



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

Document title: Bate Bay Coastal Management Program
Coastal Zone Emergency Action Subplan
Document short title: Bate Bay CZEAS
Reference: PA2189-RHD-BB-CZEAS-AT-0004
Status: 0004/Final
Date: 18 July 2024
Project name: Bate Bay CMP
Project number: PA2189
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Date: 18 July 2024

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Date: 18 July 2024

Classification

Project related

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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 SEPP¹), 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 (OEHL, 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**.

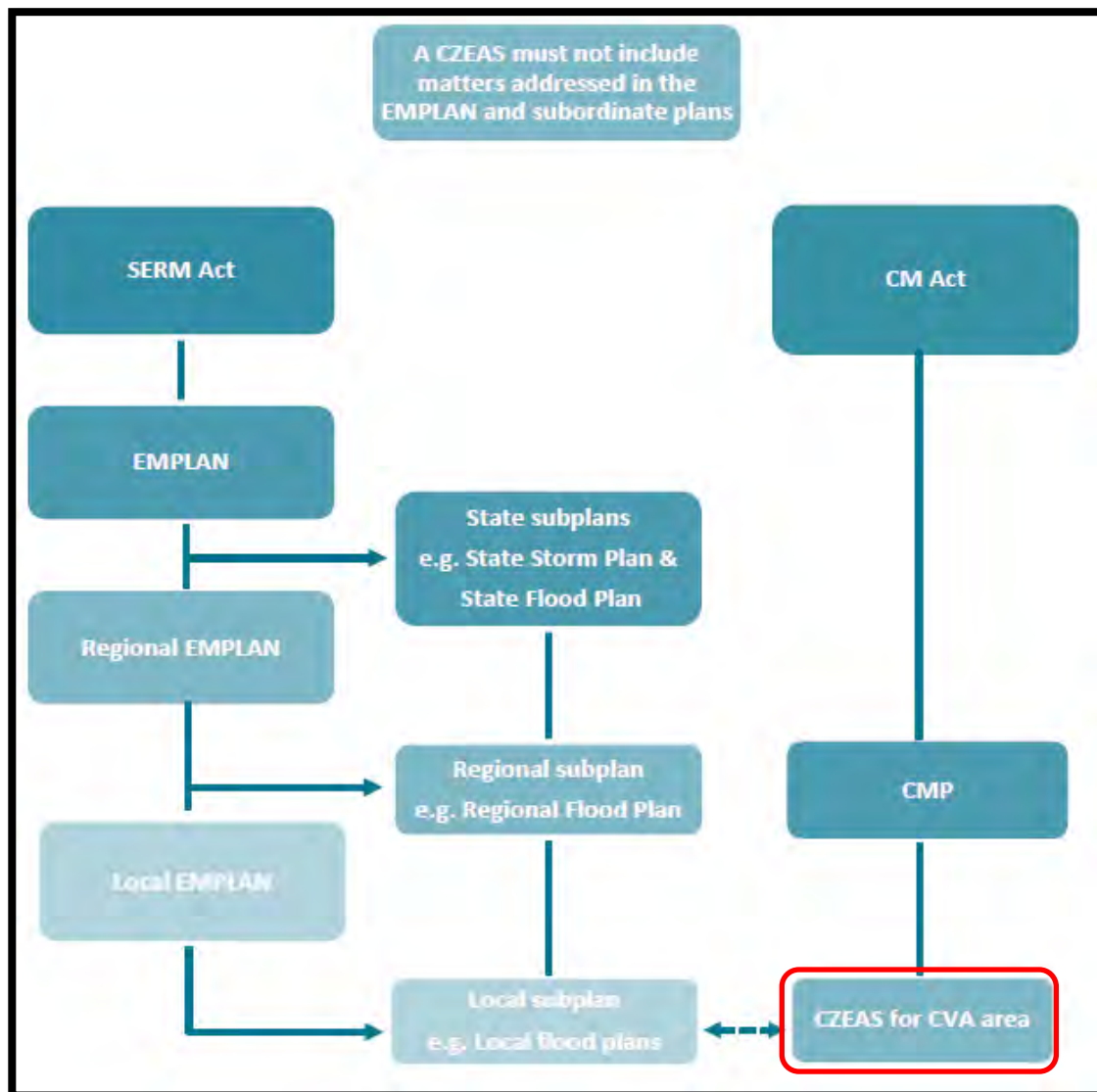


Figure 1-1: Simplified legislative framework for emergency management in NSW and its relationship with coastal management legislation and coastal management programs related to coastal hazards (DPIE, 2019), with the CZEAS noted in red.

