Eurobodalla Open Coast Coastal Management Program

Final

Eurobodalla Shire Council pays its respects and recognises Aboriginal people as the original inhabitants and custodians of all land and water within the Eurobodalla and respects their enduring cultural and spiritual connection to it.

“You hold up 8 fingers and each one represents 10,000 years. That’s how long Aboriginal people have been looking after this land”

The Open Coast Coastal Management program recognises the ongoing and vital role played by the Aboriginal people in protecting Eurobodalla’s cultural history, mythology and health.

“We all need to be part of the protection of our historical middens, the cultural and heritage stories. The elders, the community… we are the custodians of land and sea, and we have a responsibility as Aboriginal people to protect country” - CEO, Mogo LALC

At the time of adoption, no Sea Country plans have been completed for Eurobodalla, but Eurobodalla Shire Council recognises that this Coastal Management Program is one of many pathways to management of the Coast, and commits to undertaking management alongside the traditional custodians, the Aboriginal people.

Artwork: Rockpools by Bronwyn Smith

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Acknowledgements

Acknowledgement of Traditional Owners

Eurobodalla Shire Council recognises Aboriginal people as the original inhabitants and custodians of all land and water in the Eurobodalla and respects their enduring cultural and spiritual connection to it.

Acknowledgment of Financial Assistance

Eurobodalla Shire Council has prepared this document with financial and technical assistance from the NSW Government through its Coastal and Estuary Grants Program. This document does not necessarily represent the opinions of the NSW Government or the NSW Department of Planning and Environment (DPE).

Acknowledgement of contributors

Eurobodalla Shire Council acknowledges the contributions from the Eurobodalla community and all other stakeholders which were invaluable in the preparation of this Coastal Management Program. Council particularly wishes to extent its appreciation to members of the Coastal & Estuary Management Advisor Committee (CEMAC), community Reference Groups, the Technical Advisory Group, Traditional Owners and knowledge holders, Local Aboriginal Land Councils and the Batemans Bay Coastal Agency Taskforce.

Executive Summary

Eurobodalla Shire Council, with the assistance of the NSW Government, has prepared this Coastal Management Program (CMP) for the Eurobodalla Coastline, in accordance with the provisions of the NSW Coastal Management Act 2016 (CM Act).

A CMP is a plan of action for Council, public authorities and land managers responsible for management of the coastal zone to:

- address coastal hazard risks
- preserve habitats and cultural uses
- encourage sustainable agricultural, economic and built development in the coastal zone
- maintain or improve recreational amenity and resilience
- adapt to emerging issues such as population growth and climate change.

The NSW Coastal Management Manual specifies five stages of preparing a CMP (**Figure E-1**).

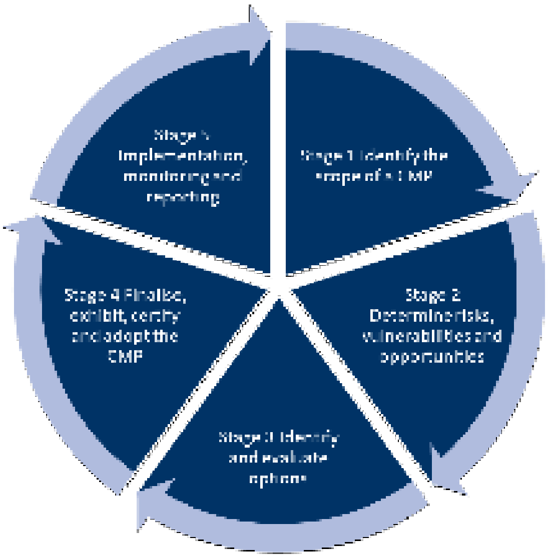

Figure E-1 The Five Stages of a CMP (Adapted from OEH, 2018)

CMP Study Area

The study area covers the full extent of the coastline within the Eurobodalla Shire Council LGA, extending from the South Durras in the north to the entrance of Wallaga Lake in the south. The study area for the Eurobodalla Open Coast CMP is shown on **Figure E-2**.

Figure E2 Overview of Study Area

Purpose, Vision, Objectives and Strategic Direction

The purpose of the CMP, as defined in the CM Act, is to set the long-term strategy for the coordinated management of land within the coastal zone with a focus on achieving the objectives of the CM Act.

The CMP provides a strategic and collaborative approach for relevant land managers to implement a range of credible, evidence-based actions to address current and future risks, not only from coastal hazards, but for a broad range of community, stakeholder, economic, climate change, catchment processes and environmental issues and values. Certification of the CMP will allow Council to access State Government funding to implement coastal management actions on a priorities basis for the coastline, estuaries and catchments of the study area.

The vision established for coastal management of the Eurobodalla open coast is:

> *A healthy and resilient open coast for Eurobodalla, managed in flexible, adaptive and innovative ways to the benefit of all locals, visitors, and traditional owners of the land, now and into the future. The significant Aboriginal cultural, economic, recreational and natural values of the Eurobodalla open coast are recognized and considered in a holistic approach to managing existing and emerging coastal threats.*

Supporting the vision are a series of coastal management objectives which have been developed to align with those in the CM Act, as further detailed in **Section 1.3**.

Values of and Threats to the Study Area

A key outcome of the Stage 1 Scoping Study was understanding how the community value the coastal zone. A list of 13 key values was identified through review of previous community consultation undertaken within the coastal zone and across the LGA, as shown in **Table E-2**.

The coastal management threats (also referred to as issues) to the study area are shown in **Table E-3** and include 24 priority threats. The current and future risk ratings are also shown in **Table E-3**.

Table E-2 Priority Values of the Study Area

Theme	Values
Healthy environment	Natural character and geodiversity Biodiversity and ecosystem integrity Clean waters, beaches and coastal environment
Recreational and social values	Accessibility, property protection and safety Amenity and recreation Public space to gather, socialise and participate in community activities Education / scientific Non-Aboriginal heritage
Aboriginal cultural heritage and use	Aboriginal cultural heritage and use
Economic values	Tourism Fishing (recreational, cultural, commercial) Agriculture and urban lands Support for aged care and assisted living

Table E-3 Threats to the Eurobodalla Open Coast and Risk Assessment Results

ID	Threat	Current Risk (2022)	Future Risk (100 years)
CH Threat 1	Beach erosion	High	Extreme
CH Threat 2	Shoreline recession	Medium	Extreme
CH Threat 3	Coastal inundation	High	Extreme
CH Threat 4	Tidal inundation	Low	High
CH Threat 5	Erosion and inundation of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters	Not assessed for open coast	
CH Threat 6	Coastal watercourse entrance instability	High	High
CH Threat 7	Coastal watercourse entrance modifications (interventions in natural opening regimes for ICOLLs)	Medium	High
CH Threat 8	Dune slope instability	Low	Medium
CH Threat 9	Coastal cliff instability	Low	Medium
RA Threat 1	Conflict over resource access and use (e.g. beach users and dog walkers)	Low	Medium
RA Threat 2	Habitat (physical) and wildlife disturbance (e.g. from overuse, overcrowding, foreshore development, commercial and recreational fishing methods, etc)	Medium	High
RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Medium	Medium
RA Threat 4	Anti-social behaviour and unsafe practices	Low	Medium
RA Threat 5	Passive recreational use (swimming, surfing, bush walking, etc)	Low	Medium
RA Threat 6	Active recreational use (recreational boating, motorised watercraft, camping etc) - recreational activities needing associated infrastructure	Medium	High
RA Threat 7	Commercial and recreational fishing	Medium	High
CD Threat 1	Coastal development resulting in loss of plant and animal species (habitat disturbance or loss)	Medium	High
CD Threat 2	Water pollution from urban stormwater and treated effluent discharge	Low	Medium
CD Threat 3	Pollution of water, beach sand and other habitat areas with litter, solid waste, marine debris and microplastics	Low	Medium
CD Threat 4	Coastal development encroaching onto natural coastal processes to exacerbate hazard impacts	Medium	High
EGC Threat 1	Lack of compliance with regulations (by users) or lack of compliance resources (by agencies)	Medium	High
EGC Threat 2	Insufficient community and visitor awareness of the values and threats to the coastal environment, and lack of engagement with managing this environment	Medium	High
EGC Threat 3	Insufficient or inappropriate governance and management of the coastal environment	Medium	High
EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	High	Extreme

CH – Coastal Hazard, RA – Recreational Activity, CD – Coastal Development, EGC – Engagement, Governance and Compliance

The first pass risk assessment undertaken during the Stage 1 Scoping Study for the entire study area as well as the results of the Stage 2 Vulnerability Assessments was used to determine the risk ratings as shown in **Table E-3**.

The first pass risk assessment identified locations where coastal hazards (such as erosion and inundation) may result in unacceptable consequences (e.g. loss of public assets or private property). These locations were then assessed in further detail in Stage 2.

The Stage 2 CMP document (Rhelm, 2022b) along with the previous coastal vulnerability assessments (WRL, 2017 and SMEC, 2011) and engagement with the community and stakeholders assisted Council and community to understand the complexity of the issues and risks affecting the environmental, social and economic assets and values in each coastal management area.

Evaluation of Coastal Management Options

This CMP provides a management framework that aims to protect the social, ecological and cultural values associated with the Eurobodalla coastline and to manage the largely conflicting desires for the protection of ecological values and enhancing recreational opportunities. The approach is consistent with the long-term vision, the management objectives and community values. The CMP recognises that the coastal zone has suffered impacts from past and current human use and faces current and future pressures including population increases and natural influences such as erosion, flooding, sea level rise and climate change.

There are many aspects of the management of the Eurobodalla coastline that can be targeted through the coastal management framework and there are some aspects that are beyond the reach of this process. Development of management actions was focused on those mechanisms that are available through the CMP process and 10 year delivery timeframe.

A total of 141 potential actions across the entire Eurobodalla coastline were compiled from an audit of previous management plans and studies, engagement with the community and agency stakeholders, and direct outcomes of the Stage 2 CMP vulnerability assessments. There was a higher density of options in the northern portion of the shire where urban development is centred; resulting in a higher risk to urban development from coastal hazards, and a higher risk of impact on the coastal environment from urban development.

Initially, a feasibility assessment was undertaken to ‘rule out’ any options that did not address an existing or future risk to the coast, to consolidate overlapping options, or to identify options that were not feasible through engagement with relevant agency staff.

A viability assessment was then undertaken either through:

- a simple economic analysis and a multicriteria assessment for options that have low risk, impact and complexity; or
- a detailed cost-benefit analysis, preliminary design and viability analysis (e.g. modelling) as well as the use of the multicriteria assessment for options that have high risks, impacts and complexities.

Recommended Coastal Management Actions

The CMP provides a suite of coastal planning and management actions that have been developed and prioritised based on the assessed risk of the threats to the study area.

Actions consist of a combination of studies, investigations and on-ground works and were selected to address the key risks. Actions are based on professional consideration of the legal, technical and engineering feasibility, the economic viability and the acceptability of actions to the community and stakeholders.

The CMP includes 73 actions that have been grouped according to the key threat addressed by each action, although it is acknowledged that many actions address multiple threats and provide multiple opportunities.

The outcome being:

- 6 actions that address coastal development threats
- 35 actions that address coastal hazard threats
- 9 actions that address recreational activity threats
- 17 actions that address engagement and governance threats
- 1 action that addresses an opportunity rather than a threat
- 5 actions that relate to the monitoring and evaluation of the CMP implementation.

The major structural actions to mitigate coastal hazards in and around Batemans Bay are shown on **Figure E-3**.

The CMP includes the preparation of a planning proposal (Action CHA_A) to incorporate the proposed Coastal Vulnerability Area (**Section 8.2.1**) into the *Resilience and Hazards SEPP*. The CMP Stage 2 technical studies will support the submission of a planning proposal.

A Business Plan has been developed for the CMP which outlines the key components of the funding strategy for the CMP, including the cost of proposed actions, proposed cost-sharing arrangements, beneficiaries, and other potential funding mechanisms. Delivery of the Eurobodalla Open Coast CMP is estimated to cost approximately $46.9 Million in capital and operational expenses over the 10 year CMP implementation period.

The CMP actions are expected to be funded through Eurobodalla Shire Council and State Government contributions, monetary grants and volunteer works by community members and organisations. Eurobodalla Shire Council contribution is costed to be $13.6 Million over 10 years, with anticipated State Government contributions of $33.3 Million over 10 years. For all organisations identified, the actions are subject to the availability of resources, contestable grant program processes, funding allocations, policy and legislation changes and organisational and/or government priorities.

Once the program is certified, Eurobodalla Shire Council will be responsible for facilitating through its governance and budgetary processes the implementation of the plan, using both specific staff resources and using existing elements of the NSW Integrated Planning and Reporting (IP&R) Framework of Council to undertake, track and measure the success of actions in the CMP.

Management actions have been developed for a ten-year period and have been aligned with Council's four-year Delivery Programs under the NSW IP&R Framework.

This CMP and the progress of the management actions will be reviewed periodically to ensure the actions remain relevant and the implementation of the plan is being achieved.

Figure E-3a Batemans Bay Structural Coastal Management Actions

SECTIONS

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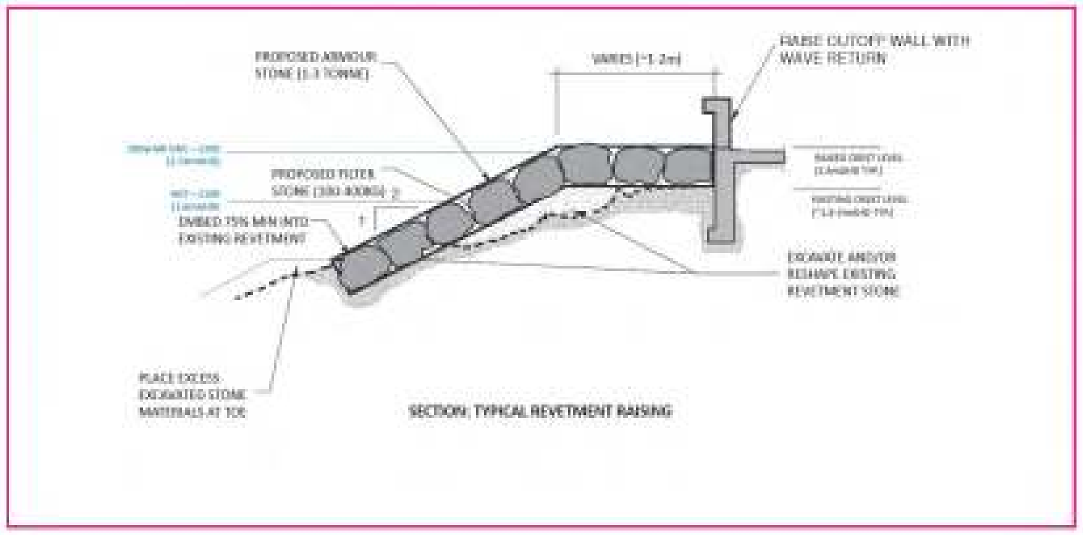

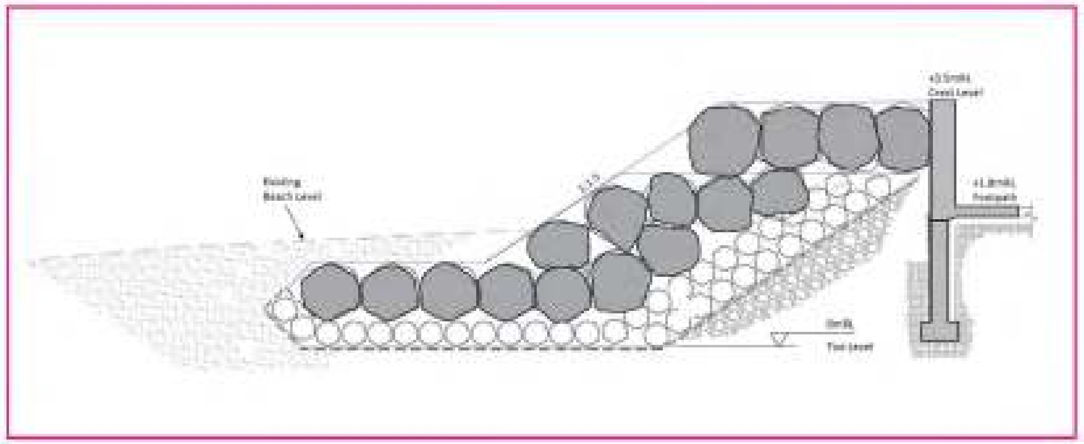

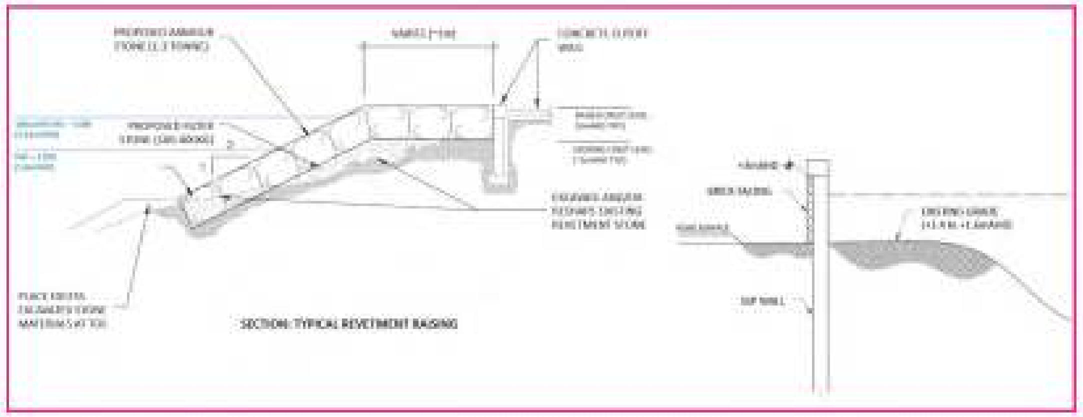

Figure E-3b Batemans Bay Structural Coastal Management Actions

SECTIONS

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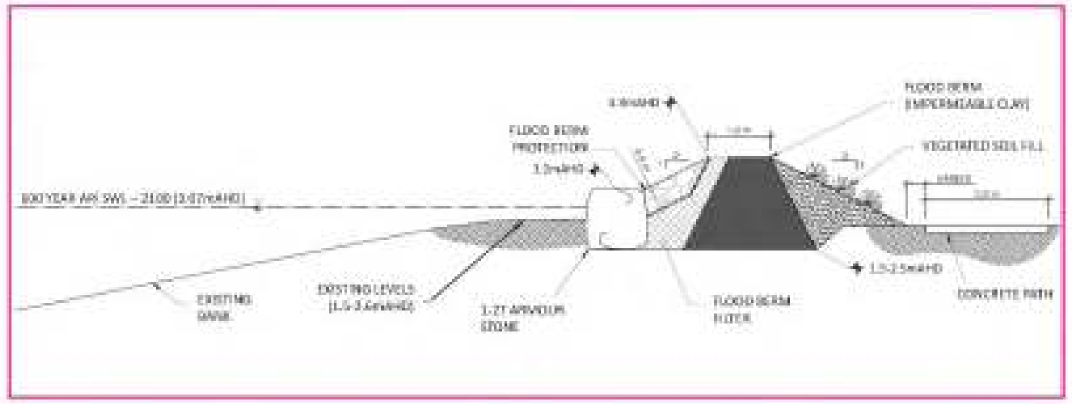

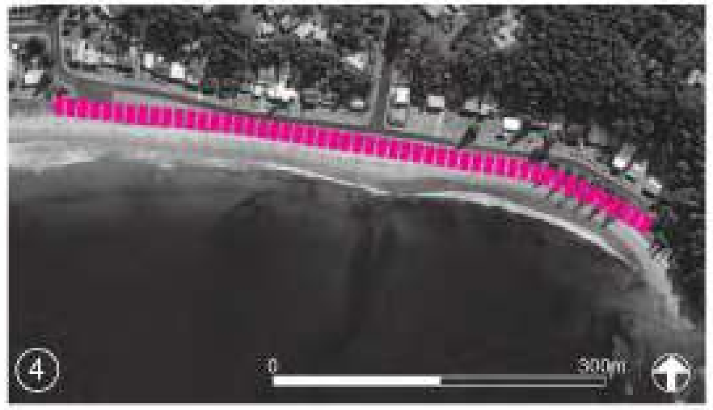

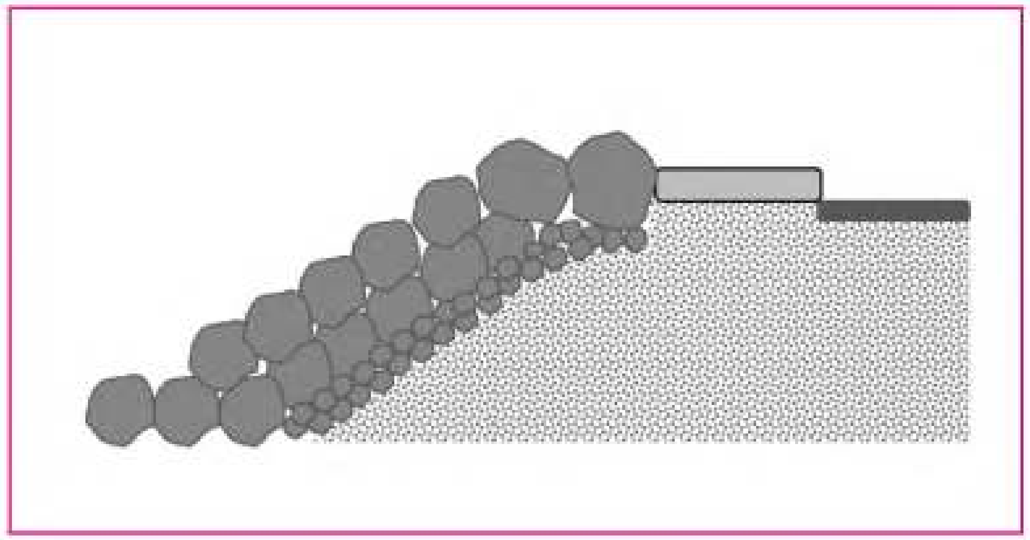

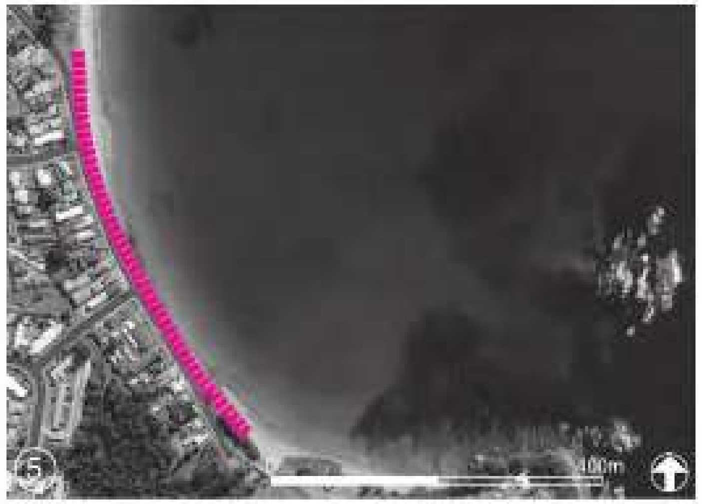

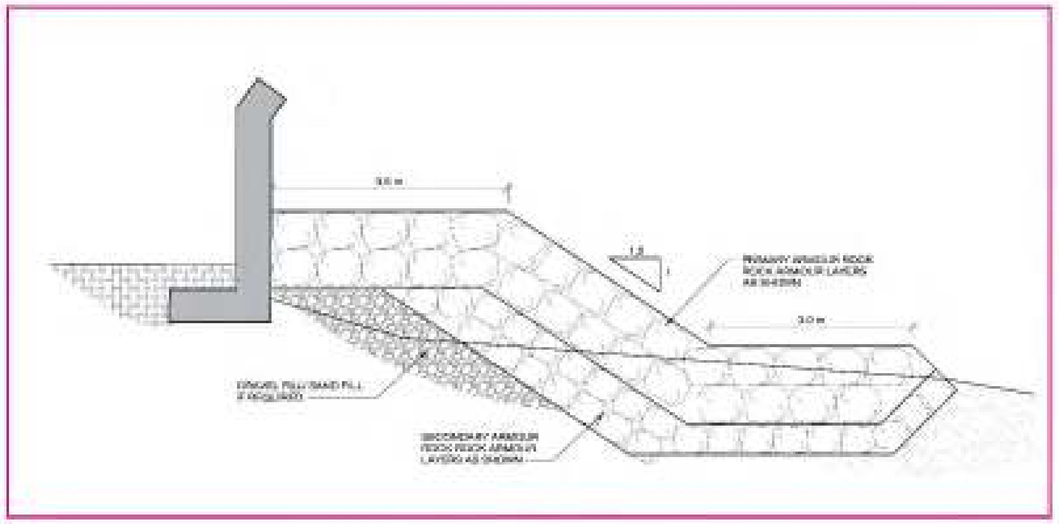

Figure E-3c **Batemans Bay Structural Coastal Management Actions**

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1 Introduction

Eurobodalla Shire Council (Council) with the assistance of NSW Government Agencies resolved to prepare this Coastal Management Program (CMP) to provide strategic direction and specific actions to address threats to the coast and to maintain the ecological, social and economic values of the coast.

The Eurobodalla Open Coast CMP has been prepared in accordance with the mandatory requirements for CMPs specified in the *Coastal Management Act 2016* (the CM Act) and accompanying NSW Coastal Management Manual (CM Manual; OEH, 2018).

A CMP is prepared in five stages as discussed in **Section 1.5**. Previous stages that have been completed and support this CMP include:

- Stage 1 Scoping Study for the Eurobodalla Open Coast Coastal Management Program (Rhelm, 2022a), which set the context and scope for the CMP
- Stage 2 Vulnerability Assessments for the Eurobodalla Open Coast Coastal Management Program (Rhelm, 2022b), which included additional erosion, geotechnical and coastal inundation assessments to fill existing knowledge gaps.

This CMP document constitutes Stages 3 and 4 of the CMP process for the open coast area of the Eurobodalla Local Government Area (LGA) including 140km of beaches, headlands and shorelines and will be publicly exhibited prior to adoption and implementation.

1.1 Purpose of the Eurobodalla Open Coast CMP

This CMP outlines the strategic aims for the coordinated management of the Eurobodalla coastal zone and identifies specific actions to mitigate the threats and issues identified for the coast that are to be implemented over the next 10 years. Clear details for how actions will be implemented, funded, monitored, and reviewed are given in this CMP. The CMP is an operational document for the community and government to take action to manage, preserve, improve, promote and rehabilitate the coast.

A CMP is a plan of action for Council, public authorities and land managers responsible for management of the coastal zone to:

- address coastal hazard risks
- preserve habitats and cultural uses
- encourage sustainable agricultural, economic and built development in the coastal zone
- maintain or improve recreational amenity and resilience
- adapt to emerging issues such as population growth and climate change.

1.2 Area covered by this CMP

To ensure a consistent management approach across the entire LGA open coast, the study area of this CMP covers the full extent of the coastline within the Eurobodalla Shire Council LGA, extending from the South Durras in the north to the entrance of Wallaga Lake in the south. This CMP only applies to areas within the mapped coastal zone. The study area for the Eurobodalla Open Coast CMP is shown on **Map RG-01-01**.

This CMP applies to part of the coastal zone within the Eurobodalla LGA. The study area incorporates the open coast and the entrances to estuaries within the LGA. The study area only extends into the estuaries where coastal inundation risk has been identified. This is captured as part of the proposed coastal vulnerability area (**Section 8.2.1**).

A separate Estuary Coastal Management Plan covers the estuary / intermittently closed and open lakes and lagoons (ICOLLs) of the Moruya River, Mummuga Lake and Wagonga Inlet (Salients, 2022). The study area is shown in **Figure 1-1** and this CMP does not apply to the area covered by the estuary CMP. The management of the remaining estuaries and ICOLLs is split across multiple smaller plans of management, an update to these will be addressed in future Estuary Coastal Management Programs.

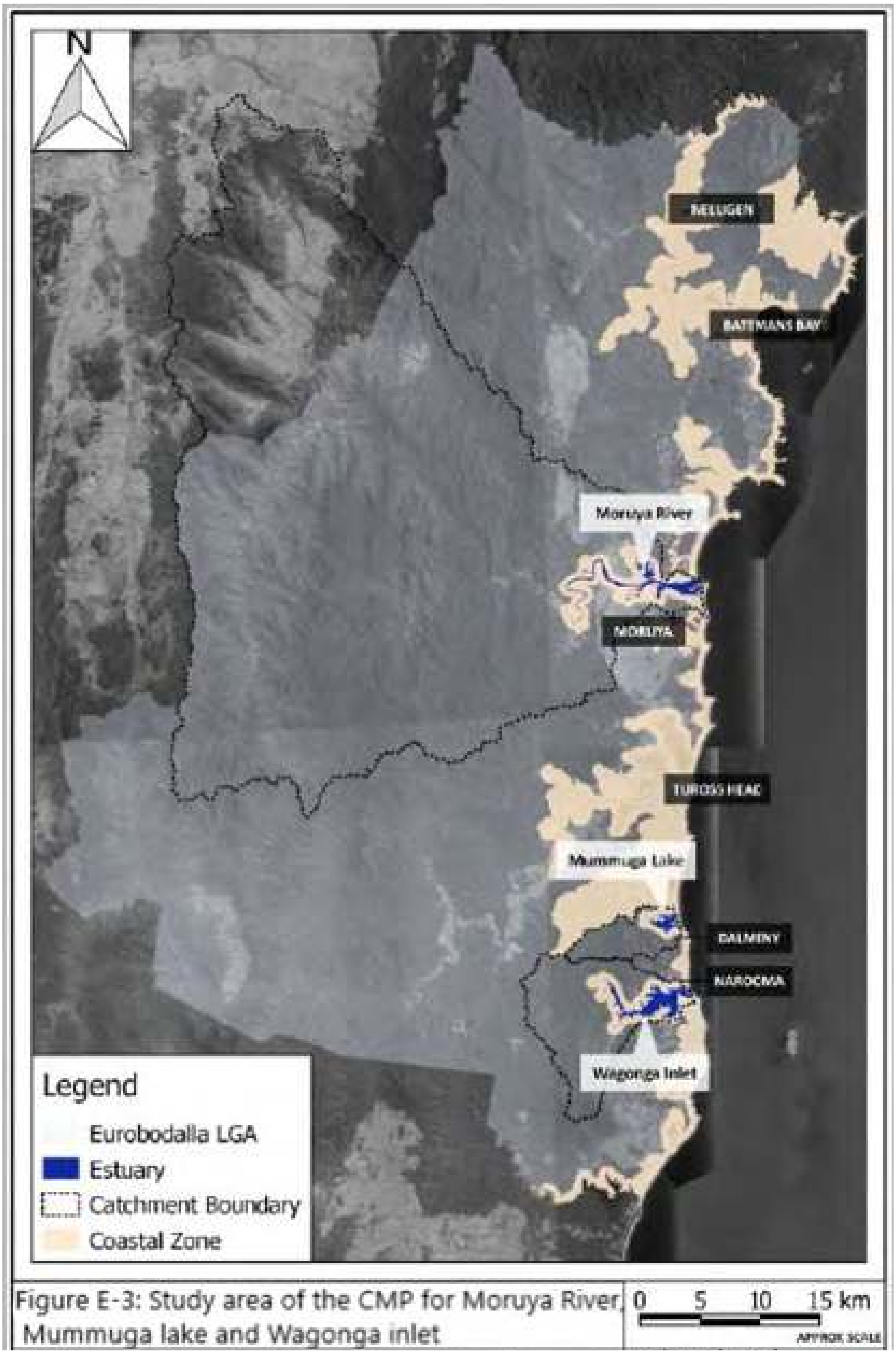


Figure 1-1 Study Area of the CMP for Moruya River, Mummuga Lake and Wogonga Inlet (from Salients, 2022)

1.2.1 Coastal Management Areas Included in the CMP

There are four coastal management areas as defined by the CM Act and *State Environmental Planning Policy (Resilience and Hazards) 2021* (Resilience and Hazards SEPP). All four coastal management areas have been included in the scope of this CMP, being:

- **Coastal Wetlands and Littoral Rainforests** – The study area includes Coastal Wetlands and small areas of Littoral Rainforest Proximity Area that extend into the study area.
- **Coastal Vulnerability Area (CVA)** – The study area has a range of vulnerabilities. There is presently no mapping for the CVA within the Resilience and Hazards SEPP. This CMP includes draft mapping of a CVA in **Section 8.2**, suitable for a planning proposal to update the Resilience and Hazards SEPP mapping
- **Coastal Use Area** – The study area has a range of existing uses and a series of planned future uses
- **Coastal Environment Area** – The coastal environment area maps natural features of the coast such as coastal waters of NSW, estuaries, beaches, dunes, coastal lakes and lagoons and undeveloped coastal headlands and rock platforms.

Map RG-01-01 presents all the coastal management areas along with the proposed Coastal Vulnerability Area. The Coastal Vulnerability Area mapping is discussed in further detail in **Section 8.2** and shown on a separate series of maps **Map RG-07-01**.

1.2.2 Coastal Sediment Compartments

Eurobodalla Shire is identified within two primary coastal sediment compartments and six secondary sediment compartments, as listed below and shown on **Map RG-05-02**:

- Beecroft Head to Wasp Head (South Durras)
  - Lake Tabourie coast – Warden Head to Wasp Head (Durras Beach is at the far southern end of this secondary compartment)
- Wasp Head to Cape Howe
  - Murramarang – Wasp Head to Three Islet Point
  - Batemans Bay – Three Islet Point to South Head (Mosquito Bay)
  - Moruya River – South head (Mosquito Bay) to Bingie Point
  - Eurobodalla coast – Bingie Bingie Point to Cape Dromedary
  - Mount Gulaga (Dromedary) Coast – Cape Dromedary to Goalen Head (noting that most of this compartment is in the Bega Valley Shire).

Eurobodalla Shire Council share primary coastal sediment compartments with Shoalhaven City Council to the north and Bega Valley Shire Council to the south and consultation has been undertaken with these councils.

1.3 Vision, Objectives and Strategic Direction

The vision established for coastal management of the Eurobodalla open coast, consistent with the state's vision and community input, is as follows:

A healthy and resilient open coast for Eurobodalla, managed in flexible, adaptive and innovative ways to the benefit of all locals, visitors, and traditional owners of the land, now and into the future. The significant Aboriginal cultural, economic, recreational and natural values of the Eurobodalla open coast are recognised and considered in a holistic approach to managing existing and emerging coastal threats.

Supporting the vision are a series of local coastal management objectives which have been developed to align with the state's objectives for the NSW coastal zone in the CM Act. The five key coastal management objectives for the study area are:

- *sustain the natural coastal environment*
- *maintain public access, amenity, use and safety on the coast and the lifestyle enjoyed by local people*
- *help build the local coast-dependent economy*
- *improve council and community resilience to coastal change*
- *support community involvement in looking after the coast and decisions about its management.*

A review of how this CMP supports the objects of the CM Act, and objectives for each coastal management area of the *Resilience and Hazards SEPP* is provided in **Table 1-1**. In addition, the risks to the objectives of the CM Act have been identified through the evaluation of the threats described in **Table 2-3** and consideration given in addressing these risks and threats through the development of specific management actions as outlined in **Table 1-1**.

The strategic direction for the study area has been formulated through acknowledging existing visions, strategies and directives outlined in existing documentation by state, regional and local strategic planning documents, which have also shaped development of Council's vision and coastal management objectives. the strategic direction for the study area is discussed further in **Section 3.1.1**. The vision, objectives and strategic direction of the CMP consider the objects and objectives of the CM Act of which management actions subsequently consider

Table 1-1 Objects of the CM Act and the Coastal Management Area Objectives

Section 3 - Objects of the CM Act and Objectives of the Resilience and Hazards SEPP	How this is addressed in this CMP
The objects of the CM Act are to manage the coastal environment of New South Wales in a manner consistent with the principles of ecologically sustainable development for the social, cultural and economic well-being of the people of the State, and in particular—	
(a) to protect and enhance natural coastal processes and coastal environmental values including natural character, scenic value, biological diversity and ecosystem integrity and resilience, and	Management options (Section 3) were identified that address the threats (Section 2.2) to the values of the coastal zone (Section 2.1).
(b) to support the social and cultural values of the coastal zone and maintain public access, amenity, use and safety, and	Management options (Section 3) were identified that address the threats (Section 2.2) to the values of the coastal zone (Section 2.1).

Section 3 - Objects of the CM Act and Objectives of the Resilience and Hazards SEPP	How this is addressed in this CMP
(c) to acknowledge Aboriginal peoples' spiritual, social, customary and economic use of the coastal zone, and	Extensive engagement with Traditional Owners has been undertaken as part of the preparation of this CMP (Appendix A) and has informed specific management actions in Section 3.
(d) to recognise the coastal zone as a vital economic zone and to support sustainable coastal economies, and	Management options (Section 3) were identified that address the threats (Section 2.2) to the values of the coastal zone (Section 2.1).
(e) to facilitate ecologically sustainable development in the coastal zone and promote sustainable land use planning decision-making, and	Management options (Section 3) were identified that address the threats (Section 2.2) to the values of the coastal zone (Section 2.1). Specifically coastal development threat (CD) options.
(f) to mitigate current and future risks from coastal hazards, taking into account the effects of climate change, and	Current future coastal hazards were assessed in the Stage 2 Study. Options addressing coastal hazards have IDs starting with CH (Section 3).
(g) to recognise that the local and regional scale effects of coastal processes, and the inherently ambulatory and dynamic nature of the shoreline, may result in the loss of coastal land to the sea (including estuaries and other arms of the sea), and to manage coastal use and development accordingly, and	Local and regional coastal processes were assessed in the Stage 2 study. Recommendations regarding planning controls in these areas are provided in Section 4.
(h) to promote integrated and co-ordinated coastal planning, management and reporting, and	Section 1.4, 5 and 7
(i) to encourage and promote plans and strategies to improve the resilience of coastal assets to the impacts of an uncertain climate future including impacts of extreme storm events, and	Stage 2 – Vulnerability Study Section 3.2
(j) to ensure co-ordination of the policies and activities of government and public authorities relating to the coastal zone and to facilitate the proper integration of their management activities, and	This CMP Appendix A Letters of support from Agencies
(k) to support public participation in coastal management and planning and greater public awareness, education and understanding of coastal processes and management actions, and	Appendix A
(l) to facilitate the identification of land in the coastal zone for acquisition by public or local authorities in order to promote the	Action CH1_M

Section 3 - Objects of the CM Act and Objectives of the Resilience and Hazards SEPP	How this is addressed in this CMP
protection, enhancement, maintenance and restoration of the environment of the coastal zone, and	
(m) to support the objects of the Marine Estate Management Act 2014.	Section 1.5 Actions that address the following threats: RA Threat 2, CD Threat 2, CD Threat 3, CD Threat 4, EGC Threat 1, EGC Threat 3
The management objectives for the coastal wetlands and littoral rainforests area are as follows—	
(a) to protect coastal wetlands and littoral rainforests in their natural state, including their biological diversity and ecosystem integrity,	Section 1.2.1 Table 2-2 Risk to the objectives have been identified through threats: RA Threat 2, CD Threat 4, CH Threat 8, EGC Threat 1, EGC Threat 3 Consideration given in addressing these risks and threats though the development of specific management actions such as CH8_B, EGC2_A, CD3_C, CD8_C.
(b) to promote the rehabilitation and restoration of degraded coastal wetlands and littoral rainforests,	
(c) to improve the resilience of coastal wetlands and littoral rainforests to the impacts of climate change, including opportunities for migration,	
(d) to support the social and cultural values of coastal wetlands and littoral rainforests,	
(e) to promote the objectives of State policies and programs for wetlands or littoral rainforest management.	
The management objectives for the coastal vulnerability area are as follows—	
(a) to ensure public safety and prevent risks to human life,	Section 1.2.1 Table 2-2 Risk to the objectives have been identified through Coastal Hazard threats. Consideration given in addressing these risks and threats though the development of specific management actions such as all actions with an ID starting with CD.
(b) to mitigate current and future risk from coastal hazards by taking into account the effects of coastal processes and climate change,	
(c) to maintain the presence of beaches, dunes and the natural features of foreshores, taking into account the beach system operating at the relevant place,	
(d) to maintain public access, amenity and use of beaches and foreshores,	
(e) to encourage land use that reduces exposure to risks from coastal hazards, including through siting, design, construction and operational decisions,	
(f) to adopt coastal management strategies that reduce exposure to coastal hazards—	
(i) in the first instance and wherever possible, by restoring or enhancing natural defences including coastal dunes, vegetation and wetlands, and	
(ii) if that is not sufficient, by taking other action to reduce exposure to those coastal hazards,	

Section 3 - Objects of the CM Act and Objectives of the Resilience and Hazards SEPP	How this is addressed in this CMP
(g) if taking that other action to reduce exposure to coastal hazards—	
(i) to avoid significant degradation of biological diversity and ecosystem integrity, and	
(ii) to avoid significant degradation of or disruption to ecological, biophysical, geological and geomorphological coastal processes, and	
(iii) to avoid significant degradation of or disruption to beach and foreshore amenity and social and cultural values, and	
(iv) to avoid adverse impacts on adjoining land, resources or assets, and	
(v) to provide for the restoration of a beach, or land adjacent to the beach, if any increased erosion of the beach or adjacent land is caused by actions to reduce exposure to coastal hazards,	
(h) to prioritise actions that support the continued functionality of essential infrastructure during and immediately after a coastal hazard emergency,	
(i) to improve the resilience of coastal development and communities by improving adaptive capacity and reducing reliance on emergency responses.	
The management objectives for the coastal environment area are as follows—	
(a) to protect and enhance the coastal environmental values and natural processes of coastal waters, estuaries, coastal lakes and coastal lagoons, and enhance natural character, scenic value, biological diversity and ecosystem integrity,	Section 1.2.1 Table 2-2 Risk to the objectives have been identified through threats: RA Threat 2, RA Threat 5, CD Threat 1, CD Threat 3, All EGC Threats. Consideration given in addressing these risks and threats though the development of specific management actions such as CD3_B, CD3_C, RA2_B, RA2_E, RA2_F, RA2_G, and all actions with IDs EGC.
(b) to reduce threats to and improve the resilience of coastal waters, estuaries, coastal lakes and coastal lagoons, including in response to climate change,	
(c) to maintain and improve water quality and estuary health,	
(d) to support the social and cultural values of coastal waters, estuaries, coastal lakes and coastal lagoons,	
(e) to maintain the presence of beaches, dunes and the natural features of foreshores, taking into account the beach system operating at the relevant place,	
(f) to maintain and, where practicable, improve public access, amenity and use of beaches, foreshores, headlands and rock platforms.	
The management objectives for the coastal use area are as follows—	
(a) to protect and enhance the scenic, social and cultural values of the coast by ensuring that—	Section 1.2.1 Table 2-2 Risk to the objectives have been identified through threats: All RA Threats, CD
(i) the type, bulk, scale and size of development is appropriate for the location and natural scenic quality of the coast, and	
(ii) adverse impacts of development on cultural and built environment heritage are avoided or mitigated, and	

Section 3 - Objects of the CM Act and Objectives of the Resilience and Hazards SEPP	How this is addressed in this CMP
(iii) urban design, including water sensitive urban design, is supported and incorporated into development activities, and	Threat 2, EGC Threat 1, EGC Threat 3, EGC Threat 4. Consideration given in addressing these risks and threats though the development of specific management actions such as CD2_A, EGC3_B, EGC3_D, EGC4_A, EGC4_B, and all actions with IDs RA.
(iv) adequate public open space is provided, including for recreational activities and associated infrastructure, and	
(v) the use of the surf zone is considered,	
(b) to accommodate both urbanised and natural stretches of coastline.	

1.4 Key Stakeholders, their Interests and Issues

Federal, State and Local level organisations are involved in governing the coastal zone with their governance role largely tied to land tenure and Native Title (under the EPBC Act). The study area comprises a mixture of land tenure and land management arrangements including private freehold land, Council public land (community and operational land), Crown (unreserved), Crown Land that is reserved or dedicated (called Crown Reserves and Crown Dedications), state conservation areas / national parks / nature reserves / Aboriginal Areas, marine park, road reserve, and railway lands.

A Community and Stakeholder Engagement Plan for this CMP has been prepared, and is provided in **Appendix A**. The Engagement Plan sets out the strategy to engage with the broader community and stakeholders, as required by the CM Act and the CM Manual.

Council has undertaken a range of community engagement and consultation processes as part of developing this CMP, as summarised in **Table 1-2**, including further community and stakeholder engagement undertaken as part of the public exhibition of the CMP (Stage 4).

As part of the preparation of this CMP Council has engagement with Bega Valley Shire Council regarding the Cape Dromedary-Goalen Head sediment compartment, and with Shoalhaven City Council regarding the Warden head to Beagle Bay compartment. There only management action proposed within the CMP that requires cross-boundary collaboration, is the review of the South Durras ICOL Entrance Management Policy. Shoalhaven City Council is a support agency for this action (CH8_B).

Public authorities in which implementation of the CMP will affect have been consulted regarding the coastal zone management issues and actions contained in this CMP, as documented in **Appendix A** and **Table 1-2** below

Table 1-2 Summary of Engagement Activities undertaken during each CMP Stage

Stage	Engagement Activities
Stage 1	• Detailed investigation of previous coastal community engagement activities to identify values and management issues associated with the study area • Community interest registration (via Council's website)

Stage	Engagement Activities
	• Presentations to the Eurobodalla Shire Council's Coastal and Environment Management Advisory Committee • Presentations to the Batemans Bay Coastal Agency Taskforce • Meeting with Aboriginal community representatives on Country to scope the CMP, discuss cultural values and management issues • NSW government agency and adjoining Council discussions • Updates on progress on Council's website (first newsletter)
Stage 2	• Series of online workshops with community representatives in August 2021 to present the draft findings of the Stage 2 assessments and obtain input into identifying coastal management issues for consideration in the CMP • Coastal & Environment Management Advisory Committee (CEMAC) Briefing • Batemans Bay Taskforce Briefing • Updates on progress on Council's website (second newsletter)
Stage 3	• Aboriginal engagement co-design workshop to identify approach for Stage 4 Aboriginal Engagement • CEMAC workshop to present the draft findings of the Stage 2 assessments and obtain input into identifying coastal management issues for consideration in the CMP • Batemans Bay Taskforce Briefing
Stage 4	• Aboriginal engagement sessions • Targeted Agency engagement of recommended CMP actions • Community working groups undertake review of CMP recommendations in workshop environment • Coastal & Environment Management Advisory Committee (CEMAC) Briefing • Batemans Bay Taskforce Briefing • Public exhibition of this draft CMP • Public drop-in sessions and online submissions during draft CMP exhibition • Updates on progress on Council's website

Potential governance and management arrangements for the CMP are outline in **Table 1-3**. Many of these key stakeholders have direct land ownership and management responsibilities in the CMP study area.

Table 1-3 Potential CMP Governance and Management

Entity	Responsibility
Eurobodalla Shire Council	Lead agency for development, coordination and implementation of CMP
State Agencies/Land Managers NSW Department of Planning and Environment (DPE) – Environment and Heritage Group (EHG) DPE – Water DPE – Planning	Support on CMP recommendations, collaboration and action(s) implementation (as defined)

Entity	Responsibility
DPE – Crown Lands DPE - Heritage NSW Department of Primary Industries (DPI) Fisheries (including Batemans Marine Park) Local Aboriginal Land Councils (LALCs) Local Land Services (LLS) National Parks and Wildlife Service (NPWS) Transport for NSW (TfNSW) Maritime Infrastructure Delivery Office (MIDO) NSW State Emergency Service (NSW SES)	
Coastal & Environment Management Advisory Committee (CEMAC) Eurobodalla Shire Council Agencies (above who have direct land ownership and management responsibilities in the CMP study area) Regional Bodies (LLS, Regional Development Australia, LALCs, etc) NSW Rural Fire Service and NSW State Emergency Service Selected community and user group(s)	Non-statutory committee to assist facilitating local community and stakeholder involvement and oversight of the planning and implementation process(es). Advisory only, potentially a committee of council under S355 of the *Local Government Act 1993.*

1.5 Planning Framework

Local Councils in NSW are to undertake management of their coastal areas in accordance with the coastal management framework (**Figure 1-2**), underpinned by the CM Act and Resilience and Hazards SEPP. To achieve this, Councils are required to develop CMPs. The NSW Coastal Management Manual (OEH, 2018) provides information and guidance to Councils in preparing their CMPs.

Figure 1-2 Coastal Management Framework (Adapted from OEH, 2018)

A CMP is prepared in five stages, as shown in **Figure 1-3**. A Stage 1 Scoping Study for the Eurobodalla Open Coast was prepared by Rhelm and Baird (2022a). Subsequently Stage 2 Vulnerability Assessments were undertaken by Rhelm and Baird (2022b). This CMP document constitutes Stages 3 and 4 of the CMP process.

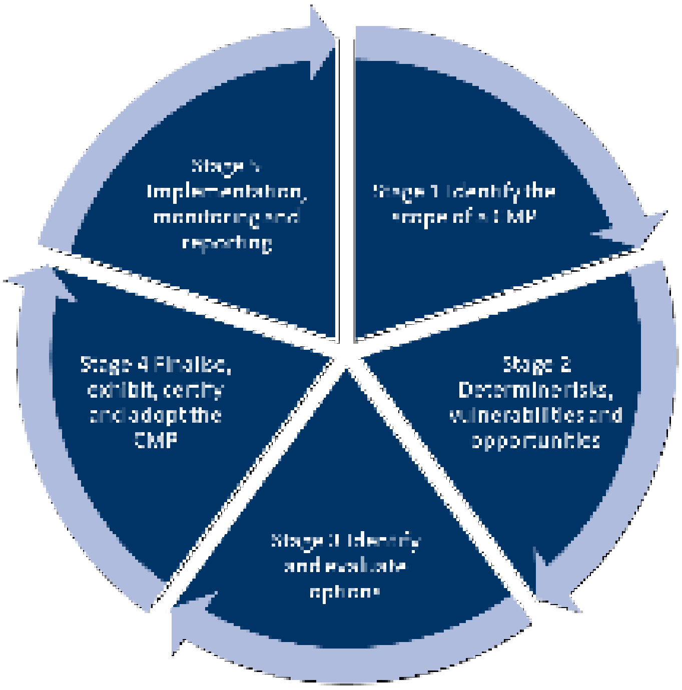


Figure 1-3 The Five Stages of a CMP (Adapted from OEH, 2018)

1.6 Review of Existing Information and Management Arrangements

An assessment of the adequacy of existing information and management arrangements for the study area was completed during the CMP Scoping Study (Rhelm, 2022a).

