Widening the path to a minimum of 5 metres which has the advantage of catering for increased pedestrian and cycle usage as well as potentially keeping users further away from the cliff face. The existing seawall stairs are retained and encased in the new structure thereby reducing construction costs. The new stairs are at 90 degrees to the wall. The design will include new lights and new handrails.	Does not provide mobility impaired access ramp to the rocks and rock pools.
3	**$5.02M**	Provides a 5 metre wide path in the current	Highest cost.

Esplanade widening with access via ramps and bleachers to the rock platform and pools		alignment for the length of the path meeting accessibility codes, and provides part bleachers at the southern end. The path is supported by a new seawall located in front of the existing seawall which will remain in situ. The design will include new lights and new handrails. Being made of concrete the structure would require minimum maintenance for many years. Access to the rock shelf and rock pools will be via stairs and ramps thereby servicing the more mobility impaired.	

5.3 Endorsed - Esplanade Upgrade Option 3

The recommendations of the North Cronulla to Cronulla Esplanade - Renewal Design Options Report (Council, 2021), which are supported by the Bate Bay CMP, are that:

1. The assessment considered that for **Option 1** and **Option 2** the benefits are outweighed by the disadvantages;

2. Although it is the most expensive of the new works, **Option 3 provides the least risk, most benefit to the public and the least maintenance. As such it is the best value for money, and has been endorsed through the Bate Bay CMP.**

The concept design of Option 3 includes balustrades where necessary. The balustrades should include kerbs or kickplates to prevent wheeled or round objects from falling off the Esplanade onto the beach or rock platform below. The balustrade design will be nominated by Council landscape architecture staff from the in-house designs developed for use in public domain areas throughout the Sutherland Shire.

It is recommended that horizontal surfaces being trafficked have a non-slip finish. This can be achieved on concrete surfaces with a stiff broom pattern or various other ways described in Guide to Concrete Flatwork Finishes (Cement Concrete & Aggregates Australia, 2008).

Sandstone cliffs with rock overhangs, loose soil, rock and other debris present the potential hazard of rock falls onto pathway traffic in some sections of the Esplanade. Fencing and low-maintenance garden beds

are currently being used to create exclusion zones between pedestrians and potential rock fall areas. It is proposed that the same strategy is continued in the design of the upgrade works.

The design life recommended in AS 4997:2005 – Guidelines for the design of maritime structures is 50 years. It is assumed that the Esplanade would be periodically inspected for structural defects. Components would be remediated where required.

Being constructed of mass concrete, it is expected that maintenance costs of the structure would be minimal, while general cleaning/servicing maintenance would be required, in the same manner as the existing structure – i.e. no additional longer term cost to Council.

6 North Cronulla Beach and Dunningham Park

6.1 Management Options – Description and Comparison

Given the long-identified risk to Dunningham Park and the North Cronulla Surf Life Saving Club building, a seawall is proposed for North Cronulla Beach to provide permanent protection from coastal erosion. This involves replacing the existing informal non-continuous rock wall with an engineered structure that could comprise a combination of rock revetment, vertical wall and concrete bleachers. It is noted that the 2003 Coastline Management Plan recommended construction of a seawall at North Cronulla Beach fronting Dunningham Park, however this seawall has not yet been constructed.

The proposed seawall would be constructed as far landward as practical to minimise impact on the useable beach area. The end points or “headlands” of North Cronulla embayment are assumed to be fixed in position; The Kingsway roadhead rock works to the south, and Prince Street seawall to the north (as described in **Section 7**), are both expected to remain in place.

As well as the “base case” of maintaining the existing ad hoc rock structure as a comparison, a range of conceptual seawall designs have been provided as options for consideration. Each option provides for varying quantity and quality of public beach access, retention of dune vegetation and usable beach following a coastal erosion event. A description of each of the options, their advantages, disadvantages, and estimated costs is provided in **Table 6-1**. Detailed economic analysis is provided in **Section 11** and **Supporting Document E**.

It is important to note that ongoing beach nourishment is recommended in conjunction with all options described below, to widen the beach and provide short- to medium-term improvements to general beach amenity (see **Section 11** for further detail).

Table 6-1: Comparison of Management Options for Dunningham Park

Option	Scope of Works	Advantages	Disadvantages	Capital Cost Estimate	Overall Assessment
Base Case: Maintain status quo	Reactive repairs and maintenance as needed "Beach scraping" sand to maintain access from Peryman Square	• Minimal upfront capital cost • Access closures, maintenance and repairs to address immediate public safety and are able to be rapidly undertaken.	• Existing limited mobility access maintained • No protection from coastal hazards • Predicted (and historical) deterioration of dunes and loss of access during storm • Predicted long term loss of access, exposure of underlying materials • Ongoing amenity and access issues – presence of ad hoc rock structure and unstable dune scarp when beach is eroded	**$0** (Immediate). Likely to require higher ongoing maintenance than Options 1 -4. Potential replacement costs of public assets.	**Undesirable access and amenity conditions particularly after storms.** **Predicted loss of valuable public assets.**
Option 1. **Rock revetment**	Construction of rock revetment seawall connecting Peryman Square to Prince Street seawall	• Provides coastal hazard protection of assets • Once constructed, can be covered with sand and revegetated, reinstating current amenity • Access similar to, or slightly improved on, "status quo" reinstated	• Access only available when sand is available (beach full) supplemented by sand scraping • No all-ability access • Encroachment seaward of existing structure o Potential impact on surf amenity at the Alley (permanent rip current located at the southern end of North Cronulla Beach) • Large 'footprint' of works, utilising beach area for rock revetment • Loss of dune vegetation during construction	**$5,000,000**	**Lowest cost option for coastal protection works.** **Provides limited access.** **Large structure exposed when beach eroded, loss of useable area.**

Option	Scope of Works	Advantages	Disadvantages	Capital Cost Estimate	Overall Assessment
			• Moderate amenity issues when exposed – presence of large rock structure when not buried		
Option 2. **Rock revetment with bleachers and ramp access**	Construction of rock revetment at Peryman Square, integrated bleachers and access ramp, with continuation of rock revetment connecting to Prince Street Seawall	• Provides coastal hazard protection of assets • Once constructed, can be covered with sand and revegetated, reinstating current amenity • Provides large area of concrete bleachers (concrete steps and seating area) for amenity and public benefit • Provides integrated ramp for all-abilities access, including for Council and SLSC vehicle and vessel access if required	• Encroachment seaward of existing structure o Potential impact on surf amenity at the Alley (permanent rip current located at the southern end of North Cronulla Beach) • Large 'footprint' of works, utilising beach area for rock revetment • Potential public safety issues when exposed (loss of covering sand) • Moderate amenity issues when exposed – presence of large rock structure when not buried • Loss of dune vegetation during construction	**$7,500,000**	**Medium cost option for coastal protection works.** **Provides notable access and amenity benefits.** **Large structure exposed when beach eroded, loss of useable area.**
Option 3. **Vertical seawall with bleachers and ramp access**	Construction of vertical concrete seawall at Peryman Square, integrated bleachers and access ramp, with continuation of vertical concrete seawall connecting to Prince Street Seawall	• Provides coastal hazard protection of assets • Once constructed, sand dunes can be reconstructed and revegetated, reinstating current amenity • Provides large area of concrete bleachers (concrete steps and seating area) for amenity and public benefit • Provides integrated ramp for all-abilities access, including for Council and SLSC vehicle and vessel access if required	• Potential amenity issues when exposed • Loss of dune vegetation during construction	**$9,200,000**	**Highest cost option for coastal protection works.** **Provides notable access and amenity benefits.** **Minimal structure exposed when beach eroded, maximised useable area.**

Option	Scope of Works	Advantages	Disadvantages	Capital Cost Estimate	Overall Assessment
		• Reduced encroachment seaward at Peryman Square compared to existing structure o Minimal (if any) adverse impact on surf amenity expected at the Alley (permanent rip current located at the southern end of North Cronulla Beach) • Small 'footprint' of works, utilising minimal beach area			
Option 4. **Combination vertical wall with bleachers and ramp access, rock revetment**	Construction of vertical concrete seawall at Peryman Square, integrated bleachers and access ramp, with rock revetment connecting to Prince Street Seawall	• Provides coastal hazard protection of assets • Once constructed, sand dunes can be reconstructed and revegetated, reinstating current amenity • Provides large area of concrete bleachers (concrete steps and seating area) for amenity and public benefit • Provides integrated ramp for all-abilities access, including for Council and SLSC vehicle and vessel access if required • Reduced encroachment seaward at Peryman Square compared to existing structure o Minimal (if any) adverse impact on surf amenity expected at the Alley (permanent rip current located at the southern end of North Cronulla Beach)	• Seaward of Dunningham Park, large 'footprint' of works, utilising beach area for rock revetment • Potential amenity issues when exposed • Loss of dune vegetation during construction	**$8,300,000**	**Medium-High cost option for coastal protection works.** **Provides notable access and amenity benefits.** **Large structure exposed when beach eroded, loss of useable area.**

6.2 Endorsed - Dunningham Park - Option 4. Combination vertical wall with bleachers and access ramp, rock revetment

Option 4 provides for construction of a combination of Option 2 and Option 3, with an initial vertical concrete seawall commencing adjacent to Peryman Square, before transitioning to integrated bleachers (steps and seating areas) and access ramp, followed by a rock revetment seawall connecting to the Prince Street seawall. Option 4 provides a medium-high cost option for appropriate coastal protection works for Dunningham Park and the assets within, while providing notable access and amenity benefits.

Consistent with Option 2 and Option 3, **Option 4** provides approximately 80 metres of integrated bleachers (steps and seating areas) and access ramp within the coastal protection works, providing significantly improved public access and amenity value to North Cronulla Beach. As previously noted, construction of bleachers as an integral part of protection works is relatively common within greater Sydney and other highly visited coastal locations, enabling beach access under almost all conditions (subject to storm events), providing locations where people can sit and view the beach, and importantly, providing all-abilities access for beach users as well as vehicles if required.

In keeping with Option 1 and Option 2, **Option 4** also proposes that the majority of the rock revetment at Dunningham Park will be located in a similar position to the existing dunes, and as such is likely able to be buried in sand and vegetated for the majority of the time. When the rock revetment is covered in sand and vegetated as a dune, providing amenity and environmental benefit, public board and chain accessways (or similar) are able to be established and maintained, while retaining the fundamental purpose of the rock revetment as a last line of defence during a significant erosion event.

The section of the vertical seawall adjacent to Peryman Square would be positioned further landward than the existing rock structure, however it is still expected to be exposed in the same manner as the existing rock structure. A significant benefit of **Option 4**, as previously noted for Option 3, is that a vertical concrete seawall requires a minimal “footprint” of beach while providing protection from coastal hazards, utilising approximately 3-5 metres of width when constructed, compared to approximately 15-20m for a rock revetment. Having a smaller footprint provides an increased public beach area for use when the beach is eroded, while still preventing coastal erosion, and subsequent loss of assets.

If this option is preferred, consideration will be required as to potential impact on coastal processes and surf amenity at the Alley (the permanent rip current located at the southern end of North Cronulla Beach), due to the change in location of the structure, although minimal (if any) adverse impact on surf amenity is expected.

Estimated capital cost of **Option 4** is **$8,300,000**.

It is anticipated that, once constructed, ongoing maintenance of the coastal protection works will require two approaches; the vertical wall and bleachers, being mass concrete structures, will require general cleaning etc but are not expected to require significant maintenance for many years. The rock revetment however is expected to require external treatment following erosion event(s), with the quantity of work related to the impact of the event.

Removal of sand will likely require nourishment of access ramps (potentially by ‘sand scraping’), revegetation of dunes, and possible replacement of fencing as needed. Following more powerful events, rocks may be dislodged and require adjustment / relocation back into the revetment– a significant benefit

of a flexible structure that can adjust and be repaired. of rocks within revetment, re-covering of sand, revegetation etc.

Draft images of **Option 4**, a combination of vertical wall with bleachers and access ramp, and rock revetment, are provided in **Figure 6-1, Figure 6-2, Figure 6-3, Figure 6-4, Figure 6-5, Figure 6-6** and **Figure 6-7**.

Figure 6-1: Dunningham Park - Option 4. Combination vertical wall with bleachers and access ramp, and rock revetment - Southern End - Full Beach

Figure 6-2: Dunningham Park - Option 4. Combination vertical wall with bleachers and access ramp, and rock revetment - Southern End - Full Beach - Eye Level

Figure 6-3: Dunningham Park - Option 4. Combination vertical wall with bleachers and access ramp, and rock revetment - Southern End – Eroded (Post-Storm)

Figure 6-4: Dunningham Park - Option 4. Combination vertical wall with bleachers and access ramp, and rock revetment - Northern End - Full Beach

Figure 6-5: Dunningham Park - Option 4. Combination vertical wall with bleachers and access ramp, and rock revetment - Northern End - Full Beach - Eye Level

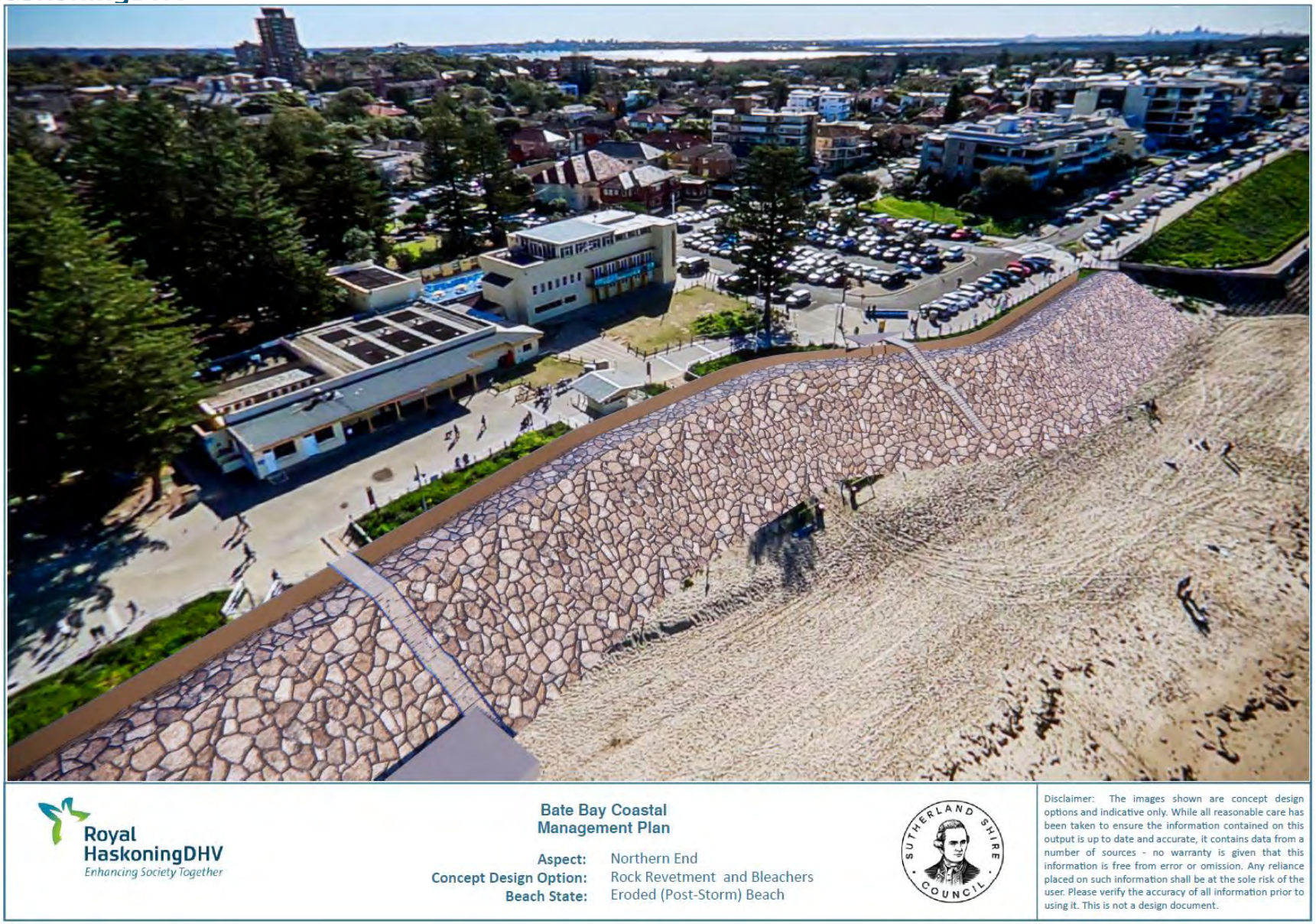

Figure 6-6: Dunningham Park - Option 4. Combination vertical wall with bleachers and access ramp, and rock revetment - Northern End – Eroded (Post-Storm)

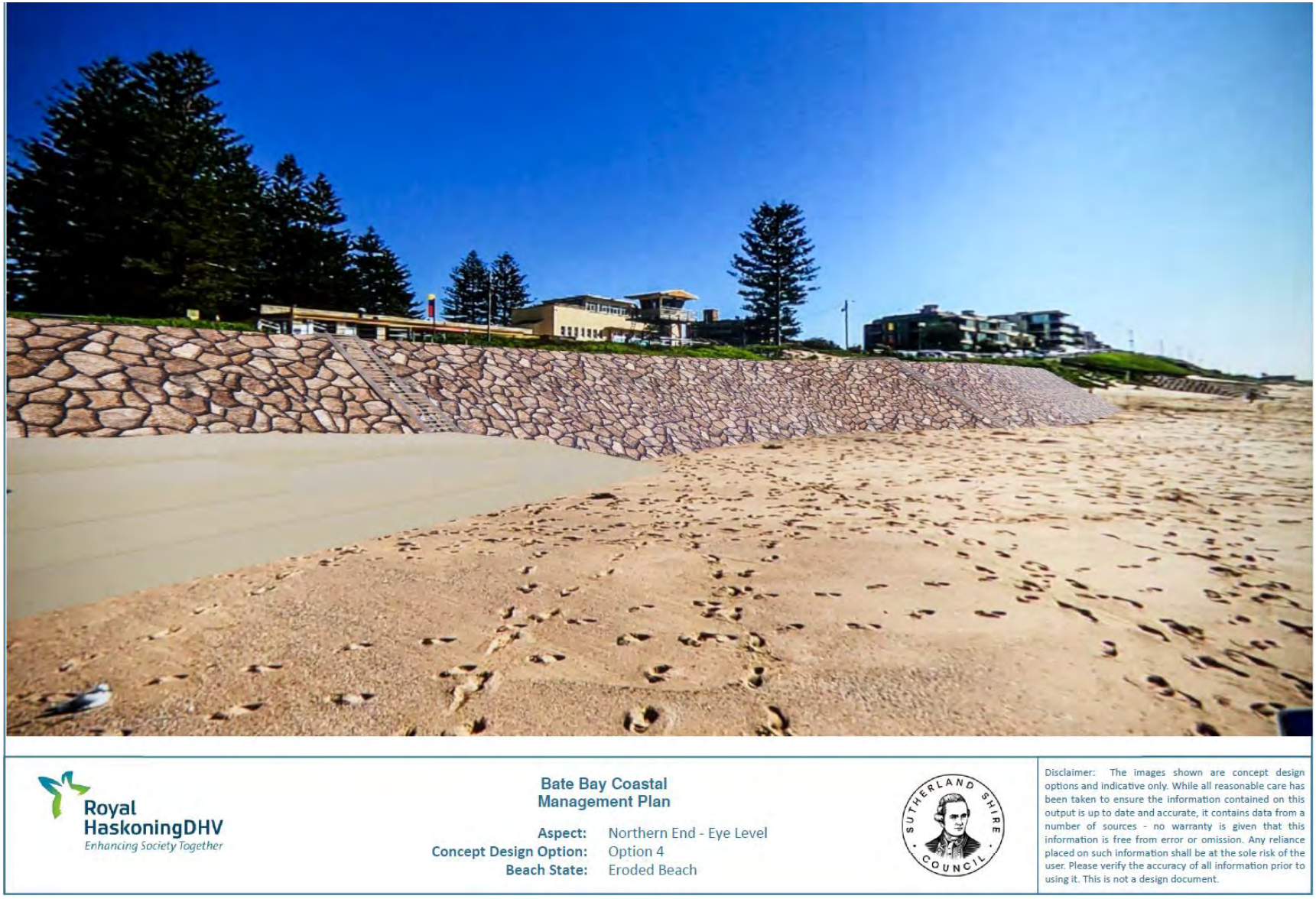

Figure 6-7: Dunningham Park - Option 4. Combination vertical wall with bleachers and access ramp, and rock revetment - Northern End – Eroded (Post-Storm) - Eye Level

7 Prince Street Seawall

The Prince Street seawall is considered a key location for management actions within the Bate Bay CMP. As well as historically being subjected to coastal erosion requiring the construction of coastal protection works, the Prince Street seawall has ongoing structural issues that are likely to lead to further failures and significant ongoing repair unless an effective asset management plan is actioned.

RHDHV have reviewed all available historic data into previous and current management concerns, investigated options for rectifying and managing the Prince Street seawall, and have provided an endorsed management strategy for inclusion within the Bate Bay CMP. The full Advice on Management of Prince Street Seawall report is included as **Supporting Document F**.

The Prince Street seawall requires restorative works to address the loss of sand from beneath the seawall face and thereby minimise the risk of localised subsidence. Various approaches for rectifying and managing the structure have been considered, focused on:

- Identifying asset management approach;
- Determining existing/new asset design life;
- Assessing management options;
- Producing an asset management strategy; and,
- Evaluating costs and schedule.

The current 360 m long seawall is located along North Cronulla Beach in front of Prince Street, as shown in **Figure 7-1**.

Figure 7-1: Site Location - Aerial View of Prince Street Seabee Seawall, North Cronulla

The original recommended rectification works to address the damage to the rock mattress and gabion "toe" comprised a row of contiguous bored piles, installed through the mattress just seaward of the gabions, to a depth of approximately -8 m AHD, with a concrete capping beam, restrained by permanent ground anchors, as shown in **Figure 7-2**. The concrete capping beam was cast over the gabion, between the new piles and the bottom row of Seabees, so as to prevent further settlement of the Seabees and provide an adequate factor of safety for slope stability (Patterson Britton, 2006). The seawall rectification works were undertaken between 2008-2010, at an approximate cost of $5 million (Sutherland Shire Council, 2009).

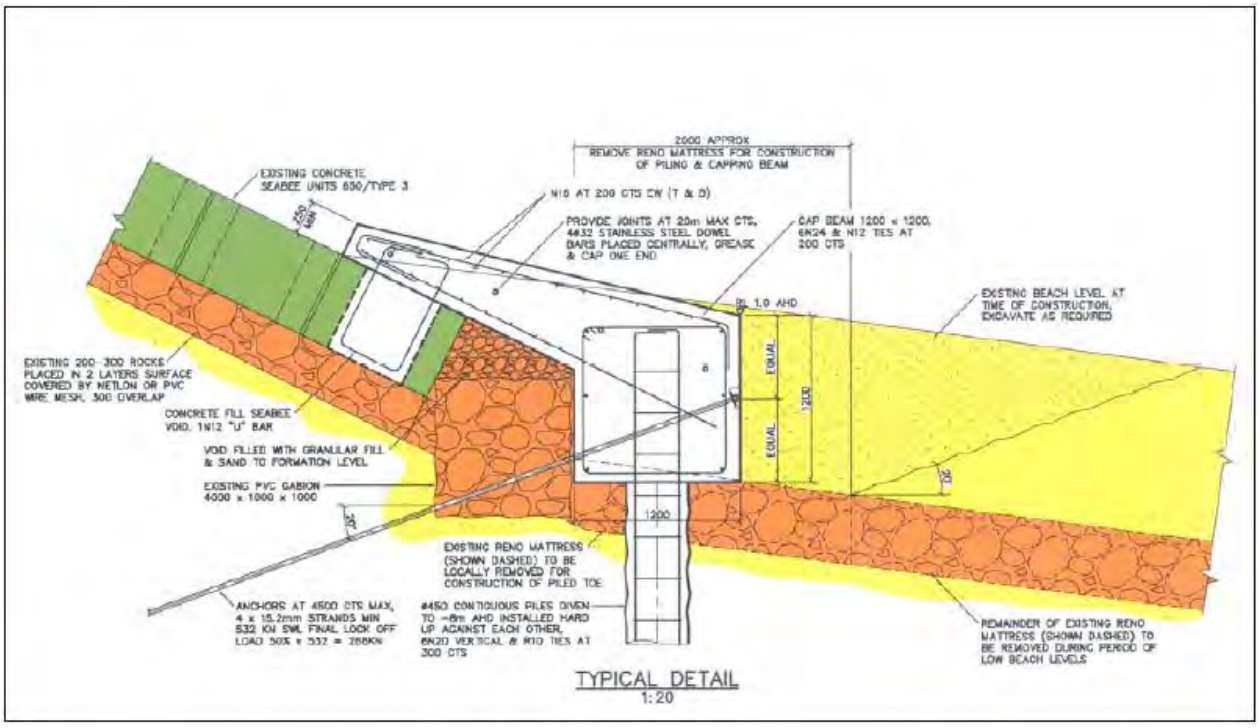

Figure 7-2: Typical section through stabilisation works to Prince Street Seawall

Following the 2008-2010 rectification works, shortcomings in the workmanship were identified, which resulted in subsequent additional faults, including partial displacement and subsidence of a number of Seabee units. The mechanism of failure of the Seabee units following the 2008 rectification works can be summarised as follows:

1. The contiguous pile wall has not been constructed in accordance with the design, leaving significant 'gaps' between adjacent piles that should be contiguous (touching), as well as gaps between the tops of the piles and the soffit (or underside) of the capping beam;

2. When the beach level is lowered due to loss of sand in front of the piles, ongoing tidal and wave action through the gaps undermines and erodes the sand fill beneath the Seabee units, resulting in cave-like formations behind the piles / below the Seabee units; and,

3. The removal of the sand fill creates voids beneath the rock underlayer (and geotextile) and Seabee units, into which some units have subsided.

It is recognised that without the repair / rectification of the gaps between the piles, addressing the root-cause of the problem, the above mechanism of failure will continue. More Seabee units will be displaced,

causing a hazard to the public, as well as the potential for greater failures and subsequent ongoing repairs being more difficult and costly.

In 2015, a review of the structural condition of the Prince Street Seawall was undertaken by Taylor Thomson Whitting (TTW) after significant subsidence was observed on site, reported to have increased and affected a larger area over time. It was anticipated subsidence would continue until rectification measures were undertaken. A trial of rectification measures was undertaken in 2017, filling gaps between the piles and voids behind the wall using expanding geofoam, as shown in **Figure 7-3**. The trial was considered moderately successful, and further trials were recommended (TTW, 2017).

Figure 7-3: Trial Application of Encap-6 to Contiguous Piles

In 2018, further trials were recommended which consisted of filling gaps between piles, top of pile repair, treatment of pile faces and filling voids/levelling Seabees. However, this additional trial was not undertaken.

Several storm events in October and November 2020 eroded additional sand and caused further washout of material from behind the seawall foundations. As a result, a large number of Seabee units subsided/dropped due to formation of large cavities underneath, as shown in **Figure 7-4**. In December 2020, large voids beneath the Seabees were filled with approximately 160 m^3 of stabilised sand (low density concrete/sand mixture, with 4:1 ratio of sand to concrete).

The Bate Bay CMP provides an opportunity for Council and the community to consider the most appropriate management approach to the Prince Street seawall, at the same time as other proposed actions nearby, such as the Dunningham Park seawall. Consideration has been given to short-term works to address current issues, medium-term works to prolong the useful life of the structure, as well as long-term options for removal and reconstruction.

Figure 7-4: Undermined Seabee units at Prince Street Seawall, 2020

7.1 Asset Management Strategy

Three alternative asset management strategies have been considered:

1. **Maintain only**

    - Continue to undertake ad-hoc repairs as required.
    - It is expected that these repairs will continue to increase in severity and cost with time.

2. **Rectify and Maintain**

    - Rectify the wall such that the root cause of the underlying problem (i.e. gaps in contiguous piling) is addressed so that there is no more leaching of sand fill material.
    - Minor repairs ongoing as required.

3. **Rebuild and Maintain**

    - Rebuilding will require the complete demolition of the existing seawall.
    - A new seawall would be constructed that would initially not require significant ongoing maintenance.
    - Minor maintenance would need to start at some point in the future (assumed Year 15) as the asset ages.
    - Maintenance as required (e.g. filling of voids with sand-cement).

Potential costs for delivery of each of these management strategies are provided below as Orders of Magnitude (OOM) to enable comparison of the relative difference between options, and are not necessarily an accurate estimate of work that may be required. For ‘Repair” options, OOM costs per year would be highly variable, reflective of the unknown extent of ad-hoc works required.

7.2 Repairs

Repairs are typically of an ad-hoc nature to rectify any obvious localised problem (e.g., Seabee settlement, voids). More than one of the options to repair may be required, and may need to be undertaken on more than one occasion.

Some of the repair options include:

- **Raise Seabees** - Method includes installing concrete extension to settled Seabee units. This type of repair work needs to be ongoing and conducted every 2 years. The OOM cost is estimated to be **$50,000**.
- **Contiguous Pile Wall - Resin** - Method includes applying resin to the front of the contiguous pile wall to seal existing gaps (down to -3mAHD). If successful, this type of repair work needs to be conducted one time only (noting site conditions). The OOM cost is estimated to be **$250,000**.
- **Contiguous Pile Wall - Shotcrete** - Method includes applying shotcrete to the front of the contiguous pile wall to seal existing gaps (down to -3mAHD).). If successful, this type of repair work needs to be conducted one time only (noting site conditions). The OOM cost is estimated to be **$150,000**.
- **Voids - expanding foam** - Method involves injecting resin/expanding foam to fill voids. There is no way to determine if the repair was successful (no quality control). This type of repair work needs to be conducted every 2 years. The OOM cost is estimated to be **$100,000**.
- **Voids - sand / cement** - Method includes pumping sand/cement mix into voids. It is uncertain whether the voids are filled, in addition the mix is likely to break down over time. This type of repair work needs to be conducted every 2 years. The OOM cost is estimated to be **$100,000**.
- **Remnant Seawall - obstructions** - Method includes removing dangerous obstructions, such as exposed reinforcement. The removal of dangerous items associated with the remnant seawall removes safety concern for potential injury of surfers/public. This type of repair work needs to be conducted one time only. The OOM cost is estimated to be **$50,000**.

7.3 Rectification

Rectification is intended to solve the root cause of the problem, i.e. gaps in the contiguous piling, which allows escape of foundation material (sand) and causes settlement of the Seabees.

Rectification options are as follows:

- **Removal of Remnant Seawall** - Method involves removing all remaining debris from the remnant seawall, addressing public hazard and allowing better access for potential rectification works to the contiguous wall. The OOM cost is estimated to be **$200,000**.
- **Scour Protection** of Contiguous Pile Wall

- **Beach Nourishment** - Method involves placing sand in front of the seawall to at least the underside of the capping beam. This type of rectification needs to be conducted every 3 to 4 years and is not recommended. The OOM cost is estimated to be **++$200,000**.
- **Rip Rap Protection** - Method includes placing relatively small rock, held together with mesh (also 'rock bags'). This type of rectification needs to be conducted one time only, however it is not recommended. The OOM cost is estimated to be **$300,000**.
- **Armour Rock Protection** - Method includes placing large rocks. This type of rectification needs to be conducted one time only, however it is not recommended. The OOM cost is estimated to be **$500,000**.
- **Sand-filled Geobags** - Method includes placing large geotextile bags hydraulically filled with sand. This type of rectification needs to be conducted one time only, however it is not recommended. The OOM cost is estimated to be **$200,000**.

- Contiguous Pile Wall - **New wall behind**
  - **Sheet Pile Wall** - Method includes sheet piling behind the existing capping beam (down to -3mAHD), for full length of the wall. This type of rectification needs to be conducted one time only, however it is not recommended. The OOM cost is estimated to be **$1,200,000**.

- Contiguous Pile Wall - **Refurbishment of existing wall**
  - **Contiguous Pile Wall - Shotcrete** - Method includes applying shotcrete to front of contiguous pile wall to seal existing gaps, as well as for full length of wall (down to -3mAHD). This type of rectification needs to be conducted one time only, however it is not recommended. The OOM cost is estimated to be **$750,000**.

- Contiguous Pile Wall - **New wall in front**
  - **Contiguous Pile Wall - Formed wall** - Method includes installing a concrete wall to the front of the contiguous pile wall to seal the existing gaps, as well as for full length of wall (down to -3mAHD). This type of rectification needs to be conducted one time only, however it is not recommended due to the challenges of access and dewatering. The OOM cost is estimated to be **$1,250,000**.
  - **Steel Sheet Piling** - Method includes driving steel sheet piling in front of the capping beam. For a 50 year planning period it is prudent to consider that this rectification may need to be undertaken again (i.e. Year 30). The OOM cost is estimated to be **$1,000,000**.
  - **Sheet Pile Wall - Vinyl or Composite material -** Method includes installing sheets in front of the capping beam, as shown in **Figure 7-5** and **Figure 7-6**. For a 50 year planning period it is prudent to consider that this rectification may need to be undertaken again (i.e. Year 30). The OOM cost is estimated to be **$1,000,000**.

7.4 Reconstruction

Reconstruction would involve the complete demolition of the existing Prince Street seawall and re-build of a new seawall. This is a permanent long-term solution, and is recommended for consideration by Council as the existing structure nears the end of its design and practical life.

The reconstruction could involve a range of options including a vertical wall with (or without) a small rock revetment for scour/toe protection, a rock revetment (relatively traditional coastal protection), or use of proprietary engineered structures (similar or alternative to Seabee units).

The incorporation of a vertical wall (less footprint) could increase the width of beach and improve public amenity. A rock revetment would become a safety hazard at low beach levels, and the height of the wall and retained material would require a substantial wall. Reconstruction option is a one-off.

OOM cost is estimated to be **$15,000,000** (minimum).

7.5 Recommended Management Approach

A Net Present Value (NPV) economic analysis was undertaken of the three asset management strategies described above, comparing the predicted future expenditure over time for each option, which is then discounted to a current value (or cost) (see **Supporting Document E** for further description).

Based on the NPV analysis, the recommended strategy for the Prince Street seawall is to 'Rectify and Maintain' in the near term, with ongoing maintenance as required, providing the most effective short- and medium-term management actions that address immediate hazards, and seek to extend the useful life of the structure for approximately a further 50 years.

As well as providing the lowest NPV (Cost), the other options are not preferred for the following reasons:

- The 'Maintain only' option is likely to create more ongoing and increasing maintenance costs over time if the root cause of the problem is not addressed adequately. There is the likelihood of increased risks and hazards to visitors to the location, requiring potentially costly reactive actions.

- The 'Rebuild and Maintain' option is very costly up-front ($15M minimum) and it is unlikely that this funding is immediately available at Local and State level, even considering starting construction in 5 years' time.

7.6 Endorsed Rectification Solution

The endorsed rectification option is the installation of sheet piling in front of the existing contiguous piling, as shown in **Figure 7-5**. This sheeting would be sufficiently embedded into the beach sand below a future scour level and fixed to the existing capping beam. This method removes the need for de-watering, which has proved challenging in the trials previously undertaken.

It is also recommended to fill between the existing contiguous pile wall and the new sheet piling with concrete. This could be placed by the tremie method, which allows for placement of concrete below water. This would then create a significant barrier to any potential leaching of fill material between the gaps in the contiguous piling. It would also assist in halting further degradation of the contiguous piling. This method does not require dewatering, which proved very difficult during the trial undertaken in 2015.

It is further recommended to consider the use of vinyl sheet piling rather than steel sheet piling from a durability and maintenance perspective (50 year design life). This type of piling has seen recent advancements in terms of its strength, resistance to UV, and potential for leaching of any chemicals. Vinyl sheet piling can be up to 95% recycled, which is a positive for sustainability.

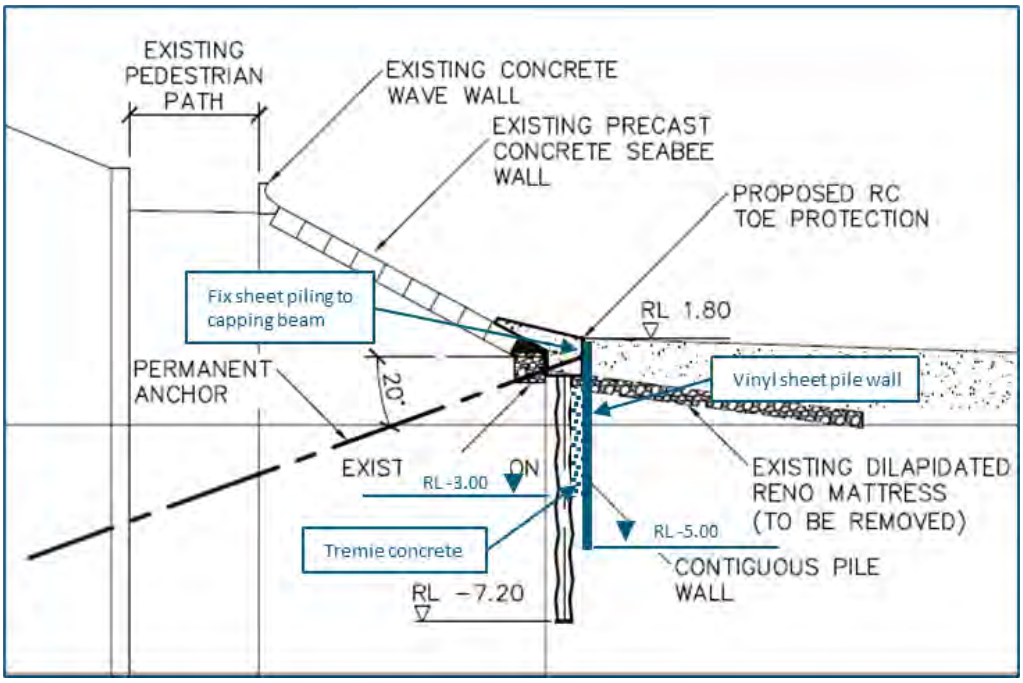

Figure 7-5: Vinyl Sheet Pile Wall installation in front of contiguous pile wall

Installation of vinyl sheet piling is shown in **Figure 7-6**. This example also demonstrates the use of a steel mandrel which enables the vinyl sheet piling to be driven through difficult ground conditions (e.g. through potential obstructions on the beach).

Figure 7-6: Vinyl sheet installation at Woolooware Bay using mandrel (Ford Civil)

7.7 Inspections, Monitoring & Maintenance

As well as undertaking rectification works, it is recommended that the following inspection / monitoring / maintenance works are undertaken over the next 1-4 years:

- Regular inspections (at least yearly, and after significant storm events)
- Survey of existing seawall
- Remnant seawall:
  - Removal of obstructions
  - Mapping
  - Removal of debris
- Maintenance as required (e.g. filling of voids with sand-cement)

7.8 Costs and Timing

Funding for the proposed strategy for the next 4 years is summarised in **Table 7-1**, with major rectification works (as shown in **Figure 7-7**) proposed for Year 2 (please note, the depth of sheet piling shown is indicative, to be determined during detailed design stage). This timing has been taken from the assumptions for the NPV analysis.

Table 7-1: Prince Street Seawall Funding (Years 1-4)

Activity	Year	Cost (OOM)
Remnant Seawall - obstructions	1-2	$50,000
Remnant Seawall - mapping	1-2	$75,000
Remnant Seawall - removal	2-4	$200,000
Survey / Inspection / Maintenance	1	$50,000
Maintenance / Inspections	2	$25,000
Rectification	2	$1,000,000
Maintenance / Inspections	3	$25,000
Maintenance / Inspections	4	$25,000
Total		**$1,450,000**

Above costs not escalated.

For a 50 year planning horizon, present day costs are:

- Ongoing Maintenance / Inspection costs (on average): $25,000 / year
- Major Rectification in Year 30: $1,000,000. It is assumed that rectification works would be required again at Year 30 (for 50 year planning period).

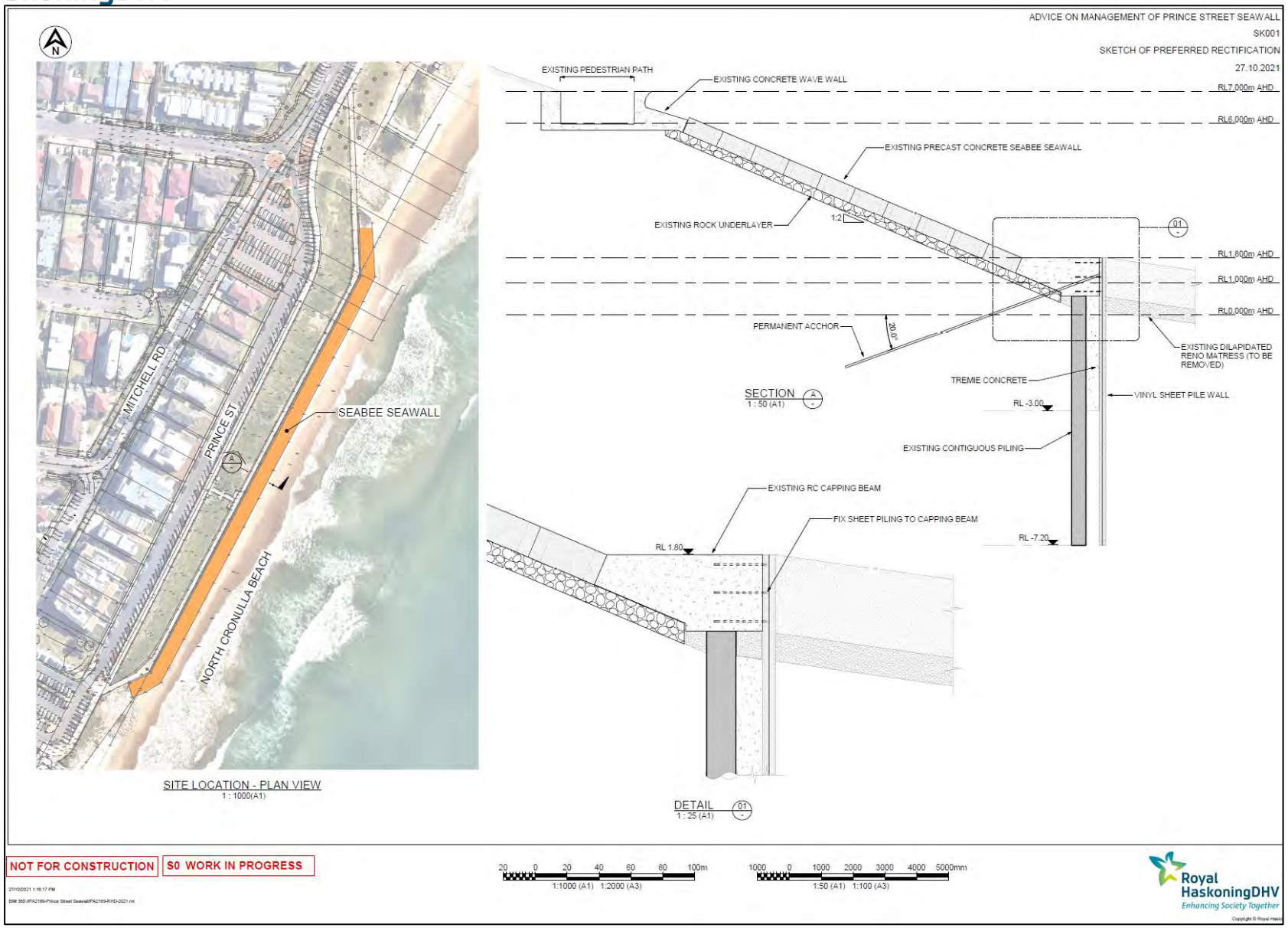

Figure 7-7: Advice on Management of Prince Street Seawall - Sketch of Preferred Rectification

8 The City Beaches and Surf Beaches

The sandy beaches of Bate Bay and the Kurnell Peninsular have a well-documented history of pre- and post-European settlement and a variety of land uses, including removal of vegetation to enable grazing, and significant sand mining operations. From the 1930's till around 1990, it is estimated that over 70 million tonnes of sand was removed to supply the construction industry, resulting in bare and destabilised sand dunes, as shown in **Figure 8-1**.

Figure 8-1: Aerial photograph of Cronulla, 1942 (source: DCCEEW – BCS)

Removal of large volumes of sand and vegetation reduced the resilience of the peninsula to coastal processes and storms. The 1974 "Sygna" storm caused devastation across the Bate Bay coastline, with waves overtopping the reduced Kurnell dune system and reportedly nearly reaching Botany Bay, causing significant erosion of the beach and sand dunes as shown in **Figure 8-2**.

Figure 8-2: Wanda dunes looking north, 1974 (source: Angus Gordon)

In response, a collaboration between the NSW Government and Council resulted in development and implementation of large scale reconstruction and rehabilitation program for Bate Bay, including the establishment of Sydney's largest dune stabilisation project across a significant proportion of the 93-hectare native sand dune system on the Kurnell Peninsula. In 1974, the Soil Conservation Service (SCS) commenced dune reconstruction and revegetation, strengthening dune stability and aiding progressive natural deposition of wind-blown sand into the dunes of the peninsula.

The rehabilitation program has created and retains a continuous cover of diverse native vegetation as shown in **Figure 8-3**, increasing the biodiversity value of both flora and fauna in the area. The Wanda Dunes provide a corridor between the adjacent National Park and other public reserves, as well as maintaining long-term stability of the coastal dune system between Wanda Beach and Boat Harbour. Cronulla Sand Dune and Wanda Beach Coastal Landscape was listed on the New South Wales State Heritage Register on 26 September 2003.

Figure 8-3: Wanda dunes circa 2016; image Soil Conservation Service

It is noted that Besmaw Pty Ltd have proactively undertaken comparable dune management within their lands since circa 1950s, including collection and sowing of wattle seed, planting of endemic species, removal of bitou bush and other invasive species, and management of dune 'blow outs'. As a result, the Besmaw Pty Ltd foreshore lands present as stable, well established dunal systems.

8.1 Beach Nourishment Campaigns

While Bate Bay is a "closed" system (no net loss of sand from within the embayment), there is still significant erosion that occurs at the southern beaches due to the longshore sediment transport within the Bay as shown in **Figure 8-4**. As a result of this continuous erosion and due to the lack of a current natural source of sand to replenish the loss, significant beach nourishment operations have occurred in the past 50 years to maintain beach width and amenity in the southern area of the Bay.

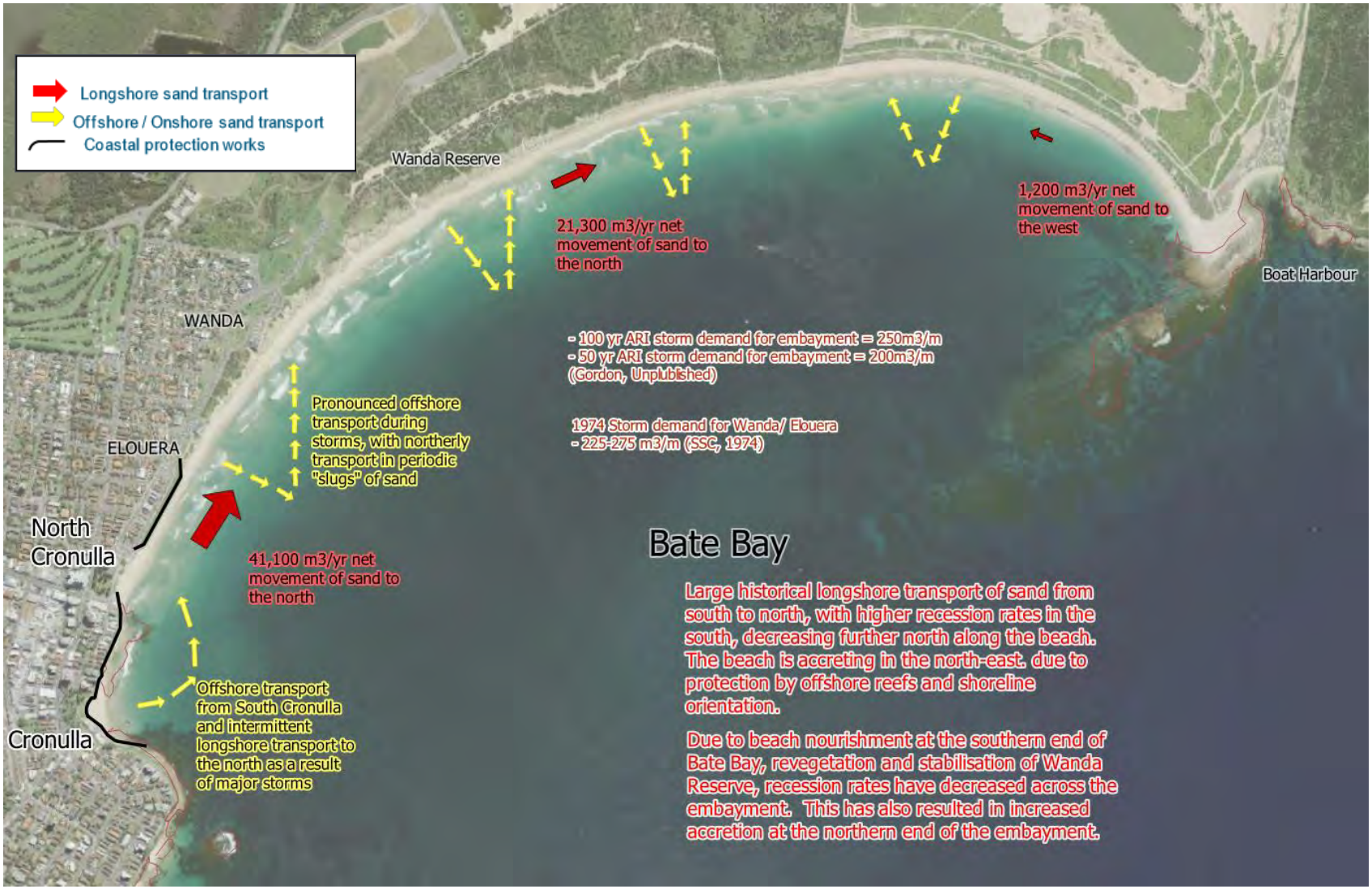

Figure 8-4: Sediment Transport within Bate Bay

Beach nourishment has been completed under the guidance of Council on five occasions between 1977 and 2012, with sand being brought in from outside the closed sediment system. The volume of sand and placement methodologies have been refined over time.

In 1977/1978 more than 127,000m^3 of sand obtained from the dunes behind Wanda was trucked in and placed on Cronulla Beach to improve the amenity of the beach, which had become highly eroded. The sand was placed in the sub-aerial (above water line) portion of the beach. The quantity of sand deposited exceeded the capacity of the pocket beach, and resulted in sand covering most of the intertidal rock platforms and in-filling the adjacent rock pools, as shown in **Figure 8-5**.

Figure 8-5: The highly nourished state of Cronulla Beach at the end of August 1977, midway through the first stage of nourishment (note that the saturated subaerial portion of the beach filled in adjacent rockpools) (Patterson Britton, 2006)

The subsequent four beach nourishment campaigns have occurred in conjunction with periodic maintenance dredging of the navigation channels within Port Hacking being undertaken by the NSW Government. Benefiting from being located close by, the beaches of Bate Bay receive the sand as a beneficial reuse of the dredged material. The sand was placed in the subaqueous (below water) beach profile by bottom dumping.

Nearshore deposition by bottom dumping during the 2003 sand nourishment campaign is shown in **Figure 8-6**.

Figure 8-6: Port Frederick and Faucon hopper dredges placing sand at Cronulla Beach (from Port Hacking dredging) through split hopper bottom dumping, circa 2003

Table 8-1 summarises the beach nourishment operations, including the volume of sand placed and from where the sand was sourced, while **Figure 8-7** indicates placement locations.

Table 8-1: Historical Beach Nourishment. Information sourced from Patterson Britton (2001) and (2007)

Year	Volume of sand placed into system	Location placed	Additional Information
1977-78	127,000m^3 total 80,000m^3 in Stage 1 and 47,000m^3 in Stage 2	Cronulla Beach	Sand was trucked in from west of the dunes at Wanda and placed in the subaerial beach zone. It was completed in two stages
1999	60,000 m^3	Offshore of Cronulla beaches	Dredging of Port Hacking navigation channels led to the sand being placed 250m offshore
2003	90,000 m^3	Offshore of Cronulla beaches	Maintenance dredging in Port Hacking led to the placement of sand in the nearshore zone
2007	90,000 m^3	Offshore of Cronulla beaches	Maintenance dredging in Port Hacking led to the placement of sand in the offshore zone
2012	76,000 m^3	Offshore of Cronulla beaches	Maintenance dredging in Port Hacking led to the placement of sand in the offshore zone

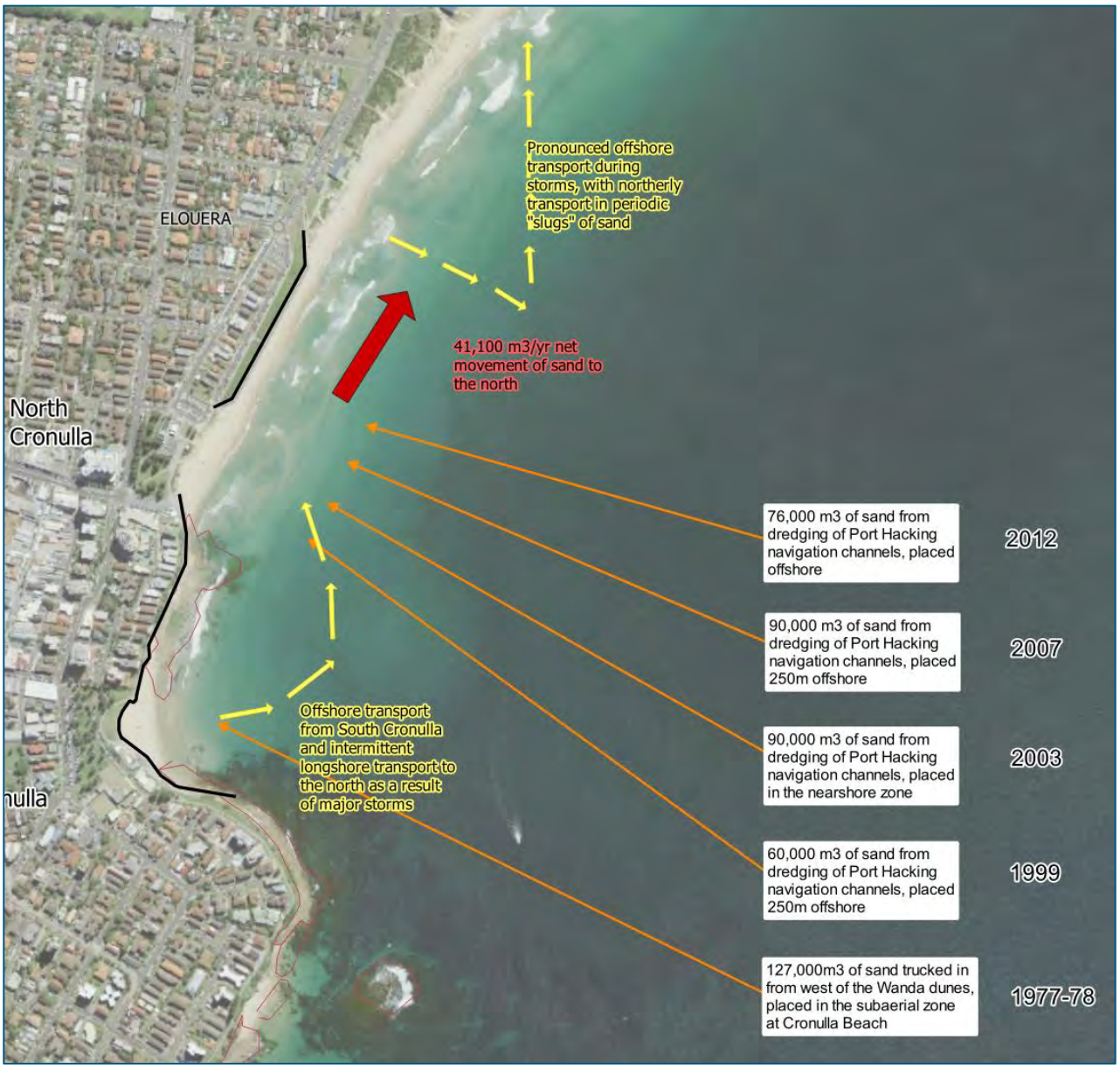

Figure 8-7: Dates, volumes and approximate locations, of sand nourishment campaigns

A comprehensive Beach Nourishment Strategy (Patterson Britton, 2006) was developed as an action from the Bate Bay Coastline Management Plan (Patterson Britton, 2002) to consider quantities of sand that would be required for a range of nourishment campaigns (based on desired end state), potential sources of sand, and the possible use of structures to retain material. A range of methodologies for delivery of material were considered, including a pipeline from Gunnamatta Bay to the Cronulla Beaches, along with potential environmental impacts, before development of preferred strategies for Emergency, Major and Maintenance nourishment campaigns. The final Strategy was used to guide the maintenance nourishment campaigns of 2007 and 2012.