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 Act².

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):

- Assist the NSW SES with the delivery of evacuation warnings and evacuation orders.
- Assist the NSW SES with the conduct of evacuations.

Section 1.5.17 NSW Police Force, Sutherland Local Area Command (LAC):

- Assist the NSW SES with the delivery of evacuation warnings and evacuation orders.
- Assist the NSW SES with the conduct of evacuation operations.
- Conduct road and traffic control operations in conjunction with council and/or RMS.
- Coordinate the registration of evacuees.
- Secure evacuated areas.
- 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:

- Assist the NSW SES with the warning and/or evacuation of at risk communities; and
- Provide space in Surf Life Saving facilities for evacuation centres where required.

Section 1.5.28 Sutherland Shire Council Local Emergency Operations Controller (LEOCON):

- Monitor flood operations.
- 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:

- Provide executive support to the LEMC and LEOCON in accordance with the Sutherland Shire Council Local Emergency Management Plan.
- 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

- Establish and maintain floodplain and **coastal risk management committees** and ensure that key agencies are represented on such committees.
- Provide levee studies, flood studies, floodplain management studies and **coastal management studies** to the NSW SES.
- Provide information on the consequences of dam failure to the NSW SES for incorporation into planning and flood intelligence.
- Maintain a plant and equipment resource list for the council area.
- 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:
 - 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
- 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 be 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, tsunamis 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

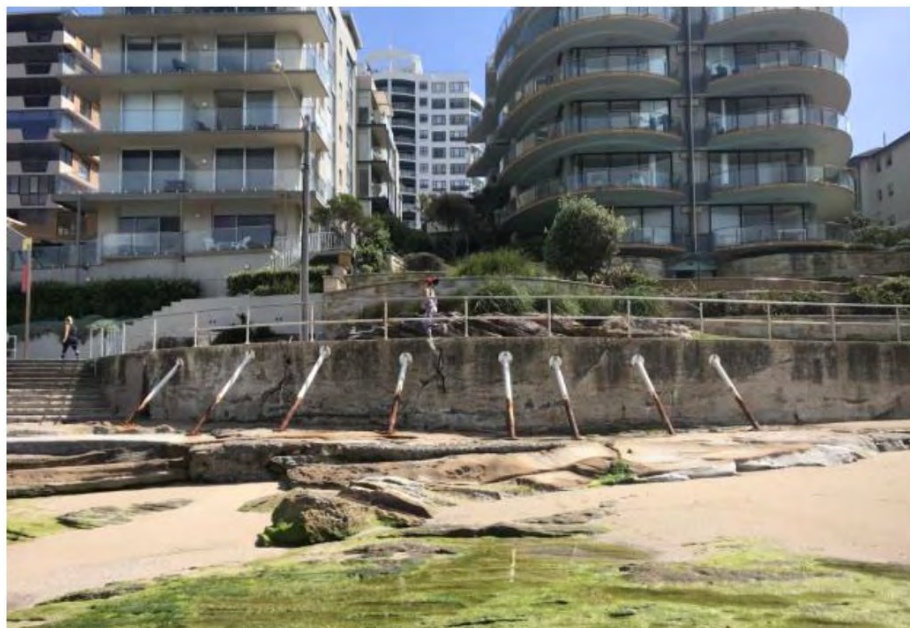


Figure 8-6: Concrete/sandstone block/rendered seawall supporting The Esplanade, northern end of Cronulla Beach



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:
- 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.
 - Fill voids up to the underside of Seabee units (reference level for visual monitoring).
 - 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.