A first pass risk assessment was completed during the preparation of the CMP Scoping Study (Rhelm, 2022a). Coastal risks were identified through a combined review of background information, site inspections and prior community consultation.

During the preparation of the CMP, the risk assessment was amended to reflect the outcomes of CMP stages 2 and 3 as detailed in **Section 2.4**, **Appendix B** Stage 2 Vulnerability Assessments (Rhelm, 2022b) and updated threats to the study area outlined in **Section 2.2**.

CMP Stage 2 studies identified as necessary for completion within the Scoping Study are detailed in **Appendix B**.

Coastal management opportunities have been identified during CMP Stage 3 as management actions, to address priority risks documented within **Appendix C and D**.

2 A Snapshot of Issues

The Eurobodalla Open Coast study area includes 140km of spectacular beaches, headlands and shorelines. The pristine coastline includes many popular beaches such as Surf Beach, Malua Bay Beach and Broulee Beach near Batemans Bay and also Moruya Beach, Congo and Bingie further south.

The Stage 1 Scoping Study describes in detail the environmental, social and cultural, economic and future context for coastal management planning for the Eurobodalla Open Coast. This context sets the scope for the CMP and fed heavily into the understanding of the values of and priority threats to the study area.

The outcomes of engagement activities undertaken prior to the preparation of the CMP (see **Appendix A**) were a key input to identifying the values and threats in the coastal zone. In addition, engagement undertaken in Stages 1, 2 and 3 of the CMP further informed the understanding of coastal values and threats. Details of the engagement activities are provided in **Appendix A**, and included:

- Meeting on Country with Traditional Owners (Stages 1 and 3)
- Community working groups (Stage 2 and 3)
- Ongoing liaison with Council staff, Councillors, adjoining councils, and State Government Agencies.

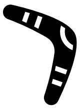
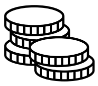
Sections 2.1 and **2.2** provide a summary of the values of the study area and the priority threats to the study area, as developed in consultation with key stakeholders and based on feedback from the community, during the Stage 1 Scoping Study and Stage 2 Vulnerability Study.

Section 2.3 identifies the key issues for each of the coastal management areas, drawing in relevant environmental/social/cultural/economic/future context details from the Stage 1 Scoping Study, as well as key locations at risk, to provide context for the coastal management options developed and included in this CMP.

2.1 Values of the Study Area

A key outcome of the Stage 1 Scoping Study was understanding how the community value the coastal zone. A list of 13 key values was identified through review of previous community consultation undertaken within the coastal zone and across the LGA, as shown in **Table 2-1**.

Table 2-1 Priority Values of the Study Area

Theme		Values
	**Healthy environment**	Natural character and geodiversity Biodiversity and ecosystem integrity Clean waters, beaches and coastal environment
	**Recreational and social values**	Accessibility, property protection and safety Amenity and recreation Public space to gather, socialise and participate in community activities Education / scientific Non-Aboriginal heritage
	**Aboriginal cultural heritage and use**	Aboriginal cultural heritage and use
	**Economic values**	Tourism Fishing (recreational, cultural, commercial) Agriculture and urban lands Support for aged care and assisted living

2.2 Threats to the Study Area

There are a number of coastal hazards and threats to the Eurobodalla Open Coast, its coastal ecosystems and values. A key outcome of the Stage 1 Scoping Study was to understand and prioritise the threats to the coastal zone, which were considered across a range of planning timeframes and pathways and developed from a range of sources of information, including community and stakeholder feedback.

The coastal management threats (also referred to as issues) to the study area are shown in **Table 2-2** and include 24 priority threats, under four themes. It is noted that the Scoping Study also included a threat associated with water pollution from agricultural diffuse sources. Further assessment of this threat during Stage 3 of the CMP concluded that this was not a relevant threat to the Eurobodalla Open Coast but may be considered a relevant threat in the estuaries.

In developing these threats to the study area and undertaking the risk assessments as discussed in **Section 2.4**, the CMP has considered the following matters, which are discussed in detail in the Stage 1 Scoping Study:

- current and future risks, at timeframes of immediate, 20 years, 50 years, 100 years
- the effects of climate change
- the local and regional-scale effects of coastal processes
- the ambulatory and dynamic nature of the shoreline
- population growth and demographic changes
- projected use of the coastal zone.

Table 2-2 Priority Coastal Management Threats in the Study Area

Threat ID	Threat Description
Coastal Hazards	
CH Threat 1	Beach erosion
CH Threat 2	Shoreline recession
CH Threat 3	Omitted
CH Threat 4	Coastal inundation
CH Threat 5	Tidal inundation
CH Threat 6	Erosion and inundation of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters
CH Threat 7	Coastal watercourse entrance instability
CH Threat 8	Coastal watercourse entrance modifications (interventions in natural opening regimes for ICOLLs)
CH Threat 9	Dune slope instability
CH Threat 10	Coastal cliff instability
Recreational Activities	
RA Threat 1	Conflict over resource access and use (e.g. beach users and dog walkers)
RA Threat 2	Habitat (physical) and wildlife disturbance (e.g. from overuse, overcrowding, foreshore development, commercial and recreational fishing methods, etc)
RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities
RA Threat 4	Anti-social behaviour and unsafe practices
RA Threat 5	Passive recreational use (swimming, surfing, bush walking, etc)
RA Threat 6	Active recreational use (recreational boating, motorised watercraft, camping etc) - recreational activities needing associated infrastructure
RA Threat 7	Commercial and recreational fishing
Coastal Development Threats	
CD Threat 1	Coastal development resulting in loss of plant and animal species (habitat disturbance or loss)
CD Threat 2	Water pollution from urban stormwater and treated effluent discharge
CD Threat 3	Pollution of water, beach sand and other habitat areas with litter, solid waste, marine debris and microplastics
CD Threat 4	Coastal development encroaching onto natural coastal processes to exacerbate hazard impacts
Engagement and Governance and Compliance Threats	
EGC Threat 1	Lack of compliance with regulations (by users) or lack of compliance resources (by agencies)
EGC Threat 2	Insufficient community and visitor awareness of the values and threats to the coastal environment, and lack of engagement with managing this environment
EGC Threat 3	Insufficient or inappropriate governance and management of the coastal environment
EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment

2.2.1 Threats Refined by Stage 2 Vulnerability Assessments

Following identification of the threats and data gaps and the first pass risk assessment in the Stage 1 Scoping Study (discussed further in **Section 2.4**), Stage 2 Vulnerability Assessments were undertaken (Rhelm, 2022b).

The Stage 2 Vulnerability Assessments report, which is contained in **Appendix B**, addresses and fills knowledge gaps identified in the Stage 1 Scoping Study, and in doing so builds upon on the coastal vulnerability information for the Eurobodalla coastline.

The Stage 2 additional studies completed and presented in the Stage 2 Vulnerability Assessments report are:

- Erosion assessments at key risk locations identified in Stage 1
- Geotechnical assessments at key locations identified in Stage 1
- Coastal inundation assessments at key risk locations identified in Stage 1
- Conceptual sediment transport analysis of Batemans Bay.

The outcomes of these vulnerability assessments further informed the locations and severity of several threats to the study area, as discussed in **Section 2.3**.

2.3 Snapshot of Issues for each Coastal Management Area

Table 2-3 identifies the coastal management issues that arise within each of the four coastal management areas, recognising that some issues may affect more than one area.

Table 2-3 Key Coastal Management Threats within each Coastal Management Areas

Coastal Management Area (CMA)	Threats within CMA	Context for Threats	Key Locations for Threats
Coastal Wetlands and Littoral Rainforests Area	RA Threat 2 CD Threat 4 CH Threat 8 EGC Threat 1 EGC Threat 3	The study area includes Coastal Wetlands and small areas of Littoral Rainforest Proximity Area that extend into the study area. The identified threats present a risk to the health, biodiversity, resilience and integrity of these Coastal Wetland areas.	Key areas of existing Coastal Wetlands are shown on **Map RG-01-01**. Some of these extents are currently at risk of degradation, being threatened by land-use pressures and climate change into the future.
Coastal Vulnerability Area (CVA)	ALL CH Threats All EGC Threats	The ambulatory and dynamic nature of the shoreline has been considered in the CMP through using the understanding of coastal processes to inform management response, including how coastal hazards will be exacerbated with climate change. Of the coastal hazard threats the key ones are: • Beach erosion • Shoreline recession • Coastal inundation • Tidal inundation • Coastal watercourse entrance instability • Coastal watercourse entrance modifications. The above-listed coastal hazards present a risk to public safety and risk to life, as well as a risk to property and public assets. The erosion of beaches through cross shore sediment transport under coastal storm conditions is a key coastal process that affects all beaches within the study area and is considered within the concept of sediment compartments. The engagement, governance and compliance threats may have an impact on natural features of the coastline such as beaches and dunes, including public access, use and amenity of these features. These threats may also have an impact on Aboriginal cultural heritage and management of the coastal environment may not be optimised without all relevant parties and the community on board.	The highest priority locations where the beach erosion and coastal inundation are occurring and impacting on properties and critical infrastructure, based on Stage 2 vulnerability assessments, are as follows: • Shoreline recession and beach erosion: Maloneys Beach, Long Beach, Surfside, Wharf Road, Caseys Beach, Sunshine Bay, Malua Bay, Guerilla Bay (south), Barlings Beach, Tomakin Cove, and Broulee. • Coastal and tidal inundation: Durras Beach (south), Cookies Beach, Maloneys Beach, Long Beach, Surfside, Wharf Road, Batemans Bay CBD, Boat Harbour, Corrigans Beach, Caseys Beach, Malua Bay, Guerilla Bay, Barlings Beach, and Broulee. • Cliff instability was identified as a risk at Corrigans Headland, Sunshine Bay, Caseys Beach Headland and Long Beach Headland. • Dune instability was identified as a risk at Murramarang Nature Resort, beach reserves at Maloneys Beach, Long Beach, Surfside, Corrigans (include Clyde View Holiday Park) and Malua Bay. • ICOLL entrances with entrances that require intervention and management (i.e. have current entrance management plans): South Durras, Surfside, Joes Creek, Short Beach, Wimbie Beach, Kianga, Little Lake (Narooma), Nangudga Lake, Congo, Potato Point, Lake Brou, Corunna Lake.

Coastal Management Area (CMA)	Threats within CMA	Context for Threats	Key Locations for Threats
Coastal Use Area	All RA Threats CD Threat 2 EGC Threat 1 EGC Threat 3 EGC Threat 4	The Coastal Use Area encompasses much of the Eurobodalla Open Coastline. The threats identified to this area risk the scenic, recreational, social and cultural values of the open coast. The current population of the Eurobodalla Shire is approximately 38,000 people. Whilst the population is growing very slowly, it is ageing rapidly. Tourism is also a major part of the social and cultural context of the study area. Coupled with the influx of tourists, the region's population balloons in the summer months from 38,000 to over 110,000. This highly variable and non-permanent population is a key driver of many aspects of the Eurobodalla social and cultural context. Insufficient involvement of traditional owners in the management of cultural heritage and use within the coastal environment is an ongoing issue. Effective coastal management cannot occur without the involvement of the Traditional Owners.	Some of the key locations where conflicts over resource access and use are occurring are: • The Bingie Dreaming Track • Beach access issues (such as dune trampling) at South Durras, Rosedale Beach and Broulee among other locations. Inappropriate access and supporting facilities have been identified at key high use coastal areas by previous plans and by the community working groups, including: • Lack of connecting coastal walks and cycleways at Batemans Bay, • Lack of promotion, maintenance and use of existing walking tracks such as coastal walks in Murramarang National Park, Broulee Island, Bingie Dreaming, Mystery Bay to 1080 Beach, Mangrove walk at Cullendulla Creek, Durras discovery and Banksia Walk at Burrewarra Point, Mill Bay Board walk at Narooma. • Lack of and poorly maintained facilities at high use beaches, such as Corrigans Beach, Malua Bay, McKenzies Beach, One Tree Beach • Lack of appropriate parking and safe access to parking at McKenzies Beach • Unsafe or inappropriate beach access (particularly lack of disability inclusive access to beaches). The high usage of bike tracks between Broulee Head and Moruya Heads is impacting on vegetation and increased volumes of little have been reported in these sensitive environmental and cultural areas. Lack of cultural access for Traditional Owners has been identified at numerous locations along the coast. Some specific examples include access for fishing and collection of traditional diet, and access to healing sites. In addition, there is dissatisfaction by Traditional Owners in the current management arrangements for some culturally significant locations, including at Broulee Island and Barlings Beach.
Coastal Environment Area	RA Threat 2 RA Threat 5 CD Threat 1 CD Threat 3 All EGC Threats	The Coastal Environment Area encompasses much of the Eurobodalla Open Coast. The identified threats, such as recreational activities and coastal development threats, are impacting coastal ecosystems, biological diversity, ecosystem integrity and water quality (to a lesser extent) along the open coast. Dune vegetation management is key in the coastal environment area to mitigate erosion risk to properties and assets such as roads located behind the dune systems. Weeds impact significant areas along the coast, including weeds of national significance.	Some of the key locations where dune vegetation is being impacted by pedestrian and vehicle access are: • South Durras • Rosedale Beach • Tomakin Beach (spit) • Broulee Shorebird nesting sites have been impacted by pest species and inappropriate use and access of nesting sites. The penguins local to Batemans Bay are found only on islands, where there were no cats, foxes, dogs or humans. About 15 percent of this population live on Snapper Island. Council's sustainability team and Landcare volunteers undertake work on Snapper Island, clearing environmental weeds and plastic pollution and providing additional nesting opportunities for the Little Penguins. Potato Point was identified by Council as a key location for weed management. Water quality issues have been identified by the community (through the community working groups) and by Mogo LALC. It was suspected that the issues were a result of landfill leachate / runoff, stormwater or sewer overflow.

2.4 Risk Assessment

A first pass risk assessment process was applied during the Stage 1 Scoping Study to better understand the severity of known threats in the study area, at present and in the future and to help inform the scope of the CMP. The goal was to identify what values and assets might be at risk and then establish whether the risk is large enough to warrant a more detailed assessment / further assessed in subsequent stages of the CMP (OEH, 2018).

The results of the first pass risk assessment and the methodology for the risk assessment process are described in the Stage 1 Scoping Study (Rhelm, 2022a).

Following this the Stage 2 Vulnerability Assessments (Rhelm, 2022b) were undertaken where the first pass risk assessment had indicated further assessment was required. The outcomes of each of the vulnerability assessments undertaken in the Stage 2 Vulnerability Assessments were categorised against three levels of risk as per the CM Manual to provide the framework and approach for Stage 3. The results of the Stage 2 Risk Assessment are shown in Table 7-1 in the Stage 2 Vulnerability Assessments report in **Appendix B**.

Note that the risk assessment methodology to assess coastal hazard threats in the Stage 1 Scoping Study was undertaken differently to the other threats. Locations at risk of coastal hazards were identified and a risk rating applied at individual locations, rather than an overall risk rating applied to the entire open coast. Information from CMP Stages 1 and 2 has been used to determine the coastal hazards risk ratings in **Table 2-4**, conservatively based on the highest risk rating identified across all locations at risk for each coastal hazard. In some instances, there may only be one location at high risk (i.e. only Tomakin Beach is at high risk of coastal watercourse entrance instability currently and into the future, while all other locations assessed were at low risk currently and into the future). Even in instances like this the most conservative risk rating has still been applied to the entire open coast in **Table 2-4** (i.e. see high risk rating for Coastal Hazard Threat 6).

As part of this stage of the CMP process the First Pass Risk Assessment was revised, incorporating the Stage 2 Vulnerability Assessments results. The threats were reviewed with respect to the coastal management area extents and their objectives, in light of the additional information.

Threats to the Eurobodalla Open Coast study area and corresponding risk levels identified by the revised risk assessment are summarised in **Table 2-4** as current and future risk (20 year, 50 year and 100 year). High consequence, low probability events that affect all relevant areas have been considered by assessing 100 Year ARI coastal events under the above current a future risk timeframes.

It is noted that a decision was made in the scoping study due to the suitability of coastal hazard assessment and associated mapping completed for present day, 2050, 2065 and 2100, including Councils adopted Sea level Rise and Policy Framework that the timeframes were adequate for coastal management planning and previous studies would allow for fast tracking of Stage 2 at most locations. Additional analysis under the same timeframes i.e. present day, 2050, 2065 and 2100 were undertaken and analysed to fill gaps and this was undertaken in Stage 2. This forms the basis of the risk and management option analysis.

Table 2-4 Risk Assessment Results for Eurobodalla Open Coast Threats

ID	Threat	Current Risk (2022)	Future Risk (20 years)	Future Risk (50 years)	Future Risk (100 years)
Coastal Hazards Threats					
CH Threat 1	Beach erosion	High	High	High	Extreme
CH Threat 2	Shoreline recession	Medium	Medium	High	Extreme
CH Threat 4	Coastal inundation	High	High	High	Extreme
CH Threat 5	Tidal inundation	Low	Medium	Medium	High
CH Threat 6	Erosion and inundation of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters	Not assessed for the open coast			
CH Threat 7	Coastal watercourse entrance instability[1]	High	High	High	High
CH Threat 8	Coastal watercourse entrance modifications (interventions in natural opening regimes for ICOLLs)	Medium	Medium	High	High
CH Threat 9	Dune slope instability	Low	Low	Medium	Medium
CH Threat 10	Coastal cliff instability	Low	Low	Medium	Medium
Recreational Activities Threats					
RA Threat 1	Conflict over resource access and use (e.g. beach users and dog walkers)	Low	Low	Medium	Medium
RA Threat 2	Habitat (physical) and wildlife disturbance (e.g. from overuse, overcrowding, foreshore development, commercial and recreational fishing methods, etc)	Medium	Medium	High	High
RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Medium	Medium	Medium	Medium
RA Threat 4	Anti-social behaviour and unsafe practices	Low	Low	Medium	Medium
RA Threat 5	Passive recreational use (swimming, surfing, bush walking, etc)	Low	Low	Medium	Medium
RA Threat 6	Active recreational use (recreational boating, motorised watercraft, camping etc) - recreational activities needing associated infrastructure	Medium	Medium	High	High
RA Threat 7	Commercial and recreational fishing	Medium	Medium	High	High

[1] The only location where CH Threat 7 was high risk was Tomakin Beach due to the risk of breakout across the spit. Stage 3 assessment of options at this location identified the need for a separate management plan being undertaken by Council separately to this CMP.

ID	Threat	Current Risk (2022)	Future Risk (20 years)	Future Risk (50 years)	Future Risk (100 years)
Coastal Development Threats					
CD Threat 1	Coastal development resulting in loss of plant and animal species (habitat disturbance or loss)	Medium	Medium	High	High
CD Threat 2	Water pollution from urban stormwater and treated effluent discharge	Low	Low	Medium	Medium
CD Threat 3	Pollution of water, beach sand and other habitat areas with litter, solid waste, marine debris and microplastics	Low	Low	Medium	Medium
CD Threat 4	Coastal development encroaching onto natural coastal processes to exacerbate hazard impacts	Medium	Medium	High	High
Engagement and Governance and Compliance Threats					
EGC Threat 1	Lack of compliance with regulations (by users) or lack of compliance resources (by agencies)	Medium	Medium	High	High
EGC Threat 2	Insufficient community and visitor awareness of the values and threats to the coastal environment, and lack of engagement with managing this environment	Medium	Medium	High	High
EGC Threat 3	Insufficient or inappropriate governance and management of the coastal environment	Medium	Medium	High	High
EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	High	High	Extreme	Extreme

3 Actions to be Implemented by the Council or by Public Authorities

3.1 Evaluation of coastal management options

The coastal management program (CMP) process involves councils identifying coastal management issues affecting the areas to which the CMP is to apply and identifying coastal management actions required to address those coastal management issues in an integrated and strategic manner. The aim is to develop strategies and identify coastal management actions that address coastal management issues, reduce exposure to coastal hazards, and to take advantage of opportunities, consistent with provisions in Section 14 and 15 of the CM Act. Councils also decide the priority of identified coastal management actions and propose integrated and strategic delivery pathways.

Stages 1 and 2 of this CMP (including the engagement activities undertaken) developed an understanding of the coastal management issues, including an analysis of the risks, vulnerabilities and opportunities in their local area. This information is summarised in **Section 2** and helps to determine what coastal management actions may be identified in a CMP to address coastal management issues in an integrated and strategic manner.

Stage 3 of the CMP identified and evaluated management options to select preferred coastal management actions with a focus on achieving the objects of the CM Act. This process was undertaken in accordance with the four steps outlined in the Manual, summarised in **Figure 3-1**.

Community and stakeholder engagement informed this process through the identification of options at the community working groups and meetings on Country with Traditional Owners.

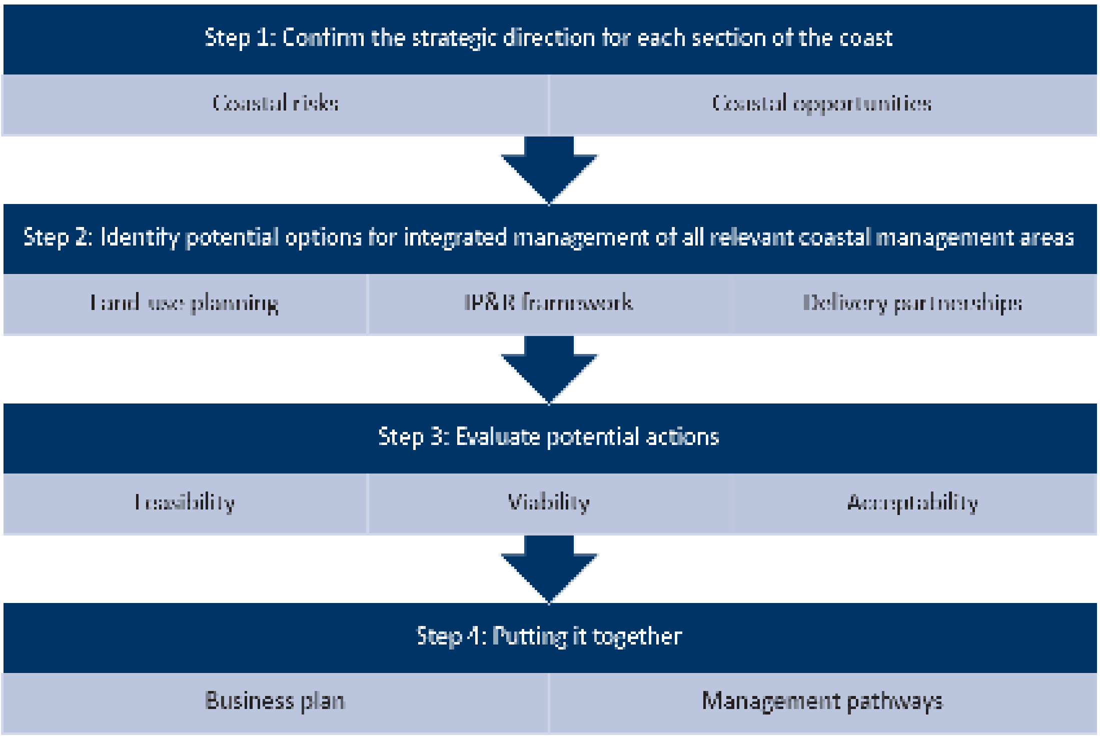


Figure 3-1 Four steps in action identification and evaluation (adapted from CM Manual)

3.1.1 Confirm Strategic Direction

The purpose of a CMP is to set the long-term strategy for the coordinated management of land within the coastal zone with a focus on achieving the objects of the CM Act. The long-term strategic direction for the Eurobodalla LGA Open Coast is encapsulated by the vision that has been developed for the coast along with the local coastal management objectives (**Section 1.3**), aligned with the CM Act.

The strategic context for coastal management in the Eurobodalla open coast is defined in detail in the Stage 1 Scoping Study to set the environmental, social/cultural, economic and legal/planning context for coastal management. This includes consideration of population and demographics, housing and settlement patterns, regional strategic planning, tourism, recreation, conservation and Aboriginal cultural and how these will likely change over time. All these aspects have been considered by Council in the development of this CMP including threats and its long term strategy including delivery actions such as CH1_M and CH4.

3.1.2 Identifying Options

A total of 139 potential actions were compiled from the audit of the previous management plans for the coast (Wharf Road CZMP, 2009 and Geotechnical Slope Instability Risk Assessment, 2012), the Draft Scoping Study (Umwelt, 2018), outcomes of the Stage 2 vulnerability assessments and engagement with the community and traditional owners.

A list of the options identified, and how they were identified (i.e. the source of the options) is provided in **Appendix C**. For each option, the following information is also provided:

- An option ID to allow for tracking through the options evaluation process
- An option description
- The coastal threat the option addresses
- The coastal management area to which the option applies
- The type of management action proposed (i.e. alert, avoid risk, active intervention,).

3.1.3 Evaluating Options

Councils are advised in the CM Manual to undertake a structured and transparent evaluation process to select and adopt the most appropriate coastal management actions. It is recommended that proposed coastal management actions be evaluated in relation to feasibility, viability and acceptability. This approach has been adopted in this CMP. An overview of the options assessment process is shown in **Figure 3-2**.

The long list of 139 options identified in Stage 3 of the CMP were subject to varying degrees of assessment for feasibility, viability and acceptability, depending on the complexity and magnitude of the options.

Initially, a feasibility assessment was undertaken to ‘rule out’ any options that did not address an existing or future risk to the coast, to consolidate overlapping options, or to identify options that were not feasible through engagement with relevant agency staff. The outcome was 85 options for further assessment.

A viability assessment was then undertaken either through:

- a simple economic analysis and a multicriteria assessment for options that have low risk, impact and complexity; or
- a detailed cost-benefit analysis, preliminary design and viability analysis (e.g. modelling) as well as the use of the multicriteria assessment for options that have high risks, impacts and complexities.

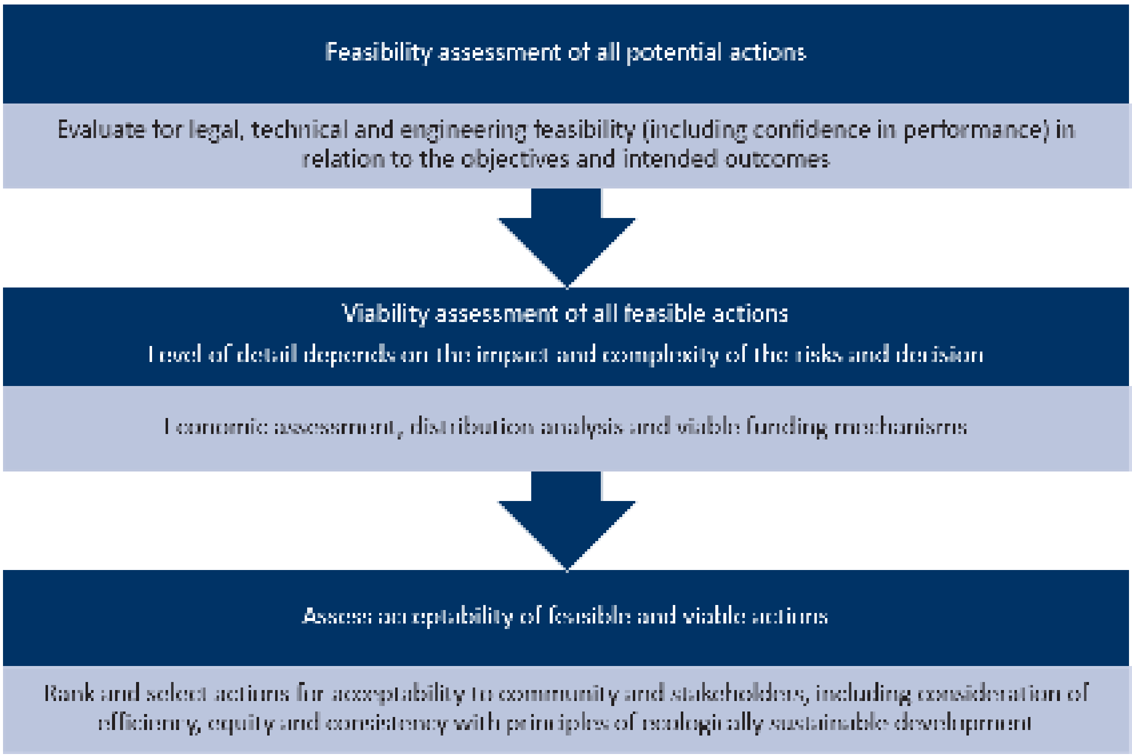


Figure 3-2 Staged option evaluation process

3.1.3.1 Feasibility Assessment

The feasibility of the options was assessed using the guidance in the CM Manual, by assessing the options against the criteria shown in **Table 3-1**.

Table 3-1 Feasibility Assessment Criteria

Feasibility Criteria	CM Manual Guidance
Statutory and policy compliance	Are consistent with the objects of the CM Act and management objectives of the coastal management areas
	Comply with statutory and policy requirements at local, state and Commonwealth levels
	Are environmentally acceptable and consistent with Ecologically Sustainable Development (ESD) principles
Engineering feasibility	Are feasible in engineering terms, i.e. a structure can realistically be built, given the local process context
	Are broadly able to be implemented, in terms of available capacity and capability

Feasibility Criteria	CM Manual Guidance
Reduces risk	Can address the identified issues, mitigating risks or enhancing opportunities, based on previous experience
	Are likely to contribute new knowledge about effective management; for instance, a response that is structured as a carefully controlled trial of new technology
Adaptive	Are adaptive and can transition to alternative approaches when circumstances change

When evaluating the feasibility of the options, the following aspects were also considered in consultation with Council and DPE:

- the timeframe over which the effectiveness of an action can be maintained
- evidence from application of the action in similar situations
- the limits to effectiveness (e.g. a threshold event in which a response will fail)
- the potential for any unintended or unanticipated negative consequences (sometimes referred to as perverse outcomes)
- the irreversibility of some actions that predetermines the future action or pathway
- the level of expertise required to evaluate the design, implementation, monitoring and review of actions
- whether the selection of a strategy allows for adaptive management.

The feasibility assessment is provided in **Appendix C**. The feasibility assessment identified 91 options to progress to the viability assessment.

3.1.3.2 Viability Assessment

The viability of coastal management options was assessed through a range of processes, depending on the risk, impact and complexity associated with the option. Viability assessment involved a multicriteria assessment in all cases and a cost benefit analysis for selected options.

A range of details associated with the options were produced to inform the viability assessments, including costs (capital and recurrent), design, and impacts (e.g. hydraulic and coastal modelling). For the majority of options, these details are provided in simple format in **Appendix D**. For options addressing higher risks or involving high costs and complexities, more comprehensive option details are provided in **Appendix E**, with details of cost estimates provided in **Appendix F**.

3.1.3.2.1 Multi-criteria assessment

The 91 options identified through the feasibility assessment were assessed for their viability using a multi-criteria assessment (MCA) to confirm consistency with the CM Act. The MCA involved assessment of:

- **Threat mitigation score (effectiveness)** comprised on the scoring of the option to address each of the threats listed in **Section 2.2**. Scores were applied in accordance with **Table 3-2**.
- **Social and environmental score (benefits)** assessed the options benefits. Scores were applied in accordance with **Table 3-2**.

- **Acceptability score (community)** estimated the likely community acceptance of the options. This score will be updated as an outcome of the Stage 4 community engagement activities, where required. Scores were applied in accordance with **Table 3-3**.
- **Cost Score (financial)** was applied to the MCA as a weighting, in accordance with **Table 3-4**.

A CMP must consider projected population growth and demographic changes. However, as detailed in the Scoping Study (Rhelm, 2022a), the population of the Eurobodalla region is relatively stable and therefore did not require inclusion in the criterion used to assess management options. Although there is a shift in demographics towards an increase in the proportion of the population in the over 65 years age group, changing demographics was also not considered suitable for inclusion in the multi-criteria assessment. Current and future population has been considered in the cost benefit analysis (see **Section 3.1.3.2.2**).

Table 3-2 Threat mitigation and Social/Environmental benefits scoring system

Influence	Score
Direct Positive	2
Indirect Positive	1
No Influence	0
Indirect Negative	-1
Direct Negative	-2

Table 3-3 Community acceptability scoring system

Likely community acceptance	Score
Strong support	2
Moderate support	1
Neither support nor oppose	0
Moderate opposition	-1
Strong opposition	-2

Table 3-4 Cost scoring system

Cost	Adjustment / weighting
<$10000	1
$10,000 < $100,000	2
$100,000 < $1000,000	3
>$1,000,000	4

Options with a cost-adjusted MCA score of 5 or more were recommended for action as an outcome of this CMP. Selected options with lower cost-adjusted scores, but high unadjusted scores were recommended for action, if the detailed Cost Benefit Analysis identified their economic viability.

3.1.3.2.2 Cost Benefit Analysis

Economic assessment can help decision-makers better understand the socioeconomic implications of adopting different management actions and help them to make choices about prioritisation of actions to maximise net benefits to the community. Such information was used to also assist in developing the business plan and determining cost-sharing arrangements.

The scope and level of detail included in an economic assessment should be proportionate to the nature and scale of the coastal issue(s) being addressed. Detailed cost-benefit analysis (CBA) is not warranted for projects that are only expected to have minor costs and/or benefits and for which a real-world net benefit realisation is well understood. Where there is uncertainty or complexity as to whether a project has economic merit or not, economic assessment through cost benefit analysis is the NSW Government's recommended approach to analysis.

Coastal management actions which will operate over relatively long timeframes, including engineering works with long design lives, and can represent such complex investment opportunities. Coastal management actions may affect a range of stakeholders (some positively, some negatively) and generate potentially large direct and indirect costs and benefits. A detailed CBA for such large-scale or long-lasting actions was undertaken to determine whether the benefits outweigh the costs.

The following 13 options were identified as requiring a detailed CBA to fully assess their viability:

- **CH1_B:** This option involves the upgrading of Northcove Road at Maloneys Beach. This would include raising the road with the additional support of a seawall and culvert cells. These upgrades seek to provide resilience from waves and catchment inundation, flooding and coastal erosion.
- **CH1_D and CH1_E:** This option involves the construction of a low revetment along Bay Road at Long Beach to protect public infrastructure from beach erosion. The two stages of these works have been assessed separately.
- **CH1_Ka:** This option involves the protection of Wharf Road from coastal erosion and inundation risk including construction of coastal protection works and rehabilitating the beach.
- **CH1_Kb:** This option involves the protection of Wharf Road and surrounding properties from coastal inundation through upgrading the existing seawall across the waterfront and constructing a new seawall along Wharf Road.
- **CH1_L:** This option involves the undertaking of sand nourishment at Northern Batemans Bay beaches (wherever need is greatest) when dredging is undertaken in Batemans Bay and Clyde River.
- **CH1_M:** This option includes the purchase of private properties at Wharf Road to assure current and future generations have public access to the foreshore and beaches.

- **CH1_Pa and CH1_Pb:** This upgrade of existing seawall at Caseys Beach reduces the likelihood of damages from wave overtopping during storm events. Two options for the approach to the seawall were assessed.
- **CH1_V:** This option includes the purchase of private properties at risk from coastal erosion at the North end of Broulee.
- **CH4_D** This option involves the implementation of a Coastal Inundation Levee to protect against storm surge inundation from creek / estuary (Surfside Creek and Cullendulla).
- **CH4_Ka and CH4_Kb:** This option involves raising the seawall and install wave return barriers on the sea wall protecting the Batemans Bay foreshore. A CBA was undertaken for completing these works in a single (Ka) or a two staged process (Kb).
- **CH1_ZA** This option involves the combined nourishment and construction of a groyne at Surfside Beach West (Dog Beach / Mcleods Beach), Surfside.

Approach

The economic assessment was undertaken by cost benefit analysis and considers the comparative net costs and benefits of each of the 13 management options (including variations therein) against a base case scenario. Where the net benefits of a management option (relative to the base case) exceed the net costs (relative to the base case) of the option, the option is considered to be economically viable. The key metrics by which this viability is expressed are:

- Net Present Value (NPV): The present value of net benefits minus present value of net costs (a positive NPV indicates an economically viable project)
- Benefit Cost Ratio (BCR): The present value of net benefits divided by the present value of net costs (a BCR greater than one indicates an economically viable project).

As both cost and benefits of an option are assessed relative to a base case comparator, adoption of the base case is critical to the analysis. The base case should represent the most likely scenario that would be realised into the future if the proposed options was not implemented. For each location at which the management options assessed are to be implemented the base case was considered to be a Do Minimum scenario in which the on-going and gradual realisation of erosion and inundation in accordance with the hazard mapping and associated loss of assets at risk was assumed to occur. It also assumes the continuation of any actions (and associated expenditure) included in the Eurobodalla Open Coast Coastal Zone Emergency Action Subplan (**Appendix H**).

Reflecting the nature of the coastal hazards of which the 13 proposed management actions aim to ameliorate, the key benefits incorporated within the benefit analysis (CBA) assessment were in the form of:

- Maintained beach area and amenity and associated non-use and use values.
- Reduced loss and damage of property and land to both private landowner and public assets.

Economic Model assumptions

For the purpose of this assessment several assumptions have been made to facilitate evaluation of project performance through the CBA, these include:

- A discount rate of seven per cent per annum has been applied.

- The initial works for all options has been assumed to be undertaken by 2025, with representing the first full year of operation and benefits.
- Options with a multiple stage structural works were assumed to be undertaken in the years of 2035 or 2050 or 2065 (as relevant)
- A benefit evaluation period of 50 years from the first full year of operation was adopted. Longer assessment periods are unlikely to generate material benefits due to the effects of the assumed seven per cent discount rate per annum
- Population growth for study areas is held constant at 0.86% growth per year
- The base year of assessment was assumed to be 2022 and all values are in 2022 dollars.

The following sections outline the derivation of project cost and benefits, as well as any further specific assumptions adopted.

Capital costs

The assumed capital costs for each option are summarised in **Table 3-5**. Further details on how the costs were derived are provided in **Appendix F**. The base case capital costs are $- for all option locations.

Table 3-5 Capital Costs

Option	Vertical structure types	Vertical Structures Length (m)	Cost ($M)	Other Capital Cost	Other Costs ($M)	Total Cost NPV (7%) ($M)
Base Case	N/A	N/A	0.0	N/A	0.0	0.00
CH1_B	Revetment	250	1.9			1.55
CH1_D	Revetment	200	2.7			2.2
CH1_E	Revetment	530	6.2			2.73
CH1_Ka	Seawall	100	2.1			1.71
CH1_Kb	Seawall	690	5.9			4.82
CH1_L	N/A	N/A	N/A	Sand nourishment costs assessed as ongoing costs not capital costs	N/A	0.00
CH1_M	N/A	N/A	N/A	Private land acquisition	4.0	3.27
CH1_Pa	Seawall and revetment	535	7.9			6.45
CH1_Pb	Seawall and revetment	1070	10			6.80
CH1_V	N/A	N/A	N/A	Private land acquisition	4.8	3.92
CH4_D	Coastal Inundation Levee	1240	13.3			4.49
CH4_Ka	Seawall and wave return structure	650	15.5			12.65
CH4_Kb	Seawall and wave return structure	650	16.5			9.80
CH1_Za	Culvert Extension and Groyne	90	3.6			2.94

Operational and maintenance costs

For ten of the thirteen management options there is a requirement for on-going periodic maintenance of vertical structures in order to maintain functionality and ensure the protection of public and private assets from inundation events. The assumed maintenance works, frequencies and associated costs are summarised in **Table 3-6**. The table also outlines the resultant as well as the associated Present Value of future (7%) maintenance works under each option.

Table 3-6 Operational and Maintenance Costs

Project case	Operational and maintenance Costs	Maintenance Regularity	Project Lifespan (economically assessed)	Total Cost NPV (7%) ($M)
Base Case	0	N/A	N/A	0.00
CH1_B	$19,000	Annually	50 years	0.23
CH1_D	$27,000	Annually	50 years	0.33
CH1_E	$62,000	Annually	50 years	0.75
CH1_Ka	$21,000	Annually	50 years	0.25
CH1_Kb	$40,000	Annually	50 years	0.48
CH1_L	$7500	Annually	50 years	0.26
CH1_M	0	N/A	N/A	0.00
CH1_Pa	$79,000	Annually	50 years	0.95
CH1_Pb	$100,000	Annually	50 years	1.21
CH1_V	N/A	N/A	N/A	0.06
CH4_D	$133,000	Annually	50 years	1.50
CH4_Ka	$155,000	Annually	50 years	1.87
CH4_Kb	$165,000	Annually	50 years	1.99
CH1_Za	$72,000	Annually	50 years	0.87

Quantified Benefits

For the purposes of the CBA and given the magnitude of the costs identified the analysis has focussed upon quantification of the major benefit streams. The following benefits were estimated:

- Beach amenity (use and non-use values)
- Avoided private property damage
- Avoided public road resurfacing by erosion and inundation events
- Avoided access issues arising from inundation events leading to community severance.

The following sections details the derivation of the each of the benefits identified.

Beach Amenity

Beach amenity is a broad term that can capture a wide range of beach values to both active and non-active beach users. For the purposes of this economic assessment, beach amenity is defined to be the collective use and non-use values ascribed to the presence and extent of the beach of relevance to the option. In the absence of site-specific information regarding usage of the various beaches and associated foreshore areas of the study area, a Benefit Transfer approach was adopted. A literature review was undertaken to identify potential benefit values derived from more detailed studies in other locations which could then be applied as representative of beach use and non-use values of the beach in question.

A number of studies have been completed recently which attempt to place high level order of magnitude values to both beach:

- Use values - the values humans derive from the beach through some form of interaction with it; this may be direct (e.g. visitation) or indirect (e.g. ecosystem services provide by the beach that support fisheries)
- Non-use values - the intrinsic value assigned by individuals to the beach that it should continue to exist, independent of personal use.

A notable study was conducted by Pascoe et al. (2017) and Pascoe and Doshi (2018). Pascoe's work represents a state-wide investigation (considering both Sydney and regional locations) to estimate use and non-use values per hectare of beach area. The studies provide a use and non-use value for the Eurobodalla Shire Council area and more specifically for Batemans Bay. This paper's methodology combines a range of techniques (revealed and stated preference, choice experiments and analytic hierarchy processes), based on a single survey. While the resultant valuations are highly influenced by LGA populations and there are numerous caveats to its implementation, for the purposes of this CBA the valuations are potentially representative of a lower valuation range and represent the most current data set available in terms of beach utilisation.

Based on the estimated current annual beach visitation rates (Pascoe and Doshi (2018)), population and household size within the areas of Surfside, Batemans Bay and Batehaven, and the current beach area, an estimated of beach value per square metre of beach area was estimated[2] :

- Beach Use per m^2 per year: $29.75 (variable rates dependent on demographic and local population)
- Beach Non-use per m^2 year: $7.89 - $13.09 (variable rates dependent on demographic and local population)
- Dune value per m^2 per year: $5.83
- Scrubland value per m^2 per year: $5.83.

These values are at the lower end of the estimates derived from other similar projects (e.g. Stockton Beach, Newcastle estimates a beach use value of $40.28 and a non-use value of $14.37 per square metre).

It is recognised that the local community have strongly expressed their concern for protection of the beach and the preservation of connectivity, supporting an elevated level of beach value. However, a limitation of the utilisation of per square metre metrics is that it does not recognise the variation that may arise in valuation between circumstances in which there is little or a lot of

[2] For use values 90%:10% was applied to Pascoe et al (2017), Deloitte (2016) For non-use values 90%:10% was applied to Pascoe et al (2017). For non-use values for features other than beaches, there Pascoe valuation are solely used.

additional beach area and how this may vary over time. In particular, in non-use values are likely to be relatively inelastic to changes in beach areas, while beach use is typically more elastic. For the purposes of the assessment, non-use values were only considered in options in which the entire beach area was assumed to be at risk, with the assessment focusing on lost/gained usage value associate with options protecting or enhancing the available beach area and associated activities able to be undertaken.

Avoided Property Damage

Property damage includes residential and commercial areas which are affected by coastal inundation events. An Average Annual Damage (AAD) was calculated based on riverine flooding damage curves provided by DPE (2022) and shown in **Figure 3-3**. The damages analysis was not based on property survey but instead it assumed that all residential buildings were single storey, slab on ground with floor levels 0.3m above a ground level obtained at the dwelling. While there are differences associated with the type of damages incurred from coastal inundation in comparison to riverine inundation, for the purposes of this assessment, the damage curves were considered of sufficient alignment to estimate damage costs under the base case and project case scenarios assessed.

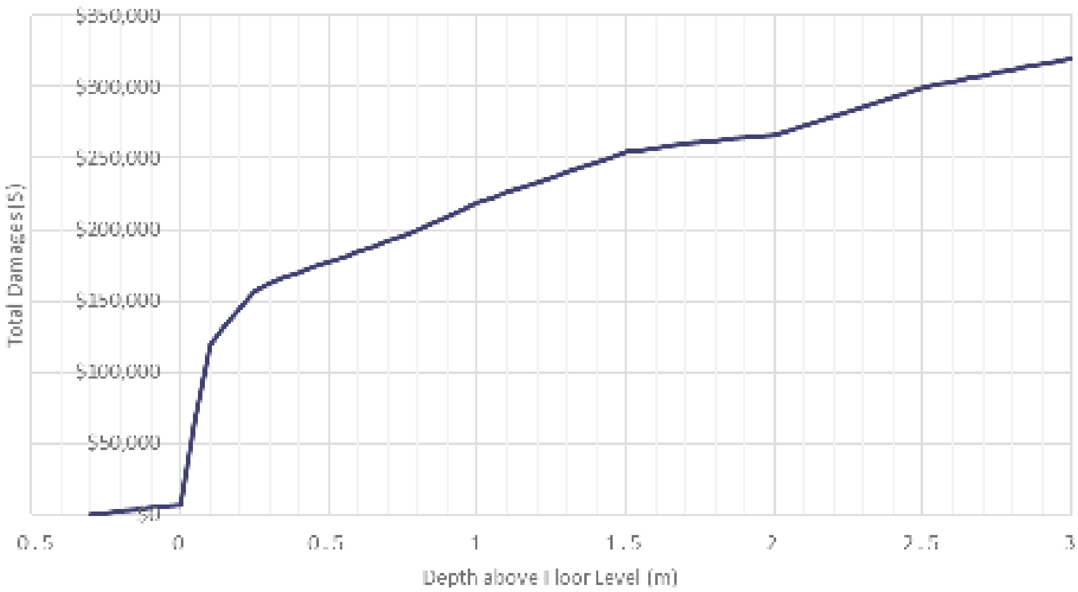


Figure 3-3 Residential Damage Curves (DPE, 2022)

Commercial property damages commercial damages were assessed on a per square metre basis, in line with the damage curve presented in **Figure 3-4**. Based on the current and future year inundation hazard extents and depths of 1% and 5% AEP events, both now and out to 2100, where relevant, estimates of expected annual average damages to affected residences and commercial properties were developed.

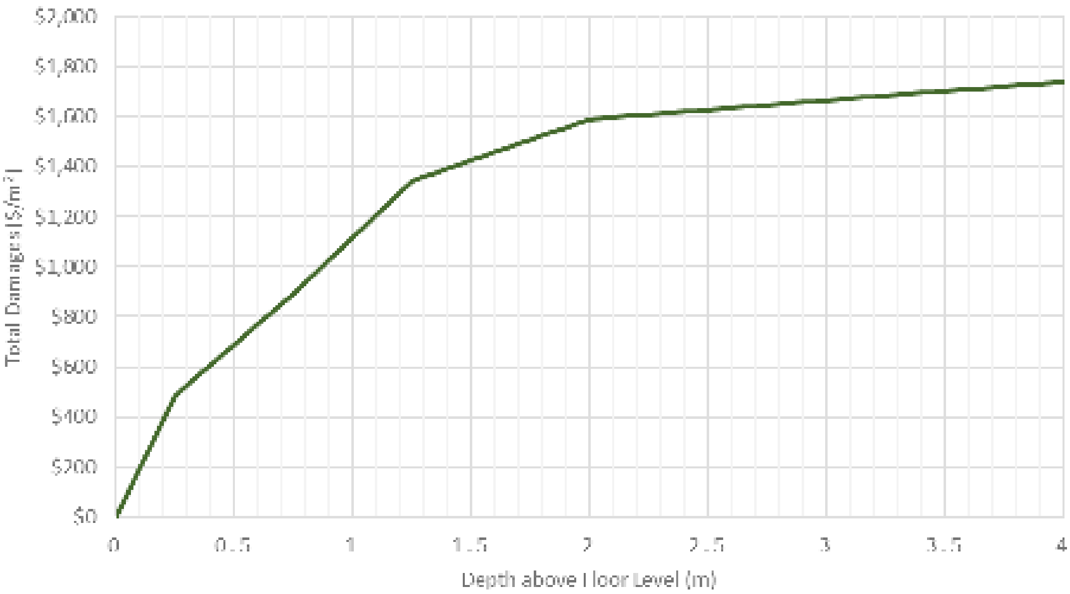


Figure 3-4 Commercial Damage Curves (DPE, 2022)

Avoided resurfacing/repair costs

A significant benefit in the economic analysis for each option was valuing the costings of resurfacing and replacing public infrastructure, including beach front carparks, pathways and roads. Similar to private residential or commercial properties, where such infrastructure is affected damage and repair costs are incurred ("resurfacing costs"). Transport for NSW (TfNSW, 2020 – Economic Parameter Values) provides standard repair costs associated with such damage and loss:

- Carpark space loss = $8,853
- Road replacement cost per m^2 = $3,429
- Road and pavement resurfacing cost per m^2 = $143

In conjunction with replacement repair works, a temporary road installation cost was implemented to account for the required access of roads to residents and visitors. This was estimated through a survey of local construction and hire companies advertised costings for metal temporary 2.4 m x 1.2 m sheeting. Replacement works for the purpose of this plan are averagely estimated to be two weeks. This is estimated to cost $269 per metre in length for a replacement road over the two-week period. This valuation task into account the cost of hiring a temporary sheeting for each side of the road and an added 0.10-0.20 metres of overlapping per sheeting to maintain structural integrity.