8.2 Assessment of Beach Nourishment

Anecdotal information received from community members during preparation of the Bate Bay CMP noted significant amenity benefits that resulted from the successive beach nourishment campaigns. Comments reflected increased beach width at Cronulla and North Cronulla beaches in particular, as well as improvements to surfing quality through creation of nearshore banks. In addition to short term variation in beach volume due to weather and wave action (erosion and accretion), it was recognised that the benefits were relatively temporary, and that the beach profile was subject to progressive loss of sand over time.

The NSW government Beach Profile Database collates and presents aerial survey data of NSW coastal locations dating back to the 1930's. Profile data has been collected at more than 150 locations along the NSW Coast, from as far north as Tweed Heads and to as far south as Eden. A combination of interpolated photogrammetry has been supplemented by modern aerial survey techniques, including LiDAR and drone surveying, providing surveyed 'transects', or cross sections of beaches (DPIE, 2021).

Analysis of beach profiles within Bate Bay such as at North Cronulla Beach (shown as the blue transect line in **Figure 8-8**) provide a 'snapshot' of beach widths, vertical height, and sand volume at points in time, which enable assessment of whether the beach is decreasing in width (recession) or increasing in width (progradation) over time.

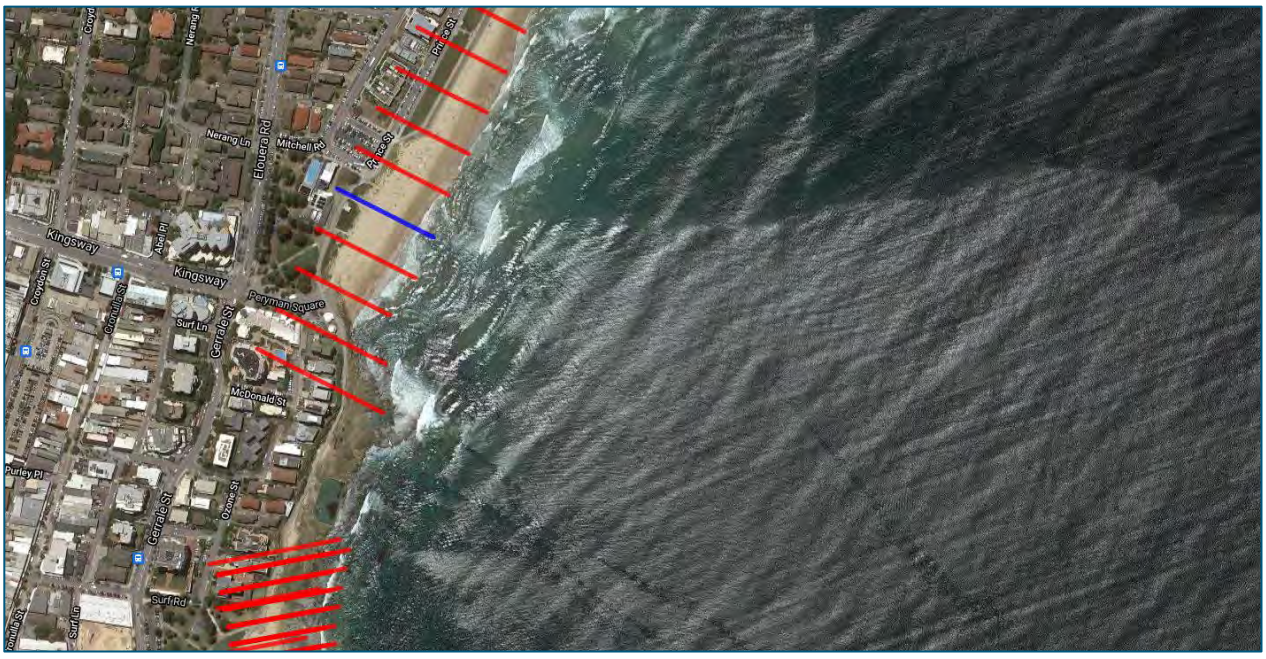

Figure 8-8: North Cronulla Beach survey transect - Beach Profile Database (source: wwww.nswbpd.wrl.unsw.edu.au)

As shown in **Figure 8-9**, the volume of sand above 0m AHD (effectively, above the waterline) on North Cronulla Beach since 1930 varies at the time of each assessment (blue continuous line), notably reducing significantly in 1974 due to the "Sygna" storm. The trend shows a linear regression, or shoreline recession, over time (black dotted line). However, surveys undertaken since 1977 indicate that the volume of sand on North Cronulla Beach has been relatively stable, which coincides with the era of periodic beach nourishment campaigns.

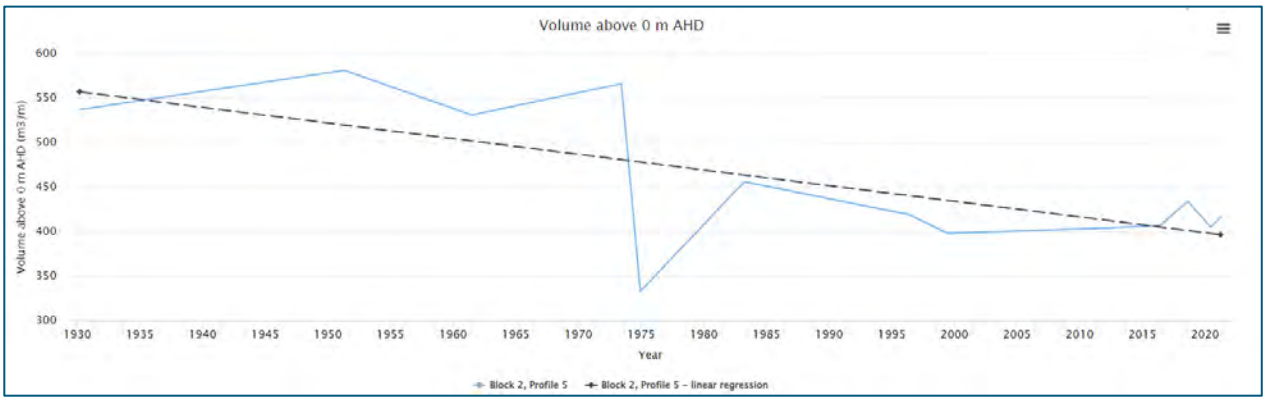

Figure 8-9: North Cronulla Beach survey cross section - Beach Profile Database (source: wwww.nswbpd.wrl.unsw.edu.au)

8.3 Future Sand Nourishment Opportunities

Council has an adopted Dredging Policy (Council, 2020), which recognises that financial responsibility for dredging of navigation channels where the bed of the waterway is owned by the NSW Government, rests fully with the NSW Government given it has the administrative responsibility for safe navigation and receives all revenue from the use of the waterways. The policy notes that Council is available to manage dredging projects on behalf of the NSW Government and/or residents, subject to the full funding of pre-dredging investigations and dredging works by the NSW Government and/or residents.

Noting that the most recent beach nourishment campaign was undertaken in 2012, it is beneficial that the NSW government has recently committed to dredging of navigation channels within Port Hacking to maintain recreational amenity, and improve safety for commercial and private vessels. Council has been provided a grant of $2.5 million from Transport for NSW (TfNSW) to complete the Port Hacking Navigation Channel Dredging project.

The Port Hacking Dredging project seeks to dredge the main navigation channels to the intended (design) depth by removal of ~60,000 m^3 of marine sand, potentially similar to **Figure 8-10**. A secondary outcome is beneficial reuse through placement of the sand to nourish Bate Bay beaches, and potentially Deeban Spit / Bonnie Vale campground and the eastern foreshore of Gunnamatta Bay. The project is intended to be delivered in 2022, subject to a range of factors including contractor availability, shorebird breeding / migration, and environmental approvals.

Figure 8-10: Proposed 2022 dredging configuration to maintain viability of navigation channels (source: Council, 2021)

It is recognised that while the NSW Government has funded four previous dredging campaigns and one upcoming dredging campaign, which have resulted in sand nourishment of Bate Bay beaches, future dredging and nourishment campaigns cannot be guaranteed. It is recommended that Council continue to investigate alternative opportunities for accessing appropriate sources of sand for beach nourishment.

There may be potential to source tunnel spoil from Sydney tunnelling projects for the purpose of beach nourishment, although it is noted that sea disposal of terrestrially generated material is not common in Australia, with most material disposal occurring to land. Where this has involved material that is potentially suitable for beach nourishment purposes, such as Sydney Sandstone and Hawkesbury Sandstone, this could be considered as a series of missed opportunities.

Council may also continue to collaborate with other coastal councils and the NSW government to investigate potential offshore sand sources. While noting that offshore marine sand sources are not currently available due to regulatory constraints, there may be opportunities to access these sources in the future.

8.4 Minor Beach Management Works

Beach scraping is a management tool used widely by Councils in NSW to address short-term access and other amenity impacts caused by beach erosion. During large storms sand is eroded from the back beach and dune and transported offshore into the surf zone forming bars. Most of this sand is returned shoreward during subsequent fair-weather periods. Incomplete recovery of the beach and dune due to sand losses from the beach system (e.g. windborne losses onshore, or leakage seaward from the compartment) give rise to long-term shoreline recession.

Beach scraping involves manually relocating sand from the swash zone to the back beach and dune using excavators and dozers, expediting the natural beach rebuilding process. Beach scraping may be used to restore beach access across the erosion escarpment and dune but would not reduce the immediate or future erosion hazard as it is simply redistributing sand, not adding additional sand volume.

Figure 8-11 below shows North Cronulla Beach during the 2007 “Pasha Bulka” storm event. Once the swell had abated and natural beach recovery had commenced, beach scraping would likely have been a useful measure for expediting the rebuilding of the back beach and dune, to cover the exposed rocks, and to restore pedestrian access onto the beach.

Figure 8-11: Erosion of North Cronulla during 2007 storm event (source: Sutherland Shire Council)

9 Management Actions within the Bate Bay CMP Area through Community Consultation

Through widespread community and stakeholder engagement undertaken during Stages 1, 2 and 3 of the CMP process, Council sought to develop a greater understanding of the community's values, issues and aspirations for the wider Bate Bay foreshore. The community's values, issues and aspirations were captured through online consultation as well as key stakeholder engagement and have provided direction for development of a range of management actions.

To this end, an interactive map of the Bate Bay foreshore was provided online, via the Council's "Join the Conversation" platform (see **Figure 9-1**), and comments invited (using marker pins) from the community:

- Values: What do you value, like or enjoy about Bate Bay and its foreshore?
- Issues: What issues, problems or concerns do you have with Bate Bay and its foreshore?
- Aspirations: What would you like to see or experience along the Bate Bay foreshore?

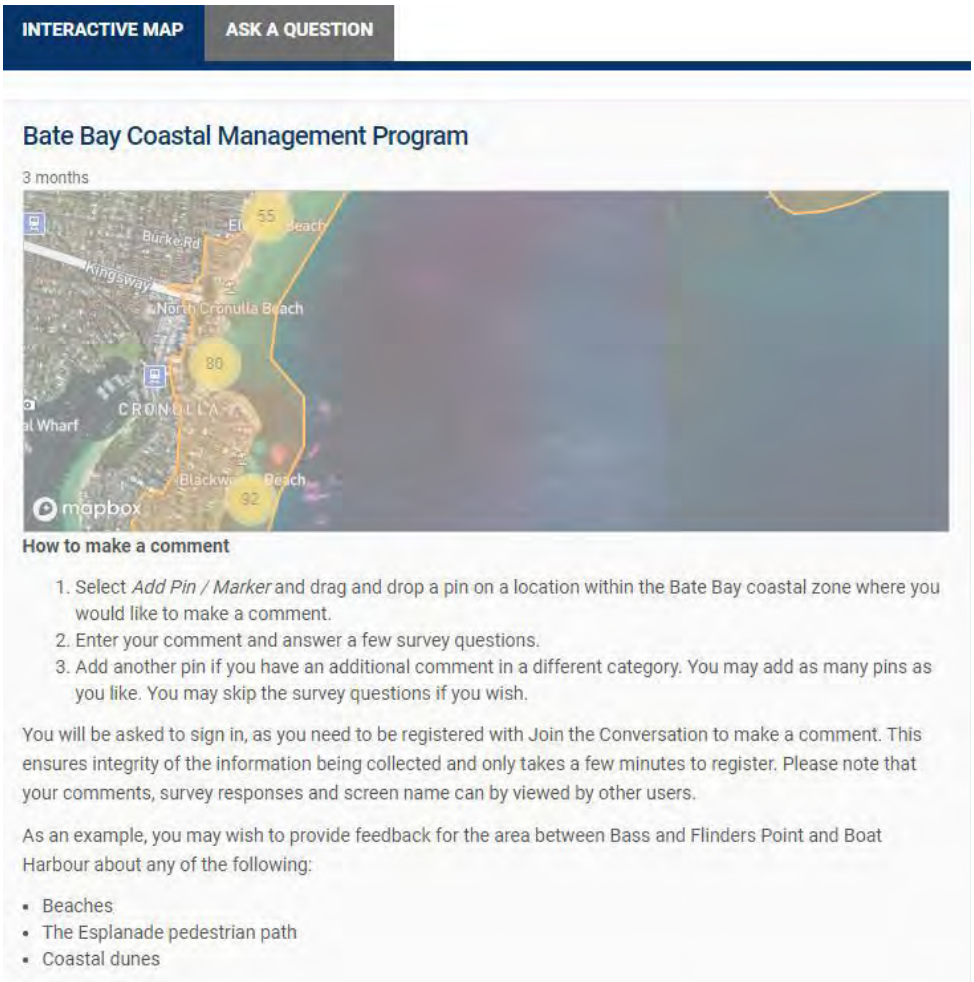

Figure 9-1: 'Join the Conversation' online forum

The comment period ran from 1 June to 8 July 2020. The online site received a total of 1830 visitors, with 162 active participants adding 421 comments to the map (see **Figure 9-2**).

Figure 9-2: Study Area and example of how comments were provided using Marker Pins

The responses received have been analysed based on a 'grounded theory approach' (Schensul, 2012). This approach is designed to draw out concepts, patterns, interpretations and insights from the data by classifying the information obtained into categories or themes. The process is known as 'thematic analysis' and the approach adopted here is shown in **Figure 9-3**.

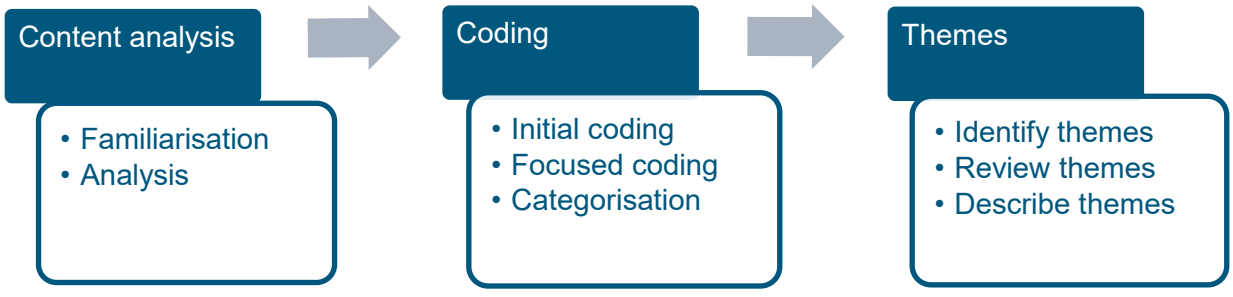

Figure 9-3: Process for Thematic Analysis

Comments received were compiled and sorted according to the question being addressed. The comments were then reviewed and summarised based on the following:

- Relevance of the response to the question.
- Level of trustworthiness, understanding and knowledge.
- Key words that were interesting / potentially meaningful in the context of values, issues and aspirations (vision).
- Reoccurrence (i.e. issues raised by a number of respondents were highlighted (emboldened)).

A content summary is provided in **Table 9-1** and content analysis in **Table 9-2**, while the methodology is described within the Community Consultation Thematic Analysis report (**Supporting Document G**).

Table 9-1: Content Summary (repeated points are emboldened)

Question	Comment Summary
1. What do you value, like or enjoy about Bate Bay and its foreshore?	• Our foreshore is a source of pride and the bay a treasure of the Shire and south Sydney. • The natural beauty of the area, including its native vegetation, and its accessibility for walking. • Well maintained beaches, clean water and safe swimming spots. • Ocean swimming, surfing, snorkelling and diving (e.g. from South Cronulla to Shark Island) and the array of marine life. • Green spaces not overshadowed by development (including Cronulla's foreshore); with positive benefits for mental health. • Long, unspoilt sections of beach to explore (e.g. North Cronulla to Boat Harbour) and a wide range of beach options. • Wonderful safe family fishing along the entire beach. • Greenhills is a great area of coastal bush that should be preserved, invasive species controlled and expanded. • Blackwoods Beach is a great spot to sunbathe and swim (but note the currents). • The rock platform at Boat Harbour is extremely important for migratory and resident sea and shore birds. • The opportunities for food gathering and (safe) spearfishing (including at Boat Harbour and Merries Reef) and ability to access the entire foreshore for fishing. • The beauty and amenity of an easily accessible Esplanade, particularly the two-way Esplanade in the northern section. • The rocky foreshore below the Esplanade (albeit marred by graffiti). • Ability to walk dogs (off the leash) on the beach. • The amenity value of social and cultural activities. • Ability to drive cars on the beach. • A gym at the beach; the Live Life Active classes. • The effort made to keep the beach clean and tidy. • The improvements to Cronulla Beach. • The opportunity for rest, renewal and reflection.
2. What issues, problems or concerns do you have with	• Concerns regarding development / overdevelopment without care for the surrounding environment; development in the dune systems. • Overdevelopment in South Cronulla. • Flattening and clearance of coastal land; disrupting habitat continuity. • Illegal clearing of trees and bush versus trees obscuring views from the Esplanade.

Question	Comment Summary
Bate Bay and its foreshore?	• In places, too many Norfolk Island pines planted too close together (e.g. Shelly and Dunningham Park). • Further development will cause a loss of natural beauty. • Seawall no longer serving its function; beach continuously eroding. • Uncontrolled dogs (vehicles, cyclists, reef walkers and fishers) disturbing seabirds at critical periods, amongst other things (including dog poo). • Vehicles damaging the dunes and foreshore. 4WDs and the link to rubbish being left on the foreshore. • Parking is a problem in the summer versus do not expand current car parking allowances and remove car parking from green spaces. • Apparent preference for cars over walkers. • Overflowing bins; more bins and policing are needed. • Esplanade is too narrow and uneven in places. • Private ownership of beach access (Boat Harbour; which is not accessible to less able walkers). • The reserves are being mined of sand while the Hacking River is being choked with sediment. • The illegal collection of shellfish from the aquatic reserve and illegal spearfishing; spearfishing close to shore/swimmers. • Dirty stormwater runoff. • Lighting at the water's edge (potentially) affecting the behaviour of fish. • Insufficient lifeguard cover of unpatrolled areas. • Need to repair the sea swimming pools (e.g. Oak Park). • Insufficient areas for body surfers. • Concerns over the Holt site. • Current plan is very engineering focused and does not address the natural, cultural and social values of the area; fails to set broader objectives and aspirations that relate to values.
3. What would you like to see or experience along the Bate Bay foreshore?	• Protection and regeneration of vegetation on the dunes; fencing to limit dogs, people and vehicles to paths; landscape regeneration, maintenance and design (using local experts). • Greater public awareness of the importance of preservation and restoration of the dune system. • Protection of areas with high biodiversity in the marine environment (e.g. Shark Island to Windy Point and Merries Reef) from fishing, spearfishing and boats (but not swimming and snorkelling); or limiting numbers. • A Bate Bay (Cronulla / Shark Island) marine reserve (increasing safety and marine life). • Eco-boardwalks to showcase rare birds etc. and educational displays on the local marine life and history of the area, e.g. along the Esplanade. • The stretch from Greenhills to Boat Harbour to be kept as a nature strip. • Fishing and boats prohibited in primary swimming areas; motorised craft excluded from a zone 500m from the shoreline (other than rescue craft) or speeds limited. • Preservation of all current green space (no development from Don Lucas Reserve to Kurnell). • Ongoing assessment of water and air quality and relocation of industrial sites from the coast. • Further initiatives to trap pollution from stormwater runoff (and better maintenance of these) and stormwater recycling. • Awareness campaign on the regulations pertaining to spearfishing and fishing to avoid ecosystems impacts.

Question	Comment Summary
	• Community education around local marine life and its protection. • More patrols to enforce restrictions and better signage (pertaining to dogs, spearfishing, cycling, jet skis etc.). • No further development; no higher development. • A continuation of the two-way Esplanade for its full length, smoother surfaces (no gutter drains), widening for multiple use, extension to Boat Harbour and more areas to sit / viewing platforms (e.g. end of Girriland Road and Tullimabar Road); as well as more water stations, toilets, bike barriers and tree maintenance (removal of non-natives), and better lighting. Or, keep the path as it is, no concrete no lighting. • Cycle lanes (removal of bike restrictions) and safe links to the existing cycle paths from stations and town centres. • Completion of the 'trail' around the entire peninsula; walking track to continue from Greenhills to the 4WD area and a bike track. • 4WDs excluded from Boat Harbour and Greenhills beach, particularly the dune-backed stretch, to enhance fishing. 4WD park closed and incorporated in the National Park (or numbers limited and managed). • A refurbished beach wall and restoration of the beach after storms (a permanent renewal program). • More events along the Esplanade (e.g. markets, sculptures etc.). • Community clean-ups and more dog waste bins (compostable), collection bins for recycling and compostable food and electric car chargers. • Longer hours for dog access on the dog beach or a permanent dog beach near Blackwoods. • The remaining areas for spearfishing in Bate Bay to be kept open. • Preservation of aboriginal cultural sites and displays relating to historical use of Bate Bay; as well as duel-naming/restoration of traditional names. • Removal of graffiti. • The development of Boat Harbour as a destination point for visitors versus removal of the shanty town and designation of a national park / protected marine area. • Steps from the Esplanade to Blackwoods Beach versus avoiding formalising the access to reduce crowding. • More community (rather than commercial) spaces; including in Surf Clubs. • BBQ areas and family picnic zones. • Removal of shark nets, which can be harmful to other species. • Improvement of public amenities on the old Fisheries site. • Promotion of public transport. • Retendering of some restaurant spaces to get better quality. • The residual sand mining sites should be closed and the area restored. • Public moorings (including in Boat Harbour to protect the marine area). • Bike racks. • Fixed poles for beach volleyball. • Further zoning for jet skis. • Lifeguard stations on the dog beach and an additional patrolled at Greenhills. • A scooter/bike/walking path around Oak Park.
4. Other ideas	• Provide more amenity facilities, e.g. a play zone for families, an artificial reef for fishing, snorkelling and diving and dig out the little beach at Nuns Pool so it is deeper for swimming.

Question	Comment Summary
	• Outdoor beach seating on the beach side of restaurants and cafes to help alleviate congestion on the esplanade. • Sediment should be removed from the Hacking River (to improve boat access) and placed on the Bate Bay beaches (to tackle erosion). • Use of sand from Bate Bay and Port Hacking to replenish the beaches; with a financial contribution from the sand mining company. • Using sand that has built up in the dunes between Elouera Surf Club and Wanda Surf Club in the last 10 years to replenish the beach in front. • An artificial reef to help retain sand on Cronulla Beach, support surfers, help mitigate overcrowding and provide marine habitat. • A cosy corner at the southern end of Elouera and an offshore reef to protect the beach and encourage marine life. • Removal of the marram grass (trees and scrubs) from the dune systems to let the sand move (e.g. between Elouera Surf Club and Wanda Surf Club). • An underwater sculpture trail. • Underground car parking. • A ferry service from La Perouse to Kurnell. • A masterplan to redesign and modernise Dunningham Park and Perryman Square. • Parking fees for non-SSC residents; time-limits on parking. • Introduce “3 for the Sea” stations with bags, pincers and bins. • Zoning, i.e. banning spearfishing and shellfish gathering from Shelly Pool to Cronulla Beach and Shark Island; allowing spearfishing between Shelly Pool and Oak Park. • Divert dog walkers to the skate park carpark and provide access to the beach here, to take pressure off the Wanda beaches. • Classify zones (or themes) for the foreshore based on unique values, land use and management. • Ensure objectives are SMART.

Table 9-2: Content Analysis (key points are emboldened)

Question	Analysis
1. What do you value, like or enjoy about Bate Bay and its foreshore?	Respondents value the: • Natural beauty of the area, well maintained beaches, clean water and safe swimming spots. • Ocean swimming, surfing, snorkelling and diving and the array of marine life. • Green spaces not overshadowed by development. • Fishing and spearfishing. • The beauty and amenity of the Esplanade and walking. • Ability to walk dogs (off the leash) on the beach. • Ability to drive cars (4WDs) on the beach. • The opportunity for rest, renewal and reflection. The concerns raised in response to Question 2 reflect these values and their potential loss.
2. What issues, problems or concerns do you have with	Respondents are concerned about: • Development / overdevelopment causing a loss of natural beauty. • In places, too many trees (Norfolk Island pines), obscuring views. • Seawall no longer serving its function; beach continuously eroding. • Uncontrolled dogs and dog poo.

Question	Analysis
Bate Bay and its foreshore?	• Vehicles damaging the dunes and foreshore. • Parking in the summer. • Overflowing bins. • Esplanade is too narrow and uneven in places. • Private ownership of access to the beach (Boat Harbour). • Sand mining and sediment accumulation in the Hacking River. • The illegal collection of shellfish and illegal spearfishing; spearfishing close to the shore. • Stormwater runoff. • Insufficient lifeguard cover of unpatrolled areas. • Need to repair the sea swimming pools.
3. What would you like to see or experience along the Bate Bay foreshore?	Respondents would like to see/experience: • Protection and regeneration of vegetation on the dunes; fencing to limit egress by dogs, people and vehicles. • Protection of areas with high biodiversity in the marine environment. • Enhance heritage and natural values through increased signage / interpretation. • Fishing and boats prohibited in primary swimming areas. • A Bate Bay marine reserve. • Preservation of all current green space. • Further initiatives to trap pollution from stormwater runoff. • More control over spearfishing and fishing. • More patrols to enforce restrictions and better signage. • No further development; no higher development. • Restoration of the beach after storms. • Upgrade of the Esplanade, more areas to sit and viewing platforms. • Cycle lanes (removal of bike restrictions). • More events along the Esplanade (e.g. markets, sculptures etc.). • Community clean-ups and more bins. • Longer hours for dog access. • The remaining areas for spearfishing in Bate Bay to be kept open. • Duel-naming/restoration of traditional names. • 4WDs excluded from Boat Harbour and Greenhills beach. • More community (rather than commercial) spaces and more amenity facilities. • Promotion of public transport. • The residual sand mining sites should be closed and the area restored. • Public moorings and bike racks.
4. Other ideas	• Sediment should be removed from the Hacking River and placed on the Bate Bay beaches. • Use of sand from Bate Bay and Port Hacking to replenish the beaches. • Using sand that has built up in the dunes to replenish the beach in front. • An artificial reef to help retain sand, support surfers and provide marine habitat. • Banning spearfishing and shellfish gathering from Shelly Pool to Cronulla Beach and Shark Island; allowing spearfishing between Shelly Pool and Oak Park. • Removal of the marram grass (non-native trees and scrubs) from the dune systems. Zoning, i.e. classifying foreshore zones based on unique values, land use and management.

Table 9-3: Primary Codes

Values	Issues	Aspirations	Other ideas
Natural beauty, clean water	Further development / over development	Protection of the dunes and marine environment	
Marine life	Vegetation (too much / too little)	More community spaces, amenity facilities and bins	An artificial reef
Walking and dog walking	Uncontrolled dogs and dog waste	More dog access	
Swimming, snorkelling and diving	Spearfishing and boats close to swimmers	More enforcement of restrictions	Zoning (e.g. boats, fishers, 4WD and swimmers)
Surfing	Rubbish	Enhanced signage and local information	
Fishing and spearfishing	Illegal fishing	More control over spearfishing; remaining areas to be kept open	
Green spaces without development	Sand mining	Preservation of green space; no further development	
4WD access to the beach	Vehicles on the beach	Cycle lanes; enhanced public transport	
The Esplanade	The quality of the Esplanade	Upgrade of the Esplanade; but maintenance of tracks	
Rest, renewal, reflection	Beach erosion	Restoration of the beaches	Use of sediment from Port Hacking, Bate Bay or the dunes
		Use of traditional place names	

From the feedback received, the following key themes of interest / concern were derived.

9.1 Green spaces

Green spaces: maintenance of green spaces and restrictions on further development.

A consistent theme derived from almost all responses was appreciation for the natural beauty, marine life and largely unspoilt nature of the Bate Bay foreshore. It was considered that the existing foreshore provides ample opportunity for rest, restoration and outdoor activities. While several respondents sought the upgrade of The Esplanade, a very large majority do not want further development of the area (a cessation of existing 'industrial' activities) and for its natural, open character to be retained.

A tension exists, however, between those that want an upgrade to The Esplanade, the length of the bay and better access to beaches, and those that want certain areas to retain a wilder nature and to be less accessible (to limit overcrowding). A tension appears to exist between those that want either wholesale or

partial protection of the bay (e.g. an extended marine reserve with greater restrictions on boats, fishing and spearfishing) and those that want to be able to continue these pursuits.

Alongside the maintenance of green spaces was a request for more community spaces and amenity facilities.

9.2 Dune and vegetation management

Dune and vegetation management: the requirement for dune protection and vegetation management.

Another consistent theme was the need for dune and vegetation protection and management. Views on the best approaches for this, however, varied (from less trees to more trees). With regard to vegetation, the majority view was for the restoration of native vegetation, better vegetation management and the removal of non-natives. It is recommended that a vegetation management strategy is developed that provides a consistent approach to vegetation management along the spatial extent of Bate Bay, providing a connected and cohesive corridor of diverse native vegetation between the adjacent National Park and other public reserves, increasing the biodiversity value of both flora and fauna in the area.

The desire to keep people, 4WDs and unleashed dogs off the majority of the dune system (and to designated tracks) was strongly acknowledged. This was accompanied by an appeal for better signage and enforcement of restrictions.

Better management of rubbish was also a consistent theme.

9.3 Information and control

Information and control: better information on and control of use/users.

As above, a repeated comment was the need for better information and control on the actions and behaviours observed and/or experienced within Bate Bay. Increased information was requested on restrictions (e.g. regarding dogs, bikes, 4WD and fishing) but also information on the marine life and history of Bate Bay. This included a call for information about the original inhabitants of the area and accurate information about the settlers (i.e. not the “discoverers”).

The community is requesting clearer signage on restrictions and greater policing / patrols (across the study area), as well as increased educational / interpretive information.

9.4 Restoration

Restoration of the beaches.

The need for restoration of (i.e. more sand on) the beaches was raised by several respondents, but this issue was not as pervasive as the comments about management of use and amenity. This requirement for beach nourishment was seen to be something that needed to happen on a regular basis and, particularly, after storm events. Various possible sources for this nourishment sand were referenced.

In the context of coastal management, it is notable that restoration and maintenance of the beach was the focus on the comments provided rather than coastal defence (i.e. protection from the sea).

9.5 Zoning

Zoning: the need to clearly distinguish between areas for wildlife (reserves), walking, biking, dogs, swimming, surfing, fishing/spearfishing, snorkelling/diving and boating.

Many of the views on use of the foreshore are polarised. For example, support for spearfishing versus banning spearfishing; support for 4WD use of the beaches versus banning 4WD use; support for dogs off the leash versus a ban on dogs off the leash; support for cycleways versus banning cycling on The Esplanade; and upgrading The Esplanade and access to more remote beaches versus rougher tracks and less access to remote areas.

The cases made for the continuation of spearfishing in the bay were very passionate, as were the cases for less fishing and greater protection; and the same can be said regarding dog access and dog restrictions. Consideration may be given to a management approach that allows for a wide range of activities to occur across Bate Bay, but to separate them. That is, to provide different areas for different uses and users.

9.6 Recommended Management Actions

As well as online community consultation, a range of workshops were held with key stakeholder groups including (but not limited to) Surf Life Saving Clubs, representatives of the surfing community, and Bushcare Volunteers.

In order to adequately address the range of concerns and opportunities raised during the consultation process, a wide range of actions have been developed and included within the Business Plan (**Section 14**) as recommended actions to address:

- Coastal Hazards Management **Table 14-1**
- Coastal Environment Management **Table 14-2**
- Foreshore Access Management **Table 14-3**
- Coastal Amenity Management **Table 14-4**
- Culture and Safety **Table 14-5**

10 Whether the CMP identifies recommended changes to the relevant planning controls, including any proposed maps

10.1 Sutherland Shire Local Environmental Plan 2015

The Sutherland Shire Local Environmental Plan 2015 ('SSLEP 2015') includes a number of provisions relevant to coastal management.

Clause 5.7 refers to development below mean high water mark. This is not considered to be generally relevant to development in the mapped coastal hazard areas but is noted for completeness.

Clause 6.10 provides heads of consideration for development on the foreshores of Port Hacking, Georges River, Woronora River and Port Botany. This clause has similar objectives and similar heads of consideration to those found in the Resilience and Hazards SEPP, such as provisions to ensure foreshore access, amenity and hazards (e.g. sea level rise). These provisions, however, relate to foreshores in enclosed waters and do not apply to the open coast lands the subject of the Bate Bay CMP.

Clause 5.21 Flood planning applies to the flood planning area but requires consideration of the potential to modify, relocate or remove buildings if impacted by coastal erosion. The Flood Planning Maps under the SSLEP 2015, as shown in **Figure 10-1**, do not apply to any of the open coast lands the subject of the Bate Bay CMP.

Figure 10-1: SSLEP 2015 Flood Planning Map FLD_008A (detail)

The SSLEP definition of *environmentally sensitive area* includes the coastal waters of the state, but not areas landward of the coastal waters. Planning provisions related to the environmentally sensitive areas limit the application of complying development but do not introduce any development controls for coastal hazards.

10.2 Sutherland Shire Development Control Plan 2015

The Sutherland Shire Development Control Plan 2015 ('SSDCP 2015') supports the provisions of Sutherland Shire Local Environmental Plan 2015. It applies to all lands in Sutherland Shire except lands identified as *deferred matter*. The SSDCP is a policy document (i.e. non-statutory) and in the event of any inconsistency between the SSLEP 2015 or any SEPP, and the SSDCP 2015, the SEPP or LEP prevails.

The SSDCP 2015 contains detailed objectives and controls that will be used by Council when determining applications under Section 4.15 of the *Environmental Planning and Assessment Act 1979* ('EP&A Act'). The Wetlands and Waterways Maps under the SSDCP 2015 do not include the open coast.

The Flood Risk Management Maps under the SSDCP 2015, which identify areas where the SSDCP flood development controls apply, do not include the open coast. Note that the term 'flood' is defined under the SSDCP 2015 to include coastal inundation.

SSDCP 2015 Chapter 10 deals with Foreshores and W1 Natural Waterways but its scope is limited to development in enclosed waters and it considers developments such as boat sheds and slipways. The spatial scope for the CMP does not extend to areas such as estuaries and embayments, and hence there is no application of this Chapter of the SSDCP to the CMP area.

SSDCP 2015 Chapter 11 deals with Foreshores and W2 Recreational Waterways. The scope is generally focussed on enclosed waters and it considers developments such as marinas, mooring pens, boat sheds and inclinators. The spatial scope for the CMP does not extend to areas such as estuaries and embayments, and hence there is no application of this Chapter of the SSDCP to the CMP area. It is noted that Chapter 11 does include provisions relating to seawalls but these appear to be written for locations within estuaries.

10.3 State Environmental Planning Policy (Kurnell Peninsula) 1989 (*as of 1 March 2022; State Environmental Planning Policy (Precincts - Central River City) 2021*)

As noted above, the SSLEP does not apply to lands identified as 'deferred matter', Refer to **Figure 10-2.**

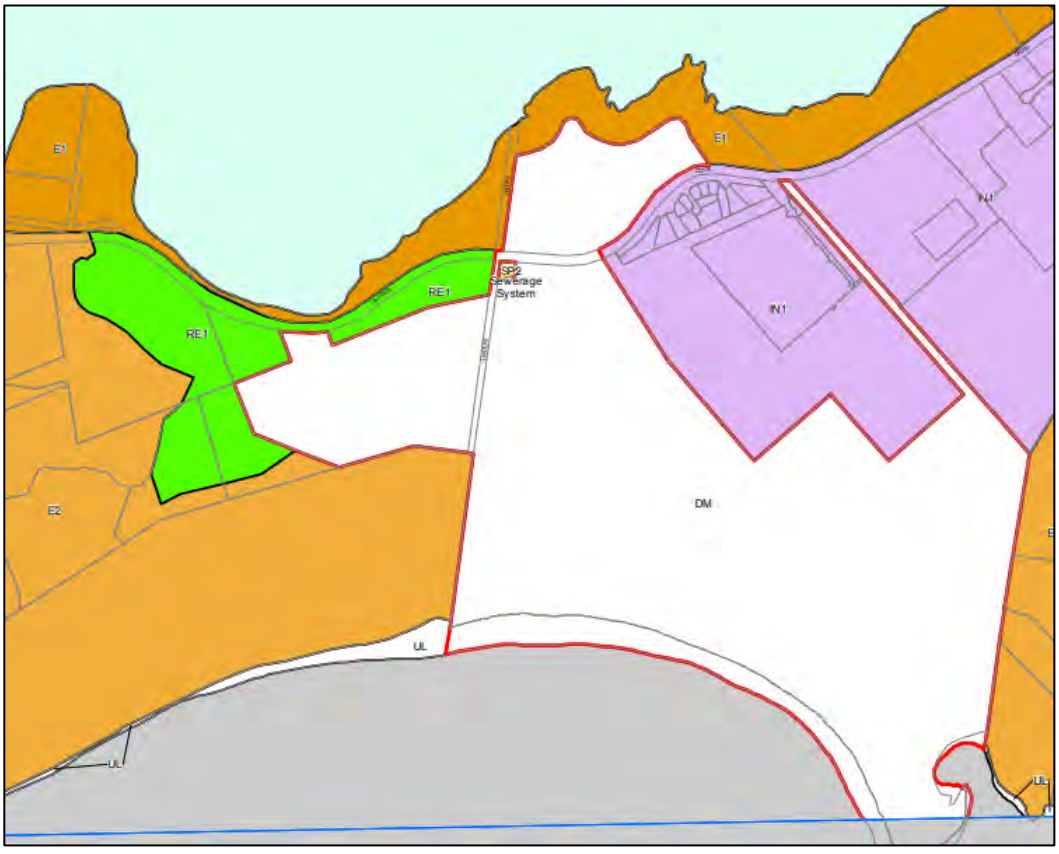

Figure 10-2: SSLEP 2015 Land Zoning Map LZN_007 (detail)

The SSLEP 2015 also provides:

1.8 Repeal of planning instruments applying to land

(1) All local environmental plans and deemed environmental planning instruments applying only to the land to which this Plan applies are repealed.

(2) All local environmental plans and deemed environmental planning instruments applying to the land to which this Plan applies and to other land cease to apply to the land to which this Plan applies.

Note—
While the following environmental planning instruments no longer apply to the land to which this Plan applies, they continue to apply to the land identified as "Deferred matter" under clause 1.3(1A)—
State Environmental Planning Policy (Kurnell Peninsula) 1989
Sutherland Shire Local Environmental Plan 2006

The Sydney Regional Environmental Plan No 3 —Kurnell Peninsula was re-made as a State environmental planning policy in 2002, and the relevant instrument became the State Environmental Planning Policy (Kurnell Peninsula) 1989 ('Kurnell SEPP').

It is noted that the 45 existing State Environmental Planning Policies have been consolidated by the NSW government into 11 policies, which came into effect on 1 March 2022. State Environmental Planning Policy (Kurnell Peninsula) 1989 has been incorporated into the State Environmental Planning Policy (Precincts - Central River City) 2021 (Precincts - Central River City SEPP). Consolidation was based on the transferred provisions arrangements under the *Interpretation Act 1987* (NSW).

Section 2.5 of the Resilience and Hazards SEPP provides:
In the event of an inconsistency between this Policy and another environmental planning instrument, whether made before or after the commencement of this Policy, this Policy prevails to the extent of the inconsistency.

The Precincts - Central River City SEPP does not have an equivalent or superior provision and hence the Resilience and Hazards SEPP prevails to the extent of any inconsistency between those two SEPPs.

Chapter 5 of the Precincts - Central River City SEPP "Kurnell Peninsula" provides specific directions and planning controls in relation to this location, however it does not directly address coastal hazards.

Clause 5.37 deals with development controls for coastal areas, and provides:

Before granting consent to development on land affected or likely to be affected by coastal processes, the Council shall—
(a) require as a condition of development consent that disturbed foreshore areas be rehabilitated, and
(b) require as a condition of development consent that access across foredune areas be confined to specified points.

It is noted that consolidation of the Kurnell SEPP into the Precincts - Central River City SEPP has resulted in the removal of previous clause 27(a), being:

Before granting consent to development on land affected or likely to be affected by coastal processes, the Council shall—
(a) consult with the Commissioner of the Soil Conservation Service of New South Wales and shall take into consideration the Commissioner's comments on the proposed development,

However clause 27(a) of the Kurnell SEPP was considered a procedural requirement rather than an outcome requirement which would be required under the Resilience and Hazards SEPP, so no further action is required.

10.4 Summary of Sutherland Shire Council Planning Instruments

The SSLEP does not have provisions which set heads of consideration or development controls for the open coast land which is mapped under this CMP as being exposed to coastal hazards. The SSLEP also does not apply to the Besmaw Ltd Pty lands at the northern extent of Bate Bay.

The SSDCP similarly does not specifically address matters related to management of the open coast and also does not apply to the Besmaw Ltd Pty lands.

The provisions of the Precincts - Central River City SEPP apply only to the Besmaw Ltd Pty lands and not to the remainder of the open coast lands that are the subject of the CMP. The provisions of the Precincts - Central River City SEPP are also narrower than the provisions available under the Resilience and Hazards SEPP.

There is no statutory impediment to a CVA being mapped across both those lands subject to the SSLEP and lands subject to the Precincts - Central River City SEPP.

The current planning controls under both the SSLEP and Precincts - Central River City SEPP, in the absence of a mapped Coastal Vulnerability Area, are unlikely to provide Council with an adequate framework for management of development along the open coast.

As noted, it is conceivable that Council will need to determine development applications, particularly in areas south of Bate Bay Road, and the only hazard related requirement is currently applied via Section 2.12 of the Resilience and Hazards SEPP. Section 2.12 requires consideration of the likelihood that the proposed development will cause increased risk of coastal hazards on the subject land or other land. It does not require consideration of the impacts of coastal hazards on the proposed development. Section 2.9 of the Resilience and Hazards SEPP, if applied via a CVA, does require consideration of the impact of coastal hazards on the proposed development and the measures to adapt to future hazards.

10.4.1 Potential additional Surf Life Saving Club in proximity to Greenhills / Boat Harbour

Consideration of developments such as a Surf Life Saving Club in the north of Bate Bay – which would invariably be within the coastal zone – suggests that such a development would be characterised as a community facility.

A community facility means *a building or place: (a) owned or controlled by a public authority or non-profit community organisation, and (b) used for the physical, social, cultural or intellectual development or welfare of the community, but does not include an educational establishment, hospital, retail premises, place of public worship or residential accommodation*.

A development such as a Surf Life Saving Club will need to address the Resilience and Hazards SEPP and the provisions relating to the relevant coastal management areas. At present the coastal management areas are limited to Coastal Use Area and Coastal Environment Area. The impact of the proposed facility on coastal hazards needs to be considered pursuant to Section 2.12 of the Resilience and Hazards SEPP.

The application of SSDCP provisions will depend on whether the club facility is in the ‘deferred area’ or not. The approval pathway for a Surf Life Saving Club cannot be confirmed until factors such as the applicant, the location, and the capital investment value are known.

10.5 Matters to consider

The following discussion relates to both the land subject to SSLEP provisions and land subject to the Precincts - Central River City SEPP. Both areas are considered because the coastal zone already includes the entire open coast of Bate Bay and the Resilience and Hazards SEPP applies to all such mapped land, as shown in **Figure 10-3**.

Figure 10-3: Resilience and Hazards SEPP (2021) – Coastal Use and Coastal Environment Management Areas

10.6 Planning assumptions

The mapped hazard projections are for a 100-year planning horizon and therefore the design life of any structure which mitigates one or more of those hazards is an important planning consideration.

For example, if Council commits to the installation of a seawall at Prince Street for the next 100 years, then hazard lines for inundation and erosion should not extend landward of the seawall. If, on the other hand, the revised design for The Esplanade only provides mitigation against inundation until 2060, then hazard lines for inundation should still be shown for dates between 2060 and 2020. In the case of The Esplanade, the inundation may only extend to the base of the rock cliff face, but this needs to be shown.

Beach nourishment is not a coastal defence which can provide any guaranteed protection for meaningful periods, and hence it should be regarded as an amenity benefit rather than a defence against hazards and should not cause hazard lines to be removed or modified.

10.7 State Environmental Planning Policy (Resilience and Hazards) 2021

State Environmental Planning Policy (Resilience and Hazards) 2021 ('Resilience and Hazards SEPP') applies to all of the areas that are the subject of coastal hazard mapping.

As a Coastal Vulnerability Area has not been mapped, the Coastal Use Area may be considered as the proxy primary management overlay for locations exposed to hazard areas.

The Coastal Use Area does not provide development controls aimed at mitigating coastal hazards. When Council is determining a development application for development in the Coastal Use Area, the heads of consideration are limited to matters such as beach access, amenity and cultural values.

There is a generic requirement, pursuant to Section 2.12 of the Resilience and Hazards SEPP, that *development consent must not be granted to development on land within the coastal zone unless the consent authority is satisfied that the proposed development is not likely to cause increased risk of coastal hazards on that land or other land*.

Section 2.12 can be distinguished from Section 2.9 because, whereas Section 2.12 requires consideration only of the impact of the proposed development on coastal hazards, Section 2.9 requires consideration of that same matter plus consideration of the impact of coastal hazards on the development and the capacity of the development to respond to future hazards.

It is considered that the majority of the land modelled as being exposed to current and future coastal hazards is publicly owned and managed, and development on such land requires statutory direction for the consideration of factors such as risk to life and public safety, or the capacity for a structure to be adapted to encroaching hazards in the future.

10.8 What development might be anticipated in the land shown as hazard-exposed?

The foreshore land (excluding the Besmaw Ltd Pty land) can be considered in sections as shown in **Figure 10-4**, being:

- North of Bate Bay Road
- South of Bate Bay Road

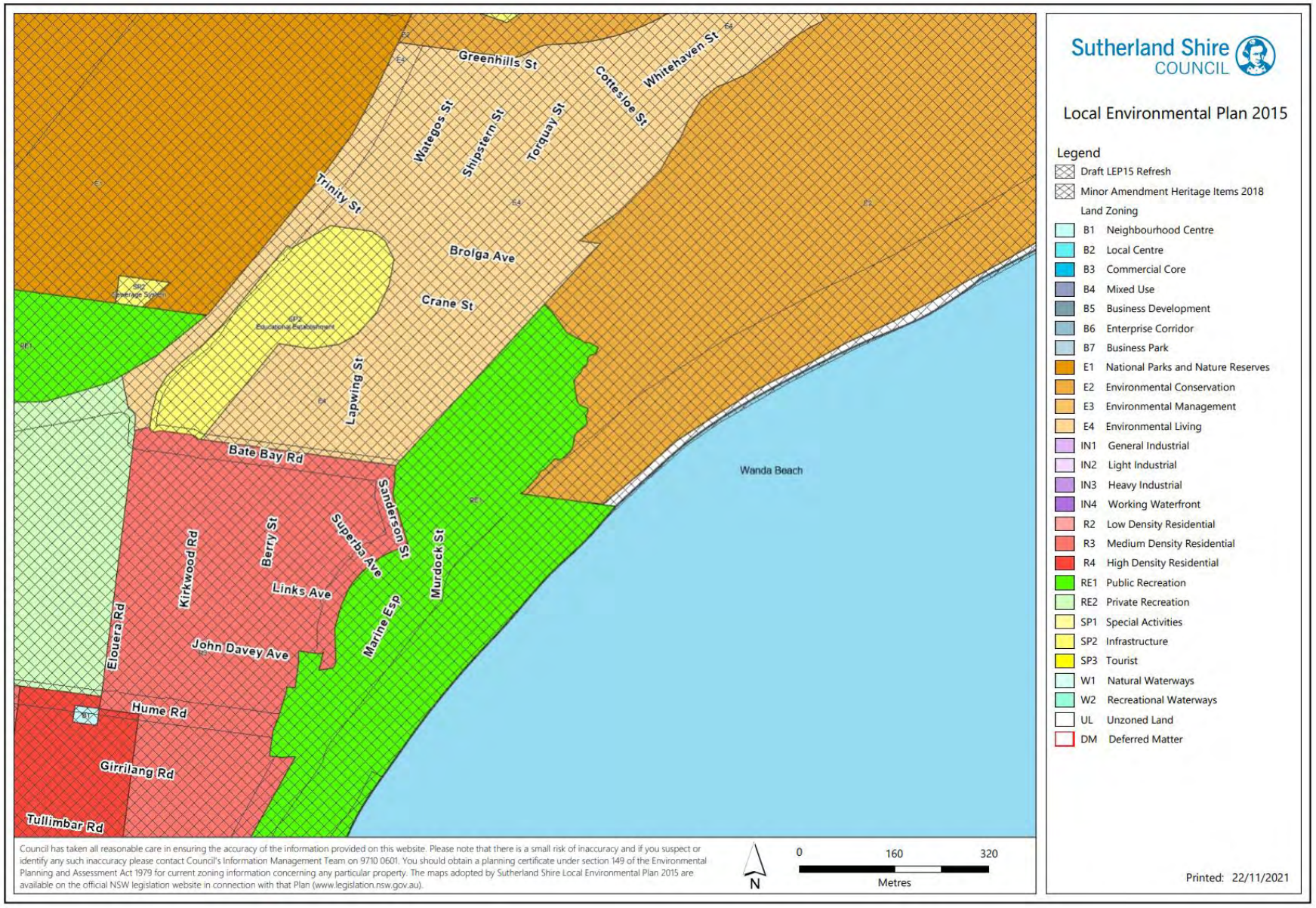

Figure 10-4: Sutherland Local Environmental Plan 2015 - Land zoning

10.8.1 North of Bate Bay Road

North of Bate Bay Road the land in the hazard area is zoned E2 Environmental Conservation or Un-zoned. The Land Use Table in SSLEP identifies that the following works are permissible with consent in land zoned E2:

- Environmental facilities;
- Environmental protection works;
- Flood mitigation works;
- Information and education facilities;
- Oyster aquaculture;
- Roads

Development such as residential dwellings are not permitted in E2 zoned land.

Most development in these categories – such as the construction of boardwalks, observation decks, visitor centre or exhibition facility, are likely to find provisions under the State Environmental Planning Policy (Transport and Infrastructure) 2021 ('Transport and Infrastructure SEPP') which make them permissible without consent.

There are conceivably few developments which might require a development application to Council. The E2 zoning therefore tends to preclude most types of development which would require consent, and therefore the types of development are unlikely to trigger the provisions of Section 2.9 of the Resilience and Hazards - *Development on land within the coastal vulnerability area* - which require Council to consider coastal processes and hazards etc.

10.8.2 South of Bate Bay Road

South of Bate Bay Road the land in the hazard area is zoned RE1 Public Recreation or Un-zoned. The Land Use Table in SSLEP identifies that the following works are permissible with consent in land zoned RE1:

- Aquaculture;
- Community facilities;
- Environmental facilities;
- Food and drink premises;
- Information and education facilities;
- Kiosks;
- Passenger transport facilities;
- Recreation areas;
- Recreation facilities (indoor);
- Recreation facilities (outdoor);
- Roads

Development such as residential dwellings are not permitted in RE1 zoned land.

There are however a range of potential development types requiring consent that could arise in land zoned RE1. Development such as kiosks, indoor recreation (e.g. swimming pool, gymnasium) or food and drink premises (small bar, take away food premises) could conceivably require a development application to Council.

There is, therefore, potential benefits in ensuring that land south of Bate Bay Road has a mechanism to require consideration of the interaction between the proposed buildings in the hazard area and the hazards likely to be manifested in that area, now and in the future.

The consideration of future hazards is a key difference between relying on the generic provision of Section 2.12 of the Resilience and Hazards (i.e. 'no increased risk to be caused by the development') and the more tailored provisions of clause 12 which applies to development on land in a mapped Coastal Vulnerability Area (CVA).

Assuming that there is a preference to apply the provisions of Section 2.9 via a mapped CVA south of Bate Bay Road, the pragmatic corollary to that initiative is the question of why the CVA should not extend to the land north of Bate Bay Road. While the CVA north of Bate Bay Road may not be enlivened often due to fewer, if any, development applications under the E2 zoning, the continuation of the CVA north of Bate Bay Road sensibly demonstrates that the risk is present in that area and ensures that any development be cognisant of that risk.

Activities permitted without consent

The Coastal Management Act 2016 ('CM Act') includes a provision at section 23 that public authorities – who might conceivably undertake activities under Part 5 rather than Part 4 of the EP&A Act – must have regard to coastal management programs.

10.9 Alternatives to mapping a CVA under the Resilience and Hazards SEPP

If the application of a mapped CVA under the Resilience and Hazards SEPP is not used, what alternative mechanisms might be available to achieve proper planning controls.

Amendment to the SSLEP 2015

It is possible to amend the SSLEP 2015 to include provisions, like the ones currently under clause 6.10 of the SSLEP, to apply to land along the open coast.

This, like the task of implementing a CVA under the Resilience and Hazards SEPP, requires a planning proposal. It is noted that the Resilience and Hazards SEPP will always prevail over a LEP and that the policy intention behind the gazettal of the Resilience and Hazards SEPP was to provide a standard set of provisions, at SEPP level, to replace the range of individual LEP provisions across coastal NSW. The Resilience and Hazards SEPP Factsheet [https://www.planning.nsw.gov.au/-/media/Files/DPE/Factsheets-and-faqs/Policy-and-legislation/SEPP-2021/Fact-Sheet---Resilience-and-Hazards-SEPP.pdf?la=en] acknowledges that

Where a council has existing additional local controls in a local environmental plan or development control plan, such as coastal risk planning provisions, these can continue to apply. We encourage councils to identify and remove duplicated planning controls from local provisions where practical. However, there may be localised reasons for councils to retain these provisions.