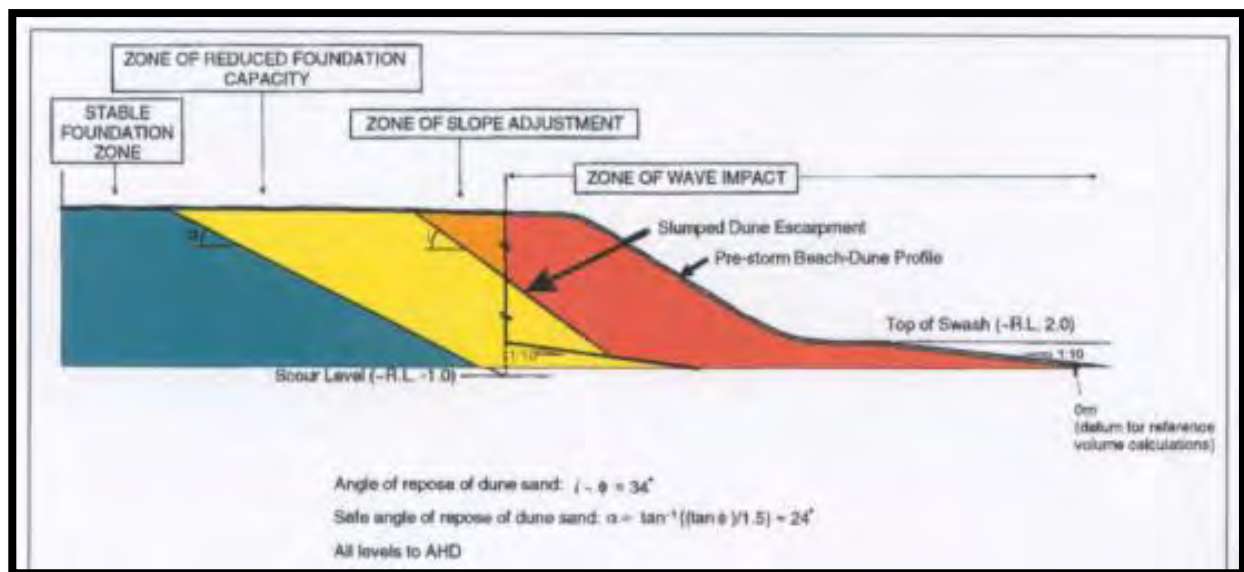


Figure 8-14: Schematic representation of the beach erosion hazard (after Nielsen et al, 1992)



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:
 - o assist with barricading and fencing the SLSC's beach accesses;
 - o assist with traffic management; and
 - o 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:
 - o removal of beach debris;
 - o updated "make safe" works requests (including signage/exclusion);
 - o 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
 - o 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.