As with property damage, based on the expected frequency of coastal inundation events (1%, 5%) out to 2100, estimates of the annual average resurfacing cost for all base case and project case scenarios were derived.

Preserved accessibility

Accessibility is a key issue in when inundation events occur. The inability of waterfront residents to safely enter and exit residential areas via vehicle during and after an inundation event occur is a cost to the residents. This accessibility cost value includes the considerations of inability of vehicle access to property and to emergency services along with the cost of isolation per household. This cost was estimated in three ways:

- The likelihood of the inability to access emergency response/services during a period of isolation driven by a coastal inundation event
- The opportunity cost for individuals to undertake their normal everyday activities (e.g. purchasing goods and services etc.) and make standard trips (e.g. travel to shops, commute to work).
- The cost of the effects on the mental health issues and overall productivity on individual affected by isolation periods.

Based on the population size of affected communities, the average frequency of emergency health incidents in the region, the averagely weekly spend per household for Eurobodalla and the average daily trips per household it was possible to make the following assumptions:

- Estimated no. of daily trips per household = 0.90
- Estimated no. of emergency events per person per year = 0.0011
- Cost per trip = $40.54
- Cost per household isolation for 1 day = $77.50
- Fatalities and Injury Costs per year = $316.35
- Cost of productivity losses and mental health impacts per person = $71.43.

Unquantified Benefits

There are a range of other intangible benefits and non-quantified benefits that were not assessed as part of the economic assessment. As such, the economic evaluation for this project should be seen as a conservative appraisal.

Other benefits arising from the Project are likely to include:

- Damage/ loss of utilities from both erosion and inundation events (where affected)
- Avoided loss of tourist and tourism expenditure due to Holiday Park/other related tourist accommodation impacts and broader economic activity.

Results

The relative costs and benefits of each option (Project Cases) was compared to the 'do minimum' scenario (Base Case) through a Cost Benefit Analysis (CBA). The results of this economic assessment are provided in **Table 3-7**. A positive Net Present Value (NPV) (Present Value Benefit – Present Value Cost) and Benefit-Cost Ratio (BCR) greater than one support a claim for the project to be considered as economically feasible.

Of the 13 available options, 4 have positive NPVs, with BCRs greater than 1. However, it is important to note that the BCR is only one element of assessing the viability of an option, and a BCR less than 1 does not preclude it from being included in the CMP actions, nor does a BCR greater than 1 guarantee its inclusion.

The breakdown of how costs and benefits were assessed can be found in each option description in **Appendix E and F**.

Table 3-7 Cost Benefit Analysis Results (7%)

Option	Option Description	Present Value Cost	Present Value Benefit	Net Present Value	Benefit Cost Ratio
CH1_B	Northcove Road (Maloneys Beach) erosion and inundation protection	$1,780,521	$1,341,657	-$438,864	**0.75**
CH1_D	Long Beach Coastal Erosion Protection Works	2,530,213	$855,987	-$1,674,226	**0.34**
CH1_E	Long Beach Coastal Erosion Protection Works (Extended Works)	$3,479,485	$1,349,088	-$2,130,397	**0.39**
CH1_Ka	Wharf Road Protection Stage 1 (seawall erosion protection works)	$1,967,362	$68,572	-$1,898,790	**0.03**
CH1_Kb	Wharf Road protection Stage 2 (seawall and flood barrier inundation protection works)	$5,299,430	$4,029,264	-$1,270,166	**0.76**
CH1_L	Sand nourishment at Surfside, Long Beach and Maloneys Beach	$97,134	$60,604	-$36,531	**0.62**
CH1_M	Wharf Road private property acquisition	$3,265,192	$2,040,368	-$1,224,824	**0.62**
CH1_Pa	Caseys Beach Seawall (present day risk)	$6,184,966	$1,081,233	-$6,321,984	**0.15**
CH1_Pb	Caseys Beach Seawall (2065 risk)	$8,006,627	$1,081,233	-$6,925,394	**0.14**
CH1_V	Broulee private property acquisition	$3,978,639	$137,221	-$3,841,417	**0.03**
CH4_D	Surfside Coastal Inundation Levee	$5,117,931	$7,219,966	$2,102,035	**1.24**
CH4_Ka	Batemans Bay CBD seawall raising (2100 risk)	$14,525,299	$47,460,493	$32,935,194	**3.27**
CH4_Kb	Batemans Bay CBD seawall raising (2065 risk)	$11,794,117	$47,460,493	$35,666,376	**4.02**
CH1_Za	Culvert Extension / Groyne, combined with beach nourishment at Surfside	$3,808,563	$3,940,978	$132,414	**1.03**

3.2 Recommended Management Actions

3.2.1 Overview

Management strategies and actions have been developed for a ten-year period.

The management actions have been categorised in terms of the key threats (**Section 2.2**) being addressed.

A timeframe for implementation of the actions is specified, using time that is equivalent with the key Council IP&R documents, as follows:

- Year 1: to match with the Operational Plan (which typically extends for one financial year)
- Year 2 to 4: to match with the Delivery Program which is a four-year program (including the Operational Plan)
- Year 5 to 10: to match with the Resourcing Plan which is a 10 year financial plan
- The term ‘ongoing’ is used where an action will need to be repeated regularly.

Actions are presented in terms of actions to be implemented by Council (**Section 3.2.2**) and by public authorities (**Section 3.2.3**).

All recommended actions that have a specific location associated with them are shown on map series **RG-05-01**. All actions in this CMP only apply to areas within the coastal zone (i.e. within one of the existing CM Areas or the proposed CVA).

The following information is provided for each action:

- Action ID
- Action name and description (detailed descriptions are provided for select options in **Section 3.2.4**)
- Coastal Management Area (Batemans Marine Park also noted, where appropriate)
- Locations
- Indicative costs
- Responsible and supporting organisations (note: DPI Fisheries refers to both Marine Parks and the Coastal Systems Unit)
- Performance measures.

The major structural actions to mitigate coastal hazards in and around Batemans Bay are shown on **Figure E-3** (in the Executive Summary of this document).

Where environmental protection works are proposed, it has been assumed (and identified) that these may occur within the Coastal Wetland Area. No actions are located within Littoral Rainforest Areas (or proximity areas).

3.2.2 Actions to be implemented by Council

There are 65 actions identified for implementation by Council, including:

- 6 actions that address coastal development threats
- 30 actions that address coastal hazard threats
- 9 actions that address recreational activity threats
- 14 actions that address engagement and governance threats

- 1 action that addresses an opportunity rather than a threat
- 5 actions that relate to the monitoring and evaluation of the CMP implementation (see **Section 7**).

These actions are presented in **Table 3-8**. Detailed descriptions are provided for complex and high cost actions in **Section 3.2.4**.

Table 3-8 Actions to be implemented by Council

ID	Management Area	Management Action	Action Details	Location	Lead Agency	Partners	Timing	Performance Measures
Actions that address Coastal Development Threats								
CD1_A	Coastal Environment Area, Coastal Use Area Map, Coastal Vulnerability Area,	Continue to implement Snapper Island Penguin monitoring program	The penguins local to Batemans Bay are found only on islands, where there were no cats, foxes, dogs or humans. About 15 percent of this population live on Snapper Island. Council's sustainability team alongside Landcare & youth volunteers undertake work on Snapper Island, clearing environmental weeds and plastic pollution and providing additional nesting opportunities for the little penguins The monitoring program informs the Australian Marine Debris Database and assists in the preparation of educational materials on reducing pollution. Ongoing monitoring of the Penguin colony on Snapper Island to support ongoing viability of the Penguin colony population and habitat is required.	Snapper Island, Batemans Bay	Council	DPE-EHG	Year 1 and ongoing	Annual reporting of monitoring program
CD1_B	Coastal Environment Area, Coastal Vulnerability Area,	Design and implement dune vegetation management – northern end of Broulee beach	Dune vegetation management to be undertaken to prioritise the northern end of the beach to mitigate erosion risk to the road and private properties.	Broulee	Council	DPE-EHG	Year 2 to 4 and ongoing	Established new vegetation and reduced impact on existing vegetation from pedestrian access across dunes
CD1_C	Coastal Zone, potentially within Coastal Wetland Area	Continuation of Council's weed management program in coastal areas	Council staff identified significant weed growth along many of the coastal headlands within the LGA. Weed management to be undertaken at hot spots identified by Council.	All including potentially within the coastal wetlands shown on Map RG-01-01 –Study Area	Council	DPE-EHG, DPI-LLS	Year 2 to 4 and ongoing	Increased number of resources (days and or staff numbers) undertaking coastal weed management
CD2_A	Coastal Environment Area, Coastal Use Area Map, Coastal Vulnerability Area, Batemans Marine Park	Investigate source of water quality issues at Surf Beach	Water quality issues have been identified by the community (through the community working groups) and by Mogo LALC. It was suspected that the issues were a result of landfill leachate / runoff, stormwater or sewer overflow. Examination of the issue is to be continued by Council at Surf Beach. This will include engaging an expert to investigate the issue.	Surf Beach	Council	DPE-EHG, Traditional Owners, DPI-Fisheries	Year 2 to 4 and ongoing	Report outlining source and severity of water quality issues. Management plan prepared, if required from investigations.
CD3_B	Coastal Environment Area, Coastal Use Area Map, Batemans Marine Park	Beach watch monitoring program for water quality at recreational beaches to be continued	The Beachwatch Program, in partnership with DPE, is undertaken every year from the start of November to the end of March, with five samples collected each month from 11 popular beaches. This program is to be continued by Council in partnership with DPE.	Cookies Beach Caseys Beach Surf Beach Malua Bay Broulee North South Broulee Beach Shelley Beach Tuross Main Beach Brou Beach Narooma shark net Narooma Main Beach	Council	DPE-EHG, DPI-Fisheries	Year 1 and ongoing	Ongoing participation by Council Beachwatch Program on an annual basis

ID	Management Area	Management Action	Action Details	Location	Lead Agency	Partners	Timing	Performance Measures
CD3_C	Coastal Zone, Coastal Wetland Area	Support DPI-Fisheries in preparing a *Marine Vegetation Strategy* to identify priority areas for the protection of healthy mangrove and saltmarsh areas and rehabilitation of degraded areas.	The community engagement undertaken as part of this CMP identified protection of intertidal macrophyte ecosystems under climate change and urban pressures as a key community issue. The Marine Vegetation Strategy methodology and its estuary specific application, focuses on increasing the resilience of intertidal macrophyte systems to sea-level rise and other threats and risks in ways that maintain, and maximise, the social, cultural and economic values these systems provide to the community well-being. DPI Fisheries is expecting to commence a strategy for Eurobodalla in mid-2022. Council will assist DPI in the preparation of this strategy through provision of Council information.	All	Council	DPI-Fisheries, DPE-EHG	Year 1	All data and inputs requested by DPI are provided to them by Council
Actions that address Coastal Hazard Threats								
CHA_A	Coastal Vulnerability Area	Update Property Development Planning Controls and undertake Planning Proposal to adopt CVA	A Draft Coastal Hazards Code (Appendix G) is to be adopted until such time that the DCP and LEP can be updated to include coastal hazard controls. A Planning Proposal will be submitted to adopt the proposed CVA map as part of the SEPP. The CMP Stage 2 technical studies will support the submission of a planning proposal. See Section 4 of CMP for details of proposed planning controls and Section 8.2.1 for details of proposed CVA mapping.	Coastal Vulnerability Area	Council	DPE-EHG, DPE-Planning	Year 2 to 4	Adoption of updated Coastal Hazard Code Future update of LEP and DCP Future successful planning proposal for CVA mapping
CH1_B	Coastal Environment Area, Coastal Use Area Map,	Maloney Beach Erosion Protection Stage 1: Undertake investigation and design for Northcove Road erosion protection and flood proofing	The analysis undertaken of the full implementation of the works as part of the CMP identified that the existing risk was not significant, and as a result the coast benefit analysis did not support the implementation of erosion and flood proofing within the CMP 10 year plan. However, a future need for these works was identified, as a result the investigation and design works will be undertaken as part of the CMP. Further details can be found in **Section 3.2.4**.	Maloneys Beach	Council	DPE-EHG, , DPI-Fisheries	Year 2 to 4	Investigation and design complete
CH1_D Phase 1	Coastal Environment Area, Coastal Use Area Map, Batemans Marine Park	Long Beach Coastal Erosion Protection Works – Phase 1: Undertake investigation and design report, including community engagement	Undertake an investigation and design report including community engagement and environmental assessment to construct a low crested revetment to protect Bay Road from coastal erosion impacts under present day and future sea level rise scenarios. The intention of this option to preserve the foundation of Bay Road under severe coastal storm events. Further details can be found in **Section 3.2.4**.	Long Beach	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Year 1	Investigation and design complete
CH1_D Phase 2	Coastal Environment Area, Coastal Use Area Map,	Long Beach Coastal Erosion Protection Works – Phase 2: Construct a ≈ 250m low crested revetment and beach nourishment	Construct ≈ 250m of low crested revetment to protect Bay Road from coastal erosion impacts that has been investigated and designed under through action CH1_D. The intention of this option to preserve the foundation of Bay Road under severe coastal storm events targeting the location of immediate risk. Beach nourishment to ensure amenity and beach use is maintained will also likely be required pending outcomes of phase 1 investigation and design. Further details can be found in Section 3.2.4.	Long Beach	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Year 2 to 4	Completed works
CH1_D Phase 3	Coastal Environment Area, Coastal Use Area Map,	Long Beach Coastal Erosion Protection Works – Phase 3: Maintenance of constructed revetment structure and nourishment of beach	Undertake maintenance of constructed revetment structure and beach nourishment as required to ensure public beach use is preserved.	Long Beach	Council	DPE-Crown Lands, DPI-Fisheries	Year 5 to 10	Use of the beach in front of structure is preserved and structure maintained
CH1_Ka Phase 1	Coastal Environment Area, Coastal Use Area Map, Batemans Marine Park	Wharf Road Stage 1: Priority coastal protection works, remediation and reinstatement of beach for public use - Phase 1 Site remediation assessment and coastal protection investigation and design	Undertake site remediation assessment to enable public access and use of the beach following private property acquisition (action CH1_M) and complete investigation and design including environmental assessment of coastal protection structure including reuse of onsite materials. Further details can be found in **Section 3.2.4**.	Wharf Road	Council	DPE-EHG, DPE-Planning, DPI-Fisheries	Year 1	Reports complete

ID	Management Area	Management Action	Action Details	Location	Lead Agency	Partners	Timing	Performance Measures
CH1_Ka Phase 2	Coastal Environment Area, Coastal Use Area Map, Batemans Marine Park	Wharf Road Stage 1: Priority coastal protection works, remediation and reinstatement of beach for public use- Phase 2 Complete coastal protection works	Complete coastal protection works identified in CH1_Ka phase 1 and rehabilitation of beach to enable public use and access, improve amenity, integrate coastal education opportunities and ecological health restoration outcomes. Opportunity to rename the rehabilitated beach via the Geographic Names Board of NSW following community consultation to be explored. Further details can be found in **Section 3.2.4**.	Wharf Road	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Year 2 to 4	Completed works and renaming of the beach following community consultation outcomes
CH1_Ka Phase 3	Coastal Environment Area, Coastal Use Area Map, Batemans Marine Park	Wharf Road Stage 1: Priority coastal protection works, remediation and reinstatement of beach for public use- Phase 3: Maintain and enhance coastal vegetation and beach for safe public use	Maintain and enhance coastal vegetation and beach for safe public use. This includes continued clean-up of introduced material if exposed, sand nourishment, replanting of suitable coastal vegetation species, amenity and access enhancements and other identified improvements required following private property acquisition and landform changes resulting from removal of illegal structures and coastal processes. Further details can be found in **Section 3.2.4**.	Wharf Road	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Year 5 to 10	Completed works and safe beach use maintained and environmental enhancement
CH1_Kb	Coastal Environment Area, Coastal Use Area Map,	Wharf Road Protection Stage 2: Inundation protection to be undertaken	Stage 2 protection of Wharf Road consists of the following: • Raising of the existing seawall that fronts the Holiday Park (440m in length). • Construct a flood wall along the seaward alignment of Wharf Road east of the Wharf Road corner, consisting of a Steel Sheet Pile wall (250m in length). Further details can be found in **Section 3.2.4**.	Wharf Road	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Year 5 to 10	Completed works
CH1_Kc	Coastal Environment Area, Coastal Use Area Map,	Raise Wharf Road level as part of routine resurfacing works	Opportunistic raising of Wharf Road to be undertaken as routine road upgrade works are undertaken or funding becomes available to maintain access during inundation events. Road raising to provide resilience against future coastal inundation. Further details can be found in **Section 3.2.4**.	Wharf Road	Council	DPE-EHG	Year 5 to 10	Completed works
CH1_P	Coastal Environment Area, Coastal Use Area Map, Batemans Marine Park	Upgrade existing coastal protection works at Caseys Beach	Construct rubble mound seawall to address present day risks and retrofit a vertical crest wall in future (approximately 2035). Further details can be found in **Section 3.2.4**.	Batehaven	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Year 2 to 4	Completed works
CH1_X	Coastal Environment Area, Coastal Use Area Map, Batemans Marine Park	Preparing a Review of Environmental factors to identify preferred options for disposal of sand from maintenance activities at Tuross boat ramp.	Preparing a Review of Environmental factors to identify preferred options for disposal of sand from maintenance activities at Tuross boat ramp.	Tuross Heads	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Year 2 to 4	REF complete
CH1_Y	Coastal Environment Area, Coastal Use Area Map,	Sewage pump stations and reticulation infrastructure at risk to be include in future works plans	Council maintains a network of reticulation and sewer infrastructure, with a number of assets located along the coastline. The CMP identified which assets are at risk (both existing and future) of damage during erosion events (Appendix E). At-risk assets should be included in future works plans to incorporate management and/or protection measures when undertaking works (maintenance, upgrades, replacements, etc) on these assets.	Long Beach Malua Bay Broulee	Council	NA	Year 1 and ongoing	Erosion and inundation risk to assets recorded within Council asset documentation to allow for relocation or protection to be incorporated into any future planned works.
CH1_Z	Coastal Environment Area, Coastal Use Area Map,	Monitor stormwater assets in erosion areas	The CMP identified which stormwater outlets are at risk (both existing and future) of damage during erosion events (Appendix E). At-risk assets should be included in future works plans to incorporate management and/or protection measures when undertaking works (maintenance, upgrades, replacements, etc) on these assets.	All	Council	NA	Year 1 and ongoing	Erosion and inundation risk to assets recorded within Council asset documentation to allow for relocation or protection to be incorporated into any future planned works.

ID	Management Area	Management Action	Action Details	Location	Lead Agency	Partners	Timing	Performance Measures
CH1_ZB	Coastal Environment Area, Coastal Use Area Map,	Implement Open Coast Coastal Zone Emergency Action Subplan	The Coastal Zone Emergency Action Subplan (CZEAS) which forms part of this CMP identifies a list of actions Council has responsibility to implement if resources and safety permits in preparation, response and recovery of a coastal emergency event at identified locations. This action supports implementation of these responsibilities including provision of signage, sand containers and sand nourishment works.	All	Council	NSW SES, Heritage NSW, DPE-EHG	Year 1 and ongoing	CZEAS implemented when triggers reached.
CH1_ZC	Coastal Environment Area, Coastal Use Area Map,	Design and construct a coastal erosion structure to protect Wharf Road at Surfside Beach West (Dog Beach/Mcleods Beach) against coastal erosion	A rock revetment protecting the undermined bank adjacent to Wharf Road creek culvert will be constructed to tie into natural rock to the west. A concrete extension of the wing wall to the east will provide increased erosion protection to the road and resilience to the culvert.	Surfside	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Year 1	Completed works
CH10_C	Coastal Environment Area, Coastal Use Area Map,	Conduct periodic inspections of the slopes of the cliffs and bluffs and utilise Lidar data to monitor long term recession	Respond to incoming customer requests regarding the stability of cliffs and bluffs at Corrigans Headland, Sunshine Bay, Caseys Beach Headland and Long Beach Headland to identify evidence of instability, such as loose rock, mantle creep, stormwater incision, tension cracks or leaning or fallen trees. State government Lidar data should be utilised to identify and monitor any recession in these areas due to erosion.	Corrigans Headland, Sunshine Bay, Caseys Beach Headland and Long Beach Headland	Council	NA	Year 1 and ongoing	Inspections undertaken and recorded
CH10_E	Coastal Environment Area, Coastal Use Area Map,	Maintain or improve native vegetation cover on steep slopes on coastal cliffs and bluffs	Maintain or improve native vegetation cover on steep slopes on coastal cliffs and bluffs. This may also involve weed management and use of matting/geotextile to protect the surface from erosion as well as control weeds.	Priority to those affected by geotechnical hazards, and are accessible	Council	DPE-EHG, DPE-Crown Lands	Year 1 and ongoing	Increased native vegetation cover at high risk locations
CH10_G	Coastal Environment Area, Coastal Use Area Map,	Install safety and warning signs relating to cliff instability	- Install general warning signs along the base of the headlands at Corrigans, Caseys and Long Beaches to warn walkers of the potential hazards. - Fences and warning signs be installed along the top of steep slopes where a risk exists of persons falling over the edge.	All	Council	DPE-EHG	Year 1 and ongoing	Signage installed
CH10_I	Coastal Zone	Install and maintain surface dish drains at priority slope instability sites	Install and maintain a surface dish drain at the top of slopes (identified as high priority locations in ACT Geotechnical Engineers Pty Ltd, 2012) to divert water away from slopes that are being eroded or have the potential to be so causing environmental impacts.	All	Council	DPE-EHG	Year 5 to 10	Completed works
CH9_A	Coastal Environment Area, Coastal Use Area Map,	Prepare frontal dune management plans	Prepare frontal dune management plan for dunes seaward of caravan parks and camping grounds, and foreshore reserves to optimise resilience of the dunes as protection for temporary land uses and enhance ecological connectivity. Target locations to include beach reserves at Maloneys Beach, Long Beach, Surfside, Corrigans (include Clyde View Holiday Park) and Malua Bay Reserve. The locations do not include Coastal Wetland Areas.	Beach reserves at Maloneys Beach, Long Beach, Surfside, Corrigans (include Clyde View Holiday Park) and Malua Bay	Council	DPE-EHG, DPE-Crown Lands	Year 2 to 4	Management plans prepared, adopted and in use
CH4_D Phase 1	Coastal Environment Area, Coastal Use Area Map,	Investigate, design and construct a coastal inundation levee to protect against storm surge inundation from creek / estuary (Surf Side Creek) - Phase 1	Construct a flood berm to protect the low-lying residential precinct of Surfside adjacent to the bay to protect the region from inundation in an existing 100-year ARI ocean storm. Construct section seaward of Wharf Road and undertake dune management to ensure the dune provide adequate protection from coastal inundation. Further details can be found in **Section 3.2.4**.	Surfside	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Year 1 to 2	Stage 1 Phase 1 works completed
CH4_D Phase 2	Coastal Environment Area, Coastal Use Area Map,	Investigate, design and construct a coastal inundation levee to protect against storm surge inundation from creek / estuary (Surf Side Creek) – Phase 2	Construct a flood berm to protect the low-lying residential precinct of Surfside adjacent to the bay to protect the region from inundation in an existing 100-year ARI ocean storm. Refine design of Phase 2 section of levee through the Floodplain Risk Management Study and construct. Further details can be found in **Section 3.2.4**.	Surfside	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Year 2 to 4	Stage 1 works completed

ID	Management Area	Management Action	Action Details	Location	Lead Agency	Partners	Timing	Performance Measures
CH4_G	Coastal Environment Area, Coastal Use Area Map, Batemans Marine Park	Installation of flood gates on priority outlets	Low-lying areas of land, while protected by adjacent coastal protection structures or dunes, can experience inundation as a result of surcharge from the local pit network when adjacent bay / ocean levels are high. Investigate and construct flood gates on selected pipes to prevent this surcharge. Priority locations are identified in Appendix E.	Wharf Road Batemans Bay to Batehaven	Council	DPE-EHG, DPI-Fisheries	Year 5 to 10	Installation complete
CH4_K	Coastal Environment Area, Coastal Use Area Map, Batemans Marine Park	Investigate, design, and construct seawall raising and wave return barriers in Batemans Bay	Raise seawall protecting the Batemans Bay foreshore, to reduce impact of wave overtopping in the short to medium term. Further details can be found in **Section 3.2.4**.	Batemans Bay to Batehaven	Council	DPE-EHG, DPI-Fisheries, DPE-Crown Lands	Year 5 to 10	Completed works
CH4_M	Coastal Environment Area, Coastal Use Area Map,	Undertake an adaptation plan for low lying areas to be impacted by tidal inundation under sea level rise	Adaptation planning will be undertaken for low lying areas around Batemans Bay that have existing exposure to large ocean storms and will increasingly be at risk under sea level rise. Adaptation planning will look to identify suitable approaches to continue to viability of this land. The planning will investigate a combination of rezoning land, landform adaptation through filling and raising of assets and roads, and property development controls. Further details can be found in **Section 3.2.4**.	Batemans Bay, North Batemans Bay and Surfside	Council	DPE-EHG	Year 2 to 4	Adaptation plan completed, providing recommendations for changes to planning controls and land use zoning, as required.
CH4_V	Coastal Environment Area,	Undertake access road raising to provide resilience to coastal inundation risk – Beachcomber Holiday Park	There is a low lying section of the access road to Beachcomber Holiday Park. Road levels should be raised at this location to match adjoining levels to improve access and evacuation access during a coastal storm event.	Potato Point	Council	DPE-EHG	Year 2 to 4	Completed works
CH8_B	Coastal Environment Area, Coastal Use Area Map, Coastal Wetland, Batemans Marine Park	Undertake a review of ICOLL EMPs	Council to review its existing Estuary Entrance Management Plans, in accordance with relevant state government policies and guidelines regarding ICOLL entrance openings. Consultation with local stakeholders and Traditional knowledge holders is to occur as part of this process. The EMPs will need to consider impacts of entrance management on Coastal Wetland Areas	South Durras, Surfside, Joes Creek, Short Beach, Wimbie Beach, Kianga, Little Lake (Narooma), Nangudga Lake	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries, Shoalhaven City Council	Year 2 to 4	ICOLL EMPs updated, adopted and in use
CH9_B	Coastal Environment Area, Coastal Use Area Map, Coastal Vulnerability Area,	Erosion management to be undertaken on dunes at Knowlman Road, Rosedale	Erosion management of dune caused by stormwater runoff, access and possibly wave impacts at the end of Knowlman Road. This will likely include soft coastal protection works such as coir logs and revegetation. Erosion management to be undertaken to manage wave impacts, limit pedestrian access and support vegetation.	Rosedale Beach	Council	DPE-EHG	Year 1	Completed works
CH14_B	Coastal Environment Area, Coastal Use Area Map,	Educate Malua Bay SLSC on the erosion hazard risk at the site	Of the Surf Clubs and Surf Life Saving Clubs along the Eurobodalla Shire coastline, only the Surf Life Saving Club at Malua Bay was found to at risk of erosion. It is presently beyond the erosion hazard line under existing conditions, but is at risk in the 2100 event, as shown in the figure below. The SLSC will be informed of this finding. It is noted that the risk is not immediate, but advance warning of future risks will allow the club to plan for future management options including when renewal or upgrades are undertaken.	Malua Bay	Council	NA	Year 2 to 4	Malua Bay SLSC advised of future coastal hazard risk to enable suitable planning
Opportunity								
CHO_B	Coastal Zone	Undertake a community event to promote tourism opportunities, when funding opportunities arise	Council to hold a coast event/festival to promote tourism opportunities specifically linked to coastal values. This may integrate with existing festivals such as Narooma Oyster Festival, River of Art and Bay Paddle Challenge. Funding or co-funding the event could occur through competitive government grants as opportunities arise such as from Tourism NSW, NSW DPI- Fisheries or other grant programs.	All	Council	Tourism NSW, DPI Fisheries	Year 2 to 4	Event undertaken. Increased awareness of coastal management issues (could be evaluated through a pre and post event survey)

ID	Management Area	Management Action	Action Details	Location	Lead Agency	Partners	Timing	Performance Measures
Actions that address Recreational Activities Threats								
RA1_A	Coastal Environment Area, Coastal Use Area Map, Coastal Vulnerability Area,	Manage user conflicts at Bingie Dreaming Track and Shark Bay / Broulee Island track	The community reported conflicts between pedestrian and cycle users of and around the Bingie Dreaming Track. Council, NPWS and local Aboriginal Knowledge Holders to identify key issues and develop management approaches. This will consider the recommendations of the Draft Tuross and Coila Lakes Estuaries CMP (installation of bollards, formalisation of a carpark to limit vehicle access, and retaining the existing Bingie Dreaming Track as a walking track only).	Congo	Council	NPWS, Traditional Owners	Year 2 to 4	To be confirmed through engagement with Traditional Owners as part of action
RA2_B	Coastal Environment Area, Coastal Use Area Map, Coastal Vulnerability Area,	Undertake dune vegetation management and minimise unregulated pedestrian access	The dune vegetation at Rosedale Beach is being impacted by unregulated pedestrian access and in some cases illegal clearing of vegetation. An annual strategy will be undertaken to target these actions, replace vegetation, where possible, and install barriers and / or signage. The community identified that pedestrian access occurs across the dunes at numerous locations at Broulee. Access to be consolidated through clearly marked and structured access points, and barriers to close off those access locations no longer to be used. During public exhibition, concerns were raised in regard to unregulated access at Maloneys Beach. This action includes resources to address this issue.	Rosedale Beach, Broulee, Maloneys Beach	Council	DPE-EHG	Year 2 to 4 and ongoing	Increased cover of dune vegetation
RA2_E	Coastal Zone	Undertake shorebird management across Eurobodalla coastal zone	Target shorebird nesting sites for pest control. Monitoring and education programs to be undertaken to protect shorebirds. Continued implementation of Save Our Shorebirds Program.	All	Council / NPWS	DPE-EHG, DPI-LLS	Year 1 and ongoing	Reduction in pest species threatening shore birds nesting sites
RA2_F	Coastal Zone, potentially within Coastal Wetland Area	Support Coastcare/Landcare projects.	Provide direction, funding and support for community involvement in on ground works along the Council coast – through Coastcare/Landcare projects.	All including potentially within the coastal wetlands shown on Map RG-01-01 –Study Area	Council	NPWS	Year 1 and ongoing	Support of at least one Coastcare / Landcare project per year
RA2_G	Coastal Zone, potentially within Coastal Wetland Area	Management of weeds of National Significance in coastal reserves	Conduct follow up work on weeds of National Significance in coastal reserves. Undertake engagement of adjoining landholders to reduce weed impacts on reserves.	All including potentially within the coastal wetlands shown on Map RG-01-01 –Study Area	Council	NPWS	Year 1 and ongoing	Reduction of weeds in coastal reserves. Engagement with adjoining property owners undertaken.
RA3_J	Coastal Environment Area, Coastal Use Area Map,	Investigate improved access at McKenzies Beach	Illegal parking and crowding along the road edge at McKenzies Beach is a safety and environmental issue. An investigation to be undertaken to improve access. The investigation should seek to minimise future impacts on vegetation and could consider alternatives to just increasing parking, such as the implementation of a shuttle bus service.	McKenzies Beach	Council	DPE-EHG, TfNSW	Year 2 to 4 and ongoing	Completed works
RA3_O	Coastal Zone	Continue to promote existing coastal walks	Continue to promote existing coastal walks such as coastal walks in Murramarang National Park, Broulee Island, Bingie Dreaming, , Mangrove walk at Cullendulla Creek, Durras discovery and Banksia Walk at Burrewarra Point, Mill Bay Board walk at Narooma.	All	Council	DPE-EHG, NPWS	Year 1	Preparation of promotion materials (may be online or hard copies)
RA3_R	Coastal Environment Area, Coastal Use Area Map, Coastal Vulnerability Area,	Implement disability-friendly access improvements to 8 of Council's most frequently visited beaches, including permanent floating decking from carparks to beach access, and roll-out mobility matting to improve foreshore access.	Consultation has identified a community desire to see additional accessibility considerations given to beaches for disabilities, walkers and elderly visitors or parents with strollers. Eurobodalla Shire Council will begin works on improving access to a number of beaches through it's "Improving accessibility at Eurobodalla Shire patrolled beaches" project, funded through the 2021 Regional Tourism Activation Fund. This grant will allow Council to improve access to up to eight patrolled beaches and the calm-water shark-netted swimming area in Narooma. The project is set to begin implementation in late 2022.	Surf Beach, Malua Bay Beach, South Broulee (Bengello) Beach, Moruya South Head, Tuross Head Main Beach, Dalmeny Beach, Narooma South Bar, Narooma Surf Beach	Council		Year 1 to 4	Implementation of Improving accessibility at Eurobodalla Shire patrolled beaches project
RA6_A	Coastal Use Area Map, Coastal Vulnerability Area,	Engagement and management of impacts of bike track usage between Broulee Head and Moruya Heads	Engage with local Aboriginal Knowledge Holders to understand sensitive locations and impacts of high usage of bike tracks on area between Broulee Head and Moruya Heads. Implement appropriate management measures as a result of this engagement.	Bengello Beach	Council	DPE-EHG, NPWS, Traditional Owners, DPE-Crown Lands	Year 1 and ongoing	Identify key location and monitoring undertaken at these locations

ID	Management Area	Management Action	Action Details	Location	Lead Agency	Partners	Timing	Performance Measures
Actions that address Engagement and Governance Threats								
EGC2_A	Coastal Zone, Coastal Wetlands, Batemans Marine Park	Install coastal protection signage strategy to reduce illegal ICOLL openings	It is illegal to open an ICOLL without appropriate approval from State Government. High priority coastal protection signage strategy to be implemented: where illegal ICOLL openings are occurring, where shorebird habitat is being disturbed, erosion hotspots.	All	Council	DPE-EHG, DPI-Fisheries	Year 1 and ongoing	Signage installed
EGC2_B	Coastal Zone	Identify opportunities to promote, support and undertake citizen science and research initiatives with the coastal zone	Opportunities exist to promote, support and undertake citizen science and research opportunities within the Eurobodalla Open Coast coastal management areas covered by the CMP. Examples include promotion of Councils existing CoastSnap program; use of drones and citizen scientists to survey and analyse beach change and cliff erosion, provide citizen access to relevant data to support citizen science, support research endeavours such as university honours, doctorate and post doctorate investigations within the Eurobodalla coastal zone.	All	Council	DPE-EHG,	Year 1 and ongoing	Citizen science and research initiatives undertaken
EGC2_C	Coastal Use Area Map, Coastal Vulnerability Area	Preparation of community fact sheets to explain key issues in the CMP in a simple and readily understandable way.	During public exhibition some community members expressed concern that the size and complexity of the CMP was a barrier to understanding what the outcomes and benefits were. A suggestion to provide supporting information to simplify understanding of the issues identified in a CMP and how they are addressed. A "plain English" fact sheet that simplifies this information will be prepared by Council with support of Department of Planning and Environment.	All	Council	DPE-EHG,	Year 1	Fact sheet prepared and placed online
EGC3_B	Coastal Zone	Work with relevant State Agencies to strengthen shared and consistent management of coastal land	Ensure ongoing function of CEMAC, and ongoing representation of all Agencies listed as responsible or supporting CMP Actions	All	Council	DPE-EHG, DPE-Crown Lands, DPE-Planning, NPWS, DPI-LLS, NSW SES DPI-Fisheries	Year 1 and ongoing	CEMAC have met at least once per year
EGC3_D	Coastal Zone	Update PoM for reserve lands to address coastal risk	Use the CMP information to update plans of management for the reserved lands and highlight assets (natural or built) within the reserves that need changed management to mitigate coastal risks.	All	Council	NA	Year 1 and ongoing	POMs updated
EGC4_A	Coastal Zone, potentially within Coastal Wetland Area	Identify opportunities for and undertake cultural burning in the coastal zone	Identify opportunities for and undertake cultural burning in the coastal zone, particularly headlands to improve natural resilience to coastal threats. Work closely with local Aboriginal Community to develop implement appropriately.	All including potentially within the coastal wetlands shown on Map RG-01-01 – Study Area	Council	NPWS, DPE-EHG, DPE-Crown Lands, DPI-LLS, Traditional Owners	Year 1 and ongoing	One cultural burn undertaken every two years
EGC4_C	Coastal Zone	Support Aboriginal cultural tourism opportunities in the coastal zone to protect Aboriginal heritage	Provide support to Aboriginal individuals or groups seeking to implement business opportunities to increase local and tourist awareness of Aboriginal culture in the Eurobodalla coastal area to protect Aboriginal heritage	All	Council	Traditional Owners, DPE-EHG, NPWS, DPI-Fisheries	Year 1 and ongoing	$30k in grant funding awarded per year
EGC4_D	Coastal Zone	Embed traditional Aboriginal knowledge, wisdom and culture in strategic planning by providing knowledge consulting fees to knowledge holders involved in coastal management to protect Aboriginal heritage in the coastal zone	Protect Aboriginal heritage in the coastal zone by involving Knowledge Holders and Elders in coastal management activities. Suitable remuneration should be paid for their time.	All	Council	Traditional Owners, DPE-EHG, NPWS	Year 1 and ongoing	Method for reimbursing Traditional Owners established and on average $10,000 per year paid
EGC4_E	Coastal Zone, potentially within Coastal Wetland Area	Support local Aboriginal Communities manage cultural heritage from coastal hazards and sea level rise and other coastal threats	Work with Traditional Owners to protect special Aboriginal cultural values and sites from the impacts of foreshore and riparian development, erosion, climate change, four wheel driving, domestic dogs and pedestrians. Education, infrastructure, rules and spatial management can protect important sites from specific threats where and when needed. Costs include remuneration of Traditional Owners ($20k/year) and costs of works from year 2 ($50k/year).	All - coastal zone including potentially in coastal wetlands as shown within Map RG-01-01 – Study Area	Council	Traditional Owners, DPE-EHG, DPI-Fisheries, DPE-Crown Lands, NPWS	Year 1 and ongoing	To be confirmed through engagement with Traditional Owners as part of action

ID	Management Area	Management Action	Action Details	Location	Lead Agency	Partners	Timing	Performance Measures
EGC4_F	Coastal Zone	Improve access to Country in the coastal zone through the establishment of an Access to Country Plan	Council and state agencies to work with Traditional Land Owners to establish an Access to Country Plan or Agreement, which would identify key locations on Country where access need to be retained or established. Implementation of this plan may require minor on ground works, which have been allowed for in the option costing. Environmental assessment of impacts of works or access to be undertaken. Safety to the environment and users would also need to be considered.	All	Council	Traditional Owners, NPWS, DPE-EHG, State Forest, Crown Lands	Year 2 to 4 and ongoing	Access to Country agreement es established
EGC4_G	Coastal Zone	Identify and use Aboriginal place names in the coastal zone	Work with Traditional Owners to identify traditional Aboriginal names for key locations in the coastal area and include local Aboriginal language in coastal education material and signage.	All	Council	Traditional Owners, NPWS, DPE-EHG, DPE-Planning, DPI-Fisheries, NSW Geographic names board	Year 2 to 4	Inclusion of Aboriginal place names used in Council materials and communications
EGC4_H	Coastal Environment Area, Coastal Use Area Map,	Review, update and implement PoM for Aboriginal Place at Barlings Beach	Engagement with Mogo LALC identified that the PoM is not being implemented as it is intended to protect coastal vegetation and Aboriginal heritage, and the land is not being managed properly.	Barlings Beach	Council	Traditional Owners, DPE-EHG, DPE-Crown Lands	Year 1 and ongoing	PoM updated and in use
EGC4_I	Coastal Zone	Prepare an Aboriginal Seasonal Calendar	Collaborate with the Local Aboriginal Community to prepare an Aboriginal Seasonal Calendar to showcase traditional land management, food & medicine practices and deeper understanding of the land & climate.	All	Council	Traditional Owners	1	Seasonal Calendar Produced
EGC4_J	Coastal Environment Area, Coastal Use Area Map, potentially within Coastal Wetland Area	Manage access issues and erosion at targeted sites of significant value to the Aboriginal Community as identified by the LALC's	Traditional owners are not satisfied with the current management of highly significant cultural sites. This option would improve management of these sites in consultation with Traditional Owners to protect Aboriginal Heritage. Conversation and consultation with Traditional Owners about preferred approaches to managing issues associated with access and erosion at these locations . Management actions may involve implementing coastal protection works, rationalising beach access and enhancing dune vegetation to assist with the management of cultural values.	Tilba Beach, Nangudga, Broulee including potentially within the coastal wetlands at these locations shown in Map RG-01-01 – Study Area	Council	Traditional Owners, NPWS DPE-EHG, Crown Lands	1	Improved management measures in place

3.2.3 Actions recommended for public authorities

Public authorities have been identified for the majority of options to support Eurobodalla Shire Council to implement the action, predominately through the provision of technical or project management support. However, there are also several actions for which a public authority has been identified at the lead agency.

There are 8 actions identified for implementation by public authorities, including:

- 5 actions that address coastal hazard threats
- 3 actions that address engagement and governance threats.

These actions are presented in **Table 3-9**. Additional details for each option can be found in **Appendix D**, with detailed descriptions provided for complex and high cost options in **Section3.2.4**.

Table 3-9 Actions to be implemented by public authorities

ID	Management Area	Management Action	Action Details	Location	Lead Agency	Partners	Timing	Performance Measures
CH1_L	Coastal Environment Area, Coastal Use Area Map, Batemans Marine Park	Subject to environmental planning approvals, undertake nourishment at Northern Batemans Bay beaches when dredging is undertaken in Batemans Bay / Clyde River as required for navigational purposes	Protection of the existing Northern Batemans Bay shorelines by increasing the sub-areal beach volume through beach nourishment. Maintenance dredging of navigable areas of Batemans Bay produces a volume dredged material that will be used for beach nourishment on adjacent shoreline areas.	Surfside /Surfside west/ Wharf Road/Long Beach	TfNSW-MIDO	Council, DPE-EHG, DPE-Crown Lands, DPI- Fisheries	Once every 4 years	Observable contribution towards beach sand presence as a result of sand nourishment, subject to environmental planning approvals and suitability of dredged material.
CH1_M	Coastal Environment Area, Coastal Use Area Map,	Purchase private properties at Wharf Road to assure current and future generations have public access to the foreshore and beaches	NSW Government to purchase private property at Wharf Road and return the areas of beach and the beach access to public ownership. Further details provided in **Section3.2.4**.	Wharf Road	DPE-Planning	Council	Year 1 to 3	Private property purchases complete and site remediation complete
CH4_S	Coastal Environment Area,	Emergency Response Plan	In partnership with NSW SES, prepare an Emergency Response Plan to address flood risk to Big4 Batemans Bay Beach Resort from coastal storm inundation.	Big4 Batemans Bay Beach Resort, Beachcomber Holiday Park	NSW SES	Council, DPE-EHG	Year 1 and ongoing	ERP prepared and in use
CH8_C	Coastal Environment Area, Coastal Vulnerability Area, Coastal Wetlands, Batemans Marine Park	ICOLL Entrance Management Policy – engagement and finalisation	Draft Estuary Management Plans to be put through consultation with relevant agencies and community before finalisation and adoption by NPWS.	Congo, Potato Point, Lake Brou, Corunna Lake	NPWS	DPE-EHG, Council, DPE-Crown Lands DPI-Fisheries	Year 1	ICOLL EMP engagement complete and EMP adopted and in use
CHALL_A	Coastal Zone	NPWS Coastal Hazard Assessment	NPWS to undertake targeted coastal risk assessments to better understand coastal risks identified in the CMP Scoping Study first pass risk assessment	National Parks	NPWS	Council	Year 5 to 10	Coastal hazard assessment complete
EGC3_E	Coastal Zone	Incorporate coastal hazard risks into PoM as part of scheduled updates	As part of updating plans of management for coastal national parks, include a review of current arrangements for access, interactions between national parks and adjoining lands for recreation and tourism (include maintenance of access infrastructure), weed species; address or foreshadow, when necessary, any coastal hazard risks.	National Parks	NPWS	Council, DPE-EHG	Year 1 and ongoing	POMs updated
EGC3_F	Coastal Zone	Undertaken maintenance of State Agency owned coastal assets to engineering and safety standards	Several state agency owned assets require condition assessment and appropriate maintenance as an outcome of exposure to the coastal environment. Management will be undertaken by state agencies to ensure these assets meet appropriate engineering and safety standards. As part of this process, asset ownership will be investigated and confirmed.	All	MIDO	DPE-Crown Lands	Year 1 and ongoing	Assets achieve appropriate engineering and safety standards
EGC4_B	Coastal Zone	Support DPI Fisheries with the implementation of MEMS initiative 4	Support DPI Fisheries with the implementation of Objective 4) To Partner with Aboriginal people for the protection of Aboriginal cultural values and improved marine park management of the NSW Mainland Marine Park Network Management Plan 2022 – 2033	All	DPI-Fisheries	Traditional Owners, Council, DPE-EHG, NPWS	Year 1 and ongoing	Cultural resource use agreements prepared

3.2.4 Further Details on Complex Recommended Actions

A number of actions listed in **Sections 3.2.2 and 3.2.3** refer to additional details provided on the following pages. The action included in this section are summarised in **Table 3-10**.

Table 3-10 Complex actions where further details are provided

CMP Action ID	Description of CMP Action
CH1_B	Undertake investigation and design for Northcove Road erosion protection and flood proofing
CH1_D	Long Beach Coastal Erosion Protection Works
CH1_K	Wharf Road Protection Stage 1 (CH1_Ka): Priority works at exposed corner of Wharf Road to be undertaken, remediation of beach and reinstatement of public access Wharf Road Protection Stage 2 (CH1_Kb): Inundation protection to be undertaken Wharf Road Protection Stage 3 (CH1_Kc): Wharf Road Raising
CH1_L	Undertake nourishment at northern Batemans Bay beaches when dredging is undertaken in Batemans Bay / Clyde River as required for navigational purposes
CH1_M	Purchase private properties at Wharf Road to assure current and future generations have public access to the foreshore and beaches.
CH1_P	Upgrade existing coastal protection works at Caseys Beach
CH4_D	Investigate, design and construct a coastal inundation levee to protect Surfside against storm surge inundation
CH4_K	Investigate, design, and construct seawall raising and wave return barriers in Batemans Bay
CH4_M	Undertake an adaptation plan for low lying areas to be impacted by tidal inundation under sea level rise

CH1_B	**Northcove Road Upgrade**

Location(s): Maloneys Beach

Description

The Stage 2 Coastal Hazards Assessment determined that Northcove Road was at risk of coastal erosion impacting the road at both the 2017 and 2100 100-year ARI extents. While not identified as being within the direct erosion zone currently, the road runs through the zone of reduce foundation capacity and is therefore at risk of being structurally undermined following a large storm event.

Northcove Road and bridge at the western end of Maloneys Beach can also be inundated at both the 20-year and 100-year ARI, with the potential to cause access issues during severe coastal events. This is due to both coastal inundation, and coincident catchment flooding landwards of Northcove Road, and also wave run-up and overtopping of the roadway.

Consultation with the Maloney's community during the public exhibition of the Batemans Bay Urban Creeks Flood Study (Rhelm 2020) also saw this issue raised, with community suggesting the road needed to be upgraded, or an alternate route be provided.

Wave overtopping also has the potential to impact a significant length of the road, causing access issues during a coastal storm and potential damage to the road surface, requiring maintenance following a storm event.

To address these risks, road raising of a 100m-120m section of Northcove Road along with a vertical retaining structure with a wave return barrier at its crest has been conceptually designed as part of the CMP preparation to protect the public road from erosion and wave damages and to maintain continuous access to Maloneys Beach during severe coastal storms.

The investigations and design for these works will be undertaken as part of the CMP. The construction of the works is not required within the next 10 years, and as such should be considered as part of a future CMP.

Costs

Investigation and design cost of $200,000.

Timing

The investigation and design will be undertaken in years 2 to 4 of the 10 year CMP Business Plan.

Construction is not included in the current CMP 10 year Business Plan. Construction should be considered as part of any future CMP.

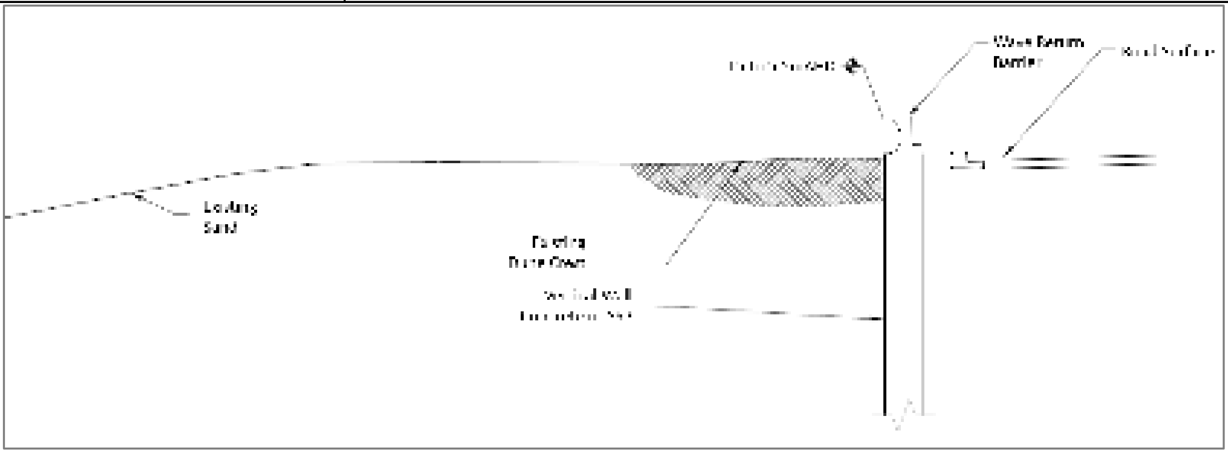
Design

The conceptual design of the retaining structure has prioritised the following:

- Ensuring a small footprint so as to minimise the disturbance to the existing beach and dune areas
- Placing the structure outside of the area of direct coastal erosion to remove any influence of the structure on the nature and extent of coastal erosion.