In the case of Sutherland Shire, however, there are not clauses which reflect the older and now abandoned 'model clauses' for coastal management, nor are there any bespoke clauses for development control on the open coast.

It remains open to Council to add LEP clauses. Council could, for example, create a mapped CVA via the Resilience and Hazards SEPP (i.e. a 'land application' map which would trigger the provisions of Resilience and Hazards SEPP Section 2.9) and also add LEP clauses and maps which reveal greater detail derived from the CMP process, and any provisions specific to key local issues, such as setbacks or geotechnical requirements.

Amendment to the SDEP 2015

It is possible to revise the SSDCP to include provisions related to the open coast lands. The SSDCP can, however, only embroider the cloth that is available under the SSLEP and, as noted above, there are not substantial provisions under the SSLEP on which to add policy settings for development via a DCP.

10.10 Conclusion

The purpose of the Coastal Management Act 2016 ('CM Act') is to set the long-term strategy for the co-ordinated management of land within the coastal zone.

Councils are obliged by section 14 of the CM Act to prepare a coastal management program and in doing so to must:

(a) consider and promote the objects of this Act, and
(b) give effect to the management objectives for the coastal management areas covered by the program, and
(c) consider the State and regional policies and plans prescribed by the regulations for the purposes of this section.

The objects of the CM Act include "to mitigate current and future risks from coastal hazards, taking into account the effects of climate change". Council must therefore consider the extent to which alternatives to proposing a CVA adequately satisfy this (and other) objects of the CM Act.

The CM Act also states (section 15) that a CMP must "identify the actions required to address those coastal management issues in an integrated and strategic manner".

10.11 Recommendations

It is recommended that Council undertake consultation that is reflective of the CMP process for the making of a planning proposal to establish a CVA for Bate Bay, following resolution of the Besmaw Pty Ltd land planning proposal. Subject to the outcomes of that consultation process, Council may formally endorse the preparation of a planning proposal.

The making of the planning proposal for a CVA could, if warranted, be combined with proposed revisions to the mapping of other coastal management areas in the Sutherland LGA (as a product of other CMPs that are developed). For example, proposing adjustments to incorrectly mapped coastal wetlands or revisions to the default settings of the Coastal Use Area and Coastal Environment Area.

Pending the decision regarding the CVA, other matters such as revisions to SSLEP or SSDCP could be considered to enhance the local provisions which would apply in support of the Resilience and Hazards SEPP for the various coastal management areas, including the CVA. The requirements and processes for preparation of a planning proposal are described in "*A guide to preparing planning proposals"* (DPIE, 2018).

This CMP does not propose any specific amendments to mapping of the relevant coastal management areas at this time. Mapping the CVA has been specifically excluded as an action until resolution of the Besmaw Pty Ltd land planning proposal, and will be considered as an action item at that time.

11 Economic Assessment for the Bate Bay Coastline Management Plan

Gillespie Economics was engaged by RHDHV to undertake an economic analysis of proposed management actions within the Bate Bay CMP (included as **Supporting Document E** – Economic Assessment – Bate Bay Coastline Management Plan, (Gillespie Economics, 2021)). Economic assessment is primarily concerned with identifying changes in aggregate community welfare, associated with alternative resource use patterns, and a cost benefit analysis (CBA) is the standard technique applied to estimate these wealth changes.

CBA includes the consideration of costs and benefits to all members of society i.e. consumers, producers and the broader society as represented by the government. For the purpose of this analysis, the CBA was undertaken from a NSW perspective initially, with distributional analysis to also consider the costs and benefits to the Sutherland LGA community.

RHDHV (2021) generated probabilistic coastal hazard lines for year 1 (2020), year 50 (2070) and year 100 (2120). For the purpose of the economic analysis the year 1 and year 50 probabilistic coastal hazard lines have been used, providing an evaluation period of 50 years. Impacts between these years have been linearly interpolated.

11.1 Cost Benefit Analysis

11.1.1 Identification of the Problem

As noted previously, Bate Bay is impacted by many coastal hazards, most notably, beach erosion and shoreline recession (RHDHV, 2021). Long term shoreline recession, particularly in the south of the embayment, pose a risk to land, assets, amenity and the environment.

A number of different types of interventions are possible to reduce the impacts of shoreline recession on land, assets, amenity and the environment. However, from an economic efficiency perspective, interventions are only desirable if the benefits of the interventions exceed the costs of the interventions. Where there are multiple alternative interventions, the intervention with the greatest net benefit is preferred from an economic efficiency perspective.

11.1.2 Base Case

The base case is the scenario that would arise if no new specific interventions (investments or management actions) were taken to address coastal erosion risks at Bate Bay. It is a ‘business as usual’ option, rather than a ‘do nothing’ approach, and hence includes a continuation of currently programmed actions. For this analysis, it was assumed that Council will continue to undertake routine maintenance on existing assets. Notwithstanding, the Bate Bay coastline will increasingly be at risk of shoreline recession because of a combination of sea level rise, net sand loss, etc.

Generically the asset types potentially at risk from shoreline recession include:

- Private property – land, houses, commercial buildings etc;
- Built infrastructure – roads, utilities, government buildings;
- Non built assets – parks, beaches, other environmental assets.

Across the four coastal precincts of Bate Bay, RHDHV undertook probabilistic hazard modelling to provide probabilities of annual exceedance (PoE) – 95%, 50%, 20%, 5%, 1% and 0.1% - for shoreline recession and erosion setbacks for years 2020 and 2070. For this analysis, the probabilistic hazard modelling for the Zone of Reduced Foundation Capacity (ZRFC) has been used.

The key inputs parameters in a probabilistic coastal hazard assessment comprise:

- shoreline movement due to sediment budget differentials – 'Underlying/Long-Term Recession';
- sea level rise and the shoreline recession in response to sea level rise – 'SLR Recession'; and
- event-based erosion due to storm activity – 'Storm Demand'.

This modelling indicates the probabilities associated with the shoreline location during a storm event. It does not indicate the permanent location of the shoreline. After the storm event the shoreline and beach will recover over a period of time. Based on this modelling, the specific assets, and asset uses at risk over the 50-year time frame in each precinct are summarised in **Table 11-1** below.

Table 11-1: Assets and Uses at Risk from Shoreline Recession

Precinct	Assets at Risk	Activity/Use
Precinct 1: The Esplanade – (a.k.a. 'The Cliff-top Walk'), Bass and Flinders Point, Oak Park, Shelly Park, Shelly and Blackwoods Beaches	• Minimal	• Minimal
Precinct 2: The City Beaches – Cronulla Beach to North Cronulla Beach.	• Dunningham Park • North Cronulla Surf Life Saving Club (not piled) and adjacent buildings/swimming pool • The Esplanade • Prince St Car Park • Units on Mitchell St • Life Guard Tower	• Use of Dunningham Park because of erosion of land/infrastructure • Use of the Surf Life Savings Club and adjacent buildings/infrastructure • Use of the section of Esplanade because of reduced foundation • Beach use
Precinct 3: The Surf Beaches – Prince Street Seawall, Elouera Beach to Wanda Reserve.	• Elouera Surf Life Saving Club (piled) and adjacent buildings • Wanda Surf Club (piled) and adjacent buildings • The Esplanade • Mitchell Road • Murdock St	• Use of sections of The Esplanade because of reduced foundation • Beach use
Precinct 4: The Beach Reserve – Green Hills, Boat Harbour, Potter Point.	• Minimal	• Minimal

Note 1: The Risk Assessment found that while Cronulla Beach may experience erosion due to storm demand, it will not experience long term recession.
Note 2: Use of the beaches following storm events will be impacted. However, all intervention options will also result in beach use being temporarily impacted following storm events.
Note 3: The Prince St seawall is subject to a separate asset replacement analysis – intervention options have minimal impacts on the seawall.

While assets and uses in both Precinct 2 and Precinct 3 are at risk, the most at-risk assets are in Precinct 2, particularly at North Cronulla Beach. In addition (in the absence of any beach nourishment), a 0.36m sea level rise from 2020 to 2070 will result in a reduction in beach width and area at all the city beaches, with the impact dependent on typical cross-sectional profile. Assumed beach areas and lengths and reductions in beach width and area are identified in **Table 11-2.**

Table 11-2: Assumed Reduction in Beach Area from Sea Level Rise (2020-2070)

	Area	Length	Reduced Width	Reduced Area
Cronulla Beach	7,680	178	5	890
North Cronulla Beach (including in front of Prince St)	24,550	570	10	5,700
Elouera Beach	33,000	365	10	3,650
Wanda Beach	75,000	630	10	6,300

Note: The lower impact on beach width at Cronulla beach is due to its generally steeper cross section.

11.1.3 Management Options

RHDHV has developed several options to protect beachfront assets at North Cronulla Beach from the effects of coastal processes, and the amenity of the City and Surf Beaches, as described in **Section 8**. These are:

Option 1 - Rock Revetment along the length of North Cronulla foreshore.
Option 2 - Bleachers (1/3) with Rock Revetment (2/3) along the length of North Cronulla foreshore.
Option 3 - Bleachers (1/3) with Vertical Wall (2/3) along the length of North Cronulla foreshore.
Option 4 - Bleachers (1/3) with Rock Revetment (1/3) and Vertical Wall (1/3) along the length of North Cronulla foreshore.
Option 5 - Beach Nourishment.

Each management option proposes a way of addressing the physical impacts of coastal processes predicted under the modelling. However, each option will have its own combination of physical impacts on the beach and surrounds, and economic impacts on stakeholders. Options 1 to 4 provide protection for the foreshore assets and activities at North Cronulla Beach.

Option 5 will not provide any substantive protection for foreshore assets but will provide an increase in beach width and amenity. It can therefore be considered supplementary to Options 1 to 4.

11.1.4 Identification of Costs and Benefits

Each interventions option is associated with its own set of direct and indirect costs. The options may have a range of potential costs and benefits relative to the base case. **Table 11-3** summarises the potential costs and benefits of interventions at North Cronulla beach.

Options 1 to 4 have direct capital and operating costs associated with the construction of different foreshore seawalls. Bleachers and a Rock Revetment will also result in some reduction in beach width and hence potentially have impacts on beach amenity for users. However, Bleachers provide an alternative space to sit and enjoy the beach and hence are assumed not to impact beach user amenity. When Rock Revetments are covered in sand, they are assumed to have no impact on beach user amenity. However, when periodically uncovered beach use amenity is assumed to be reduced. Vertical Walls have minimal impact on beach width and hence are assumed to have no impact on beach amenity.

Options 1 to 4 will avoid the base case impacts on both the built assets behind North Cronulla Beach and the use of these assets. These benefits are common to each option. Option 5, beach nourishment, will have periodic capital costs. This option will provide a benefit to all the city beaches by increasing beach width/amenity, relative to the gradual reduction in beach width/amenity under the base case due to sea level rise.

For the analysis, it was assumed that the life of Options is 50 years, coinciding with the period of the analysis and hence there are no residual values or replacement costs to be included in the analysis.

Table 11-3: Costs and Benefits Items for Each Investment Option

Potential Costs	Option 1	Option 2	Option 3	Option 4	Option 5
Direct capital costs of intervention	X	X	X	X	X
Direct operating costs of intervention	X	X	X	X	
Decreased beach width/user amenity from revetment	X	X		X	
Potential Benefits					
Avoided Infrastructure and Land Impacts					
Avoided impacts on Dunningham Park	X	X	X	X	
Avoided impacts on North Cronulla SLSC and adjacent buildings	X	X	X	X	
Avoided impacts on the Esplanade in front of North Cronulla SLSC	X	X	X	X	
Avoided impacts on the North Cronulla Lifeguard Tower	X	X	X	X	
Avoided impacts on Prince St Car Park - South	X	X	X	X	
Avoided impact on Residential Units on Mitchell St	X	X	X	X	
Residual value of assets intervention assets	X	X	X	X	
Avoided Use Impacts	X	X	X	X	
Avoided use impacts on Dunningham Park	X	X	X	X	
Avoided use impacts on North Cronulla SLSC					
Avoided use impacts on the Esplanade at North Cronulla	X	X	X	X	
Reduce beach area/amenity impact of rock revetment					X
Reduced beach area/amenity impact of sea level rise					X

11.1.5 Quantification and Valuation of Costs and Benefits

It is difficult to accurately predict the behaviour of the coastal processes affecting shoreline recession, and the physical and monetary impacts on stakeholders under the different options. It is therefore necessary to make several assumptions about the impact of options and the response of stakeholders.

11.1.5.1 Capital and Operating Costs

RHDHV provided unit cost estimates for revetments, bleachers and vertical walls. These were combined with assumptions for foreshore length and option characteristics to estimate the capital and operating costs of each option. Assumptions are provided in **Table 11-4**. Capital and operating costs of options are provided in **Table 11-5**. Capital costs are assumed to occur in year 1 of the analysis.

Table 11-4: Cost Assumptions

Unit Costs	$	Width (m)
Revetment /m	20,000	20
Bleachers /m	50,000	20
Vertical wall /m	30,000	3
Maintenance/yr	2%	
North Cronulla Beach Wall Length (m)	250	

Table 11-5: Capital and Operating Costs of Intervention Options

Options	Total Capital Costs	Operating/Maintenance Costs Per Annum	Present Value of Capital and Operating Costs (7% discount rate)
Option 1 – Rock Revetment	$5,000,000	2%	$5,962,687
Option 2 - Bleachers (1/3), Rock Revetment (2/3)	$6,250,000	2%	$7,453,358
Option 3 - Bleachers (1/3), Vertical Wall (2/3)	$7,916,667	2%	$9,440,920
Option 4 - Bleachers (1/3), Rock Revetment (1/3), Vertical Wall (1/3)	$7,083,333	2%	$8,447,139
Option 5 – Beach Nourishment	$3,000,000 every 4 yrs	NA	$11,474,268

11.1.6 Estimation of Net Present Value of Options

The net present value (NPV) of options, indicates that all options have a positive net present value apart from Option 1 (Rock Revetment).

Option 5 – Beach Nourishment has the highest net present value. While this option has a greater capital cost than the other options, it has high beach amenity benefits from small changes in amenity value per person aggregated over many beach users. However, this Option alone does not provide any protection of foreshore assets and their uses.

For the options that provide some protection of foreshore assets and their uses, Option 3 (Bleachers (1/3) with Vertical Wall (2/3)) has the highest net benefits followed by Option 4, Option 2 and Option 1. The main driver of this result is the assumed reduction in beach area/amenity from periodic exposure of the rock revetment component of the Options. This impact more than offsets differences in the capital and operating costs of Options.

The benefits are the same between Options 1 to 4, with the major benefits being avoided impacts on the use of the Esplanade and the North Cronulla Surf Life Saving Club rather than protection of infrastructure values.

Combining Option 5 – Beach Nourishment with each of the other options, improves the net benefits of all options with Option 3 (Bleachers (1/3) with Vertical Wall (2/3)) having the highest net present value followed by Option 4, Option 2, and Option 1.

11.2 Conclusion

Bate Bay is impacted by many coastal hazards, most notably, beach erosion and shoreline recession (RHDHV, 2021). Long term shoreline recession, particularly in the south of the embayment at North Cronulla Beach, pose a risk to land, assets, and park/asset/beach amenity.

A CBA of four asset protection options (Options 1 - 4) and one beach nourishment option (Option 5) found that all options have a positive NPV apart from Option 1 – Rock Revetment. **Option 5 – Beach Nourishment had the highest NPV** driven by small changes in amenity value per person aggregated over many beach users. However, this option alone does not provide any protection of foreshore assets and their uses.

Option 3 - Bleachers (1/3) with Vertical Wall (2/3) along the length of North Cronulla foreshore had the highest NPV of the asset protection options. The main driver of this result is the assumed reduction in beach area/amenity from periodic exposure of the rock revetment component of the Options, with Option 3 not having any rock revetment component.

The periodic adverse amenity impact of the rock revetment component of options more than offset differences in the capital and operating costs of options. The major asset protection benefit of options were avoided impacts on the use of the Esplanade and the North Cronulla Surf Life Saving Club rather than protection of infrastructure asset values.

Combining Option 5 – Beach Nourishment with each of the other options, improves the net benefits of all options with Option 3+5 having the highest net present value followed by Option 4+5, Option 2+5, and Option 1+5.

A caveat on the analysis is the lack of aggregate data on asset uses e.g. annual use of The Esplanade, Dunningham Park etc, and the values that people hold for these activities. This necessitated the making of several assumptions around which there is considerable uncertainty. These assumptions have been identified in the economic assessment report (Gillespie Economics, 2021) so that the implications of any alternative assumptions can be explored.

12 Funding sources

Council may fund management actions outlined in the Bate Bay CMP through a combination of sources, including Council internal funds and competitive State or Federal Government grant programs. The range of current funding sources that may be applicable for coastal management actions within the Bate Bay CMP, as well as potential emergency and disaster support, are outlined in **Table 12-1**.

The objectives and availability of funding programs are regularly changing, and Council are expected to maintain an awareness of appropriate funding opportunities as they arise.

The Integrated Planning and Reporting framework described in **Section 16** requires Council to develop a four year Delivery Program and annual Operational Plan to achieve the objectives and strategies detailed in the Sutherland Shire Council Community Strategic Plan (Council CSP, 2017).

The Bate Bay CMP management actions will be incorporated into future iterations of the Delivery Program and Operational Plan for funding through Council's working funds. Management actions may also be included into Council's asset management plans for alternative allocation of funding.

Table 12-1: Potential funding sources and application for Bate Bay CMP actions

Potential Funding Source	Description and Potential Application of Funding
Council Ordinary Rates, Revenue	The majority of funding available to Sutherland Shire Council (65% in the 2021/2022 Operational Plan) is generated through annual charges and ordinary rates, which are levied against all rateable land within the local government area, under the Local Government Act 1993. Another 22% of Council's income is derived from user charges and fees, investments, and other revenue sources. This yearly revenue is used to fund ongoing delivery of a range of community assets and services, and may also be used to implement capital (e.g. constructed assets) and operational (e.g. environmental outcomes) coastal management actions.
Development Contributions	Financial contributions are collected by Council as a levy on new development under the NSW Environmental Planning and Assessment Act 1979, and are used to improve and expand open space, recreation facilities and public amenities required as a consequence of development. These contributions may be used for coastal management in some instances, such as funding capital works to manage the development impacts on the coast, or reduce risk to the development from coastal hazards.
NSW Coastal and Estuary Grants Program	Under this program, the NSW Government provides technical and financial support to local government to help manage the coastal zone. This includes grant funding of coastal management planning (e.g. hazard assessments, management programs) and actions to manage the risks of coastal hazards (e.g. erosion protection), restore degraded coastal habitats (e.g. dunes and wetlands) and improve the health of NSW estuaries. The grant funding program is administered by DCCEEW - BCS, with prioritisation given to Councils with certified CZMPs and CMPs. Successful grant applications currently receive $2 of State Government funding for every $1 provided by the Council (2:1 ratio).

Potential Funding Source	Description and Potential Application of Funding
NSW Environment Trust	The NSW Environmental Trust provides funding to a range of community, government and industry stakeholders to deliver projects that conserve, protect and rehabilitate the NSW environment, or that promote environmental education and sustainability. The Trust is administered by DCCEEW - BCS, and provide a range of grant programs that may support coastal management applications such as; action in conserving and restoring natural ecosystems; protecting threatened species; undertaking priority environmental research; waste reduction; knowledge and capacity through education; and promoting cultural awareness.
Crown Reserves Improvement Fund	The Crown Reserves Improvement Fund (CRIF) is an annual NSW Government funding program that provides financial support to develop, maintain and improve Crown reserves. It can be used for repairs and maintenance projects, pest and weed control, recreational infrastructure or environmental initiatives. A significant proportion of the coastal area within Bate Bay is Crown Land that is managed by Council (e.g. Wanda Dunes, the beaches). Council may apply for funding of coastal management activities and works on Crown land that support the objectives of CRIF, such as enhancement of environmental assets by supporting conservation initiatives, bushfire management and invasive species (pest and weed) control; and to manage and renovate infrastructure and other assets on public reserves to optimise value to the community and comply with regulatory obligations, in particular to ensure public safety.
NSW Heritage Grant Programs	The NSW Heritage Grant program is administered by Heritage NSW, and aims to fund projects that provide sustainable, long-term heritage benefits and provide public benefit and enjoyment from heritage. These grants support the protection or repairs to declared Aboriginal Places, items listed on the State Heritage Register. Cronulla Sand Dune and Wanda Beach Coastal Landscape was listed on the New South Wales State Heritage Register on 26 September 2003. Council may consider applying for Caring for State Heritage Grant funding for activities that encourage promotion, celebration and cultural participation of the State's heritage, and for coastal management actions such as physical conservation works, or preparation for disasters and climate change.
Disaster Relief and Support	The NSW Government provides financial relief and support services for eligible local councils following a natural disaster through Resilience NSW. Some types of support require a disaster declaration for the affected location. Assistance is available to restore essential public assets that have been damaged as a direct result of a natural disaster. Transport for NSW provide assistance to restore public roads, road infrastructure and bridges, while Public Works Advisory provide assistance to restore other essential public assets.

Potential Funding Source	Description and Potential Application of Funding
National Recovery and Resilience Agency	The Australian Government's National Recovery and Resilience Agency (NRRA) was established to consolidate a number of former recovery agencies, and administers the Emergency Response Fund. The NRRA provides funding and support for emergency response and recovery from natural disasters, drought and other hazards that have a significant or catastrophic impact. The Australian Government has supported over 100 Local Government Areas (LGAs) that have recently been impacted by disasters, including the 2019-20 Black Summer bushfires, 2021 Tropical Cyclone Seroja, 2019 North Queensland Flood, and the March 2021 Flood.

13 Public Exhibition, Stakeholder Engagement and Incorporation of Feedback

It is a mandatory requirement of the Coastal management manual that a draft CMP be exhibited for a period of not less than 28 calendar days, the Bate Bay CMP was publicly exhibited from 1 December 2021 to 17 January 2022 through Council's Join the Conversation Bate Bay CMP online pages.

A description of the Public Exhibition process, feedback received and how submissions have been addressed is provided within **Supporting Document J** – Bate Bay CMP – Public Exhibition Report, with some highlights provided below.

There were 565 different visits to the exhibition pages, with 23 new (for Council) registrations, and 213 document downloads, with a burst of visits in the last days of exhibition, as shown in **Figure 13-1**.

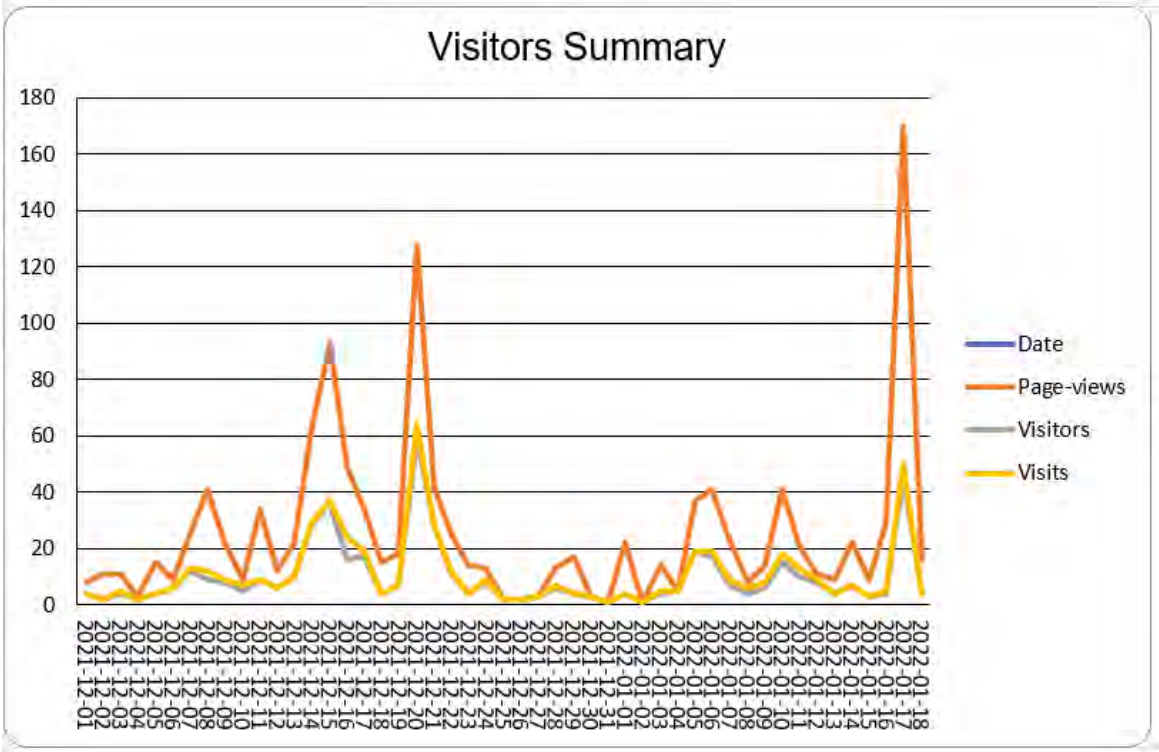

Figure 13-1: Public Exhibition Visitors Summary

Seventy seven individuals responded to the survey questions, providing a wealth of detailed information about preferences and concerns, along with a range of valuable suggestions.

It is noted that the majority of responders (60%) were Satisfied to Highly Satisfied with the draft CMP in toto, while the levels of support for each of the recommended key actions (sand nourishment, Esplanade upgrade and North Cronulla protection works) were scored higher when considered individually (at 69%, 81% and 62% respectively).

In addition to the range of information provided during stakeholder workshops when developing the draft CMP, feedback was sought and received from key agencies and stakeholders, including DCCEEW - BCS, DPHI - Crown Lands, DPIRD - Fisheries, Besmaw Pty Ltd, and the North Cronulla Surf Life Saving Club.

Feedback and suggestions provided have been incorporated as appropriate within the final CMP, with discussion contained within **Supporting Document J**.

There were no submissions that required substantial changes to the CMP. As noted that overwhelming majority provided support for the direction and actions found within.

Specific feedback from DPIRD - Fisheries noted that CMP stakeholder consultation concerns raised about fishing activities in the Bate Bay area, with an equal but not greater than support for these activities. DPIRD - Fisheries stated their support for the current management for recreational fishing and spearfishing activities in the Bate Bay area, noting that Marine Estate zoning in conjunction with DPIRD - Fisheries management and legislation has supported a healthy marine ecosystem to date.

DPIRD - Fisheries supports working with Council on initiatives to address stakeholder concern with recreational fishing and spearfishing, and noted a preference for actions that promote snorkelling and diving access, recognising that Sutherland Shire LGA has very active snorkelling and diving groups in the area, including Bate Bay, particularly between Bass and Flinders Point to the south and Cronulla beach, and that Boat Harbour is potentially another area.

A review of the final draft Bate Bay CMP has been carried out with reference to the DCCEEW - BCS document Bate Bay CMP – Coastal Management Program Checklist, which has been provided as **Supporting Document K**.

14 Business Plan

14.1 Management action approvals and considerations, including Crown Land

Coastal management actions in the Bate Bay CMP will potentially require approvals or authorisation from relevant landowners, government agencies with statutory responsibilities or stakeholders with interest in the land, where the management action is proposed. These approvals or authorisations may potentially be required under various legislative instruments and will be obtained prior to commencement of the management action.

Where management actions are proposed on Crown land relevant authorisations and approvals may need to be obtained under the *Crown Land Management Act 2016* (e.g. management actions CH5, CH6). Management actions undertaken on Crown land will also need to consider Aboriginal Land Claims lodged under the *Aboriginal Land Rights Act 1983*. All activities relating to the use of Crown land must be consistent with the Commonwealth *Native Title Act 1993* (NT Act).

There are a number of tenure arrangements for this study area, which include:

- Council managed Crown reserves (R80595, R72699, R500413 and R73473) for the purposes of Public Recreation.
- Council is the holder of a lease on Lot 939 DP752064.
- Reserve No. R1015388 is Cronulla Surfing Reserve for the purpose of Surfing Recreation.
- Reserve 752064 is managed by the Minister for the purposes of Future Public Requirements.

With respect to works and activities that are proposed in the CMP, if they are to occur on Crown land and Council is the appointed Crown land manager, and the proposed works are consistent with the reserve purpose and/or a Plan of Management, then no other form of authorisation under the CLM Act will generally be required.

All activities/works relating to the use of Crown land must be consistent with the Commonwealth *Native Title Act 1993*, and must give consideration to any relevant Aboriginal Land Claims lodged under the *Aboriginal Land Rights Act 1987*.

All Plans of Management prepared for Crown Land will make reference to this CMP as appropriate, to ensure that actions within the CMP and relevant Plan of Management are consistent / aligned.

14.2 Disclaimer

Note:

- All cost estimates provided in the Business Plan is based on project experience and external inputs, are for budgetary purposes only, and shall not be relied upon for any other purpose.

- Costs against actions are indicative at this stage, as the high level scope/definition of the actions makes it difficult to provide a meaningful breakdown of capital/operating/maintenance costs.

- In the absence of specific funding agreements, all costs are distributed to Council and other public authorities through the potential funding sources identified, predominantly being Council funds and grant funding opportunities.

- As the majority of actions do not identify or address private beneficiaries, the benefits of actions within the CMP accrue broadly to the Sutherland Shire LGA and the wider NSW community.

Table 14-1: Management actions to address Coastal Hazards

Action #	Approach	Precinct / Location(s)	Management Action	Primary responsibility	Key Stakeholders[5]	Cost estimate ($ '000s)			Evaluation method	Timeframe (Year)
						Low	High	Potential Funding Source(s)		
CH1	Planning	The Esplanade	Investigation, design and documentation of rectification / upgrade works to The Esplanade between Peryman Square and Cronulla Beach, including widening, consideration of wave overtopping / potential wave return structure, potential incorporation of "environmentally friendly' coastal protection works (as defined by the *Coastal Management Act 2016*), consideration of use of "sand" coloured concrete to reduce the visual impact, ensure appropriate slope of access ramp (likely 1:20 V:H), vehicle loading and width requirements, traffic management etc.	Council	DPHI - Crown Lands, DCCEEW – BCS, DPIRD - Fisheries	70	140	Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program	Completed investigation and design documentation	2-4
CH2	Planning	The Esplanade	Environmental Assessment and associated approvals of proposed rectification / upgrade works	Council	DPHI - Crown Lands, DCCEEW – BCS, DPIRD - Fisheries	40	90	Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program	Completed Environmental Assessment report and associated approvals	3-4
CH3	On-ground works	The Esplanade	Construction of rectification / upgrade works Council to maintain appropriate procurement process and contract management	Council	DCCEEW – BCS, DPIRD - Fisheries	4,500	5,500	Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program	Works complete.	5-7
CH4	Maintenance	The Esplanade	Ongoing maintenance of The Esplanade upgrade site. Bulk concrete structure would require minimum maintenance for many years, minor maintenance of e.g. railings, ramps as necessary following inspection	Council	DCCEEW – BCS, DPIRD - Fisheries	Minimal	10	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Identified maintenance requirements completed	ongoing (as needed)
CH5	Planning	Dunningham Park / North Cronulla Beach	Investigation, design and documentation of coastal protection works (as defined by the *Coastal Management Act 2016)* at Dunningham Park / North Cronulla Beach, including consideration of use of "sand" coloured concrete to reduce the visual impact of coastal protection works; ensure appropriate slope of access ramp (likely 1:20 V:H), vehicle loading and width requirements, traffic management etc. Consider design of bleachers / access ramp and related / complimentary management actions with respect to beach safety including consultation with relevant stakeholders, i.e. whether built form 'guides' beach users towards known hazards / rips (e.g. the Alley). Consider form and functionality of the seawall crest and upper land area – potential fencing of vegetated dune bays, placement and width of walkway with respect to accessways as well as structures (e.g. lifeguard tower, SLSC building), complimentary landscaping.	Council	DPHI - Crown Lands, DCCEEW - BCS	85	130	Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program	Completed investigation and design documentation	1-3
CH6	Planning	Dunningham Park / North Cronulla Beach	Environmental Assessment and associated approvals of coastal protection works	Council	DPHI - Crown Lands, DCCEEW - BCS	20	30	Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program	Completed Environmental Assessment report and associated approvals	2-4
CH7	On-ground works	Dunningham Park / North Cronulla Beach	Construction of coastal protection works (as defined by the *Coastal Management Act 2016*), to protect public assets at Dunningham Park / North Cronulla Beach, including reinstatement of dunes over (buried) rock revetment, revegetation of dune bays, re-establishment of controlled accessways, and reinstatement of Lifeguard tower Council to maintain appropriate procurement process and contract management.	Council	DPHI - Crown Lands, DCCEEW - BCS	7,300	9,300	Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program	Works completed and certified, handover to Council asset manager.	4-6

[5]Key Stakeholders include government agencies (some with statutory responsibilities), stakeholders with ownership of land and/or with an interest in the proposed management action, and will be consulted from the time of project initiation. Key stakeholders may or may not be financial contributors to the proposed management action. Inclusion as a Key Stakeholder does not indicate pre-emptive approval of identified actions, which may be subject to relevant authorisations and approvals as appropriate.

Action #	Approach	Precinct / Location(s)	Management Action	Primary responsibility	Key Stakeholders[5]	Cost estimate ($ '000s)			Evaluation method	Timeframe (Year)
						Low	High	Potential Funding Source(s)		
CH8	On-ground works	Dunningham Park / North Cronulla Beach	Removal of remnant shoreline protection works (may be able to re-use material within new works)	Council	DPHI - Crown Lands, DCCEEW - BCS	15	95	Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program	Remnant material re-used or removed from site	4-6
CH9	Maintenance	Dunningham Park / North Cronulla Beach	Ongoing maintenance of coastal protection works (as defined by the *Coastal Management Act 2016*), and external treatment following erosion even(s) – nourishment of access ramps, revegetation of dune, replacement of fencing as needed. Following significant event may require adjustment / relocation of rocks within revetment, re-covering of sand, revegetation etc.	Council	DCCEEW – BCS, DPHI - Crown Lands	Minimal	50	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Identified maintenance requirements completed	ongoing (as needed)
CH10	Monitoring On-ground works	Prince Street Seawall	Survey, inspection and maintenance of existing seawall. Prior to completion of CH15, ongoing survey / observation of subsidence of existing structure, may require additional stabilisation though pumping of 4:1 sand/cement mix or similar material.	Council	DCCEEW - BCS	40	75	Council (Ordinary Rates, Revenue) Council (in-kind contribution)	Survey completed and stored in appropriate format. Maintenance requirements identified and rectified	Annual until completion of CH15
CH11	Planning	Prince Street Seawall	Mapping of remnant seawall	Council	DCCEEW - BCS	65	85	Council (Ordinary Rates, Revenue) Council (in-kind contribution) NSW Coastal and Estuary Grants Program	Mapping completed and stored in appropriate format	1-2
CH12	Monitoring On-ground works	Prince Street Seawall	Identification and removal of potentially hazardous remnant seawall obstructions in advance of complete removal of remnant failed structure (CH16)	Council	DCCEEW - BCS	30	55	Council (Ordinary Rates, Revenue) Council (in-kind contribution)	Location and removal of obstructions considered to be hazardous	1-2
CH13	Planning	Prince Street Seawall	Investigation, design and documentation of rectification works	Council	DCCEEW - BCS	60	80	Council (Ordinary Rates, Revenue) Council (in-kind contribution) NSW Coastal and Estuary Grants Program	Completed investigation and design documentation	1
CH14	Planning	Prince Street Seawall	Environmental Assessment and associated approvals of rectification works	Council	DCCEEW – BCS, DPIRD - Fisheries	20	30	Council (Ordinary Rates, Revenue) Council (in-kind contribution) NSW Coastal and Estuary Grants Program	Completed Environmental Assessment report and associated approvals	1
CH15	On-ground works	Prince Street Seawall	Council to maintain appropriate procurement process and contract management Construction of rectification works	Council	DCCEEW – BCS, DPIRD - Fisheries	850	1,150	Council (Ordinary Rates, Revenue) Council (in-kind contribution) NSW Coastal and Estuary Grants Program	Rectification works completed, handover to Council asset manager	2-3
CH16	On-ground works	Prince Street Seawall	Following completion of rectification works (CH15), removal of (failed) remnant seawall structure seaward of current seawall	Council	DCCEEW - BCS	150	300	Council (Ordinary Rates, Revenue) Council (in-kind contribution) NSW Coastal and Estuary Grants Program	Location and removal of remnant seawall (as feasible)	3-4
CH17	Monitoring On-ground works Maintenance	Prince Street Seawall	Following completion of CH15, ongoing survey / observation of subsidence of existing structure, may require additional stabilisation though pumping of 4:1 sand/cement mix or similar material, likely reducing over time	Council	DCCEEW - BCS	Minimal	40	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Maintenance requirements identified and rectified	3-10 (annual action)
CH18	Planning	Precinct 2 & 3 - City Beaches Surf Beaches	Investigation, design and documentation of beach nourishment campaign, with beneficial re-use of dredged material (sand) from Port Hacking navigation maintenance, placed nearshore to Cronulla and/or North Cronulla beaches for natural redistribution northwards within Bate Bay	Council	DPHI - Crown Lands, DCCEEW – BCS, DPIRD – Fisheries, TfNSW, DPHI - Planning	70	120	Council (in-kind contribution) Transport for NSW (TfNSW)	Completed investigation and design documentation	1
CH19	Planning	Precinct 2 & 3 - City Beaches Surf Beaches	Environmental Assessment and associated approvals of beach nourishment campaign	Council	DPHI - Crown Lands, DCCEEW – BCS, DPIRD – Fisheries,	20	40	Council (in-kind contribution) Transport for NSW (TfNSW)	Completed Environmental Assessment report and associated approvals	1

Action #	Approach	Precinct / Location(s)	Management Action	Primary responsibility	Key Stakeholders[5]	Cost estimate ($ '000s)			Evaluation method	Timeframe (Year)
						Low	High	Potential Funding Source(s)		
					TfNSW, DPHI - Planning					
CH20	On-ground works	Precinct 2 & 3 - City Beaches Surf Beaches	Delivery of beach nourishment campaign	Council	DPHI - Crown Lands, DCCEEW – BCS, DPIRD – Fisheries, DPHI - Planning	2,400	3,200	Council (in-kind contribution) Transport for NSW (TfNSW)	Works complete.	1-2 Periodic ongoing action (subject to funding)
CH21	Planning	Precinct 2 & 3 - City Beaches Surf Beaches	Consider potential alternative sand sources and opportunities for beach nourishment. If required, Council to engage with relevant agencies to investigate the potential to increase the frequency and/or volume of sand generated through dredging of Port Hacking (and/or other sources), subject to consideration of navigation, environmental and other factors.	Council	DPHI - Crown Lands, DCCEEW – BCS, DPIRD – Fisheries, DPHI – Planning, TfNSW	Minimal	Minimal	Council (in-kind contribution)	Source identified, permissibility and funding confirmed	2-10
CH22	Planning On-ground works	All	Incorporation of coastal hazard considerations into Council's service asset plans and implement service asset plans.	Council	DCCEEW - BCS	Minimal	20	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Coastal hazard analysis included in service asset plans.	1-3
CH23	Planning	All	Consider impacts of coastal hazards when renewing or constructing public assets within the Bate Bay CMP area	Council	DCCEEW – BCS, DPHI - Crown Lands	Minimal	100	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Incorporation of coastal hazards into project design documents.	ongoing
CH24	Planning - Development controls	All Precinct 4 - The Beach Reserve	Council to consider potential benefit of preparation of a Coastal Vulnerability Area (CVA) map and associated Planning Proposal.	Council	DCCEEW – BCS, DPHI - Planning	Minimal	35	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	If beneficial, amendment of SSLEP, and amendment of Chapter 2 Coastal Management of the Resilience and Hazards SEPP 2021to include the CVA.	2-6
CH25	Planning - Development controls	All	Revisions to SSLEP or SSDCP to enhance the local provisions (such as coastal risk planning clauses in the LEP) which would apply in support of the Resilience and Hazards SEPP for the various coastal management areas	Council	DPHI - Planning	Minimal	30	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Amendment of SSLEP and/or SSDCP local provisions to support the Resilience and Hazards SEPP	2-6
CH26	Planning - Development controls	Precinct 4 - The Beach Reserve	New subdivisions or greenfield development to be located landward of 2120 ZRFC coastal hazard line.	Council	DPHI - Planning	Minimal	35	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Design of subdivisions or development landward of 2120 ZRFC coastal hazard line.	3-8
CH27	Monitoring	Precinct 1 – The Esplanade (a.k.a. The Cliff-top Walk)	Establish annual and event-based cliff line and foreshore soil slopes stability monitoring program. Notable locations: • Bass and Flinders Point lookout, • Glaishers Point lookout, • cliff line above The Esplanade, • foreshore soil slopes above the crest of the cliff line between 25 Elizabeth Place and 12 Arthur Avenue Recommended event triggers: • Heavy Rainfall: at least 100mm of rainfall in one day, and • Prolonged Rainfall: at least 150mm of rainfall over a 5 day period. Geotechnical re-assessment undertaken on a ten yearly basis.	Council	DCCEEW – BCS, DPHI - Crown Lands	10	25	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Annual and event-based cliff line and foreshore soil slopes stability monitoring program established. Geotechnical re-assessment undertaken on a ten yearly basis.	ongoing (annual expense)
CH28	Monitoring	Precinct 2 & 3 - City Beaches Surf Beaches	Establish annual and event-based seawall and rock revetment monitoring program. Notable locations: • The Esplanade, • Peryman Square • Prince Street Seawall Recommended event triggers:	Council	DCCEEW – BCS, DPHI - Crown Lands	Minimal	20	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Annual and event-based seawall and rock revetment monitoring program established	ongoing (annual expense)

Action #	Approach	Precinct / Location(s)	Management Action	Primary responsibility	Key Stakeholders[5]	Cost estimate ($ '000s)			Evaluation method	Timeframe (Year)
						Low	High	Potential Funding Source(s)		
			after significant high tide/coastal storm events when rock revetment is exposed							
CH29	Monitoring On-ground works	Precinct 1 – The Esplanade (a.k.a. The Cliff-top Walk)	Monitor and consider asset replacement of loosely stacked sandstone masonry retaining wall opposite No. 88 and 87 The Esplanade - assessed to be of 'Moderate Risk' to property (the coastal path and/or the relevant structural element).	Council	DCCEEW - BCS	Minimal	10	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Monitoring program established Asset replacement at appropriate time	ongoing (annual expense) until asset replaced
CH30	Monitoring On-ground works	Precinct 1 – The Esplanade (a.k.a. The Cliff-top Walk)	That Council liaise with responsible asset owners to ensure regular condition assessment of public and private subsurface drains, sewers and other water carrying pipelines, and undertake rectification measures as required Notable locations recommended for assessment: • steel stormwater pipe located opposite No. 34 The Esplanade, • dilapidated concrete headwall supporting the seaward side of the coastal path at Shelly Park; • exposed/external sewer pipes along Cronulla headland from South Cronulla That Council liaise with Sydney Water to ensure that adequate control measures have been considered and are in place (if appropriate) for failure of stormwater and sewerage infrastructure	Council	Sydney Water, Private Landowners, DPIRD – Fisheries, DCCEEW - BCS	Minimal	45	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Monitoring program established Asset replacement at appropriate time	ongoing (annual expense) until asset replaced
CH31	Planning, Engagement, On-ground works	Precinct 2 & 3 - City Beaches Surf Beaches	Undertake planning, engagement and emergency works, if appropriate, to manage beach erosion before, during and after storm events in accordance with the Bate Bay Coastal Zone Emergency Action Subplan contained in **Appendix A.**	Council	NSW SES, DCCEEW – BCS, DPHI - Crown Lands, NSW Police	Minimal	25	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Emergency response in accordance with Bate Bay Coastal Zone Emergency Action Subplan completed as required.	ongoing (as needed)
CH32	Engagement	All	Conduct community engagement and education programs focusing on environment and coastal processes within the Bate Bay CMP area including inundation and erosion hazards.	Council	DCCEEW - BCS	Minimal	20	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Environment Trust programs	Education programs developed and presented to community.	ongoing
CH33	Planning	Precinct 2 & 3 - City Beaches Surf Beaches	Environmental assessment and associated approvals of beach management works, such as beach scraping (REF)	Council	DPHI - Crown Lands, DCCEEW – BCS, DPHI – Planning, DPIRD - Fisheries	Minimal	15	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Completed environmental assessment and associated approvals	1
CH34	On-ground works	Precinct 2 & 3 - City Beaches Surf Beaches	Subject to CH33, conduct beach management works, such as beach scraping, in areas south and north of the Prince Street seawall to increase dune volume.	Council	DCCEEW – BCS, DPIRD – Fisheries, DPHI - Crown Lands	Minimal	15	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Identified beach scraping activities completed as conditions permit	ongoing (annual expense)

Table 14-2: Management actions to address Coastal Environment

Action #	Approach	Precinct / Location	Management Action	Primary responsibility	Key Stakeholders [6]	Cost estimate ($ '000s)			Evaluation method	Timeframe (Year)
						Low	High	Potential Funding Source(s)		
CE1	On-ground works	Precinct 4 – The Beach Reserve	Maintain State and Council collaboration for delivery of restoration and environmental management works within the Wanda beach dunes	Council	DPHI - Crown Lands, DCCEEW - BCS	20	50	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program Crown Reserves Improvement Fund	Continuation of environmental management works	ongoing
CE2	Planning	Precinct 4 – The Beach Reserve	Noting that Boat Harbour has a Beachwatch annual beach suitability grade of "Good", occasionally exceeding the safe swimming limit after little or no rain. Council to consider collaboration with DCCEEW - BCS and/or Sydney Water to investigate and address potential cause(s).	Council	Private Landowner, DCCEEW – BCS, DPIRD - Fisheries	Minimal	25	Council (in-kind contribution) Council (Ordinary Rates, Revenue) Developer Contribution	Improved water quality in Boat Harbour	4-8
CE3	On-ground works	Precincts 2 & 3 - City Beaches Surf Beaches	Inspection and maintenance of back beach stormwater outlets, inlet pits and infiltration devices to prevent blockages, minimise localised beach erosion and reduce water quality impacts	Council	DCCEEW – BCS, DPIRD - Fisheries	Minimal	5	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Works complete.	ongoing
CE4	Engagement On-ground works	Precincts 1, 2 & 3 Esplanade City Beaches Surf Beaches	Maintain and expand Council and community collaborative volunteer Bushcare program	Council	DCCEEW - BCS	10	20	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program Crown Reserves Improvement Fund NSW Environment Trust NSW Heritage Grant Programs	Continuation and expansion of Bushcare program	ongoing (annual expense)
CE5	Engagement Planning	All	GIS mapping of Bushcare sites within the LGA, enabling improved coordination of planned revegetation between reserves, as well as a potential community engagement tool as to the scale and impact of Bushcare activities	Council	DCCEEW - BCS	10	20	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program NSW Environment Trust	Improved coordination of planned revegetation between reserves, continuation and expansion of Bushcare program	1-2
CE6	Engagement On-ground works	Precincts 1, 2 & 3 Esplanade City Beaches Surf Beaches	Conduct community engagement and behaviour change programs on, as well as enforcement of, Council's Tree Vandalism Policy	Council	DCCEEW - BCS	Minimal	10	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program	Decrease in frequency of tree vandalism	Ongoing (annual expense)
CE7	Planning On-ground works	Precincts 1, 2 & 3 Esplanade City Beaches Surf Beaches	Development and implementation of a coordinated revegetation strategy for improved connectivity between all reserves and public open spaces within the CMP study area, reflective of Council's Greenweb program, Environment Strategy, and Chapter 38 of Council's DCP2015, with prioritisation of native vegetation in keeping with Council's Open Space Strategy and Implementation Plan.	Council	DPHI - Crown Lands, DCCEEW - BCS	5	50	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program NSW Environment Trust	Strategy for increased connectivity between reserves developed and implemented	2-3
CE8	Planning On-ground works	Precinct 4 – The Beach Reserve	Subject to resolution of the Besmaw Pty Ltd land planning proposal, consideration of establishing (and maintaining) a wildlife corridor along the foreshore linking Wanda Reserve to Boat Harbour within Council's Open Space Strategy and Implementation Plan.	Council	DCCEEW - BCS	5	50	Council (in-kind contribution) Council (Ordinary Rates, Revenue) Developer Contribution NSW Coastal and Estuary Grants Program NSW Environment Trust	Wildlife corridor along the foreshore linking Wanda Reserve to Boat Harbour established and maintained	3-8
CE9	Planning On-ground works	Precincts 1, 2 & 3 Esplanade City Beaches Surf Beaches	Implementation of Council's Environment Strategy, and enforcement of Chapter 38 of Council's DCP2015 in relation to vegetation within and adjoining private development, and Council's Greenweb program	Council	DCCEEW - BCS	Minimal	10	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program	Maintained or enhanced vegetation within and adjoining private development	ongoing
CE10	Engagement On-ground works	All	Conduct community engagement and behaviour change programs to promote Council's Greenweb program, with inspection of properties by Council's Greenweb Officer, invitations to residents for voluntary participation in the program, development and distribution of various	Council	DCCEEW - BCS	Minimal	20	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program	Increased community uptake of Greenweb principles and practices, enhanced vegetation within and adjoining private development	Ongoing (annual expense)

[6] Key Stakeholders include government agencies (some with statutory responsibilities), stakeholders with ownership of land and/or with an interest in the proposed management action, and will be consulted from the time of project initiation. Key stakeholders may or may not be financial contributors to the proposed management action. Inclusion as a Key Stakeholder does not indicate pre-emptive approval of identified actions, which may be subject to relevant authorisations and approvals as appropriate.