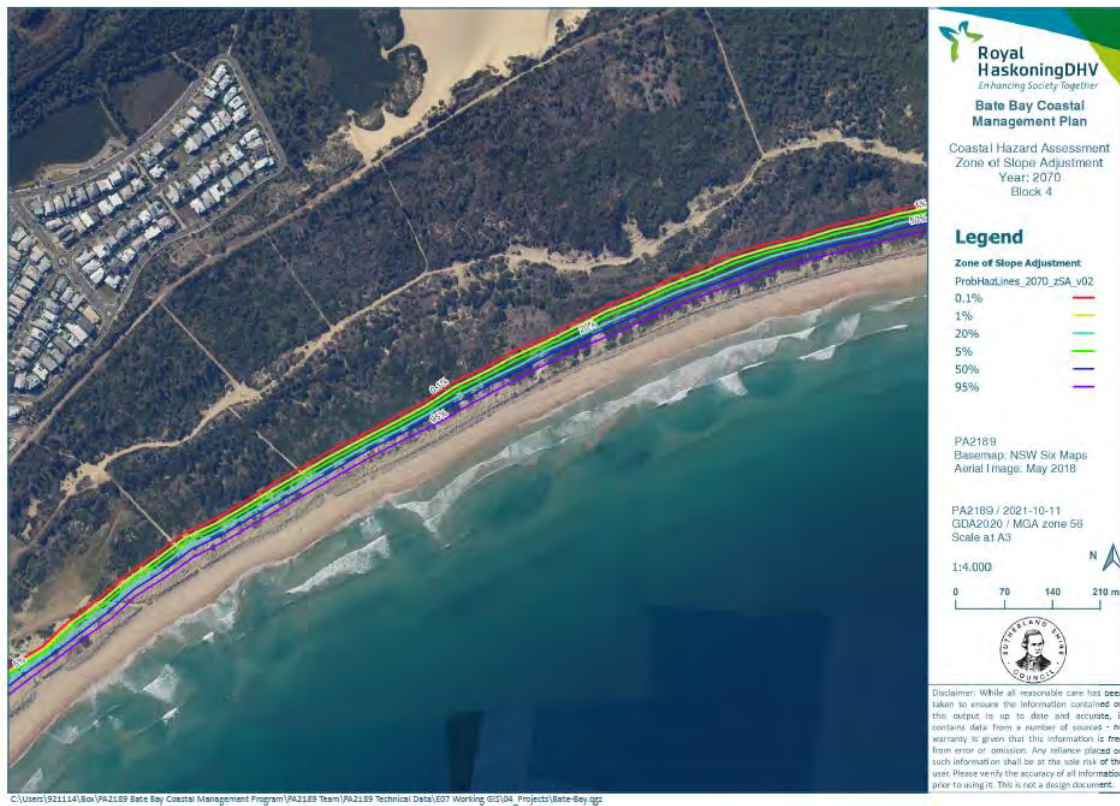


Figure 8-19: Wanda Reserve - Zone of Slope Adjustment 2020

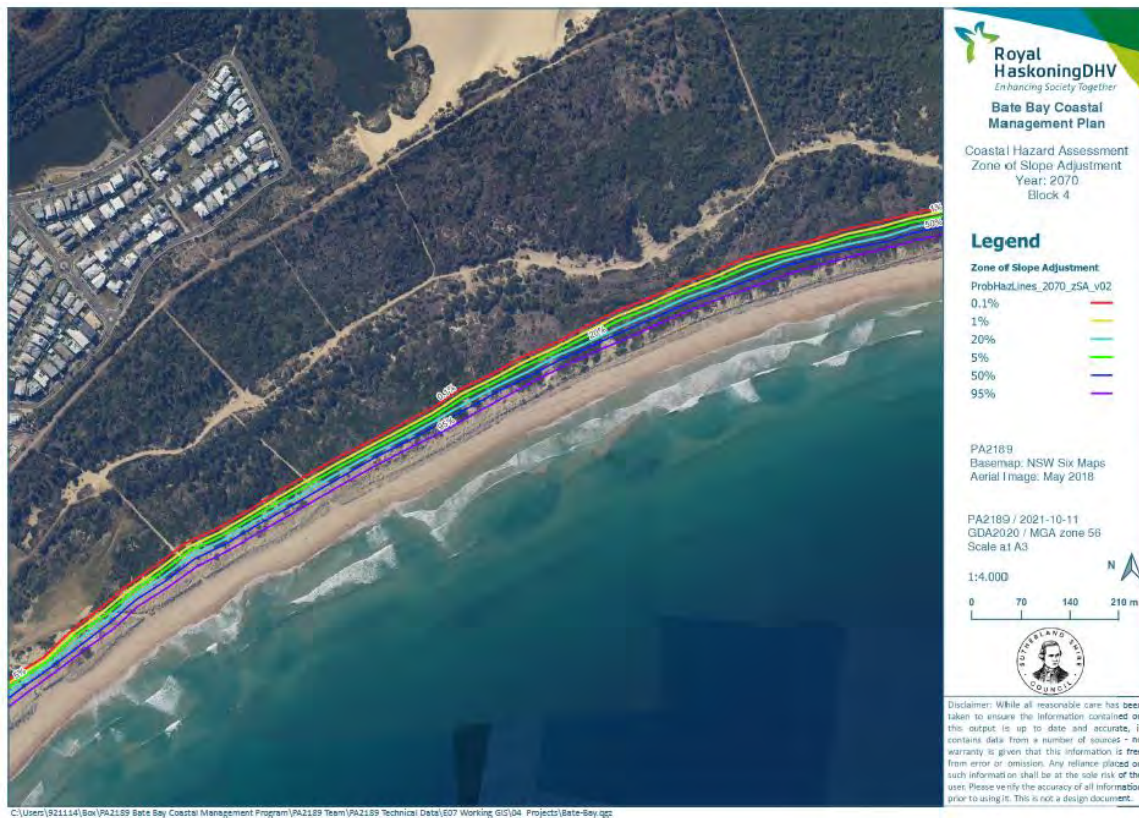


Figure 8-20: Wanda Reserve - Zone of Slope Adjustment 2070