A typical section for the retaining structure is presented on the image below, which includes construction of a vertical wall on the seaward edge of the road alignment. The wall could comprise of reinforced concrete panels or driven sheet pile and would require approximately 5m embedment below the desired crest level, which could be reduced if ground anchoring was adopted. Based on current estimates the retaining wall would not be directly exposed to coastal hazards and hence scour protection is not required. The structure crest would be at a level consistent with the existing road surface (+5 to +5.5mAHD at eastern end) and would comprise a wave return barrier of varying height.

CH1_B	Northcove Road Upgrade



Typical section of a retaining structure with a wave return barrier at the crest

The concept design assessed as part of the CMP comprises a sheet pile retaining wall of 5m embedment with a concrete wave return barrier of 1.2m height (just East of bridge) reducing in height to the east along the alignment of the wall. The image below provides an indication of the structure form (sheet pile with concrete capping beam), noting that following construction it would be buried within the dune and not be at risk of exposure due to coastal erosion from 100year ARI event both now and at 2100.

Road raising could be incorporated into the design to also mitigate inundation associated with catchment flooding, and if undertaken would reduce the required height of the wave return barrier. This design would need to be optimised in consultation with the floodplain risk management program and may include upgrading of the culverts under the bridge.

No detailed design of the retaining structure has been completed, however an assessment of wave runup and overtopping was performed using methods outlined in Eurotop (2018) to test the feasibility of the conceptual design and to ensure adequate protection of the roadway against overtopping, both under present day and future sea level rise scenarios. The following table summarises the results, noting an average overtopping rate of less than 25 L/s/m is targeted to reduce the risk to cars transiting near the crest (Eurotop, 2018).

Mean Overtopping Rates (q) for the 100year ARI coastal storm under sea level rise scenarios just east of the Northcove Road Bridge (road level of 2.8mAHD)

	Present	2050	2065	2100
q (L/s/m)	70	150	200	540

The required crest level of the wave return wall to reduce mean wave overtopping to an acceptable rate (i.e. 25 L/s/m) is presented in the table below.

CH1_B	Northcove Road Upgrade

Required Wave Return wall height (m above road level) to reduce risk to cars for the 100year ARI coastal storm under sea level rise scenarios

	Present	2050	2065	2100
Just East of Bridge (Northcove Road)	1m	1.2m	1.3m	1.7m
Maloneys Drive	0m	0.2m	0.3m	0.7m

Benefits

- The retaining structure would provide structural support to road following severe storm erosion of Maloneys Beach and enable continued access to Maloneys Beach.
- If the crest level of the retaining structure is of sufficient height, coastal inundation and overtopping will be reduced to a tolerable level for the safe access of cars and will minimise road surface failures due to coastal processes.
- Road raising of Northcove Road would be required to manage the impact of catchment flooding on the road. This should be considered as part of the floodplain risk management process to attract appropriate funding mechanisms.

CH1_D	Long Beach Coastal Erosion Protection Works

Location: Long Beach

Description

Phase 1: Then investigation and design of coastal erosion protection (hard terminal) works, which may include seawall, revetment or geotextile containers, for the *Investigation Area* shown on the map below. Investigation and design of works for the *High Priority Works Area* will be prioritised to enable expediated delivery of Phase 2 as part of the CMP.

The intention of the investigation and design is to develop with community and government agencies a holistic design for works that can be undertaken in a staged approach. With immediate works to protect the eastern end of Bay Road from severe coastal storm events under existing sea levels.

Phase 2: Construct ≈ 200m of coastal protection works at the high priority area identified in red below resulting from Phase 1 investigation and design. This will be a hard terminal structure which may be a seawall, revetment, geotextile containers or a combination. The intention of this phase is to preserve the foundation of Bay Road under severe coastal storm events targeting the location of immediate risk. Beach nourishment to ensure amenity and beach use will also likely be required pending outcomes of Phase 1 investigation and design.

CH1_D Long Beach Investigation and High Priority Works Areas

Costs

- CH1_D Phase 1: Investigation and design including environmental assessment and community engagement for coastal erosion structure: $200,000
- CH1_D Phase 2: Construction of ≈ 200m coastal protection works and beach nourishment: $2,500,000
- CH1_D Phase 3: Maintenance and nourishment of beach: 1% of capital costs for structure maintenance plus $10,000 per year for nourishment, over life of structure.

Timing

Phase 1 Investigation and design to occur in 2023, with Phase 2 construction estimated to occur in 2024 (upon completion of the investigation and design). Phase 3 will be ongoing following completion of Phase 2.

Coastal Threats Addressed

Deterministic calculation of coastal erosion extents based on storm demand identified that the eastern sections of Bay Road was at risk of erosion as a result of a 100year ARI storm event under present day sea

CH1_D	Long Beach Coastal Erosion Protection Works

levels. Under future projected sea level rise, the full length of Bay Road adjacent to the Long Beach foreshore is at risk of erosion.

Design

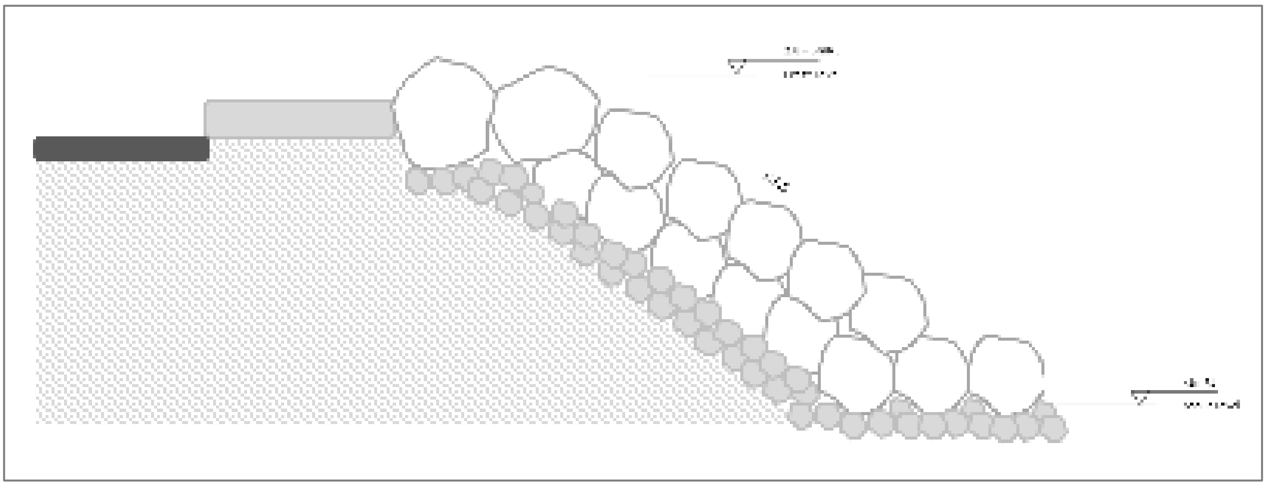
Phase 1 will involve detailed investigation and design in consultation with community and government agencies to develop a coastal protection design that provides a suitable level of protection to Bay Road while maintaining beach amenity.

Engagement with the local community during the preparation of the CMP, identified the following key issues for consideration as part of the design process:

- Minimising the crest level to not disturb the visual amenity and beach access
- Vegetation selection to consider access, amenity and bushfire risk, with a preference for low lying dune stabilisers (e.g. native grasses) to maintain dune cover of revetment
- Retaining the existing rock revetment as part of the short term, priority works
- Minimising the footprint of the coastal protection structure so as to minimise disturbance to the existing beach and dune areas
- A footpath is not necessarily preferred by the community along the stretch of works, and the absence of this design feature would allow for the structure to be place further back from the high tide mark, allowing better beach recovery between events
- Short term protection works such as geotextile containers may be more suitable for the protection of the Norfolk Pines, as they are nearing the end of life. More permanent long term coastal works could be constructed adjacent to Bay Road once the pines are no longer healthy.

A low crested revetment has been conceptually designed for the high priority works area as one approach that could be taken to protect the public road from being impacted by coastal erosion. The purpose of this design is to inform concept cost estimates in the CMP Business Plan and should not be considered the preferred design outcome.

A typical section for a revetment design is provided below and would remain buried below the dune system under normal beach conditions. The structure crest would be at a level consistent with the existing road surface (+2.8 to +3.2mAHD).



A typical cross section for low crested rock revetment at Long Beach

CH1_D	Long Beach Coastal Erosion Protection Works
Additional benefits of coastal protection works would be a reduction in future still water inundation as a result of elevated coastal water levels. A crest level of +2.9mAHD provides protection for the 100year ARI still water level under sea level rise out to 2100. Wave runup and overtopping of the coastal protection structure would occur at the proposed heights, as is currently expected in a 100 Year ARI event, across the dune crest, road and into properties. Under future sea level rise conditions, this wave run-up and overtopping may be significant with potential damage to the road surface likely. Estimates of wave overtopping under present day sea levels, indicate mean overtopping rates remain only marginally above tolerable limits for cars directly behind the crest in the 100 year design storm (Eurotop, 2018). While wave overtopping hazard would remain, the nature of the road, its limited use and the short duration of the overtopping hazard (at the peak of the tide), the risk does not warrant large scale coastal protection works to reduce the overtopping risk within the 10 year delivery of this CMP, particularly when impacts to user amenity and community feedback is considered.	
Benefits • Preserves Bay Road and associated services from critical erosion damage and maintains access to the eastern end of Long Beach and for up to 14 foreshore properties. • Management of coastal inundation of Bay Road. • Provides opportunity to establish formal and controlled access to the beach across the dunes. • Extends benefits of existing buried structure.	

CH1_Ka, CH1_Kb and CH1_Kc	Wharf Road Erosion and Inundation Protection Stages 1, 2 and 3

Location(s): Wharf Road, North Batemans Bay

Description

Stage 1 Works (CH1_Ka)

The corner of Wharf Road at North Batemans Bay was identified as being at extreme risk of coastal erosion and asset failure under existing conditions due its proximity to the existing shoreline. Conceptual design of a seawall has been developed to address this risk, with the following objectives:

- Provide structural protection to Wharf Road against existing and future coastal erosion risk
- Limit the rate of wave overtopping to the roadway to maximise the duration of safe access along Wharf Road during elevated coastal storm conditions
- Tie in with existing coastal protection to the west, at the Easts Riverside Holiday Park
- Provide formal public access and connection from the Holiday Park to the beach and public open space to the east.

Stage 1 works also involve remediation of the adjacent land being returned to public open space as part of private property acquisition (CH1_M).

Stage 2 Works

The low-lying areas of North Batemans Bay along Wharf Road have been identified as being at risk of coastal inundation under a present day 100yrARI coastal water level, with inundation depth exceeding 1m in some area. Conceptual design of flood barriers along the foreshore and Wharf Road to address this inundation issue involve:

- Raising of the existing seawall that fronts the Holiday Park (≈ 440m in length).
- Construct a flood wall along the seaward alignment of Wharf Road east of the Wharf Road corner, consisting of a Steel Sheet Pile wall with capping (≈ 250m in length).

Stage 3 Works

Opportunistic raising of Wharf Road to be undertaken as routine road upgrade works are undertaken or funding becomes available to maintain access during inundation events. Road raising to provide resilience against future coastal inundation.

Costs

The proposed design and cost estimates for Stages 1 and 2 are for the coastal hazard protection purpose of the seawall only. Additional public benefits should be considered and incorporated at the detailed design stage, such as viewing platforms, beach access ramps and stairs, footpath incorporated into the crest of the structure and other amenity details or educational features.

Stage 1: Coastal Protection works, remediation and reinstatement of beach for public use

- Phase 1: Site remediation assessment and I&D for coastal protection structure: $200,000
- Phase 2: Construction of coastal protection works and beach rehabilitation: $2,200,000
- Phase 3: Maintenance and enhancement of beach and coastal vegetation: $60,0000 over 6 years ($10K per annum)
- Seawall Maintenance Costs: 1% of capital costs annually over life of structure

Stage 2: Precinct inundation protection

- Seawall Capital Cost: $3,800,000
- Flood Wall Capital Cost: $2,100,000

CH1_Ka, CH1_Kb and CH1_Kc	Wharf Road Erosion and Inundation Protection Stages 1, 2 and 3

- Seawall Maintenance Costs: 1% of capital costs annually over life of seawall.
  Negligible maintenance costs for flood wall.

Stage 3 (road raising and drainage improvement)

- $500,000

Timing

The Stage 1 works should be implemented as a high priority item to protect against an existing coastal erosion risk, with design and construction to commence in 'Year 1' of the CMP. The seawall, in its initial form, would have a limited lifespan (~20years) and form a foundation for further management works to address coastal inundation across the wider Wharf Road area.

Timing of these works, and associated works is outlined below.

2023
- Property acquisition (CH1_M)
- Stage 1 Wharf Road works (CH1_Ka) commenced

2024-2026
- Property acquisition (CH1_M) to continue
- Stage 2 Wharf Road works (CH1_Kb)

2027 Onwards
- Wharf Road incremental raising (CH1_Kc)

Design

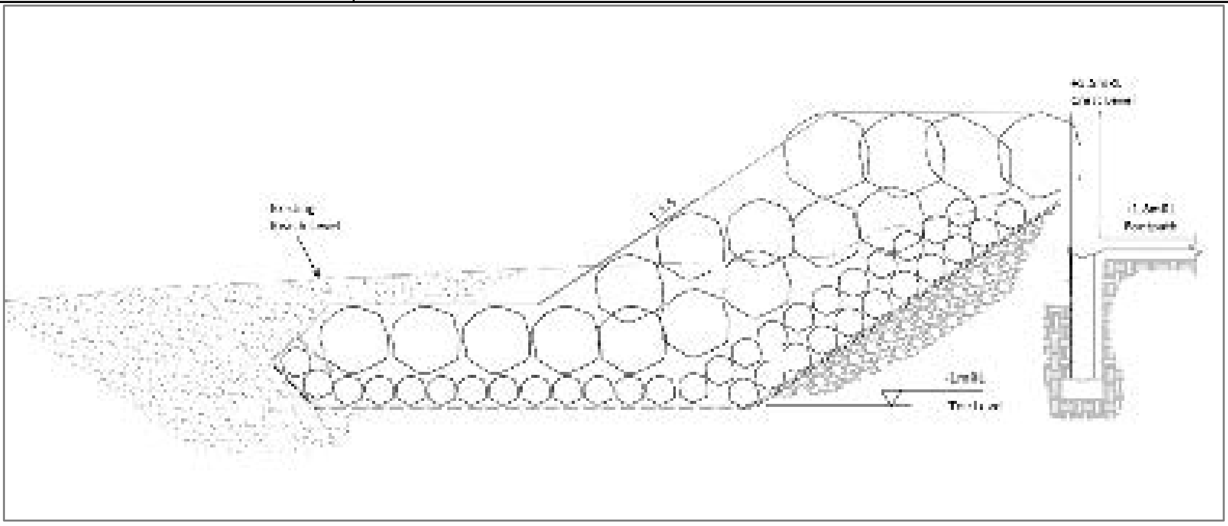
Stage 1

A typical section for the seawall design concept is presented below and includes construction of a 3.0m wide crest at +3.5mAHD and 1 in 1.5 seawall slope that extends down to a toe level of -1mAHD. Behind the crest of the seawall a concrete cut-off wall would reduce the permeability of structure (thereby providing a barrier to still water inundation). A footpath could also be integrated into the structure at detailed design. This footpath could occur at the crest of the structure to facilitate views or at the base of the structure cut-off wall in keeping with the existing road level as depicted in the image below.

A crest level of +3.5mAHD is established to reduce the rate of overtopping of the structure under severe coastal storm conditions. To meet a tolerable overtopping threshold of <50 L/s/m, a threshold for the safety of vehicles behind the crest (i.e. on Wharf Road), a crest elevation of +3.5mAHD with a crest width of 3m is required (based on wave overtopping calculations for rubble mound structures in Eurotop, 2018 under the 2100 scenario). Armour stone sizing of 3-4t is required to ensure stability under design wave conditions (using the empirical stability methods of van der Meer, 1988).

Both the existing ad hoc protection and from the unapproved structure to the east would be removed and armour stones could be reused as material for the new structure.

CH1_Ka, CH1_Kb and CH1_Kc	Wharf Road Erosion and Inundation Protection Stages 1, 2 and 3



Typical Cross Section of Seawall Concept at Wharf Road Corner.

The alignment of the structure would run between the existing seawall that protects Holiday Park to the west and along approximately 85m of Wharf Road (100m in total length), as shown on the adjacent image. Given the alignment of the seawall, the structure would block the natural drainage of the landside area and existing ocean outfall. As such drainage would need to be incorporated into the seawall design and may take the form of a pipe outlet through the structure with non-return value to inhibit the ingress of coastal waters during elevated sea level conditions (noting its limited functionality under rising sea levels).

Stage 2

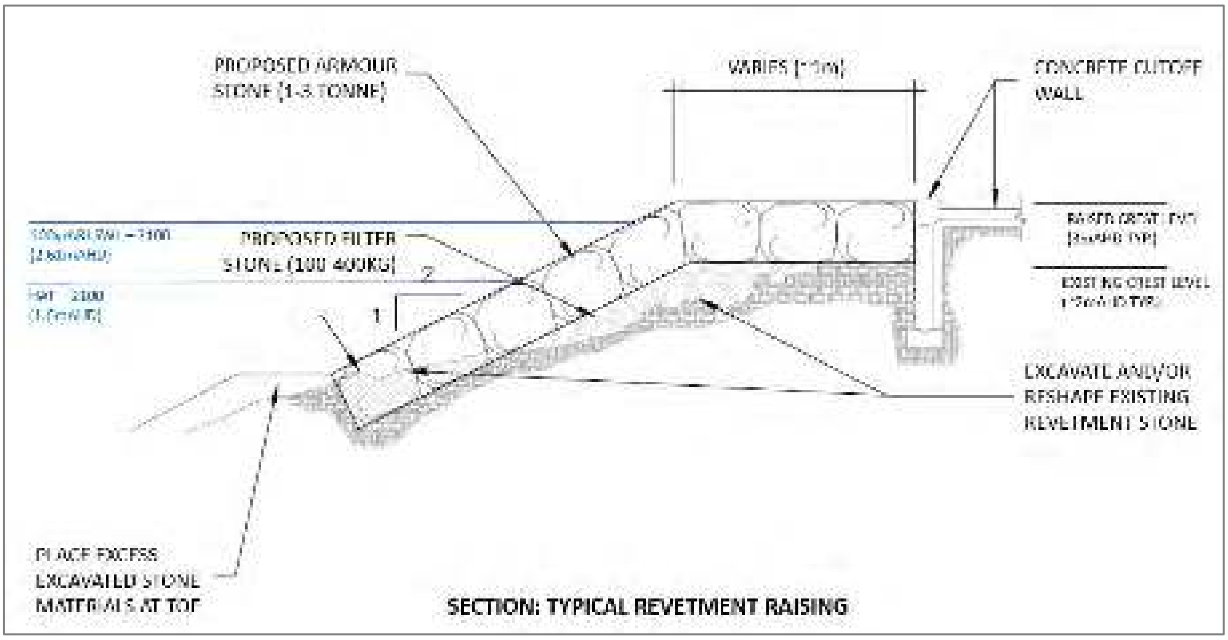
The alignment and extent of structures is presented below. The flood protection would be constructed to a level that will prevent coastal still water inundation up to the year 2100 (for 100-year ARI immunity – crest level ~3mAHD + freeboard) and will tie into the Stage 1 protection works (Option CH1_Ka). Wave overtopping of the holiday park would be reduced by the seawall raising, however would not be a targeted outcome of the works as focus is coastal inundation protection to the precinct.

A concept seawall raising option has been designed that would leverage of the existing seawall as a foundation but increase the crest level to +3.0mAHD, above the 100-year ARI Storm Tide level in 2100 + freeboard. A typical section for the seawall raising design is presented below and includes construction of a 1m wide crest and 1 in 2 seawall slope that is placed on top of the existing seawall armour layer (also 1 in 2 slope). At the back of the crest of the raised seawall a concrete cut-off wall would reduce the permeability of structure and neatly tie the seawall into the land behind.

CH1_Ka, CH1_Kb and CH1_Kc	Wharf Road Erosion and Inundation Protection Stages 1, 2 and 3

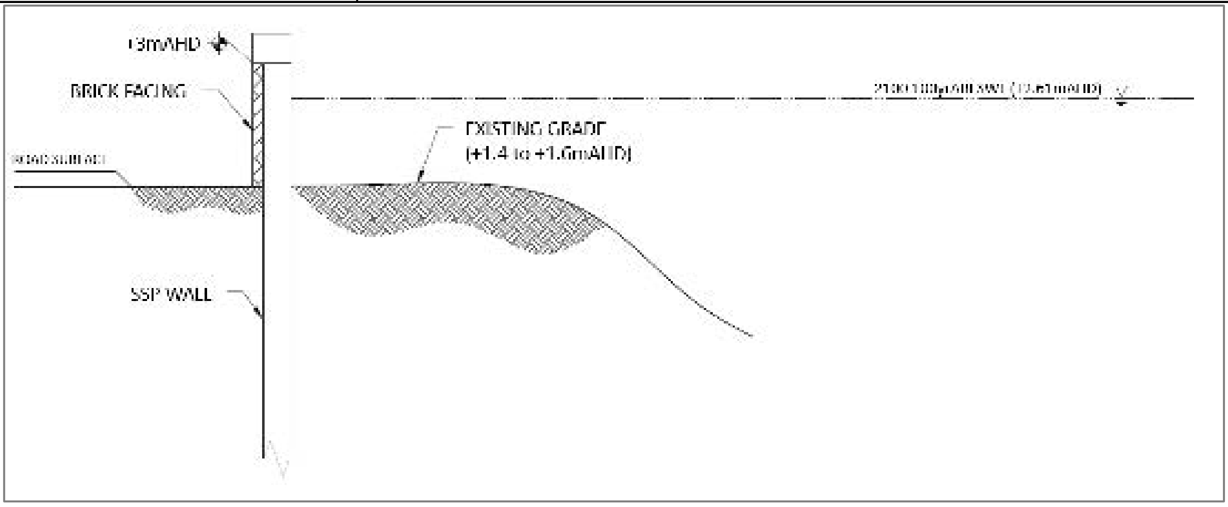
Alignment and extent of Stage 2 Inundation Protection of Wharf Road (Red: Raising of Seawall, Blue: Vertical SSP)

A typical section for the flood wall along Wharf Road is presented below which includes installation of a vertical Steel Sheet Pile (SSP) structure on the seaward edge of the road alignment. The SSP panels could be concealed with capping and facia and would also provide structural support for future road raising works.



Typical cross section for raising of the Seawall fronting the Easts Riverside Holiday Park

CH1_Ka, CH1_Kb and CH1_Kc	Wharf Road Erosion and Inundation Protection Stages 1, 2 and 3



Typical cross section for SSP Wall along Wharf Road

Benefits

- Stage 1: The structure will provide protection to Wharf Road and maintain the road as a vital access way for the area. Provides the opportunity to establish formal connection between the existing developments and open space to the east. Note: it is assumed voluntary acquisition of the properties to the east of Wharf Road is completed and the area is returned to public open space (for more information see Action CH1_M).
- Stage 2: The structure will provide protection from coastal inundation to the North Batemans Bay area and maintain Wharf Road as a vital access way for the area during an ocean storm event.
- Stage 3: Resilience against future coastal inundation.

CH1_L	**Undertake nourishment at northern Batemans Bay beaches when dredging is undertaken in Batemans Bay / Clyde River as required for navigational purposes**

Location(s): Surfside Beach, Surfside Beach West (Dog Beach / Mcleods Beach), North Batemans Bay Beach (Wharf Road), Long Beach

Description

Dredging of Batemans Bay and Clyde River has occurred on an infrequent basis since at least the early 1900s, with dredge spoil deposited at Corrigans Beach and Surfside throughout the century. Recent dredging and nourishment campaigns have occurred in 2013, 2016 and 2020. The 2020 campaign deposited sand offshore Surfside Beach, consisting of 10,000 m^3 of Clyde River sand. In 1996 12,000 m^3 of sand from navigational dredging was deposited on the northern end of Surfside Beach. This management action would redirect all dredged material to the Northern shorelines of Batemans Bay to increase the sub-areal beach volume of Surfside Beach, Surfside Beach West (Dog Beach), North Batemans Bay Beach (Wharf Road) and Long Beach.

Beach nourishment is opportunistic and would occur as and when dredge sediment from Batemans Bay /Clyde River becomes available.

Nourishment and dredging activities are subject to approvals issued by the State Government and suitability of the dredged material.

Costs

A capital cost of $250,000 per nourishment campaign, with no ongoing maintenance cost.

Timing

Beach nourishment is opportunistic and would occur as and when dredge sediment from Batemans Bay and Clyde River becomes available.

Based on previous dredge campaigns, it is estimated that it will be repeated every 5-10 years (on average).

Design

Surfside Beach Nourishment

The 100 Year ARI storm demand at Surfside Beach is approximately 55m^3/m of beach length. Therefore, the volume of sand required to replace erosion after a 100 Year ARI event for the full 800m length of beach is approximately 50,000m^3.

However, if nourishment were to occur in response to navigation dredging within the Clyde River channel, it is estimated that placement of approximately 10,000m^3 of sand at the northern end of Surfside Beach (as shown on the image below), would result in approximately a 10m gain in beach width.

It should be noted placement of dredge material directly on the beach or marginally offshore (within 100m of shoreline as per image below) is required to ensure nourishment of the beach is achieved. It has been shown offshore placement may not result in movement of sand to the beach shoreline particularly if it coincides with Clyde River flood flows.

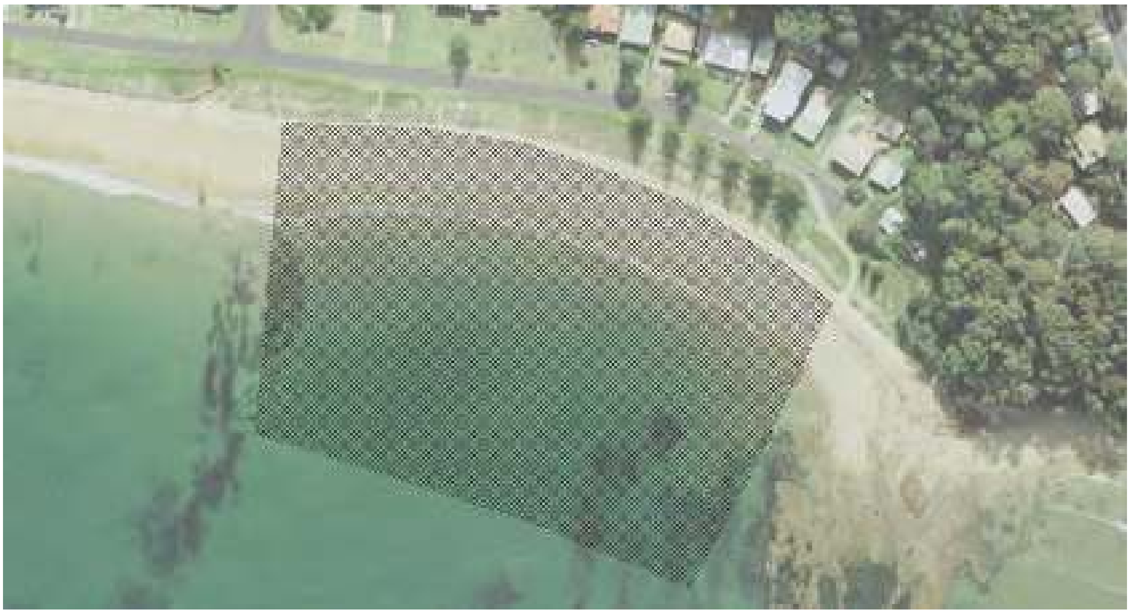
CH1_L	**Undertake nourishment at northern Batemans Bay beaches when dredging is undertaken in Batemans Bay / Clyde River as required for navigational purposes**

Long Beach

The 100 Year ARI storm demand at Long Beach is approximately 90m³/m of beach length. Therefore, the volume of sand required to replace erosion after a 100 Year ARI event for the full 1,000m length of beach is approximately 90,000m³.

However, if nourishment were to occur in response to navigation dredging within the Clyde River channel, it is estimated that placement of approximately 15,000m³ of sand at the eastern end of Long Beach (as shown on the image below), would result in approximately a 15m gain in beach width.

It should be noted placement of dredge material directly on the beach or marginally offshore (within 100m of shoreline) is required to ensure nourishment of the beach is achieved (as per figure below).



CH1_L	**Undertake nourishment at northern Batemans Bay beaches when dredging is undertaken in Batemans Bay / Clyde River as required for navigational purposes**

Surfside Beach West (Dog Beach / Mcleods Beach)

Placement of 5,000m^3 of sand in response to navigation dredging within the Clyde River channel, would result in a 15m gain in beach width.

It should be noted placement of dredge material directly on the beach or marginally offshore (within 50m of shoreline) is required to ensure nourishment of the beach is achieved (as per figure below). Placement heights if directly on the beach should be graded to ensure the dredge material is at least ½ meter lower than the foredune crest height to minimise sand loss by wind, over the foredune into property and onto the road.

Dune Nourishment

If beach width is greater than 30 m at all Northern Batemans Bay beaches when navigation dredging of the Clyde River channel occurs, targeted nourishment of the dune system at Surfside Beach or Surfside Beach West (Dog Beach / Mcleods Beach)) will be undertaken to achieve an elevated dune crest level to protect against coastal inundation under future climate change scenarios.

Benefits

- Avoided loss of access.
- Avoided loss of amenity.
- Reduction in erosion risk to foreshore assets
- Reduced need for emergency erosion protection works (as outlined in the CZEAS)

CH1_M	Property acquisition and restore land to safe public use area
Location(s): Wharf Road, North Batemans Bay	

Description

Public ownership of beaches has long been a foundation of the coastal management approach in NSW.

Restoring public ownership of the beach at Wharf Road was a priority issue for the Wharf Road CZMP. This would return the areas of beach and the beach access to public ownership. The location of private lots for acquisition is shown in the image below in pink.

Restoring public access to the beach is high priority and an appropriate means to also address the coastal risk affecting Wharf Road.

DPE-Planning will require the land to be free of debris and in an uncontaminated state as part of any condition of purchase. It is noted that given the residual risk of unknown quantities of buried material being unearthed, it is likely that, even if cleaned up by the current owner(s), the sites may still require some remediation to make the land suitable for open space.

Access to the existing and future public reserve should be improved to a safe standard. As part of the site remediation, the illegal foreshore structures should be removed. The use of the rock contained within this structure should be considered for use in the Wharf Road Stage 1 Protection Works (CH1_Ka).

Additional site improvements and opportunities can be explored (such as revegetation, biobanking and a recreational use plan), however, they would be additional to the core aspects of this action included in the CMP and completed under CH1_Ka.

Properties identified for acquisition

Costs

Property acquisition through the Coastal Lands Protection Scheme amounts to an estimated $4,000,000

Timing

Voluntary acquisition of private lots should occur in 2023 – 2026 subject to private landowner decisions.

Remediation of public land should commence immediately, with remediation of future public land to occur following completion of property acquisition process and site contamination and remediation plan.

CH1_M	Property acquisition and restore land to safe public use area
Benefits This option derives benefits from anticipated creation of nearly 11,575m^2 of public beach and vegetated open space from the purchase of 42 lots from private owners. This will allow for greater access to the beach for the public increasing its use values. Additional non-quantifiable benefits could include improved habitat and connection to Country opportunities.	

CH1_P	Casey Beach Seawall

Location(s): Caseys Beach

Description

The existing coastal protection works at Caseys Beach will be replaced to protect Beach Road and reduce the likelihood of damage and access impacts from wave overtopping during storm events.

There currently exists a proposed seawall design for Caseys that has been developed and approved by Council. Modification of the existing design would be required to ensure the proposed seawall design meets overtopping estimates under future sea level rise scenarios.

Costs

Capital Cost: $7,900,000. Maintenance Costs: 1% of capital costs over life of structure

Timing

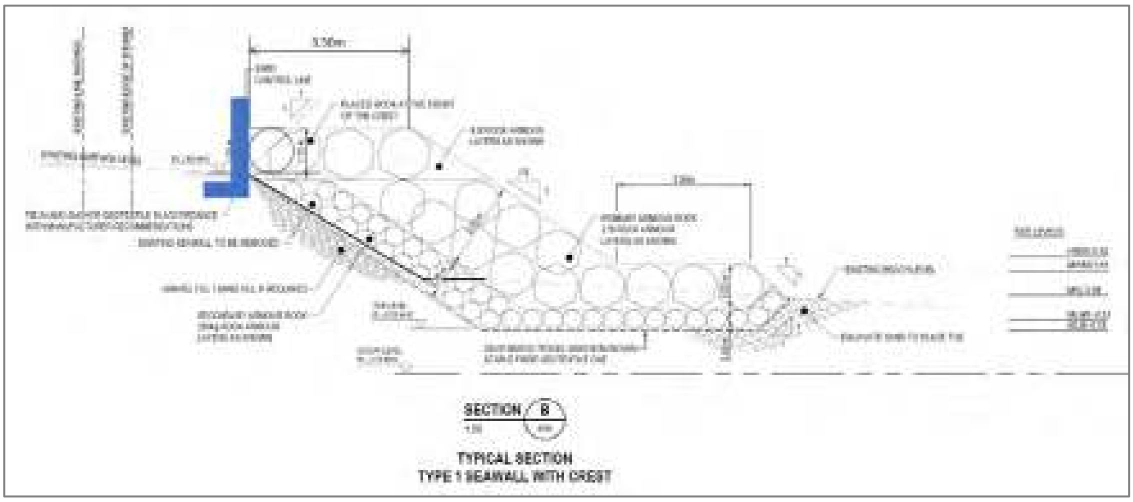
These works will be completed in yeas 2 to 4 of the CMP 10 Year Business Plan.

Design

The proposed seawall design shown in the image below (Aurecon, 2019) will provide adequate protection to ensure Beach Road is not impacted by coastal erosion and is adequately designed to withstand extreme coastal conditions.

To manage the risk of future wave overtopping a modification of the seawall design will be required. A possible modification to the seawall design is presented in the image below and incorporates a vertical wall directly behind the structure crest (shown in blue). Modifications to the proposed seawall design would need to subject to detailed design, including physical modelling if deemed required. Further details can be found in Appendix E.

Reprofiling/raising of the road in conjunction with seawall crest raising may be desirable to ensure adequate drainage of the overtopped volume of water. Such works would need to consider access and drainage of private property along Beach Road.



Seawall with Crest Typical Section

Benefits

This option derives benefits from protection of Beach Road from coastal erosion and inundation (from wave overtopping).

CH4_D	**Surfside Coastal Inundation Levee** and Dune Management
Location: Surfside	

Description

The urban regions of the Surfside subcatchment adjacent to the bay are low lying and at risk of inundation in coastal storm events. Properties and assets are currently affected in the 20-year ARI coastal storm event, and affectation and associated risks increases in the future due to sea level rise exacerbating flood levels.

The locations within Surfside lying below ground levels of 2.1 mAHD are at risk of 100 Year ARI flooding under existing sea levels, and the natural topography does not afford Surfside flood protection from large coastal storms and widespread inundation.

As part of the CMP, a Coastal Inundation Levee will be constructed to increase protection of the low-lying residential precinct including council assets adjacent to the bay from the inundation threat posed by a 100-year ARI storm under existing sea levels including a 0.4m freeboard. As wave runup heights will exceed the structure crest level, the levee will be designed to withstand erosion and overtopping. Future CMPs may consider raising and extending the Coastal Inundation Levee to protect against the increased risk of inundation as a result of sea level rise. This is discussed further in **Appendix E**.

Whilst the Coastal Inundation Levee has been developed in response to ocean flooding, it will also protect the precinct from catchment driven flood events. The phase 2 design should be examined and optimised (including road treatment, levee location and design) as part of a Floodplain Risk Management Study and Plan for the area.

The approximate location of the proposed levee is shown below. It is proposed to construct the levee in two phases:

- Phase 1 (shown in red) comprises the section at Surfside West Beach (Dog Beach) will be undertaken as a high priority task following certification of the CMP.
- Phase 2 (shown in yellow) comprises the remaining sections to be completed under this CMP, with investigation and design to be completed with input from the Floodplain Risk Management Study and Plan.

In addition, the connection of the levee into the surrounding ground levels to ensure flood protection requires the dune along Surfside Beach to be nourished to ensure the crest of the levee is at or above 2.5mAHD. The stability of the dune should also be ensured through vegetation management and dune building.

CH4_D	**Surfside Coastal Inundation Levee** and Dune Management

Approximate Coastal Inundation Levee Location

Costs

Total Capital Cost: $3,100,000

Maintenance Costs: 1% of capital costs over life of structure

Costs to construct Phase 1, Surfside West Beach (Dog Beach) section: $1,500,000

Cost to construct Phase 2 section: $1,500,000

Dune nourishment and vegetation management: $100,000

Timing

Investigation and design of Phase 1 to occur in 2023, with construction estimated to occur in 2024 (upon completion of the investigation and design).

Phase 2 design would progress as part of the Floodplain Risk Management Study and Plan, estimated to commence in 2023, with construction estimated to occur in 2025.

Design

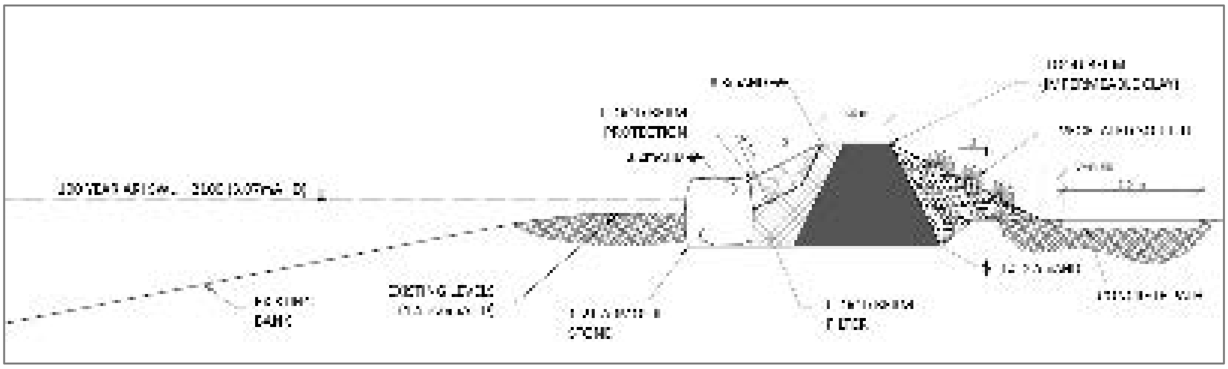
A concept design for Phase 1 and Phase 2 of the Coastal Inundation Levee is presented in the cross-section below.

The design and costs have assumed a berm that consists of an impermeable core with armouring on the flood prone side and a vegetated slope on the protected side. However, the detailed design process will need to consider construction impacts on Aboriginal heritage and could result in the impermeable core

CH4_D	**Surfside Coastal Inundation Levee** and Dune Management

being constructed using sheet piling (rather than impermeable clay as shown on the typical section below).

The horizontal footprint of the Coastal Inundation Levee will be dependent on crest level targeted and existing ground level. Existing ground levels along the first stage of levee vary between 1.5 and 2mAHD, such that a Coastal Inundation Levee with height of 0.5-1m and width (at the base) of 3 to 5m would be required to achieve a crest level of +2.5mAHD.



Benefits

- The Coastal Inundation Levee will protect the residential precinct (and the associated infrastructure and Council assets) in events up to and including the 100-year ARI ocean storm under existing sea levels plus 0.5m freeboard.
- Whilst the option has been developed in response to ocean flooding, it will also protect the region from catchment driven flood events.
- The effectiveness of the option will be dependent on the ongoing monitoring and maintenance of the levee and dune works to ensure they remain higher than projected storm levels.
- Climate change will reduce the effectiveness of a given levee level. To address this, the works can be adapted, to lift the height of the levee and extend its length in line with projected increases in ocean flood levels. This would need to be assessed in future CMPs.

CH4_K	Seawall Raising and wave return barriers
Location(s): Batemans Bay to Batehaven	

Description

An assessment of coastal inundation hazard has identified that significant portions of the CBD seawall are subject to existing risks of wave overtopping. Under future climate scenarios, as sea levels rise, storm tide (still water) inundation and increased wave overtopping will be experienced.

Under current mean sea levels, the existing risk of inundation is predominantly limited to wave overtopping as shown in Figure 1 for the 20-year ARI (infrequent) and 100-year ARI (extreme) event. For the medium term up to 2065, under sea level rise scenarios, the likelihood and extent of inundation only increases, with up to 95% of the seawall length inundated under a 100-year ARI event.

Based on an analysis of the existing crest levels, seawall raising will be undertaken for the 1,200m length of seawall shown on the adjacent image to protect against coastal inundation events up to the 100 Year ARI event at 2100.

Costs

The seawall raising estimated costs are:

Capital cost: $10,500,000
Maintenance costs: 1% of capital costs per year over life of structure

Timing

The seawall raising will be undertaken in Years 5 to 10 of the CMP Business Plan.

Coastal Threats Addressed

The seawall raising will manage risks associated with coastal inundation and wave overtopping.

Design

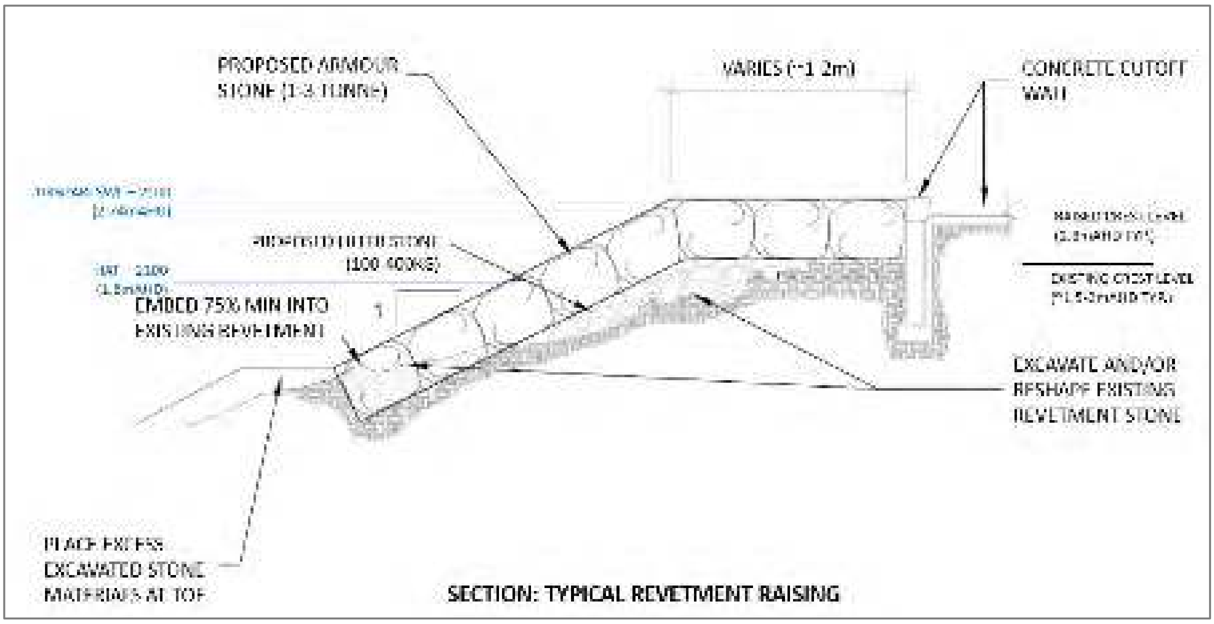
Seawall raising will be undertaken that leverages off the existing seawall as a foundation but increase the crest level to +3.0mAHD, above the 100-year ARI Storm Tide level in 2100. A typical section for the seawall raising design is presented in the image below and includes construction of a 1-2m wide crest and 1 in 2 seawall slope that keys into the existing seawall armour layer. At the back of the crest of the raised seawall a concrete cut-off wall would reduce the permeability of structure and neatly tie the seawall into the promenade behind.

Initial analysis suggests that the proposed crest level and seawall design would be sufficient to ensure pedestrian safety up to the year 2050 (based on a 100-year ARI design storm). Beyond this, overtopping rates become hazardous for people near the crest and additional protection would be required to manage this future risk from wave overtopping. A wave return barrier could be incorporated into the

CH4_K	Seawall Raising and wave return barriers

seawall as part of future CMP actions or expeditated if master plan implementation is expediated (further details are provided in Appendix E).

The design of the seawall should be undertaken in a manner to minimise any impacts on fisheries habitat and areas of the Batemans Marine Park. Where possible the works should be contained to the footprint of the existing infrastructure.



Typical cross section for raising of the CBD

Benefits

A correctly designed and constructed seawall will provide effective protection to both coastal flooding (from elevated storm tides) and foreshore hazard (from wave overtopping) along the length of the CBD and will ensure the safe use of Beach Road and foreshore promenade areas under a greater range of coastal conditions.

Seawall raising would not impact on the sediment dynamics of Batemans Bay, beyond the influence of the existing seawall, as all works would occur at elevations above the active channel bed and margins and would have negligible influence on tidal and flood hydrodynamics along the length of the seawall. As such, no detrimental impacts to shorelines on the northern side of the Bay area expected from raising of the seawall.

CH4_M	Adaptation plan for low lying areas to be impacted by tidal inundation
Location(s): Batemans Bay	

Description

There are low lying areas in Batemans Bay that have existing exposure to large ocean storms and will increasingly be at risk under sea level rise.

The coastal vulnerability modelling undertaken in Stage 2 of the CMP identified locations in Batemans that will be inundated several times a year by 2100 (i.e. these areas are below the 2100 HHWS tidal level). Shown in blue hatching on the map below.

The modelling also identified that even greater areas will be impacted on average annually by inundation from ocean storm events. Shown in pink hatching on the map below.

This frequency of inundation is an unacceptable level of risk, and would likely result in these areas being uninhabitable not only due to regular inundation, but sub-ground level impacts on structural foundations, underground assets etc.

Adaptation planning should commence immediately for these areas to identify suitable approaches to continue to viability of this land. This may involve a combination of rezoning land, landform adaptation through filling and raising of assets and roads, and property development controls.

Detailed assessments are required to ensure the effectiveness of the strategy, including consideration of:

- Access to imported fill,
- Design to tie into existing surrounding levels,
- Access to existing properties (e.g. driveways),

CH4_M	Adaptation plan for low lying areas to be impacted by tidal inundation

- Land acquisition,
- Management of inter-lot drainage,
- Existing manhole levels/depths,
- Electricity clearance heights,
- Drainage improvements for local rainfall events,
- Sequence of works and timeframe for overall scheme,
- Determine acceptable cumulative impacts on flood behaviour as scheme is implemented,
- Multi stakeholder involvement.

Costs

The action for inclusion in the CMP is the preparation of an adaptation plan and associated flood modelling, civil design and community engagement. This has been estimated at a cost of $200,000.

Timing

The timing for adaptation planning will be dependent on identifying the “Thresholds” and “Triggers” for continued liveability of the low lying areas of Batemans Bay. These would be established as part of the adaptation planning. However, for the purpose of CMP planning, it can be seen that frequent inundation of the low lying areas of Batemans Bay will likely occur by 2065. This may be considered the threshold where these locations begin to lose their liveability. The trigger point for this threshold requires analysis of the timeline between when the threshold is reached and when a response is required to avoid losing liveability of the area. This analysis would include consideration of a monitoring period, response time, and a safety buffer for uncertainty.

In order to adequately plan, prepare and implement adaptation, the planning will commence as soon as possible. The preparation of an adaptation plan at a concept stage has been included in this CMP and could be completed jointly as part of the floodplain risk management study and plan for this location depending on timing. If the concept stage plan identifies the need for more detailed planning, this would then proceed. This could also include implementing actions from the flood risk management study and plan ensuring joint outcomes for dealing with coastal inundation hazards identified through this CMP.

Benefits

- Ongoing viability of low lying urban areas as sea level result in frequent inundation (i.e. tidal inundation)
- Reduce exposure of low lying urban areas to inundation from coastal storms.

4 Whether the CMP Identifies Recommended Changes to Planning Controls, Including any Proposed Maps

Land use planning considerations and recommendations are an integral component to managing current and future risk and the coastal environment.

Council currently imposes planning controls related to coastal hazards through its Local Environmental Plan (LEP), Clause 2.12 of the Resilience and Hazards SEPP and an Interim Coastal Hazard Adaptation Code (last updated in 2017). Other planning controls on the coastal environment that are not hazard related are applied through Clauses 2.7 – 2.11 of the Resilience and Hazards SEPP as well as a range of provisions in the Eurobodalla LEP 2012. Coastal protection works are regulated under Section 27 of the CM Act.

This CMP has reviewed the current coastal planning arrangements, with a particular focus on the coastal hazard and vulnerability provisions and made recommendations for changes utilising the coastal hazard/vulnerability information developed as part of this CMP. A proposed Coastal Vulnerability Area (CVA) has been prepared (**Section 8.2.1**) to support a future planning proposal (Action CHA_A). The CMP Stage 2 technical studies will support the submission of a planning proposal.

A summary of Council's current coastal planning arrangements as they relate to coastal hazards is provided in **Table 4-1**.