Action #	Approach	Precinct / Location	Management Action	Primary responsibility	Key Stakeholders [6]	Cost estimate ($ '000s)			Evaluation method	Timeframe (Year)
						Low	High	Potential Funding Source(s)		
			communication materials, and the 'Schools in Greenweb' program							
CE11	Engagement On-ground works	All	Conduct community engagement and behaviour change programs on, and implementation of, weed control programs, including site inspections by Council Officers, and implementation of seasonal control programs	Council	DCCEEW - BCS	Minimal	10	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program	Reduction in weeds within private and public land	Ongoing (annual expense)
CE12	Engagement On-ground works	All	Conduct community engagement and behaviour change programs on, as well as enforcement of, stormwater quality improvements, focussed on personal, residential and commercial contributions to poor water quality.	Council	DCCEEW – BCS, Sydney Water	Minimal	25	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program NSW Environment Trust	Improvement in measured and / or perceived water quality	Ongoing (annual expense)
CE13	Engagement On-ground works	All	Conduct community engagement and behaviour change programs on, and implementation of, pest species control programs, including site inspections by Council Officers	Council	DCCEEW - BCS	Minimal	20	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program NSW Environment Trust	Reduction in pest species within private and public land	Ongoing (annual expense)
CE14	Planning On-ground works	Precincts 1, 2 & 3 Esplanade City Beaches Surf Beaches	Implementation of Council's Environment Strategy, and enforcement of Chapter 38 of SDCP2015 in relation to incorporation of water sensitive urban design into future and existing development	Council	DCCEEW - BCS	Minimal	20	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program NSW Environment Trust	Maintained or enhanced water quality within and adjoining private development	ongoing
CE15	Engagement Planning	Precinct 4 – The Beach Reserve	Council to collaborate with the community, local landowners, DCCEEW - BCS and DPIRD - Fisheries to assess and (if required) address potential environmental risk of 4WD vehicle access through dunes and onto the beaches at Greenhills and Boat Harbour, with respect to Council's Open Space Strategy and Implementation Plan. Note connection to FA1 Note: subject to agreement by stakeholders, may occur prior to resolution of the Besmaw Pty Ltd land planning proposal.	Council	Private Landowners, DPHI - Crown Lands, DCCEEW – BCS, DPIRD - Fisheries	Minimal	10	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program Crown Reserves Improvement Fund NSW Environment Trust	Mitigation of potential environmental impact	1-2
CE16	Engagement Planning	Precincts 3 & 4 - Surf Beaches The Beach Reserve	Council to collaborate with the community, local landowners and DCCEEW - BCS to assess and (if required) address potential environmental risk of on-leash and off-leash dog access through dunes and onto the beaches within Council's Open Space Strategy and Implementation Plan Note connection to FA2	Council	Private Landowners, DPHI - Crown Lands, DCCEEW - BCS	Minimal	20	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program Crown Reserves Improvement Fund NSW Environment Trust	Mitigation of potential environmental impact	1-3
CE17	Engagement Planning	Precincts 2, 3 & 4 City Beaches Surf Beaches The Beach Reserve	Council to collaborate with DPIRD - Fisheries, TfNSW, the community, DPHI - Crown Lands and DCCEEW - BCS to assess and (if required) address potential environmental impacts of aquatic activities (including scuba diving, snorkelling, recreational vessels, personal watercraft) within Bate Bay, with specific consideration of Boat Harbour Aquatic Reserve, in keeping with the principles and goals of the NSW Marine Estate Management Strategy 2018–2028.	Council	DPHI - Crown Lands, DCCEEW – BCS, La Perouse LALC, DPIRD - Fisheries	Minimal	20	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program NSW Environment Trust	Mitigation of potential environmental impact	2-4
CE18	Engagement On-ground works	All	Conduct activities to promote community appreciation of, and engagement with, the range of terrestrial and aquatic environments, associated flora and fauna within Bate Bay, including Boat Harbour Aquatic Reserve. Development and distribution of various communication materials, interpretative signage, information and installations, potential school and community group interactions. DPIRD - Fisheries note that any interpretive signage on the beach front should include information about marine habitats and species in consultation with DPIRD - Fisheries and local interest groups e.g. snorkelling and diving groups.	Council	DCCEEW – BCS, Department of Education, Schools, Community, La Perouse LALC, DPIRD - Fisheries	Minimal	40	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program NSW Environment Trust	Increased community engagement with, and uptake of, environmentally sensitive principles and practices. Improved local knowledge and protection of Boat Harbour Aquatic Reserve.	ongoing

Action #	Approach	Precinct / Location	Management Action	Primary responsibility	Key Stakeholders [6]	Cost estimate ($ '000s)			Evaluation method	Timeframe (Year)
						Low	High	Potential Funding Source(s)		
CE19	Engagement Planning On-ground works	Precincts 3 & 4 - Surf Beaches The Beach Reserve	Council to collaborate with the community, local landowners and DCCEEW - BCS to assess potential requirement to amend the number and location of accessways through the dunes and onto the beach, within Council's Open Space Strategy and Implementation Plan. Note connection to FA4	Council	DPHI - Crown Lands, DCCEEW - BCS	Minimal	30	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program Crown Reserves Improvement Fund NSW Environment Trust	Mitigation of potential environmental impact	2-4
CE20	Engagement Planning On-ground works	Precincts 3 & 4 - Surf Beaches The Beach Reserve	Council to collaborate with the community, local landowners and DCCEEW - BCS to assess and, if required, address potential environmental impact of potential creation of bicycle paths through dunes, within Council's Open Space Strategy and Implementation Plan. Note connection to FA5	Council	DPHI - Crown Lands, DCCEEW - BCS	Minimal	30	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program Crown Reserves Improvement Fund NSW Environment Trust	Mitigation of potential environmental impact	2-4
CE21	Engagement	All	Update and enhance Council's website with information about coastal processes, management of the coastal environment.	Council	DCCEEW - BCS	Minimal	25	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Environment Trust programs Crown Reserves Improvement Fund	Council website updated, increase in visitation rates	ongoing

Table 14-3: Management actions to address Foreshore Access

Action #	Approach	Precinct / Location	Management Action	Primary responsibility	Key Stakeholders [7]	Cost estimate ($ '000s)			Evaluation method	Timeframe (Year)
						Low	High	Potential Funding Source(s)		
FA1	Engagement Planning	Precinct 4 – The Beach Reserve	Subject to the outcomes of CE15, if required, Council to collaborate with local landowners, DCCEEW - BCS and DPIRD - Fisheries to develop and implement a strategic approach to capacity and spatial extent of vehicle access to the beaches at Greenhills and Boat Harbour, within Council's Open Space Strategy and Implementation Plan. Note: subject to agreement by stakeholders, may occur prior to resolution of the Besmaw Pty Ltd land planning proposal.	Council	Private Landowner, DPHI - Crown Lands, DCCEEW – BCS, DPIRD - Fisheries	Minimal	10	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program Crown Reserves Improvement Fund NSW Environment Trust	Strategic approach agreed and implemented	1-2
FA2	Planning On-ground works	Precincts 3 & 4 - Surf Beaches The Beach Reserve	Subject to the outcomes of CE16, if required, Council to collaborate with the community, local landowners and DCCEEW - BCS to develop and implement a strategic approach to potential on-leash and off-leash dog access through dunes and onto the beaches, within Council's Open Space Strategy and Implementation Plan	Council	Private Landowner, DCCEEW - BCS	Minimal	25	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program Crown Reserves Improvement Fund	Strategic approach agreed and implemented	2-4
FA3	Engagement Planning	Precincts 2, 3 & 4 City Beaches Surf Beaches The Beach Reserve	Subject to the outcomes of CE17, if required, Council to collaborate with DPIRD - Fisheries, TfNSW, the community, DPHI - Crown Lands and DCCEEW - BCS to determine the range of activities undertaken and level of use in Boat Harbour Aquatic Reserve. Once identified, develop and implement a strategic approach to capacity and spatial extent of aquatic activities within Bate Bay in keeping with the principles and goals of the NSW Marine Estate Management Strategy 2018–2028	Council	DPHI - Crown Lands, DCCEEW – BCS, DPIRD - Fisheries	Minimal	20	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program	Strategic approach agreed and implemented	3-5
FA4	Engagement Planning On-ground works	Precincts 3 & 4 - Surf Beaches The Beach Reserve	Council to continue to maintain appropriate accessways through Wanda dunes and if required, subject to the outcomes of CE19, Council to collaborate with the community, local landowners and DCCEEW - BCS to consider amendment of the number and location of	Council	DPHI - Crown Lands, DCCEEW - BCS	Minimal	45	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program Crown Reserves Improvement Fund NSW Environment Trust	Strategic approach agreed and implemented	2-4

[7] *Key Stakeholders include government agencies (some with statutory responsibilities), stakeholders with ownership of land and/or with an interest in the proposed management action, and will be consulted from the time of project initiation. Key stakeholders may or may not be financial contributors to the proposed management action. Inclusion as a Key Stakeholder does not indicate pre-emptive approval of identified actions, which may be subject to relevant authorisations and approvals as appropriate.*

Action #	Approach	Precinct / Location	Management Action	Primary responsibility	Key Stakeholders [7]	Cost estimate ($ '000s)			Evaluation method	Timeframe (Year)
						Low	High	Potential Funding Source(s)		
			accessways through the dunes and onto the beach, within Council's Open Space Strategy and Implementation Plan.							
FA5	Engagement Planning On-ground works	Precincts 3 & 4 - Surf Beaches The Beach Reserve	Subject to the outcomes of CE20, Council to collaborate with the community, local landowners and DCCEEW - BCS to support implementation of cycle paths proposed within Sutherland Shire Council's Bike Path Plan, and consideration	Council	DPHI - Crown Lands, DCCEEW - BCS	Minimal	10	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program Crown Reserves Improvement Fund NSW Environment Trust	Strategic approach agreed and implemented	2-4
FA6	Planning On-ground works	Precincts 2 - City Beaches	Upgrade of The Esplanade Please note connection to CH1, CH2 and CH3	Council	DPHI - Crown Lands, DCCEEW – BCS, DPIRD - Fisheries	Minimal	10	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program	Increased all-access opportunities along foreshore and to foreshore rock pool	1-4
FA7	Planning On-ground works	Precincts 2 - City Beaches	Council engage with relevant agencies to investigate the potential to increase the frequency and/or volume of sand generated through dredging of Port Hacking (and/or other sources), subject to consideration of navigation, environmental and other factors, for placement (as required) within Bate Bay and/or other relevant areas.	Council	DPHI - Crown Lands, DCCEEW – BCS, DPIRD – Fisheries, TfNSW, DPHI - Planning	Minimal	-	Council (in-kind contribution) Transport for NSW (TfNSW)	Completed investigation and design documentation	1
FA8	Planning	Precinct 1 - Esplanade	Implementation of cycle paths proposed within Sutherland Shire Council's Bike Path Plan, and consideration of potential to link foreshore areas by increased public transport	Council	TfNSW	15	45	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Completed implementation of recommendations	2-4
FA9	Planning	Precinct 1 - Esplanade	Consideration of potential to provide a pedestrian link into Endeavour Heights and Captain Cook's landing place	Council	TfNSW	Minimal	10	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Completed investigation, consideration of recommendations	2-5
FA10	Planning	Precinct 4 – The Beach Reserve	Subject to resolution of the Besmaw Pty Ltd land planning proposal, extension of the public reserve for the full length of the beach frontage to increase public access. Recommend that width of the reserve is to be based on providing adequate spatial extent for the foredune and public access during the 100 year future planning period, in keeping with Council's Open Space Strategy and Implementation Plan.	Council	Landowner, DCCEEW – BCS, DPHI - Planning	Minimal	20	Council (in-kind contribution) Council (Ordinary Rates, Revenue) Developer Contribution	Completed investigation, consideration of recommendations	5-8
FA11	Planning	Precinct 4 – The Beach Reserve	Consideration of improvement of pedestrian access to Potter Point for recreation, in keeping with Council's Open Space Strategy and Implementation Plan.	Council	DPHI - Crown Lands, DCCEEW – BCS, NPWS, Sydney Water, La Perouse LALC	Minimal	10	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program	Completed investigation, consideration of recommendations	2-5
FA12	Planning	Precinct 4 – The Beach Reserve	Review of controlled vehicular access to Potter Point (Sydney Water) track; and consideration of potential to make pedestrian and cycle access only (i.e. proposed cycle path in Sutherland Shire Cycleway Network Map) , in keeping with Council's Open Space Strategy and Implementation Plan.	Council	DPHI - Crown Lands, DCCEEW – BCS, NPWS Sydney Water, La Perouse LALC	Minimal	20	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program	Completed investigation, consideration of recommendations	2-4

Table 14-4: Management actions to address Coastal Amenity (note: coastal amenity is also addressed by actions within Tables 14-1 to 14-3)

Action #	Approach	Precinct / Location	Management Action	Primary responsibility	Key Stakeholders [8]	Cost estimate ($ '000s)			Evaluation method	Timeframe (Year)
						Low	High	Potential Funding Source(s)		
CA1	Planning	Precinct 4 – The Beach Reserve	Noting linkage to CH1, CH2 and CH3, Council to develop a Masterplan for the spatial extent of The Esplanade, in consultation with the community and stakeholders, that considers: • Widening the extent of The Esplanade along the length of the Cronulla peninsula (south of Cronulla Beach) to provide a "shared path" for increased pedestrian bicycle use; • Incorporate interpretive artworks along The Esplanade in consultation with Council's Cultural arm; • Installation of additional seating at convenient locations; • Provision of occasional 'viewing areas' of extra width to increase amenity as well as improve flow of users; • Development and installation of a consistent suite of signage and incorporation of interpretive signs; • Opportunity for small-scale café/kiosk at Oak and Shelly Parks; • Formalisation and/or closure (as appropriate) of informal access tracks to the foreshore; • Improvements to stormwater drainage and overland flow paths; • Increased weed management; and • Opportunity for increased number and extent of Bushcare sites, improved connectivity of native vegetation.	Council	DPHI - Crown Lands, DCCEEW - BCS	30	60	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program Crown Reserves Improvement Fund NSW Environment Trust	Masterplan agreed and implemented	2-4
CA2	On-ground works	Precincts 2 & 3 - City Beaches Surf Beaches	Consideration of relocation of stormwater outlets away from rock pools where practicable, particularly those adjacent to the pool at Oak Park and near the northern pool between Cronulla Beach and North Cronulla Beach	Council	DCCEEW - BCS	45	90	Council (in-kind contribution) Council (Ordinary Rates, Revenue)	Works completed (as necessary).	2-4
CA3	On-ground works	All	Conduct community engagement and behaviour change programs on, as well as enforcement of, Council's waste and public place policies, focussed on social and environmental impacts of litter / waste / pollution / graffiti, as per Council's Graffiti policy and management plan and Waste strategy and implementation plan. Potential avenue for engagement is through Council's Open Space Strategy and Implementation Plan	Council	DCCEEW - BCS	25	60	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program Crown Reserves Improvement Fund	Improved foreshore amenity along Bate Bay	TBC
CA4 (note repeat of CH18)	Planning	Precinct 2 & 3 - City Beaches Surf Beaches	Investigation, design and documentation of beach nourishment campaign, with beneficial re-use of dredged material (sand) from Port Hacking navigation maintenance, placed nearshore to Cronulla and/or North Cronulla beaches for natural redistribution northwards within Bate Bay	Council	DPHI - Crown Lands, DCCEEW – BCS, DPIRD – Fisheries, TfNSW, DPHI - Planning	70	120	Council (in-kind contribution) Transport for NSW (TfNSW)	Completed investigation and design documentation	1

[8] *Key Stakeholders include government agencies (some with statutory responsibilities), stakeholders with ownership of land and/or with an interest in the proposed management action, and will be consulted from the time of project initiation. Key stakeholders may or may not be financial contributors to the proposed management action. Inclusion as a Key Stakeholder does not indicate pre-emptive approval of identified actions, which may be subject to relevant authorisations and approvals as appropriate.*

Table 14-5: Management actions to address Culture and Safety

Action #	Approach	Precinct / Location	Management Action	Primary responsibility	Key Stakeholders [9]	Cost estimate ($ '000s)			Evaluation method	Timeframe (Year)
						Low	High	Potential Funding Source(s)		
CS1	Planning	Precinct 4 – The Beach Reserve	Council and the community collaborate to continue promotion of the Cronulla National Surfing Reserve, local events and local business development.	Community Stakeholders	Council	5	20	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program NSW Environment Trust	Increased recognition of the Cronulla National Surfing Reserve, local events and local business development	ongoing
CS2	Planning	Precinct 4 – The Beach Reserve	Assessment/amendment (if required) of implementation of development controls to protect sites of archaeological and cultural heritage significance	Council	DCCEEW – BCS, DPHI - Planning	Minimal	20	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program NSW Environment Trust	Increased protection of sites of archaeological and cultural heritage significance	1-5
CS3	On-ground works	Precincts 1, 2 & 3 - Esplanade City Beaches Surf Beaches	Consider development of interpretive signage/brochures/installations for cultural heritage items within Council's Open Space Strategy and Implementation Plan	Council	DCCEEW - BCS	15	45	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program NSW Environment Trust	Delivery of interpretive signage/brochures/installations for cultural heritage items	2-4
CS4	Planning	Precinct 3 & 4 Surf Beaches The Beach Reserve	Continuation of protection of North Cronulla Heritage Dune and implementation of the Plan of Management.	Council	DCCEEW - BCS	Minimal	25	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program Crown Reserves Improvement Fund NSW Environment Trust NSW Heritage Grant Programs	Continued protection of North Cronulla Heritage Dune and implementation of the Plan of Management	1
CS5	Planning	Precinct 4 – The Beach Reserve	Consider installation of temporary lifeguard observation tower and Emergency Response Beacon at Greenhills Beach	Council	DCCEEW - BCS	Minimal	15	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program	Completed review, consideration of recommendations	1-3
CS6	On-ground works	Precinct 3 & 4 Surf Beaches The Beach Reserve	Consider installation of high-powered CCTV camera at Wanda SLSC to improve lifeguard vision to the north up to 'Voodoo' surf break	Council	DCCEEW - BCS	Minimal	15	Council (in-kind contribution) Council (Ordinary Rates, Revenue) NSW Coastal and Estuary Grants Program	Completed review, consideration of recommendations	1-2

[9] *Key Stakeholders include government agencies (some with statutory responsibilities), stakeholders with ownership of land and/or with an interest in the proposed management action, and will be consulted from the time of project initiation. Key stakeholders may or may not be financial contributors to the proposed management action. Inclusion as a Key Stakeholder does not indicate pre-emptive approval of identified actions, which may be subject to relevant authorisations and approvals as appropriate.*

15 Coastal Zone Emergency Action Subplan

The CM Act defines seven forms of coastal hazards, requires specific emergency management considerations for impacts associated with beach erosion, coastal inundation and cliff instability. The CM Act (section 15(1)(e)) outlines that a Coastal Zone Emergency Action Subplan (CZEAS) must be included in a CMP if the local council's local government area contains land within the Coastal Vulnerability Area (CVA) and beach erosion, coastal inundation or cliff instability is occurring on that land due to storm activity or an extreme or irregular event.

As the NSW government did not adopt a CVA map, section 15(1)(e)) of the CM Act does not apply to the Bate Bay CMP, and preparation of a CZEAS is not required. However it is recognised that Bate Bay has been impacted by coastal hazards, notably beach erosion, on numerous occasions, and as such it is considered appropriate to develop a CZEAS for this location. Other coastal hazards identified in Section 4 of the CM Act (shoreline recession, coastal lake or watercourse entrance instability, tidal inundation and erosion and inundation of foreshores caused by tidal waters and the action of waves) are outside the scope of a CZEAS.

Mandatory requirements for a CMP, including the preparation of a CZEAS where required, have been identified in Part A of the Coastal Management Manual (OEH 2018). Further direction on the preparation of a CZEAS is provided in the *"Guideline for preparing a coastal zone emergency action subplan"* (DPIE, 2019). The Bate Bay Coastal Zone Emergency Action Subplan (BBCZEAS) has been developed in accordance with this guidance, and is attached as **Appendix A**.

The overarching framework for emergency management in New South Wales is established by the *State Emergency and Rescue Management Act 1989* (SERM Act). The SERM Act outlines roles and responsibilities for all emergency management in New South Wales, and establishes the hierarchy and requirements of emergency management plans (EMPLANS) from a State through to local level.

The NSW State Emergency Service (NSW SES) prepares the State Storm Plan, State Flood Plan and State Tsunami Plan, which are Subplans to the EMPLAN, and is the designated combat agency for management of floods, tsunami and storms, including severe storms which cause coastal erosion.

Council is a signatory to the Sutherland Shire Local Emergency Management Plan (Sutherland EMPLAN) (New South Wales Government, 2019), which details arrangements for prevention of, preparation for, response to, demobilisation from and transition of control for emergencies, between combat agencies including Council, the NSW Police, Ambulance Service, NSW SES, Fire and Rescue NSW and others.

The Sutherland Shire Flood Emergency Sub Plan (Sutherland FESP) (Sutherland Shire Council, 2013) was endorsed by the Sutherland Shire Council Local Emergency Management Committee as a sub plan of the Local EMPLAN, and covers preparedness measures, the conduct of response operations and the coordination of immediate recovery measures from flooding and management of coastal erosion in the council area, notably through defining specific roles and responsibilities of the NSW SES, Council, and other agencies.

The BBCZEAS is designed to be consistent with, and complimentary to, other Subplans prepared under the SERM Act including the state, regional and local EMPLANs, State Storm Plan and State Flood Plan. The relationship between the SERM Act and CM Act is detailed in **Figure 15-1**.

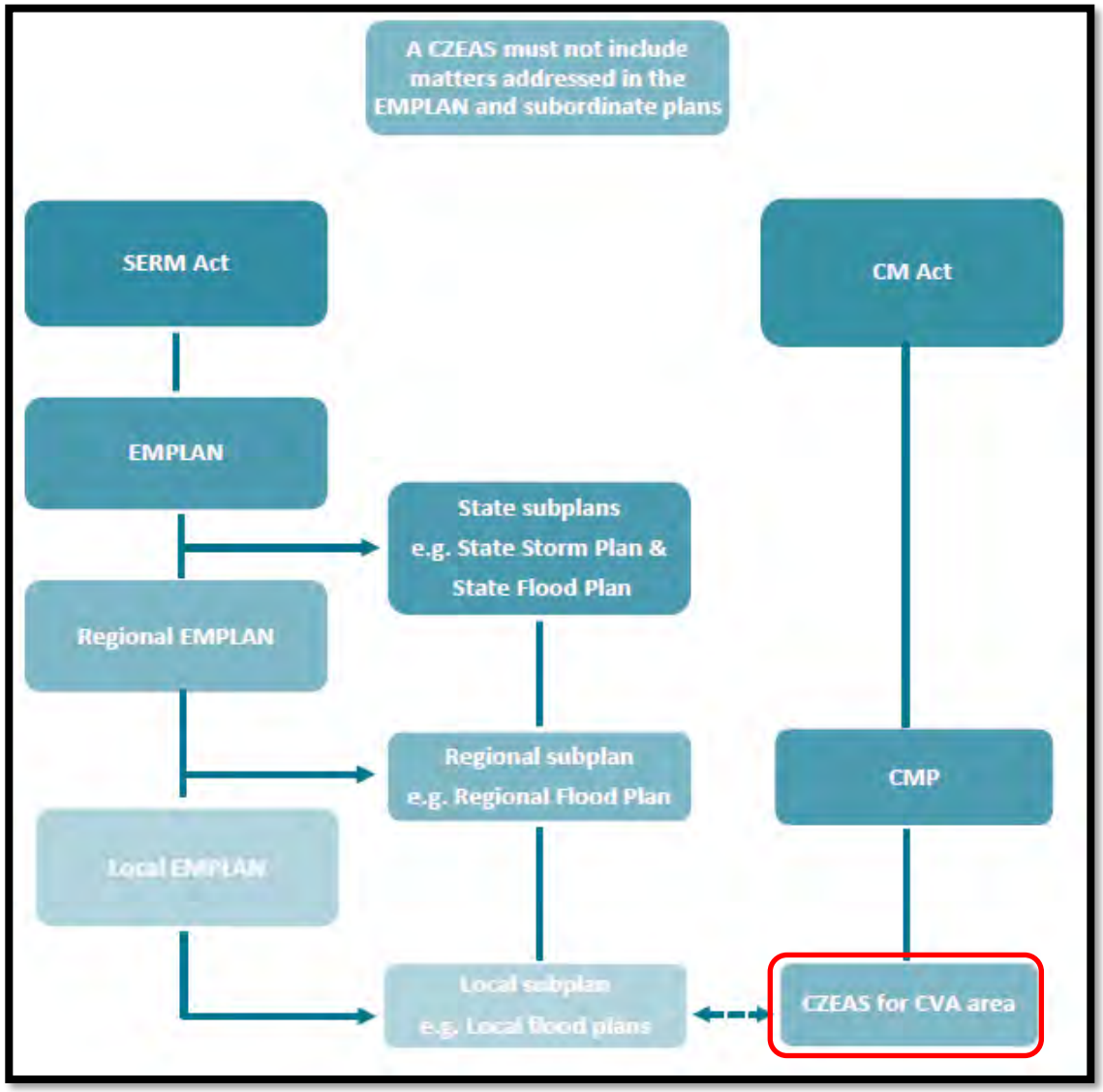

Figure 15-1: Simplified legislative framework for emergency management in NSW and its relationship with coastal management legislation and coastal management programs related to coastal hazards (DPIE, 2019), with the CZEAS noted in red.

The BBCZEAS is intended to be a Sub Plan to the Sutherland EMPLAN and a Supporting Plan to the Sutherland FESP providing:

- objectives and scope of the CZEAS, consistent with the objects of the CM Act, management objectives of the CVA and the strategic direction of the CMP;
- a definition of coastal emergencies;
- criteria/thresholds/triggers for when a coastal emergency is occurring;
- a map and/or register of land and assets that are, or may be, affected by beach erosion, coastal inundation or cliff instability;
- coastal emergency actions for the four phases of emergency management: Prevention, Preparation, Response and Recovery; and
- a protocol for communication and engagement before, during and after an emergency event.

16 Monitoring, Evaluation and Reporting Program

Sutherland Shire Council is required to implement a monitoring, evaluation and reporting (MER) programme as part of the Bate Bay CMP, to identify key indicators, trigger points and thresholds as measures of success of actions in reducing the threats and maintaining the values of Bate Bay, as well as mitigation actions should the actions not achieve the desired outcomes.

The CM Act requires Coastal Management Programs to be reviewed at least once every ten years, to ensure that actions to manage locations such as Bate Bay remain current and relevant.

Council must maintain sufficient information and records about its management of the relevant parts of the coastal zone to demonstrate how the Bate Bay CMP has been implemented, and what has been achieved in connection with the Bate Bay CMP, including whether coastal management actions have been carried out within the timeframes identified in the Bate Bay CMP.

The Integrated Planning and Reporting (IP&R) framework as shown in **Figure 16-1** is a legislative requirement for councils under the *Local Government Act 1993*. IP&R considers the longer term future of an area and is based around a Community Strategic Plan which reflects the community's aspirations and needs for the future.

Figure 16-1: Sutherland Shire Council Integrated Planning and Reporting (IP&R) framework

16.1 Our Community Plan - 10+ years

'Our Community Plan' articulates where Sutherland Shire Council want to be as a community in 10 years' time, what they need to do to get there, and how they will know when they have arrived. It is the highest level plan for the Sutherland Shire. The 10-year plan is supported by a suite of documents that outline how Council will contribute to fulfilling the community's vision and the activities and actions that will be taken.

The key partners to this plan:

- Australian government
- NSW government
- Sutherland Shire Council
- non-government organisations
- business chambers
- local business and industry
- individuals
- developers.

16.2 Delivery Program - 4 Years

The Delivery Program outlines the principal activities that Council will deliver over four years to implement the 10-year Community Strategic Plan.

16.3 The Operational Plan - 1 year (what Council proposes to do)

The Operational Plan is the annual plan that details the specific actions that Council will undertake and its budget for completing these.

16.4 Resourcing Strategy

- The **Long-Term Financial Plan** is about the financial resources needed over the next 10 years to ensure the plans can be delivered and Council continues to operate in a financially sustainable manner.
- The **Workforce Strategy** is about our people and details the four-year staffing, skills and human resources that are required in Council to achieve the outcomes documented in the plans.
- The **Asset Management Strategy** is about our infrastructure and outlines the 10-year plan for ensuring that our assets are developed, managed and maintained effectively and efficiently to meet current and future community needs.

Council's formal adoption of the Bate Bay CMP following public exhibition will commit Council and other identified stakeholders to implementing the recommended actions. These actions will be largely implemented by the Asset Services and Project Delivery teams utilising existing resources, in consultation with staff from Parks Operations, Civil Operations, Public Safety & Lifeguards, Traffic & Public Domain Services and Environmental Science.

Detailed planning, investigation, design and approval is required for several actions such as the North Cronulla Beach seawall and The Esplanade widening. This will take account of previous investigations and concept designs, as well as community feedback from the CMP exhibition.

The significant costs associated with these actions, once confirmed, will need to be reported to Council for approval and be reflected in Council's Long Term Financial Plan and the projects appropriately scheduled

in Council's Delivery Program and Operational Plans. The proposed works are generally located on land owned or managed by Council or the NSW Government. Funding is expected to be sourced from Council, State and Federal Governments. Council will seek to apply for funding assistance from all relevant grant programs, including the NSW Coastal & Estuary Grants Program, for all phases of these projects. New or upgraded assets and their associated lifecycle costs will also need to be reflected in the relevant asset management plan.

For example, further funding for restorative works to the Prince Street seawall is already proposed for the 2022/23 financial year.

There is also ongoing funding from NSW DPHI - Crown Lands for Wanda dune restoration works as part of a recently renewed agreement with Council. DPHI – Crown Lands has provided funding assistance up to $400,000 ex GST over three years (2021 - 2023) for management of this site. This is to allow for the transition to a funding model that is consistent with other councils across the state and aligned with departmental policy.

Council is aware of the requirement to clarify future funding and responsibilities for dune restoration works at the Wanda Dunes site (Action CE1), and have identified potential sources of funds as follows:

i. Council's internal funding sources (in-kind contribution, Ordinary Rates, Revenue);
ii. NSW Government's Coastal and Estuary Grants Program, administered by DCCEEW - BCS – by application; and
iii. Crown Reserves Improvement Fund (CRIF) –by application, noting applications are assessed on merit against the criteria and other applications.

The IP&R framework consists of four layers of plans:

- the Community Strategic Plan,
- the Resourcing Strategy is a 10-year plan describing the resources that council will use to achieve the objectives and strategies detailed in its CSP,
- the Delivery Program is a four-year program outlining the commitments and key partnerships required and measures to monitor success in achieving the Strategies, and
- the Operational Plan outlines in more detail the individual Actions that council will undertake in a financial year in order to meet the commitments made in the Delivery Program.

In accordance with the CM Act, the Bate Bay CMP needs to align with Council's IP&R Framework. This aims to mainstream coastal management into Council's overall service delivery and asset management responsibilities. It is also likely that integrating actions from the Bate Bay CMP into the service delivery and asset management processes of Council will improve implementation of the Bate Bay CMP.

Generally, the operational plan and delivery program are updated on a yearly basis (as the delivery program is a rolling four-year program), and it is at this stage that actions from the Bate Bay CMP can and should be incorporated into these documents.

Integrated Planning & Reporting requires the preparation of a Delivery Program that sets out a four-year plan to achieve the objectives of the 'Our Community Plan' Community Strategic Plan (Sutherland Shire Council, 2017). The business plan in **Section 14** outlines how the management actions within the Bate Bay CMP will meet the objectives and strategies of the 'Our Community Plan' Community Strategic Plan (Sutherland Shire Council, 2017).

To support the integration of the Bate Bay CMP with the day to day operations of Council, it is recommended that 12 months after the Bate Bay CMP is certified, and at yearly intervals until superseded, a workshop is held between key staff that are responsible for its implementation and DCCEEW - BCS Coastal representative(s), to assess implementation and current status of the Bate Bay CMP.

Sutherland Shire Council delivers an Annual Report which demonstrates progress in implementing the Delivery Program and Operational Plan activities over each financial year, and it is recommended that this report provides the main reporting mechanism for the MER program. Performance measures are included for each action in the Operational Plan, which can be used to gauge whether the Bate Bay CMP actions have been implemented or not, which can then be reported in the Annual Report. This provides for a yearly evaluation of the implementation status of each action in the Bate Bay CMP.

17 Maps

17.1 Mapped Probabilistic Coastal Hazard Lines

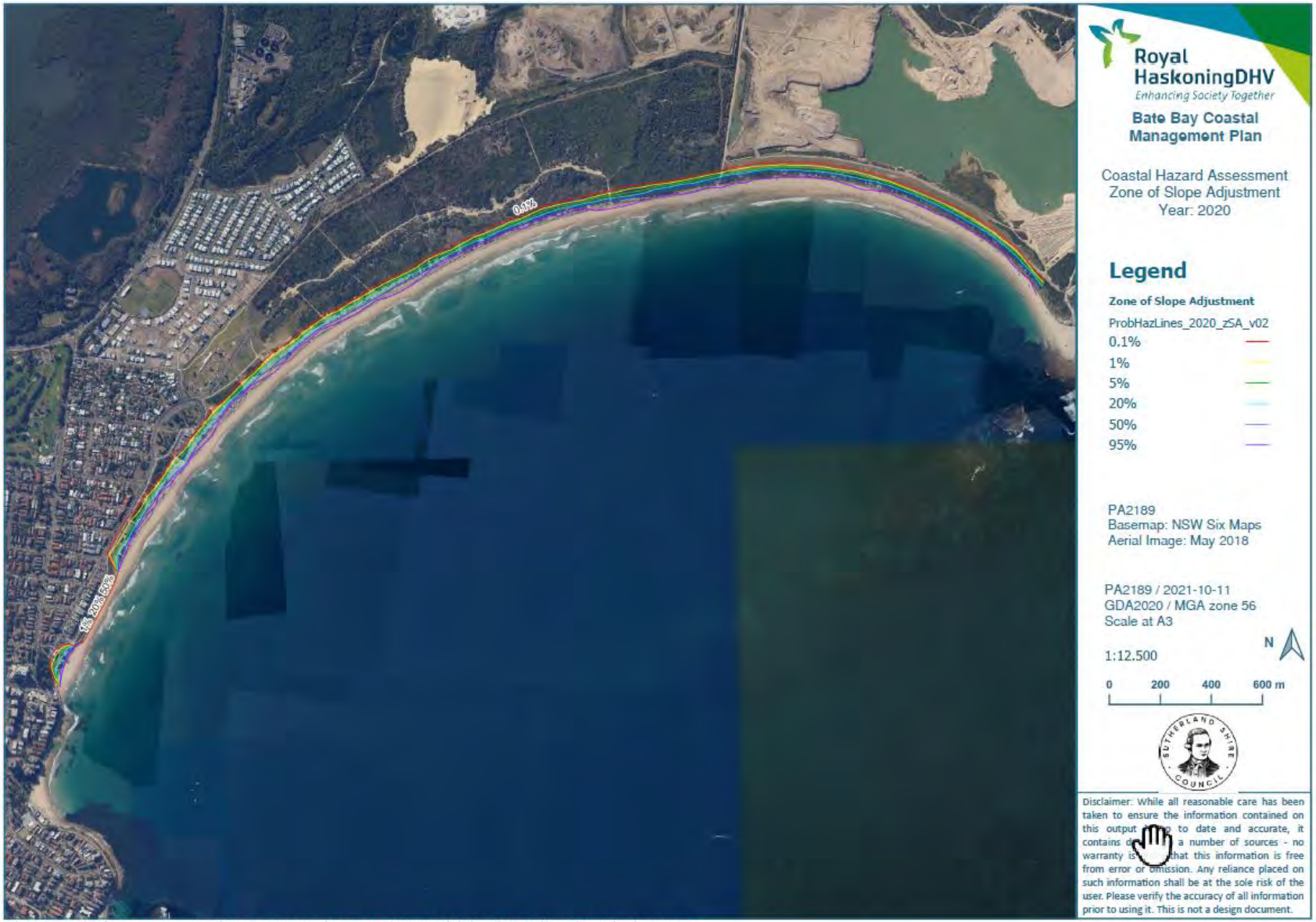

Figure 17-1: Coastal Hazard Assessment Zone of Slope Adjustment - Year: 2020

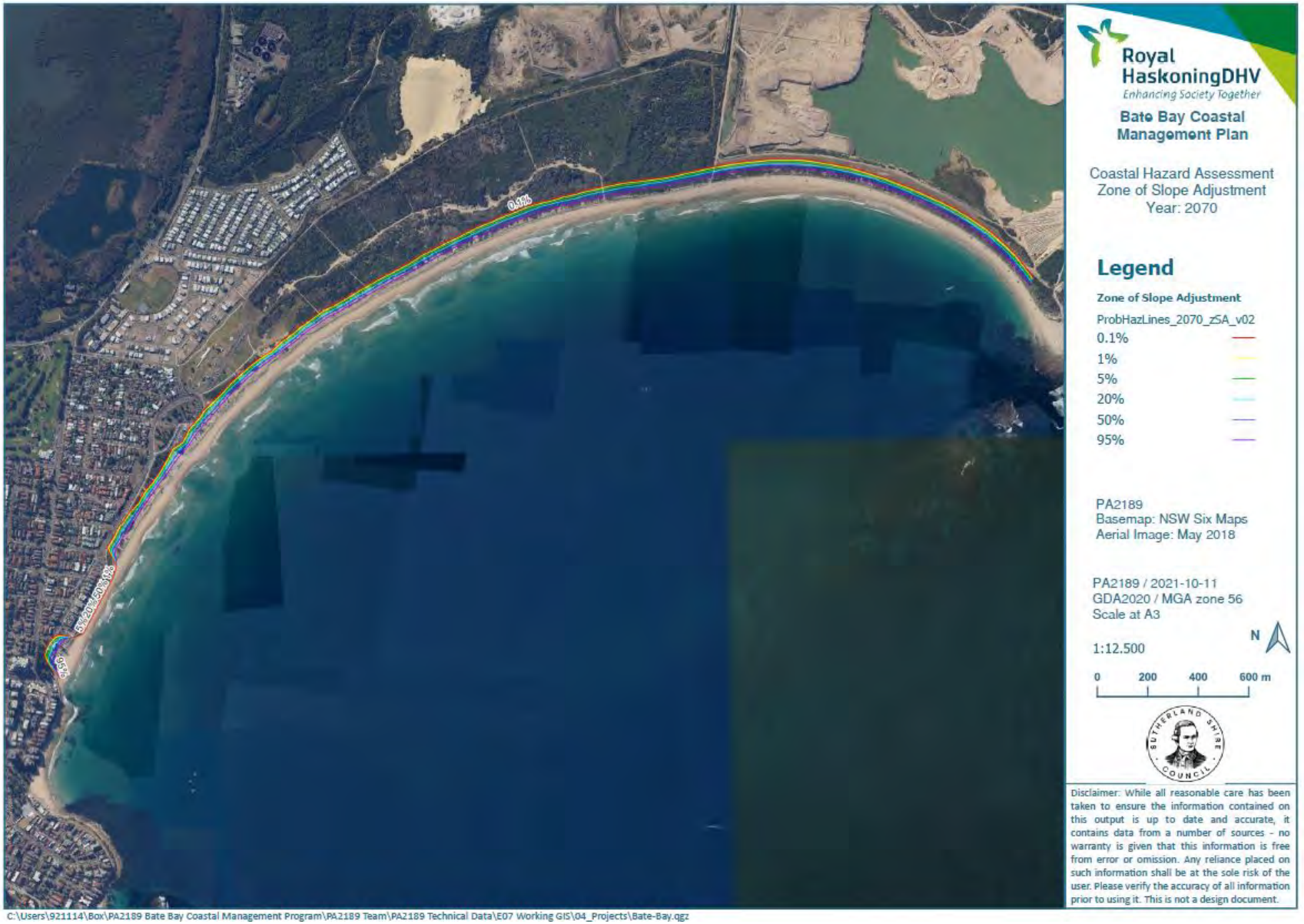

Figure 17-2: Coastal Hazard Assessment Zone of Slope Adjustment - Year: 2070

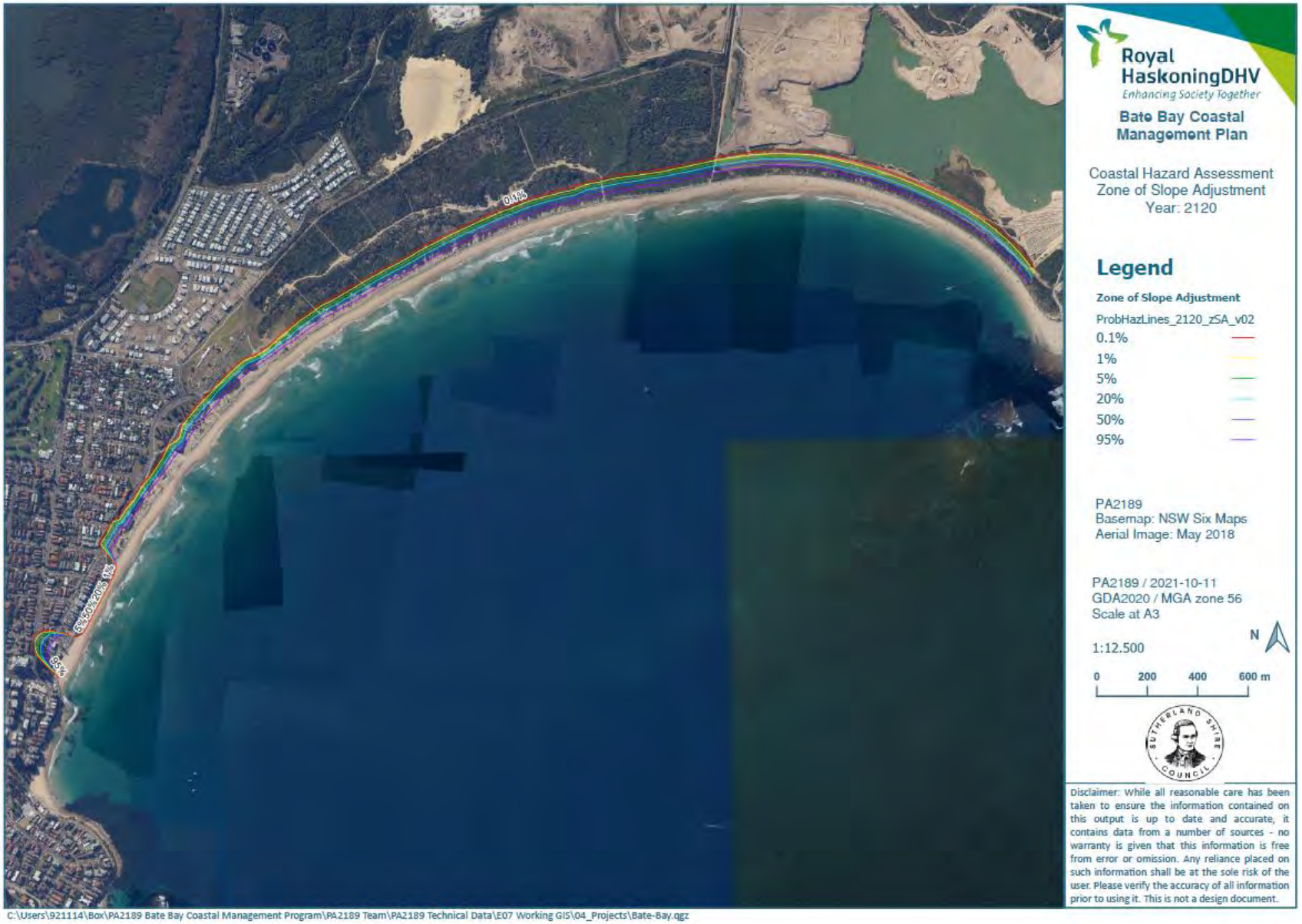

Figure 17-3: Coastal Hazard Assessment Zone of Slope Adjustment - Year: 2120

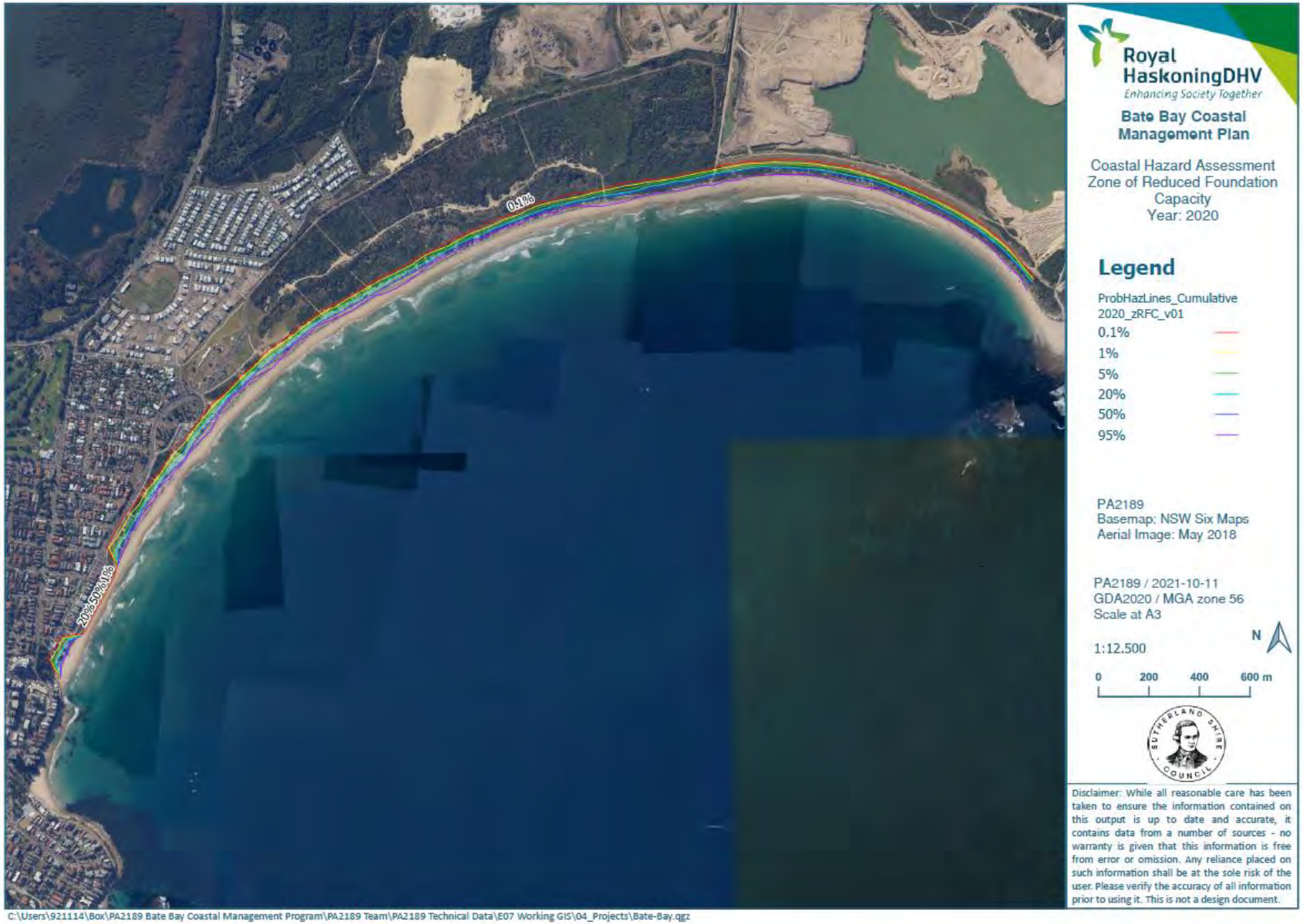

Figure 17-4: Coastal Hazard Assessment Zone of Reduced Foundation Capacity - Year: 2020

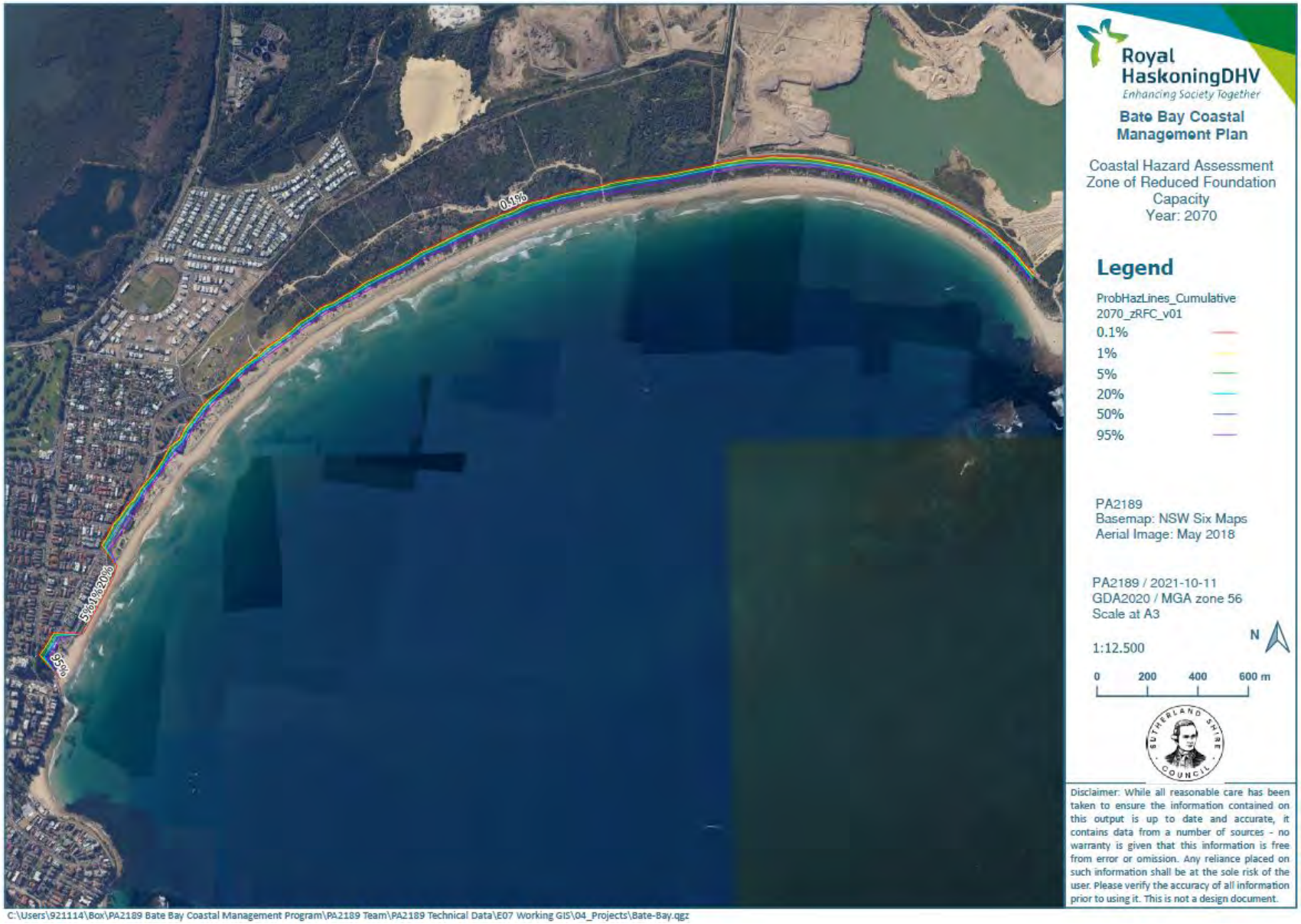

Figure 17-5: Coastal Hazard Assessment Zone of Reduced Foundation Capacity - Year: 2070

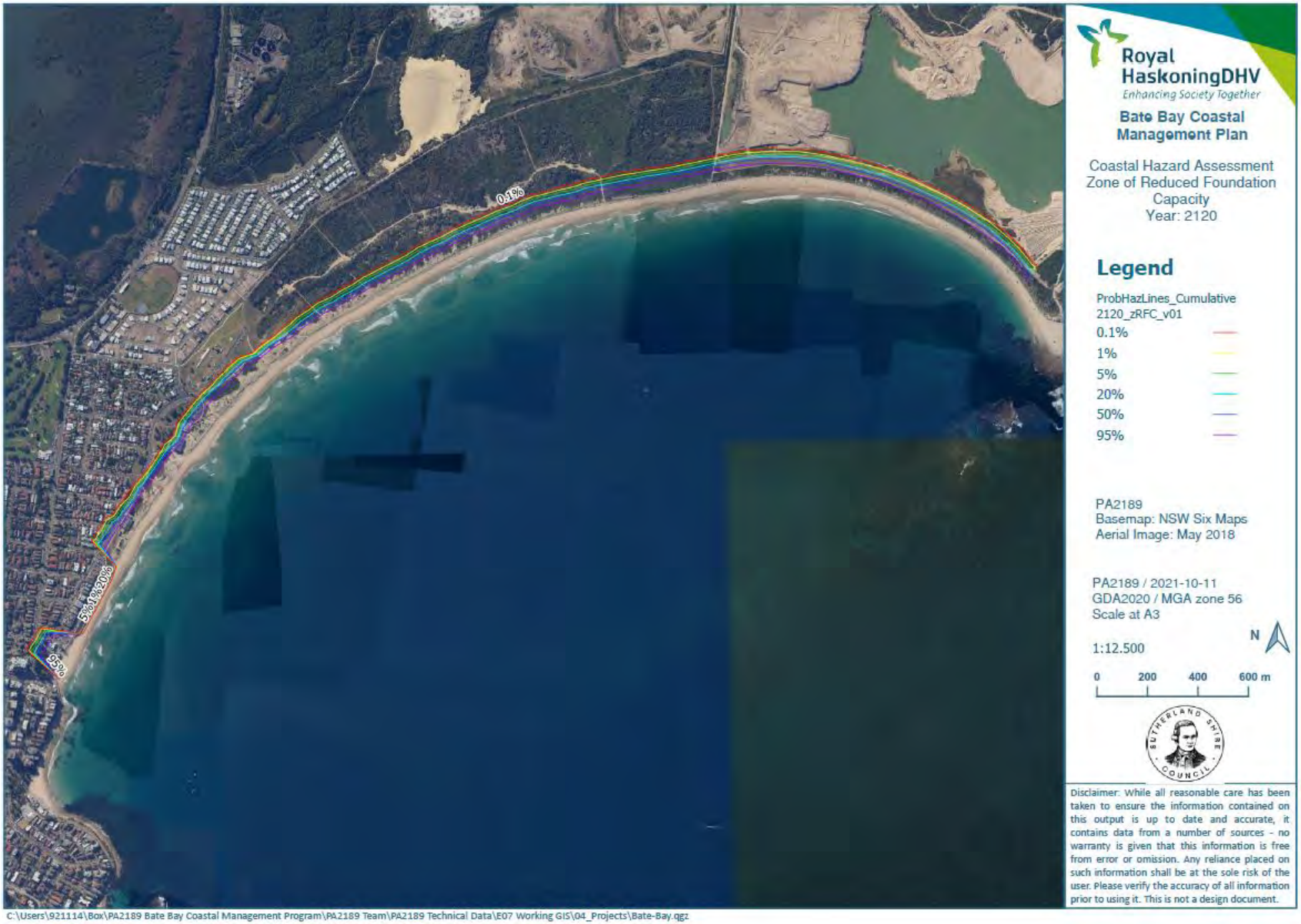

Figure 17-6: Coastal Hazard Assessment Zone of Reduced Foundation Capacity - Year: 2120

17.2 Geotechnical Hazard Sites

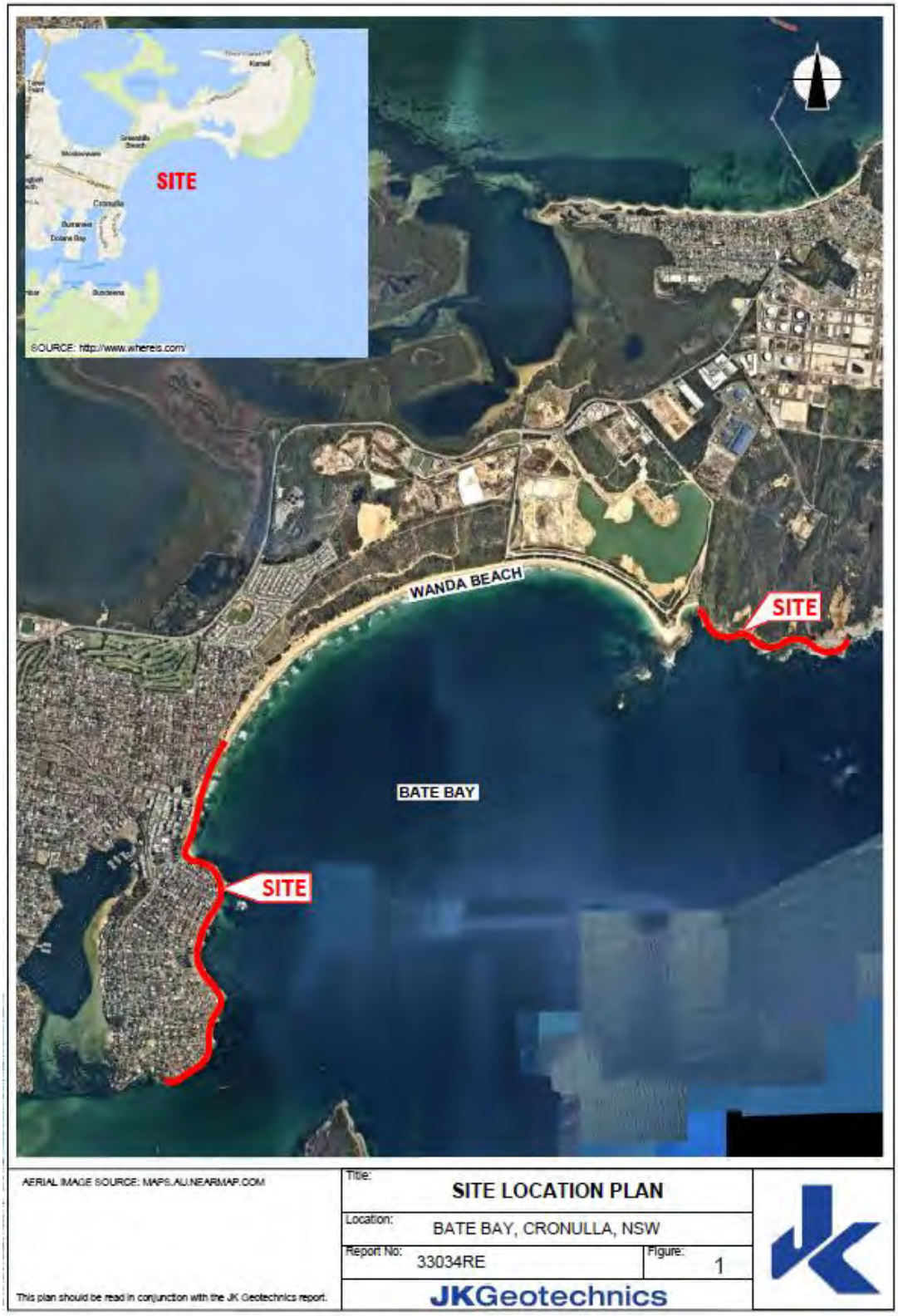

Figure 17-7: Geotechnical Hazard Zones Site Location Plan

Figure 17-8: Geotechnical Hazard Zones - Precinct 1 (Southern Section), (key locations marked in red)

Figure 17-9: Geotechnical Hazard Zones - Precinct 1 (Middle Section) (key location marked in red)

Figure 17-10: Geotechnical Hazard Zones - Precinct 1 (Northern Section), (key location marked in red)

Figure 17-11: Geotechnical Hazard Zones - Precinct 2

Figure 17-12: Geotechnical Hazard Zones - Precinct 3

Figure 17-13: Geotechnical Hazard Zones - Precinct 4 (Western Section)

Figure 17-14: Geotechnical Hazard Zones - Precinct 4 (Middle Section)

Figure 17-15: Geotechnical Hazard Zones - Precinct 4 (Eastern Section)

17.3 Mapped Coastal Management Areas within the Bate Bay CMP study area:

- Coastal Environment Area (refer **Figure 17-16**); and
- Coastal Use Area (refer **Figure 17-17**)

Figure 17-16: Coastal Environment Area (blue shading) as mapped within Resilience and Hazards SEPP

Figure 17-17: Coastal Use Area (pink shading) as mapped within Resilience and Hazards SEPP

17.4 Mapped Key Locations identified for action items within the Bate Bay CMP

17.4.1 Key Location 1 - The Esplanade site between Cronulla and North Cronulla Beaches

The Esplanade site between Cronulla and North Cronulla Beaches (key action described in **Section 5)** is shown in **Figure 17-18**.

Figure 17-18: Key Location 1 - The Esplanade site between Cronulla and North Cronulla Beaches

17.4.2 Key Location 2 - Dunningham Park, North Cronulla Beach

Dunningham Park (key action described in **Section 6**), located at North Cronulla Beach, is shown in **Figure 17-19**.

Figure 17-19: Key Location 2 – Dunningham Park, North Cronulla Beach (marked in red)

17.4.3 Key Location 3 - Prince Street Seawall, North Cronulla Beach

The Prince Street Seawall (key action described in **Section 7**) , located along North Cronulla Beach, is shown in **Figure 17-20**.