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:
 - o assist with barricading and fencing the foreshore and beach accessways;
 - o 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.

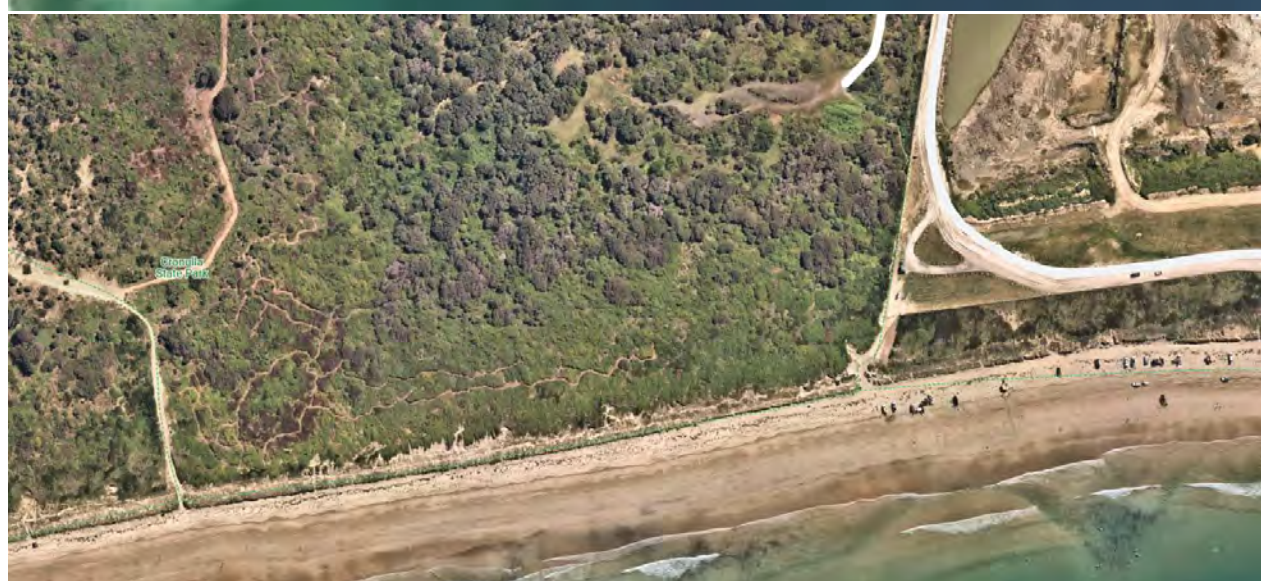
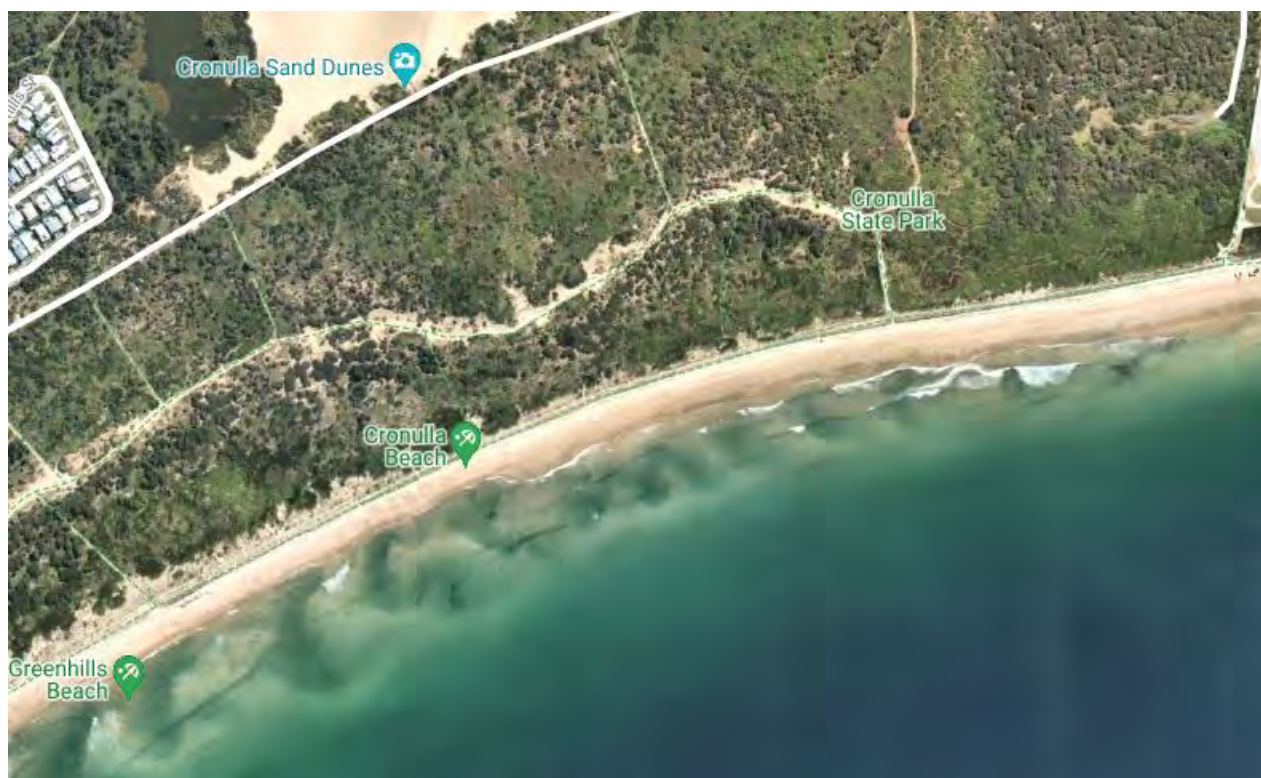
Note: *Placement of temporary works are to be undertaken in consultation with suitably qualified coastal or geotechnical engineer.*