Table 4-1 Council's current coastal hazard planning arrangements

Environmental Planning Instrument or Relevant Code	Relevant Controls
State Environmental Planning Policy (Resilience and Hazards) 2021	Clause 2.12 imposes a requirement for consideration of not increasing the coastal hazards on that land or other land (applies to all land under the Resilience and Hazards SEPP). Offers an interim solution and is currently operable.
State Environmental Planning Policy (Exempt and Complying Development Codes) 2008	Clause 1.19(e) states that complying development is not permitted in environmentally sensitive areas (defined by Coastal wetlands/proximity to coastal wetlands). Clause 1.19(f) states that complying development may not be carried out on land that is identified by an environmental planning instrument, a development control plan or a policy adopted by the council as being or affected by— (i) a coastline hazard, or (ii) a coastal hazard, or (iii) a coastal erosion hazard.
Eurobodalla Local Environmental Plan 2012	No specific provisions relating to the control of coastal hazards currently operate. Note that there are no LEP Standard Instrument provisions that can be used for coastal hazards as the state relies on the Resilience and Hazards SEPP provisions in this regard.

Environmental Planning Instrument or Relevant Code	Relevant Controls
	Clause 5.7 deals with the prohibition of building below mean high water as a mandatory clause from the Standard Instrument. There is no current foreshore building line clause in the LEP.
Interim Coastal Hazard Adaptation Code	Council applies controls using the Interim Code (last updated 2017). The code includes key details/controls derived from Whitehead & Associates (2014) Appendix C recommendations which relate to building design life. The Code identified that it is to be replaced once a CZMP is adopted (now CMP). Council's mapping system shows Sea Level Rise Investigation Areas (these are called up in the Code). Inundation levels are reported in the Code (Schedule 1). Clause 12 of the Code applies to the Beach Road area as an *Area of Critical Utility* and has a merits-based assessment approach due to existing protection works. The interim code contemplates related aspects for development such as: • variations in controls depending on the type/life of development • time limited consents • managed retreat using Section 88B instruments. The Code is applicable until such time as the Eurobodalla Coastal Management Program is completed (this CMP).
Environmental Planning and Assessment Act 1979 Section 10.7 Certificates	Council's planning certificates (known as a Section 10.7 certificate) identify if the land, or part thereof, is exposed or has potential future exposure to coastal hazards. The Interim Code is currently referred to on certificates issued by Council with regards to restrictions on development.
Local Planning Direction 4.2 Coastal Management	This direction applies when a planning proposal authority prepares a planning proposal that applies to land that is within the coastal zone, as defined under the *Coastal Management Act 2016* - comprising the coastal wetlands and littoral rainforests area, coastal vulnerability area, coastal environment area and coastal use area - and as identified by chapter 2 of the *State Environmental Planning Policy (Resilience and Hazards) 2021.*

The current land use planning provisions in **Table 4-1** have been reviewed in the context of establishing more contemporary approaches that reflect the outputs of Stage 2 Vulnerability Assessments to manage current and future coastal hazards.

Recommended changes to the coastal hazard planning arrangements are provided in **Table 4-2**.

Table 4-2 Recommended changes to coastal hazard planning arrangements

Planning Policy	Recommendations
State Environmental Planning Policy (Resilience and Hazards) 2021	Prepare a planning proposal to incorporate the CVA (**Section 8.2.1**) into the Resilience and Hazards SEPP. Once the CVA map comes into operation, Clause 2.9 will apply. Clause 2.9 states: *Development consent must not be granted to development on land that is within the area identified as "coastal vulnerability area" on the Coastal Vulnerability Area Map unless the consent authority is satisfied that—* *(a) if the proposed development comprises the erection of a building or works—the building or works are engineered to withstand current and projected coastal hazards for the design life of the building or works, and* *(b) the proposed development—* *(i) is not likely to alter coastal processes to the detriment of the natural environment or other land, and* *(ii) is not likely to reduce the public amenity, access to and use of any beach, foreshore, rock platform or headland adjacent to the proposed development, and* *(iii) incorporates appropriate measures to manage risk to life and public safety from coastal hazards, and* *(c) measures are in place to ensure that there are appropriate responses to, and management of, anticipated coastal processes and current and future coastal hazards.* Note that the design life of the building (2.9(a)) is not formally defined in the Resilience and Hazards SEPP. Using the CVA provisions of the Resilience and Hazards SEPP give greater weight to achieving the objectives as the SEPP provisions will prevail over any other environmental planning instruments (Clause 2.5(1)) where there is inconsistency.
Eurobodalla Local Environmental Plan 2012	As an alternate to using the CVA provisions in the SEPP, it is noted that the existing LEP could be amended to include Local Provisions (Part 6) for Coastline Risks/Hazards. There is no current foreshore building line (FBL) clause in the LEP. Where detailed CVA mapping is not available or inconsistent with the level of detail in other areas, the use of the foreshore building line clause is a potential way to achieve the outcomes intended under the Interim Code level that is applied to manage climate change risks. The associated mapping to a map using LiDAR data would set a contour for the building line (such as the 4 m AHD contour). This approach would ensure that complying development SEPP provisions cannot be applied to lands below the FBL.
Development Control Plan	It is recommended that Council create a section in a new LGA-wide Development Control Plan (DCP) to provide coastal hazard development controls to support either the CVA SEPP provisions or the proposed LEP Local Provision amendments. Controls by land use type should ensure for all land use types in the CVA that: • appropriate (coastal inundation compatible) building materials are used below 100 Year ARI coastal inundation levels with climate change (plus a freeboard)

Planning Policy	Recommendations
	• habitable floor levels are set above 100 Year ARI coastal inundation levels with climate change (plus a freeboard) • below ground level non-habitable areas and covered and bunded carparking facilities have all access, ventilation and any other potential water entry points above the 100 Year ARI coastal inundation levels with climate change (plus a freeboard) and include an inundation free pedestrian evacuation route • all development is designed and constructed to have a low risk of damage and instability due to wave action, inundation, and / or erosion hazards in a 100 Year ARI coastal storm event • all electrical equipment, wiring, fuel lines or any other service pipes and connections are waterproofed to 100 year ARI coastal inundation levels with climate change (plus a freeboard) • new development and major additions to existing development are sited on the landward side of the 2100 reduced foundation capacity line • A safe evacuation route is available from the development in the event of coastal inundation exceeding the habitable floor level. Other controls may apply to ensure the safe and appropriate development of the coastal zone. These may express Council's aspirations as they relate to the coastal environment area and the coastal use area (with respect to built-form, landscaping, sustainability views etc). Other explicit controls are recommended with respect to specifically addressing post-hazard event recovery. These controls are commonly referred to as 'Build Back Better' type controls, seek to ensure that any existing development in vulnerable areas that has been damaged or destroyed is either not built in the same location or, where appropriate, is built to a contemporary standard to withstand coastal hazards. These types of controls would be activated for use say for up to five years from the date of a hazard event. Any coastal protection works that are required to support development will need to be consistent with the provision of Clause 27 of the CM Act and this CMP. Further definition will be required around what constitutes major additions in the preparation of the DCP. Further consideration will be required around design life and service life of various development types with respect to sea level rise risk.
Coastal Hazard Code	Recognising that updating Council's DCP may take some time, and with the intention that the *Interim Coastal Hazard Adaptation Code (2017)* to be repealed following adoption of this CMP, a Draft Coastal Hazard Code has been provided in **Appendix G** to consider the outcomes of this CMP and replace the existing *Interim Coastal Hazard Adaptation Code (2017)*.
Section 10.7 Certificates	Council's planning certificates should continue to identify if the land, or part thereof, that is exposed or has potential future exposure to coastal hazards. If the Resilience and Hazards SEPP (inclusive of CVA Mapping) is in force, then this will be automated. The proposed DCP clauses should be referred to with regards to restrictions on development. Until the DCP clauses are updated, the Coastal Hazard Code should be referenced.

Planning Policy	Recommendations
Adaptation Planning	Low lying areas of Batemans Bay are currently at risk from coastal inundation hazards. In the coming decades, these areas will become increasingly inundated by extreme tides, and eventually will become uninhabitable due to regular tidal inundation. Adaptation planning should commence immediately for these areas to identify suitable approaches to continue to viability of this land. This may involve a combination of rezoning land, landform adaptation through filling and raising of assets and roads, and property development controls. This is discussed further in action CH4_M (see **Section 3.2.4**).

5 A Business Plan

5.1 Intent and Value of Implementing the Eurobodalla Open Coast CMP

The Eurobodalla Open Coast CMP is a program of physical works, monitoring and investigations, and planning and education initiatives that target the threats to the environmental, social, cultural and economic values of the open coast. The CMP also includes actions to target coastal hazards impacting the coastline now and into the future.

Investment in the Eurobodalla Open Coast CMP provides an opportunity to directly improve and preserve the condition of beaches, environmental habitats, cultural spaces and recreational opportunities of the open coast, and in doing so, bring benefits to the public, in particular mitigating the risk to people and property presented by coastal hazards.

The Eurobodalla Open Coast CMP contains 68 actions that aim to manage, preserve, improve, promote and rehabilitate the open coastline. An additional five actions have been recommended to monitor and evaluate the performance of the CMP implementation.

The actions contained within this business plan primarily mitigate coastal risks to public beneficiaries, with consideration of balancing benefits across the range of locations, environments and threats within the Eurobodalla Open Coast. As such, no beneficiary pays models have been allocated to private beneficiaries in the business plan and therefore, a coastal protection service charge would not be activated.

5.2 Resourcing, Funding and Financing

A Business Plan has been developed for the CMP which outlines the key components of the funding strategy for the CMP, including the cost of proposed actions, proposed cost-sharing arrangements and other potential funding mechanisms. Delivery of the Eurobodalla Open Coast CMP is estimated to cost $46.9 Million (2022 dollars) over 10 years.

The CMP actions are expected to be funded through Eurobodalla Shire Council and state government contributions, monetary grants and volunteer works by community members and organisations. Eurobodalla Shire Council contribution is costed to be $13.6 Million over 10 years, with anticipated State Government contributions of $33.3 Million over 10 years. For all responsible or supporting organisations, the identified actions remain subject to the availability of resources, contestable grant program processes, funding allocations, policy and legislation changes and organisational and/or government priorities. For example, Council's ability to implement numerous CMP actions will depend on successfully obtaining government grant funding. If Council is unsuccessful in obtaining government grant funding, the program will need to be scaled back, affecting the timing of and/or ability to implement CMP actions. Notwithstanding, the actions have been included in good faith, that the funds shown in Table 52- Business Plan will be obtainable. Furthermore, Council will take advantage of any alternative funding opportunities that become available in the future to implement actions such as those identified for funding under the NSW Coast and Estuaries Grants Program. This could include new State and Federal funding programs and or other opportunities as they become available.

Cost estimates for the complex engineered management options have been based on concept level design sections of each structure type, extrapolated on a unit length basis over the spatial extent of the proposed option. Capital cost estimates adopted unit cost rates (per length of structure) for each structure type, using cost data from similar coastal protection projects adjusted to present day using industry standard benchmarking data. Local site-specific benchmarking of the unit cost rates for rock armoured seawalls was available for the Caseys Seawall, for which a detailed cost estimate was developed in 2019 (Aurecon, 2019). Cost escalation since 2019 was accounted for by considering escalation in labour, materials (quarry stone) and general market conditions (contractor availability), resulting in an escalation of +25% in the capital cost. A summary of the adopted unit cost rates and development of costs for each engineered management option are presented in **Appendix F**. Given the level of design maturity and nature of the cost build-up, the cost estimates should be considered Class 5, with an accuracy of +/-50%. Actual costs will be dependent on engineering refinement during detailed design and market conditions at the time of tendering and construction.

The CMP actions are expected to be funded through Council and state government contributions, monetary grants and volunteer works by community members and organisations. Some actions are funded under Council's normal operating budgets or through existing programs and grants. As identified above it will not be possible for Council to implement all actions identified in this CMP without additional sources of funding. As such, identification of grants and the submission of successful funding applications is an important component of this CMP.

Potential sources of funding identified for the CMP actions are described in **Table 5-1**, the potential source of funding for each management action is provided in **Table 5-2**.

Table 5-1 Local and NSW Goverment Funding Mechanisms

Funding Source	Details
Council Funding Mechanisms	
Council Ordinary Rates	A key funding mechanism for Council are statutory rates and charges, which can be applied to private landowners and businesses. Under the *Local Government Act 1993* (LG Act), ordinary rates can be applied to all rateable land within a local government area. This money can be used to fund delivery of community assets and services and may also be used to implement coastal management actions.
Special Rates	Specific works, services, facilities or activities that benefit certain parcels of rateable land can be funded (in whole or part) by Council by applying special rates under the LG Act. Where a coastal management action directly benefits a property owner, special rates provide a mechanism for Council to secure contributions from those landowners over time. Special rates can be implemented in different ways. Council can issue rates over a property or alternatively enter into an arrangement with the owner for payment of a lump-sum amount.
Development Contribution	Developer contributions enabled under the *Environmental Planning and Assessment Act 1979* may be used for coastal management in some instances, such as funding capital works to manage the development impacts on the

Funding Source	Details
	coast or reduce risk to the development from coastal hazards. The criteria and ability to use those contributions will be dependent on the relevant Developer Contribution Plan.
Revenue Generated by Council	Council can also fund coastal management initiatives through revenue they may generate through hire, rental or other commercial partnerships (e.g. Surf Life Savings Clubs, Holiday Parks etc).
NSW Government Funding Mechanisms	
NSW Coastal and Estuary Grants Program	Under this program, the NSW Government provides grants to local government to support coastal management planning (e.g. hazards studies, management plans/programs) and actions to manage the risks of coastal hazards (e.g. erosion protection), and restore degraded coastal habitats (e.g. wetlands, dunes). Funding of up to two thirds of a project cost is available to successful applications and the program is administered by DPE-EHG. This grant funding program is contestable, prioritised to Council applications with certified Coastal Management Programs and subject to State government funding priorities and allocations.
NSW Floodplain Management Grants Program	The Floodplain Management Program provides financial support to local councils and eligible public land managers to help them manage flood risk in their communities. The program supports the implementation of the NSW Government's Flood Prone Land Policy, which is outlined in the Floodplain Development Manual. Support provided under the programs usually involves $2 from government for every $1 provided by the applicant. Grant funding is contestable and subject to State government funding priorities and allocations.
Election commitment	In February 2019 Environment Minister Gabrielle Upton and Member for Bega Andrew Constance announced that up to $5 million in funding was reserved to help find a solution to erosion along the Batemans Bay waterfront. *“The NSW Government will lead the study with an immediate, additional grant of $250,000 to fund an urgent options study,” she said.* *“We are acting fast to address the urgent concerns of residents on the northern shore of Batemans Bay including Wharf Road, Surfside and Long Beach.”* The options study was the CMP document (this document). The $5 million has been allocated to the following works in this business plan: • Protection of Wharf Road and remediation of adjoining land for public use and access (CH1_Ka Phase 1 and 2). • Protection of Surfside from coastal inundation (CH4_D Phase 1) • Protection of Bay Road, Long Beach from beach erosion (CH1_D Phase 1 and Phase 2). This action will also receive contribution of funds from Council and the NSW Coastal and Estuary Grants Program.

Funding Source	Details
NSW Environmental Trust	The NSW Environmental Trust provides funding to a range of community, government and industry stakeholders to deliver projects that conserve, protect and rehabilitate the NSW environment, or that promote environmental education and sustainability. The Trust provides this funding through a range of contestable grant programs and strategic investments. The Trust administers both long-standing annual programs and one-off, issue-specific programs. The funded programs support: • action in conserving and restoring natural ecosystems • protecting threatened species • undertaking priority environmental research • building community skills • knowledge and capacity through education • promoting cultural awareness • dealing with pollution.
Crown Reserves Improvement Fund	The Crown Reserves Improvement Fund (CRIF) supports Crown land managers (CLMs) by providing funding for repairs, maintenance and improvements on Crown reserves. The funding aims to benefit the community, boost our economy and contribute to the cultural, sporting and recreational life of NSW.
NSW Heritage Grant Program	The NSW Heritage Grants Program provides grants to heritage owners and custodians, local government and the community, to deliver a broad range of heritage outcomes. The program is supported by the Heritage Council of NSW.
Coastal Lands Protection Scheme	The Coastal Lands Protection Scheme is a long-running NSW Government program that began in 1973. The scheme is used to bring significant coastal lands into public ownership and supports long-term management and care of this land, while improving public access to our coastal environments. The department administers the scheme through an annual budget allocation of $3 million for strategic acquisitions. The scheme operates along the entire NSW coastal zone except for the Greater Sydney metropolitan area. Land acquired under the scheme must meet at least one of three criteria: • Public access - to promote public access to the coastal foreshore. • Scenic quality - to maintain the scenic quality of the NSW coast and to maintain landscape breaks to separate and articulate existing coastal towns and settlements. • Ecological values - to protect ecological sites of regional, state and/or national significance.
Crown Lands Rescuing our Waterways Program	To improve accessibility to the state's waterways, the NSW Government has developed the Rescuing our Waterways program. The program grants funding to councils on a dollar-for-dollar basis to help deliver better access to local waterways for recreational and commercial waterway boaters and other users. This creates flow-on benefits for tourism and local economies.

Funding Source	Details
	Coastal councils can apply and are required to make a financial contribution of at least 50% of project costs and be responsible for developing and managing their projects. Dredging projects that may be subsidised under this program include: • Dredging strategies and/or their supporting studies (e.g. sediment hydrodynamics) • Navigation for a range of vessels (recreational, tourism and commercial) • Access to public waterway infrastructures such as boat ramps and wharves • Pre-dredge activities for projects which are eligible and likely to proceed to dredging. for vessel navigation.
State Disaster Risk Reduction stream grants	Under two funding pathways, Discovery and Scale, the State Risk Reduction stream aims to reduce or enable the reduction of state-level risks, risks of state significance and systemic risks potentially impacting NSW. The Discovery Projects pathway offers funding of up to $500,000, for projects that will test and pilot new approaches to achieve breakthrough disaster risk reduction outcomes. The projects must have potential for state-wide significance or impact. The Scale Projects pathway offers funding of up to $2.5 million, for projects that aim to generate a new product, technology, platform or approach that will have state-wide impact at a scale beyond piloting or testing.
Infrastructure Grants: disaster readiness (Clubgrants Category 3)	The objective of the Clubgrants Category 3 Infrastructure Grants program is to fund the costs of construction, alteration, renovation, completion and fit-out of buildings and community infrastructure to deliver outcomes for disadvantaged NSW communities including regional and remote areas, culturally and linguistically diverse, disability and Aboriginal communities. Local council applicants are required to cash-match the funding amount requested.
Other funding opportunities	
Landcare Grants	Landcare Australia works with governments, corporate and philanthropic organisations and donors to facilitate funding for good quality, hands on projects and programs that will improve environmental outcomes for the Landcare community.
Coastcare Grants	Coastcare grants support community groups working on projects across Australia. Grants support Landcare and Coastcare groups with projects like dune protection, revegetation of native coastal environments, protection of endangered coastal species habitats, collection and prevention of storm water pollution, weed and non-native plant removal, and control of human access to sensitive and vulnerable areas.
Crown Reserves Improvement Fund	The Crown Reserves Improvement Fund (CRIF) supports Crown land managers (CLMs) by providing funding for repairs, maintenance and improvements on Crown reserves. The funding aims to benefit the community, boost our economy and contribute to the cultural, sporting and recreational life of NSW.

5.3 Alignment with the IP&R Framework

To assist with the scheduling the implementation of actions, a Gantt chart for the actions (timeline and budget) has been included in **Table 5-2**.

Budgets have been allocated for capital and ongoing costs, where the action would only require existing staff time, assets and services, these are noted as “$ST”.

Table 5-2 Business Plan

ID	Management Action	Location	Lead Agency	Partners	Potential Funding Source	Cost Sharing	CMP Capital Cost	Ongoing Capital Cost and/or Maintenance (Annual)	Total Cost over CMP Business Plan	Council Costs	Stage Government Costs	Year 1	Year 2 to 4	Year 5 to 10
CD1_A	Continue to implement Snapper Island Penguin monitoring program	Snapper Island, Batemans Bay	Council	DPE-EHG	Council, C&E Grants, NSW Environmental Trust	Council (1) : C&E Grant (2)	$9,000	$9,000	$90,000	$30,000	$60,000	$9,000	$27,000	$54,000
CD1_B	Design and implement dune vegetation management – northern end of Broulee beach	Broulee	Council	DPE-EHG	Council, C&E Grants, NSW Environmental Trust, Coastcare Grants	Council (1) : C&E Grant (2)	$10,000	$10,000	$80,000	$26,667	$53,333	$-	$20,000	$60,000
CD1_C	Continuation of Council's weed management program in coastal areas	All	Council	DPE-EHG, DPI-LLS	Council, C&E Grants, NSW Environmental Trust, Coastcare Grants	Council (1) : C&E Grant (2)	$10,000	$10,000	$80,000	$26,667	$53,333	$-	$20,000	$60,000
CD2_A	Investigate source of water quality issues at Surf Beach	Surf Beach	Council	DPE-EHG, Traditional Owners, DPI-Fisheries	Council, C&E Grants, NSW Environmental Trust	Council (1) : C&E Grant (2)	$30,000	$-	$30,000	$10,000	$20,000	$-	$30,000	$-
CD3_B	Beach watch monitoring program for water quality at recreational beaches to be continued	Cookies Beach, Caseys Beach, Surf Beach, Malua Bay, Broulee North, South Broulee Beach, Shelley Beach, Tuross Main Beach, Brou Beach, Narooma shark net, Narooma Main Beach	Council	DPE-EHG, DPI-Fisheries	Council	Council	$10,000	$10,000	$100,000	$100,000	$-	$10,000	$30,000	$60,000
CD3_C	Support DPI-Fisheries in preparing a *Marine Vegetation Strategy* to identify priority areas for the protection of healthy mangrove and saltmarsh areas and rehabilitation of degraded areas.	All	Council	DPI, DPE	Council	Council staff time	$ST	$ST	$ST	$ST	$ST	$ST	$ST	$ST
CHA_A	Update Property Development Planning Controls and undertake Planning Proposal to adopt CVA	Coastal Vulnerability Area	Council	DPE-EHG, DPE-Planning	Council	Council (1) : C&E Grant (2)	$100,000	$-	$100,000	$33,333	$66,667	$-	$100,000	$-
CH1_B	Maloney Beach Erosion Protection Stage 1: Undertake investigation and design for Northcove Road erosion protection and flood proofing	Maloneys Beach	Council	DPE-EHG, DPI-Fisheries	Council, C&E Grants, Floodplain Management Grants	Council (1) : C&E Grant (2)	$200,000	$-	$200,000	$66,667	$133,333	$-	$200,000	$-

ID	Management Action	Location	Lead Agency	Partners	Potential Funding Source	Cost Sharing	CMP Capital Cost	Ongoing Capital Cost and/or Maintenance (Annual)	Total Cost over CMP Business Plan	Council Costs	Stage Government Costs	Year 1	Year 2 to 4	Year 5 to 10
CH1_D Phase 1	Long Beach Coastal Erosion Protection Works – Phase 1: Undertake investigation and design report, including community engagement	Long Beach	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Election Commitment	Election Commitment (DPE)	$200,000	$-	$200,000	$-	$200,000	$200,000	$-	$-
CH1_D Phase 2	Long Beach Coastal Erosion Protection Works – Phase 2: Construct a ≈ 200m low crested revetment and beach nourishment	Long Beach	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Election Commitment, Council, C&E Grants	$900k - Election commitment$2.2M - Council (1) : C&E Grant (2)	$2,500,000	$-	$2,500,000	$533,333	$1,966,667	$-	$2,500,000	$-
CH1_D Phase 3	Long Beach Coastal Erosion Protection Works – Phase 3: Maintenance of constructed revetment structure and nourishment of beach	Long Beach	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Council, C&E Grants	Structure maintenance: Council Beach nourishment: Council (1) : DPE (2)	$41,000	$41,000	$246,000	$206,000	$40,000	$-	$-	$246,000
CH1_Ka Phase 1	Wharf Road Stage 1: Priority coastal protection works, remediation and reinstatement of beach for public use - Phase 1 Site remediation assessment and coastal protection investigation and design	Wharf Road	Council	DPE-EHG, DPE-Planning, DPI-Fisheries	Election Commitment	Election Commitment (DPE)	$200,000	$-	$200,000	$-	$200,000	$200,000	$-	$-
CH1_Ka Phase 2	Wharf Road Stage 1: Priority coastal protection works, remediation and reinstatement of beach for public use- Phase 2 Complete coastal protection works	Wharf Road	Council	DPE-EHG, DPE-Planning, DPE-Crown Lands, DPI-Fisheries	Election Commitment, Council	Election Commitment (DPE) for construction Council for maintenance.	$2,200,000	$22,000	$2,376,000	$176,000	$2,200,000	$-	$2,244,000	$132,000
CH1_Ka Phase 3	Wharf Road Stage 1: Priority coastal protection works, remediation and reinstatement of beach for public use- Phase 3: Maintain and enhance coastal vegetation and beach for safe public use	Wharf Road	Council	DPE-EHG, DPE-Planning, DPE-Crown Lands, DPI-Fisheries	Council, C&E Grants	Council (1) : C&E Grant (2)	$10,000	$10,000	$60,000	$20,000	$40,000	$-	$-	$60,000
CH1_Kb	Wharf Road Protection Stage 2: Inundation protection to be undertaken	Wharf Road	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Council, C&E Grants	Construction - Council (1) : C&E Grant (2) Maintenance - Council	$5,900,000	$59,000	$6,195,000	$2,261,667	$3,933,333	$-	$-	$6,195,000
CH1_Kc	Raise Wharf Road level as part of routine resurfacing works	Wharf Road	Council	DPE-EHG	Council, C&E Grants	Council (1) : C&E Grant (2)	$500,000	$-	$500,000	$166,667	$333,333	$-	$-	$500,000
CH1_L	Subject to environmental planning approvals, undertake nourishment at Northern Batemans Bay beaches when dredging is undertaken in Batemans Bay / Clyde River as required for navigational purposes	Surfside / Wharf Road	TfNSW-MIDO	Council, DPE-EHG, DPE-Crown Lands, DPI- Fisheries	MIDO	MIDO	$1,000,000	$-	$1,000,000	$-	$1,000,000	$-	$500,000	$500,000

ID	Management Action	Location	Lead Agency	Partners	Potential Funding Source	Cost Sharing	CMP Capital Cost	Ongoing Capital Cost and/or Maintenance (Annual)	Total Cost over CMP Business Plan	Council Costs	Stage Government Costs	Year 1	Year 2 to 4	Year 5 to 10
CH1_M	Purchase private properties at Wharf Road to assure current and future generations have public access to the foreshore and beach	Wharf Road	DPE-Planning	Council	Coastal Lands Protection Scheme	Coastal Lands Protection Scheme	$4,000,000	$-	$4,000,000	$-	$4,000,000	$1,000,000	$3,000,000	$-
CH1_P	Upgrade existing coastal protection works at Caseys Beach	Batehaven	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Council, C&E Grants	Construction - Council (1) : C&E Grant (2) Maintenance - Council	$7,900,000	$79,000	$8,532,000	$3,265,333	$5,266,667	$-	$8,058,000	$474,000
CH1_X	Preparing a Review of Environmental factors to identify preferred options for disposal of sand from maintenance activities at Tuross boat ramp.	Tuross Heads	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Council, Rescuing our Waterways	Council staff time	$ST	$ST	$ST	$ST	$ST	$ST	$ST	$ST
CH1_Y	Sewage pump stations and reticulation infrastructure at risk to be include in future works plans	Long Beach, Malua Bay, Broulee	Council	NA	Council	Council staff time	$ST	$ST	$ST	$ST	$ST	$ST	$ST	$ST
CH1_Z	Monitor stormwater assets in erosion areas	All	Council	NA	Council	Council staff time	$ST	$ST	$ST	$ST	$ST	$ST	$ST	$ST
CH1_ZB	Implement Open Coast Coastal Zone Emergency Action Subplan	All	Council	NSW SES, Heritage, DPE-EHG	Council, C&E Grants	Council (1) : C&E Grant (2)	$50,000	$-	$50,000	$16,666	$33,333	$5,000	$15,000	$30,000
CH1_ZC	Design and construct a coastal erosion structure to protect Wharf Road at Surfside Beach West (Dog Beach/Mcleods Beach) against coastal erosion	Surfside	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Council, C&E Grants	Construction - Council (1) : C&E Grant (2) Maintenance - Council	$100,000	$1,000	$109,000	$42,333	$66,666.67	$100,000	$3,000	$6,000
CH10_C	Conduct periodic inspections of the slopes of the cliffs and bluffs and utilise Lidar data to monitor long term recession	Corrigans Headland, Sunshine Bay, Caseys Beach Headland and Long Beach Headland	Council	NA	Council	Council staff time	$ST	$ST	$ST	$ST	$ST	$ST	$ST	$ST
CH10_E	Maintain or improve native vegetation cover on steep slopes on coastal cliffs and bluffs	Priority to those affected by geotechnical hazards, and accessible	Council	DPE-EHG, DPE-Crown Lands	Council, C&E Grants, NSW Environmental Trust, Coastcare Grants	Council (1) : C&E Grant (2)	$15,000	$15,000	$150,000	$50,000	$100,000	$15,000	$45,000	$90,000
CH10_G	Install safety and warning signs relating to cliff instability	All	Council	DPE-EHG	Council, C&E Grants	Council (1) : C&E Grant (2)	$10,000	$10,000	$100,000	$33,333	$66,667	$10,000	$30,000	$60,000
CH10_I	Install and maintain a surface dish drain	All	Council	DPE-EHG	Council, C&E Grants	Construction - Council (1) : C&E Grant (2) Maintenance - Council	$20,000	$1,000	$25,000	$11,666	$13,333	$-	$-	$25,000

ID	Management Action	Location	Lead Agency	Partners	Potential Funding Source	Cost Sharing	CMP Capital Cost	Ongoing Capital Cost and/or Maintenance (Annual)	Total Cost over CMP Business Plan	Council Costs	Stage Government Costs	Year 1	Year 2 to 4	Year 5 to 10
CH9_A	Prepare frontal dune management plans	Beach reserves at Maloneys Beach, Long Beach, Surfside, Corrigans (include Clyde View Holiday Park) and Malua Bay	Council	DPE-EHG, DPE-Crown Lands	Council, C&E Grants, NSW Environmental Trust, Coastcare Grants	Council (1) : C&E Grant (2) for plan preparation and annual implementation costs	$80,000	$5,000	$120,000	$40,000.00	$80,000.00	$-	$90,000	$30,000
CH4_D Phase 1	Investigate, design and construct a coastal inundation levee to protect against storm surge inundation from creek / estuary (Surf Side Creek)	Surfside	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Council, C&E Grants	Election Commitment for design and construct Council for ongoing maintenance	$1,500,000	$12,000	$1,596,000	$96,000	$1,500,000	$300,000	$1,224,000	$72,000
CH4_D Phase 2	Investigate, design and construct a coastal inundation levee to protect against storm surge inundation from creek / estuary (Surf Side Creek and Cullendulla)	Surfside	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries	Floodplain Management Grants	Council (1) : NSW Floodplain Grants (2)	$1,600,000	$12,000	$1,684,000	$617,333	$1,066,667	$-	$1,612,000	$72,000
CH4_G	Installation of flood gates on priority outlets	Wharf RoadBatemans Bay to Batehaven	Council	DPE-EHG, DPI-Fisheries	Council, C&E Grants	Construction - Council (1) : C&E Grant (2)Maintenance - Council	$35,000	$3,000	$44,000	$20,666	$23,333	$-	$-	$44,000
CH4_K	Investigate, design, and construct seawall raising and wave return barriers in Batemans Bay	Batemans Bay to Batehaven	Council	DPE-EHG, DPI-Fisheries, DPE-Crown Lands	Council, C&E Grants	Construction - Council (1) : C&E Grant (2) Maintenance - Council	$10,500,000	$105,000	$11,025,000	$4,025,000	$7,000,000	$-	$-	$11,025,000
CH4_M	Undertake an adaptation plan for low lying areas to be impacted by tidal inundation under sea level rise	Batemans Bay, North Batemans Bay and Surfside	Council	DPE-EHG	Council, C&E Grants	Council (1) : C&E Grant (2)	$150,000	$-	$150,000	$50,000.00	$100,000	$-	$150,000	$-
CH4_S	Emergency Response Plan	Big4 Batemans Bay Beach Resort Beachcomber Holiday Park	NSW SES	Council, DPE-EHG	Council and SES existing staff resources	SES / Council (staff time)	$ST	$ST	$ST	$ST	$ST	$ST	$ST	$ST
CH4_V	Undertake access road raising to provide resilience to coastal inundation risk - Beachcomber Holiday Park	Potato Point	Council	DPE-EHG	Council, C&E Grants	Council (1) : C&E Grant (2)	$100,000	$-	$100,000	$33,333	$66,666	$-	$100,000	$-

ID	Management Action	Location	Lead Agency	Partners	Potential Funding Source	Cost Sharing	CMP Capital Cost	Ongoing Capital Cost and/or Maintenance (Annual)	Total Cost over CMP Business Plan	Council Costs	Stage Government Costs	Year 1	Year 2 to 4	Year 5 to 10
CH8_B	Undertake a review of ICOLL EMPs	South Durras, Surfside, Joes Creek, Short Beach, Wimbie Beach, Kianga, Little Lake (Narooma), Nangudga Lake	Council	DPE-EHG, DPE-Crown Lands, DPI-Fisheries, DPE-Planning	Council, C&E Grants	Council (1) : C&E Grant (2)	$150,000	$-	$150,000	$50,000	$100,000	$-	$150,000	$-
CH8_C	ICOLL Entrance Management Policy - engagement and finalisation	Congo, Potato Point, Lake Brou, Corunna Lake	NPWS	DPE-EHG, DPE-Crown Lands, DPI-Fisheries, DPE-Planning	NPWS	NPWS	$20,000	$-	$20,000	$-	$20,000	$20,000	$-	$-
CH9_B	Erosion management to be undertaken on dunes a Knowlman Road, Rosedale	Rosedale Beach	Council	DPE-EHG	Council, C&E Grants, NSW Environmental Trust, Coastcare Grants	Council (1) : C&E Grant (2)	$20,000	$-	$20,000	$6,666	$13,333	$20,000	$-	$-
CHALL_A	NPWS Coastal Hazard Assessment	National Parks	NPWS	Council	NPWS	NPWS	$60,000	$-	$60,000	$20,000	$40,000	$-	$-	$60,000
CH14_B	Educate Malua Bay SLSC on the erosion hazard risk at the site	Malua Bay	Council	NA	Council	Council	$ST	$ST	$ST	$ST	$ST	$ST	$ST	$ST
CHO_B	Undertake a community event to promote coastal values, when funding opportunities arise	All	Council	Tourism NSW, DPI Fisheries	Tourism NSW	Council (1) : Tourism NSW (1)	$100,000	$-	$100,000	$50,000	$50,000	$-	$100,000	$-
RA1_A	Manage user conflicts at Bingie Dreaming Track and Shark Bay / Broulee Island track	Congo	Council	NPWS, Traditional Owners	Council	Council and NPWS staff time	$ST	$ST	$ST	$ST	$ST	$ST	$ST	$ST
RA2_B	Undertake dune vegetation management and minimise unregulated pedestrian access	Rosedale Beach, Broulee, Maloneys Beach	Council	DPE-EHG	Council, C&E Grants, NSW Environmental Trust, Coastcare Grants	Council (1) : C&E Grant (2)	$7,000	$7,000	$63,000	$21,000	$42,000	$-	$21,000	$42,000
RA2_E	Undertake shorebird management across Eurobodalla coastal zone.	All	Council / NPWS	DPE-EHG,DPI-LLS	Council and NPWS existing staff resources	Council and NPWS staff time	$ST	$ST	$ST	$ST	$ST	$ST	$ST	$ST
RA2_F	Support Coastcare/Landcare projects.	All	Council	DPE-EHG, NPWS	C&E Grant, Landcare Grants, Coastcare Grants	Landcare and Coastcare Grant Council (1) : C&E Grant (2)	$20,000	$20,000	$200,000	$-	$200,000	$20,000	$60,000	$120,000
RA2_G	Management of weeds of National Significance in coastal reserves	All	Council	NPWS	NPWS and Council existing staff resources	NPWS and Council existing staff resources	$ST	$ST	$ST	$ST	$ST	$ST	$ST	$ST
RA3_J	Investigate improved access at McKenzies Beach	McKenzies Beach	Council	DPE-EHG, TfNSW	Council, C&E Grants	Council (1) : C&E Grant (2)	$100,000	$-	$100,000	$33,333	$66,667	$-	$100,000	$-

ID	Management Action	Location	Lead Agency	Partners	Potential Funding Source	Cost Sharing	CMP Capital Cost	Ongoing Capital Cost and/or Maintenance (Annual)	Total Cost over CMP Business Plan	Council Costs	Stage Government Costs	Year 1	Year 2 to 4	Year 5 to 10
RA3_O	Continue to promote existing coastal walks	All	Council	DPE-EHG, NPWS	Council and NPWS existing staff resources	Council staff time	$ST	$ST	$ST	$ST	$ST	$ST	$ST	$ST
RA3_R	Implement disability-friendly access improvements to 8 of Council's most frequently visited beaches, including permanent floating decking from carparks to beach access, and roll-out mobility matting to improve foreshore access.	Surf Beach, Malua Bay Beach, South Broulee (Bengello) Beach, Moruya South Head, Tuross Head Main Beach, Dalmeny Beach, Narooma South Bar, Narooma Surf Beach	Council	None	2021 Regional Tourism Activation Fund	Regional Tourism Activation Grant	$123,750	$123,750	$495,000	$- (full cost covered by grant)	$-	$123,750	$371,250	$-
RA6_A	Engagement and management of impacts of bike track usage between Broulee Head and Moruya Heads	Bengello Beach	Council	DPE-EHG, DPE-Crown Lands Traditional Owners	Council	Council (1) : C&E Grant (2)	$-	$10,000	$90,000	$30,000	$60,000	$-	$30,000	$60,000
EGC2_A	Install coastal protection signage strategy to reduce illegal ICOLL openings	All	Council	DPE-EHG, DPI-Fisheries	Council, C&E Grants, NSW Environmental Trust	Council (1) : C&E Grant (2)	$20,000	$-	$20,000	$6,667	$13,333	$20,000	$-	$-
EGC2_B	Identify opportunities to promote, support and undertake citizen science and research initiatives with the coastal zone	All	Council	DPE-EHG,	Council, C&E Grants	Council (1) : C&E Grant (2)	$10,000	$10,000	$100,000	$33,333	$66,667	$10,000	$30,000	$60,000
EGC2_C	Preparation of community fact sheets to explain key issues in the CMP in a simple and readily understandable way.	All	Council	DPE-EHG	Council, C&E Grants	Council (1) : C&E Grant (2)	$20,000	$-	$20,000	$6,667	$13,333	$20,000	$-	$-
EGC3_B	Work with relevant State Agencies to strengthen shared and consistent management of coastal land	All	Council	DPE-EHG, DPE-Crown Lands, DPE-Planning, NPWS, DPI-LLS, SES DPI-Fisheries	Council	Multi-agency staff time	$ST	$ST	$ST	$ST	$ST	$ST	$ST	$ST
EGC3_D	Update PoM for reserve lands to address coastal risk	All	Council	NA	Council	Council staff time	$ST	$ST	$ST	$ST	$ST	$ST	$ST	$ST
EGC3_E	Incorporate coastal hazard risks into PoM as part of scheduled updates	National Parks	NPWS	Council, DPE-EHG	NPWS	NPWS staff time	$ST	$ST	$ST	$ST	$ST	$ST	$ST	$ST
EGC3_F	Undertaken maintenance of State Agency owned coastal assets to engineering and safety standards	All	MIDO	DPE-Crown Lands	MIDO	MIDO	$100,000	$100,000	$1,000,000	0	$1,000,000	$100,000	$300,000	$600,000

ID	Management Action	Location	Lead Agency	Partners	Potential Funding Source	Cost Sharing	CMP Capital Cost	Ongoing Capital Cost and/or Maintenance (Annual)	Total Cost over CMP Business Plan	Council Costs	Stage Government Costs	Year 1	Year 2 to 4	Year 5 to 10
EGC4_A	Identify opportunities for and undertake cultural burning in the coastal zone	All	Council	Traditional Owner , DPE-EHG, DPI-LLS, s, Heritage NSW, NPWS, DPE-Crown Lands	Council, C&E Grants, NSW Heritage Grant Program	Council (1) : C&E Grant (2)	$50,000	$25,000	$250,000	$83,333	$166,667	$50,000	$50,000	$150,000
EGC4_B	Support DPI Fisheries with the implementation of MEMS initiative 4	All	DPI-Fisheries	Traditional Owners, Council, DPE-EHG, NPWS	Council, NSW Heritage Grant Program	DPI, Marine Estate Management Strategy, NSW Heritage Grant Program	$100,000	$10,000	$190,000	$-	$190,000	$100,000	$30,000	$60,000
EGC4_C	Support Aboriginal cultural tourism opportunities in the coastal zone to protect Aboriginal heritage	All	Council	Traditional Owners, DPE-EHG, NPWS, DPI-Fisheries, Heritage NSW	Council, C&E Grants, NSW Heritage Grant Program	Council (1) : C&E Grant (2)	$30,000	$30,000	$300,000	$100,000	$200,000	$30,000	$90,000	$180,000
EGC4_D	Embed traditional Aboriginal knowledge, wisdom and culture in strategic planning by providing knowledge consulting fees to knowledge holders involved in coastal management to protect Aboriginal heritage in the coastal zone	All	Council	Traditional Owners, DPE-EHG, Heritage NSW	Council, C&E Grants, NSW Heritage Grant Program	Council (1) : C&E Grant (2)	$10,000	$10,000	$100,000	$33,333	$66,667	$10,000	$30,000	$60,000
EGC4_E	Support local Aboriginal Communities manage cultural heritage from coastal hazards and sea level rise and other coastal threats	All	Council	Traditional Owners, DPE-EHG, DPI-Fisheries, NPWS, Heritage NSW, DPE- Crown Lands	Council, C&E Grants, NSW Heritage Grant Program	Council (1) : C&E Grant (2)	$20,000	$70,000	$650,000	$216,667	$433,333	$20,000	$210,000	$420,000
EGC4_F	Improve access to Country in the coastal zone through the establishment of an Access to Country Plan	All	Council	Traditional Owners, NPWS, DPE-EHG, State Forest, DPE-Crown Lands	Council, C&E Grants, NSW Heritage Grant Program	Council (1) : C&E Grant (2)	$20,000	$5,000	$60,000	$20,000	$40,000	$-	$30,000	$30,000
EGC4_G	Identify and use Aboriginal place names	All	Council	Traditional Owners, NPWS, DPE-EHG, Geographical Names Board	Council, C&E Grants, NSW Heritage Grant Program	Council staff time	$ST	$ST	$ST	$ST	$ST	$ST	$ST	$ST
EGC4_H	Review, update and implement PoM for Aboriginal Place at Barlings Beach	Barlings Beach	Council	Traditional Owners, DPE-EHG, DPE-Crown Lands	Council, C&E Grants, NSW Heritage Grant Program	Council (1) : C&E Grant (2)	$5,000	$5,000	$50,000	$16,667	$33,333	$5,000	$15,000	$30,000
EGC4_I	Prepare an Aboriginal Seasonal Calendar	All	Council	Traditional Owners	Council, NSW Heritage Grant Program	Council	$15,000	$-	$15,000	$15,000	0	$15,000	$-	$-

ID	Management Action	Location	Lead Agency	Partners	Potential Funding Source	Cost Sharing	CMP Capital Cost	Ongoing Capital Cost and/or Maintenance (Annual)	Total Cost over CMP Business Plan	Council Costs	Stage Government Costs	Year 1	Year 2 to 4	Year 5 to 10
EGC4_J	Manage access issues and erosion at targeted sites of significant value to Aboriginal Community as identified by the LALC's	Tilba Beach, Nangudga, Broulee	Council	Traditional Owners, NPWS, DPE-EHG, DPE-Crown Lands	Council, C&E Grants	Council (1) : C&E Grant (2)	$15,000	$-	$15,000	$5,000	$10,000	$15,000	$-	$-
MER1	Coastal Hazards Monitoring Program	All	Council	DPE – EHG, DPE-Crown Lands	Council, C&E Grants	Council (1) : C&E Grant (2)	$100,000	$-	$100,000	$33,333	$66,667	$100,000	$-	$-
MER2	Habitat Condition Monitoring Program	All	Council	DPE – EHG DPI – Fisheries Seek opportunities to engage or partner with universities for this action	Council, C&E Grants	Council (1) : C&E Grant (2)	$150,000	$33,333	$450,000	$150,000	$300,000	$150,000	$150,000	$150,000
MER3	Bathymetry survey in Batemans Bay	Batemans Bay	Council	DPE – EHG	Council, C&E Grants	Council (1) : C&E Grant (2)	$160,000	$20,000	$320,000	$106,667	$213,333	$-	$160,000	$160,000
MER4	Review of CMP progress	All	Council	N/A	Council, C&E Grants	Council and DPE-EHG Staff time	$ST	$ST	$ST	$ST	$ST	$ST	$ST	$ST
MER5	10-year review of CMP	All	Council	CEMAC, DPE – EHG	Council, C&E Grants	Council (1) : C&E Grant (2)	$350,000	$-	$350,000	$116,667	$233,333	$-	$-	$350,000

6 Coastal Zone Emergency Action Subplan, if the *Coastal Management Act 2016* Requires that Subplan to be Prepared

The CM Act requires that a Coastal Zone Emergency Action Subplan (CZEAS) be included in the CMP if Council's LGA contains land within the CVA and beach erosion, coastal inundation or cliff instability is occurring on that land due to storm activity or an extreme or irregular event.

The CVA prepared for the Eurobodalla Shire coastline is shown in **Map RG-07-01** and described in **Section 8.2**.

The Eurobodalla Shire open coast is subject to the coastal hazards of beach erosion, coastal inundation and cliff instability within the CVA. As such, a CZEAS has been prepared in accordance with the mandatory requirements for CZEAS' specified in the CM Act and accompanying NSW Coastal Management Manual (OEH, 2018).

The CZEAS for the Eurobodalla Open Coast is contained in **Appendix H**.

7 Monitoring, Evaluation and Reporting Program

Management actions have been developed for a Monitoring Evaluation and Reporting (MER) Program for the Eurobodalla Open Coast over a ten-year period, to monitor, evaluate and report on the success of the implementation of this CMP.

This CMP and all progressed actions should be reviewed to ensure the actions remain relevant and the implementation of the CMP is being achieved, through achievement of performance targets. Where performance targets have not been achieved, then remedial actions will be required.

The actions to be implemented as part of the MER Program are listed in **Table 7-1**. Reporting requirements for the program are captured in MER4 and end of implementation period reporting requirements for the program are captured in MER5.

The recommended MER actions in **Table 7-1** have been described in terms of:

- Action ID – code for each action for easy reference
- Description – an outline of the scope of works required
- Lead Organisation – agency responsible for implementation of the action
- Support Organisation(s) – may be required and/or requested to assist in implementation of the action, either through on-ground works, in-kind contributions or as a potential funding or information source.
- Indicative Cost – an estimate of total costs for implementation over the ten-year life of the plan is provided (2022$). Where actions require Council staff resources, actual costs have only been applied where it is expected that implementation will exceed current resourcing levels and additional funding is required.
- Indicative Timeframe – indicative timeframe for implementation and alignment with Council's Delivery Program.
- Performance targets – these can be used to measure the level of success of the plan.

Table 7-1 Monitoring, Evaluation and Reporting (MER) Program

ID	Action	Description	Lead Organisation	Support Organisation(s)	Indicative Cost (10 Year)	Indicative Timeframe	Performance Targets
MER1	Coastal Hazards Monitoring Program	Design and implement a Coastal Hazards Monitoring Program to underpin Council's adaptive management of coastal risks. The strategy would incorporate: a) Assessment of condition and effectiveness of coastal protection infrastructure, public access, coastal event response etc. b) Determine whether trigger points for changing coastal risk management approaches have been reached. Based on the above determine the need to update existing coastal hazard assessment and mapping or supplement with local scale assessments in high risk areas.	Council	DPE – EHG, DPE-Crown Lands	$100,000	Ongoing	Design of program complete by Year 2 Interim report at Year 5 to report on outcomes and any required works
MER2	Habitat Condition Monitoring Program	Monitor condition of habitats of high ecological and/or conservation value e.g. dune systems. Monitoring program to track the health and condition of key habitats. Mapping of condition will form the key output.	Council	DPE – EHG DPI - Fisheries Seek opportunities to engage or partner with universities for this action	$150,000	Every 3 years starting in Year 1	Reporting and condition mapping complete in Year 1, Year 4, Year 7 and Year 10
MER3	Bathymetry survey in Batemans Bay	Undertake bathymetric surveys in Batemans Bay to improve the understanding of sand movement and sand availability in this location for dredging and beach nourishment purposes. Ideally two surveys throughout the 10 year implementation of this CMP would provide adequate data to adjust proposed sand nourishment volumes. Bathymetric surveys at this location may also be triggered by significant coastal erosion or flood events that appear to have significantly changed the offshore sand deposits in Batemans Bay.	Council	DPE – EHG	$160,000	Every 5 years starting in Year 2 or triggered by significant coastal erosion or flood events	Reporting and bathymetric survey complete in Year 2 and Year 7.
MER4	Review of CMP progress	Documentation of the effectiveness of the proposed strategies and actions will be reported as part of Council's Annual Report (which is part of the IP&R framework), including progress towards or full achievement of the performance targets included for each action. Where performance targets have not been achieved, then remedial actions will be required, and these remedial actions should also be documented in the Annual Report. The cause of non-compliance should be ascertained i.e. lack of funding, lack of resources and the remedial actions put in place to address the non-compliance i.e. identify additional funding sources, allocate additional resources, etc	Council	N/A	No additional cost (staff time)	Annually (Annual Report)	CMP progress included in Annual Report.
MER5	10-year review of CMP	The CMP and the specified management actions should be reviewed to ensure they are being achieved and are resulting in the desired outcomes. A ten-year review (or earlier if warranted by legislative or management changes or improved scientific understanding) of the CMP is required to consider: a) Results of the Annual Reporting b) Review of status of CMP actions including overall success and any barriers to effective implementation c) Any new or updated scientific knowledge d) Data provided by MER actions in this CMP e) Prevailing community attitudes, government policy and strategic planning status.	Council	CEMAC, DPE – EHG	$350,000	Year 10	Review and reporting undertaken by the end of Year 10. Adoption and certification of the amended CMP as required.