Figure 17-20: Key Location 3 - Prince Street Seabee Seawall, North Cronulla Beach (marked in red)

17.4.4 Key Location 4 - City Beaches and Surf Beaches

Precincts 2 & 3, the City Beaches and Surf Beaches (key actions described in **Section 8**), located from Cronulla Beach through North Cronulla Beach to Elouera Beach and Wanda Beach, are shown in **Figure 17-21**.

Figure 17-21: Key Location 4 – Precincts 2 & 3, the City Beaches and Surf Beaches (marked in red)

18 Glossary

This glossary provides definitions of terms that are in common use when describing coastal processes and coastal management. It supplements definitions provided in the *Coastal Management Act 2016* (CM Act) and State Environment Planning Policy (Resilience and Hazards) 2021. It is not a comprehensive dictionary of coastal terminology.

Many definitions are included with acknowledgement of the Coastal Management Glossary developed by State of NSW and Office of Environment and Heritage (2018), while others are sourced from the US Army Corps of Engineers as well as from glossaries provided in relevant Standards and other coastal management guidelines in current use in Australia.

Aboriginal Cultural Heritage - includes tangible (physical) and intangible (non-physical) aspects – it is the landscapes, places, objects, customs and cultural traditions and practices that communities have inherited from the past and wish to conserve as part of their Country for the benefit of current and future generations.

Acceptable risk – a risk that, following an understanding of the likelihood and consequences, is sufficiently low to require no new treatments or actions to reduce risk further. Individuals and society can live with this risk without feeling the necessity to reduce risks further. Positive and negative risks are negligible or so small that no risk treatments are needed.

Accretion – as the build-up of sediments to form land or shoaling in coastal waters or waterways. It may be either natural or artificial. Natural accretion is the build-up of land on the beach, dunes, or in the water by natural processes, such as waves, current and wind. Artificial accretion is a similar build-up of land resulting from built structures such as groynes or breakwaters, or activities such as filling and beach nourishment, or also aggradation. (USACE)

Adaptation – adjustment in natural or human systems in response to actual or expected climate change or its effect, to moderate harm or to take advantage of beneficial opportunities.

Alongshore or Longshore – parallel to and near the shoreline.

Ambulatory – in relation to the coastal foreshore, this means the movement of the foreshore seaward or landward over time, in response to coastal processes and sediment budgets. The movement of the foreshore may occur at different rates or in different directions along a beach or within a sediment compartment.

Annual Exceedance Probability (AEP) – the probability (expressed as a percentage) of an exceedance (e.g. large wave height or high water level) in a given year.

Artificial nourishment – see 'beach nourishment'

Asset – something of value and may be environmental, economic, social, recreational or a piece of built infrastructure.

Audit – independent appraisal of social, financial and environmental performance.

Average Recurrence Interval (ARI) – the average time between which a threshold is reached or exceeded (e.g. large wave height or high water level) of a given value. Also known as Return Period.

Back beach or back shore – the zone of the shore or beach lying between the foreshore and the coastline comprising the berm or berms and acted upon by waves only during severe storms, especially when combined with exceptionally high water.

Bathymetric data – measurements of the shape of the bed or the depth of a body of water.

Beach – the CM Act defines beach as an area that is generally composed of sand or pebbles or similar sediment that extends landward from the lowest astronomical tide to the line of vegetation or bedrock or structure.

Beach erosion – refers to landward movement of the shoreline and/or a reduction in beach volume, usually associated with storm events or a series of events, which occurs within the beach fluctuation

zone. Beach erosion occurs due to one or more process drivers; wind, waves, tides, currents, ocean water level, and downslope movement of material due to gravity.

Beach fluctuation zone – CM Act defines beach fluctuation zone as 'the range of natural locations a beach profile occupies from its fully accreted condition to its fully eroded condition, with

a) a landward limit defined by the escarpment resulting from the erosion associated with a 1% storm event or a more extreme event of record, whichever is the greater landward limit, and

b) a seaward limit that is the 40m depth seaward of the highest astronomical tide for the open coast and 10m depth seaward of the highest astronomical tide for estuaries or tidal coastal lakes.'

Beach material – granular sediments, usually sand or shingle moved by the sea.

Beach nourishment – beach restoration or augmentation using clean dredged or fill sand. Dredged sand is usually hydraulically pumped and placed directly onto an eroded beach or placed in the littoral transport system. When the sand is dredged in combination with constructing, improving, or maintaining a navigation project, beach nourishment is a form of beneficial use of dredged material.

Beach plan shape – the shape of the beach in plan; usually shown as a contour line, combination of contour lines or recognisable features such as beach crest and/or the still water line.

Beach profile – a cross-section taken perpendicular to a given beach contour; the profile may include the face of a dune or seawall, extend over the backshore, across the foreshore, and seaward underwater into the nearshore zone.

Beach ridge – a nearly continuous mound or ridge of beach material (including sand, shell, coral and gravel) that has been shaped by wave or other action. Beach ridges may occur singly or as a series of approximately parallel deposits. A beach ridge plain is composed of a series of parallel beach ridges. The ridges may be of different heights and spacing. They provide evidence of changes to deposition and erosion rates over time.

Beach scraping – also referred to as 'nature assisted beach enhancement' (NABE) is a mechanical intervention to speed up the natural processes of berm and foredune recovery after a storm event.

Beach system – the CM Act defines as 'the processes that produce the beach fluctuation zone and the incipient foredunes and foredunes landward of the relevant beach'. In general, this means coastal lands, composed of sand, gravel or shell, between a seaward limit of 40 metres depth in the State coastal waters and a landward limit at the lee side of the dunes.

Bedrock – a general term for the rock, usually solid, that underlies soil or other unconsolidated, superficial material.

Beneficial uses – placement or use of dredged material for some productive purpose. May involve either the use of the dredged material or the placement site as the integral component of the use.

Benthic – of, pertaining to, or related to, the bottom of a stream or other body of water.

Berm – on a beach, a nearly horizontal plateau on the beach face or backshore, formed by the deposition of beach material by wave action or by means of a mechanical plant as part of a beach renourishment scheme. Some natural beaches have no berm, others have several.

Breaker zone – the zone within which waves approaching the coastline commence breaking, typically in water depths of between five and 10 metres for ocean coasts, but sometimes in shallower water.

Breakwater – a man-made structure protecting a shore area, harbour, anchorage or basin from waves.

Bruun Rule – a commonly used method for estimating the response of a sandy shoreline to rising sea levels.

Bypassing, sand – hydraulic or mechanical movement of sand from the accreting up–drift side to the eroding down-drift side of an inlet or harbour entrance. The hydraulic movement may include natural movement as well as movement caused by humans.

Catchment area – the area which drains naturally to a particular point on a river, thus contributing to its natural discharge.

Cliff – a high, steep face of rock; a precipice.

Climate – the characteristic weather of a region, particularly regarding temperature and precipitation, averaged over some significant interval of time (years).

Climate change – occurs naturally in response to long-term variables, but often used to describe a change of climate that is directly attributable to human activity that alters the global atmosphere, increasing change beyond natural variability and trends.

Closure depth – do not detect vertical seabed changes, generally considered the seaward limit of littoral transport (collected over several years). The depth can be determined from repeated cross-shore profile surveys or estimated using formulas based on wave statistics. Note that this does not imply the lack of sediment motion beyond this depth.

Coast – a strip of land of variable width that extends from the shoreline inland to the first significant landform that is not influenced by coastal processes (such as waves, tides and associated currents).

Coastal asset – includes natural features of the coastal zone, including landforms, ecosystems and species; and built assets such as infrastructure, public and private buildings or structures.

Coastal dune – vegetated and unvegetated sand ridges built-up at the back of a beach. They comprise dry beach sand that has been blown landward and trapped by plants or other obstructions. Stable sand dunes act as a buffer against wave damage during storms, protecting the land behind from salt water intrusion, sea spray and strong winds. Coastal dunes also act as a reservoir of sand to replenish and maintain the beach at times of erosion.

Coastal engineering – a branch of civil engineering that applies engineering principles specifically to projects within the coastal zone (nearshore, estuary, marine, and shoreline).

Coastal environment – the landscape, functions and communities in the coastal zone.

Coastal environment area – land identified in the CM Act as land containing coastal features such as coastal waters of the State, estuaries, coastal lakes, coastal lagoons and land adjoining those features, including headlands and rock platforms. The Resilience and Hazards SEPP maps the extent of the coastal environment area for planning purposes.

Coastal Erosion - The loss of land along the shoreline predominantly by the offshore movement of sand during storms

Coastal forcing – the natural processes which drive coastal hydro and morpho-dynamics (e.g. winds, waves, tides, etc.).

Coastal hazard – defined in the CM Act to mean the following:

- beach erosion
- shoreline recession
- coastal lake or watercourse entrance instability
- coastal inundation
- coastal cliff or slope instability
- tidal inundation
- erosion and inundation of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters.

Coastal inundation – coastal inundation occurs when a combination of marine and atmospheric processes raises the water level at the coast above normal elevations, causing land that is usually 'dry' to become inundated by sea water. Alternatively, the elevated water level may result in wave run-up and overtopping of natural or built shoreline structures (e.g. dunes, seawalls).

Coastal Management Area – any one of four areas that make up the coastal zone as defined in the CM Act. These are the coastal wetlands and littoral rainforests area, coastal vulnerability area, coastal environment area, and the coastal use area.

Coastal management objectives – specific objectives identified in the CM Act for each of the four coastal management areas.

Coastal management program – a long-term strategy for the coordinated management of land within the coastal zone, prepared and adopted under Part 3 of the CM Act.

Coastal management units – may be identified for the purposes of coastal management at a local or community level. They are sections of the coast that are affected by similar coastal hazards and risks or have several important social and economic features in common.

Coastal model – model of a coastal area. Often a movable bed model used to reproduce coastal sediment transport; or a model of estuary circulation.

Coastal processes – marine, physical, meteorological and biological activities that interact with the geology and sediments to produce a particular coastal system.

Coastal protection works – the CM Act defines coastal protection works as:

a) beach nourishment

b) activities or works to reduce the impact of coastal hazards on land adjacent to tidal waters, including (but not limited to) seawalls, revetments and groynes.

Coastal risk – a risk that relates to the likelihood and consequences of coastal hazards or threats affecting coastal values.

Coastal sediment compartment – an area of the coast defined by its sediment flows and landforms. Coastal sediment compartments may be mapped at primary, secondary or tertiary (local) scales. Boundaries are generally defined by structural features related to the geologic frameworks that define the planform of the coast.

Coastal threat – a process or activity that is putting pressure on or impacting on the health or function of a coastal ecosystem, or on the amenity and social or cultural value of the coastal landscape. Examples include the discharge of effluent or poor-quality stormwater into coastal lakes and lagoons, discharges from acid sulfate soils, or the spread of invasive species. High recreational demand can also be a threat to coastal ecosystem health.

Coastal use area – land identified by the CM Act and Resilience and Hazards SEPP as being land adjacent to coastal waters, estuaries, coastal lakes and lagoons where development is or may be carried out (now or in the future). The Resilience and Hazards SEPP maps the extent of the coastal use area for planning purposes.

Coastal vulnerability area – defined in the CM Act as land subject to seven coastal hazards.

Coastal wetland – wetlands are areas that are inundated cyclically, intermittently or permanently with fresh, brackish or saline water and have soils, plants and animals in them that are adapted to, and depend on, moist conditions for at least part of their lifecycle. Coastal wetlands include marshes, mangroves, swamps, melaleuca forests, casuarina forests, sedgelands, brackish and freshwater swamps and wet meadows.

Coastal zone – as defined in the CM Act and Resilience and Hazards SEPP: the area of land comprised of the following coastal management areas: the coastal wetlands and littoral rainforest area, the coastal vulnerability area, the coastal environment area and the coastal use area.

Coastal zone (general) – the transition zone where the land meets water, the region that is directly influenced by marine and lacustrine hydrodynamic processes. Extends offshore to the continental shelf break and onshore to the first major change in topography above the reach of major storm waves. On barrier coasts, includes the bays and lagoons between the barrier and the mainland.

Coastal zone management – the integrated management of issues affecting the coastal zone. Coastal zone management is not restricted to coastal protection works, but includes also development and activities to manage the economical, ecological, cultural and social values of the coast.

Coastal zone management plan – a management plan for the open coast, an estuary or a coastal lake, prepared under the *Coastal Protection Act 1979*.

Community objectives – local scale objectives for management of the coast, based on the aspirations and priorities of local communities. When included in a coastal management program, these objectives will be based on, and must align with, the objectives expressed in a council's Community Strategic Plan.

Conceptual model – a simplified representation of the physical hydro-geologic setting. This includes the identification and description of the geologic and hydrologic framework, media type, hydraulic properties, and sources and sinks of flow.

Consequence – the outcome or impact of a hazard or threat.

Cost analysis – evaluation of the specific cost elements of a contract or proposal to appraise their statutory compliance, distribution, and reasonableness.

Cross-shore transport – refers to the sediment moved in a cross-shore direction to the coastline induced by water motions due to waves and currents.

Current, coastal – one of the offshore currents flowing generally parallel to the shoreline in the deeper water beyond and near the surf zone; these are not related genetically to waves and resulting surf, but may be related to tides, winds, or distribution of mass.

Current, littoral – any current in the littoral zone caused primarily by wave action; e.g. longshore current, rip current.

Current, longshore – the littoral current in the breaker zone moving essentially parallel to the shore, usually generated by waves breaking at an angle to the shoreline.

Cusp (or beach cusp) – one of a series of short ridges on the foreshore separated by crescent-shaped troughs spaced at more or less regular intervals. Between these cusps are hollows. The cusps are spaced at somewhat uniform distances along beaches. They represent a combination of constructive and destructive processes.

Design storm – a hypothetical extreme storm with waves that coastal protection structures will often be designed to withstand. The severity of the storm (i.e. return period) is chosen in view of the acceptable level of risk of damage or failure. A design storm consists of a design wave condition, a design water level and a duration.

Design wave – in the design of harbour works, coastal protection works etc., the type or types of waves selected as having the characteristics against which protection is desired.

Diffraction of water waves – the phenomenon by which energy is transmitted laterally along a wave crest. When a part of a train of waves is interrupted by a barrier, such as a breakwater, the effect of diffraction is manifested by propagation of waves into the sheltered region within the barrier's geometric shadow.

Dredging - An underwater excavation activity intended to remove sediments and debris. Often used to keep navigable pathways within waterways

Drowned river valley – a type of wave-dominated estuary, usually a deep bedrock embayment, with a wide, deep mouth.

Dune – underwater: flow-transverse bedform with spacing from under one metre to over 1000 metres that develops on a sediment bed under unidirectional currents.

Dune – subaerial (see coastal dune).

East Coast Low – an intense low-pressure system that occurs off the east coast of Australia, bringing storms, high waves and heavy rain. East coast lows generally occur in autumn and winter off NSW, southern Queensland and eastern Victoria.

Economic evaluation – an assessment that helps decision-makers to understand the socioeconomic implications of adopting alternative management options and to make choices that will provide net benefits to the community. Cost-benefit analysis is a type of economic evaluation that considers and evaluates a wide range of costs and benefits associated with a proposal, in qualitative or quantitative (monetary) terms (with future costs and benefits reduced to today's prices), compared with a base case. It may be used in conjunction with other criteria (such as technical feasibility, community acceptance or environmental impact) to select optimal management responses. A multi-criteria assessment is not an economic evaluation but may assist decision-making in other ways.

Ecosystem – the living organisms and the non-living environment interacting in an area, encompassing the relationships between biological, geochemical, and geophysical systems; or a community and its environment including living and non-living components.

El Niño southern oscillation (ENSO) – a year to year fluctuation in atmospheric pressure, ocean temperatures and rainfall associated with El Niño (warming of the oceans in the equatorial eastern and central Pacific). El Niño tends to bring below average rainfall.

Emergency Alert - A national telephony based alerting system available for use by emergency service agencies to send SMS and voice messages to landlines and/or mobile telephones (by billing address) in times of emergency.

EMPLAN (Emergency Management Plan) - The object of a EMPLAN is to ensure the coordinated response by all agencies having responsibilities and functions in emergencies.

Endangered Ecological Community - An assemblage of species occupying a particular area, listed as endangered under relevant State and Federal legislation.

Entrance management - Includes artificial opening of entrances, managing the configuration, height or location of the beach to enable entrance opening at a level lower than the natural range.

Entrance training - Deployment of man-made structures designed to constrain river discharges to a desired location.

Environment – surroundings, the physical and biological system supporting life, including humans and their built environment. Includes cultural features of archaeological or historical interest.

Eolian or Aeolian processes – pertaining to the wind, especially used with deposits such as loess and dune sand, and sedimentary structures like wind-formed ripple marks.

Erosion – the wearing away of land by the action of natural forces. On a beach, the carrying away of beach material by wave action, tidal currents, littoral currents, or by deflation.

Escarpment (storm bite) – the landward limit of erosion in the dune system caused by storm waves. At the end of a storm the escarpment may be nearly vertical; as it dries out the sand slumps to a typical slope of one vertical to 1.5 horizontal.

Essential infrastructure – CM Act defines to include infrastructure for the following purposes: electricity generation, transmission and distribution, telecommunications, rail, roads, gas, sewerage systems, water supply systems or stormwater management systems, airports, ports shipping and harbours.

Essential services – those services that are considered essential to the life of communities and include energy, transport, health services, sanitation services, water and welfare institutions (*State Flood Plan and Essential Services Act 1988*).

Essential utilities – those services that are considered essential to public safety and organised communities. Such services include electricity, gas, water, sewerage, sanitation, telecommunications and waste collection (*State Flood Plan and Essential Services Act 1988*).

Estuary – CM Act defines as any part of a river, lake, lagoon, or coastal creek whose level is periodically or intermittently affected by coastal tides, up to the highest astronomical tide.

Estuary inundation – flooding around the shoreline of an estuary or coastal lake, by a mixture of tidal water and catchment flood water.

Exposure – the potential for assets to be impacted by a hazard based on data or modelling of the hazard.

Extreme storm event – storm for which characteristics (wave height, period, water level etc.) were derived by statistical ‘extreme value’ analysis. Typically, these are storms with average recurrence intervals (ARI) ranging from one to 100 years.

Evacuation - The temporary movement of people from a dangerous or potentially dangerous place to a safe location, and their eventual return. It is a safety strategy which uses distance to separate people from the danger created by the hazard.

Evacuation Order - Notification to the community, authorised by the NSW SES, when the intent of an Incident Controller is to instruct a community to immediately evacuate in response to an imminent threat.

Evacuation Warning - Notification to the community, authorised by the NSW SES, when the intent of an Incident Controller is to warn a community of the need to prepare for a possible evacuation.

Fit for purpose – right for the job it is intended to do. A fit for purpose assessment considers the level of data detail and the types of consultation required to make a reasonable management decision. In general, the detail and consultation required will increase with risk, complexity and impact.

Flash flooding - Flooding which is sudden and often unexpected because it is caused by sudden local or nearby heavy rainfall. It is sometimes defined as flooding which occurs within six hours of the rain that causes it.

Flood - Relatively high water level which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences, including Tsunami.

Flood classification - Locally defined flood levels used in flood warnings to give an indication of the severity of flooding (minor, moderate or major) expected. These levels are used by the State Emergency Service and the Australian Government Bureau of Meteorology in flood bulletins and flood warnings.

Flood intelligence - The product of collecting, collating, analysing and interpreting flood related data to produce meaningful information (intelligence) to allow for the timely preparation, planning and warning for and response to a flood.

Flood fringe - The remaining area of flood prone land after floodway and flood storage have been defined.

Flood liable land (also referred to as flood prone land) - Land susceptible to flooding by the Probable Maximum Flood (PMF) event. This term also describes the maximum extent of a floodplain which is an area of a river valley, adjacent to the river channel, which is subject to inundation in floods up to this event.

Flood of record - Maximum observed historical flood.

Floodplain Management Plan - A plan developed in accordance with the principles and guidelines in the New South Wales Floodplain Development Manual. Such a plan usually includes both written and diagrammatic information describing how particular areas of flood prone land can be used and managed to achieve defined objectives.

Flood Plan - A response strategy plan that deals specifically with flooding and is a sub-plan of a Emergency Management Plan. Flood plans describe agreed roles, responsibilities, functions, strategies and management arrangements for the conduct of flood operations and for preparing for them. A flood plan contains information and arrangements for all floods whereas an IAP is for a specific flood/event.

Flood Rescue - The rescue or retrieval of persons trapped by floodwaters. Flood storage areas. Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation.

Floodway - An area where a significant volume of water flows during floods. Such areas are often aligned with obvious naturally-defined channels and are areas that, if partially blocked, would cause a significant redistribution of flood flow which may in turn adversely affect other areas. They are often, but not necessarily, the areas of deeper flow or the areas where higher velocities occur.

Flood Watch - A Flood Watch is a notification of the potential for a flood to occur as a result of a developing weather situation and consists of short generalised statements about the developing weather including forecast rainfall totals, description of catchment conditions and indicates streams at risk. The Bureau will also attempt to estimate the magnitude of likely flooding in terms of the adopted flood classifications. Flood Watches are normally issued 24 to 36 hours in advance of likely flooding. Flood watches are issued on a catchment wide basis.

Flood Warning - A Flood Warning is a gauge specific forecast of actual or imminent flooding. Flood Warnings specify the river valley, the locations expected to be flooded, the likely severity of flooding and when it will occur.

Foredune – the larger and more mature dune lying between the incipient dune and the hind-dune area. Foredune vegetation is characterised by grasses and shrubs. Foredunes provide an essential reserve

of sand to meet the erosion demand during storm conditions. During storm events, the foredune can be eroded back to produce a pronounced dune scarp.

Foreshore – the part of the shore, lying between the crest of the seaward berm (or upper limit of wave wash at high tide) and the ordinary low water mark, that is ordinarily traversed by the uprush and backrush of the waves as the tides rise and fall; or the beach face, the portion of the shore extending from the low water line up to the limit of wave uprush at high tide. The CM Act defines the foreshore as 'the area of land between highest astronomical tide and the lowest astronomical tide'.

Gabion – steel wire mesh basket to hold stones or crushed rock to protect a bank or bottom from erosion; or structures composed of masses of rocks, rubble or masonry held tightly together usually by wire mesh to form blocks or walls. Sometimes used on heavy erosion areas to retard wave action or as a foundation for breakwaters or jetties.

Geomorphology – that branch of physical geography which deals with the form of the earth, the general configuration of its surface, the distribution of the land, water, etc.; or the investigation of the history of geologic changes through the interpretation of topographic forms.

Geotechnical investigations – subsurface investigation of soils, rock, and other strata for the purposes of engineering design.

Geotextile – a synthetic fabric which may be woven or non–woven and used as a filter.

Global warming – the increase in the earth's temperature due to the emissions of greenhouse gases.

Groyne – a shore protection structure built (usually perpendicular to the shoreline) to trap littoral drift or retard erosion of the shore; or a narrow, roughly shore normal structure built to reduce longshore currents, and/or to trap and retain littoral material. Most groynes are of timber or rock and extend from a seawall, or the backshore, well onto the foreshore and rarely even further offshore.

Hard defences (protection) – general term applied to impermeable coastal defence (protection) structures of concrete, timber, steel, masonry, etc., which reflect a high proportion of incident wave energy.

Hazard – a process, or activity that affects an asset or value. See also 'coastal hazards' which are the specific hazards defined in the CM Act.

Highest astronomical tide (HAT) – the highest level which can be predicted to occur under average meteorological conditions and any combination of astronomical conditions. In Australia HAT is calculated as the highest level from tide predictions over the tidal datum epoch (TDE), this is currently set to 1992 to 2011.

The HAT and the **Lowest Astronomical Tide (LAT)** levels will not be reached every year. LAT and HAT are not the extreme water levels which can be reached, as storm surges may cause considerably higher and lower levels to occur.

Holocene – an epoch of the Quaternary period, from the end of the Pleistocene, about 8000 years ago, to the present time.

Hydrodynamic – relates to the specific scientific principles that deal with the motion of fluids and the forces acting on solid bodies immersed in fluids, and in motion relative to them.

Impacts – include damage, harm or losses to exposed communities, property, services, livelihoods, access, use and amenity, heritage, ecosystems and the environment because of exposure and sensitivity. Impacts may also be positive.

Incident Action Plan (IAP) - An action plan for managing a specific event. Information from the Local Flood Plan is used to develop the flood IAP.

Incipient dune – the most seaward and immature dune of the dune system. Vegetation characterised by grasses such as spinifex. On an accreting coastline, the incipient dune will develop into a foredune.

Indirect Effect - Indirect effects are generally a consequence of infrastructure damage or interruption of services and can affect communities distant from the actual flood footprint i.e. floodplain. Indirect effects can also refer to indirect losses due to disruption of economic activity, both in areas which are inundated or isolated. Indirect effects are one of the three primary sources of risk in the context of flooding (the other two are inundation and isolation).

Inshore zone – in beach terminology, the zone of variable width extending from the low water line through the breaker zone.

Interdecadal Pacific Oscillation (IPO) – an irregular interdecadal sea surface temperature in the Pacific Ocean that modulates the strength and frequency of the El Niño Southern Oscillation.

Intertidal – that land area between mean low water and mean high water that is inundated periodically by tides.

Inundation - See definition for Flood.

King tides – any high water level that is well above the average, commonly applied to two spring tides that are the highest for the year, one during summer and one in winter.

La Niña – the opposite state to El Niño, occurring when the SOI is positive. La Niña tends to bring above average rainfall over much of Australia.

Lagoon – a shallow body of open water, partly or completely separated from the sea by a coastal barrier or reef. Sometimes connected to the sea via an inlet.

Likelihood – the chance of something happening, whether defined, measured or determined objectively or subjectively, qualitatively or quantitatively, and described using general terms or mathematically (such as a probability or a frequency over a given time period).

Littoral – of or pertaining to a shore, especially of the sea. Often used as a general term for the coastal zone influenced by wave action, or, more specifically, the shore zone between the high and low water marks.

Littoral transport rate – rate of transport of sedimentary material parallel or perpendicular to the shore in the littoral zone. Usually expressed in cubic metres per year. Commonly synonymous with longshore transport rate.

Local council – for the purposes of the coastal management manual, a council that is wholly or partly within the coastal zone of NSW.

Longshore transport (littoral drift) – refers to the sediment moved along a coastline under the action of wave-induced longshore currents (Dean and Dalrymple, 2002). The net drift is the sum of the positive (conventionally northwards direction in NSW) and negative (southwards in NSW) direction. The gross drift is the sum of the drift magnitudes (absolute values). The differential drift is the difference between the net drift into and out of a coastal compartment. Both gross and net drift are typically averaged over a year and expressed in m^3/yr.

Macro-invertebrates – large invertebrates which may be found in waterways and consisting largely of larval insects, worms, and related organisms.

Maintenance dredging – the recurrent dredging of sediment from a waterway, including existing navigation channels, approaches and berths, to allow safe navigation by commercial or recreational boating traffic.

Managed retreat – also referred to as managed realignment. For the coastal zone (generally the coastal vulnerability area), managed retreat allows the shoreline to migrate landward unimpeded. It allows an area that was not previously exposed to coastal processes and hazards to become exposed, for instance by removing or breaching coastal protection works. Managed retreat may involve the relocation landward, out of a coastal risk area, of homes and infrastructure under threat from coastal erosion, recession or inundation. It may also involve the deliberate setting back (moving landward) of the existing line of sea defence to obtain engineering or environmental advantages. During a managed retreat process, a new foreshore area or new intertidal habitat may be created.

Marine sediment – sediment originating from the sea.

Mean high water mark – the line of the medium high tide between the highest tide each lunar month (the springs) and the lowest tide each lunar month (the neap) averaged over out over the year. In NSW, the methods for determining the position of the MHWM are outlined in the Crown Directions to Surveyors - No. 6 Water as a Boundary.

Mean sea level – the arithmetic mean of hourly heights of the sea at a tidal station, observed over a long period of time.

Midden - Aboriginal place of significance where debris from eating shellfish and other food has accumulated over time. Often found on headlands, beaches and dunes, around estuaries, swamps and along the banks of rivers, creeks and lakes.

Multi-criteria analysis – a logical and structured decision-making tool for complex problems involving multiple factors or criteria, where a consensus is difficult to achieve. It may involve processes such as ranking, rating (with relative or ordinal scales) or pairwise comparisons. The process allows participants to consider, discuss and test complex trade-offs among alternatives

Natural character – includes all-natural aspects of the land and sea, including the underlying ecological, hydrological and geomorphological processes that shape landforms (including underwater features) and the natural movements of water and sediment. Natural character also includes aspects of the environment that affect human experience including the natural darkness of the night sky, the sounds and smell of the coast, and the context and setting of natural places.

Natural coastal processes – the coastal processes over which people have no control, such as wind, waves and tides.

Natural heritage – the natural living and non-living components, that is, the biodiversity and geodiversity, of the world that humans inherit.

Near shore – the area of ocean close to the coast that is affected by waves, tides and longshore currents.

NSW Coastal Council – established under Part 4 of the CM Act. A group of three to seven coastal experts, appointed by the Minister to provide advice on coastal management issues.

Nutrient cycling - The movement and exchange of organic and inorganic matter back into the production of matter.

Outflanking or end effects – erosion behind or around the land-based end of a groyne, jetty or breakwater or the terminus of a revetment or seawall, usually causing failure of the structure or its function.

Overfill ratio - also known as the **overfill** factor, describes the volume of borrow sediment that, in theory, will ultimately yield a residual unit volume of sediment on the beach, after grain sorting and losses.

Over-wash – the part of the wave uprush that runs over the crest of a berm or structure and does not flow directly back to the ocean or lake. When waves overtop a coastal protection structure they often carry sediment landwards which is then lost to the beach system. Also defines a process in which waves penetrate inland of the beach, which is common on low barriers.

Peak height - The highest level reached, at a nominated gauging station, during a particular flood event.

Pollution – the condition caused by the presence of substances of such character and in such quantities that the quality of the environment is impaired; or the human-induced alteration of the chemical, physical, biological or radiological integrity of an aquatic ecosystem.

Probabilistic hazard assessment – a risk-based approach to managing coastal hazard that takes uncertainty into account by considering both the likelihood and consequence of hazard occurrence. It applies a stochastic simulation to evaluate coastal processes. The technique uses a distribution of values for each parameter to account for expected variation, or uncertainty, rather than single values. Parameters are then combined by a Monte-Carlo technique to produce a probabilistic forecast of future shoreline position. This is quite different to traditional deterministic hazard assessments that produce single values for beach erosion and shoreline recession.

Probabilistic model – mathematical model in which the behaviour of one or more of the variables is either completely or partially subject to probability laws.

Progradation – the building forward or outward toward the sea of a shoreline or coastline (as with a beach, delta, or fan) by nearshore deposition of river-borne sediments or by continuous accumulation of beach material thrown up by waves or moved by longshore drifting.

Public Authority – defined in the CM Act as a Minister of the Crown of the State, a State-owned corporation, an electricity supply authority, a department or instrumentality of the State, a local council and any other public or local authority constituted by or under any Act and includes any prescribed body.

Recession – a continuing landward movement of the shoreline; or a net landward movement of the shoreline over a specified time.
Reflection – the process by which the energy of the wave is returned seaward.
Refraction – the process by which the direction of a wave moving in shallow water at an angle to the contours is changed. The part of the wave advancing in shallower water moves more slowly than that part still advancing in deeper water, causing the wave crest to bend toward alignment with the underwater contours; or the bending of wave crests by currents.
Rehabilitation - The process of returning the environment in a given area to some degree of its natural state, after some process has resulted in its damage.
Riparian vegetation - Vegetation located along the banks of a body of water, usually rivers.
Residual risk – the risk which remains after managing and reducing risks. It may include for example, risks due to very severe storms or from unexpected hazards.
Resilience – the ability of a system (human or natural) to adapt to changing conditions (including hazards or threats, variability and extremes), and rapidly recover from disruption due to emergencies. Resilient systems or communities have the capacity to 'bounce back' after a disrupting event such as a major storm or an extended heat wave, to moderate potential damages, take advantage of opportunities, maintain or restore function or to cope with the consequences.
Revetment or seawall – a type of coastal protection work which protects assets from coastal erosion by armouring the shore with erosion–resistant material. Large rocks/boulders, concrete or other hard materials are used, depending on the specific design requirements.
Rip – a narrow, strong shore normal current in the nearshore area of most wave-dominated beaches (i.e. most beaches along the open coast of NSW). They are fed by along shore feeder currents initiated by the deflection of waves at the shoreline. There are diverse types of rip on NSW beaches and they affect beach safety.
Riparian – pertaining to the banks of a body of water, such as an estuary.
Risk – effect of uncertainty on planning and management objectives, usually characterised by reference to potential hazards, their consequence and their likelihood. Consequence combines the concepts of magnitude, sensitivity and duration.
Risk-based Framework - a protocol that decision-makers, such as councils and environmental regulators, can use to help manage the impact of land-use activities on the health of waterways in New South Wales.
Sand drift – the movement of sand by wind. On the coast, this generally describes sand movement resulting from natural or human-induced degradation of dune vegetation, resulting in either nuisance or major sand drift (dune transgression).
Sea level rise – an increase in the mean level of the oceans. Relative sea level occurs where there is a local increase in the level of the ocean relative to the land, which might be caused by ocean rising, the land subsiding, or both. In areas with rapid land level uplift (e.g. seismically active areas), relative sea level can fall.
Sediment cells (tertiary) – small and relatively contained sediment compartments. A tertiary sediment cell may apply to a single beach/embayment.
Sediment transport – the process whereby sediment is moved offshore, onshore or along shore by wave, current or wind action.
Sensitivity – the degree to which a built, natural or human system is directly or indirectly affected by changes in hazards, threats or climate conditions.
Shoreline recession – refers to continuing landward movement of the shoreline, that is, a net landward movement of the shoreline, generally assessed over a period of several years. As shoreline recession occurs the beach fluctuation zone is translated landward.
Southern Oscillation Index – the normalised mean atmospheric pressure difference between Tahiti and Darwin, measured at sea level. The SOI is negative during El Niño and positive during La Niña.
Stakeholder – a person or organisation with an interest or concern in something.

State objectives – the state's objectives for the coast are set out in the CM Act.

Storm surge – the increase in coastal water level caused by the effects of storms. Storm surge consists of two components – the increase in water level caused by the reduction in barometric pressure and the increase in water level caused by the action of wind blowing over the sea surface (wind set-up).

Storm tide – an abnormally high water level that occurs when a storm surge combines with a high astronomical tide. The storm tide must be accurately predicted to determine the extent of coastal inundation.

Strategic management of the coast – planning and management that is wide-ranging, considers multiple issues at multiple spatial scales and multiple timeframes. It identifies the opportunities and constraints of different broad options to achieve big-picture objectives and defines the best way forward.

Surf zone – defined in CM Act as the area from the line of the outer most breaking waves to the limit of wave run-up on the beach.

Sustainable management – develops and implements proposals that meet the needs of present communities without compromising the ability of future generations to meet their own needs.

Swash zone – the zone of wave action on the beach, which moves as water levels vary, extending from the limit of run down to the limit of run-up.

Swell waves – ocean waves that travel beyond the area where they are generated.

Temporal scale - The habitat lifespan relative to the generation.

Threats – see Coastal threats. In the coastal management context, a threat is a process or activity which puts pressure on one or more coastal assets or values. Threats may include land uses (e.g. urban, recreation), land management, climate change, industrial discharges, stormwater runoff, overfishing, invasive species as well as the pressures from coastal hazards.

Threshold – can be identified for aspects of coastal systems, to highlight tipping points for irreversible change.

An ecological threshold is the point at which there is an abrupt change in the structure, quality, or functioning of an ecosystem or where external changes produce large and persistent responses in an ecosystem. A species threshold may disrupt aspects of the species population, productivity, reproduction, or habitat in response to a stressor. Such 'tipping points' can lead to unwanted changes in ecosystems and may slow the recovery of ecosystems or limit their ability to achieve more resilient states following a disturbance.

Similarly, a social or economic threshold of change in a coastal community indicates the point at which the structure, function, social connectedness, equality or economic activity of the community changes beyond recovery.

Thresholds can also be defined for coastal water levels as they relate to the resilience of certain types of development.

Tidal channel – a major channel followed by tidal currents, extending from offshore into a tidal marsh or a tidal flat; tidal inlet.

Tidal circulation – the movement of fresh water and seawater that are mixed by currents and flows in an estuary, in response to ocean tides.

Tidal currents - Currents caused by the incoming (flood) or outgoing (ebb) tide (see Tide). Tidal currents are typically the main current within estuaries, particularly in the entrance area where tidal currents transport marine sediments (sand).

Tidal delta – where an inlet of a barrier estuary or open coastal lake is dominated by tidal processes, a flood tide delta develops inside the entrance, as tidal currents transport marine sand into the estuary. Ebb tide deltas may also occur, outside the mouth of an estuary.

Tidal inundation – the inundation of land by tidal action under average meteorological conditions and the incursion of sea water onto low lying land that is not normally inundated, during a high sea level event such as a king tide or due to longer-term sea level rise.

Tidal limit – the maximum upstream location on a watercourse at which a tidal variation in water level is observed.

Tidal prism - The total amount of water that flows into a harbour, estuary or lake or out again with movement of the tide, excluding any freshwater flow.

Tide - The periodic rise and fall of the water of oceans, seas, bays, etc., caused mainly by the gravitational interactions between the Earth, Moon and Sun.

Tolerable risk – a risk that, following an understanding of the likelihood and consequences, is low enough to allow the exposure to continue, and at the same time high enough to require new treatments or actions to reduce risk. Society can live with this risk but believe that as much as is reasonably practical should be done to reduce the risks further. Note that individuals may find this risk unacceptable and choose to take their own steps, within reason, to make this risk acceptable. Residual risks are considered tolerable only if risk reduction is impractical.

Training walls – walls constructed at the entrances of estuaries and rivers to improve navigability.

Tributary - A stream or river that flows into a larger stream or lake.

Trigger – pre-negotiated decision-making points and commitments, so that action on coastal risks is taken when necessary, and when it is most convenient and affordable for the affected community

Tropical cyclone – intense low-pressure system in which winds of at least 63km/hour whirl in a clockwise direction, in the southern hemisphere around a region of calm air.

Tsunami – a long period water wave caused by an underwater disturbance such as a volcanic eruption or earthquake. Sometimes (incorrectly) called a ‘tidal wave’.

Unacceptable risk – a risk that, following an understanding of the likelihood and consequences, is so high that it requires actions to avoid or reduce the risk. Individuals and society will not accept this risk and measures should be put in place to reduce risks to at least a tolerable level.

Vulnerability – a function of exposure and sensitivity of assets to a hazard, which determines the potential impacts of the hazard. For instance, the vulnerability of coastal assets may be influenced by the extent and impact of environmental, social and economic factors such as saline contamination of soils from flooding, erosion of built-up and natural areas, loss of vegetation, disruption to use, or access, or continuity of service, or loss of amenity, corrosion of built structures, undermining of foundations or damage to contents. Vulnerability also considers the adaptive capacity which is the capacity to adapt or the resilience in the system to manage the impacts and changes.

Wave amplitude – the magnitude of the displacement of a wave from a mean value. An ocean wave has an amplitude equal to the vertical distance from the still water level to wave crest. For a sinusoidal wave, amplitude is one–half the wave height. (USACE).

Wave climate – the seasonal and annual distribution of wave height, period and direction.

Wave-dominated coast – the coast of south eastern Australia is a wave-dominated system. This affects the beach type and the types of estuaries that occur in the landscape.

Wave energy – the capacity of waves to do work. The energy of a wave system is theoretically proportional to the square of the wave height; a high–energy coast is characterised by breaker heights greater than 50 centimetres and a low–energy coast is characterised by breaker heights less than 10 centimetres. Most of the wave energy along equilibrium beaches is used in shoaling and in sand movement. The NSW coast is a high wave energy coast.

Wave run-up – the vertical distance above mean water level reached by the uprush of water from waves across a beach or up a structure.

Wave set-up – the rise in the water level above the still water level when a wave reaches the coast. It can be very important during storm events as it results in further increases in water level above the tide and surge levels.

Wind waves – ocean waves resulting from the action of the wind on the surface of the water.

Zone of profile fluctuation – the area within which the subaerial beach profile can be expected to fluctuate under the current patterns of climate and weather conditions (i.e. including storms and decadal scale cycles).

Zone of Slope Adjustment – the area landward of an escarpment cut by storm bite, which may be affected by slumping to the angle of repose of the sand as it dries.

19 Acronyms

The following pages provide a list of acronyms that are in common use when describing the NSW coastal management framework, and are often used during development of Coastal Management Programs:

ABS	Australian Bureau of Statistics
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ALERT	Automated Local Evaluation in Real Time
BoM	Bureau of Meteorology
CEMP	Construction Environmental Management Plan
CM Act	*Coastal Management Act 2016*
CM SEPP	State Environmental Planning Policy (Coastal Management) 2018 (now consolidated within State Environmental Planning Policy (Resilience and Hazards) 2021
CMP	Coastal Management Program (prepared under the Coastal Management Act 2016)
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Council	Sutherland Shire Council
CVA	Coastal Vulnerability Area
CZMP	Coastal Zone Management Plan (prepared under the former Coastal Protection Act 1979)
DCCEEW	Department of Climate Change, Energy, the Environment & Water
DCP	Development Control Plan
DECC	Department of Environment Climate Change (now DCCEEW)
DOE	Department of Environment (now DCCEEW)
DPI	Department of Primary Industries (now DPIRD)
DPIE	Department of Planning, Industry and Environment (now DCCEEW)
DPIRD	Department of Primary Industries & Regional Development
EEC	Endangered Ecological Community
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPA	Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FM Act	*Fisheries Management Act 1994*
FM Regulation	Fisheries Management (General) Regulation 2002
IAP2	International Association for Public Participation
ICOLL	Intermittently Closed and Open Lake/Lagoon
IP&R	Integrated Planning and Reporting (in accordance with the *Local Government Act 1993*)
ISEPP	State Environmental Planning Policy (Infrastructure) 2007 (now consolidated within State Environmental Planning Policy (Transport and Infrastructure) 2021)
ISO	International Organisation for Standardization
LEP	Local Environment Plan
LGA	Local Government Area
MEMA	Marine Estate Management Authority
MHL	Manly Hydraulics Laboratory
MHWS	Mean High Water Springs
MLWM	Mean Low Water Mark
NES	National Environmental Significance
NOW	NSW Office of Water
NPWS	National Parks and Wildlife Services

NSR	National Surfing Reserve
NSW GIS	New South Wales Geographic Information System
OEH	Office of Environment and Heritage (previously DECCW, now DCCEEW)
PoEO Act	*Protection of the Environment Operations Act 1997*
REF	Review of Environmental Factors
Resilience and Hazards SEPP	State Environmental Planning Policy (Resilience and Hazards) 2021
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
SLSC	Surf Life Saving Club
Transport and Infrastructure SEPP	State Environmental Planning Policy (Transport and Infrastructure) 2021
TfNSW	Transport for New South Wales
TSC Act	*Threatened Species Conservation Act 1995*

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APPENDIX A – Bate Bay Coastal Zone Emergency Action Subplan

REPORT

Bate Bay Coastal Management Program
Coastal Zone Emergency Action Subplan

Bate Bay CMP
CZEAS

Client: Sutherland Shire Council

Reference PA2189-RHD-BB-CZEAS-AT-0004
Status Final 0004
Date 18 July 2024

Royal HaskoningDHV
Enhancing Society Together

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Date:	18 July 2024
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Classification
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Revision history

Revision	Date	Description
0001	17 August 2021	Initial Draft CZEAS for Sutherland Shire Council review
0002	31 October 2021	Draft CZEAS for Council approval and consultation
0003	30 March 2022	Final CZEAS for Council approval
0004	18 July 2024	Update Agency names

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Sutherland Shire Council Acknowledgement of Country

Sutherland Shire Council acknowledges the Dharawal speaking people who are the Traditional Custodians of the land of Sutherland Shire.

Council pays respect to the Elders past and present of the Dharawal nation and extends that respect to other Aboriginal people visiting this site.

1 Executive Summary

The Bate Bay coastline is one of the Sutherland Shire's most important natural assets and is highly valued for the quality of its beaches, surf, coastal vegetation and overall recreational and scenic amenity. Sutherland Shire Council (Council) has for many decades proactively managed the coastline to enhance these values and protect against coastal hazards. This has included constructing coastal protection works, improving access to and along the foreshore, sand nourishment of beaches, ongoing coastal dune management and supporting the designation of the beaches as a National Surfing Reserve.

The NSW Government has established a coastal management framework under the *Coastal Management Act 2016* (CM Act) and incorporates the State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP[1]), grant funding, technical guidance and governance arrangements. Coastal Management Programs (CMPs) prepared by local councils are the primary mechanism for achieving the objectives and requirements of the CM Act.

The CM Act identifies specific emergency management considerations associated with beach erosion, coastal inundation and cliff instability. The CM Act (section 15(1)(e)) outlines that a Coastal Zone Emergency Action Subplan (CZEAS) must be included in a CMP if the local council's local government area contains land within the Coastal Vulnerability Area (CVA) and beach erosion, coastal inundation or cliff instability is occurring on that land due to storm activity or an extreme or irregular event.

While noting that at the commencement of the CM SEPP, no CVA Map was adopted and therefore no CVA has been identified, it is recognised that Bate Bay beaches have been impacted by coastal hazards on numerous occasions and it is considered appropriate to develop a CZEAS for this location. Other coastal hazards identified in s. 4 of the CM Act (shoreline recession, coastal lake or watercourse entrance instability, tidal inundation and erosion and inundation of foreshores caused by tidal waters and the action of waves) are outside the scope of the CZEAS.

Mandatory requirements for a CMP, including the preparation of a CZEAS have been identified in Part A of the Coastal Management Manual (OEH, 2018). Further direction on the preparation of a CZEAS is provided in the *"Guideline for preparing a coastal zone emergency action subplan"* (DPIE, 2019). The Bate Bay Coastal Zone Emergency Action Subplan (BBCZEAS) has been developed in accordance with this guidance.

The following key principles are applied to emergency management in New South Wales:

- Prevention: to eliminate or reduce the level of the risk or severity of emergencies.
- Preparation: to enhance capacity of agencies and communities to cope with the consequences of emergencies.
- Response: to ensure the immediate consequences of emergencies to communities are minimised.
- Recovery: measures which support individuals and communities affected by emergencies in the reconstruction of physical infrastructure and restoration of physical, emotional, environmental and

[1] ***Please note***:
As of 1 March 2022:
- *the State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP) was consolidated within State Environmental Planning Policy (Resilience and Hazards) 2021. All references to State Environmental Planning Policy (Coastal Management) and CM SEPP are deemed to be equivalent to references to State Environmental Planning Policy (Resilience and Hazards) 2021.*

economic well-being.

The overarching framework for emergency management in New South Wales is established by the *State Emergency and Rescue Management Act 1989* (SERM Act). The SERM Act outlines roles and responsibilities for all emergency management in New South Wales, and establishes the hierarchy and requirements of emergency management plans (EMPLANS) from a State through to local level.

The NSW State Emergency Service (NSW SES) prepares the State Storm Plan, State Flood Plan and State Tsunami Plan, which are subplans to the EMPLAN, and is the designated combat agency for management of floods, tsunami and storms, including severe storms which cause coastal erosion.

The CZEAS is designed to be consistent with, and complimentary to, plans prepared under the SERM Act including the state, regional and local EMPLANs, State Storm Plan and State Flood Plan. The relationship between the SERM Act and CM Act is detailed in **Figure 1-1**.

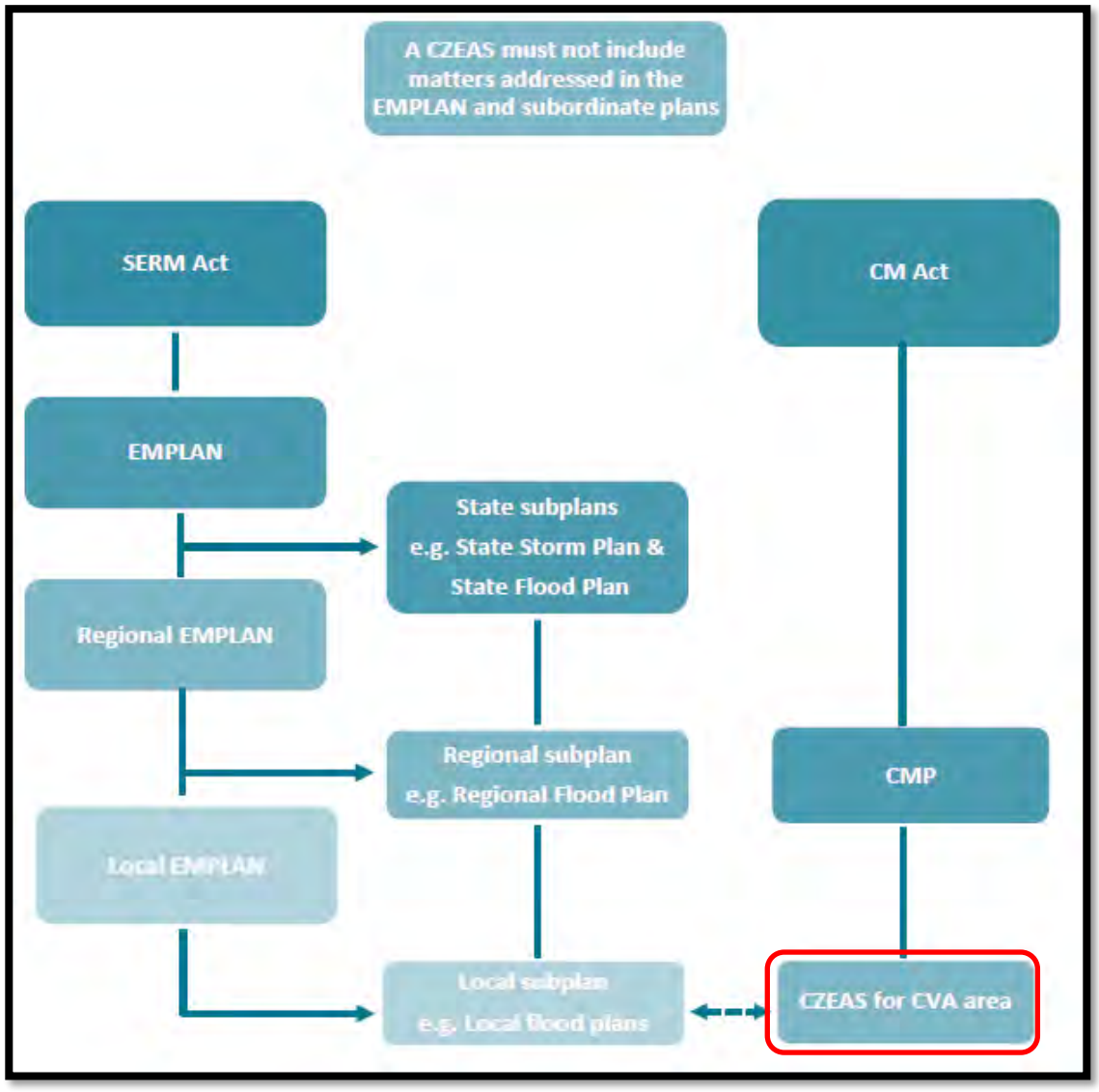


Figure 1-1: Simplified legislative framework for emergency management in NSW and its relationship with coastal management legislation and coastal management programs related to coastal hazards (DPIE, 2019), with the CZEAS noted in red.

Council is a signatory to the Sutherland Shire Local Emergency Management Plan (Sutherland EMPLAN) (New South Wales Government, 2019), which details arrangements for prevention of, preparation for, response to, demobilisation from and transition of control for emergencies, between combat agencies including Council, the NSW Police, Ambulance Service, NSW SES, Fire and Rescue NSW and others.

The Sutherland Shire Flood Emergency Sub Plan (Sutherland FESP) (Sutherland Shire Council, 2013) was endorsed by the Sutherland Shire Council Local Emergency Management Committee as a sub plan of the Local EMPLAN, and covers preparedness measures, the conduct of response operations and the coordination of immediate recovery measures from flooding and management of coastal erosion in the council area, notably through defining specific roles and responsibilities of the NSW SES, Council, and other agencies.

The BBCZEAS is intended to be a Sub Plan to the Sutherland EMPLAN and a Supporting Plan to the Sutherland FESP (further description provided in **Section 5**), providing:

- objectives and scope of the CZEAS, consistent with the objects of the CM Act, management objectives of the CVA and the strategic direction of the CMP;
- a definition of coastal emergencies;
- criteria/thresholds/triggers for when a coastal emergency is occurring;
- a map and/or register of land and assets that are, or may be, affected by beach erosion, coastal inundation or cliff instability;
- coastal emergency actions for the four phases of emergency management: prevention, preparation, response and recovery; and
- a protocol for communication and engagement before, during and after an emergency event.

Please note:

It is recognised that many of the actions within the BBCZEAS may already be delivered by Council as standard operations (e.g. monitoring and closure of beach accessways as required).

*The BBCZEAS is intended to provide additional guidance to Council (and other agencies) in relation to actions required in response to a coastal **emergency** as defined under the SERM Act.*

2 Introduction

The Bate Bay coastline is one of the Sutherland Shire's most important natural assets and is highly valued for the quality of its beaches, surf, coastal vegetation and overall recreational and scenic amenity. Sutherland Shire Council (Council) has for many decades proactively managed the coastline to enhance these values and protect against coastal hazards.

Council developed and adopted the Bate Bay Coastline Management Plan in 2003 (Patterson Britton, 2003) in accordance with the requirements of the *Coastal Protection Act 1979*. The issues, objectives, strategies and actions contained within this document have generally been used as the basis for management of coastal areas within Bate Bay up until the present time. This has included constructing coastal protection works, improving access to and along the foreshore, sand nourishment of beaches, ongoing coastal dune management and supporting the designation of the beaches as a National Surfing Reserve.

The NSW Government has established a revised coastal management framework that aims to achieve a healthy and resilient coastline with thriving coastal communities. The introduction of the *Coastal Management Act 2016* (CM Act), the State Environmental Planning Policy (Coastal Management) 2018 (CM SEPP) and the NSW Coastal Management Manual (the Manual) (OEH, 2018) Prepared by local councils in accordance with the five stage process outlined in the Manual, Coastal Management Programs (CMPs) are the primary mechanism for achieving the objectives of the CM Act), and aim to set a long-term, coordinated and sustainable direction for the management of coasts and estuaries.

In 2018, Council embarked on the staged preparation of a CMP for Bate Bay in accordance with the NSW coastal management framework and with financial and technical assistance provided through the NSW Coastal and Estuary Grants Program and the NSW Department of Climate Change, Energy, the Environment & Water.

The Bate Bay CMP provides a set of prioritised, coordinated and cost-effective actions that, when progressively implemented, will help to ensure that Bate Bay is ecologically healthy, resilient, attractive and accessible. The CMP builds on the positive work undertaken over many decades but takes greater account of the complexity of this dynamic stretch of coastline by incorporating updated technical understanding of coastal processes and coastal development since the 2003 Bate Bay Coastline Management Plan (Patterson Britton, 2003), as well as reflecting current community interests and legislative requirements.

The coastal area to the south of Bate Bay comprises Port Hacking, which is primarily an estuarine environment. The coastal areas to the north of Bate Bay include the rocky cliffs within Kamay Botany Bay National Park and the shoreline areas within Botany Bay. The management of coastal areas within Port Hacking and Botany Bay will be documented in separate CMPs. The study area for the purposes of this report extends from Bass and Flinders Point in the south to Potter Point in the north, and has been divided into four (4) precincts based on the relative homogeneity of the natural and cultural values and settings within each zone (Patterson Britton, 2003). These precincts are shown on Figure 2-1, and encompass:

- Precinct 1: The Cliff-Top Walk – 'The Esplanade', Bass and Flinders Point, Oak Park, Shelly Park, Shelly and Blackwoods Beaches.
- Precinct 2: The City Beaches – Cronulla Beach to North Cronulla Beach.
- Precinct 3: The Surf Beaches – Prince Street Seawall, Elouera Beach to Wanda Reserve.
- Precinct 4: The Beach Reserve – Green Hills, Boat Harbour, Potter Point.