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:
 - o removal of beach debris;
 - o updated “make safe” works requests (including signage/exclusion);
 - o 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
 - o 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)







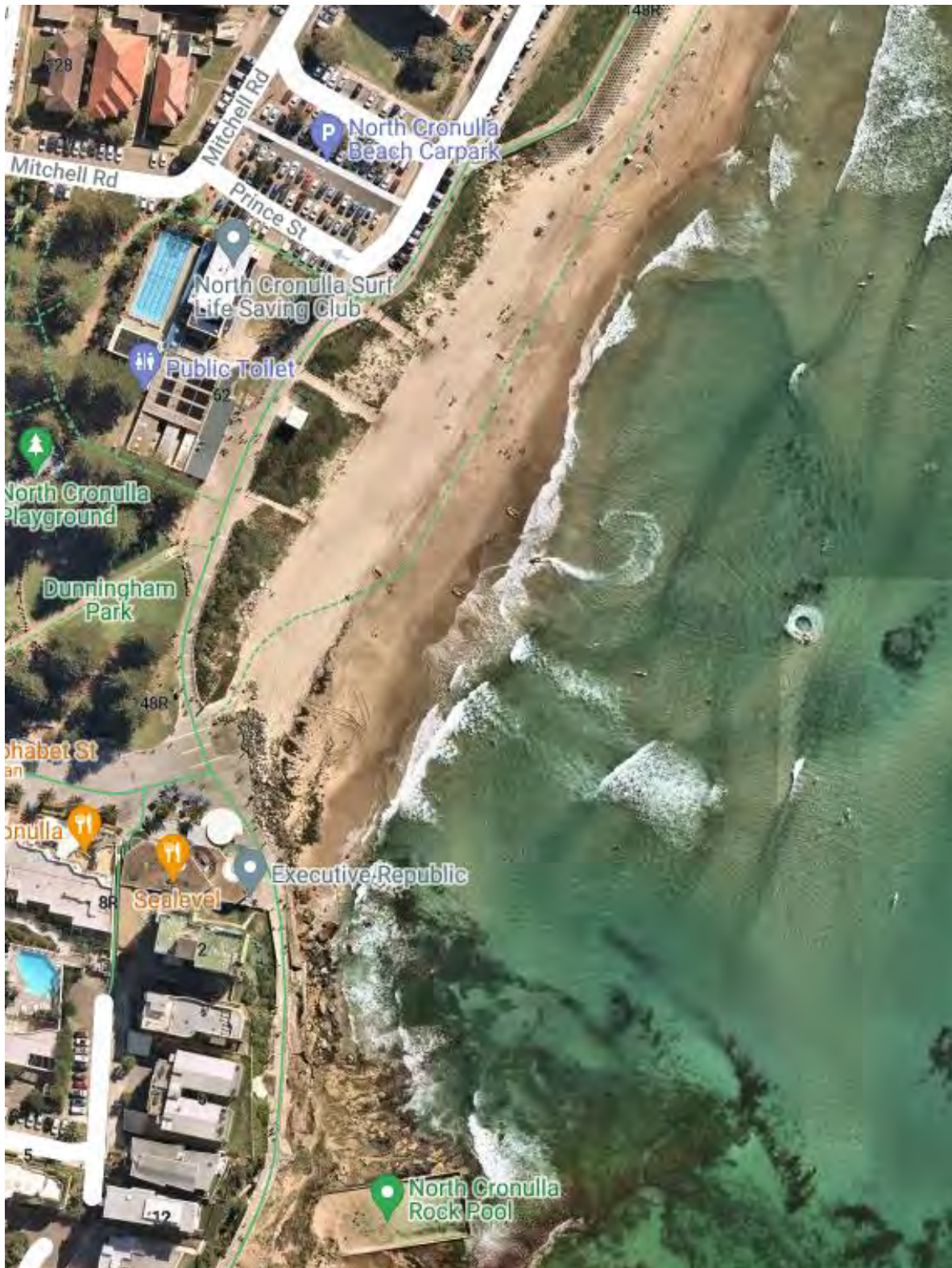












Figure 8-21a to 8-21l: Precincts 1 to 4 – Bate Bay Beaches and Foreshore access locations (North to South)

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 <i>Bate Bay Emergency Management Operational Procedures</i> 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.
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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 <i>Bate Bay Emergency Management Operational Procedures</i> : - 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. <i>Note: approval processes already prepared.</i>
Significant erosion escarpment forms and predicted increase in storm threat <i>Note: Actions as a result of this trigger are to be applied to all trigger responses below</i>	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: - reconnaissance of the area effected by the emergency; and - 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: - 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

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 <i>Bate Bay Emergency Management Operational Procedures</i> ; 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;*
 - o *Sustained winds of gale force (63 km/h) or more*
 - o *Abnormally high tides (or storm tides) expected to exceed highest astronomical tide*
 - o *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, sedgeland, 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 MHWMM 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	<i>Coastal Management Act 2016</i>
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	<i>Environmental Planning and Assessment Act 1979</i>
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 <i>Local Government Act 1993</i>)
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	<i>Protection of the Environment Operations Act 1997</i>
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
SEOCN	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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