8 Maps

8.1 Overview of mapping

Mapping in this CMP includes:

- Coastal management areas (**Section 8.2**) including coastal vulnerability area (**Section 7.2.1**)
- Coastal sediment compartments (**Section 1.2.2** and **Map RG-05-02**)
- Coastal hazard mapping (**Appendix B**)
- Coastal management actions (details on actions provided in **Section 5**).

8.2 Coastal Management Areas

As discussed in **Section 1.2.1** the four coastal management areas as defined by the CM Act and Resilience and Hazards SEPP are included in this CMP.

Map RG-01-01 presents all the coastal management areas including the proposed Coastal Vulnerability Area.

No changes to the mapping of the following coastal management areas are proposed:

- Coastal Wetlands and Littoral Rainforests
- Coastal Use Area
- Coastal Environment Area.

The proposed Coastal Vulnerability Area mapping is discussed in **Section 8.2.1**.

8.2.1 Coastal Vulnerability Area

The requirement for the mapping of the CVA is set out in the CM Act. The purpose of the mapping is to ensure the targeted application of coastal management measures to:

- manage safety and risk associated with current and future coastal hazards
- to mitigate current and future risk from coastal hazards
- to maintain the existing ecosystems
- to maintain public amenity
- to encourage land appropriate land use
- to support the continued functionality of essential infrastructure during and immediately after a coastal hazard emergency.

The Act does not explicitly define what is to be incorporated into the CVA, but rather than it should cover "land subject to coastal hazards". The Act does require that future risk and the impacts of climate change be incorporated into the CVA.

Based on the CVA mapping, the Resilience and Hazards SEPP prohibits development within the CVA unless the consent authority is satisfied that:

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

(b) the proposed development:

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

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

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

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

The CVA prepared for the Eurobodalla Shire coastline is shown in **Map RG-07-01**.

The extent of the CVA takes into account the full range of coastal hazards identified in the CM Act, namely:

- Beach erosion
- Shoreline recession
- Coastal lake or watercourse 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.

Beach erosion, shoreline recession, coastal inundation and tidal inundation were all assessed as part of the Stage 2 vulnerability assessment. The Stage 2 assessment identified high risks associated with these coastal hazards at a number of locations. The Stage 2 assessment identified that management of these risks was required. The affectation extents of these hazards from the Stage 2 assessment have been used to define the CVA to assist in the appropriate management of the risks associated with the coastal hazards.

Coastal lake or watercourse instability and erosion and inundation of lake or watercourse foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters have not been included explicitly as their assessment was beyond the scope of this CMP. However, the regions where they may be applicable are captured by the extent of coastal inundation, which is the key driver of the CVA extent.

Coastal and cliff instability has been incorporated in Long Beach, Corrigans Beach and Caseys Beach based on the findings of the *Geotechnical Slope Instability Risk Assessment* undertaken as part of the CZMP for Batemans Bay by ACT Geotechnical Engineers (2012). The study identified several discrete locations that were experiencing coastal and cliff instability that required management and were therefore included in the CVA mapping. For the purposes of the CVA mapping, adjacent areas that exhibited similar landforms were also included.

The Act requires the consideration of future climate change. As such, all extents used in defining the CVA have been based on the 2100 planning horizon, which incorporates the projected effects sea level rise on coastal hazards. The use of the 2100 scenario is required to allow Council to control developments (such as subdivisions) that are expected to have a lifetime out to this planning horizon.

9 Reference List

ACT Geotechnical Engineers Pty Ltd (2012). *Geotechnical Slope Instability Risk Assessment*. Prepared on behalf of Umwelt Australia Pty Ltd as an input to the CZMP

BMT WBM (2009). *Wharf Road Coastal Hazard Assessment and Hazard Management Plan.* Report prepared for Eurobodalla Shire Council.

DPE (2022) Flood Risk Management Guide MM01: Flood Risk Management Measures

OEH (2018). Coastal Management Manual.

Rhelm (2022a) *Eurobodalla Open Coast Coastal Management Program Stage 1 – Scoping Study.* Prepared for Eurobodalla Shire Council. Final report, June 2022.

Rhelm (2022b) *Eurobodalla Open Coast Coastal Management Program Stage 2 – Vulnerability Assessments.* Prepared for Eurobodalla Shire Council. Final report, 21 January 2022.

Pascoe, S., Doshi, A., Kovac, M and Austin, A. 2017. *What's my beach worth? Economic values of NSW coastal assets*, Proceedings 26th Annual NSW Coastal Conference.

Pascoe, S. and Doshi, A., 2018. Estimating coastal values using multi-criteria and valuation methods.

Salients (2022) *Moruya River, Mummuga Lake and Wagonga Inlet Estuarine Coastal Management Program*, prepared for Eurobodalla Shire Council

Whitehead & Associates (2014). South Coast Regional Sea Level Rise Policy and Planning Framework. Report prepared for Eurobodalla Shire and Shoalhaven City Councils, Final, October.

10 Acronyms and Abbreviations

AAD	Average Annual Damage
AHD	Australian Height Datum
ARI	Average Recurrence Interval
BCR	Benefit-Cost Ratio
CBA	Cost-Benefit Analysis
CEMAC	Coastal & Environment Management Advisory Committee
CM Act	NSW *Coastal Management Act 2016*
CM Manual	NSW Coastal Management Manual
CMP	Coastal Management Program
CVA	Coastal Vulnerability Area
CZMP	Coastal Zone Management Plan
CZEAS	Coastal Zone Emergency Action Subplan
DCP	Development Control Plan
DECC	Former NSW Department of Energy and Climate Change
DPE	NSW Department of Planning and Environment (formerly DPIE)
DPI	NSW Department of Primary Industries
DPIE	Former NSW Department of Planning, Industry and Environment (now DPE)
ESD	Ecologically Sustainable Development
FBL	Foreshore building line
FYRR	First Year Rate of Return
ICOLL	Intermittently closed and open lake or lagoon
IRR	Internal Rate of Return
km^2	Square kilometres
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local government area
LLS	Local Land Services
m^2	Square metres
m^3	Cubic metres
m/s	Metres per second
m^3/s	Cubic metres per second
MCA	Multi-Criteria Assessment
MER	Monitoring, Evaluation and Reporting
MIDO	Maritime Infrastructure Delivery Office
MSL	Mean Sea Level

NPV	Net Present Value
NPVI	Net Present Value of Investment
NPWS	National Parks and Wildlife Service
NSW	New South Wales
OEH	Former NSW Office of Environment and Heritage, now Department of Planning and Environment (DPE)
PoM	Plan of Management
PV	Present Value
SEPP	State Environmental Planning Policy
TfNSW	Transport for NSW
WRL	Water Research Laboratory

11 Glossary*

Average Annual Damage (AAD)	The AAD is the average damage per year that would occur in a particular area from a natural disaster event i.e. flooding, over a very long period of time. In many years there may be no damage, in some years there will be minor damage (i.e. caused by small, relatively frequent flood events) and in some years there will be major damage (i.e. caused by large, rare flood events). AAD provides the basis for comparing the economic effectiveness of different management measures against natural disaster events of all sizes i.e. their ability to reduce the AAD.
Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level.
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.
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 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.
Benefit-Cost Ratio (BCR)	The ratio of the present value of total incremental benefits over the present value of total incremental costs. A BCR is an indicator showing the relationship between the relative costs and benefits of a proposed project or option. If a project has a BCR greater than 1.0, the project is expected to deliver a positive net present value and can be considered as economically feasible.
Cost Analysis	An evaluation of the specific cost elements of a contract or proposal to appraise their statutory compliance, distribution, and reasonableness.
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
Climate change	A process that 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.

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 environment area	Land identified in the CM Act as land containing coastal features such as coastal waters of the State, estuaries, coastal lakes, coastal lagoons and land adjoining those features, including headlands and rock platforms. The Resilience and Hazards SEPP maps the extent of the coastal environment area for planning purposes.
Coastal hazard	Coastal hazards, as defined by the CM Act, include beach erosion, shoreline recession, coastal lake or watercourse entrance instability, coastal inundation, coastal cliff or slope instability, tidal inundation, and 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). In the case of an estuary, coastal inundation may be caused by a combination of processes including high tides, storm surge and wave run-up onto the foreshore.
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 Program (CMP)	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 processes	Coastal processes are the set of mechanisms that operate at the land-water interface. These processes incorporate sediment transport and are governed by factors such as tide, wave and wind energy.
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 use area	Land identified by the CM Act and Resilience and Hazards SEPP as being land adjacent to coastal waters, estuaries, coastal lakes and lagoons where development is or may be carried out (now or in the future). The Resilience and Hazards SEPP maps the extent of the coastal use area for planning purposes.
Coastal vulnerability area (CVA)	Defined in the CM Act as land subject to seven coastal hazards.

Coastal Zone	The coastal zone, as defined by the CM Act, means the area of land comprised of the following coastal management areas: (a) the coastal wetlands and littoral rainforests area, (b) the coastal vulnerability area, (c) the coastal environment area, (d) the coastal use area.
Development	As defined in the *Environmental Planning and Assessment Act 1979*. New development refers to development of a completely different nature to that associated with the former land use, e.g. the urban subdivision of an area previously used for rural purposes. New developments involve re-zoning and typically require major extensions of existing urban services, such as roads, water supply, sewerage and electric power. Infill development refers to the development of vacant blocks of land that are generally surrounded by already developed properties and is permissible under the current zoning of the land. Conditions such as minimum floor levels may be imposed on infill development. Redevelopment refers to rebuilding in an area, e.g., as urban areas age, it may become necessary to demolish and reconstruct buildings on a relatively large scale. Redevelopment generally does not require either re-zoning or major extensions to urban services.
Dredging	Maintenance dredging is 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.
Dune	Coastal dunes are 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.
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 (CBA) 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 (MCA) is not an economic evaluation but may assist decision-making in other ways.
Estuary	The CM Act defines an estuary 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.
Extreme Ocean Water Level	The highest elevation reached by the sea/ocean as recorded by a tide gauge during a given period (after MHL, 2018).
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.
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'.
Flood	A general and temporary condition of partial or complete inundation of normally dry land areas, including inundation as a result of sea/ocean storms and other coastal processes or catchment flows.
Flood risk	Potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk is divided into three types, existing, future and continuing risks as described below: Existing flood risk is the risk a community is exposed to as a result of its location on the floodplain. Future flood risk is the risk a community may be exposed to as a result of new development on the floodplain. Residual flood risk is the risk a community is exposed to after floodplain risk management measures have been implemented.
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.

High Tide	The maximum height reached by a rising tide. The high water is due to the periodic tidal forces and the effects of meteorological, hydrologic, and/or oceanographic conditions.
Intermittently closed and open lakes and lagoons (ICOLLs)	Coastal lakes and lagoons where the entrance may be closed to the sea from time to time and for varying periods, by accretion of a berm. ICOLLs have sensitive water quality because they accumulate loads of sediment and nutrients from the catchment and may have poor water circulation and flushing.
Managed retreat	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.
Mean Sea Level (MSL)	MSL is a measure of the average height of the sea or ocean's surface such as the halfway point between the mean high tide and the mean low tide. At present, mean sea level is approximately equivalent to 0 mAHD (reported as 0.03 mAHD in MHL, 2019).
Multi-criteria assessment (MCA)	An MCA is 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.
Net Present Value (NPV)	The difference between the present value of total incremental benefits and the present value of the total incremental costs in the improved option.
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.
Risk	The chance of something happening that will have an impact on objectives, usually measured in terms of a combination of the consequences of an event and likelihood of occurrence.

Sea level rise	A rise in the level of the sea surface that has occurred or is projected to occur in the future, as measured from a point in time. The rise can be reported as a global mean or as measured at a specific point or estimated for a specific part of the sea or ocean.
Shoreline	The intersection between the sea and the land. The line delineating the shoreline is often approximated as the Mean High Water Mark, however, the definition can vary depending on the application.
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.
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.
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. For planning controls, it is defined as the land that is inundated up to the level of Highest Astronomical Tide.
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	Waves resulting from the action of the wind on the surface of the water.

*Many of the glossary terms here are derived or adapted from the *Coastal Management Glossary* (OEH, 2018).

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Maps

Rhelm

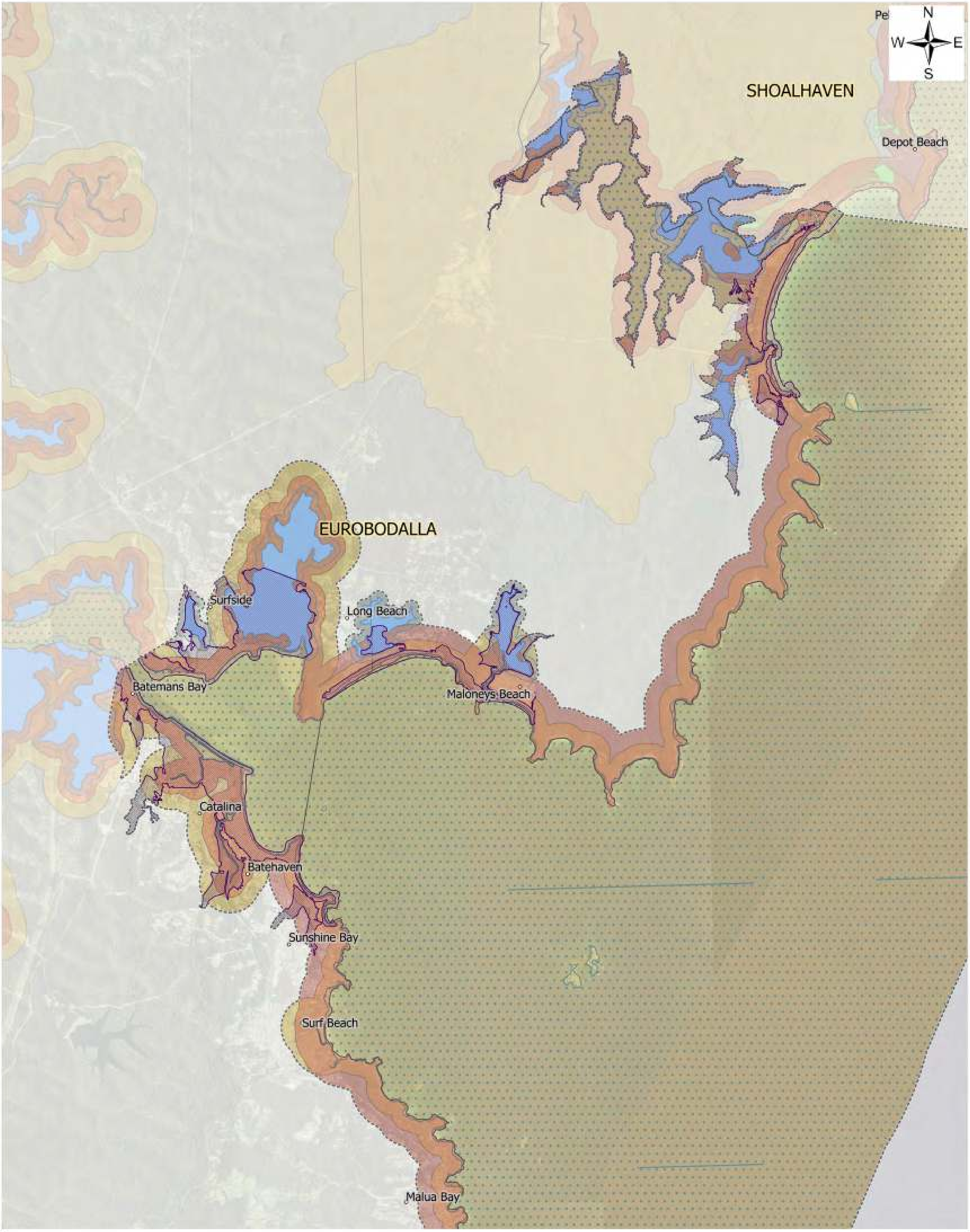
Scale : 1:30,000@A3
Date : 15 August 2022
Revision : C
Created by : LRE
Coordinate System : MGA94/56

0 5 10 15 20 25 km

Legend

- CMP Study Area
- Batemans Marine Park
- Littoral Rainforest
- Littoral_Rainforest Proximity Area
- Coastal Wetland
- Coastal Wetland Proximity Area
- Coastal Environmental Area
- Coastal Use Area
- Proposed Coastal Vulnerability Area

RG-01-01
Study Area



Rhelm

Scale : 1:30,000@A3
Date : 15 August 2022
Revision : C
Created by : LRE
Coordinate System : MGA94/56

0 1 2 3 4 5 km

Legend

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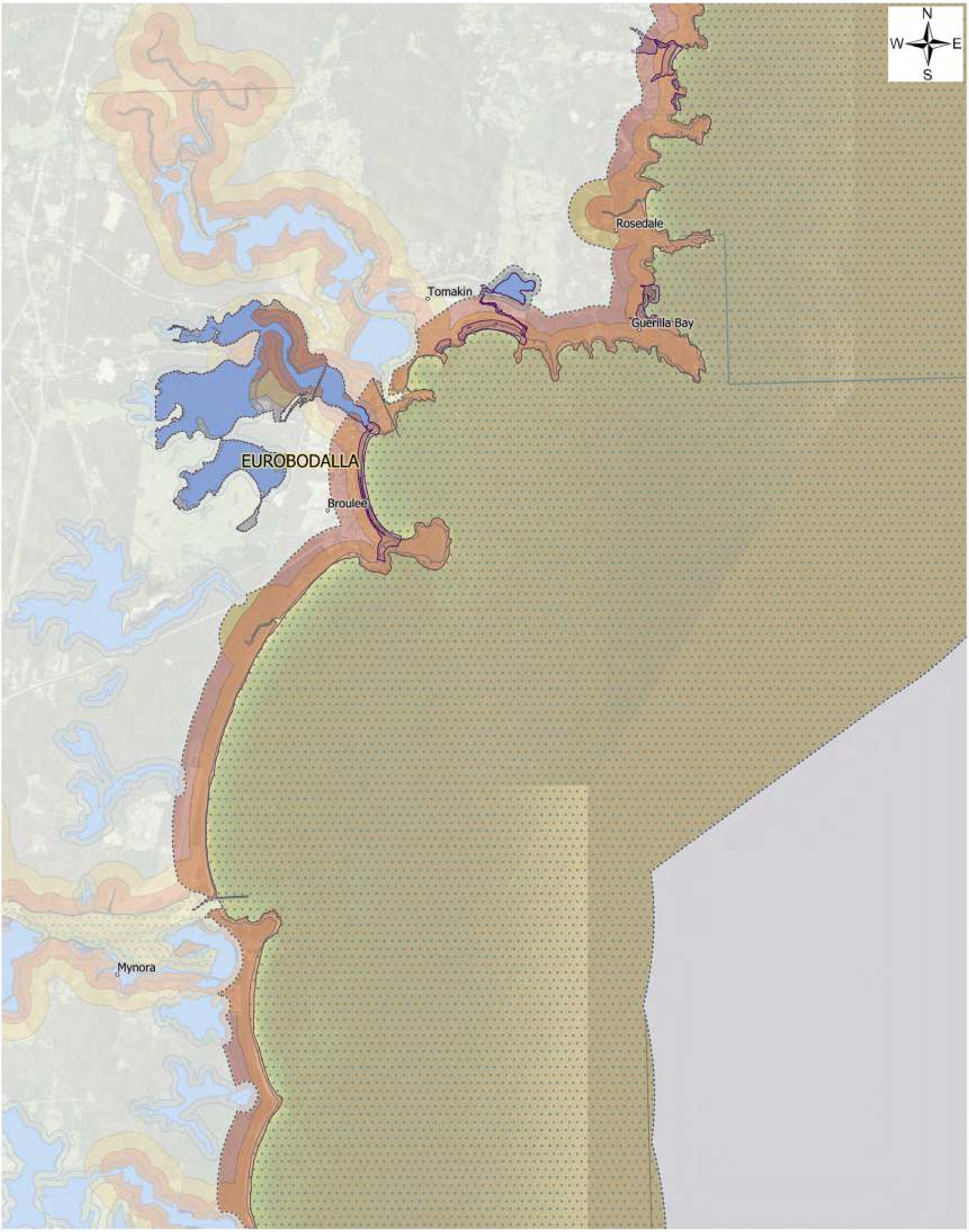
RG-01-01
Study Area



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Coordinate System : MGA94/56

0 1 2 3 4 5 km

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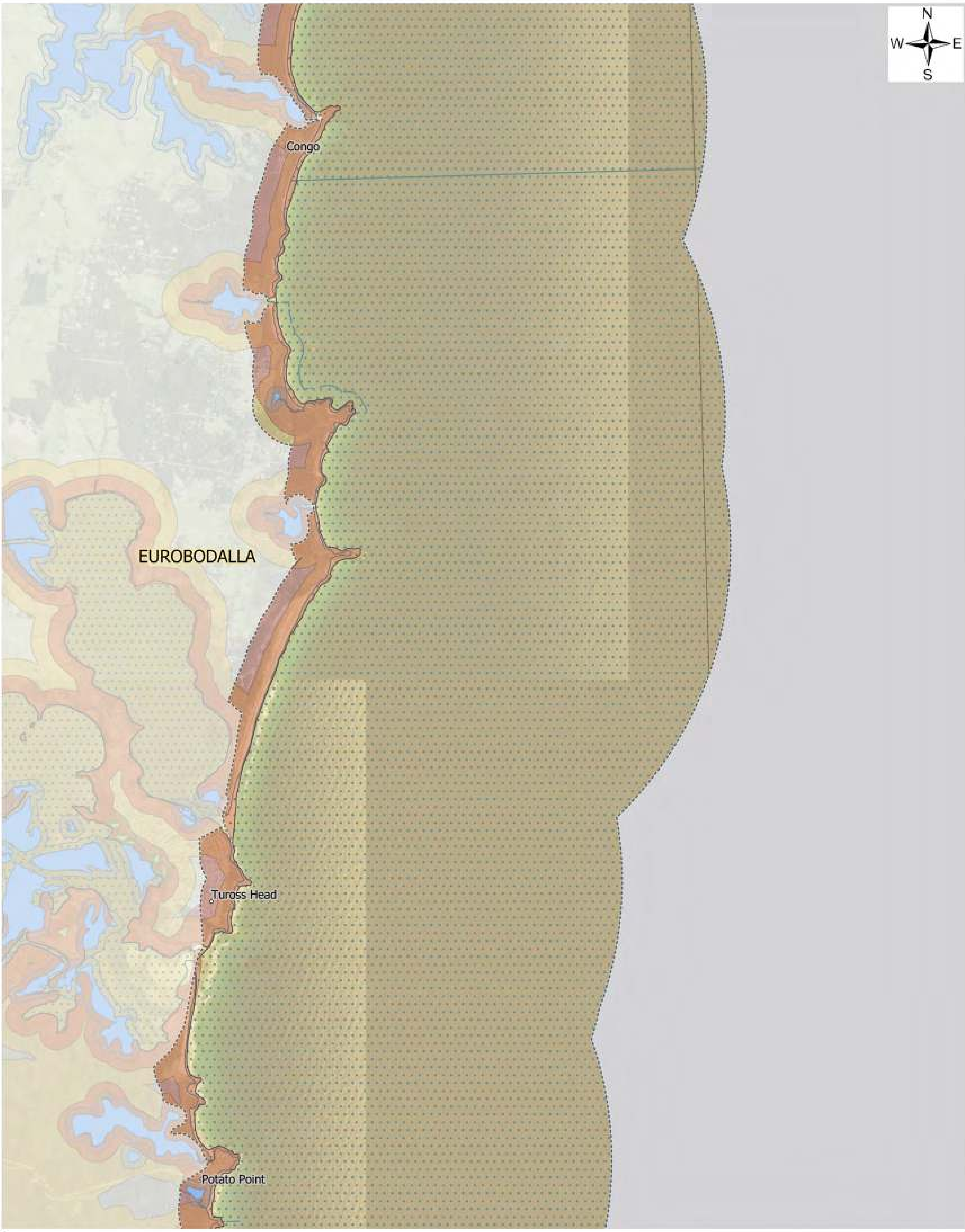
RG-01-01
Study Area



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Revision : C
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Coordinate System : MGA94/56

0 1 2 3 4 5 km

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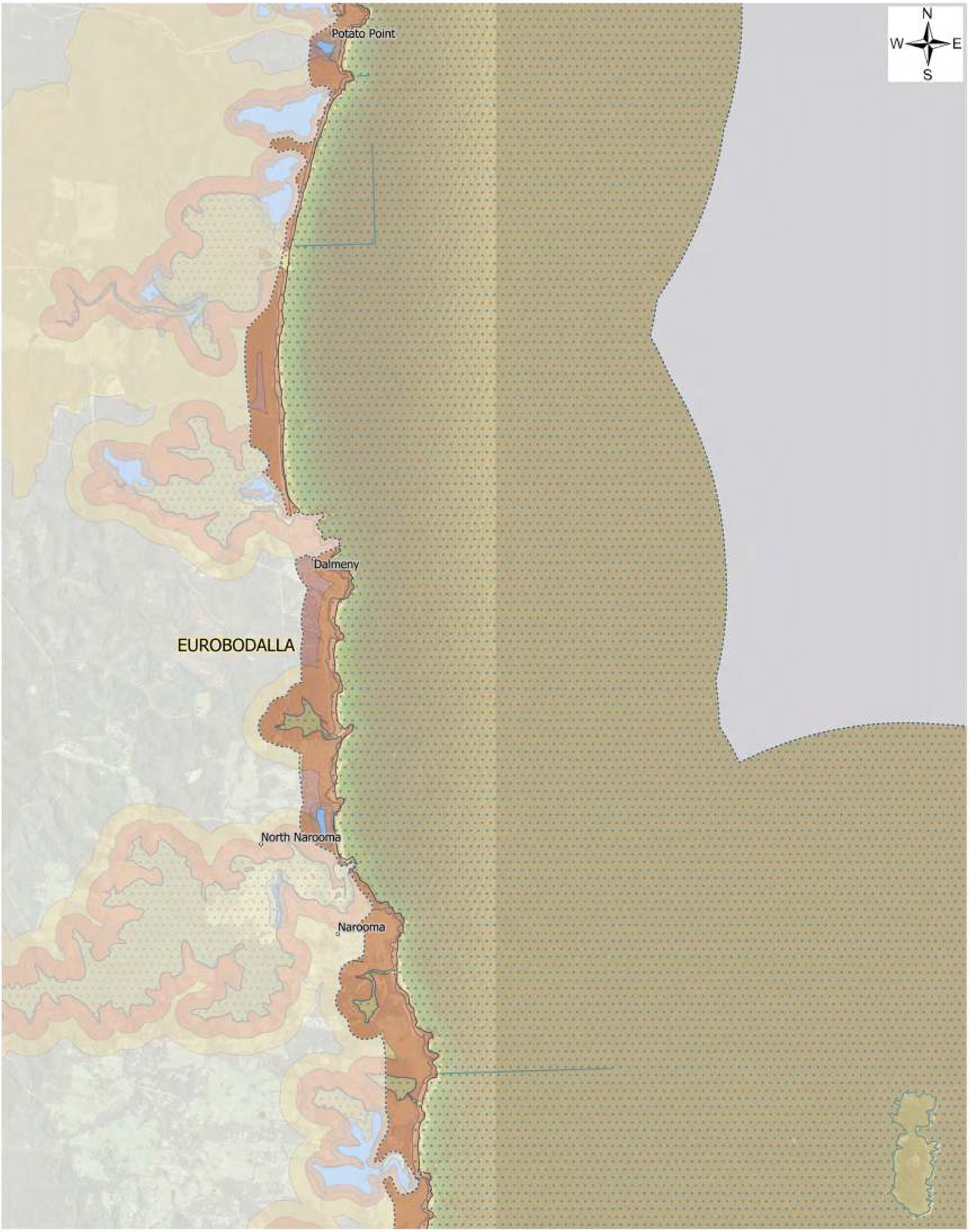
RG-01-01
Study Area



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Created by : LRE
Coordinate System : MGA94/56

0 1 2 3 4 5 km

Legend

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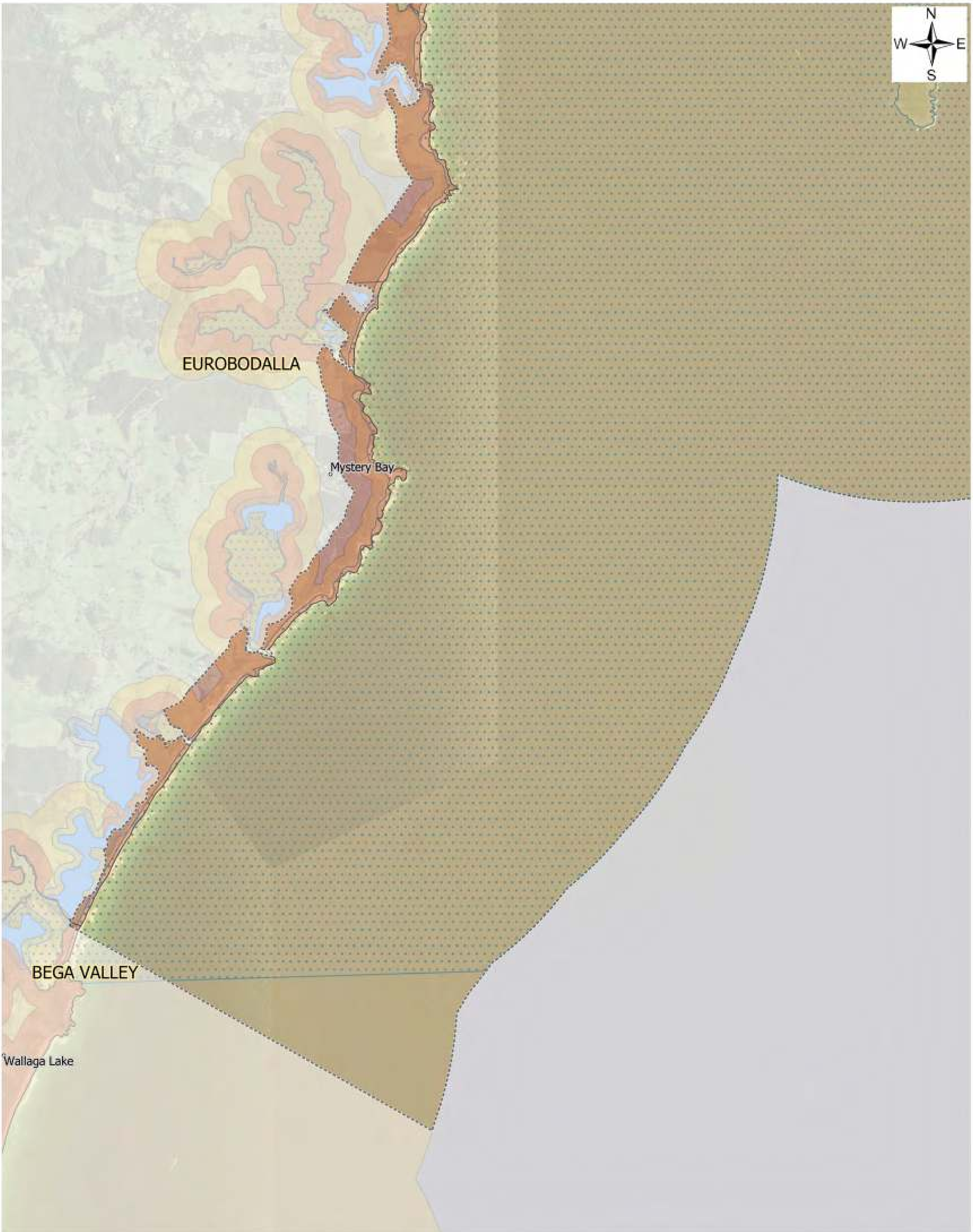
RG-01-01
Study Area



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Date : 15 August 2022
Revision : C
Created by : LRE
Coordinate System : MGA94/56

0 1 2 3 4 5 km

Legend

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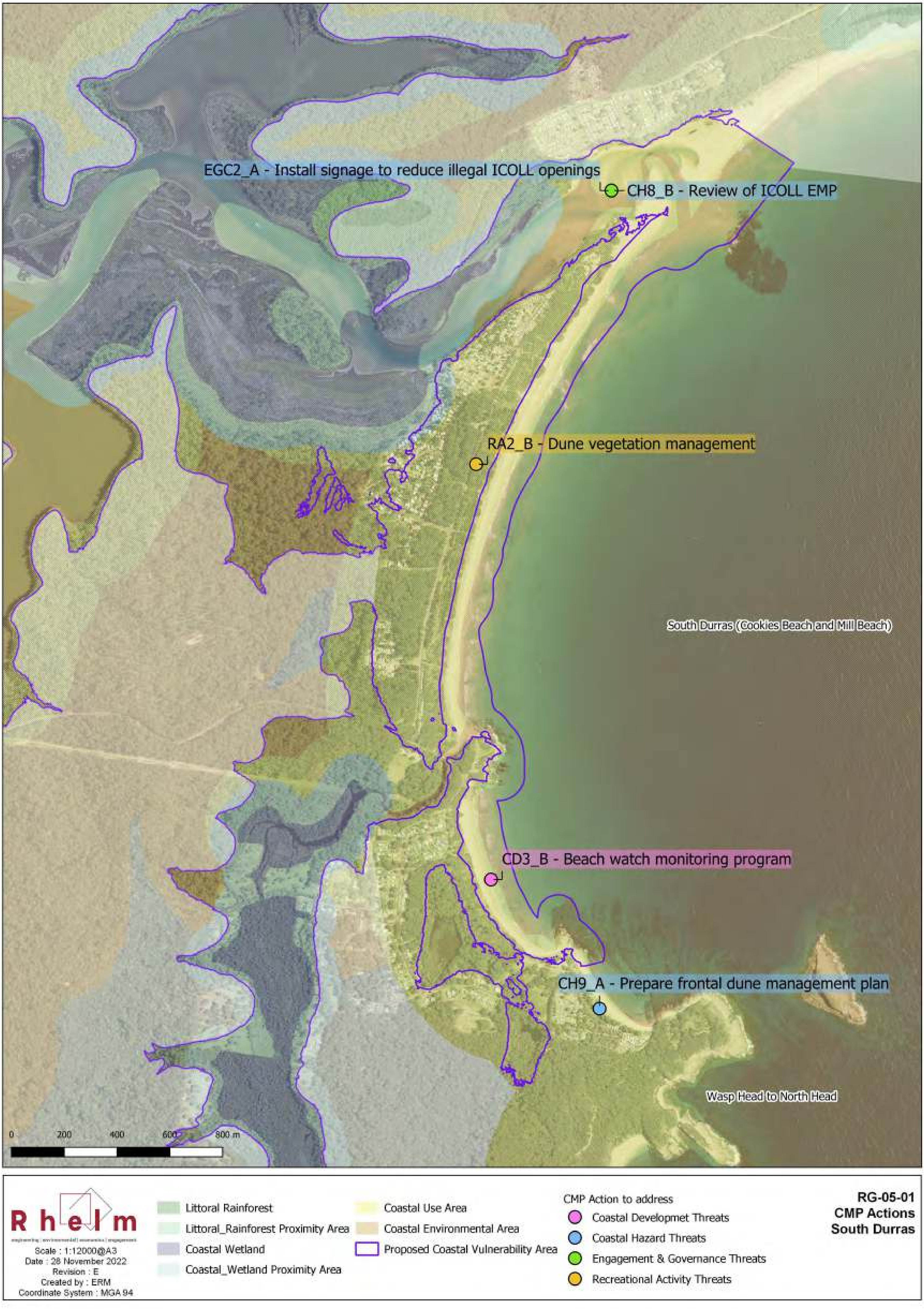
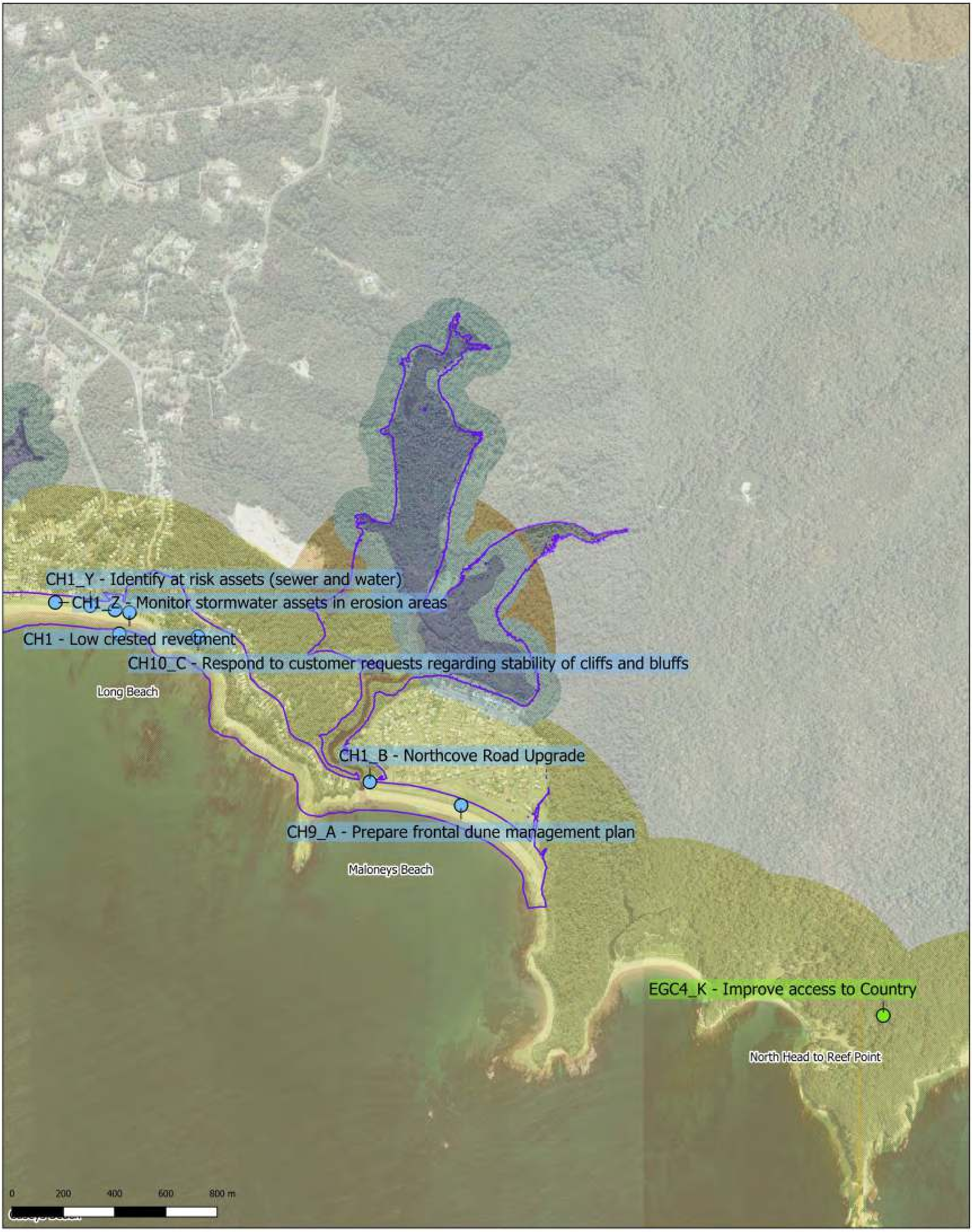
RG-01-01
Study Area



EGC2_A - Install signage to reduce illegal ICOLL openings
CH8_B - Review of ICOLL EMP
RA2_B - Dune vegetation management
South Durras (Cookies Beach and Mill Beach)
CD3_B - Beach watch monitoring program
CH9_A - Prepare frontal dune management plan
Wasp Head to North Head
0
200
400
600
800 m
Rhelm
Scale : 1:12000@A3
Date : 28 November 2022
Revision : E
Created by : ERM
Coordinate System : MGA 94
Littoral Rainforest
Littoral_Rainforest Proximity Area
Coastal Wetland
Coastal_Wetland Proximity Area
Coastal Use Area
Coastal Environmental Area
Proposed Coastal Vulnerability Area
CMP Action to address
Coastal Developmet Threats
Coastal Hazard Threats
Engagement & Governance Threats
Recreational Activity Threats
RG-05-01
CMP Actions
South Durras



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engineering | environmental | economics | engagement

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Littoral Rainforest
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Coastal Wetland
Coastal_Wetland Proximity Area
Coastal Use Area
Coastal Environmental Area
Proposed Coastal Vulnerability Area

CMP Action to address
Coastal Developmet Threats
Coastal Hazard Threats
Engagement & Governance Threats
Recreational Activity Threats

RG-05-01
CMP Actions
North Head to Long Beach

Rhelm

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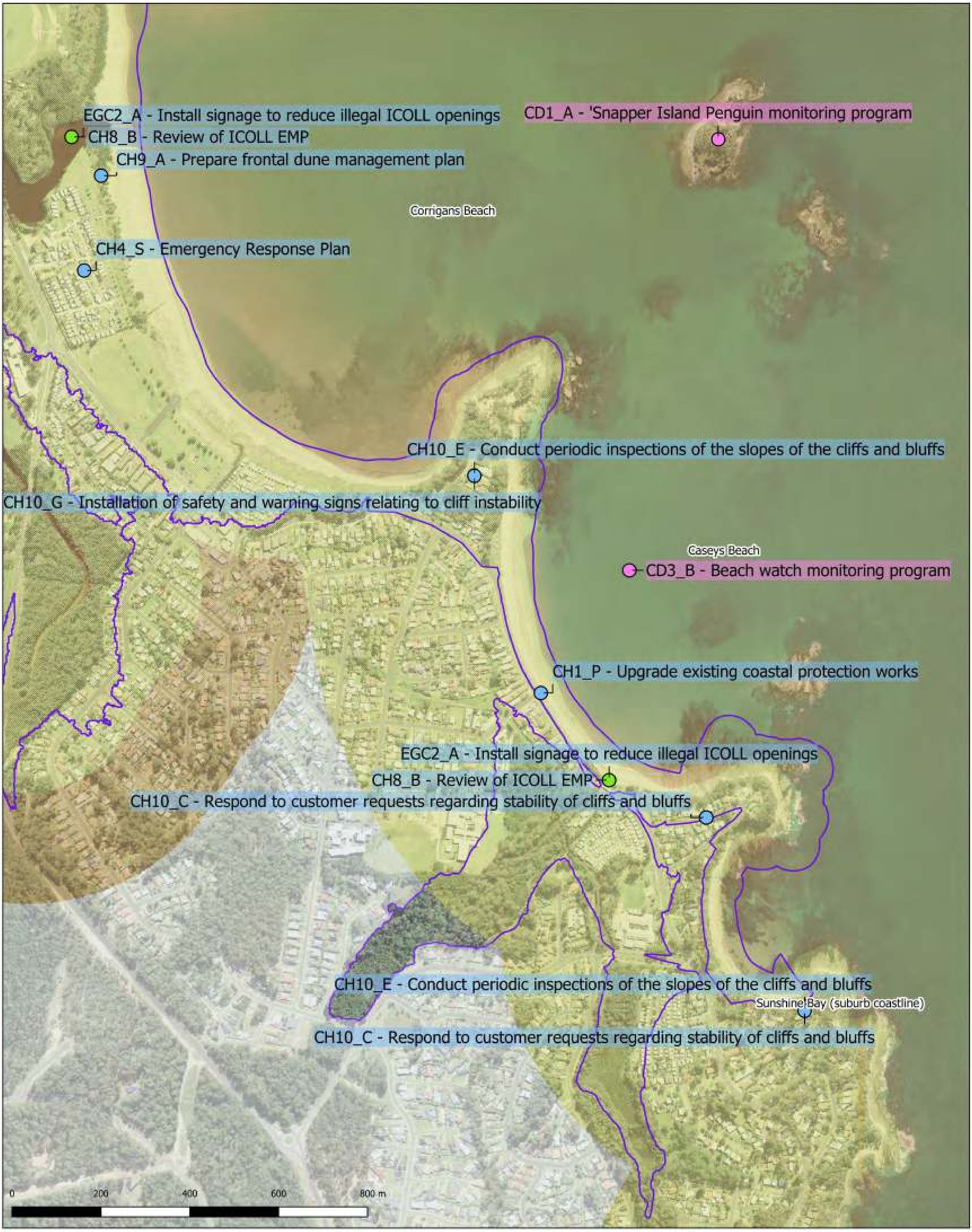
Scale : 1:7500@A3
Date : 28 November 2022
Revision : E
Created by : ERM
Coordinate System : MGA 94

Littoral Rainforest
Littoral_Rainforest Proximity Area
Coastal Wetland
Coastal_Wetland Proximity Area
Coastal Use Area
Coastal Environmental Area
Proposed Coastal Vulnerability Area

CMP Action to address
- Coastal Developmet Threats
- Coastal Hazard Threats
- Engagement & Governance Threats
- Recreational Activity Threats

RG-05-01
CMP Actions
Surfside to CBD



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Scale : 1:7500@A3
Date : 28 November 2022
Revision : E
Created by : ERM
Coordinate System : MGA 94

Littoral Rainforest
Littoral_Rainforest Proximity Area
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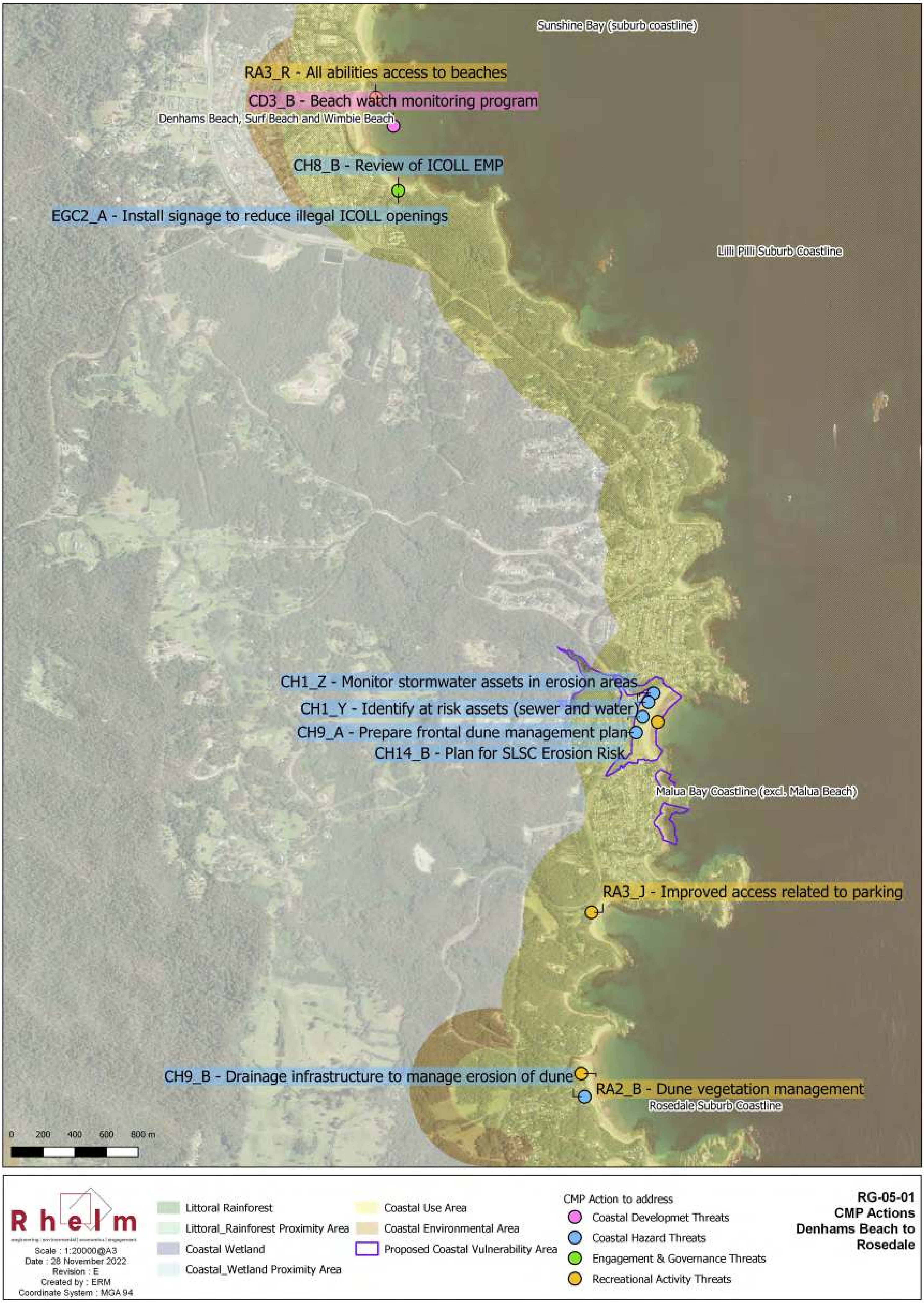
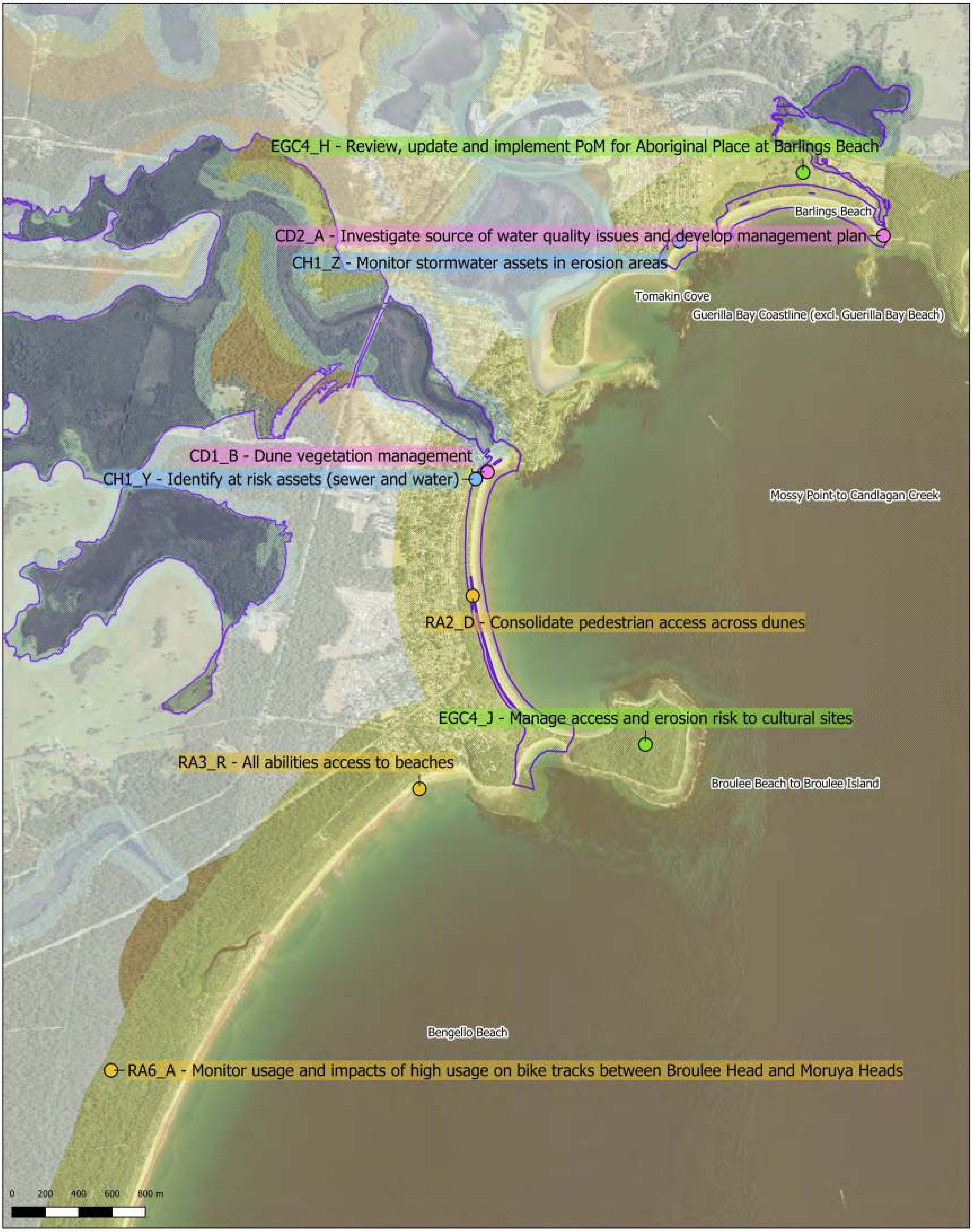
Proposed Coastal Vulnerability Area