Figure 2-1: The Bate Bay CMP Study Area and segmentation of the foreshore into Precincts

The first stage (Stage 1) of the CMP process required the preparation of a CMP Scoping Study, which was completed by Royal HaskoningDHV (RHDHV) for Council in 2018. Stage 2 of the CMP process included a detailed Coastal Vulnerability Assessment, which determined risks, vulnerabilities and opportunities within the study area, and identified a range of issues and locations that may be impacted during a coastal hazard event.

The CM Act (section 7) provides for a Coastal Vulnerability Area to include land subject to coastal hazards. “Coastal Hazard” is defined within s. 4 of the CM Act, to mean the following:

(a) beach erosion,
(b) shoreline recession,
(c) coastal lake or watercourse entrance instability,
(d) coastal inundation,
(e) coastal cliff or slope instability,
(f) tidal inundation,
(g) erosion and inundation of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters.

It is noted that the CM Act (section 15(1)) provides for a CMP to deal with *issues affecting the areas to which the program is to apply*. It is open for the CMP to address only the relevant hazards rather than seek to address hazards which are not present or not sufficiently present to be considered an issue affecting the subject area.

For the Bate Bay CMP, the following hazards are considered relevant (other hazards are not an issue at this location, and as such are not included in this assessment):

(a) beach erosion;
(b) shoreline recession;
(d) coastal inundation; and
(e) coastal cliff or slope instability.

The context and content of the BBCZEAS is provided as follows:

Section 3	Purpose of the Bate Bay CZEAS
Section 4	The overarching NSW Planning and Legislative context for emergency events and coastal management
Section 5	Coastal hazard emergency preparation and response framework, including a description of, and relationship between, Emergency Plans and Subplans
Section 6	Roles and requirements of Council, the NSW SES and other agencies
Section 7	Physical extent of the Bate Bay CZEAS
Section 8	Definition of coastal hazards within Bate Bay, and how they are addressed
Section 9	Approvals required for Coastal Protection Works
Section 10	Action Plan, describing actions to be implemented in each of the four phases of emergency management, being Prevention, Preparation, Response and Recovery
Section 11	Communication before, during and after an emergency event
Section 12	Implementation and review of the BBCZEAS
Section 13	Recommendations for amendments to the Sutherland EMPLAN and Sutherland FESP

3 Purpose of the BBCZEAS

The purpose of the BBCZEAS is to identify and facilitate the implementation of appropriate emergency responses for emergencies related to coastal hazards that will:

- Protect human life and public safety;
- Minimise damage to property and assets;
- Minimise impacts on social, environmental and economic values; and
- Not create additional hazards or risks.

Actions in the BBCZEAS aim to reduce risk:

- In areas where Council has chosen not to implement coastal protection works to reduce coastal hazard risks, which have been evaluated as tolerable or acceptable;
- Where coastal hazard risks have not been reduced or eliminated because an agreed action in the Bate Bay CMP has not yet been implemented;
- Where coastal hazard risks remain after other actions have been implemented (residual risk); and
- When rare and very large or unexpected events occur, outside the design criteria or capacity of agreed management actions in the Bate Bay CMP.

The BBCZEAS has been prepared to facilitate effective emergency responses by:

- Defining a **coastal emergency** and triggers for emergency response actions;
- Identifying the locations that may be affected by beach erosion, coastal inundation or cliff instability that would constitute a coastal emergency;
- Outlining the roles and responsibilities of all public authorities (including Council) and coordinating their response to emergencies immediately preceding or during periods of beach erosion, coastal inundation and cliff instability;
- Identifying the locations and types of works that may be undertaken for the protection of property and assets;
- Outlining what actions are to be undertaken in the prevention, preparation, response and recovery phases of emergency management; and
- Informing the public and potentially affected property owners about their responsibilities during a coastal emergency and what actions they are and are not permitted to undertake.

4 Planning and Legislative Context

4.1 *State Emergency and Rescue Management Act 1989*

The overarching framework for emergency management in New South Wales is established by the *State Emergency and Rescue Management Act 1989* (SERM Act).

The SERM Act defines an **emergency** as follows:

> *(1) In this Act:*
> ***emergency** means an emergency due to an actual or imminent occurrence (such as fire, flood, storm, earthquake, explosion, terrorist act, accident, epidemic or warlike action) which:*
> *(a) endangers, or threatens to endanger, the safety or health of persons or animals in the State, or*
> *(b) destroys or damages, or threatens to destroy or damage, property in the State, or*
> *(c) causes a failure of, or a significant disruption to, an essential service or infrastructure, being an emergency which requires a significant and coordinated response.*
>
> *(2) For the purposes of the definition of **emergency**, property in the State includes any part of the environment of the State. Accordingly, a reference in this Act to:*
> *(a) threats or danger to property includes a reference to threats or danger to the environment, and*
> *(b) the protection of property includes a reference to the protection of the environment.*

The SERM Act outlines roles and responsibilities for all emergency management in NSW. The SERM Act specifies:

- That emergency management committees are established at the state, regional and local levels;
- That emergency management plans (EMPLANs) are prepared and reviewed at the state, regional and local level;
- Arrangements for controlling emergency operations; and
- Responsibilities of emergency operations controllers.

Arrangements established by the SERM Act are explained in Emergency Management Arrangements for NSW (NSW Government, 2016) and on the NSW Emergency website. The NSW EMPLAN describes the NSW approach to emergency management, the governance and coordination arrangements, and roles and responsibilities of agencies.

The objectives of the NSW EMPLAN are to:

- Provide clarity as to command and control, roles and coordination of functions in emergency management across all levels;
- Emphasise risk management across the full spectrum of prevention, preparation, response and recovery;
- Emphasise community engagement in the development and exercise of plans as well as in their operational employment; and
- Ensure that the capability and resourcing requirements of these responsibilities are understood.

The NSW SES is the designated combat agency for management of floods, tsunami and storms, including severe storms which can be associated with coastal erosion.

The NSW SES prepared the State Storm Plan, State Flood Plan and State Tsunami Plan, which are subplans to the NSW EMPLAN.

Coastal erosion caused by storm activity is within the scope of the State Storm Plan (New South Wales Government, 2018b); which clarifies the respective roles of the NSW SES and local government in relation to coastal erosion; as follows:

- Local Government is to activate CZEASs as required (Action 5.2.10);
- Local Government is to implement emergency works, including construction of physical works (Action 5.3.6.b);
- NSW SES coordinate the protection (relocation/removal) of readily moveable household and commercial contents where time and resources permit when property is at risk from coastal erosion (Action 5.3.6.a); and
- NSW SES will control and coordinate the evacuation of affected communities/properties when there is a risk to public safety (Action 5.7.2)

Under Action 1.4.3 of the NSW Storm Plan, the emergency management of coastal erosion that is *not* caused by storm activity will be controlled and coordinated by the Local Emergency Operations Controller (LEOCON).

4.2 *Coastal Management Act 2016*

The CM Act identifies specific emergency management considerations associated with beach erosion, coastal inundation and cliff instability. The CM Act (section 15(1)(e)) outlines that a CZEAS must be included in a CMP if the local council's local government area contains land within the Coastal Vulnerability Area (CVA), and beach erosion, coastal inundation or cliff instability is occurring on that land.

While noting that at the commencement of the CM SEPP, no CVA Map was adopted and therefore no CVA has been identified, it is recognised that Bate Bay has been impacted by coastal erosion on numerous occasions and it is considered appropriate to develop a CZEAS for this location.

Mandatory requirements for a CMP, including the preparation of a CZEAS where required, are identified in Part A of the Coastal Management Manual (OEH, 2018). Further direction on the preparation of a CZEAS is provided in the *"Guideline for preparing a coastal zone emergency action subplan"* (DPIE, 2019).

Relevant statutory provisions from the CM Act:

15 Matters to be dealt with in coastal management program

(1) A coastal management program must:

(e) if the local council's local government area contains land within the coastal vulnerability area and beach erosion, coastal inundation or cliff instability is occurring on that land, include a coastal zone emergency action subplan.

(3) A coastal zone emergency action subplan is a plan that outlines the roles and responsibilities of all public authorities (including the local council) in response to emergencies immediately

preceding or during periods of beach erosion, coastal inundation or cliff instability, where the beach erosion, coastal inundation or cliff instability occurs through storm activity or an extreme or irregular event. For the purposes of this subsection, those roles and responsibilities include the carrying out of works for the protection of property affected or likely to be affected by beach erosion, coastal inundation or cliff instability.

(4) A coastal management program must not include the following:

(a) matters dealt with in any plan made under the State Emergency and Rescue Management Act 1989 in relation to the response to emergencies,
(b) proposed actions or activities to be carried out by any public authority or relating to any land or other assets owned or managed by a public authority unless the public authority has agreed to the inclusion of those proposed actions or activities in the program.

Relevant mandatory requirements of the Coastal Management Manual Part A

Requirements for preparing a CMP which includes a proposed or mapped coastal vulnerability area

10. Where coastal hazards have been identified in a coastal management area, a CMP must identify proposed coastal management actions for those hazards.

11. If the CM Act requires that a coastal zone emergency action subplan be prepared, it must identify any requirements for how emergency coastal protection works, within the meaning of the CM SEPP, are to be carried out.

Note: Clause 19(4) of the CM SEPP defines emergency coastal protection works to mean '*works comprising the placement of sand, or the placing of sandbags for a period of not more than 90 days, on a beach, or a sand dune adjacent to a beach, to mitigate the effects of coastal hazards on land*'.

5 Coastal Hazard Emergency Preparation and Response Framework

A CZEAS within a CMP must not include matters dealt with in any plan made under the *State Emergency and Rescue Management Act 1989*. Where actions, roles or responsibilities relating to coastal emergencies are covered by the SERM Act framework, the CZEAS should refer to the relevant plan or subplan, rather than duplicate those actions.

The BBCZEAS is a Sub Plan to the Sutherland Shire Local Emergency Management Plan, and a Supporting Plan to the Sutherland Shire Flood Emergency Sub Plan.

The BBCZEAS provides guidance as to actions for Council and other combat agencies can take during a "coastal hazard" emergency event, as well as recognising the actions for other types of emergency events that are described within the Sutherland Shire Local Emergency Management Plan and Sutherland Shire Flood Emergency Sub Plan.

Please note:

Specific actions within the Sutherland Shire Local Emergency Management Plan and Sutherland Shire Flood Emergency Sub Plan that relate to coastal hazards are repeated below, to facilitate rapid reference during a coastal hazard emergency event.

Additional guidance, including the definitions and locations of coastal hazards within Bate Bay is provided in ***Section 8****, and an emergency Action Plan that describes roles and responsibilities in a coastal hazard emergency event is provided in* ***Section 10****.*

Recommendations for amendments to the Sutherland EMPLAN and Sutherland FESH are provided in ***Section 13.***

5.1 Sutherland Shire Local Emergency Management Plan

The Sutherland Shire Local Emergency Management Plan (Sutherland EMPLAN) (New South Wales Government, 2019) details arrangements for prevention of, preparation for, response to, demobilisation from and transition of control for emergencies.

It encompasses arrangements for:

- emergencies controlled by combat agencies;
- emergencies controlled by combat agencies and supported by the Local Emergency Operations Controller (LEOCON);
- emergency operations for which there is no combat agency; and
- circumstances where a combat agency has passed control to the LEOCON.

The following principles are applied in the Sutherland EMPLAN:

a) The Emergency Risk Management (ERM) process is to be used as the basis for emergency planning in NSW. This methodical approach to the planning process is to be applied by Emergency Management Committees at all levels.

b) Responsibility for preparation, response and recovery rests initially at Local level. If Local agencies and available resources are not sufficient they are augmented by those at Regional level.
c) Control of emergency response and recovery operations is conducted at the lowest effective level.
d) Agencies may deploy their own resources from their own service from outside the affected Local area or Region if they are needed.
e) The LEOCON is responsible, when requested by a combat agency, to coordinate the provision of resources support. EOCONs would not normally assume control from a combat agency unless the situation can no longer be contained. Where necessary, this should only be done after consultation with the Regional Emergency Operations Controller (REOCON) and with agreement between the SEOCON and the combat agency, and with the appropriate level of control, consistent with the *State Emergency & Rescue Management Act 1989*.
f) Emergency preparation, response and recovery operations should be conducted with all agencies carrying out their normal functions wherever possible.
g) Prevention measures remain the responsibility of authorities/agencies charged by statute with the responsibility.
h) The principles outlined in the Local Emergency Management Guidelines for Disability Inclusive Disaster Risk Reduction in NSW are supported.

Annexure A of the Sutherland EMPLAN provides a summary description of the Sutherland Shire Local Government Area (LGA), including landform, climate, land use, and meteorologically related hazards.

The Coastal Risk and Vulnerability Assessment undertaken for Stage 2 of the Bate Bay CMP considered risks to public safety, infrastructure, coastal environment and public amenity, in accordance with the Manual, indicates that sections within the Bate Bay CMP area are identified as being vulnerable to *coastal hazards* as defined by the CM Act[2].

Coastal vulnerability was assessed in terms of the impacts of coastal hazards (with particular reference to beach erosion, shoreline recession, coastal cliff or slope instability, and coastal inundation), the community sensitivity to the impacts and the capacity to respond and adapt.

A geotechnical investigation was undertaken along the foreshore cliff faces and soil slopes. Although some areas of instability were identified, the associated risk was deemed to be mainly acceptable and occasionally tolerable. The probabilistic coastal hazard assessment of erosion undertaken for the sandy beaches within Bate Bay, confirmed the vulnerability of Dunningham Park, The Esplanade, Prince Street Seawall and the beaches.

Annexure B of the Sutherland EMPLAN provides a summary of hazards that have risk of causing loss of life, property, utilities, services and/or the community's ability to function within its normal capacity, i.e. identified as having the potential to create an emergency.

[2] *Coastal Management Act 2016 No 20 [NSW] Part 1 Section 4 defines "coastal hazard" to mean the following:*
(a) beach erosion,
(b) shoreline recession,
(c) coastal lake or watercourse entrance instability,
(d) coastal inundation,
(e) coastal cliff or slope instability,
(f) tidal inundation,
(g) erosion and inundation of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters.

While it is noted in Annexure A of the Sutherland EMPLAN that "On occasion, significant damage has been caused by coastal erosion along the Wanda and Cronulla Beach areas" (page 11), Annexure B does not identify "coastal hazards" (as defined in the CM Act) as having the potential to create an emergency.

Within the Sutherland EMPLAN, the risk associated with "storm" hazard is described as "Severe storm with accompanying lightning, hail, wind, and/or rain that causes severe damage and/or localised flooding (includes tornado)". Storm events are rated as "Almost Certain", with "Major" consequence, resulting in an "Extreme" risk prioritisation.

The risk associated with landslip is described as "Landslip/landslide resulting in localised or widespread damage". Landslip hazard is rated as "Unlikely", with "Minor" consequence, resulting in a "Low" risk prioritisation.

The risk associated with a tsunami is described as "A tsunami wave of magnitude that presents a risk to land and marine element". A tsunami event is rated as "Rare", with "Catastrophic" consequence, resulting in a "High" risk prioritisation.

Please note: Recommendations for amendments to the Sutherland EMPLAN and Sutherland FESH are provided in ***Section 13.***

5.2 Sutherland Shire Flood Emergency Sub Plan

The Sutherland Shire Flood Emergency Sub Plan (Sutherland FESP) (Sutherland Shire Council, 2013) covers preparedness measures, the conduct of response operations and the coordination of immediate recovery measures from flooding within the Sutherland Shire Council area. It covers operations for all levels of flooding and arrangements for the management of coastal erosion in the council area, notably through defining specific roles and responsibilities of the NSW SES, Council, and other agencies.

The Sutherland FESP has been approved by the NSW SES Sutherland Shire Local Controller and the NSW SES Sydney Southern Region Controller as a NSW SES plan and endorsed by the Sutherland Shire Council Local Emergency Management Committee as a sub plan of the Local EMPLAN.

Part 1 - Introduction

The general responsibilities of emergency service organisations and supporting services (functional areas) are listed in the Local and State Emergency Management Plans (EMPLAN), however some responsibilities relevant to coastal hazards are expanded upon within the Sutherland FESP.

Overall responsibilities relevant to coastal emergencies (though predominantly referring to "flooding"), and specific responsibilities relevant to **coastal hazards** (emphasis added throughout) within the Sutherland FESP are repeated below. Specific attention is called to **Section 1.5.30 (m)** which provides direction for response during periods of coastal erosion from ocean storms, including activation of the *Sutherland Shire Council Coastal Zone Management Plan – Emergency Action Plan* (to be replaced by the BBCZEAS).

Responsibilities relevant to coastal emergencies include:

Section 1.5.2 *NSW SES Sutherland Shire Local Controller:*

> *The NSW SES Sutherland Shire Local Controller is responsible for dealing with floods as detailed in the State Flood Plan, including:*

Preparedness:

*d. Participate in floodplain and **coastal risk management initiatives** organised by the Sutherland Shire Council.*
e. Coordinate a public education program.
*f. Identify and monitor people and/or communities at risk of flooding and **coastal erosion**.*

Response

h. Appoint an appropriate Local Incident Controller to undertake response roles. The Incident Controller will:
i. Control flood and storm response operations. This includes:
- *Directing the activities of the NSW SES units operating within the council area.*
- *Coordinating the activities of supporting agencies and organisations and ensuring that liaison is established with them.*

j. Provide an information service in relation to:
- ***Coastal erosion / inundation.***
- *Road conditions and closures.*
- *Advice on methods of limiting property damage.*
- *Confirmation of evacuation warnings and evacuation orders.*

k. Direct the evacuation of people and/or communities.
n. Coordinate operations to protect property, for example by:
- *Arranging resources for sandbagging operations.*

r. If NSW SES resources are available, assist the NSW Police Force, RMS and Council with road closure and traffic control operations.
s. Exercise financial delegations relating to the use of emergency orders as laid down in the NSW SES Controllers' Guide.
*t. Coordinate the collection of flood and **coastal erosion**/inundation information for development of intelligence.*
u. Submit Situation Reports to the NSW SES Sydney Southern Region Headquarters and agencies assisting within the council area. These will contain information on:
- *Road conditions and closures.*
- *Current flood behaviour.*
- *Current operational activities.*
- *Likely future flood behaviour.*
- *Likely future operational activities.*
- *Probable resource needs.*

v. Keep the Local Emergency Operations Controller advised of the flood situation and the operational response.
w. Issue the 'All Clear' when flood operations have been completed

Recovery

x. Ensure that appropriate After Action Reviews are held after floods [assumed to also apply to coastal erosion events].
y. Provide appropriate representation to the recovery committee for the duration of the response phase of an event and as agreed during the recovery phase.

Section 1.5.3 *NSW SES Sutherland Shire Unit Members:.*

a. *Carry out flood and* ***coastal erosion response*** *tasks. These may include:*
   - *The management of the NSW SES Sutherland Shire Local Headquarters Operations Centres.*
   - *Assist in the collection of flood and* ***coastal erosion****/inundation information for the development of intelligence.*
   - *Delivery of warnings and information.*
   - *Resupply.*
   - *Sandbagging.*
   - *Assisting with road closure and traffic control operations.*

b. *Assist with preparedness activities.*
c. *Undertake training in flood and storm response operations.*

Section 1.5.7 *Australian Government* Bureau of Meteorology (BOM):

c. ***Provide severe weather warnings when large waves and/or storm surge conditions are forecast to result in coastal erosion/inundation.***

Section 1.5.10 *Energy and Utility Services Functional Area:*

a. *When requested by NSW SES:*
   - *Implement the Energy and Utilities Services Functional Area Supporting Plan.*
   - *Where required, coordinate energy and utility services emergency management planning, preparation, response and recovery, including the restoration of services following a flood event.*
   - *Coordinate advice to the NSW SES of any need to disconnect electricity, gas, water or wastewater services.*

b. *Local Providers (electricity, gas, water, waste water):*
   - *Provide advice to the NSW SES Sutherland Shire Local Controller of any need to disconnect power/gas/water/waste water supplies or of any timetable for reconnection.*
   - *Advise the NSW SES of any hazards from utility services during flooding and* ***coastal erosion****/inundation.*
   - *Advise the public with regard to electrical hazards during flooding and* ***coastal erosion/inundation,*** *and to the availability or otherwise of the electricity supply.*
   - *Clear or make safe any hazard caused by power lines or electrical reticulation equipment.*
   - *Inspect, test and reconnect customers' electrical/ gas/ water/waste water installations as conditions allow.*

Section 1.5.11 *Engineering Services Functional Area:*

a. *When requested by NSW SES:*
   - *Provide engineering advice regarding the integrity of damaged structures.*
   - *Assist the NSW SES with damage assessment.*
   - *Acquire and/or provide specialist technical engineering expertise.*
   - *Assist with property protection, including the construction or repair of levees.*
   - *Coordinate the restoration of critical public facilities.*

- *Establish recovery centre facilities.*

Section 1.5.11 *Marine Rescue NSW, (Australian Volunteer Coast Guard, Royal Volunteer Coastal Patrol, Volunteer Rescue Association):*

a. *Assist the NSW SES with the delivery of evacuation warnings and evacuation orders.*
b. *Assist the NSW SES with the conduct of evacuations.*

Section 1.5.17 *NSW Police Force, Sutherland Local Area Command (LAC):*

a. *Assist the NSW SES with the delivery of evacuation warnings and evacuation orders.*
b. *Assist the NSW SES with the conduct of evacuation operations.*
c. *Conduct road and traffic control operations in conjunction with council and/or RMS.*
d. *Coordinate the registration of evacuees.*
e. *Secure evacuated areas.*
f. *Water Police: Provide boats and crews to assist with evacuations if required. Provide flood information to the NSW SES Sutherland Shire Local Controller.*

Section 1.5.24 *Surf Life Saving NSW:*

a. *Assist the NSW SES with the warning and/or evacuation of at risk communities; and*
b. *Provide space in Surf Life Saving facilities for evacuation centres where required.*

Section 1.5.28 *Sutherland Shire Council Local Emergency Operations Controller (LEOCON):*

a. *Monitor flood operations.*
b. *Coordinate support to the NSW SES Sutherland Shire Local Controller if requested to do so.*

Section 1.5.29 *Sutherland Shire Council Local Emergency Management Officer:*

a. *Provide executive support to the LEMC and LEOCON in accordance with the Sutherland Shire Council Local Emergency Management Plan.*
b. *At the request of the NSW SES Sutherland Shire Local Controller, advise appropriate agencies and officers of the start of response operations.*

Section 1.5.30 *Sutherland Shire Council:*

Preparedness

a. *Establish and maintain floodplain and **coastal risk management committees** and ensure that key agencies are represented on such committees.*
b. *Provide levee studies, flood studies, floodplain management studies and **coastal management studies** to the NSW SES.*
c. *Provide information on the consequences of dam failure to the NSW SES for incorporation into planning and flood intelligence.*
d. *Maintain a plant and equipment resource list for the council area.*
e. *Contribute to the development and implementation of a public education program.*

Response

f. *At the request of the NSW SES Local Controller, deploy personnel and resources for flood and **coastal erosion related activities**.*
g. *Close and reopen council roads (and other roads nominated by agreement with the RMS) and advise the NSW SES Sutherland Shire Local Controller and the Police.*
h. *Provide information on the status of roads.*
i. *Provide filled sandbags to urban and village areas in which flooding is expected.*
j.
k. *Provide back-up radio communications.*
l.
m. ***During periods of coastal erosion from ocean storms:***
   - ***Assist the NSW SES with reconnaissance of coastal erosion risk areas.***
   - ***Liaise with the NSW SES Local Controller to provide advice regarding the need for response actions by the NSW SES such as evacuations.***
   - ***Activate the Sutherland Shire Council Coastal Zone Management Plan – Emergency Action Plan.***

Recovery

n. *Provide for the management of health hazards associated with flooding. This includes removing debris and waste.*
o. *Ensure premises are fit and safe for reoccupation and assess any need for demolition.*

Part 2 - Preparedness

Section 2.2 *Floodplain and Coastal Risk Management*

Section 2.2.1 *The NSW SES Sutherland Shire Local Controller will ensure that:*

a. *NSW SES participates in local floodplain and **coastal risk management committee** activities when those committees are formed, in accordance with the protocols outlined in the NSW SES Controllers' Guide.*
b. *The NSW SES Sydney Southern Region Headquarters is informed of involvement in floodplain and coastal risk management activities.*

Section 2.5 *Public Education*

Section 2.5.1 *The NSW SES Sutherland Shire Local Controller, with the assistance of the Sutherland Shire Council, the NSW SES Sydney Southern Region Headquarters and NSW SES State Headquarters, is responsible for ensuring that the residents of the council area are aware of the flood threat in their vicinity and how to protect themselves from it.*

Section 2.5.2 *Specific strategies to be employed include:*

a. *Dissemination of flood-related brochures and booklets in flood liable areas.*
b. *Dissemination of **coastal erosion related brochures** in coastal erosion liable areas.*
c. *Talks and displays orientated to community organisations, businesses and schools.*
d. *Publicity given to this plan and to flood-orientated NSW SES activities through local media outlets, including articles in local newspapers about the flood threat and appropriate responses.*

Section 2.6 *Training*

Section 2.6.1 *Throughout this document there are references to functions that must be carried out by the members of the NSW SES Sutherland Shire Unit. The NSW SES Sutherland Shire Local Controller is responsible for ensuring that the members are:*

a. Familiar with the contents of this plan.
b. Trained in the skills necessary to carry out the tasks allocated to the NSW SES.

Section 2.7 *Resources*

Section 2.7.1 *The NSW SES Sutherland Shire Local Controller is responsible for maintaining the condition and state of readiness of NSW SES equipment and the NSW SES Sutherland Shire Local Headquarters.*

Please note: Recommendations for amendments to the Sutherland EMPLAN and Sutherland FESH are provided in ***Section 13.***

5.3 Criteria for Initiating a Coastal Erosion Emergency Response

The Sutherland FESP is noted as “always active to ensure that preparedness actions detailed in this plan are completed”.

Specifically, **Section 1.5.30** states that during periods of coastal erosion from ocean storms, Sutherland Shire Council will activate the Sutherland Shire Council Coastal Zone Management Plan – Emergency Action Plan [*as named under the Coastal Protection Act 1979 – now named Coastal Zone Emergency Action Subplan under the Coastal Management Act 2016*]. This is consistent with the NSW State Storm Plan (2018, action 5.2.10).

If associated with a storm, the NSW SES will be the combat agency primarily responsible for emergency response – under the NSW Storm Plan. Action 1.4.3. of the same plan indicates that the emergency management of coastal erosion that is not caused by storm activity will be controlled and coordinated by the LEOCON. Action 4.2.2.c requires the NSW SES to develop review and maintain storm Sub Plans and Local Flood Plans which include local level emergency response planning for coastal erosion and/or coastal inundation where required.

The Sutherland FESP is noted as approved by the NSW SES Sutherland Shire Local Controller and the NSW SES Sydney Southern Region Controller as a NSW SES plan and endorsed by the Sutherland Shire Council Local Emergency Management Committee as a sub plan of the Local EMPLAN.

The Sutherland FESP describes agreed roles, responsibilities, functions, strategies and management for the preparation for, and conduct of, flood operations within the Sutherland Shire LGA. The Sutherland FESP also covers arrangements for the management of coastal erosion in the LGA and identifies the NSW SES as the Combat Agency primarily responsible for controlling emergency responses.

Part 3 - Response Control

Section 3.1 Control Arrangements

Section 3.1.1 The NSW SES is the legislated Combat Agency for floods and is responsible for the control of flood operations. This includes the coordination of other agencies and organisations for flood management tasks.

Section 3.1.2 The NSW SES is the designated Combat Agency for damage control for storms. This includes damage control for coastal erosion and inundation from storm activity, specifically the protection of life and the coordination of the protection of readily moveable household goods and commercial stock and equipment. The NSW SES is not responsible for planning or conduct of emergency beach protection works or other physical mitigation works.

Section 3.1.3 The Local EMPLAN will operate to provide support as requested by the NSW SES Local Incident Controller.

Section 3.2 Operational Management

Section 3.2.1 NSW SES utilises the Australasian Inter-service Incident Management System (AIIMS), which is based on three principles:

a. Functional management;
b. Management by objectives; and
c. Span of control.

Section 3.2.2 AIIMS provides for different incident levels based on the complexity of management.

Section 3.2.3 The Local Government Area may be divided into sectors and divisions to manage the flood and/or coastal erosion event (divisions are usually a group of sectors).

Section 3.2.4 Sectors and divisions may be based on floodplain classifications, geographical, physical or functional boundaries. A town, city or suburb may be one sector or split into several sectors and divisions.

Section 3.3 states that response operations will begin:

a. On receipt of a Bureau of Meteorology Preliminary Flood Warning, Flood Warning, Flood Watch, Severe Thunderstorm Warning or a Severe Weather Warning for flash flooding or severe ocean conditions.
b. On receipt of a dam failure alert.
c. When other evidence leads to an expectation of flooding or coastal erosion within the council area.

The Bureau of Meteorology (BOM) provide severe weather warnings for potentially hazardous or dangerous weather include damaging or destructive winds, heavy rain, abnormally high tides, damaging waves and blizzards in Alpine areas. When the waves are expected to be powerful enough to cause damage to property or significant erosion to beaches the BOM will issue a Severe Weather Warning for Damaging or Dangerous Surf.

The BOM specifies the following thresholds for issuing warnings for ‘severe storms’:

- rainfall of sufficient intensity to cause flash flooding (generally equal to or exceeding the one in 10-year average recurrence interval);

- waves equal to or exceeding five metres height in the surf zone; or
- storm surge (see Section 2.2.8 of the 2018 State Storm Plan).

Section 11 describes actions to be undertaken in the prevention phase to align any SES NSW evacuation plans with Council intelligence around warnings and triggers for emergency response. These will be updated within Council's accompanying *Bate Bay Emergency Management Operational Procedures*.

In the absence of a BOM severe weather warning, and prior to contacting NSW SES to initiate response to a potential coastal emergency, Council must consider:

- predicted wave conditions (height, direction, period, duration and set-up);
- predicted tidal range and tidal anomaly generated by storm surge;
- condition of the beach;
- condition of dune vegetation; and
- presence and influence of adjacent headlands and coastal protection structures.

Section 3.3.3

Contact with the Bureau of Meteorology to discuss the development of flood warnings will normally be through the NSW SES Sydney Southern Region Headquarters and/or NSW SES State Headquarters.

Section 3.3.4

The following persons and organisations will be advised of the start of response operations regardless of the location and severity of the flooding anticipated [*considered to also apply to the location and severity of coastal hazard anticipated*]:

a. NSW SES Sydney Southern Region Headquarters.
b. NSW SES Sutherland Shire Unit.
c. Sutherland Shire Council Local Emergency Operations Controller (for transmission to the NSW Police Force Local Area Command Headquarters).
d. Sutherland Shire Council Local Emergency Management Officer (for transmission to appropriate Council officers and departments).
e. Sutherland Shire Council Mayor.
f. Other agencies listed in this plan will be advised by the Local Emergency Management Officer on the request of the NSW SES Sutherland Shire Local Incident Controller and as appropriate to the location and nature of the threat.

Please note: Recommendations for amendments to the Sutherland EMPLAN and Sutherland FESH are provided in ***Section 13.***

6 Roles and Responsibilities

6.1 NSW State Emergency Service

The role of the NSW SES in emergencies is outlined in Sutherland Shire Local Emergency Management Plan (Sutherland EMPLAN) as well as the Sutherland Shire Flood Emergency Sub Plan (Sutherland FESP), including:

- to protect persons from dangers to their safety and health, and to protect property from destruction or damage, arising from floods, storms and tsunamis;
- to act as the Combat Agency for damage control for storms and to coordinate the evacuation and welfare of affected communities.

Action 5.3.6 of the NSW State Storm Plan gives the NSW SES the role to coordinate the protection (relocation/removal) of readily moveable household and commercial contents where time and resources permit when property is at risk from coastal erosion. Action 5.7.2 of the NSW State Storm Plan outlines that the NSW SES will control and coordinate the evacuation of affected community properties or potentially dangerous places created by coastal erosion.

Both the State Emergency Service (SES) and Council are noted in Sutherland EMPLAN as well as the Sutherland FESP as the Combat Agencies with responsibilities in relation to coastal erosion hazards.

As noted in **Section 1.5** of the Sutherland Shire Flood Emergency Sub Plan**,** the SES are identified as the primary Combat Agency, and that the NSW SES Sutherland Shire Local Controller is responsible for initiating coastal erosion emergency response operations.

The SES is not authorised to undertake coastal emergency protective works (such as placement of rocks or sand filled geotextile containers) of any form.

6.2 Sutherland Shire Council

Sutherland Shire Council (Council) is the designated coastal authority with responsibility for care of public land within its care, control and management. The carrying out (or authorising and coordinating) of emergency coastal protective works to protect public assets from coastal erosion and inundation is the role of Council if measures are elected to be undertaken.

Council may choose to undertake physical erosion protection measures to protect public assets from coastal erosion and inundation if considered appropriate (assuming appropriate environmental assessment and approval has been obtained).

Private landholders are responsible for their own land parcels and Council does not have a positive obligation to take particular action to protect private property from erosion events. However, Council has a statutory obligation to consider development applications for coastal protection works lodged by property owners.

Council is noted in the Sutherland EMPLAN (along with the SES) as the Combat Agency primarily responsible for controlling the response to a coastal erosion emergency. During a coastal erosion emergency, Council is likely to be requested to:

- establish and maintain a Local Emergency Operations Centre (LEOC) for the Local Emergency Operations Controller (LEOCON);
- provide support staff for the LEOC;
- provide human resources, plant, equipment, materials and services, as required in dealing with an incident or emergency;
- provide support to combat agencies and functional area agencies as required including:
- reconnaissance of the area effected by the emergency; and
- post disaster damage assessment;
- assist, at their request, the Police Service, Fire and Rescue NSW, Ambulance Service and NSW SES in dealing with any incident or emergency;
- assist in any other emergency management prevention, preparedness or recovery operations, including emergency management training, for which Council's training and equipment is suitable;
- at the request of the LEOCON, coordinate disaster recovery operations, excluding welfare assistance to disaster victims for whom Department of Family and Community Services – Community Services is responsible;
- provide engineering resources required for response and recovery operations including:
    - damage assessment;
    - clear and re-establish roads and bridges;
    - demolish and shore-up buildings;
    - remove debris;
    - construct and maintain temporary levees and evacuation routes, when appropriate; and
    - erection of barricades and fences for public protection.
- provide a liaison officer and executive support to the LEOC and LEOCON or Combat Agency Controller; and
- provide an appropriately qualified officer to assist the District Environmental Functional Area Coordinator in relation to environmental emergency management matters.

If a "Severe Weather Warning for Damaging Surf" or "Severe Weather Warning for Storm Tides" has been released, or NSW SES was mobilised in some other manner as the combat agency, Council would assist NSW SES as required, or as resources permit.

There are four possible scenarios described below under which coastal erosion may occur without a severe weather warning being issued, which in turn does not trigger the EMPLAN and the NSW SES are not mobilised. In these situations, there is no designated combat agency, but Council would be the lead agency to manage the response.

Heavy swell - Swell formed at a distance from the coast may impact on coastline with little or no warning. May result in damaging surf producing large scale erosion and/or inundation. Long-range swell may erode the dune system resulting in landward recession of the erosion escarpment.

Depleted beach profile - Following beach erosion events the local beach profile may be depleted such that a low or moderate swell coinciding with a high tide may erode the dune system resulting in landward recession of the erosion escarpment.

Slumping of erosion escarpment - Following erosion of the dune system a sheer and rear vertical erosion escarpment may remain. As the sand dries the escarpment will slump to a more stable slope. Natural processes may further flatten the escarpment.

Slumping of coastal protection works - Large coastal erosion events may undermine the structural stability of coastal protection works. Slumping of works may occur some time after the event has passed and may result in landward recession of the erosion escarpment.

Council may undertake some of the activities that would otherwise by conducted by NSW SES (where resources allow though not obligated), but Council cannot order evacuation. If required, Council could request NSW SES take on a combat agency role if an emergency is occurring.

Typical tasks that Council may undertake (where required) before, during and after a coastal erosion/ inundation event (besides considering the need for and potentially implementing protective works on public land) are outlined in **Section 10**.

6.3 Local Emergency Operations Controller

The Local Emergency Operations Controller (LEOCON), appointed by the Regional Emergency Operations Controller (REOCON), is a police officer stationed within the region in which the local government area is located.

The LEOCON is responsible, when requested by a combat agency, to coordinate the provision of resource support. LEOCONs would not normally assume control from a combat agency unless the situation can no longer be contained. Where necessary, this should only be done after consultation with the REOCON and agreement of the combat agency and the appropriate level of control.

Under the NSW State Storm Plan, Action 1.4.3. indicates that the emergency management of coastal erosion that is not caused by storm activity will be controlled and coordinated by the LEOCON. As described in **Section 6.2**, Council would provide a range of support for the LEOCON.

6.4 NSW Police

During a coastal erosion emergency the NSW Police Force is responsible for the following functions:

- is the designated Combat Agency for law enforcement;
- is the designated Combat Agency for search and rescue;
- as necessary, control and coordinate the evacuation of victims from the area affected by the emergency;
- maintain law and order, protect life and property, and provide assistance and support to a Combat Agency, Functional Areas, and other Organisations as required. This may include:
    - reconnaissance of the area affected by the emergency;
    - traffic control, and crowd control, including the control of evacuations if required;
    - access and egress route security and control;
    - identifying the dead and injured, and notifying next of kin;
    - establishing temporary mortuaries;
    - maintaining the security of property;
    - statutory investigative requirements; and
    - operation of a Public Information and Inquiry Centre capable of providing general information on incidents and emergencies to members of the public;
- respond accredited "rescue units" to general and specialist rescue incidents, and control and coordinate rescue operations; and
- as determined by the State Rescue Board, provide accredited "rescue units".

Some members of the NSW Police may also be appointed as Emergency Operations Controllers. Police would typically become involved in a coastal erosion event as follows:

- Assisting NSW SES where required (e.g. controlling and coordinating evacuation) when NSW SES was acting in its combat agency role; or
- If NSW SES was not mobilised, Police may undertake or coordinate activities such as evacuation, barricading, removal of the contents of buildings and the like.

In either case (if NSW SES was or was not the combat agency) it is possible that Police may act according to their statutory powers to protect life and property including authorising emergency protective works. However, it is expected that in making such a decision, Police would need to recognise the combat agency's authority (if applicable), ensure appropriate approvals are in place for any proposed works, and seek proper advice prior to acting.

6.5 Fire and Rescue NSW

Fire and Rescue NSW (FRNSW) has a Memorandum of Understanding with the NSW SES and would have a support role during a coastal erosion emergency, providing the following functions:

- provide Primary and Secondary Accredited General Land Rescue Units as determined by the State Rescue Board;
- assist in any other response or recovery operations for which the FRNSW training and equipment is suitable, for example, the provision of emergency water supplies and pumping equipment;
- during flood and storm provide assistance to the NSW SES in accordance with the Memorandum of Understanding between FRNSW and SES; and
- provide a liaison officer to the LEOC or Combat Agency Operations Centre as appropriate.

6.6 Department of Climate Change, Energy, the Environment and Water

The Department of Climate Change, Energy, the Environment & Water is the NSW government authority responsible for advising on coastal zone management.

6.7 Bureau of Meteorology

The Bureau of Meteorology (BOM) is Australia's national weather, climate and water agency, and provides regular forecasts, warnings, monitoring and advice including drought, floods, fires, storms, tsunami and tropical cyclones.

The release of "Severe Weather Warning for Damaging Surf" or "Severe Weather Warning for Storm Tides" by the BOM is a key trigger for initiation of response operations for a coastal erosion/inundation event.

7 Physical Extent of the Bate Bay CZEAS

The BBCZEAS builds upon the previous Bate Bay Coastline Management Plan (Patterson Britton, 2003), and adopts the same spatial extent for four (4) coastal precincts based on the relative homogeneity of the natural and cultural values and settings within each zone. Continuation of differentiation of the four precincts is beneficial in regard to enabling emergency actions to be coordinated in both a holistic and site-specific manner.

These four coastal zones are shown in **Figure 7-1** and encompass:

- Precinct 1: The Cliff-Top Walk – 'The Esplanade', Bass and Flinders Point, Oak Park, Shelly Park, Shelly and Blackwoods Beaches.
- Precinct 2: The City Beaches – Cronulla Beach to North Cronulla Beach.
- Precinct 3: The Surf Beaches – Prince Street Seawall, Elouera Beach to Wanda Reserve.
- Precinct 4: The Beach Reserve – Green Hills, Boat Harbour, Potter Point.

Figure 7-1: The Bate Bay CMP Study Area and segmentation of the foreshore into Precincts

8 Definition of Coastal Emergencies

8.1 Coastal Inundation

Coastal inundation occurs when a combination of marine and atmospheric processes raises water levels at the coast above normal elevations, causing land that is usually 'dry' to be inundated by seawater. It is often associated with storms resulting in elevated still water levels (storm surge), wave set-up, wave runup and over-wash flows.

Overtopping and inundation can occur on:

- beaches and coastal dunes, causing erosion, slumping or movement of large objects;
- seawalls, revetments and entrance training structures (breakwaters), causing structural instability and safety issues with the movement of large objects; and
- cliffs and bluffs (in extreme storm conditions).

Storm surge and powerful waves can also penetrate estuaries giving rise to strong currents or standing waves. This may result in inundation of roads and low-lying land adjacent to estuaries and waves created by vehicle movement in these locations.

8.1.1 Wave Overtopping along the Esplanade

Seawall crest levels along The Esplanade vary along its length from a relatively elevated level at around 4.5m AHD where it links with Peryman Square at its northern end to the lowest crest levels at 2.6-2.7m AHD behind the North Cronulla Rock Pool. Seawall crest levels increase to the south to around 3-3.3m AHD behind the Cronulla Beach Rock Pool. At the southern end of the subject site, seawall crest levels are at around 3.5-3.6m AHD. As such, the most vulnerable areas for wave overtopping exist in the vicinity of the North Cronulla Rock Pool, where the seawall crest is low and the adjacent rock platform level is also relatively low.

In the short term, it is recommended that Council investigate potential warning signs and mechanisms for temporary closure of The Esplanade during periods of significant swell and wave overtopping, in order to educate users of The Esplanade of potential hazards, and to minimise risk to pedestrians. Mechanisms may include temporary barricades being placed at the entrance to The Esplanade immediately south of Peryman Square, as well as immediately north of Cronulla Beach. During periods of significant swell, consideration may be given to engaging security services to providing a deterrent to accessing The Esplanade.

The inclusion of sea level rise at the end of a nominal 50-year design life (2070) significantly increases design overtopping rates. Increasing the height of the Esplanade by a typical pavement thickness of say 200mm would provide a minor reduction in overtopping. An increase in elevation of several metres is required to reduce overtopping to tolerable levels for vehicle and pedestrian access for relatively frequent events (1 year ARI) under future sea level rise.

It is considered impracticable to increase the height of the Esplanade to limit overtopping to tolerable or acceptable levels and frequency over the design life of the structure. A more effective method may be to introduce wave deflecting parapets and recurve fixtures to the crest of the seawall, in addition to periodic closures.

8.2 Cliff Instability

Cliff instability refers to a variety of geotechnical processes on coastal cliffs and bluffs, including rock fall, slumps and landslides. It may be driven by coastal processes such as wave undercutting and overtopping, or by differential weathering of rock layers in cliffs and bluffs or by surface and groundwater flows. Instability may occur during or following a coastal storm event but may also occur at other times. There may be very little warning that a cliff instability incident is imminent.

These hazards may endanger life and property at the site of the process (e.g. through collapse of a lookout platform or walking track, or undermining of dwellings), and at the toe of the cliff or bluff (rock platform or beach). They may result in risks to boaters and fishers in adjacent marine areas.

8.2.1 Assessment of Risk to Property

The results of the geotechnical risk assessment undertaken within Stage 2 of the Bate Bay CMP (JKG, 2020), utilising the criteria given in Australian Geomechanics Society (AGS) (2007c), have identified that risk to property within the study area was either 'Very Low' or 'Low', with the exception of the following areas that were assessed to be of 'Moderate Risk' to property (i.e., the coastal path and/or the relevant structural element):

- The loosely stacked sandstone masonry retaining wall opposite No. 88 and 87 The Esplanade (as shown in **Figure 8-1** and **Figure 8-2**). It is noted that this wall was also identified in the geotechnical report undertaken by Jeffery & Katauskas (JKG, 2005) to inform the *Bate Bay Assessment of Shoreline Protection Works* (Patterson Britton, 2006)
- The foreshore soil slopes above the crest of the cliff line between 25 Elizabeth Place and 12 Arthur Avenue (as shown in **Figure 8-3** and **Figure 8-4**)
- The concrete/sandstone block/rendered seawall supporting the seaward side of The Esplanade at the northern end of Cronulla Beach (as shown in **Figure 8-6**).

'Very Low' and 'Low' risk is considered 'Acceptable' in accordance with AGS (2007), and 'Moderate Risk' is considered tolerable.

Figure 8-1: Loosely Stacked Sandstone Masonry Wall opposite No. 88 and 87 The Esplanade

Figure 8-2: Location of Loosely Stacked Sandstone Masonry Wall opposite No. 88 and 87 The Esplanade

Figure 8-3: Foreshore soil slopes above the crest of the cliff line between 25 Elizabeth Place and 12 Arthur Avenue (i)

Figure 8-4: Foreshore soil slopes above the crest of the cliff line between 25 Elizabeth Place and 12 Arthur Avenue (ii)

Figure 8-5: Location of Foreshore soil slopes above the crest of the cliff line between 25 Elizabeth Place and 12 Arthur Avenue

Figure 8-6: Concrete/sandstone block/rendered seawall supporting The Esplanade, northern end of Cronulla Beach

Figure 8-7: Location of Concrete/sandstone block/rendered seawall supporting The Esplanade, northern end of Cronulla Beach

8.2.2 Geotechnical Assessment Conclusions

Geotechnical investigations were undertaken by JKG along the foreshore cliff faces and soil slopes within the study area. The risk associated with potential instability of foreshore cliff faces and soil slopes, seawalls and rock revetments within the study area have been assessed to be at 'acceptable' and occasionally 'tolerable' levels. It is considered that under existing conditions and into the future, on-going monitoring by Council and periodic geotechnical and coastal engineering assessments are an appropriate method of landslide risk management (JKG, 2020).

It is difficult to predict when an instability event (rock fall, seawall failure etc.) will occur. In such a foreshore setting some instability of cliff faces is inevitable as, in the main, such instability events are a result of natural processes. JKG (2020) reiterate that although landslides do occur they tend to occur on an infrequent basis and due to the nature of the various trigger mechanisms that cause landslides in the cliff faces, the landslides tend to affect isolated sections of the cliff face.

Furthermore, the very nature of instability events (rock falls etc.) are unpredictable with regard to their occurrence. Provided seawalls and rock revetments have been engineer designed and, where damaged, are appropriately maintained, then their long term performance should be satisfactory, notwithstanding any impacts of rising sea levels. On this basis, JKG consider that the most appropriate landslide risk management measure for the study area, as outlined in **Section 8.2.3**, is on-going monitoring. Consequently, Council will be reacting to instability events which would need to be managed through an appropriate emergency management plan to assist Council in this reactive response.

8.2.3 Monitoring

JKG (2020) recommend that Council should monitor:

- All cliff lines within the study area on an annual basis and after periods of prolonged or heavy rainfall in order to assess existing conditions and any indications of deterioration such as debris/boulders on the coastal path, reserve surfaces, beach or wave cut platforms, damage to pathways etc. This is of particular importance at Bass and Flinders Point lookout, Glaishers Point lookout, and the cliff line above The Esplanade due to the high levels of pedestrian traffic and locality of the lookouts/coastal path adjacent to the cliff lines in these areas.
- The seawalls and rock revetments on an annual basis and after any significant high tide/coastline storm events in order to assess any indications of deterioration of existing conditions, such as collapse of sections of the seawall, additional cracking of the seawall, loss of concrete/sandstone blocks, development of depressions or voids on the reserve surfaces etc. The visual assessment of seawall drainage should also be included in this monitoring.

Based on previous studies of available rainfall data in relationship to landslide events, in particular a study carried out for the Pittwater area (Walker, 2007), JKG (2020) provide the following tentative definition of heavy rainfall and prolonged rainfall (representing 2 year ARI occurrences):

- Heavy Rainfall: at least 100mm of rainfall in one day; and
- Prolonged Rainfall: at least 150mm of rainfall over a 5 day period.

It is imperative that such monitoring be formally documented and that the required frequency of reporting (and to whom) is clearly defined. Where incidents of instability have occurred within the monitoring period then, where possible, JKG suggest that Council provide relevant details within the monitoring reports.

8.3 Beach erosion

Beach erosion occurs when wind, waves, currents or elevated ocean water levels are removing the sediment that comprises the beach and frontal dune system, landward of the fully accreted condition.

Storm driven beach erosion may result in:

- erosion on sandy beaches, including berms and frontal dunes, either directly because of undermining, or indirectly because the foundation capacity of the remaining dune adjacent to the eroded area has been reduced;
- high, unstable, near-vertical back-beach erosion escarpments; and
- damage to poorly designed or maintained coastal protection works.

Beach erosion can create risks to public and private assets and present public safety risks. Not all beach erosion occurring during a storm event will trigger a coastal emergency.

8.3.1 Prince Street Seawall

The site location of the Prince Street Seawall at North Cronulla Beach is shown on **Figure 8-8**. The existing seawall consists of a sloped pattern-placed Seabee seawall constructed in 1985/1986. The concrete Seabee units are placed at a slope of 1V:2H (vertical to horizontal) on a rock base layer comprising 200-300mm stone laid on geotextile fabric and covered with a PVC net. It is assumed that the foundation material beneath the rock base layer comprises sand.

The original toe of the seawall was comprised of gabions and a flexible reno mattress, and was demolished and rebuilt with a different toe structure in 2008. The existing toe structure consists of a concrete capping beam with tie back anchors, supported by a concrete contiguous pile wall.

When the toe was reconstructed in 2008, shortcomings in the workmanship resulted in the following problems with the seawall:

- gaps between the piles;
- gaps between the tops of the piles and the soffit of the capping beam;
- exposed pile reinforcement; and,
- cave-like formations behind the piles/ below the Seabee units (caused by subsequent washout of backfill by wave and tidal action through the gaps between piles).

Settlement of the Seabee units has resulted as a consequence of these structural defects.

Figure 8-8: Prince Street Seawall

Storm events have caused a large volume of sand to be eroded from the beach fronting the seawall (refer **Figure 8-9**). This has led to exacerbated washout of seawall foundation material (rock and sand backfill) from behind the seawall, causing voids to form and settlement of the foundation beneath the Seabee units. As a result, a large number of the Seabee units have subsided and, in some cases, have dropped into large cavities existing behind the toe of the wall (refer **Figure 8-10**). In other areas a 'skin' of Seabee units exists spanning over cavities without the support of foundation material, and Seabee units only being held in place by skin friction of adjacent units (refer **Figure 8-10**).

It is noted that Council undertook significant works in December 2020 to stabilise a large number of undermined Seabees. However, the Seabee units are expected to continue to subside, requiring ongoing monitoring and reactive maintenance by Council.

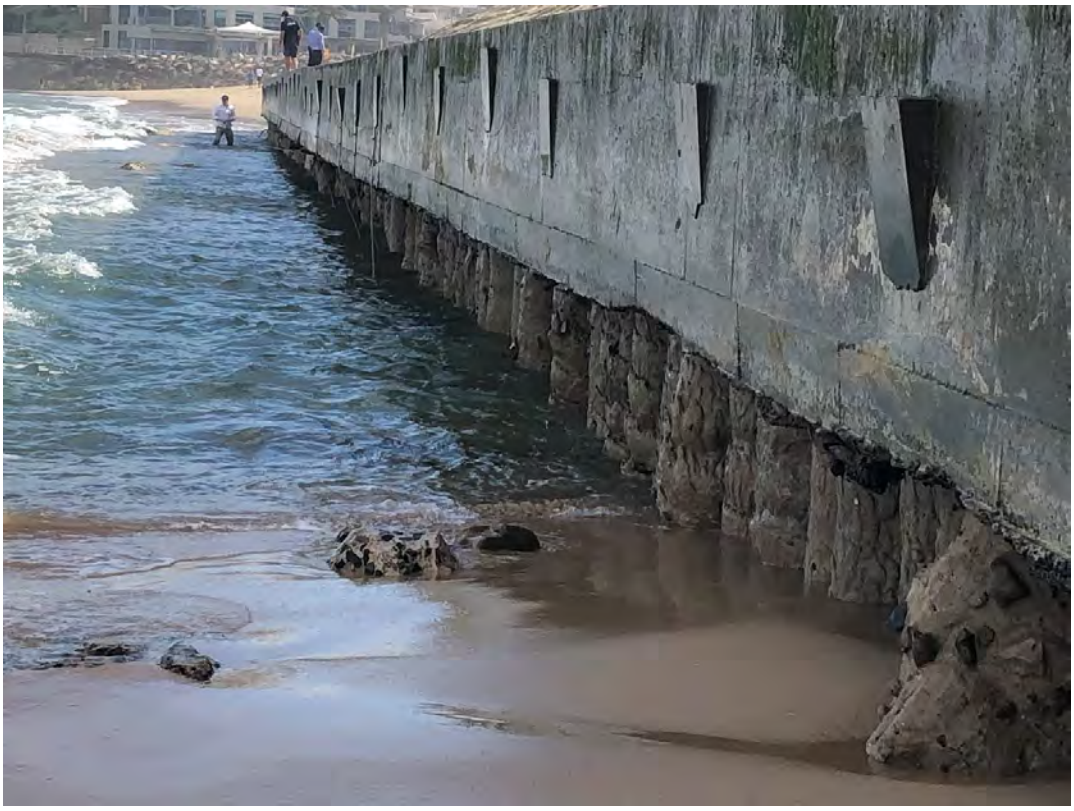


Figure 8-9: Low beach level and exposed contiguous pile face, dated 4 November 2020

Figure 8-10: Subsided Seabee units (left) and Seabee units spanning over large cavities where individual units have dropped (right)

In addition to the unstable Seabee units, the low beach level has caused dilapidated seawall elements from historical demolition of the old seawall to be exposed (refer **Figure 8-11**). Timber palings, rebar, corroded poles, concrete slabs and other similar construction waste is exposed.

Figure 8-11: Exposed remnants of historical demolition of old seawall

Following future erosion events that cause further undermining of the Prince Street Seawall, the following are recommended actions for mitigation of public safety and infrastructure damage risks, in their suggested order of implementation:

1. Installation of robust and clear signage warning the public to keep off the seawall due to new hazards. Regular inspection and replacement/repair of damaged or removed signage should also be undertaken.

2. Installation of robust temporary fencing bounding the entire area of unstable Seabee units (including areas of subsided units and areas where foundation material is not in contact with the underside of Seabee units):
   a. Fencing along the seaward side of the lower promenade to prevent access onto the Seabee units.
   b. Fencing along seaward edge of the capping beam – modified ATF (or similar) fencing with metal fence base supports and bracing fixed to the fence and bolted into the capping beam.
   c. Fencing over the Seabee seawall face slope to close off the southern and northern perimeter to establish contiguous exclusion from the site – star pickets concreted into place through the

Seabee units or within concrete buckets to act as a weight to prevent mobilisation, and parawebbing or bunting strung between the star pickets.

d. Regular monitoring of the condition of fencing and maintenance as required. Daily inspections by Lifeguards, Civil Operations staff or contractors. Weekly inspections by Council Engineering staff and following major coastal storms.