CMP Action to address
Coastal Developmet Threats
Coastal Hazard Threats
Engagement & Governance Threats
Recreational Activity Threats

RG-05-01
CMP Actions
Corrigans Beach to Sunshine Bay



Sunshine Bay (suburb coastline)
RA3_R - All abilities access to beaches
CD3_B - Beach watch monitoring program
Denhams Beach, Surf Beach and Wimbie Beach
CH8_B - Review of ICOLL EMP
EGC2_A - Install signage to reduce illegal ICOLL openings
Lilli Pilli Suburb Coastline
CH1_Z - Monitor stormwater assets in erosion areas
CH1_Y - Identify at risk assets (sewer and water)
CH9_A - Prepare frontal dune management plan
CH14_B - Plan for SLSC Erosion Risk
Malua Bay Coastline (excl. Malua Beach)
RA3_J - Improved access related to parking
CH9_B - Drainage infrastructure to manage erosion of dune
RA2_B - Dune vegetation management
Rosedale Suburb Coastline
0 200 400 600 800 m
Rhelm
Scale : 1:20000@A3
Date : 28 November 2022
Revision : E
Created by : ERM
Coordinate System : MGA 94
Littoral Rainforest
Littoral_Rainforest Proximity Area
Coastal Wetland
Coastal_Wetland Proximity Area
Coastal Use Area
Coastal Environmental Area
Proposed Coastal Vulnerability Area
CMP Action to address
Coastal Developmet Threats
Coastal Hazard Threats
Engagement & Governance Threats
Recreational Activity Threats
RG-05-01
CMP Actions
Denhams Beach to
Rosedale



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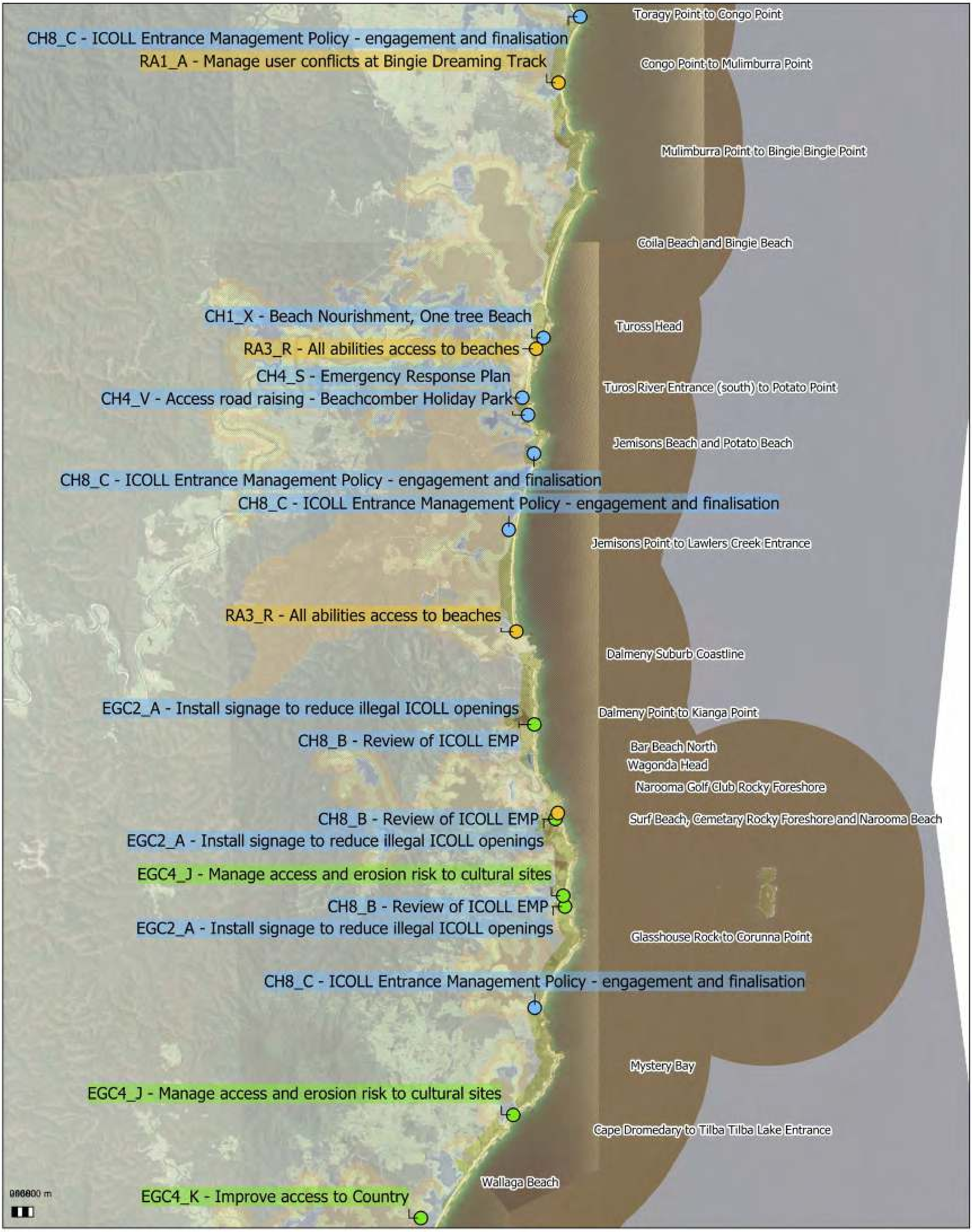
Coordinate System : MGA 94

- Littoral Rainforest
- Littoral_Rainforest Proximity Area
- Coastal Wetland
- Coastal_Wetland Proximity Area
- Coastal Use Area
- Coastal Environmental Area
- Proposed Coastal Vulnerability Area

CMP Action to address
- Coastal Developmet Threats
- Coastal Hazard Threats
- Engagement & Governance Threats
- Recreational Activity Threats

RG-05-01
CMP Actions
Guerilla Bay to Bengello Beach



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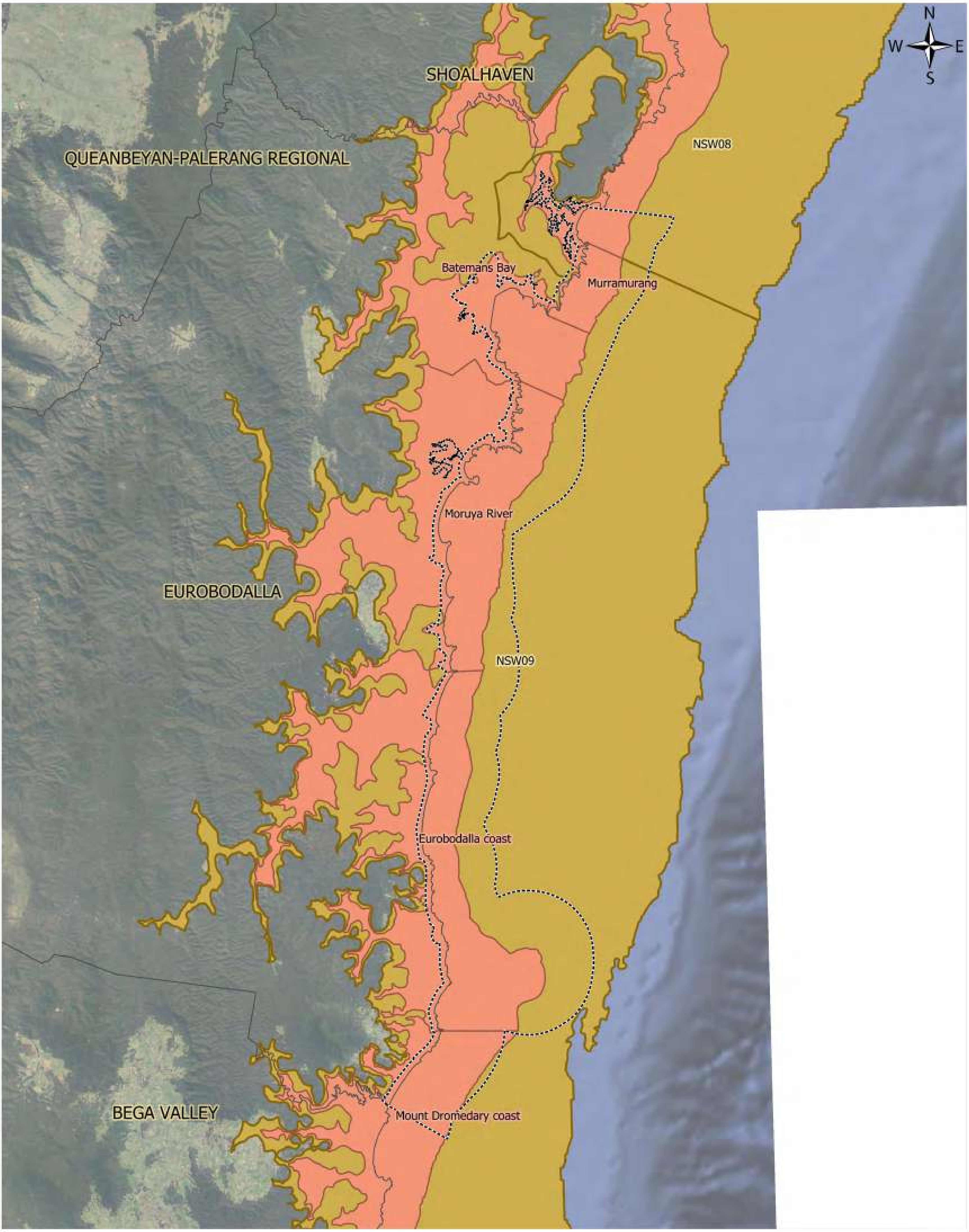
Scale : 1:125000@A3
Date : 28 November 2022
Revision : E
Created by : ERM
Coordinate System : MGA 94

- Littoral Rainforest
- Littoral_Rainforest Proximity Area
- Coastal Wetland
- Coastal_Wetland Proximity Area
- Coastal Use Area
- Coastal Environmental Area
- Proposed Coastal Vulnerability Area

CMP Action to address
- Coastal Developmet Threats
- Coastal Hazard Threats
- Engagement & Governance Threats
- Recreational Activity Threats

RG-05-01
CMP Actions
Toragy Point to Wallaga Beach



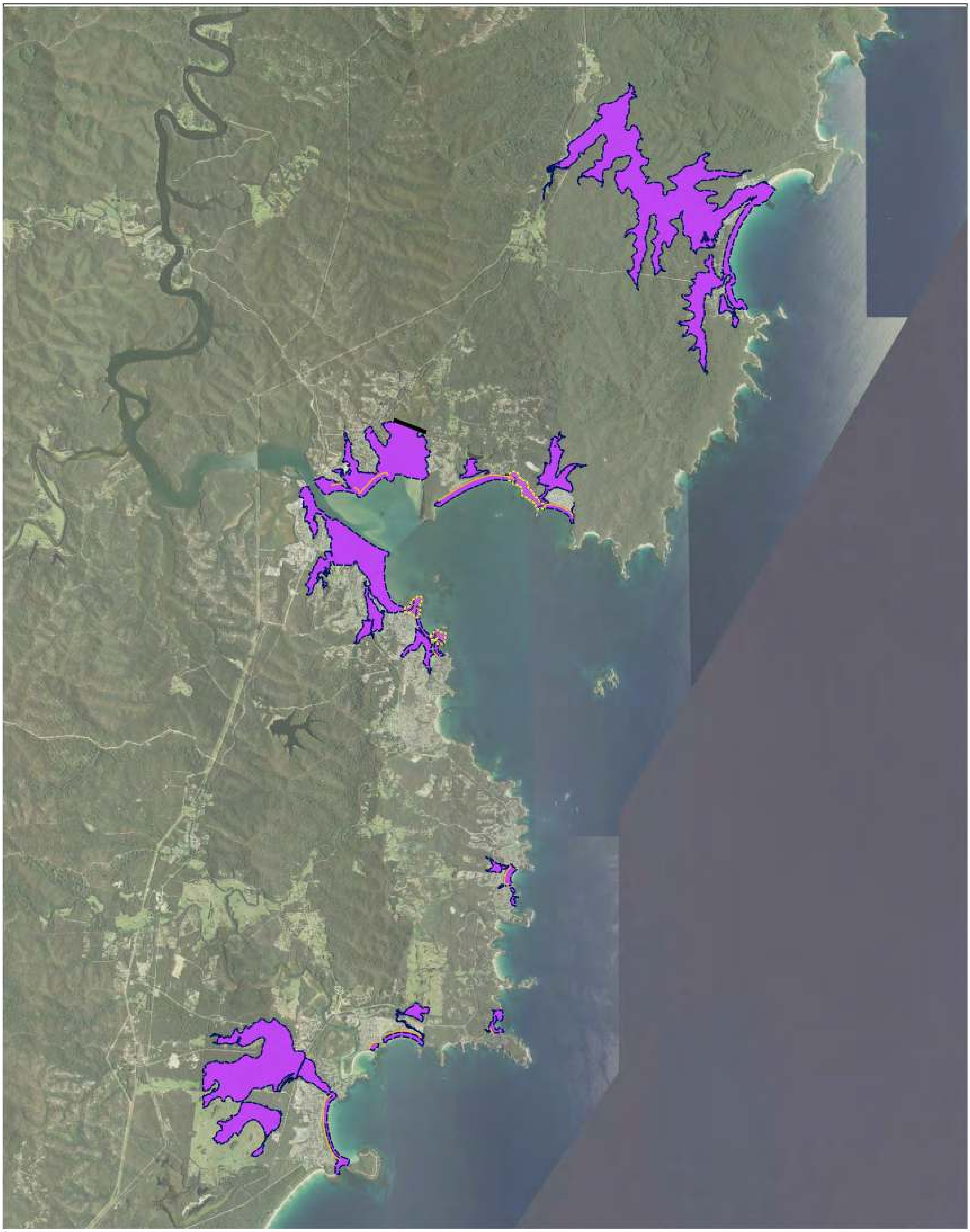
Rhelm

Scale : 1:30,000@A3
Date : 22 June 2022
Revision : B
Created by : LRE
Coordinate System : MGA94/56

0 5 10 15 20 25 km

Legend
- Study Area
- LGA Regions
- Primary compartments
- Secondary compartments

RG-05-02
Primary and Secondary Sediment Compartments



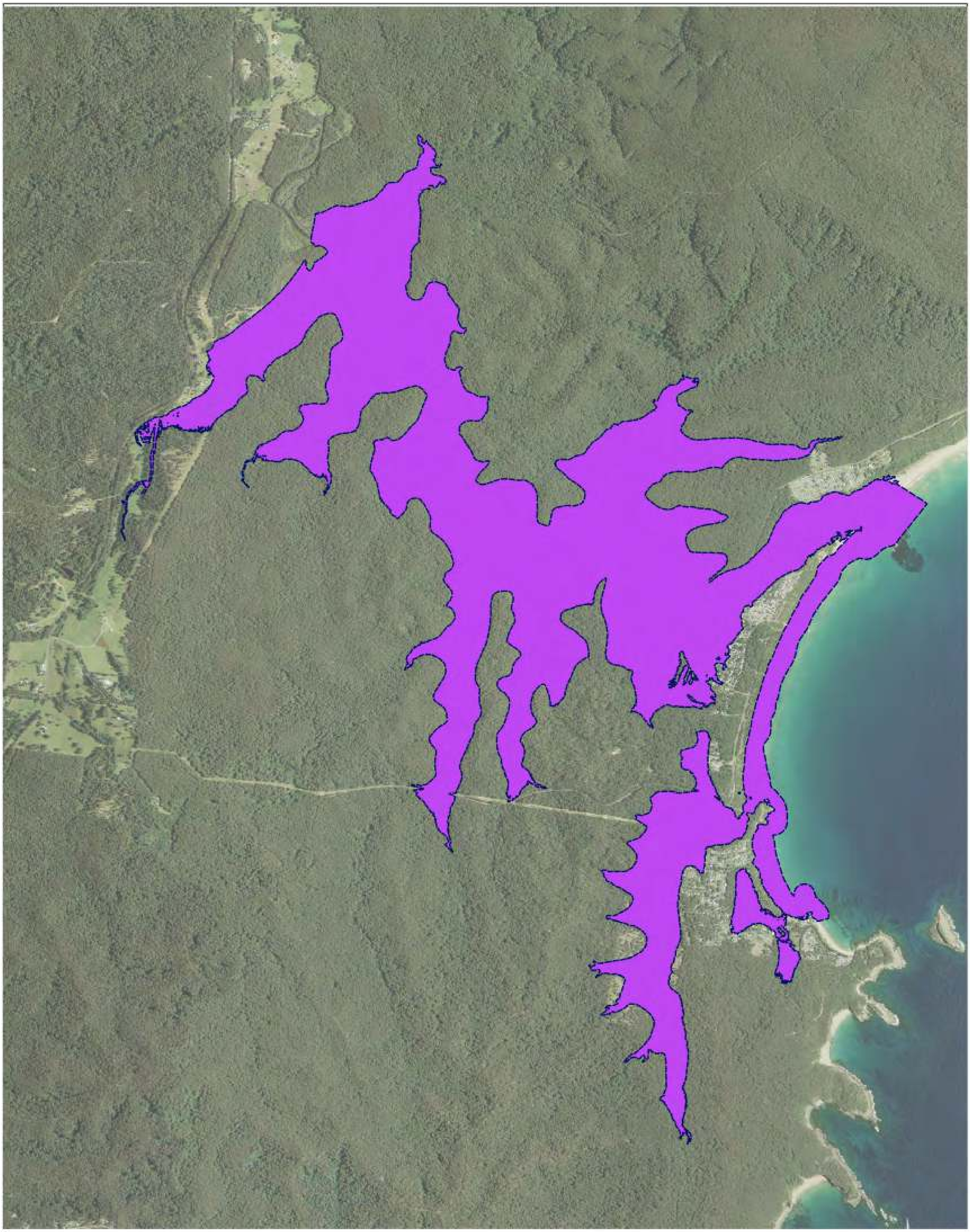
Scale : 1:@A3
Date : 1 December 2022
Revision : C
Created by : LRE
Coordinate System : MGA 94

2000 0 2000 4000 6000 m

Legend

- Coastal Vulnerability Area
- 2100 Coastal Erosion Risk
- 2100 Coastal Inundation Risk
- Coastal Cliff or Slope Instability Risk

RG-07-01
Coastal Vulnerability Area Overview

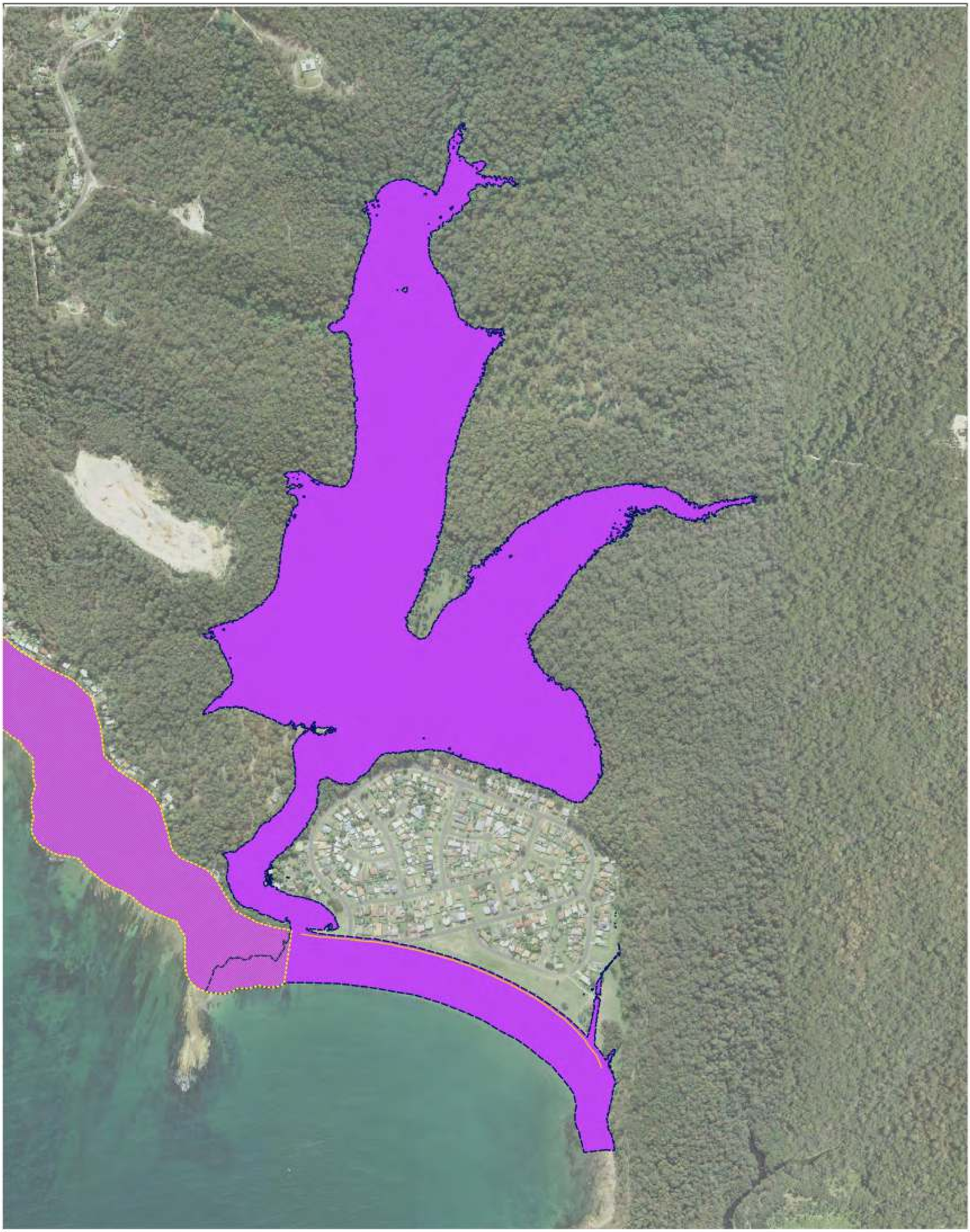


Scale : 1:@A3
Date : 1 December 2022
Revision : C
Created by : LRE
Coordinate System : MGA 94

600 0 600 1200 1800 m

Legend
Coastal Vulnerability Area
2100 Coastal Erosion Risk
2100 Coastal Inundation Risk
Coastal Cliff or Slope Instability Risk

RG-07-01
Coastal Vulnerability Area
South Durras



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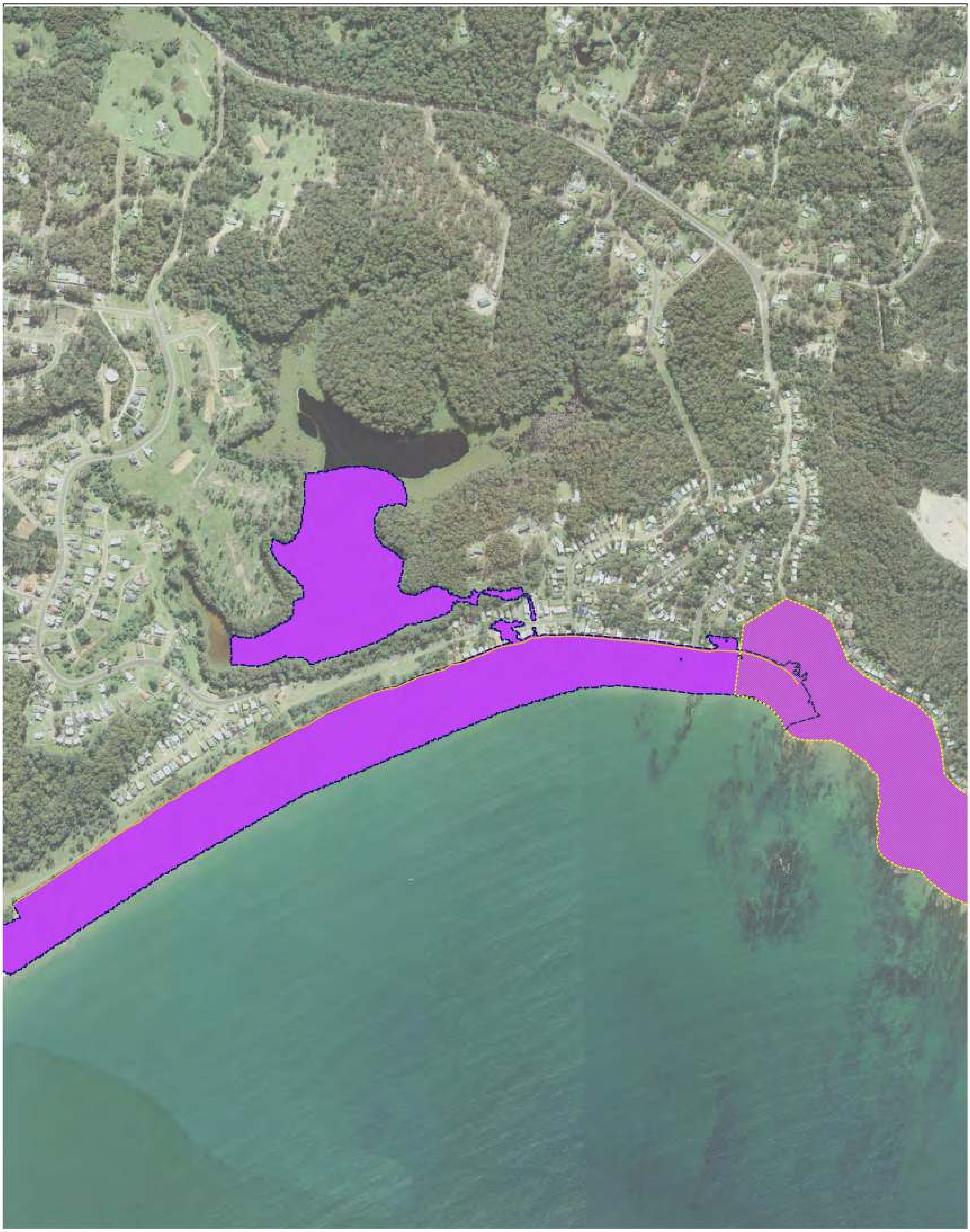
Date : 1 December 2022
Revision : C
Created by : LRE
Coordinate System : MGA 94

100 0 100 200 300 m

Legend
- Coastal Vulnerability Area
- 2100 Coastal Erosion Risk
- 2100 Coastal Inundation Risk
- Coastal Cliff or Slope Instability Risk

RG-07-01
Coastal Vulnerability Area
Maloneys Beach



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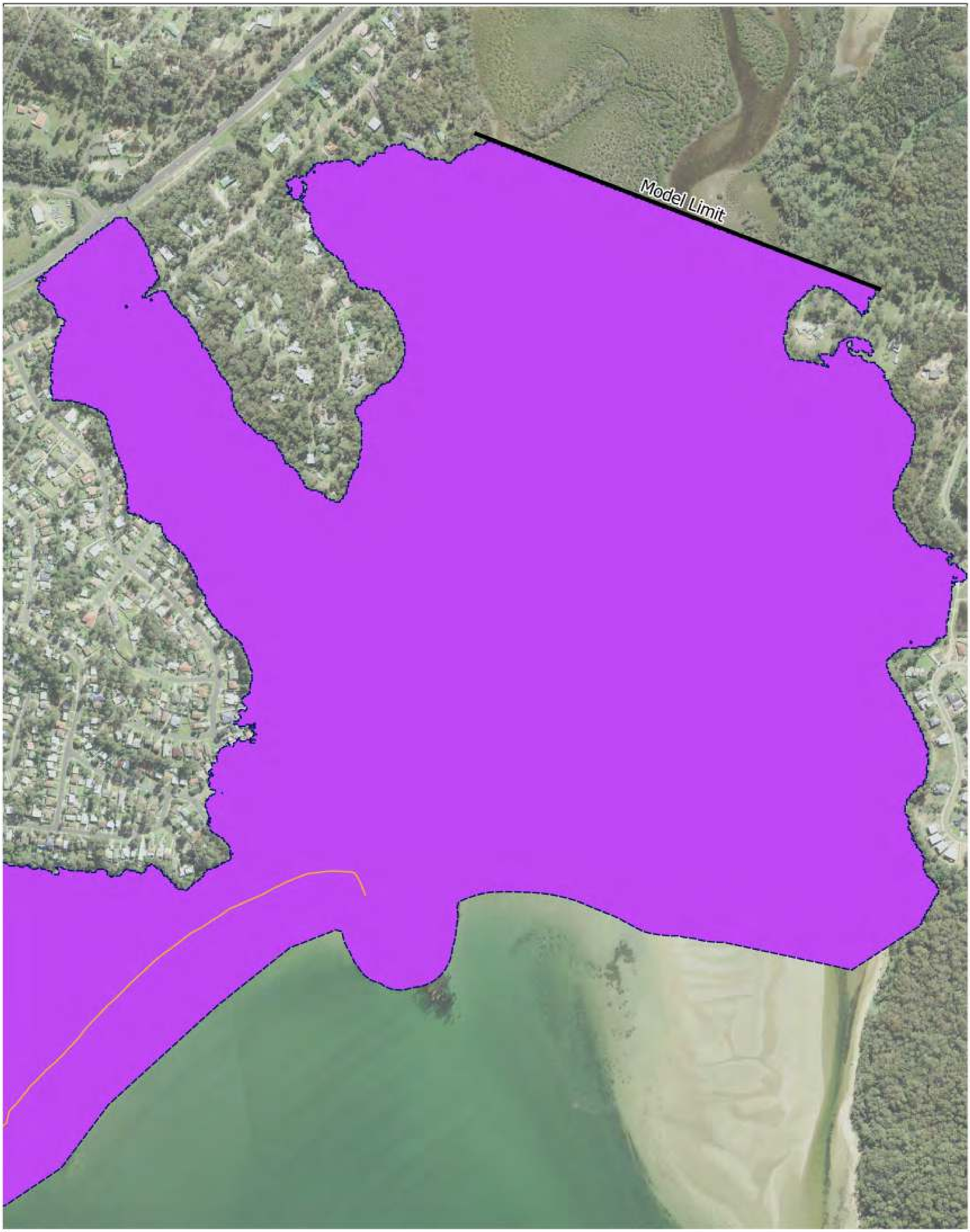
100 0 100 200 300 m

Scale : 1:8000@A3
Date : 1 December 2022
Revision : C
Created by : LRE
Coordinate System : MGA 94

Legend
- Coastal Vulnerability Area
- 2100 Coastal Erosion Risk
- 2100 Coastal Inundation Risk
- Coastal Cliff or Slope Instability Risk

RG-07-01
Coastal Vulnerability Area
Long Beach



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Revision : C
Created by : LRE
Coordinate System : MGA 94

Rhelm

100 0 100 200 300 m

Legend

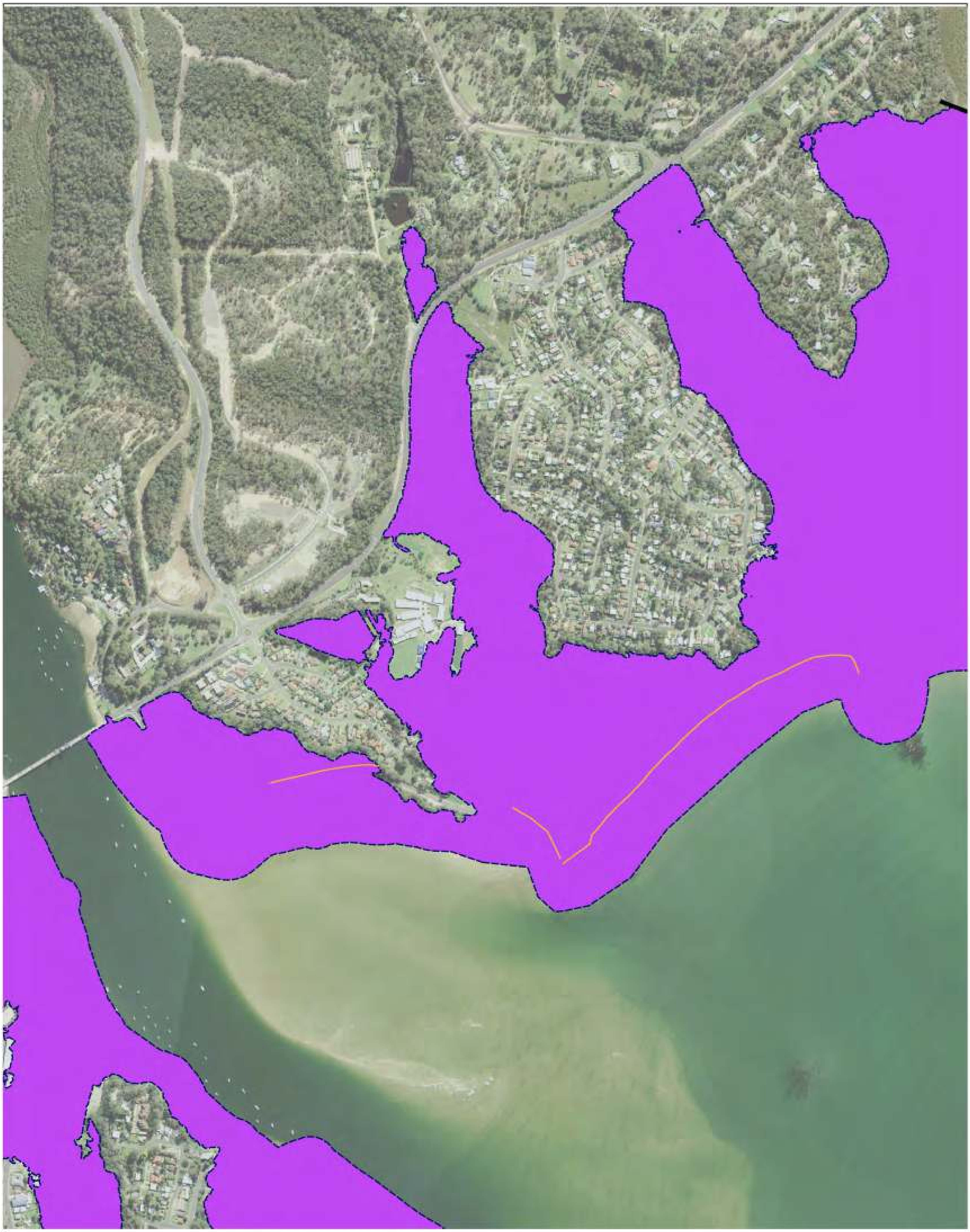
Coastal Vulnerability Area

2100 Coastal Erosion Risk

2100 Coastal Inundation Risk

Coastal Cliff or Slope Instability Risk

RG-07-01
Coastal Vulnerability Area
Cullendulla



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100 0 100 200 300 m

Scale : 1:8000@A3
Date : 1 December 2022
Revision : C
Created by : LRE
Coordinate System : MGA 94

Legend

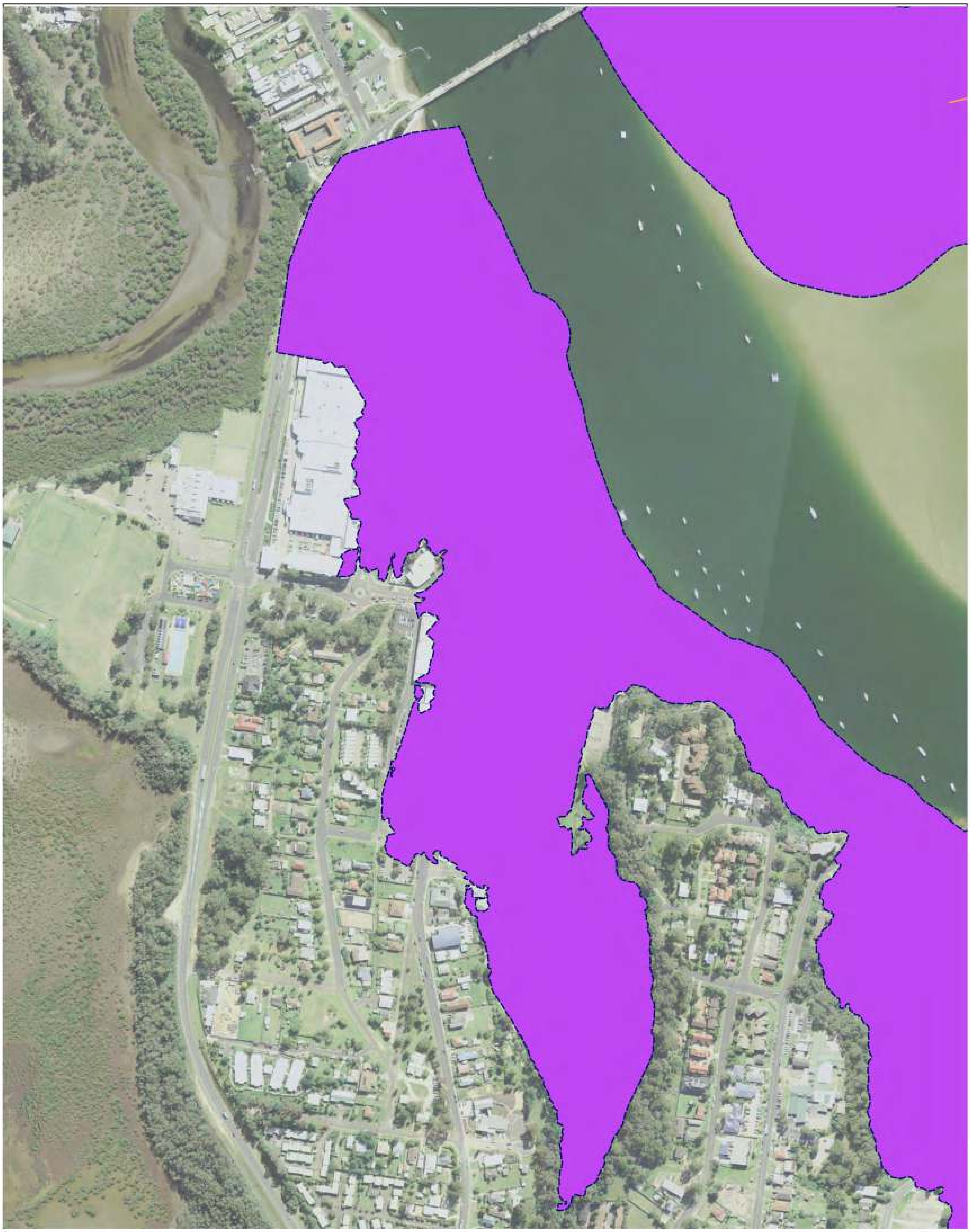
Coastal Vulnerability Area

2100 Coastal Erosion Risk

2100 Coastal Inundation Risk

Coastal Cliff or Slope Instability Risk

RG-07-01
Coastal Vulnerability Area
Surfside

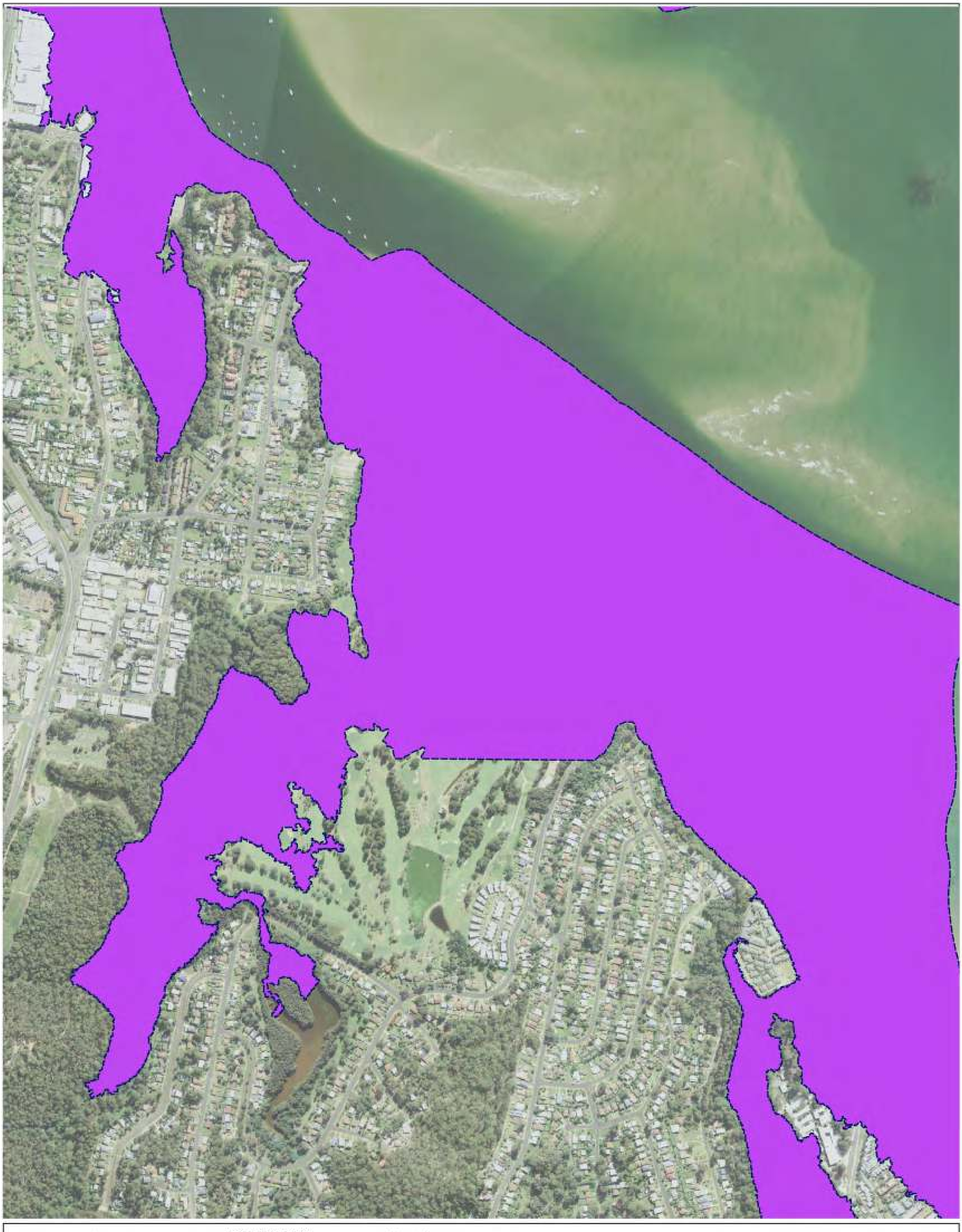


Scale : 1:4000@A3
Date : 1 December 2022
Revision : C
Created by : LRE
Coordinate System : MGA 94

90 0 90 180 270 m

Legend
Coastal Vulnerability Area
2100 Coastal Erosion Risk
2100 Coastal Inundation Risk
Coastal Cliff or Slope Instability Risk

RG-07-01
Coastal Vulnerability Area
CBD



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100 0 100 200 300 m

Scale : 1:7500@A3
Date : 1 December 2022
Revision : C
Created by : LRE
Coordinate System : MGA 94

Legend
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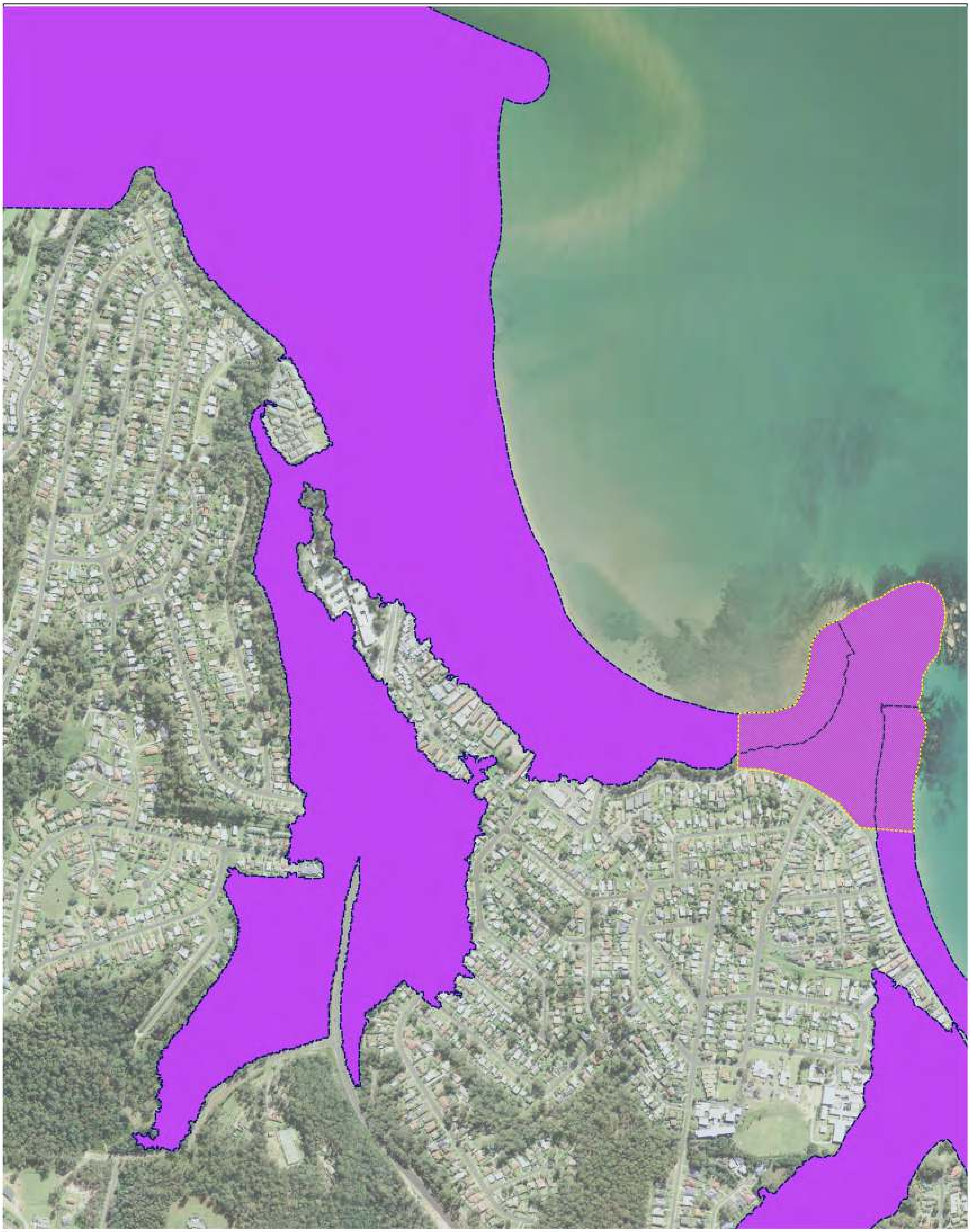
2100 Coastal Erosion Risk
2100 Coastal Inundation Risk
Coastal Cliff or Slope Instability Risk

RG-07-01
Coastal Vulnerability Area
Boat Harbour



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Created by : LRE
Coordinate System : MGA 94