3. Fill visible voids under all Seabee units with cement stabilised sand:
   a. Cement stabilised sand to be pumped into place as a flowable material that works its way into large voids behind the contiguous pile wall. Facilitated by mix control and use of hand-held concrete vibrator tools.
   b. Fill voids up to the underside of Seabee units (reference level for visual monitoring).
   c. Regular inspection of foundation material levels and topping up of foundation with additional cement stabilised sand pumping as required. Weekly inspections by Council Civil Operations/Engineering staff and following major coastal storms.

4. In-situ concrete casting of new Seabee units in area where units have completely fallen into large voids or where subsidence has created an unsafe surface for pedestrian access.

5. Consider installation of rock bags backed by geotextile fabric as an emergency measure, only in the event that uncontrolled washout of foundation material occurs that cannot be arrested by top up with additional cement stabilised sand.

8.3.2 Sandy Beaches and Public Assets - Cronulla, North Cronulla, Elouera and Wanda Surf Life Saving Clubs

The Cronulla Surf Life Saving Club (SLSC) is positioned landward of a terminal revetment (seawall) and is not considered at risk of coastal erosion, however may be impacted by wave run-up and overtopping. The North Cronulla SLSC is located within Dunningham Park. Dunningham Park in North Cronulla (and the North Cronulla SLSC) is noted as being impacted by historical coastal erosion events such as the 1974 storm event (refer **Figure 8-12** and **Figure 8-13)**, and is projected to continue to be impacted unless coastal protection works are constructed at this location.

Figure 8-12: 1974 Storm Erosion at Dunningham Park

Figure 8-13: 1974 Storm Erosion at North Cronulla Beach

Information provided by Council show that the Elouera and Wanda SLSCs have been constructed on deep piles to address known coastal erosion hazards and are therefore considered to not be at risk of impact/loss as a built asset. However, it is expected that during and, for a period of time, after a coastal erosion event, access to and from the Cronulla, North Cronulla, Elouera and Wanda SLSCs and adjoining facilities will be impacted.

It is proposed that Council's accompanying *Bate Bay Emergency Management Operational Procedures* will contain maps and asset information for a number of the assets and infrastructure items listed in the zones below and will be updated as necessary.

The end points or headlands of the embayment are assumed to be locked in position; The Peryman Square roadhead rock works to the south, and Prince Street Seawall with its upgraded toe to the north, are expected to remain in place and serviceable for at least the next 30 years. The CMP probabilistic current and future Zone of Slope Adjustment coastal hazard assessment lines (refer to **Figure 8-14**) for 2020 and 2070, as shown in **Figure 8-15** and **Figure 8-16** (respectively) assume no management intervention in the form of a seawall at North Cronulla Beach fronting Dunningham Park.

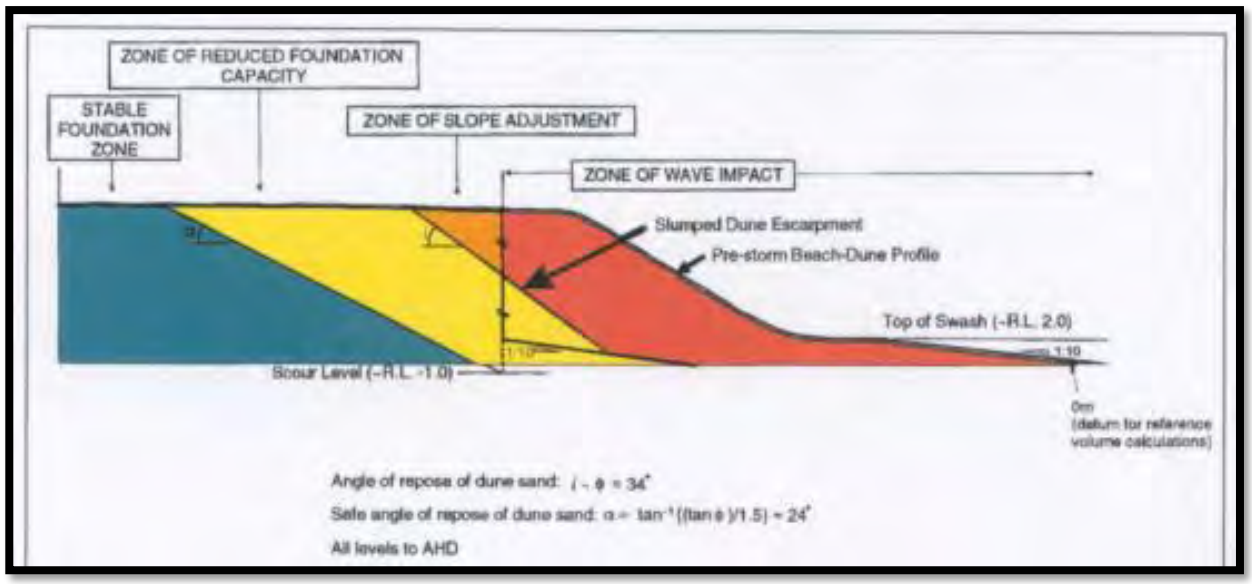


Figure 8-14: Schematic representation of the beach erosion hazard (after Nielsen et al, 1992)

Figure 8-15: Dunningham Park - Zone of Slope Adjustment 2020

Figure 8-16: Dunningham Park - Zone of Slope Adjustment 2070

It is noted that the probabilistic current and future Zone of Slope Adjustment coastal hazard assessment lines (refer to **Figure 8-14**) for 2020 and 2070, as shown in **Figure 8-17** and **Figure 8-18** (respectively) are projected to impact on the beach and vegetated sand dunes along the “surf beaches” and Wanda Reserve during an erosion event.

Figure 8-17: Surf Beaches - Zone of Slope Adjustment 2020

Figure 8-18: Surf Beaches - Zone of Slope Adjustment 2070

Typical hazards relevant to most zones of the beach frontage include:

- unstable vertical dune erosion scarps (that can collapse suddenly creating a hazard to persons/property at the crest or near the toe of scarp);
- public safety in areas of wave overtopping/inundation;
- unsafe beach accessways due to erosion;
- unsafe access to/from the Cronulla, North Cronulla, Elouera and Wanda SLSCs and adjacent facilities;
- vehicles driving on sealed surfaces e.g. roadway/carpark where founding material has been eroded or undercut;
- vegetation destabilised by erosion; and,
- submerged objects e.g. remnant/displaced stormwater assets.

In the short term, it is recommended that Council investigate potential warning signs and mechanisms for temporary closure of Cronulla, North Cronulla, Elouera and Wanda SLSCs and adjacent facilities, as well as beach accessways, during periods of significant swell and wave runup, in order to educate users of these locations of potential hazards, and to minimise risks to SLSC patrons. Mechanisms may include temporary barricades being placed at the entrances and exits to the SLSCs. During periods of significant swell, consideration may be given to engaging security services to providing a deterrent to accessing these locations.

Immediately before and during a coastal erosion event, it is likely that actions of Council and other combat agencies will include:

- Liaising with managers of Cronulla, North Cronulla, Elouera and Wanda SLSCs to:
  - assist with barricading and fencing the SLSC's beach accesses;
  - assist with traffic management; and
  - authorise closure and opening of SLSC's in coordination with SLSC managers;
- Assist the NSW SES/Police, if requested, in the evacuation of patrons as required;
- Implement temporary emergency coastal protection works (this may include Crown Land with appropriate permissions) to facilitate emergency actions or actions under the direction of the Combat Agency if required, and record all actions taken; and
- Temporary access works to facilitate emergency actions may include a range of activities e.g. placing sand filled geotextile bags, erecting temporary barriers, emergency vehicle access etc.

***Note**: Placement of temporary works are to be undertaken in consultation with suitably qualified coastal or geotechnical engineer.*

Following an erosion event, it is likely that short- and medium-term actions of Council and other combat agencies will include:

- Inspections and damage assessments of built and natural assets;
- Undertake clean-up actions and workorders including for:
  - removal of beach debris;
  - updated "make safe" works requests (including signage/exclusion);
  - short- and medium-term repairs to damaged infrastructure and assets, access ways (may include "beach scraping" actions to restore access as well as accelerate beach accretion, subject to approval); and
  - short- and medium-term repairs to dune systems and vegetation.
- Scope and implement short- and medium-term remedial actions such as reconstruction of impacted built assets (as required).

8.4 Bate Bay Coastal Beach and Foreshore Access Points that may require temporary closure during emergency events (from North to South)

It is noted that the probabilistic current and future Zone of Slope Adjustment coastal hazard assessment lines (refer to **Figure 8-14**) for 2020 and 2070, as shown in **Figure 8-15, Figure 8-16, Figure 8-17**, **Figure 8-18, Figure 8-19,** and **Figure 8-20** are projected to impact on the beach and vegetated sand dunes along the "surf beaches" and Wanda Reserve during an erosion event.

It is further noted that while the rocky headland within Precinct 1: *The Cliff-Top Walk – 'The Esplanade', Bass and Flinders Point, Oak Park, Shelly Park, Shelly and Blackwoods Beaches* is not considered at significant risk of erosion or cliff instability, there are a number of locations within this precinct, as well as Precincts 2 to 4, that provide foreshore access and must be considered within the BBCZEAS as potentially exposing users to risk during a coastal storm emergency event.

Council's accompanying *Bate Bay Emergency Management Operational Procedures* will contain maps and asset information for a number of the assets and infrastructure items listed in the zones below, and will be updated as necessary.

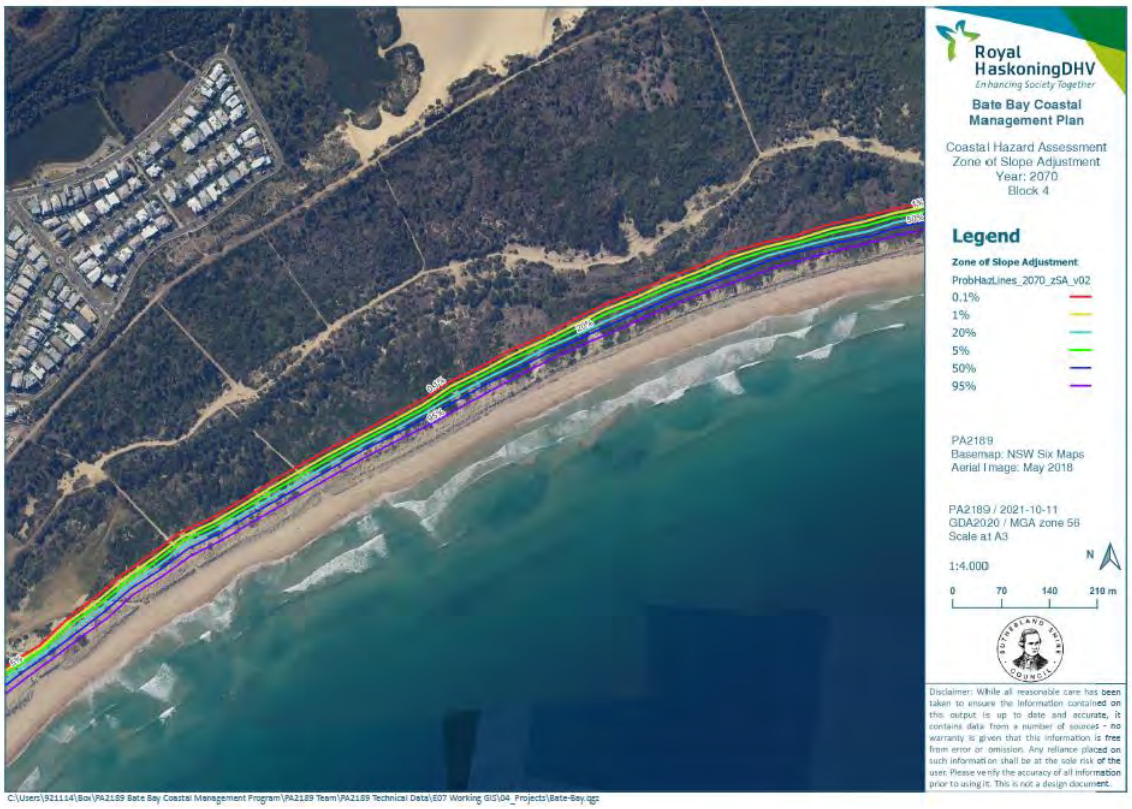


Figure 8-19: Wanda Reserve - Zone of Slope Adjustment 2020

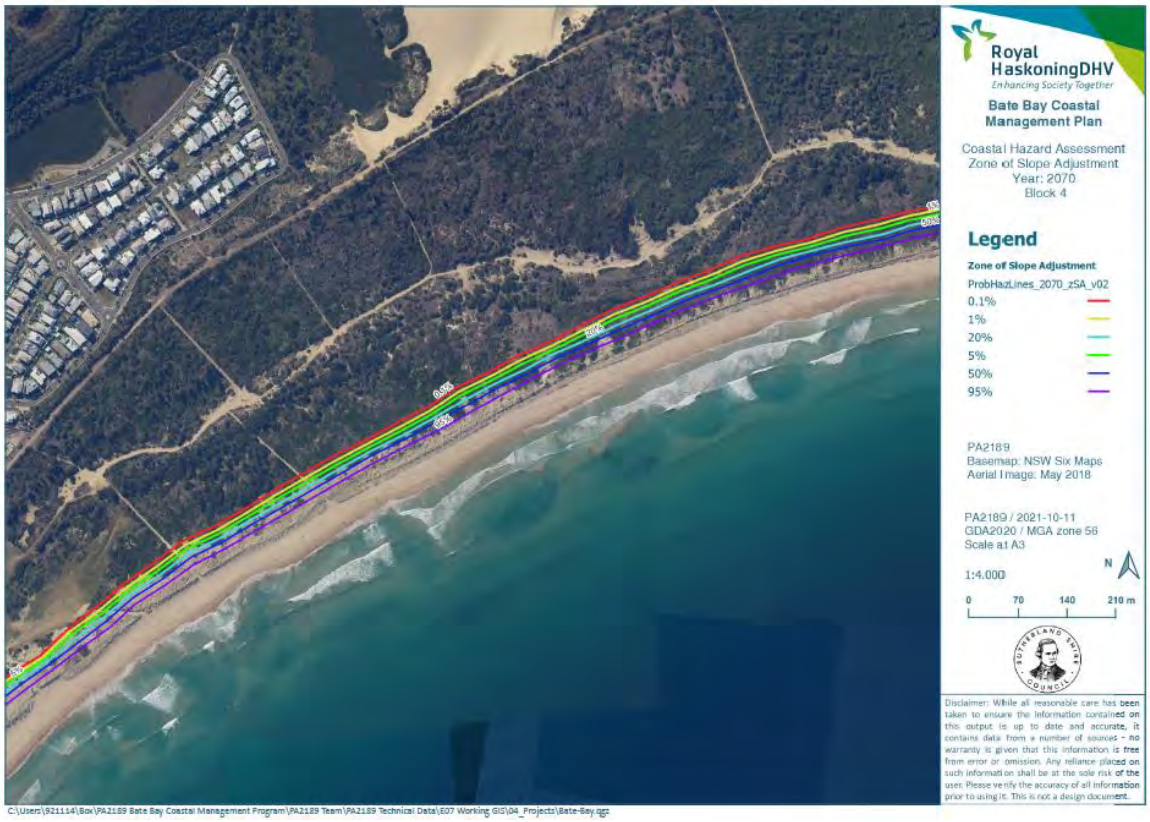


Figure 8-20: Wanda Reserve - Zone of Slope Adjustment 2070

The range of potential formal and informal beach and foreshore accessways throughout Precincts 1 to 4 are shown in **Figure 8-21a to 8-21 l** (North to South). A recommendation within the Action Plan is for Council to develop a list of all known accessways, both formal and informal, and provide name/numerical references to each so that a record may be kept of all accessways requiring closure during an emergency event. It is understood that Council has undertaken this task for the open beach accessways from Greenhills to North Cronulla Beach, however may not have been completed for the southern accessways (notably from the Cronulla Peninsular down to more isolated beaches and rock platforms).

Typical hazards relevant to most zones of the foreshore and beach frontage include:

- unstable vertical dune erosion scarps (that can collapse suddenly creating a hazard to persons/property at crest or near toe of scarp);
- public safety in areas of wave overtopping/inundation (including being impacted in the coastal "rock pools", being pulled seaward in undertow/rips, being caught on a rock platform and/or at the base of a headland);
- unsafe beach and foreshore accessways due to erosion;
- vegetation / soil destabilised by rainfall and/or erosion; and,
- submerged objects e.g. remnant/displaced accessway fencing.

Particular consideration is recommended for locations that are less publicly visible than Cronulla Beach and North Cronulla Beach, including Blackwoods Beach, Shelly Beach and Oak Park (including the rock pool).

In the short term, it is recommended that Council investigate potential warning signs and mechanisms for temporary closure of beach and foreshore accessways during periods of significant swell and wave runup, in order to educate users of these locations of potential hazards, and to minimise risk to life and property. Mechanisms may include temporary barricades being placed at the entrances to beach and foreshore accessways. During periods of significant swell, consideration may be given to engaging security services to provide a deterrent to accessing high use locations.

Immediately before and during a coastal erosion event, it is likely that actions of Council and other combat agencies will include:

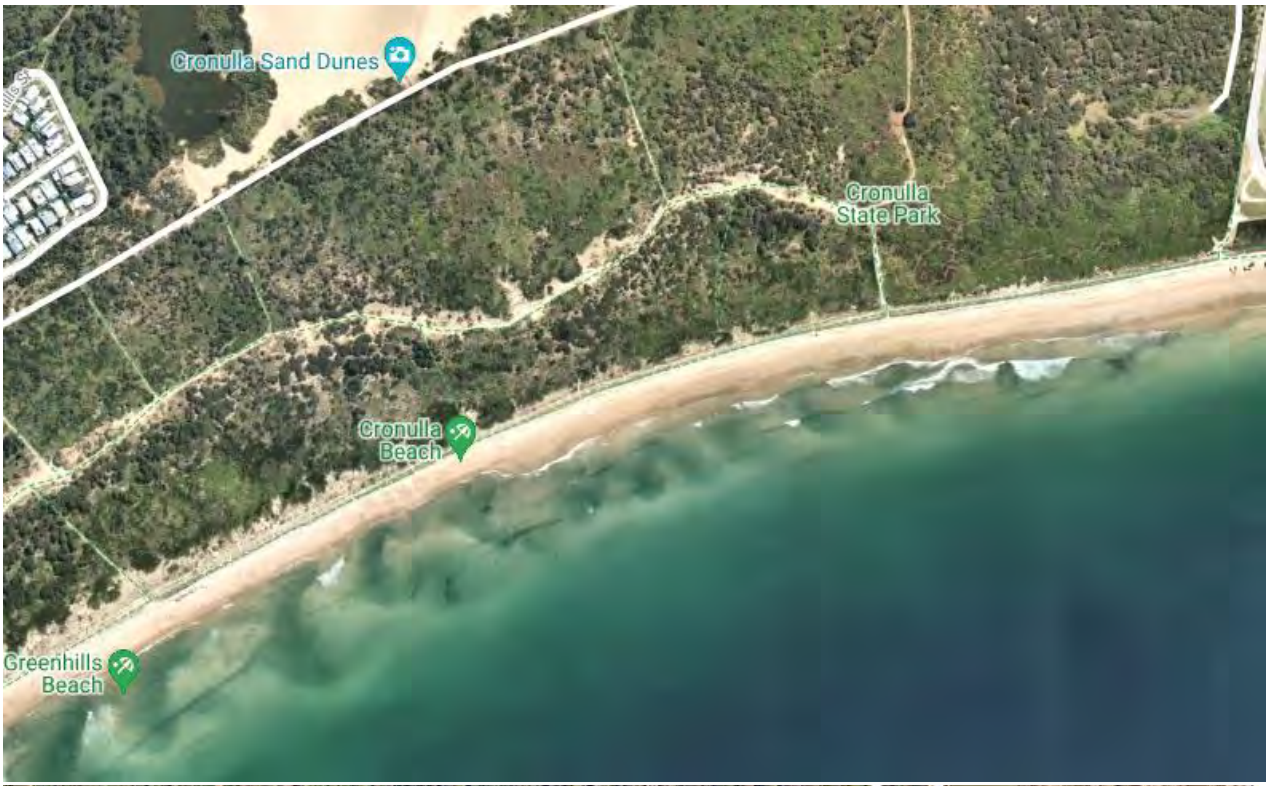
- Liaising with NSW SES, Police and other combat agencies to:
  - assist with barricading and fencing the foreshore and beach accessways;
  - if requested, in the evacuation of people/vehicles as required;
- Implement temporary emergency coastal protection works (this may include Crown Land with appropriate permissions) to facilitate emergency actions or actions under the direction of the Combat Agency if required, and record all actions taken.
- Temporary access works to facilitate emergency actions may include a range of activities e.g. placing sand filled geotextile bags, erecting temporary barriers, emergency vehicle access etc.

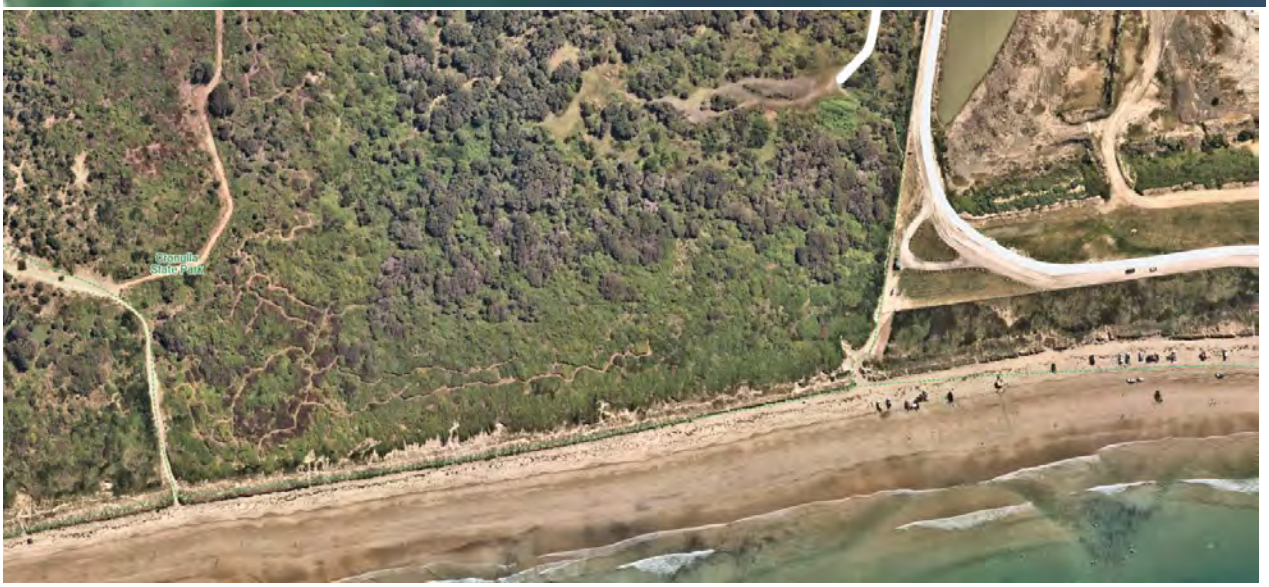
***Note**: Placement of temporary works are to be undertaken in consultation with suitably qualified coastal or geotechnical engineer.*

Following an erosion event, it is likely that short- and medium term actions of Council and other combat agencies will include:

- Inspections and damage assessments to built and natural assets;
- Undertake clean-up works and workorders including for:
    - removal of beach debris;
    - updated “make safe” works requests (including signage/exclusion);
    - short and medium repairs to damaged infrastructure and assets, accessways (may include “beach scraping” actions to restore access as well as accelerate beach accretion, subject to approval); and
    - short and medium term repairs to dune systems and vegetation.
- Scope and implement short- and medium-term remedial actions such as reconstruction of impacted built assets (as required).

Figure 8 21a to 8-21l: Precincts 1 to 4 – Bate Bay Beaches and Foreshore access locations (North to South)


Cronulla Sand Dunes
Cronulla State Park
Cronulla Beach
Greenhills Beach




Wanda Sand Dunes Meeting Point
Greenhills Beach Dog Off-Lead
Greenhills Beach
Greenhills Public Toilets
Wanda Children's Play Area
Sanderson St
Superba Ave
Mitchell Rd
Wanda Reserve
Murdock St
Links Ave
Marine Esplanade
Wanda Beach Public Toilets
Wanda Surf Life Saving Club
Wanda Beach
Patrolled beach for surfing & swimming


Hume Rd
Hume Rd
Mitchell Rd
Mitchell Rd
Mitchell Rd
TECH ACT
Active Bodys Personal Training
Bianchini's Espresso
Summer Salt
Modern Australian · $$$
Elouera Beach
Patrolled beach with surfing & swimming


Mitchell Rd
Mitchell Rd
Prince St
North Cronulla Beach Carpark
North Cronulla Surf Life Saving Club
Public Toilet
North Cronulla Playground
Dunningham Park
Executive Republic
Sealevel
North Cronulla Rock Pool


McDonald St
North Cronulla Rock Pool
South Cronulla Beach Rock Pool


Beach Volleyball Cronulla
CRONULLA BEACH
22r
30R
South Cronulla Beach
Cronulla Surf Life Saving Club
36a
Cronulla Beach Swim School
Barefoot on the Beach Cafe
Zimzala Restaurant Cronulla
Modern Australian · $$
The Esplanade
Watergrill


27-29
29
The Esplanade
10-12
The Esplanade
Shark Island
Blackwoods Beach
10
14
The Esplanade
11R


The Esplanade
Shelly Beach
Shelly Beach Ocean Pools
The Esplanade
The Esplanade
Via Mare
Via Mare
Cronulla Beach Walk
78

Figure 8-21a to 8-21l: Precincts 1 to 4 – Bate Bay Beaches and Foreshore access locations (North to South)

Please note: These figures show indicative positions of formal and informal beach access locations, which can vary in response to changing beach conditions, and are subject to change due to implementation of actions within the Bate Bay CMP. Mapping of all formal and informal accessways within the Bate Bay Emergency Management Operational Procedures will be required, and updated as necessary.

9 Approvals Required for Coastal Protection Works

Section 27 of the CM Act contains provisions dealing with the granting of development consent to development for the purpose of coastal protection works, while Section 4 (1) of the CM Act defines ***coastal protection works*** to mean:

(a) beach nourishment activities or works, and
(b) activities or works to reduce the impact of coastal hazards on land adjacent to tidal waters, including (but not limited to) seawalls, revetments and groynes.

Section 19 of the CM SEPP states that development for the purpose of coastal protection works may be carried by or on behalf of a public authority—

(a) without development consent—if the coastal protection works are—
    (i) identified in the relevant certified Coastal Management Program (or Coastal Zone Management Plan), or
    (ii) beach nourishment, or
    (iii) the placing of sandbags for a period of not more than 90 days, or
    (iv) routine maintenance works or repairs to any existing coastal protection works, or
(b) with development consent—in any other case.

The CM SEPP also provides that development for the purpose of emergency coastal protection works is exempt development if it is carried out by or on behalf of a public authority in accordance with a CZEAS. Emergency coastal protection works means works comprising the placement of sand, or the placing of sandbags for a period of not more than 90 days, on a beach, or a sand dune adjacent to a beach, to mitigate the effects of coastal hazards on land.

If proposed public or private works do not fit into any of these categories a development application would be required, and a Joint Regional Planning Panel with coastal expertise would be the consent authority.

10 Action Plan Framework

10.1 Australasian Inter-service Incident Management System

The Australasian Inter-service Incident Management System (AIIMS) is the nationally recognised system of incident management for the nation's fire and emergency service agencies, and is utilised by the majority of NSW combat agencies.

AIIMS is based on three principles:

a. Functional management;
b. Management by objectives; and
c. Span of control.

The control system of AIIMS is based on a structure of delegation with five functional areas, which ensures that all vital management and information functions are performed, being;

Control	The management of all activities necessary for the resolution of an incident.
Planning	The collection and analysis of information and the development of plans for the resolution of an incident.
Public Information	Provision of warnings, information and advice to the public and liaison with the media and affected communities.
Operations	The tasking and application of resources to achieve resolution of an incident.
Logistics	The acquisition and provision of human and physical resources, facilities, services and materials to support achievement of incident objectives.

For every incident, an Incident Controller is appointed who is ultimately responsible and accountable for all of the five functions. Depending on the size and complexity of an incident, the Incident Controller may elect to delegate one or more of the functions of planning, public information, operations and logistics.

The way in which AIIMS is "scalable" is that it does not require the full-scale response to every incident – it allows for the build-up of resources and response activity. For example, a single-story house does not require an Incident Control Centre (i.e. control room) with six people managing the incident; however, the 2016 NSW Coastal Erosion Event required all functional areas to be filled by separate individuals (with deputies as required)

A significant benefit of this scalability is that AIIMS is used by other agencies that Council interact with during emergencies, such as NSW SES and Police. Use of the AIIMS system promotes effective joint operations through the use of common structures and terminology.

Adoption of the AIIMS may enable Council to collaborate with other agencies rapidly and effectively when responding to public land emergencies (e.g. a coastal hazard emergency event, floods, fires etc.) listed within the Sutherland EMPLAN and the Sutherland FESH. Northern Beaches Council noted the benefit of having adopted AIIMS within Council prior to the coastal erosion emergency events at Collaroy-Narrabeen Beach in 2016.

Action Item 1.2 recommends that Council investigate the feasibility of adopting the principles of the Australasian Inter-service Incident Management System (AIIMS) within Council emergency systems.

10.2 Bate Bay Emergency Management Operational Procedures

Prevention and mitigation measures in relation to planned infrastructure works, asset management, land use and development controls are to be assessed and implemented in accordance with the Bate Bay CMP (2021). They are not within the scope of BBCZEAS.

While the BBCZEAS provides the overarching framework for responding to coastal hazard emergency events, it is recommended (Action1.3) that Council develop an internal document entitled *Bate Bay Emergency Management Operational Procedures* to provide detailed guidance and direction for implementation of Council's responses to a range of situations.

Detailed information and spatial data to operationalise the actions outlined in Tables 1 to 4 would be included within Council's accompanying *Bate Bay Emergency Management Operational Procedures* (Procedures). These Procedures would set out internal allocations for actions within the Tables below against current roles within the organisation, and would be reviewed and updated as necessary.

This Procedure would include specific spatial and asset data, set out internal delegations, resourcing, training, testing and post action reviews and documentation to support any Common Operating Platform (e.g. mobile data capture) for Council.

Establishment of Procedures may also assist operational groups and staff within Council through division of roles and responsibilities for discrete 'work packages' to be delivered as required. For example, in **Section 8.4** it is recommended that Council develop a map and list of all known beach and foreshore accessways, both formal and informal, and provide name/numerical reference to each accessway.

A table of this complete list of accessways can be included in the Procedure so that on-ground staff are aware of all of accessway locations and names, so that clear directions can be provided as to which accessways require closure during an emergency event. In addition, the table can be used to record the date and time of closure, as well as noting any additional relevant factors for further reference (e.g. distance to erosion scarp).

10.3 Action Plan - Delivery

Tables 1 to 4 outline the timelines, triggers and management actions for the following phases of an emergency:

1. **Prevention**
2. **Preparation**
3. **Response**
4. **Recovery**

Table 1 lists preventative actions to improve capability and capacity for emergency response and resilience.

The implementation of actions detailed in Tables 1 to 4 are dependent on a number of factors including ensuring the work health and safety (WH&S) requirements of personnel, available resources, obtaining necessary agreements and approvals, budget and time constraints. All factors will be considered in determining whether the emergency actions will be reasonable and feasible to implement.

Table 1 – Emergency Response Actions Phase 1 – Prevention

Action ID	Timing	Responsibility (Support)	Action /Reporting
1.1	Within 12 months	Local Emergency Management Officer (LEMO)	Through the Local Emergency Management Committee: Work with NSW SES / Police / FRNSW to develop, align and review agency specific emergency incident action'; evacuation and communication plans for Bate Bay, to be consistent with this BBCZEAS. Keep a revision log for the next scheduled review of the Sutherland Shire EMPLAN
1.2	Within 12 months	LEMO	Investigate feasibility of adopting the principles of the Australasian Inter-service Incident Management System (AIIMS) within Council emergency systems.
1.3	Ongoing	Manager Asset Management Services or delegate (LEMO)	Develop and maintain Council's internal *Bate Bay Emergency Management Operational Procedures* to guide Council's response to coastal hazards and events across the disaster management cycle. This procedure will include specific spatial and asset data, set out internal delegations, resourcing, training, testing and post action reviews and documentation to support any Common Operating Platform for Council. Monitor and evaluate the implementation of the Operational Procedures after an emergency event and amend where necessary.
1.4	Within 3 months and ongoing	Manager – Communication & Engagement (Support Manager Asset Management Services; LEMO)	Prepare communications strategy that provides information to the community before, during and after emergency events. This strategy is to: • Establish Council contacts and roles for the strategy; • Confirm internal authorisation arrangements for media/spokesperson roles; and • Setout how and when consultation with other agencies will occur – including operational contacts (email, mobile number) to LEMO for EMPLAN events. Prepare templates and draft collateral to enable ready deployment of this strategy to provide timely public safety and emergency information, including Council's intended emergency responses to coastal erosion. Provide ongoing information to residents and property owners about safe recreational usage, coastal erosion and inundation hazards. Promote a clear single point of contact and information source for all public enquiries.
1.5	Within 6 months	Strategic Planning	Advise owners of affected properties that their dwellings may be at risk in a severe storm event.
1.6	Within 12 months	Manager Asset Management Services or delegate	Investigate partnering with NSW SES to: • provide general information to Bate Bay residents and owners about coastal erosion and inundation hazards/ • engage with subset of potentially impacted residents build local community resilience, e.g. by supporting residents to have their own household and neighbourhood emergency plans.
1.7	Ongoing	Manager Asset Management Services or delegate	Support leaseholders of Council properties to prepare emergency response and /or business continuity plans. Provide best available coastal hazard and warning information to leaseholders for the purposes of these plans.

Table 2 – Emergency Response Actions Phase 2 – Preparation

Action ID	Timing	Responsibility (Support)	Action /Reporting
2.1	Ongoing	Manager Asset Management Services or delegate	Weekly monitoring of conditions including weather (measurements, warnings and forecasts), wave forecasts (height and direction), water level (tidal) predictions, real time wave data (height, period and direction), real time water level data (including consideration of elevated water levels due to storm surge), and beach behaviour (extent of erosion, beach width, understanding of historical beach behaviour at times of storms). Monitor and assess the erosion escarpment in relation to development at key locations. Report significant change in condition and/or weather forecast to management.
2.2	Every 6 months	LEMO	Maintain and distribute up to date contact list with after-hours emergency phone contacts for early warning purposes in case of a storm event (including but not limited to): • internal Council contacts; • NSW SES; • NSW Police; • FRNSW; • Cronulla, North Cronulla, Elouera and Wanda SLSCs; and • DCCEEW designated public information officer or similar contact details).
2.3	Ongoing	Manager Asset Management Services or delegate	Maintain procedures and guidance for monitoring, emergency inspection, damage assessments, “make safe” and reactive works to ensure public and worker safety including: • site inspections of relevant assets and hazard areas (**Section 9**); • management of storm debris (potentially containing asbestos); • installing, monitoring, maintaining exclusion zones and other “make safe” measures (barriers, fences and signage); • public accessways to the beach and dune fencing; • beach facilities and open space; • roads and footpaths; • emergency works sites; and • removal and dismantling of the above exclusion and “make safe” measures.
2.4	Ongoing	Manager Asset Management Services or delegate	Maintain the portfolio describing relevant details of all properties and assets adjacent to Bate Bay beaches, including Lot and DP, ownership, foundation type and depth, and notation of which properties and assets may require evacuation.
2.5	Ongoing	Manager Asset Management Services or delegate	Ensure site suitable barriers, fencing and signage are available; and ready for deployment to effectively close or “make safe” Council managed: • public accessways to the beach; • beach facilities and open space; • roads and footpaths; and • emergency works sites.
2.6	Within 6 months	Manager Asset Management Services or delegate	Undertake necessary environmental assessments and approvals for potential emergency coastal protection works.

2.7	Every 6 months	Manager Asset Management Services or delegate	Prepare logistics and supply chain contingency plans for likely resources needed to implement potential emergency works. For example: geotextile products; sandbags and ancillary equipment; and sand. Review the list of suppliers for, and availability of, non-stockpiled materials which may be required for intended emergency actions, such as sand or rock.

Table 3 – Emergency Response Actions Phase 3 – Early Warning and Response

Trigger	Action ID	Responsibility	Action /Reporting
BOM issues a "Severe Weather Warning for Damaging Surf" OR "Severe Weather Warning for Storm Tides" OR Council staff identify a likely coastal erosion event	3.1	Manager Asset Management Services or delegate	Undertake regular monitoring and reporting of weather, wave forecasts and beach conditions.
	3.2	Manager Asset Management Services or delegate	Undertake regular on-ground monitoring of environmental conditions and beach behaviour and close all potentially impacted areas.
	3.3	Asset Services Manager or delegate (LEMO)	In accordance with *Bate Bay Emergency Management Operational Procedures:* • Notify relevant internal staff that coastal erosion event is possible or likely. • Confirm availability of labour, resources for "make safe" arrangements and inspections for duration of the event, including early warning, response and early recovery phases. • Confirm and circulate emergency contact details.
	3.4	Manager – Communication & Engagement	Deliver early warning and response components of communications strategy as situation develops. Consultation with LEMO/other agencies as required.
	3.5	Manager Asset Management Services or delegate	Identify areas where "make safe" measures are needed and deploy accordingly. Consider where potential emergency coastal protection measures may be required (such as pre-emptive sandbag revetments in high risk areas), and deploy as necessary. *Note: approval processes already prepared.*
Significant erosion escarpment forms and predicted increase in storm threat *Note: Actions as a result of this trigger are to be applied to all trigger responses below*	3.6	Manager Asset Management Services or delegate	Increase frequency of web-based monitoring and keep records of any weather warnings/ reports of erosion.
	3.7	Manager Asset Management Services or delegate	Gather evidence of erosion escarpment. Evidence to be provided to co-ordinator. Respond with "make safe" measures or site management as required and practical.
	3.8	Manager Asset Management Services or delegate	If access is required to facilitate emergency actions or actions under the direction of the combat agency, implement necessary temporary access works.
	3.9	Manager Asset Management Services or delegate	Monitor and assess roads and foreshore access routes, and if considered unsafe organise temporary closure through barricades and safety signage.
	3.10	Manager Asset Management Services or delegate	Notify all appropriate stakeholders, including LEMO, with request to be on standby for possible emergency meeting.

Trigger	Action ID	Responsibility	Action /Reporting
Top of erosion escarpment within 20m of built asset with predicted increase in storm threat, OR Wave overtopping/ coastal inundation is affecting private or public land, OR Predicted increase in storm threat by BoM (waves exceeding 7m and tides exceeding 1.6m or storm surge greater than 0.6m)	3.11	Manager Asset Management Services or delegate (LEMO)	Notify all appropriate stakeholders including LEMO to gather for emergency meeting.
Top of erosion escarpment within 15m of a built asset with a predicted increase in storm threat, OR Significant wave overtopping/ coastal inundation is affecting private or public land	3.12	Manager Asset Management Services or delegate (LEMO, Manager – Communication & Engagement)	If the EMPLAN is invoked, and as required: • establish and maintain a LEOC for the LEOCON (see **Section 4.3**); • provide support staff for the LEOC; • provide human resources, plant, equipment, materials and services, as required in dealing with an incident or emergency; • provide support to combat agencies and functional area agencies as required including: o reconnaissance of the area effected by the emergency; and o post disaster damage assessment; • assist, at their request, NSW Police, FRNSW, Ambulance Service and NSW SES in dealing with any incident or emergency; • assist in any other emergency management prevention, preparedness or recovery operations, including emergency management training, for which Council's training and equipment is suitable; • at the request of the LEOCON, coordinate disaster recovery operations, excluding welfare assistance to disaster victims for whom Department of Family and Community Services – Community Services is responsible; • provide engineering resources required for response and recovery operations including: o damage assessment; o clear and re-establish roads and bridges; o demolish and shore-up buildings; o remove debris; o construct and maintain temporary levees and evacuation routes, when appropriate; and o erection of barricades and fences for public protection; • provide a liaison officer and executive support to the LEOC and LEOCON or Combat Agency Controller; and

Trigger	Action ID	Responsibility	Action /Reporting
			• provide an appropriately qualified officer to assist the District Environmental Functional Area Coordinator in relation to environmental emergency management matters.
	3.13	Manager Asset Management Services or delegate	Gather evidence and/or coastal and geotechnical engineering advice from suitably qualified person(s) where required, of erosion escarpment/inundation including location and other appropriate information. Evidence to be provided to emergency meeting stakeholders (3.12).
	3.14	Manager Asset Management Services Manager, Property Services) and delegates (LEMO)	Hold emergency meeting with relevant stakeholders to determine whether Evacuation Plan or actions should be triggered / implemented for private / Council buildings
	3.15	Manager Asset Management Services or delegate (LEMO, Manager – Communication & Engagement)	Inform residents/occupants of the issue. Commence evacuation of all persons from buildings determined by stakeholder meeting to be at risk; and in accordance with any evacuation plan arrangements.
	3.16	Manager Asset Management Services or delegate	Re-visit need to trigger or update emergency access (3.8) or road closures (3.9).
	3.17	Manager Asset Management Services or delegate Manager, Property Services) and delegates	Contact utility service providers to request disconnection of electrical services to the affected area; plus sewage/water if required.
	3.18	Manager Property Services	Liaise with managers of Cronulla, North Cronulla, Elouera and Wanda SLSCs to: • assist with barricading and fencing the SLSC's beach accesses • assist with traffic management • authorise closure and opening of SLSC's in coordination with SLSC managers • assist the NSW SES/Police, if requested, in the evacuation of patrons as required.
Decision is made during emergency meeting to implement	3.19	Manager Asset Management Services or delegate	Transport all necessary materials and equipment for "make safe" measures; erosion control or inundation protection to locations where emergency response works are required.

Trigger	Action ID	Responsibility	Action /Reporting
emergency coastal protection works	3.20	Manager Asset Management Services or delegate	Restrict public access where emergency coastal protection works are to be implemented.
	3.21	Manager Asset Management Services or delegate	Implement temporary emergency coastal protection works (this may include Crown Land with appropriate permissions) to facilitate emergency actions or actions under the direction of the Combat Agency if required, and record all actions taken. Placement of measures are to be undertaken in consultation with suitably qualified coastal or geotechnical engineer. Temporary access works may include a range of activities e.g. placing sand filled geotextile bags, erecting temporary barriers, emergency vehicle access etc.

Table 4 – Emergency Response Actions Phase 4 – Recovery

Trigger	Action ID	Responsibility	Action /Reporting
Storm and erosion event has abated and safe to conduct post-storm activities	4.1	Operational Services Coordinators- Support and Environment and delegates	Built and natural asset inspections and damage assessments. Define clean-up needs and workorders including for: • beach debris • updated “make safe” works requests (including signage/exclusion) • short and medium repairs to damaged infrastructure and assets, access ways • short and medium term repairs to dune systems and vegetation. Seek professional advice as needed. Scope and implement short - medium term remedial actions as required. Implement once safe /coastal system has sufficiently recovered, with reference to preventative works under the CMP.
	4.2	Operational Services Coordinators- Support and Environment and delegates	Monitor performance of emergency coastal protection works and tasks identified in 4.1. Take remedial action where required.
	4.3	Manager – Communication & Engagement	Deliver early and medium term recovery components of communications strategy. Release warnings of any persisting hazards e.g. high, unstable or near vertical erosion escarpments collapsing without notice.
	4.4	Operational Services Manager, Property Services Manager) And delegates	Ensure power, sewerage and water services are safely reconnected within Council facilities. Contact utility service providers to request reconnection of electrical services to the affected area.
	4.5	Manager Asset Management Services, Manager Property Services and delegate	Request written damage assessments by suitably qualified professionals to confirm any evacuated Council facilities are safe. Coordinate return of evacuated people and belongings to Council facilities and areas deemed safe.
	4.6	Manager Asset Management Services or delegate	Re-stock emergency materials and supplies for future erosion events.
	4.7	Manager Asset Management Services or delegate LEMO	Post-event debrief with emergency response team, review lessons learned, opportunities for improvement.
	4.8	Manager – Communication & Engagement	Communicate with the community on further outcomes and actions to be undertaken.

Review of emergency actions	4.9	LEMO (Manager Asset Management Services and delegates)	Post emergency review of BBCZEAS and Council *Bate Bay Emergency Management Operational Procedures*; track and update documents as required.
	4.10	Manager Asset Management Services or delegate	Review and collate records of the event, actions taken, issues identified and retain for reporting or future reference.

11 Communication before, during and after an emergency event

If an emergency event is anticipated, Council will liaise with the NSW SES and other emergency services to ensure consistent messages are being delivered by all to reinforce public safety advice. Council's emergency communication strategy will identify how Council staff will liaise with the combat agency. If an event occurs each combat agency and Council are responsible for their own external media.

Before and during an emergency event Council will erect appropriate signage, including where temporary access works, barricades and fencing are in place, and provide information to the community, including community groups, visitors and tourists, regarding:

- the nature and extent of the emergency;
- risks associated with the emergency e.g. collapse of sand dunes, wave overtopping;
- likely impacts, e.g. closure/loss of beach access;
- Council's emergency actions; and
- ways to minimise risk to personal and public safety, e.g. avoid the hazard areas, heed safety warnings.

It is envisaged that the following media/outlets will be utilised, depending on their suitability at the time:

- Council's website and social media posts;
- local radio;
- local newspapers;
- signage;
- hard copy fact sheets/brochures; and
- community group contacts.

After an emergency event, Council will participate in a debrief with the emergency response team to review lessons learnt and note opportunities for improvement. Council will provide information to the community as to the recovery process, including further outcomes and actions to be undertaken and any ongoing needs for "make safe" arrangements.

12 Bate Bay CZEAS Implementation and Review

This BBCZEAS applies from the date of gazettal of the Bate Bay CMP. Council will monitor and evaluate the implementation of the BBCZEAS after an emergency event, and amend where necessary.

Operational changes and adjustments will be made to Council's accompanying *Bate Bay Emergency Management Operational Procedures* – as set out in **Section 11**.

13 Recommendations for amendments to the Sutherland EMPLAN and Sutherland FESP

The BBCZEAS seeks to provide guidance as to actions that Council and other combat agencies can take during a “coastal hazard” emergency event, as well as recognising the actions for other types of emergency events identified within Coastal Risk and Vulnerability Assessment undertaken for Stage 2 of the Bate Bay CMP.

13.1 Sutherland EMPLAN

Annexure B of the Sutherland Shire Local Emergency Management Plan (Sutherland EMPLAN) provides a summary of hazards that have risk of causing loss of life, property, utilities, services and/or the community’s ability to function within its normal capacity, i.e. identified as having the potential to create an emergency, but does not include reference to coastal hazards.

The closest relevant hazard description, **Storm** is defined as: “Severe storm with accompanying lightning, hail, wind, and/or rain that causes severe damage and/or localised flooding (includes tornado)”.

While it is noted in Annexure A of the Sutherland EMPLAN that “On occasion, significant damage has been caused by coastal erosion along the Wanda and Cronulla Beach areas” (page 11), Annexure B does not identify “coastal erosion” (or other coastal hazards noted within the CM Act) as having the potential to create an emergency.

It is recommended that the Sutherland EMPLAN is reviewed and updated as necessary, including reference to “coastal hazard” (as defined in the CM Act, including coastal erosion) and to the BBCZEAS.

13.2 Sutherland FESP

The Sutherland Shire Flood Emergency Sub Plan (Sutherland FESP) is a Sub-Plan of the Sutherland EMPLAN, and covers preparedness measures, the conduct of response operations and the coordination of immediate recovery measures from flooding and the management of coastal erosion within the Sutherland Shire Council area.

A CZEAS within a CMP must not include matters dealt with in any plan made under the *State Emergency and Rescue Management Act 1989*. Where actions, roles or responsibilities relating to coastal emergencies are covered by the SERM Act framework, the CZEAS should refer to the relevant plan or subplan, rather than duplicate those actions.

The BBCZEAS is a Sub Plan to the Sutherland EMPLAN, and Supporting Plan to the Sutherland FESH, providing specific guidance as to actions that Council and other combat agencies can take in preparation for “coastal hazard” emergency events.

13.2.1 Recommended Amendment A

The Sutherland FESP describes the roles and responsibilities of agencies in relation to a range of emergency events, including specific reference to ocean storms, as follows:

Part 1 – Introduction

1.5.30 Sutherland Shire Council:

Response

m. During periods of coastal erosion from ocean storms:
- Assist the NSW SES with reconnaissance of coastal erosion risk areas.
- Liaise with the NSW SES Local Controller to provide advice regarding the need for response actions by the NSW SES such as evacuations.
- Activate the ***Sutherland Shire Council Coastal Zone Management Plan – Emergency Action Plan.***

The ***Sutherland Shire Council Coastal Zone Management Plan – Emergency Action Plan*** is a construct of the *Coastal Protection Act (1979)* (now repealed). The ***Bate Bay Coastal Zone Emergency Action Subplan*** is a construct of the Coastal Management Act 2016, and replaces the Sutherland Shire Council Coastal Zone Management Plan – Emergency Action Plan.

*It is recommended that the Sutherland FESH is reviewed and updated as necessary, including reference in section 1.5.30 (m) to "**Bate Bay Coastal Zone Emergency Action Subplan**".*

13.2.2 Recommended Amendment B

The Sutherland FESP includes a "Planning" section which describes the endorsed methodology for the collection and analysis of information and the development of plans for the resolution of an incident.

With relation to coastal hazard events, an apparent gap has been identified between monitoring of information that provides advance warning of a potential coastal hazard event, and the triggers that initiate the start of a response.

Specifically, within Part 3 – Response

Control;

3.3 Start of Response Operations

3.3.2 Response operations will begin:
a. On receipt of a ***Bureau of Meteorology*** Preliminary Flood Warning, Flood Warning, Flood Watch, Severe Thunderstorm Warning or a ***Severe Weather Warning for*** flash flooding or ***severe ocean conditions*** (emphasis added).
b. On receipt of a dam failure alert.
c. When ***other evidence leads to an expectation of*** flooding or ***coastal erosion*** within the council area (emphasis added).

3.8 Collating Situational Information

Strategy

3.8.1 The NSW SES maintains and records situational awareness of current impacts and response activities

Actions

3.8.2 The NSW SES Sutherland Shire Local Headquarters collates information on the current situation in the Sutherland Shire Council LGA and incorporates in Situation Reports.
3.8.3 The NSW SES Sydney Southern Region Headquarters collates Region-wide information for inclusion in Region NSW SES Situation Reports.
3.8.4 Sources of situational information during times of ***flooding*** are: (emphasis added)

(note: a number of sources of flooding information are provided – but no reference is made to sources of coastal hazard information)

3.8.6 Situational information relating to consequences of flooding and/or ***coastal erosion*** should be used to verify and validate NSW SES Flood Intelligence records. (emphasis added)

3.9 Provision Of ***Flood*** Information And Warnings (emphasis added)

Strategy

3.9.1 The NSW SES Sutherland Shire Local Headquarters provides advice to the NSW SES Sydney Southern Region Headquarters on current and expected impacts of ***flooding*** in the Sutherland Shire Council LGA.
3.9.2 The NSW SES Sydney Southern Region Headquarters issues NSW SES ***Flood Bulletins***, NSW SES Livestock and Equipment Warnings, Evacuation Warnings and Evacuation Orders to media outlets and agencies on behalf of all NSW SES units in the Region.

Actions

3.9.3 The NSW SES Sutherland Shire Local Incident Controller will ensure that the NSW SES Sydney Southern Region Incident Controller is regularly briefed on the progress of operations.

(Note: a number of sources of information are provided, including:

- ***Bureau of Meteorology Severe Thunderstorm Warning***
- ***Bureau of Meteorology Severe Weather Warnings for Flash Flooding***
- ***Bureau of Meteorology Flood Watches***
- ***Bureau of Meteorology Flood Warnings***

No reference is made in s 3.9 to sources of coastal hazard information, noted in s 3.2.2 as being:

- ***Bureau of Meteorology Severe Weather Warning for severe ocean conditions).***

Please note:

The Bureau of Meteorology (BOM) issues Severe Weather Warnings whenever severe weather is occurring in an area or is expected to develop or move into an area.

In relation to coastal hazards, BOM Severe Weather Warnings are issued for:

- Sustained winds of gale force (63 km/h) or more
- Abnormally high tides (or storm tides) expected to exceed highest astronomical tide
- Unusually large surf waves expected to cause dangerous conditions on the coast

Please note:

- "severe ocean conditions" (as per s 3.2.2) is ***not*** a current BOM Severe Weather Warning

It is recommended that the Sutherland FESH is reviewed and amended as necessary, including:

- *s 3.2.2 and 3.9 - updating references to reflect current BOM Severe Weather Warnings issued for;*
  - *Sustained winds of gale force (63 km/h) or more*
  - *Abnormally high tides (or storm tides) expected to exceed highest astronomical tide*
  - *Unusually large surf waves expected to cause dangerous conditions on the coast*
- *s 3.2.2 - that Council and the NSW SES local controller clarify which agency is responsible for monitoring of BOM "Severe Weather Warnings" with respect to coastal hazards.*
- *s 3.2.2 - that Council and the NSW SES local controller clarify which agency is responsible for monitoring for "when other evidence leads to an expectation of flooding or coastal erosion within the council area".*

14 Glossary of Definitions - Emergency

This glossary provides definitions of terms that are in common use when describing emergency management. This glossary of definitions is included with acknowledgement of the New South Wales State Emergency Management Plan (EMPLAN) developed by State of NSW and State Emergency Management Committee (2018).

NOTE: The definitions used in the EMPLAN are sourced from The State Emergency & Rescue Management Act, 1989, other New South Wales legislation, and The Macquarie Dictionary (Second Edition, 1991). Where possible, the reference source is identified as part of the definition (e.g. the State Emergency and Rescue Management Act, 1989 is identified as SERM Act).

Agency
: means a government agency or a non-government agency. (Source: SERM Act).

Agency Controller
: in this plan means the operational head of the agency, identified in this plan as the combat agency, who has command of the resources of the particular agency.

Casual Volunteer
: means a person who:
a) assists an accredited rescue unit in carrying out a rescue operation with the consent of the person in charge of the rescue operation; or
b) assists on his or her own initiative in a rescue operation or otherwise in response to an emergency in circumstances in which the assistance was reasonable given (Source: SERM Act).

Combat Agency
: means the agency identified in EMPLAN as the agency primarily responsible for controlling the response to a particular emergency. (Source: SERM Act).

Command
: in this plan means the direction of members and resources of an agency / organisation in the performance of the agency / organisation's roles and tasks. Authority to command is established by legislation or by agreement with the agency / organisation. Command relates to agencies/organisations only, and operates vertically within the agency/organisation.

Concept of Operations
: in this plan refers to the Controller's general idea or notion, given the anticipated problems of the effects of the event, of how the emergency response and recovery operation is to be conducted. It is a statement of the Controller's operational intentions, and may be expressed in terms of stages / phases of the emergency operation New South Wales State Disaster Plan

Control
: means the overall direction of the activities, agencies or individuals concerned. (Source: SERM Act). Control operates horizontally across all agencies / organisations, functions and individuals. Situations are controlled.

Coordination

means the bringing together of agencies and individuals to ensure effective emergency or rescue management, but does not include the control of agencies and individuals by direction. (Source: SERM Act)

Disaster

means an occurrence, whether or not due to natural causes, that causes loss of life, injury, distress or danger to persons, or loss of, or damage to, property. (Source: Community Welfare Act, 1987).

EMPLAN

means the New South Wales State Emergency Management Plan. The object of EMPLAN is to ensure the coordinated response to emergencies by all agencies having responsibilities and functions in emergencies. (Source: SERM Act).

Emergency

means an emergency due to an actual or imminent occurrence (such as fire, flood, storm, earthquake, explosion, terrorist act, accident, epidemic or warlike action) which:

a) endangers, or threatens to endanger, the safety or health of persons or animals in the State; or
b) destroys or damages, or threatens to destroy or damage, any property in the State, or
c) causes a failure of, or a significant disruption to, an essential service or infrastructure.

being an emergency which requires a significant and co-ordinated response.

For the purposes of the definition of emergency, property in the State includes any part of the environment of the State. Accordingly, a reference in the Act to:

a) threats or danger to property includes a reference to threats or danger to the environment, and
b) the protection of property includes a reference to the protection of the environment.

(Source: SERM Act).

Emergency Officer

means the Commissioner of SES or a person appointed as an Emergency Officer under Section 15 of the State Emergency Service Act. A person may be appointed as an Emergency Officer even if not a member of the NSW State Emergency Service. (Source: SES Act).

Emergency Operations Centre

means a centre established at State, Region or Local level as a centre of communication and as a centre for the coordination of operations and support during an emergency. (Source: SERM Act).

Emergency Risk Management

in this plan means the process approved by the State Emergency Management committee and published in the NSW Implementation Guide for Emergency Management Committees.

Emergency Services Officer

means a Police Officer, an officer of Fire and Rescue NSW of or above the position of station commander, an officer of the NSW State Emergency Service of or above the position of unit

commander, or a divisional executive officer or the Director, Operations of that Service, a member of the Rural Fire Service of or above the position of deputy captain, or a Region Emergency Management Officer, a member of the Ambulance Service of NSW of or above the rank of station officer. (Source: SERM Act).

Emergency Services Organisation

Means the Ambulance Service of NSW, Fire and Rescue NSW, a fire brigade within the meaning of the Fire and Rescue NSW Act 1989, NSW Police Force, NSW Rural Fire Service, NSW State Emergency Service, Surf Life Saving New South Wales, New South Wales Volunteer Rescue Association Inc, Volunteer Marine Rescue NSW, an agency that manages or controls an accredited rescue unit, a non-government agency that is prescribed by the regulations for the purposes of this definition.

Essential services

for the purposes of the Essential Services Act, 1988, a service is an essential service if it consists of any of the following:

a) the production, supply or distribution of any form of energy, power or fuel or of energy, power or fuel resources
b) the public transportation of persons or freight
c) the provision of fire-fighting services
d) the provision of public health services (including hospital or medical services)
e) the provision of ambulance services
f) the production, supply or distribution of pharmaceutical products
g) the provision of garbage, sanitary cleaning or sewerage services
h) the supply or distribution of water
i) the conduct of a welfare institution
j) the conduct of a prison
k) a service declared to be an essential service under subsection (2)
l) a service comprising the supply of goods or services necessary for providing any service referred to in paragraphs (a – k).

Functional Area

means a category of services involved in the preparations for an emergency, including the following:

a. Agriculture and Animal Services;
b. Telecommunications Services;
c. Energy and Utility Services;
d. Engineering Services;
e. Environmental Services;
f. Health Services;
g. Public Information Services;
h. Transport Services; and
i. Welfare Services.

Functional Area Coordinator

in this plan means the nominated coordinator of a Functional Area, tasked to coordinate the provision of Functional Area support and resources for emergency response and recovery operations, who, by agreement of Participating and Supporting Organisations within the Functional Area, has the authority to commit the resources of those organisations.

Government Agency

means:

a) a Public Service agency,

b) a public authority, being a body (whether incorporated or not) established by or under an Act for a public purpose, other than:

i. the Legislative Council or Legislative Assembly or a committee of either or both of those bodies; or

ii. a court or other judicial tribunal;

c) the NSW Police Force;

d) a local government council or other local authority; or

e) a member or officer of an agency referred to in paragraphs (a) – (d) or any other person in the service of the Crown who has statutory functions, other than:

i. the Governor, the Lieutenant-Governor or the Administrator of the State;

ii. a Minister of the Crown;

iii. a Member of the Legislative Council or Legislative Assembly or an officer of that Council or Assembly; or

iv. a judicial officer. (Source: SERM Act).

Hazard

in this plan means a potential or existing condition that may cause harm to people or damage to property or the environment.

Hazardous Material

means anything that, when produced, stored, moved, used or otherwise dealt with without adequate safeguards to prevent it from escaping, may cause injury or death or damage to property. [Source: Fire and Rescue NSW Act, 1989)].

Hazardous Material Incident

means an actual or impending land-based spillage or other escape of hazardous material that causes or threatens to cause injury or death or damage to property. [Source: Fire and Rescue NSW Act, 1989].

Incident

in this plan means a localised event, either accidental or deliberate, which may result in death or injury, or damage to property, which requires a normal response from an agency, or agencies.

Incident Control System (ICS)

means an operations management system using common language and procedures that allows agencies to retain their own command structure. The key principles are management by objectives and span of control using key functions of Control, Operations, Planning and Logistics.

Lead Agency

means the agency who has overall leadership in a given situation. It could be a combat agency, a Functional Area or another agency (e.g., in a recovery).

Liaison Officer (LO)

in this plan means a person, nominated or appointed by an organisation or functional area, to represent that organisation or functional area at a control centre, emergency operations centre, coordination centre or site control point, a liaison officer maintains communications with and

conveys directions/requests to their organisation or functional area, and provides advice on the status, capabilities, actions and requirements of their organisation or functional area.

Local Emergency Management Committee
: means the committee constituted under the State Emergency and Rescue Management Act, 1989 for each local government area, and is responsible for the preparation of plans in relation to the prevention of, preparation for, response to and recovery from emergencies in the local government area (Local EMPLAN) for which it is constituted. In the exercise of its functions, any such Committee is responsible to the relevant Region Emergency Management Committee. (Source: SERM Act).

Local Emergency Operations Controller
: means a Police Officer appointed by the Region Emergency Operations Controller as the Local Emergency Operations Controller for the Local Government Area.

Local Government Area
: means an area within the meaning of the Local Government Act 1993 and includes a combined local government area as referred to in section 27 of the State Emergency and Rescue Management Act, 1989.

Logistics
: in this plan means the range of operational activities concerned with supply, handling, transportation, and distribution of materials. Also applicable to the transportation of people.

Minister
: means the Minister for Emergency Services.

Mitigation
: means measures taken in advance of, or after, a disaster aimed at decreasing or eliminating its impact on society and environment.

Non-Government Agency
: means a voluntary organisation or any other private individual or body, other than a government agency. (Source: SERM Act).

Participating Organisation
: in this plan means the Government Departments, statutory authorities, volunteer organisations and other agencies who have either given formal notice to Agency Controllers or Functional Area Coordinators, or have acknowledged to the State Emergency Management Committee, that they are willing to participate in emergency management response and recovery operations under the direction of the Controller of a combat agency, or Coordinator of a Functional Area, with the levels of resources or support as appropriate to the emergency operation.

Plan
: in this plan means a step by step sequence for the conduct of a single or series of connected emergency operations to be carried out simultaneously or in succession. It is usually based upon stated assumptions, and is a promulgated record of a previously agreed set of roles, responsibilities, functions, actions and management arrangements. The designation 'plan' is usually used in preparing for emergency operations well in advance. A plan may be put into effect at a prescribed time, or on signal, and then becomes the basis of the emergency

operation order for that emergency operation.

Preparation
: in relation to an emergency includes arrangements or plans to deal with an emergency or the effects of an emergency. (Source: SERM Act).

Prevention
: in relation to an emergency includes the identification of hazards, the assessment of threats to life and property and the taking of measures to reduce potential loss to life or property. (Source: SERM Act).

Public Awareness
: The process of informing the community as to the nature of the hazard and actions needed to save lives and property prior to and in the event of disaster.

Recovery
: in relation to an emergency includes the process of returning an affected community to its proper level of functioning after an emergency. (Source: SERM Act).

Region
: the State is divided into such regions as the Minister may determine by order published in the Gazette. Any such order may describe the boundaries of a region by reference to local government areas, maps or otherwise. (Source: SERM Act).

Region Emergency Management Committee
: means the committee constituted under the *State Emergency and Rescue Management Act, 1989* (as amended), which at Region level is responsible for preparing plans in relation to the prevention of, preparation for, response to and recovery from emergencies in the Region (Region DISPLAN) for which it is constituted. In the exercise of its functions, any such Committee is responsible to the State Emergency Management Committee. (Source: SERM Act).

Region Emergency Operations Controller
: means the Region Commander of Police appointed by the Commissioner of Police, as the Region Emergency Operations Controller for the Emergency Management Region.

Relief
: the provision of immediate shelter, life support and human needs of persons affected by, or responding to, an emergency. It includes the establishment, management and provision of services to emergency relief or recovery centres.

Rescue
: means the safe removal of persons or domestic animals from actual or threatened danger of physical harm. (Source: SERM Act).

Rescue Unit
: means a unit (comprising a group of persons) which carries out rescue operations for the protection of the public or a section of the public. (Source: SERM Act).

Response
: in relation to an emergency includes the process of combating an emergency and of providing

immediate relief for persons affected by an emergency. (Source: SERM Act).

Risk

a concept used to describe the likelihood of harmful consequences arising from the interaction of hazards, communities and the environment.

Risk Assessment

the process used to determine risk management priorities by evaluating and comparing the level of risk against predetermined standards, target risk levels or other criteria.

Risk Management

the systematic application of management policies, procedures and practices to the tasks of identifying, analysing, evaluating, treating and monitoring risk.

Site Control

the location from which the Site Controller, agency commanders and functional areas coordinate the emergency. It usually includes the relevant Emergency Service Commanders and Functional Area Coordinators and other advisers as required.

Site Controller

a police officer appointed by and subject to the direction of an emergency operations controller to be responsible for determining the site, establishing site control and controlling on the ground response to an emergency. Until the Emergency Operations Controller appoints a Site Controller, the Senior Police Officer will assume control

State of Emergency

means a state of emergency declared by the Premier under Section 33(1) of the *State Emergency & Rescue Management Act, 1989* (as amended).
NOTE: Other New South Wales legislation also provides for a declaration of an emergency which has different meanings and different authorities within that specific legislation - that is: *Essential Services Act, 1988; Dam Safety Act, 1978;* and *Rural Fires Act, 1997* (as amended)

Sub Plan

in this plan means an action plan required for a specific hazard, critical task or special event. It is prepared when the management arrangements necessary to deal with the effects of the hazard, or the critical task or special event differ from the general coordination arrangements set out in the main or supporting plans for the area.

Supporting Organisation

in this plan means the Government Departments, statutory authorities, volunteer organisations and other specialist agencies who have indicated a willingness to participate and provide specialist support resources to a combat agency Controller or Functional Area Coordinator during emergency operations.

Supporting Plan

in this plan means a plan prepared by an agency / organisation or functional area, which describes the support which is to be provided to the controlling or coordinating authority during emergency operations. It is an action plan which describes how the agency / organisation or functional area is to be coordinated in order to fulfil the roles and responsibilities allocated.

15 Glossary – Coast

The contents of this glossary are included with acknowledgement of the Coastal Management Glossary developed by State of NSW and Office of Environment and Heritage (2018)

This glossary provides definitions of terms that are in common use when describing coastal processes and coastal management. It is not a comprehensive dictionary of coastal terminology. It supplements definitions provided in the CM Act and CM SEPP.

The definitions used in the glossary are sourced from the US Army Corps of Engineers (USACE) and from glossaries provided in relevant Standards, as well as from other coastal management guidelines in current use in Australia.

Acceptable risk – a risk that, following an understanding of the likelihood and consequences, is sufficiently low to require no new treatments or actions to reduce risk further. Individuals and society can live with this risk without feeling the necessity to reduce risks further. Positive and negative risks are negligible or so small that no risk treatments are needed.

Accretion – as the build-up of sediments to form land or shoaling in coastal waters or waterways. It may be either natural or artificial. Natural accretion is the build-up of land on the beach, dunes, or in the water by natural processes, such as waves, current and wind. Artificial accretion is a similar build-up of land resulting from built structures such as groynes or breakwaters, or activities such as filling and beach nourishment, or also aggradation. (USACE)

Adaptation – adjustment in natural or human systems in response to actual or expected climate change or its effect, to moderate harm or to take advantage of beneficial opportunities.

Alongshore or Longshore – parallel to and near the shoreline.

Ambulatory – in relation to the coastal foreshore, this means the movement of the foreshore seaward or landward over time, in response to coastal processes and sediment budgets. The movement of the foreshore may occur at different rates or in different directions along a beach or within a sediment compartment.

Annual Exceedance Probability (AEP) – the probability (expressed as a percentage) of an exceedance (e.g. large wave height or high water level) in a given year.

Artificial nourishment – see 'beach nourishment'

Asset – something of value and may be environmental, economic, social, recreational or a piece of built infrastructure.

Audit – independent appraisal of social, financial and environmental performance.

Average Recurrence Interval (ARI) – the average time between which a threshold is reached or exceeded (e.g. large wave height or high water level) of a given value. Also known as Return Period.

Back beach or back shore – the zone of the shore or beach lying between the foreshore and the coastline comprising the berm or berms and acted upon by waves only during severe storms, especially when combined with exceptionally high water.

Bathymetric data – measurements of the shape of the bed or the depth of a body of water.

Beach – the CM Act defines beach as an area that is generally composed of sand or pebbles or similar sediment that extends landward from the lowest astronomical tide to the line of vegetation or bedrock or structure.

Beach erosion – refers to landward movement of the shoreline and/or a reduction in beach volume, usually associated with storm events or a series of events, which occurs within the beach fluctuation zone. Beach erosion occurs due to one or more process drivers; wind, waves, tides, currents, ocean water level, and downslope movement of material due to gravity.

Beach fluctuation zone – CM Act defines beach fluctuation zone as 'the range of natural locations a beach profile occupies from its fully accreted condition to its fully eroded condition, with

a) a landward limit defined by the escarpment resulting from the erosion associated with a 1% storm event or a more extreme event of record, whichever is the greater landward limit, and
b) a seaward limit that is the 40m depth seaward of the highest astronomical tide for the open coast and 10m depth seaward of the highest astronomical tide for estuaries or tidal coastal lakes.'

Beach material – granular sediments, usually sand or shingle moved by the sea.

Beach nourishment – beach restoration or augmentation using clean dredged or fill sand. Dredged sand is usually hydraulically pumped and placed directly onto an eroded beach or placed in the littoral transport system. When the sand is dredged in combination with constructing, improving, or maintaining a navigation project, beach nourishment is a form of beneficial use of dredged material.

Beach plan shape – the shape of the beach in plan; usually shown as a contour line, combination of contour lines or recognisable features such as beach crest and/or the still water line.

Beach profile – a cross-section taken perpendicular to a given beach contour; the profile may include the face of a dune or seawall, extend over the backshore, across the foreshore, and seaward underwater into the nearshore zone.

Beach ridge – a nearly continuous mound or ridge of beach material (including sand, shell, coral and gravel) that has been shaped by wave or other action. Beach ridges may occur singly or as a series of approximately parallel deposits. A beach ridge plain is composed of a series of parallel beach ridges. The ridges may be of different heights and spacing. They provide evidence of changes to deposition and erosion rates over time.

Beach scraping – also referred to as 'nature assisted beach enhancement' (NABE) is a mechanical intervention to speed up the natural processes of berm and foredune recovery after a storm event.

Beach system – the CM Act defines as 'the processes that produce the beach fluctuation zone and the incipient foredunes and foredunes landward of the relevant beach'. In general, this means coastal lands, composed of sand, gravel or shell, between a seaward limit of 40 metres depth in the State coastal waters and a landward limit at the lee side of the dunes.

Bedrock – a general term for the rock, usually solid, that underlies soil or other unconsolidated, superficial material.

Beneficial uses – placement or use of dredged material for some productive purpose. May involve either the use of the dredged material or the placement site as the integral component of the use.

Benthic – of, pertaining to, or related to, the bottom of a stream or other body of water.

Berm – on a beach, a nearly horizontal plateau on the beach face or backshore, formed by the deposition of beach material by wave action or by means of a mechanical plant as part of a beach renourishment scheme. Some natural beaches have no berm, others have several.

Breaker zone – the zone within which waves approaching the coastline commence breaking, typically in water depths of between five and 10 metres for ocean coasts, but sometimes in shallower water.

Breakwater – a man-made structure protecting a shore area, harbour, anchorage or basin from waves.

Bruun Rule – a commonly used method for estimating the response of a sandy shoreline to rising sea levels.

Bypassing, sand – hydraulic or mechanical movement of sand from the accreting up–drift side to the eroding down-drift side of an inlet or harbour entrance. The hydraulic movement may include natural movement as well as movement caused by humans.

Catchment area – the area which drains naturally to a particular point on a river, thus contributing to its natural discharge.

Cliff – a high, steep face of rock; a precipice.

Climate – the characteristic weather of a region, particularly regarding temperature and precipitation, averaged over some significant interval of time (years).

Climate change – occurs naturally in response to long-term variables, but often used to describe a change of climate that is directly attributable to human activity that alters the global atmosphere, increasing change beyond natural variability and trends.

Closure depth – do not detect vertical seabed changes, generally considered the seaward limit of littoral transport (collected over several years). The depth can be determined from repeated cross-shore profile surveys or estimated using formulas based on wave statistics. Note that this does not imply the lack of sediment motion beyond this depth.

Coast – a strip of land of variable width that extends from the shoreline inland to the first significant landform that is not influenced by coastal processes (such as waves, tides and associated currents).

Coastal asset – includes natural features of the coastal zone, including landforms, ecosystems and species; and built assets such as infrastructure, public and private buildings or structures.

Coastal dune – vegetated and unvegetated sand ridges built-up at the back of a beach. They comprise dry beach sand that has been blown landward and trapped by plants or other obstructions. Stable sand dunes act as a buffer against wave damage during storms, protecting the land behind from salt water intrusion, sea spray and strong winds. Coastal dunes also act as a reservoir of sand to replenish and maintain the beach at times of erosion.

Coastal engineering – a branch of civil engineering that applies engineering principles specifically to projects within the coastal zone (nearshore, estuary, marine, and shoreline).

Coastal environment – the landscape, functions and communities in the coastal zone.

Coastal environment area – land identified in the CM Act as land containing coastal features such as coastal waters of the State, estuaries, coastal lakes, coastal lagoons and land adjoining those features, including headlands and rock platforms. The CM SEPP maps the extent of the coastal environment area for planning purposes.

Coastal Erosion - The loss of land along the shoreline predominantly by the offshore movement of sand during storms

Coastal forcing – the natural processes which drive coastal hydro and morpho-dynamics (e.g. winds, waves, tides, etc.).

Coastal hazard – defined in the CM Act to mean the following:

- beach erosion
- shoreline recession
- coastal lake or watercourse entrance instability
- coastal inundation
- coastal cliff or slope instability
- tidal inundation
- erosion and inundation of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters.

Coastal inundation – coastal inundation occurs when a combination of marine and atmospheric processes raises the water level at the coast above normal elevations, causing land that is usually 'dry' to become inundated by sea water. Alternatively, the elevated water level may result in wave run-up and overtopping of natural or built shoreline structures (e.g. dunes, seawalls).

Coastal Management Area – any one of four areas that make up the coastal zone as defined in the CM Act. These are the coastal wetlands and littoral rainforests area, coastal vulnerability area, coastal environment area, and the coastal use area.

Coastal management objectives – specific objectives identified in the CM Act for each of the four coastal management areas.

Coastal management program – a long-term strategy for the coordinated management of land within the coastal zone, prepared and adopted under Part 3 of the CM Act.

Coastal management units – may be identified for the purposes of coastal management at a local or community level. They are sections of the coast that are affected by similar coastal hazards and risks or have several important social and economic features in common.

Coastal model – model of a coastal area. Often a movable bed model used to reproduce coastal sediment transport; or a model of estuary circulation.

Coastal processes – marine, physical, meteorological and biological activities that interact with the geology and sediments to produce a particular coastal system.

Coastal protection works – the CM Act defines coastal protection works as:

a) beach nourishment

b) activities or works to reduce the impact of coastal hazards on land adjacent to tidal waters, including (but not limited to) seawalls, revetments and groynes.

Coastal risk – a risk that relates to the likelihood and consequences of coastal hazards or threats affecting coastal values.

Coastal sediment compartment – an area of the coast defined by its sediment flows and landforms. Coastal sediment compartments may be mapped at primary, secondary or tertiary (local) scales. Boundaries are generally defined by structural features related to the geologic frameworks that define the planform of the coast.

Coastal threat – a process or activity that is putting pressure on or impacting on the health or function of a coastal ecosystem, or on the amenity and social or cultural value of the coastal landscape. Examples include the discharge of effluent or poor-quality stormwater into coastal lakes and lagoons, discharges from acid sulfate soils, or the spread of invasive species. High recreational demand can also be a threat to coastal ecosystem health.

Coastal use area – land identified by the CM Act and CM SEPP as being land adjacent to coastal waters, estuaries, coastal lakes and lagoons where development is or may be carried out (now or in the future). The CM SEPP maps the extent of the coastal use area for planning purposes.

Coastal vulnerability area – defined in the CM Act as land subject to seven coastal hazards.

Coastal wetland – wetlands are areas that are inundated cyclically, intermittently or permanently with fresh, brackish or saline water and have soils, plants and animals in them that are adapted to, and depend on, moist conditions for at least part of their lifecycle. Coastal wetlands include marshes, mangroves, swamps, melaleuca forests, casuarina forests, sedgelands, brackish and freshwater swamps and wet meadows.

Coastal zone – as defined in the CM Act and CM SEPP: the area of land comprised of the following coastal management areas: the coastal wetlands and littoral rainforest area, the coastal vulnerability area, the coastal environment area and the coastal use area.

Coastal zone (general) – the transition zone where the land meets water, the region that is directly influenced by marine and lacustrine hydrodynamic processes. Extends offshore to the continental shelf break and onshore to the first major change in topography above the reach of major storm waves. On barrier coasts, includes the bays and lagoons between the barrier and the mainland.

Coastal zone management – the integrated management of issues affecting the coastal zone. Coastal zone management is not restricted to coastal protection works, but also includes development and activities to manage the economical, ecological, cultural and social values of the coast.

Coastal zone management plan – a management plan for the open coast, an estuary or a coastal lake, prepared under the *Coastal Protection Act 1979*.

Community objectives – local scale objectives for management of the coast, based on the aspirations and priorities of local communities. When included in a coastal management program, these

objectives will be based on, and must align with, the objectives expressed in a council's Community Strategic Plan.

Conceptual model – a simplified representation of the physical hydro-geologic setting. This includes the identification and description of the geologic and hydrologic framework, media type, hydraulic properties, and sources and sinks of flow.

Consequence – the outcome or impact of a hazard or threat.

Cost analysis – evaluation of the specific cost elements of a contract or proposal to appraise their statutory compliance, distribution, and reasonableness.

Cross-shore transport – refers to the sediment moved in a cross-shore direction to the coastline induced by water motions due to waves and currents.

Current, coastal – one of the offshore currents flowing generally parallel to the shoreline in the deeper water beyond and near the surf zone; these are not related genetically to waves and resulting surf, but may be related to tides, winds, or distribution of mass.

Current, littoral – any current in the littoral zone caused primarily by wave action; e.g. longshore current, rip current.

Current, longshore – the littoral current in the breaker zone moving essentially parallel to the shore, usually generated by waves breaking at an angle to the shoreline.

Cusp (or beach cusp) – one of a series of short ridges on the foreshore separated by crescent-shaped troughs spaced at more or less regular intervals. Between these cusps are hollows. The cusps are spaced at somewhat uniform distances along beaches. They represent a combination of constructive and destructive processes.

Design storm – a hypothetical extreme storm with waves that coastal protection structures will often be designed to withstand. The severity of the storm (i.e. return period) is chosen in view of the acceptable level of risk of damage or failure. A design storm consists of a design wave condition, a design water level and a duration.

Design wave – in the design of harbour works, coastal protection works etc., the type or types of waves selected as having the characteristics against which protection is desired.

Diffraction of water waves – the phenomenon by which energy is transmitted laterally along a wave crest. When a part of a train of waves is interrupted by a barrier, such as a breakwater, the effect of diffraction is manifested by propagation of waves into the sheltered region within the barrier's geometric shadow.

Drowned river valley – a type of wave-dominated estuary, usually a deep bedrock embayment, with a wide, deep mouth.

Dune – underwater: flow-transverse bedform with spacing from under one metre to over 1000 metres that develops on a sediment bed under unidirectional currents.

Dune – subaerial (see coastal dune).

East Coast Low – an intense low-pressure system that occurs off the east coast of Australia, bringing storms, high waves and heavy rain. East coast lows generally occur in autumn and winter off NSW, southern Queensland and eastern Victoria.

Economic evaluation – an assessment that helps decision-makers to understand the socioeconomic implications of adopting alternative management options and to make choices that will provide net benefits to the community. Cost-benefit analysis is a type of economic evaluation that considers and evaluates a wide range of costs and benefits associated with a proposal, in qualitative or quantitative (monetary) terms (with future costs and benefits reduced to today's prices), compared with a base case. It may be used in conjunction with other criteria (such as technical feasibility, community acceptance or environmental impact) to select optimal management responses. A multi-criteria assessment is not an economic evaluation but may assist decision-making in other ways.

Ecosystem – the living organisms and the non-living environment interacting in an area, encompassing the relationships between biological, geochemical, and geophysical systems; or a community and its environment including living and non-living components.

El Niño southern oscillation (ENSO) – a year to year fluctuation in atmospheric pressure, ocean temperatures and rainfall associated with El Niño (warming of the oceans in the equatorial eastern and central Pacific). El Niño tends to bring below average rainfall.

Emergency Alert - A national telephony based alerting system available for use by emergency service agencies to send SMS and voice messages to landlines and/or mobile telephones (by billing address) in times of emergency.

EMPLAN (Emergency Management Plan) - The object of a EMPLAN is to ensure the coordinated response by all agencies having responsibilities and functions in emergencies.

Environment – surroundings, the physical and biological system supporting life, including humans and their built environment. Includes cultural features of archaeological or historical interest.

Eolian or Aeolian processes – pertaining to the wind, especially used with deposits such as loess and dune sand, and sedimentary structures like wind-formed ripple marks.

Erosion – the wearing away of land by the action of natural forces. On a beach, the carrying away of beach material by wave action, tidal currents, littoral currents, or by deflation.

Escarpment (storm bite) – the landward limit of erosion in the dune system caused by storm waves. At the end of a storm the escarpment may be nearly vertical; as it dries out the sand slumps to a typical slope of one vertical to 1.5 horizontal.

Essential infrastructure – CM Act defines to include infrastructure for the following purposes: electricity generation, transmission and distribution, telecommunications, rail, roads, gas, sewerage systems, water supply systems or stormwater management systems, airports, ports shipping and harbours.

Essential services – those services that are considered essential to the life of communities and include energy, transport, health services, sanitation services, water and welfare institutions (*State Flood Plan and Essential Services Act 1988*).

Essential utilities – those services that are considered essential to public safety and organised communities. Such services include electricity, gas, water, sewerage, sanitation, telecommunications and waste collection (*State Flood Plan and Essential Services Act 1988*).

Estuary – CM Act defines as any part of a river, lake, lagoon, or coastal creek whose level is periodically or intermittently affected by coastal tides, up to the highest astronomical tide.

Estuary inundation – flooding around the shoreline of an estuary or coastal lake, by a mixture of tidal water and catchment flood water.

Exposure – the potential for assets to be impacted by a hazard based on data or modelling of the hazard.

Extreme storm event – storm for which characteristics (wave height, period, water level etc.) were derived by statistical 'extreme value' analysis. Typically, these are storms with average recurrence intervals (ARI) ranging from one to 100 years.

Evacuation - The temporary movement of people from a dangerous or potentially dangerous place to a safe location, and their eventual return. It is a safety strategy which uses distance to separate people from the danger created by the hazard.

Evacuation Order - Notification to the community, authorised by the NSW SES, when the intent of an Incident Controller is to instruct a community to immediately evacuate in response to an imminent threat.

Evacuation Warning - Notification to the community, authorised by the NSW SES, when the intent of an Incident Controller is to warn a community of the need to prepare for a possible evacuation.

Fit for purpose – right for the job it is intended to do. A fit for purpose assessment considers the level of data detail and the types of consultation required to make a reasonable management decision. In general, the detail and consultation required will increase with risk, complexity and impact.

Flash flooding - Flooding which is sudden and often unexpected because it is caused by sudden local or nearby heavy rainfall. It is sometimes defined as flooding which occurs within six hours of the rain that causes it.

Flood - Relatively high water level which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences, including Tsunami.

Flood classification - Locally defined flood levels used in flood warnings to give an indication of the severity of flooding (minor, moderate or major) expected. These levels are used by the State Emergency Service and the Australian Government Bureau of Meteorology in flood bulletins and flood warnings.

Flood intelligence - The product of collecting, collating, analysing and interpreting flood related data to produce meaningful information (intelligence) to allow for the timely preparation, planning and warning for and response to a flood.

Flood fringe - The remaining area of flood prone land after floodway and flood storage have been defined.

Flood liable land (also referred to as flood prone land) - Land susceptible to flooding by the Probable Maximum Flood (PMF) event. This term also describes the maximum extent of a floodplain which is an area of a river valley, adjacent to the river channel, which is subject to inundation in floods up to this event.

Flood of record - Maximum observed historical flood.

Floodplain Management Plan - A plan developed in accordance with the principles and guidelines in the New South Wales Floodplain Development Manual. Such a plan usually includes both written and diagrammatic information describing how particular areas of flood prone land can be used and managed to achieve defined objectives.

Flood Plan - A response strategy plan that deals specifically with flooding and is a sub-plan of a Emergency Management Plan. Flood plans describe agreed roles, responsibilities, functions, strategies and management arrangements for the conduct of flood operations and for preparing for them. A flood plan contains information and arrangements for all floods whereas an IAP is for a specific flood/event.

Flood Rescue - The rescue or retrieval of persons trapped by floodwaters. Flood storage areas. Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation.

Floodway - An area where a significant volume of water flows during floods. Such areas are often aligned with obvious naturally-defined channels and are areas that, if partially blocked, would cause a significant redistribution of flood flow which may in turn adversely affect other areas. They are often, but not necessarily, the areas of deeper flow or the areas where higher velocities occur.

Flood Watch - A Flood Watch is a notification of the potential for a flood to occur as a result of a developing weather situation and consists of short, generalised statements about the developing weather including forecast rainfall totals, description of catchment conditions and indicates streams at risk. The Bureau will also attempt to estimate the magnitude of likely flooding in terms of the adopted flood classifications. Flood Watches are normally issued 24 to 36 hours in advance of likely flooding. Flood watches are issued on a catchment wide basis.

Flood Warning - A Flood Warning is a gauge specific forecast of actual or imminent flooding. Flood Warnings specify the river valley, the locations expected to be flooded, the likely severity of flooding and when it will occur.

Foredune – the larger and more mature dune lying between the incipient dune and the hind-dune area. Foredune vegetation is characterised by grasses and shrubs. Foredunes provide an essential reserve of sand to meet the erosion demand during storm conditions. During storm events, the foredune can be eroded back to produce a pronounced dune scarp.

Foreshore – the part of the shore, lying between the crest of the seaward berm (or upper limit of wave wash at high tide) and the ordinary low water mark, that is ordinarily traversed by the uprush and backrush of the waves as the tides rise and fall; or the beach face, the portion of the shore extending

from the low water line up to the limit of wave uprush at high tide. The CM Act defines the foreshore as 'the area of land between highest astronomical tide and the lowest astronomical tide'.

Gabion – steel wire mesh basket to hold stones or crushed rock to protect a bank or bottom from erosion; or structures composed of masses of rocks, rubble or masonry held tightly together usually by wire mesh to form blocks or walls. Sometimes used on heavy erosion areas to retard wave action or as a foundation for breakwaters or jetties.

Geomorphology – that branch of physical geography which deals with the form of the earth, the general configuration of its surface, the distribution of the land, water, etc.; or the investigation of the history of geologic changes through the interpretation of topographic forms.

Geotechnical investigations – subsurface investigation of soils, rock, and other strata for the purposes of engineering design.

Geotextile – a synthetic fabric which may be woven or non–woven and used as a filter.

Global warming – the increase in the earth's temperature due to the emissions of greenhouse gases.

Groyne – a shore protection structure built (usually perpendicular to the shoreline) to trap littoral drift or retard erosion of the shore; or a narrow, roughly shore normal structure built to reduce longshore currents, and/or to trap and retain littoral material. Most groynes are of timber or rock and extend from a seawall, or the backshore, well onto the foreshore and rarely even further offshore.

Hard defences (protection) – general term applied to impermeable coastal defence (protection) structures of concrete, timber, steel, masonry, etc., which reflect a high proportion of incident wave energy.

Hazard – a process, or activity that affects an asset or value. See also 'coastal hazards' which are the specific hazards defined in the CM Act.

Highest astronomical tide (HAT) – the highest level which can be predicted to occur under average meteorological conditions and any combination of astronomical conditions. In Australia HAT is calculated as the highest level from tide predictions over the tidal datum epoch (TDE), this is currently set to 1992 to 2011.
The HAT and the **Lowest Astronomical Tide (LAT)** levels will not be reached every year. LAT and HAT are not the extreme water levels which can be reached, as storm surges may cause considerably higher and lower levels to occur.

Holocene – an epoch of the Quaternary period, from the end of the Pleistocene, about 8000 years ago, to the present time.

Hydrodynamic – relates to the specific scientific principles that deal with the motion of fluids and the forces acting on solid bodies immersed in fluids, and in motion relative to them.

Impacts – include damage, harm or losses to exposed communities, property, services, livelihoods, access, use and amenity, heritage, ecosystems and the environment because of exposure and sensitivity. Impacts may also be positive.

Incident Action Plan (IAP) - An action plan for managing a specific event. Information from the Local Flood Plan is used to develop the flood IAP.

Incipient dune – the most seaward and immature dune of the dune system. Vegetation characterised by grasses such as spinifex. On an accreting coastline, the incipient dune will develop into a foredune.

Indirect Effect - Indirect effects are generally a consequence of infrastructure damage or interruption of services and can affect communities distant from the actual flood footprint i.e. floodplain. Indirect effects can also refer to indirect losses due to disruption of economic activity, both in areas which are inundated or isolated. Indirect effects are one of the three primary sources of risk in the context of flooding (the other two are inundation and isolation).

Inshore zone – in beach terminology, the zone of variable width extending from the low water line through the breaker zone.

Interdecadal Pacific Oscillation (IPO) – an irregular interdecadal sea surface temperature in the Pacific Ocean that modulates the strength and frequency of the El Niño Southern Oscillation.

Intertidal – that land area between mean low water and mean high water that is inundated periodically by tides.

Inundation - See definition for Flood.

King tides – any high water level that is well above the average, commonly applied to two spring tides that are the highest for the year, one during summer and one in winter.

La Niña – the opposite state to El Niño, occurring when the SOI is positive. La Niña tends to bring above average rainfall over much of Australia.

Lagoon – a shallow body of open water, partly or completely separated from the sea by a coastal barrier or reef. Sometimes connected to the sea via an inlet.

Likelihood – the chance of something happening, whether defined, measured or determined objectively or subjectively, qualitatively or quantitatively, and described using general terms or mathematically (such as a probability or a frequency over a given time period).

Littoral – of or pertaining to a shore, especially of the sea. Often used as a general term for the coastal zone influenced by wave action, or, more specifically, the shore zone between the high and low water marks.

Littoral transport rate – rate of transport of sedimentary material parallel or perpendicular to the shore in the littoral zone. Usually expressed in cubic metres per year. Commonly synonymous with longshore transport rate.

Local council – for the purposes of the coastal management manual, a council that is wholly or partly within the coastal zone of NSW.

Longshore transport (littoral drift) – refers to the sediment moved along a coastline under the action of wave-induced longshore currents (Dean and Dalrymple, 2002). The net drift is the sum of the positive (conventionally northwards direction in NSW) and negative (southwards in NSW) direction. The gross

drift is the sum of the drift magnitudes (absolute values). The differential drift is the difference between the net drift into and out of a coastal compartment. Both gross and net drift are typically averaged over a year and expressed in m3/yr.

Macro-invertebrates – large invertebrates which may be found in waterways and consisting largely of larval insects, worms, and related organisms.

Maintenance dredging – the recurrent dredging of sediment from a waterway, including existing navigation channels, approaches and berths, to allow safe navigation by commercial or recreational boating traffic.

Managed retreat – also referred to as managed realignment. For the coastal zone (generally the coastal vulnerability area), managed retreat allows the shoreline to migrate landward unimpeded. It allows an area that was not previously exposed to coastal processes and hazards to become exposed, for instance by removing or breaching coastal protection works. Managed retreat may involve the relocation landward, out of a coastal risk area, of homes and infrastructure under threat from coastal erosion, recession or inundation. It may also involve the deliberate setting back (moving landward) of the existing line of sea defence to obtain engineering or environmental advantages. During a managed retreat process, a new foreshore area or new intertidal habitat may be created.

Marine sediment – sediment originating from the sea.

Mean high water mark – the line of the medium high tide between the highest tide each lunar month (the springs) and the lowest tide each lunar month (the neap) averaged over out over the year. In NSW, the methods for determining the position of the MHWM are outlined in the Crown Directions to Surveyors - No. 6 Water as a Boundary.

Mean sea level – the arithmetic mean of hourly heights of the sea at a tidal station, observed over a long period of time.

Multi-criteria analysis – a logical and structured decision-making tool for complex problems involving multiple factors or criteria, where a consensus is difficult to achieve. It may involve processes such as ranking, rating (with relative or ordinal scales) or pairwise comparisons. The process allows participants to consider, discuss and test complex trade-offs among alternatives

Natural character – includes all-natural aspects of the land and sea, including the underlying ecological, hydrological and geomorphological processes that shape landforms (including underwater features) and the natural movements of water and sediment. Natural character also includes aspects of the environment that affect human experience including the natural darkness of the night sky, the sounds and smell of the coast, and the context and setting of natural places.

Natural coastal processes – the coastal processes over which people have no control, such as wind, waves and tides.

Natural heritage – the natural living and non-living components, that is, the biodiversity and geodiversity, of the world that humans inherit.

Near shore – the area of ocean close to the coast that is affected by waves, tides and longshore currents.

NSW Coastal Council – established under Part 4 of the CM Act. A group of three to seven coastal experts, appointed by the Minister to provide advice on coastal management issues.

Outflanking or end effects – erosion behind or around the land-based end of a groyne, jetty or breakwater or the terminus of a revetment or seawall, usually causing failure of the structure or its function.

Overfill ratio - also known as the **overfill** factor, describes the volume of borrow sediment that, in theory, will ultimately yield a residual unit volume of sediment on the beach, after grain sorting and losses.

Over-wash – the part of the wave uprush that runs over the crest of a berm or structure and does not flow directly back to the ocean or lake. When waves overtop a coastal protection structure they often carry sediment landwards which is then lost to the beach system. Also defines a process in which waves penetrate inland of the beach, which is common on low barriers.

Peak height - The highest level reached, at a nominated gauging station, during a particular flood event.

Pollution – the condition caused by the presence of substances of such character and in such quantities that the quality of the environment is impaired; or the human-induced alteration of the chemical, physical, biological or radiological integrity of an aquatic ecosystem.

Probabilistic hazard assessment – a risk-based approach to managing coastal hazard that takes uncertainty into account by considering both the likelihood and consequence of hazard occurrence. It applies a stochastic simulation to evaluate coastal processes. The technique uses a distribution of values for each parameter to account for expected variation, or uncertainty, rather than single values. Parameters are then combined by a Monte-Carlo technique to produce a probabilistic forecast of future shoreline position. This is quite different to traditional deterministic hazard assessments that produce single values for beach erosion and shoreline recession.

Probabilistic model – mathematical model in which the behaviour of one or more of the variables is either completely or partially subject to probability laws.

Progradation – the building forward or outward toward the sea of a shoreline or coastline (as with a beach, delta, or fan) by nearshore deposition of river-borne sediments or by continuous accumulation of beach material thrown up by waves or moved by longshore drifting.

Public Authority – defined in the CM Act as a Minister of the Crown of the State, a State-owned corporation, an electricity supply authority, a department or instrumentality of the State, a local council and any other public or local authority constituted by or under any Act and includes any prescribed body.

Recession – a continuing landward movement of the shoreline; or a net landward movement of the shoreline over a specified time.

Reflection – the process by which the energy of the wave is returned seaward.

Refraction – the process by which the direction of a wave moving in shallow water at an angle to the contours is changed. The part of the wave advancing in shallower water moves more slowly than that part still advancing in deeper water, causing the wave crest to bend toward alignment with the underwater contours; or the bending of wave crests by currents.

Residual risk – the risk which remains after managing and reducing risks. It may include for example, risks due to very severe storms or from unexpected hazards.

Resilience – the ability of a system (human or natural) to adapt to changing conditions (including hazards or threats, variability and extremes), and rapidly recover from disruption due to emergencies. Resilient systems or communities have the capacity to 'bounce back' after a disrupting event such as a major storm or an extended heat wave, to moderate potential damages, take advantage of opportunities, maintain or restore function or to cope with the consequences.

Revetment or seawall – a type of coastal protection work which protects assets from coastal erosion by armouring the shore with erosion–resistant material. Large rocks/boulders, concrete or other hard materials are used, depending on the specific design requirements.

Rip – a narrow, strong shore normal current in the nearshore area of most wave-dominated beaches (i.e. most beaches along the open coast of NSW). They are fed by along shore feeder currents initiated by the deflection of waves at the shoreline. There are diverse types of rip on NSW beaches and they affect beach safety.

Riparian – pertaining to the banks of a body of water, such as an estuary.

Risk – effect of uncertainty on planning and management objectives, usually characterised by reference to potential hazards, their consequence and their likelihood. Consequence combines the concepts of magnitude, sensitivity and duration.

Sand drift – the movement of sand by wind. On the coast, this generally describes sand movement resulting from natural or human-induced degradation of dune vegetation, resulting in either nuisance or major sand drift (dune transgression).

Sea level rise – an increase in the mean level of the oceans. Relative sea level occurs where there is a local increase in the level of the ocean relative to the land, which might be caused by ocean rising, the land subsiding, or both. In areas with rapid land level uplift (e.g. seismically active areas), relative sea level can fall.

Sediment cells (tertiary) – small and relatively contained sediment compartments. A tertiary sediment cell may apply to a single beach/embayment.

Sediment transport – the process whereby sediment is moved offshore, onshore or along shore by wave, current or wind action.

Sensitivity – the degree to which a built, natural or human system is directly or indirectly affected by changes in hazards, threats or climate conditions.

Shoreline recession – refers to continuing landward movement of the shoreline, that is, a net landward movement of the shoreline, generally assessed over a period of several years. As shoreline recession occurs the beach fluctuation zone is translated landward.

Southern Oscillation Index – the normalised mean atmospheric pressure difference between Tahiti and Darwin, measured at sea level. The SOI is negative during El Niño and positive during La Niña.

Stakeholder – a person or organisation with an interest or concern in something.

State objectives – the state's objectives for the coast are set out in the CM Act.

Storm surge – the increase in coastal water level caused by the effects of storms. Storm surge consists of two components – the increase in water level caused by the reduction in barometric pressure and the increase in water level caused by the action of wind blowing over the sea surface (wind set-up).

Storm tide – an abnormally high water level that occurs when a storm surge combines with a high astronomical tide. The storm tide must be accurately predicted to determine the extent of coastal inundation.

Strategic management of the coast – planning and management that is wide-ranging, considers multiple issues at multiple spatial scales and multiple timeframes. It identifies the opportunities and constraints of different broad options to achieve big-picture objectives and defines the best way forward.

Surf zone – defined in CM Act as the area from the line of the outer most breaking waves to the limit of wave run-up on the beach.

Sustainable management – develops and implements proposals that meet the needs of present communities without compromising the ability of future generations to meet their own needs.

Swash zone – the zone of wave action on the beach, which moves as water levels vary, extending from the limit of run down to the limit of run-up.

Swell waves – ocean waves that travel beyond the area where they are generated.

Threats – see Coastal threats. In the coastal management context, a threat is a process or activity which puts pressure on one or more coastal assets or values. Threats may include land uses (e.g. urban, recreation), land management, climate change, industrial discharges, stormwater runoff, overfishing, invasive species as well as the pressures from coastal hazards.

Threshold – can be identified for aspects of coastal systems, to highlight tipping points for irreversible change.

An ecological threshold is the point at which there is an abrupt change in the structure, quality, or functioning of an ecosystem or where external changes produce large and persistent responses in an ecosystem. A species threshold may disrupt aspects of the species population, productivity, reproduction, or habitat in response to a stressor. Such 'tipping points' can lead to unwanted changes in ecosystems and may slow the recovery of ecosystems or limit their ability to achieve more resilient states following a disturbance.

Similarly, a social or economic threshold of change in a coastal community indicates the point at which the structure, function, social connectedness, equality or economic activity of the community changes beyond recovery.

Thresholds can also be defined for coastal water levels as they relate to the resilience of certain types of development.

Tidal channel – a major channel followed by tidal currents, extending from offshore into a tidal marsh or a tidal flat; tidal inlet.

Tidal circulation – the movement of fresh water and seawater that are mixed by currents and flows in an estuary, in response to ocean tides.

Tidal delta – where an inlet of a barrier estuary or open coastal lake is dominated by tidal processes, a flood tide delta develops inside the entrance, as tidal currents transport marine sand into the estuary. Ebb tide deltas may also occur, outside the mouth of an estuary.

Tidal inundation – the inundation of land by tidal action under average meteorological conditions and the incursion of sea water onto low lying land that is not normally inundated, during a high sea level event such as a king tide or due to longer-term sea level rise.

Tidal limit – the maximum upstream location on a watercourse at which a tidal variation in water level is observed.

Tolerable risk – a risk that, following an understanding of the likelihood and consequences, is low enough to allow the exposure to continue, and at the same time high enough to require new treatments or actions to reduce risk. Society can live with this risk but believe that as much as is reasonably practical should be done to reduce the risks further. Note that individuals may find this risk unacceptable and choose to take their own steps, within reason, to make this risk acceptable. Residual risks are considered tolerable only if risk reduction is impractical.

Training walls – walls constructed at the entrances of estuaries and rivers to improve navigability.

Trigger – pre-negotiated decision-making points and commitments, so that action on coastal risks is taken when necessary, and when it is most convenient and affordable for the affected community

Tropical cyclone – intense low-pressure system in which winds of at least 63km/hour whirl in a clockwise direction, in the southern hemisphere around a region of calm air.

Tsunami – a long period water wave caused by an underwater disturbance such as a volcanic eruption or earthquake. Sometimes (incorrectly) called a ‘tidal wave’.

Unacceptable risk – a risk that, following an understanding of the likelihood and consequences, is so high that it requires actions to avoid or reduce the risk. Individuals and society will not accept this risk and measures should be put in place to reduce risks to at least a tolerable level.

Vulnerability – a function of exposure and sensitivity of assets to a hazard, which determines the potential impacts of the hazard. For instance, the vulnerability of coastal assets may be influenced by the extent and impact of environmental, social and economic factors such as saline contamination of soils from flooding, erosion of built-up and natural areas, loss of vegetation, disruption to use, or access, or continuity of service, or loss of amenity, corrosion of built structures, undermining of foundations or damage to contents. Vulnerability also considers the adaptive capacity which is the capacity to adapt or the resilience in the system to manage the impacts and changes.

Wave amplitude – the magnitude of the displacement of a wave from a mean value. An ocean wave has an amplitude equal to the vertical distance from the still water level to wave crest. For a sinusoidal wave, amplitude is one–half the wave height. (USACE).

Wave climate – the seasonal and annual distribution of wave height, period and direction.

Wave-dominated coast – the coast of south eastern Australia is a wave-dominated system. This affects the beach type and the types of estuaries that occur in the landscape.

Wave energy – the capacity of waves to do work. The energy of a wave system is theoretically proportional to the square of the wave height; a high–energy coast is characterised by breaker heights greater than 50 centimetres and a low–energy coast is characterised by breaker heights less than 10 centimetres. Most of the wave energy along equilibrium beaches is used in shoaling and in sand movement. The NSW coast is a high wave energy coast.

Wave run-up – the vertical distance above mean water level reached by the uprush of water from waves across a beach or up a structure.

Wave set-up – the rise in the water level above the still water level when a wave reaches the coast. It can be very important during storm events as it results in further increases in water level above the tide and surge levels.

Wind waves – ocean waves resulting from the action of the wind on the surface of the water.

Zone of profile fluctuation – the area within which the subaerial beach profile can be expected to fluctuate under the current patterns of climate and weather conditions (i.e. including storms and decadal scale cycles).

Zone of Slope Adjustment – the area landward of an escarpment cut by storm bite, which may be affected by slumping to the angle of repose of the sand as it dries.

16 Abbreviations

The following abbreviations have been used in this document:

ABS	Australian Bureau of Statistics
AHD	Australian Height Datum
AIIMS	Australasian Inter-service Incident Management System
BOM	Bureau of Meteorology
Bureau	Australian Government Bureau of Meteorology
CM Act	*Coastal Management Act 2016*
CM SEPP	State Environmental Planning Policy (Coastal Management) 2018
CMP	Coastal Management Program (prepared under the Coastal Management Act 2016)
Council	Sutherland Shire Council
CVA	Coastal Vulnerability Area
CZMP	Coastal Zone Management Plan (prepared under the former Coastal Protection Act 1979)
DCCEEW	Department of Climate Change, Energy, the Environment & Water
DCF	Dam Crest Flood
DCP	Development Control Plan
DECC	Department of Environment Climate Change (now DCCEEW)
DOE	Department of Environment (now DCCEEW)
DPE	Department of Planning and Environment (now DCCEEW)
DPI	Department of Primary Industries (now DPIRD)
DPIE	Department of Planning, Industry and Environment (now DCCEEW)
DPIRD	Department of Primary Industries & Regional Development
EMPLAN	Emergency Management Plan
EP&A Act	*Environmental Planning and Assessment Act 1979*
FRNSW	Fire and Rescue New South Wales
GRN	Government Radio Network
IAP	Incident Action Plan
IP&R	Integrated Planning and Reporting (in accordance with the *Local Government Act 1993*)
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
LEMC	Local Emergency Management Committee
LEOCON	Local Emergency Operations Controller
LEMO	Local Emergency Management Officer
LEP	Local Environment Plan
LGA	Local Government Area
MEMA	Marine Estate Management Authority
MHL	Manly Hydraulics Laboratory
MHWS	Mean High Water Springs
MIDO	Maritime Infrastructure Delivery Office
MLWM	Mean Low Water Mark
NOW	NSW Office of Water
NSR	National Surfing Reserve
NSW GIS	New South Wales Geographic Information System
OEH	Office of Environment and Heritage (previously DECCW, now DCCEEW)
PoEO Act	*Protection of the Environment Operations Act 1997*
PMF	Probable Maximum Flood
PMR	Private Mobile Radio
PMP	Probable Maximum Precipitation
REF	Review of Environmental Factors

RFS	New South Wales Rural Fire Service
RMS	Roads and Maritime Services
SEOCON	State Emergency Operations Controller
SEPP	State Environmental Planning Policy
SEPP CM	State Environmental Planning Policy (Coastal Management) 2018
SERCON	State Emergency Recovery Controller
NSW SES	New South Wales State Emergency Service
SEWS	Standard Emergency Warning Signal
SLSC	Surf Life Saving Club
TfNSW	Transport for New South Wales
VRA	Volunteer Rescue Association
WH&S	Work Health & Safety
WICEN	Wireless Institute Civil Emergency Network

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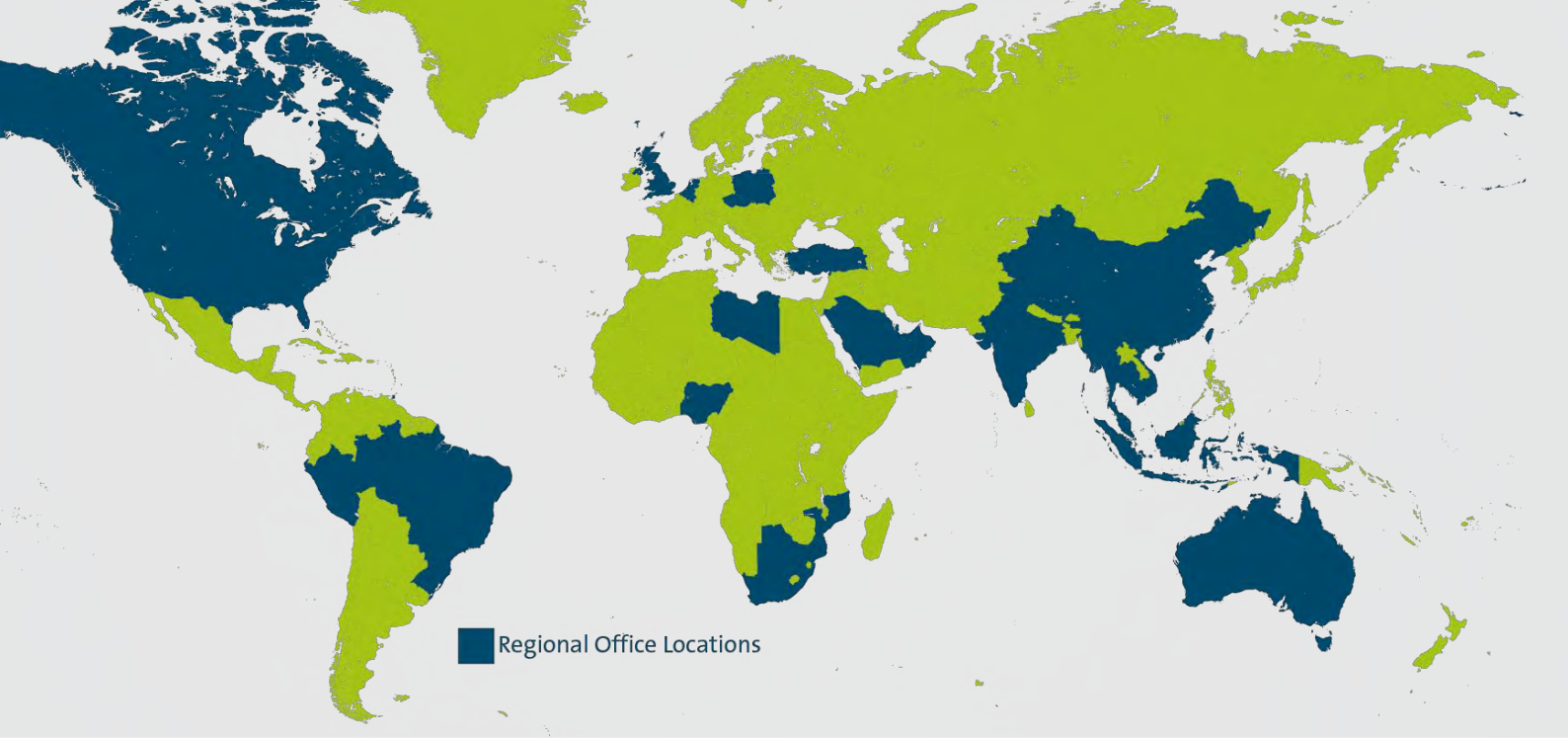

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