Rhelm

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100 0 100 200 300 m

Legend

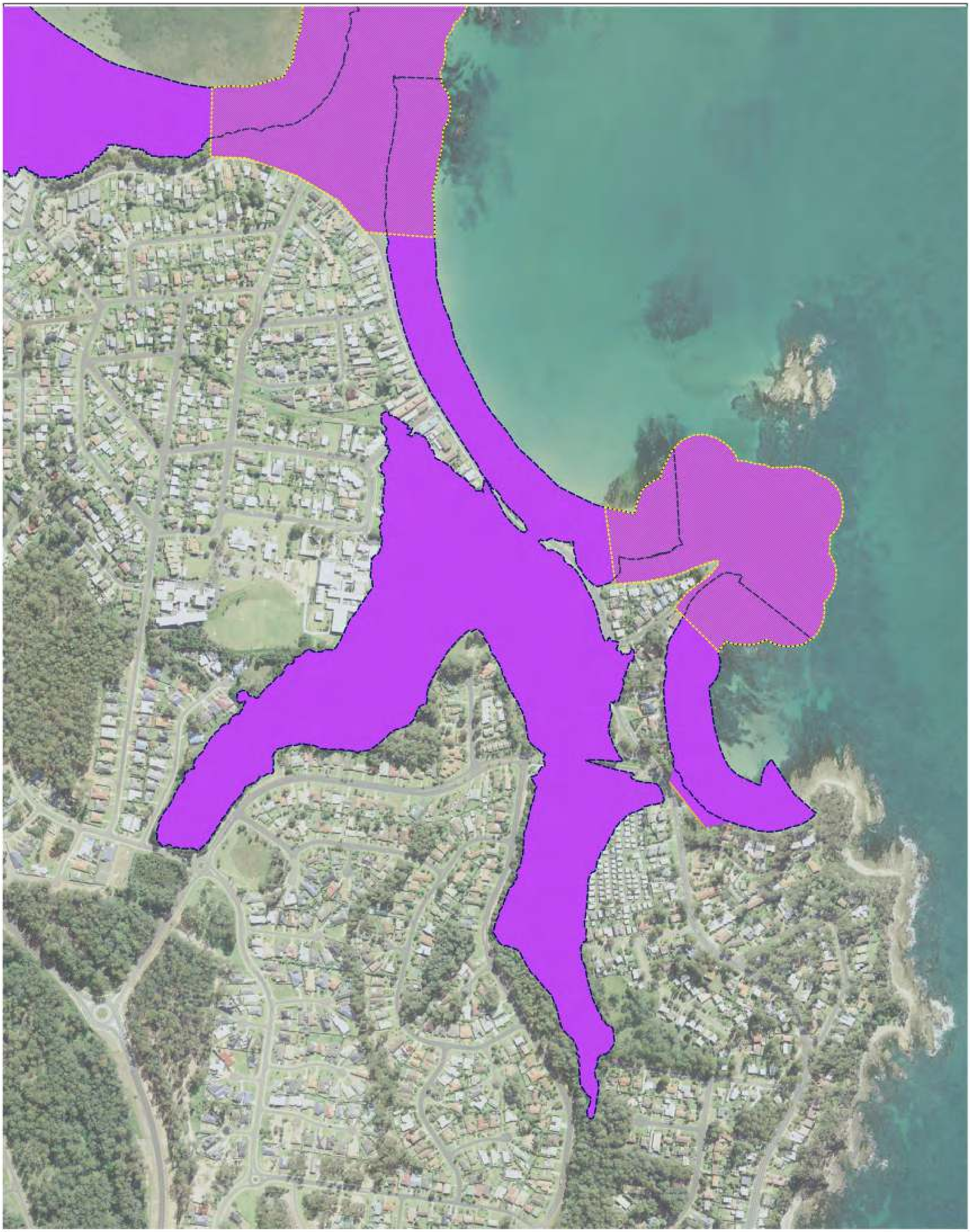
Coastal Vulnerability Area

2100 Coastal Erosion Risk

2100 Coastal Inundation Risk

Coastal Cliff or Slope Instability Risk

RG-07-01
Coastal Vulnerability Area
Corrigans Beach



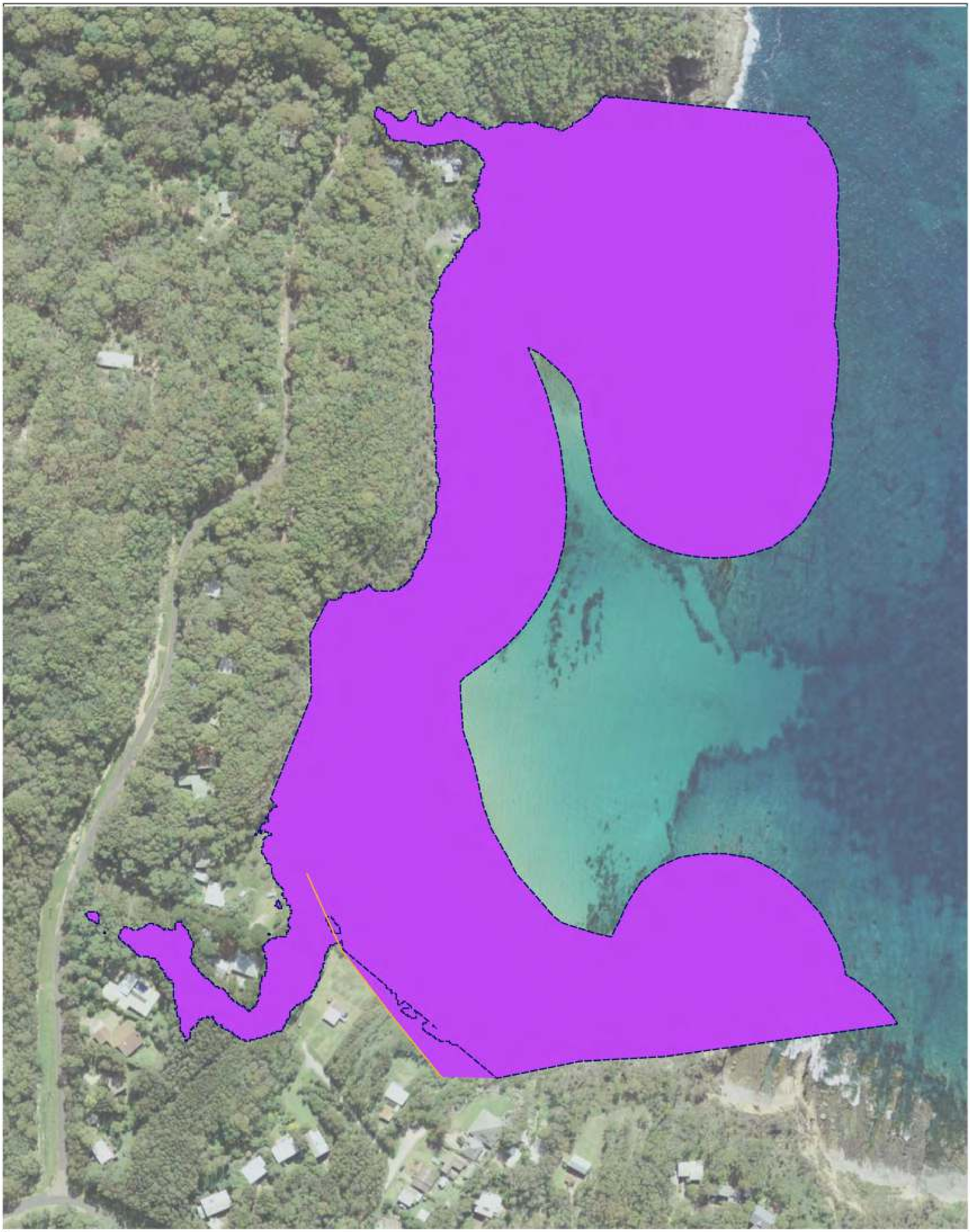
RG-07-01
Coastal Vulnerability Area
Sunshine Bay

Scale : 1:4000@A3
Date : 1 December 2022
Revision : C
Created by : LRE
Coordinate System : MGA 94

90 0 90 180 270 m

Legend
Coastal Vulnerability Area
2100 Coastal Erosion Risk
2100 Coastal Inundation Risk
Coastal Cliff or Slope Instability Risk

RG-07-01
Coastal Vulnerability Area
Malua Bay



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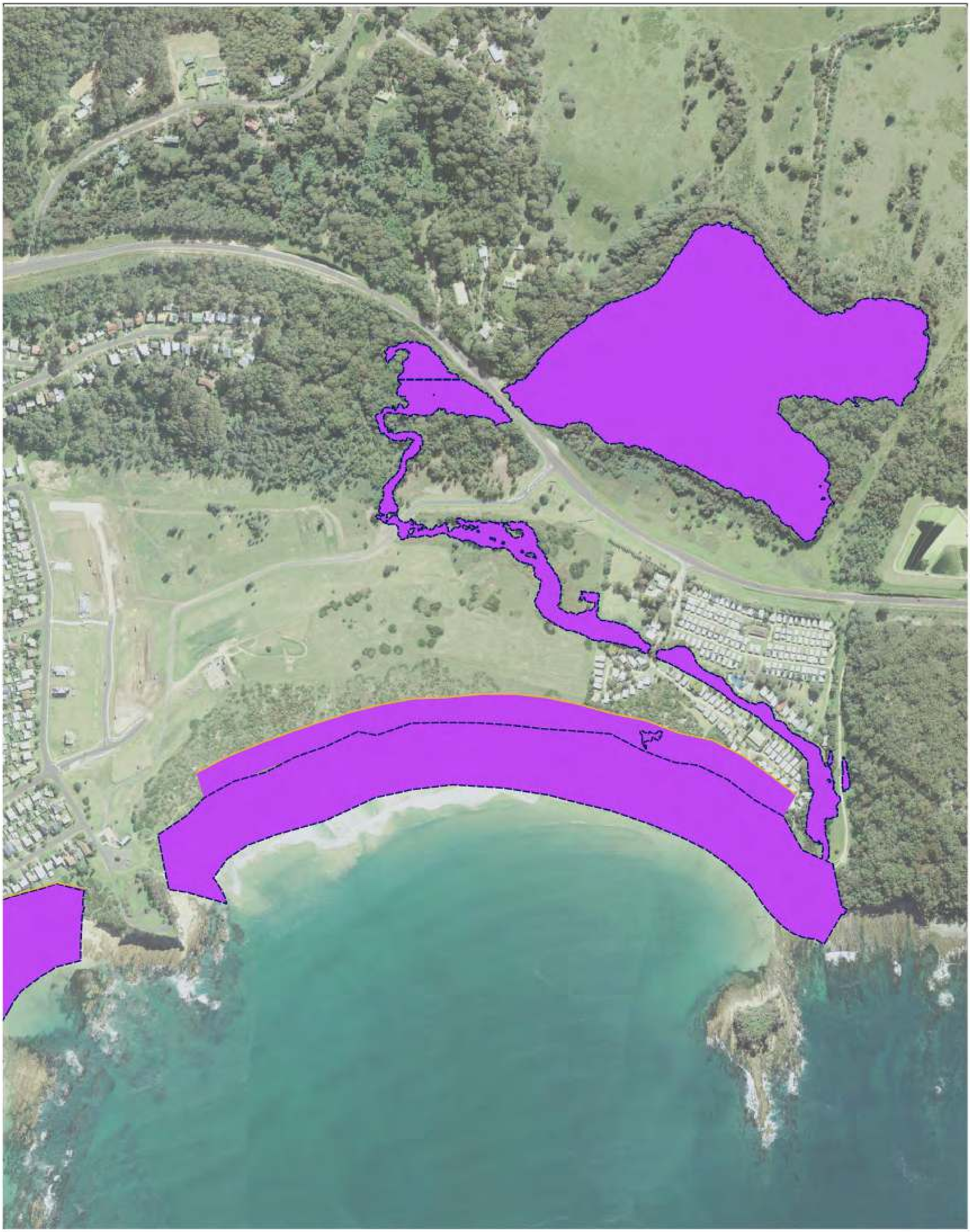
Date : 1 December 2022
Revision : C
Created by : LRE
Coordinate System : MGA 94

40 0 40 80 120 m

Legend

- Coastal Vulnerability Area
- 2100 Coastal Erosion Risk
- 2100 Coastal Inundation Risk
- Coastal Cliff or Slope Instability Risk

RG-07-01
Coastal Vulnerability Area
Guerilla Bay Beach



Scale : 1:5000@A3
Date : 1 December 2022
Revision : C
Created by : LRE
Coordinate System : MGA 94

Legend

- Coastal Vulnerability Area
- 2100 Coastal Erosion Risk
- 2100 Coastal Inundation Risk
- Coastal Cliff or Slope Instability Risk

RG-07-01
Coastal Vulnerability Area
Barlings Beach

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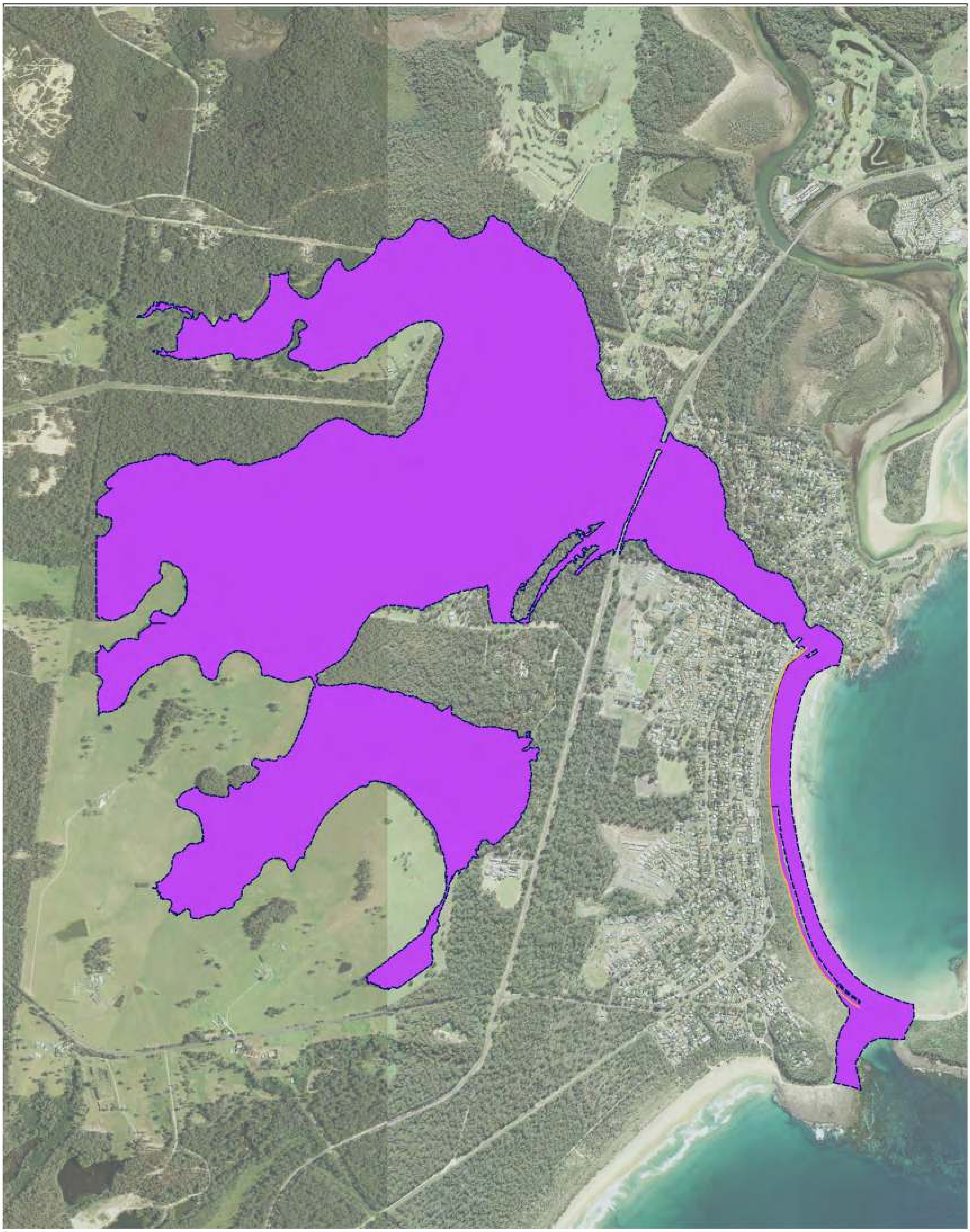
30 0 30 60 90 m

Scale : 1:1500@A3
Date : 1 December 2022
Revision : C
Created by : LRE
Coordinate System : MGA 94

Legend
- Coastal Vulnerability Area
- 2100 Coastal Erosion Risk
- 2100 Coastal Inundation Risk
- Coastal Cliff or Slope Instability Risk

RG-07-01
Coastal Vulnerability Area
Tomakin



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Date : 1 December 2022
Revision : C
Created by : LRE
Coordinate System : MGA 94

Rhelm

engineering | environmental | economics | engagement

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Legend

- Coastal Vulnerability Area
- 2100 Coastal Erosion Risk
- 2100 Coastal Inundation Risk
- Coastal Cliff or Slope Instability Risk

RG-07-01
Coastal Vulnerability Area
Broulee

Appendix A

Community and Stakeholder Engagement Plan and Summary

Eurobodalla Open Coast Coastal Management Program

Community and Stakeholder Engagement Plan and Summary

Eurobodalla Shire Council

December 2022

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Document Control

Rev	Effective Date	Description of Revision	Prepared by:	Reviewed by:
0	March 2021	Collaboratively prepared by Rhelm and ESC	Emma Maratea (Rhelm)	Cameron Whiting (ESC)
1	May 2021	Revised based on inputs from DPIE	Emma Maratea (Rhelm)	Raymond Laine (DPIE)
2	July 2021	Updated for engagement undertaken in May – June 2021	Emma Maratea (Rhelm)	-
3	July 2021	Minor updates to stakeholders	Emma Maratea (Rhelm)	-
4	June 2022	Updated for inclusion in the Draft CMP	Emma Maratea (Rhelm)	-
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Prepared For: Eurobodalla Shire Council

Project Name: Eurobodalla Open Coast CMP

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1 Context

This Community & Stakeholder Engagement Plan and Summary (CSEPS) aims to set out our strategy to engage with the broader community and stakeholders as required by the CM Act 2016 and the Coastal Management Manual 2018, including:

- Government Agencies
- Local and state Government working groups and committees:
  - Coastal and Environment Management Advisory Committee (CEMAC)
  - North Batemans Bay Coastal Agency Taskforce
- Local Aboriginal community:
  - Local Aboriginal Advisory Committee
  - Local Aboriginal Land Councils (LALC's)
  - Elders and members of the community who live in the Eurobodalla or who can speak on behalf of Country
- The broader Eurobodalla community, facilitated through community groups for each location, where available.
- A wide range of demographics, contacted through community associations including schools, surf clubs, Landcare and other users of the coast.
- Affected Landholders
- Community associations and business representatives .

The CSEPS also provides a summary of consultation undertaken over the course of this CMP.

The CSEPS aligns with IAP2 principles and Council's Community Engagement Framework, as well as the requirements of the CM Act (2016) and the Coastal Management Manual (2018) . These engagement principles are set out in section 3.

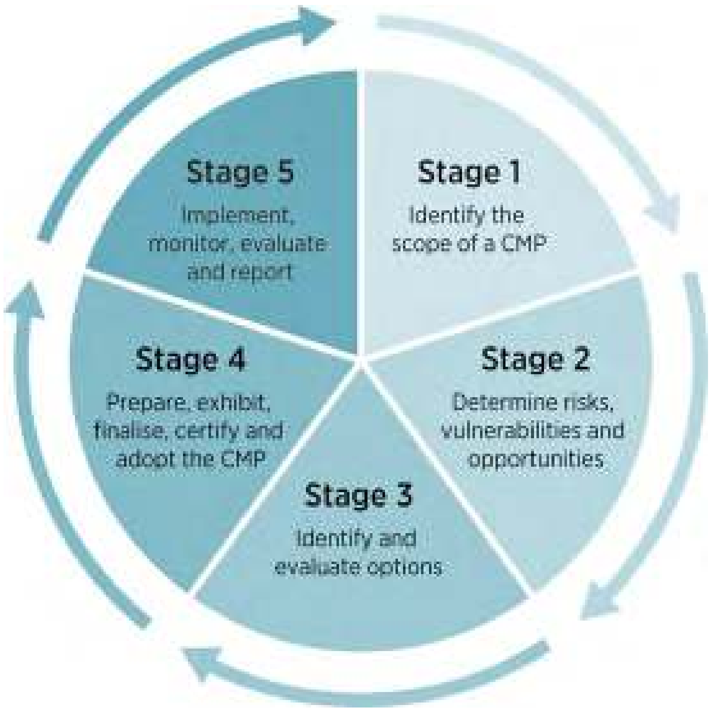

Figure 1-1 The 5 stages of the Coastal Management Program process

1.1 Background

Eurobodalla's Open Coast Coastal Management Program (Open Coast CMP) commenced as two separate projects; Batemans Bay Coastal Zone Management Plan and the Eurobodalla Coastal Zone Management Plan. The two projects were subsequently merged to provide a single strategic reference for managing the extensive coastline of Eurobodalla: The Open Coast CMP.

A range of stakeholder and community engagement activities were undertaken as part of these previous studies. A summary of the previous engagement activities is provided in **Attachment B**.

1.2 Supporting Studies and Investigations

A range of investigations have been undertaken to date that will support and inform the new Open Coast CMP:

- The South Coast Regional Sea Level Rise Policy and Planning Response (2014)
- Eurobodalla Coastal Hazard Assessment (2017)
- Coastal Zone Management Plan for Wharf Road (certified in 2018)
- Batemans Bay Independent Coastal Impact Assessment (Stage 1 and Stage 2).

As part of the process of developing these studies, extensive community consultation has been undertaken over the years, which can be used to inform our preliminary understanding of what the community expects when it comes to the management of the coast. The new Open Coast CMP considers current land use, coast dependent economic activity, aboriginal cultural heritage and captures the views and expectations within the community of how the coastline is to be managed now and into the future.

2 Purpose and Objectives

The key objectives of the CSEPS are to:

1. Confirm	Confirm that Council have taken on board the community feedback in previous consultation and are now undertaking the additional geotechnical work, hazard studies and community consultation the community has requested
2. Educate and inform	Educate and inform the community about the coastal management process and the legal requirements behind undertaking a CMP.
3. Ensure	Ensure awareness of the CMP across the whole community and facilitate residents feedback, ideas and concerns about acceptable risk and around how the coast in their local area is managed in the future.
4. Clarify and deliver	Clarify roles & responsibilities for implementation. Deliver the management progarm over the next 10 years.

Consultation about management options and the evaluation process will:

- Raise awareness of the strategic and staged approach to management of coastal issues.
- Ensure residents have had an opportunity to inform how the coast is managed in the future for their local area
- Provide council with early feedback about actions and priorities that are acceptable to local communities and the overall population of the shire and its visitors. This will facilitate pre exhibition review of the draft CMP and should streamline Stage 4.
- Clarify the agency roles and public authority position on actions that require a collaborative effort, for instance around dredging and natural defences actions
- Help identify groups that require more targeted engagement in the coming months (in the lead up to and during exhibition) to facilitate conversations and gain feedback on the coastal hazards, management options and legal implications.
- Ensure the management option evaluation process (feasibility, viability (cost benefit) and acceptability) is transparent and communicated.
- Build on previous consultation undertaken between 2017-2018 for the CMP under the previous studies. Ensure that communities feel that their previous feedback was heard and taken on board.

3 Engagement Principals

This Open Coast CMP CSEPS is aligned with the principles within Council's Community Engagement Framework. These include:

- Be open and inclusive – promoting opportunities for community involvement through the various mediums of online survey, workshops, interviews, public exhibition and communication activities.
- Generate mutual trust and respect, and be accountable – at all engagement activities it will be explained to the community how their input will be used and the final report will demonstrate how the community input has shaped the decision support tool. This will build trust of the process and hence trust in the validity of the final decision support tool.
- Engage early and provide information that is clear – communication activities are scheduled from the start of the project in number of formats to provide the community with all the information they need to participate meaningfully.
- Be considerate and provide feedback – communication activities are planned at various stages throughout the project to keep the community up to date and to feedback community input and how this input has shaped the outcome.
- Value and acknowledge skills and resources – opportunities have been identified to coordinate
- Engagement with other projects to avoid duplication and staff will be able to develop community engagement skills throughout the process.

3.1 International Association for Public Participation – IAP2

International Association for Public Participation (IAP2) is a key international organisation advancing the practice of public participation. Their mission is to advance and extend the practice of public participation through professional development, certification, standards of practice, core values, advocacy and key initiatives with strategic partners around the world.

IAP2 Australasia are a member association incorporating individuals, governments, institutions and other entities that affect the public interest throughout the world.

IAP2 has developed tools that are widely used and acknowledged. These include the **Core Values for Public Participation** for use in the development and implementation of public participation processes; and the **IAP2 Public Participation Spectrum** which assists with the selection of the level of participation that defines the public's role in any community engagement program. Additionally, the **Quality Assurance Standard for Community and Stakeholder Engagement**, is recognised as the international standard for public participation practice.

This CSEPS has been prepared in consideration of the IAP2 tools and guidelines.

3.2 CM Act and CM Manual

The *Coastal Management Act* set out the following requirements for preparing a CMP.

Before adopting a coastal management program, a local council must consult on the draft program with:

a) the community, and

b) if the local council's local government area contains:

(i) land within the coastal vulnerability area, any local council whose local government area contains land within the same coastal sediment compartment (as specified in Schedule 1), and

(ii) an estuary that is within 2 or more local government areas (as specified in Schedule 1), the other local councils, and

c) other public authorities if the coastal management program:

(iii) proposes actions or activities to be carried out by that public authority, or

(iv) proposes specific emergency actions or activities to be carried out by a public authority under the coastal zone emergency action subplan, or

(v) relates to, affects or impacts on any land or assets owned or managed by that public authority.

The Coastal Management Manual provides guidance on how to undertake engagement with stakeholders and the community to achieve the requirements of the CM Act. This guidance has been considered in the preparation of this CSEPS.

4 Stakeholder Analysis

It is important to ensure that all those who need to be involved in coastal management (i.e. those with responsibility for managing the coast, community members who use and enjoy the amenity of the coast, and those with a vested interest in its management, such as property owners) are kept informed and invited to contribute to the process to establish a common understanding of coastal management and how decisions are made.

Stakeholders may tend to make judgements about coastal management based solely on their own perceptions. These perceptions can vary due to differences in values, needs, assumptions, concepts, concerns and degrees of knowledge. Stakeholders' views can have a significant impact on how they interpret the decisions made through the coastal management process, so it is important that differences in their perceptions of risk be identified, recorded and addressed.

A stakeholder matrix has been developed to identify relevant stakeholders, and their relative level of interest, influence and impact on the Coastal Management Program. The outcomes of this analysis identify the suitable level of consultation based on the IAP2 consultation spectrum (**Table 4-1**).

The stakeholder matrix is provided in

Table 4-2. The matrix also indicates the suggested engagement method selected for each stakeholder based on the outcomes of the stakeholder analysis. Further details on the engagement methods are provided in **Section 5**.

Table 4-1 IAP2 Spectrum of Public Participation

	Inform	Consult	Involve	Collaborate	Empower
Participation Goal	To provide the stakeholders and community with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.	To obtain stakeholder and community feedback on analysis, alternatives and/or decisions.	To work directly with the community and stakeholders throughout the process to ensure that their concerns and aspirations are consistently understood and considered.	To partner with the community and stakeholders in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision making in the hands of the public or stakeholders.
Promise	We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how stakeholder and community input influenced the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how stakeholder and community input influenced the decision.	We will look to you for advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.

Table 4-2 Stakeholder Matrix

Type	Organisations	Engagement level by Stage							
		Stage 1	Methods	Stage 2	Methods	Stage 3	Methods	Stage 4	Methods
Government (State and Federal)	Federal and state members of Parliament	Inform	Council / DPE to notify, as required	Inform	Council / DPE to notify, as required	Inform	Council / DPE to notify, as required	Inform	Council / DPE to notify, as required
Councils	Eurobodalla Shire Council (Project Manager)	Empower	Regular project meetings	Empower	Regular project meetings	Empower	Regular project meetings	Empower	Regular project meetings
	Eurobodalla Shire Council (Councillors)	Empower	Council / DPE to notify, as required	Empower	Council / DPE to notify, as required	Empower	Council / DPE to notify, as required	Empower	Council / DPE to notify, as required
	Eurobodalla Shire Council (other Council Staff)	Involve	Briefing 1	Involve	Briefing 2	Involve	Briefing 3	Involve	Briefing 4
	Shoalhaven Council	Inform	Virtual meeting	Inform	Project update email	Inform	Project update email	Inform	Project update email
	Bega Valley Shire Council	Inform	Virtual meeting	Inform	Project update email	Inform	Project update email	Inform	Project update email
State Government Agencies	DPE - EHG (project team)	Collaborate	Regular project meetings, deliverable review	Collaborate	Regular project meetings, deliverable review	Collaborate	Regular project meetings, deliverable review	Collaborate	Regular project meetings, deliverable review
	DPE -EHG (other stakeholders)	Consult	Taskforce Briefing	Consult	Taskforce Briefing	Consult	Taskforce Briefing	Involve	Virtual meeting to discuss Draft CMP
	DPE- Planning	Consult	Taskforce Briefing	Consult	Taskforce Briefing	Consult	Taskforce Briefing	Involve	Virtual meeting to discuss Draft CMP
	DPE - NPWS	Consult	CEMAC Briefing 1	Consult	Taskforce Briefing & CEMAC Briefing 2	Consult	Taskforce Briefing & CEMAC Briefing 3	Involve	Virtual meeting to discuss Draft CMP
	DPE - Fisheries	Consult	Taskforce Briefing 1	Consult	Taskforce Briefing	Consult	Taskforce Briefing	Involve	Virtual meeting to discuss Draft CMP
	DPE - Marine Parks	Consult	Taskforce Briefing & CEMAC Briefing 1	Consult	Taskforce Briefing & CEMAC Briefing 2	Consult	Taskforce Briefing & CEMAC Briefing 3	Involve	Virtual meeting to discuss Draft CMP
	DPE - LLS	Consult	CEMAC Briefing	Inform	CEMAC Briefing 2	Involve	CEMAC Briefing 3	Involve	Invitation to review Draft CMP
	Transport for NSW	Consult	Taskforce Briefing	Consult	Taskforce Briefing	Consult	Taskforce Briefing	Involve	Virtual meeting to discuss Draft CMP
	MIDO	Consult	Taskforce Briefing	Consult	Taskforce Briefing	Consult	Taskforce Briefing 3	Involve	Virtual meeting to discuss Draft CMP
Advisory Bodies	Coast and Environment Management Advisory Committee (CEMAC)	Involve	Briefing 1	Involve	Briefing 2	Involve	Briefing 3	Involve	Submission on Draft CMP Drop In Sessions
	Northern Batemans Bay Coastal Taskforce	Involve	Briefing 1	Involve	Briefing 2	Involve	Briefing 3	Involve	Briefing 4
Local Aboriginal community	Council's Aboriginal Advisory Committee	Involve	Letter / email Virtual meeting	Inform	Project update email	Inform	Project update email	Consult	Invitation to review Draft CMP
	Native title claimant / NTSCORP representatives	Inform	Email	Inform	Project update email	Involve	Co-Design Workshop Meetings on Country	Involve	Meetings on Country
	LALCs and Aboriginal Community Representatives & Elders	Involve	Phone calls Meeting / walkover on Country	Inform	Phone calls and virtual meetings	Involve	Co-Design Workshop Meetings on Country	Involve	Meetings on Country
	Wider Aboriginal Community Members	Inform	Project webpage	Inform	Phone calls Meeting / walkover on Country / Meet, Eat and Yarn	Consult	Phone calls Meeting / walkover on Country / Meet, Eat and Yarn	Empower	Phone calls Meeting / walkover on Country / Meet, Eat and Yarn

Type	Organisations	Engagement level by Stage							
		Stage 1	Methods	Stage 2	Methods	Stage 3	Methods	Stage 4	Methods
Community Organisations	Batemans Bay Boating Association Broulee Surf School Broulee Surf Life Savers Club Broulee Womens Board riding Club Eurobodalla Fishing Association Malua Bay Surf Life Saving Club Narooma Surf Life Saving Club Bingie Residents Association Broulee & Mossy Point Residents Association Durras Residents Association Congo Community Association Love Long Beach Potato Point Community Association Rosedale Community Association The Rosedale Association Inc Tomakin Community Association Maloneys Beach Residents Association Tuross Head Progress Association (THPA) Tilba Environment Landcarers	Inform	Emails to associations, updates on Council's Website	Inform	Invitation to join CWGs Project Newsletter	Consult	CWG (virtual) (registered members) Project Newsletter	Consult	Submission on Draft CMP Drop In Sessions
	Surfside Engineers	Inform	Meeting at Surfside	Inform	Invitation to join CWGs Project Newsletter	Consult	CWG (virtual) Project Newsletter	Consult	Submission on Draft CMP Drop In Sessions
	Long Beach Community Association	Inform	Emails to associations, updates on Council's Website	Inform	Invitation to join CWGs Project Newsletter	Consult	Site inspections of Long Beach	Empower	Submission on Draft CMP Drop In Sessions Follow-up online meeting to discuss long-term management solutions.
Individuals	Residents and landowners	Inform	Updates on Council's Website	Inform	Media invitation to join CWG Project Newsletter (to those who registered)	Consult	CWG (virtual) (registered members) Project Newsletter (registered members)	Consult	Online submissions Targeted Sessions Drop-in Sessions CWG (face to face) (registered members)
	Visitors	Inform	Updates on Council's Website	Inform	Updates on Council's Website	Inform	Updates on Council's Website	Consult	Invite submissions and attendance at drop-in sessions

5 Engagement Methods

A range of engagement methods have been developed based on the requirements of the CM Act and CM Manual, the objectives of the consultation (**Section 2**) and the level of consultation identified for each of the stakeholders (**Table 4-2**).

A description of the engagement methods, including a summary of the outcome of each method is provided in **Table 5-1**.

Eurobodalla Shire Council also received financial assistance from the NSW State Government to support undertaking targeted engagement with the Eurobodalla Aboriginal Community. Consultation undertaken as part of this engagement was guided by a co-design approach with the Eurobodalla Aboriginal Community. The details and outcomes of this consultation are captured in **Attachment A**.

Table 5-1 Engagement Methods

Engagement Method	Details	When	Outcomes
Updates to Council's website	Inform the broad community about the project and develop a list of stakeholders that would like more tailored/detailed project updates	Project entirety starting February 2021	Public downloads of Stage 1 and Stage 2 reports. This resulted in Council being contacted by several residents with queries showing a decent level of engagement. Provided the public with access to project newsletters, project updates, and public exhibition information.
Taskforce Briefing 1	Virtual meeting to provide an update on the project and identify any issues raised by attendees before proceeding to Stage 2	February 2021	Provide Stage Agency Stakeholders with an introduction to the CMP. Stakeholders identified issues and existing management plans to be considered in the CMP preparation.
CEMAC Briefing 1	In person meeting to provide an update on the project and identify any issues raised by attendees before proceeding to Stage 2	March 2021	Provide Agency Stakeholders (some not members of the Taskforce), Community representatives, and adjoining Council (BVSC & Shoalhaven) with an introduction to the CMP. Stakeholders identified issues to be considered in the CMP preparation.
Stage 1 Aboriginal Community Stakeholder Meetings	Council & Rhelm spoke to Aboriginal Community knowledge holders and Local Aboriginal Land Council representatives first. In this engagement, 3 sessions were held on Country and a 4th was held at Tomakin Sports & Recreation Club.	April / May 2021	Approximately 20 people attended in total. Community highlighted the importance of targeted engagement with them every step of the way, of building trust and expanding the engagement beyond the LALC's and beyond standard engagement practice. The project team felt that the current scope, at that time, would not allow them to meet these targets. Council applied for a grant from the NSW Department of Planning & Environment to facilitate a more in-depth consultation approach and allow Council to undertake a series of targeted consultation sessions informed by a Co-design workshop chaired by community leaders from across the Eurobodalla.
Media Releases	Council have sent out 5 Media Releases related to this Open Coast CMP; these are also accompanied by releases on the Council's Facebook Page and Instagram; including a call for EOI's to working groups through a short video.	Ongoing	16th July 2021: Workshops to discuss future coastal management | Eurobodalla Council website (nsw.gov.au) 6th September 2021: Community reps pinpoint coastal concerns | Eurobodalla Council website (nsw.gov.au) 6th April 2022: Coastal hazard planning going swell | Eurobodalla Council website (nsw.gov.au) 12th October 2022: Coastal management program open for comment | Eurobodalla Council (nsw.gov.au) 10th November 2022: Coastal management program feedback | Eurobodalla Council (nsw.gov.au)
Community Project Updates: newsletter and stakeholder email list	Council staff set up a CMP Newsletter to inform community and stakeholders about the progress of the CMP. Community groups and resident associations were sent an email with information about how to sign up, and this has been advertised through media release and the CEMAC.	Ongoing	Currently there are over 200 stakeholders on this mailing list. Three newsletters have been sent out over the course of the CMP.
CEMAC Briefing 2	Provide an update Stages 1 and 2 of the CMP and identify any issues raised by attendees before proceeding with Stage 3.	July 2021	Provided an opportunity for members to review the outcomes of the scoping study (including the risk assessment) and the Stage 2 assessments and identify any relevant issues for consideration in the identification of management options.
Community Working Groups: Stage 1 and 2 overview	Five workshops with the Eurobodalla community and business representatives, to discuss the coastal hazard review and explore management options, were held online on the 24 and 25 August 2021. Word was spread through Media Release, Facebook and emails sent to community associations.	August 2021	33 community representatives attended these workshops, with attendees allocated a workshop based on their geographical location. Through these workshops community gained a better understanding of the coastal hazards that apply to Eurobodalla now and into the future. Community also provided a number of actions for Council and Rhelm to consider implementing through the CMP.

Engagement Method	Details	When	Outcomes
Taskforce Briefing 2	Provide an update of Stage 1 and 2 of the CMP, and a summary of the outcomes of the CWGs	September 2021	Provided an opportunity for Stage Agencies to review the outcomes of the scoping study (including the risk assessment) and the Stage 2 assessments and identify any relevant issues for consideration in the identification of management options.
CEMAC Workshop	As above – for CEMAC members	September 2021	Through these workshops CEMAC members gained a better understanding of the coastal hazards that apply to Eurobodalla now and into the future. The outcomes of the CWGs were presented, and feedback provided by CEMAC members. CEMAC members also provided a number of actions for Council and Rhelm to consider implementing through the CMP.
Aboriginal Community Stage 2 (Coastal Hazards) Presentation	Council and Rhelm presented the draft coastal hazards risk in February 2022 to community to inform actions. This was initially scheduled for November 2021 but the sessions were placed on hold due to increased Covid-19 restrictions; they were then moved to an online format.	February 2022	Through these workshops community gained a better understanding of the coastal hazards that apply to Eurobodalla now and into the future. Community also provided a number of actions for Council and Rhelm to consider implementing through the CMP.
Aboriginal Community: Co-design workshop and meetings on Country	A co-design workshop led by Evolve Studios, an Aboriginal Co-managed consulting agency specialised in engaging with First Nations people was held in March 2022. Knowledge holders and community leaders from across Eurobodalla were invited to attend and co-design the engagement approach for Council to undertake for the next stages of the CMP.	March 2022	Key outcomes of the Co-design approach: • Engage outside the box and on Country – Try to make engagement interesting, and safe. Link in to other projects or activities to avoid consultation fatigue. Most importantly, let community guide the meeting – ask them where to meet and how. • Engage outside the LALC's: the community leaders agreed to assist Council in identifying community members who don't typically get to have a say; including the youth. • Engage often; traditional owners feel that they are often consulted at the end of a project, not before or during. Effort needs to be made to ensure they have a strong understanding of the work the whole way through, not simply asked to give it their approval.
Aboriginal Community Stakeholder meetings on Country & Eat, Meet, Yarn sessions	Following the co-design workshop, Council staff worked with the co-design group leaders to organise a series of meetings on country to discuss opportunities for actions in the CMP and talk through the actions already identified. These took the form of a combination of site visits and "Eat Meet Yarn" barbecues; an informal meeting for broader community to have their say in a safe, comfortable format. These events were also an opportunity for Council and Rhelm staff to meet community members who aren't typically consulted on Council processes and helped establish familiarity with Council staff and the Coastal Management Program process.	April 2022 – November 2022	A range of management issues were identified for consideration in the CMP. Including site specific protection of Aboriginal Heritage and opportunities to better involve Traditional Owners in coastal management. These outcomes formed the basis for several of the actions in the CMP. Further details are provided in Attachment A of this document. In total, 5 "Eat, Meet & Yarn" events were held at: - Apex Park, Narooma - Mogo Oval - Smoke Point, Batemans Bay During public exhibition, an additional two sessions were held to discuss the final CMP and provide an opportunity to comment on the CMP. These latter sessions also included public screenings of the three videos prepared over the course of this CMP as part of the Eurobodalla Coastal Stories film project undertaken by the Department of Planning and Environment and supported by Council. - One at Narooma Golf Club - One at Batemans Bay SEARMS Across all 5 events an estimated 42 attendees participated from the Eurobodalla Aboriginal Community, including stakeholders from Wallaga Lake, Tilba, Narooma, Moruya, Mogo, Broulee and Batemans Bay.

Engagement Method	Details	When	Outcomes
Taskforce Briefing 3	Present the draft CMP for agency review	June 2022	State Agency representative were provided with an overview of the CMP, including details of the major structural items recommended. Agencies asked questions to inform their review of the CMP and understand their obligations to the process.
Agency Review of Draft CMP	Draft CMP supplied for review Virtual meetings undertaken to discuss specific details requiring agency support	June – August 2022	Feedback on actions relevant to agency lead or support was provided. Several amendments were made to the CMP to reflect the additional information and knowledge supplied by the agencies.
Community Working Groups: Stage 2 and 3 overview	Discuss coastal management options to obtain feedback to inform recommended actions in the draft CMP	July 2022	Four community working groups were undertaken over 2 days (25-26 July 2022) and were attended by 20 community members. Overall, the attendees responded favourably to the options presented for inclusion in the CMP and provided useful feedback to provide updates to option details.
Taskforce Briefing 4	Discuss outcomes of Agency Review	July 2022	The outcomes of the community working groups were presented to the Taskforce, along with the modifications to the draft CMP as an outcome of the Agency Review. The $5 Million Election Commitment allocation was agreed (as per the allocation shown in the Business Plan).
CEMAC Briefing 3	Present Draft CMP for Public Exhibition	October 2022	An overview of the CMP process (Stages 1 to 4) was presented, along with community and engagement activities undertaken, and the draft CMP recommendations.
Council news	Provide information on the upcoming public exhibition drop-in sessions and availability of Eurobodalla Coastal Stories film project on Council's YouTube Channel	October 2022	Public awareness of the CMP and upcoming drop-in sessions. Opportunity for community members to view the three Eurobodalla Coastal Stories films on YouTube.
Council noticeboard in local newspapers and radio announcement	Provide readers of 4 local and online newspapers and local radio station listeners with information on the exhibition of the Draft CMP and upcoming drop-in sessions	October 2022	Public awareness of the CMP and upcoming drop-in sessions.
Public Exhibition: Public Submissions	Obtain feedback on Draft CMP	12 October – 23 November 2022	83 Submissions were received during the public exhibition period. A summary of the issues raised, responses, and any updates to the CMP were provided in the Council Report (for the 13 December Council Meeting).
Public Drop In Sessions - draft CMP exhibition	Inform the community on the recommendations of the CMP. Obtain feedback on the draft CMP.	November 2022	Drop in sessions were held to provide opportunities for the community to meet with the project team and ask questions about the Draft CMP. Issues raised at the drop in sessions were noted and considered in the draft CMP updates. It is estimated that over 100 community members attended the following sessions: • 3 November 2022 – Batemans Bay - Bay Pavilions • 3 November 2022 – Long Beach RFS Shed followed by Long Beach site visit • 4 November 2022 – Narooma Golf Club • 5 November 2022 – Moruya Basil Sellers Exhibition Centre •
Public Exhibition: Public Submissions follow-up	Provided response to all stakeholders who made submissions to the CMP informing them of an updated web package containing a summary of submissions to the draft CMP and how they are addressed or proposed to be addressed in the finalised draft CMP	November 2022	Community members able to see all questions, suggestions, issues and feedback raised during public exhibition. Where changes were proposed to the draft CMP because of a submission, this was identified. Where no change was required, a response providing an answer to questions raised and clear explanation of why no change was required was provided.

Attachment A

Targeted Aboriginal Community Engagement

Acknowledgement of Participation by the Eurobodalla Aboriginal Community

Eurobodalla Shire Council and Rhelm acknowledge that this Coastal Management Program was prepared on Aboriginal Land and with significant sharing of time and knowledge from the traditional custodians of the land.

We extend our sincere gratitude in the significant contributions made to this CMP by the Walbunja, Brinja and Djirringanj elders and knowledge holders, representatives from the Local Aboriginal Land Council's, NSW Fishing Rights Group community members and families of the Eurobodalla Aboriginal Community. Consultation with the Aboriginal community should be included in every step of the CMP process to ensure that the importance of protecting values, heritage and history is captured and that this translates to outcomes for the community. A special thanks to the Mogo and Wagonga Local Aboriginal Land Councils for their assistance in organising meetings on country.

We also express gratitude for the privilege of sharing information and history with Council and Rhelm staff on country, and sharing the history of the land and sea, the flora and fauna, the people, and their totems. Through this CMP, a deeper connection has been established between Council and community that will build trust and a better understanding of how consultation with the Aboriginal community should be undertaken.

A1 The Importance of Engagement with Aboriginal Community in a CMP

The Aboriginal people are the traditional custodians of the land and sea country and have a critical role in ensuring that cultural heritage and history are protected. It is the responsibility of government, at both local and state level, to consider ongoing impacts to Aboriginal cultural heritage, and to work alongside community to protect it wherever possible. The Eurobodalla coastline is rich in recorded and unrecorded history, with middens, sacred sites, storylines and corrobboree grounds covering the coastline, headlands and estuaries.

Culturally appropriate engagement with Aboriginal communities including traditional owners, Local Aboriginal Land Councils (LALCs) and other relevant knowledge holders is an integral part of preparing a CMP. It is essential to understand the cultural significance of the coastal landscape and the influence that coastal processes and environmental change may have on the values of physical and non-physical (i.e. tangible and intangible) elements of cultural heritage. Appropriate consultation has been utilised to promote effective engagement participation and facilitate the sharing and exchange of cultural and scientific knowledge, to support the strategic integration of Aboriginal cultural heritage conservation and adaptation management approaches into the Open Coast CMP. To support and guide our engagement approach, Council and Rhelm paired with Aboriginal engagement specialists Evolve Communities to undertake authentic engagement training through the Songlines Pathway© that will not only build trust between stakeholders and project team, but impart a strong understanding of culturally appropriate, safe engagement to allow meaningful development and implementation of the CMP.

Engagement with Aboriginal communities has been undertaken in the following stages:

A2 Stage 1 Consultation on Country:

Early on in the development of the CMP Stage 1 Scoping Study, Council and Rhelm met on country with Aboriginal Community Stakeholders including LALC representatives, elders and knowledge holders. Meetings were held at the Land Council building in Narooma, on the banks of the Wagonga Inlet and at the Tomakin Sport and Recreation Club in March 2021. Through these meetings, a need for broader consultation in a respectful, safe way was identified.

Stakeholders met at this time included:

- Representatives from the Wagonga LALC
- Representatives from the Mogo LALC and community
- Representatives from the Cobowra LALC
- Representatives from the Batemans Bay LALC
- South Coast Peoples Native Title Claimants
- NSW Fishing Rights Group
- Yuin / Biripi Woman and Traditional Knowledge holder
- Various members of the Walbunja community in a large meeting at Tomakin, with support from Marine Parks and NSW Heritage.
- Meetings were scheduled with Merriman's LALC but were unfortunately cancelled due to unforeseen circumstances.

A2-1: Key messages of Stage 1 consultation:

- Better consultation needed from the start of government process and a more coordinated approach. A huge amount of consultation is expected of Aboriginal people at times with no reimbursement and often no clear benefit to community.
- There are identified cultural sites that need protection now; these include Mummaga Headland, Fullers Beach.
- The native title claim is across all of South Coast, and needs to be recognised in the CMP
- Self-determination is a value that community want to work towards
- Better mapping and therefore protection for cultural items – AHIMS is inaccurate and relying on AHIMS alone is not enough. Predictive mapping would be valuable.
- Cultural tourism should be managed and owned by local knowledge holders.
- Desire to see support for Aboriginal tourism and story telling – views that this could be a significant contribution towards employment opportunity and improve ownership of information to the Aboriginal community.

A2-2 Stage 1 Outcomes: actions relevant to consultation (See table 3-8 of the Open Coast CMP)

- EGC4_D: Embed traditional Aboriginal knowledge, wisdom and culture in strategic planning by providing knowledge consulting fees to knowledge holders involved in coastal management to protect Aboriginal heritage in the coastal zone
- EGC4_C: Support Aboriginal cultural tourism opportunities in the coastal zone to protect Aboriginal heritage
- EGC4_J: Manage access issues and erosion at targeted sites of significant value to the Aboriginal Community as identified by the LALC's
- EGC4_E: Support local Aboriginal Communities manage cultural heritage from coastal hazards and sea level rise and other coastal threats

A3-1 Stage 2 & 3 Online meetings

Due to COVID-19 restrictions, follow-up meetings with Community were not achievable through face-to-face meetings, which was the preferred method identified by Aboriginal Community. In order to present the stage 2 findings and enable early input from Aboriginal Community stakeholders into the actions list of the CMP, a series of online meetings were organised by Rhelm and Council staff. All 6 of the Eurobodalla Local Aboriginal Land Councils were invited to these meetings.

A3-2: Key messages of Stage 2 & 3 online meetings:

- Council to look for ways to support to Aboriginal individuals or groups seeking to implement business opportunities to increase local and tourist awareness of Aboriginal culture in the Eurobodalla coastal area. This could be through accessing assistance in grant funding opportunities, or simply collaborating with community in getting their own initiatives off the ground through the approvals process.
- Desire to see additional protection of heritage sites and better access to places of cultural value

A3-3 Stage 2 Online Meetings outcomes: actions relevant to consultation (See table 3-8 of the Open Coast CMP)

- EGC4_J: Manage access issues and erosion at targeted sites of significant value to the Aboriginal Community as identified by the LALC's
- EGC4_E: Support local Aboriginal Communities manage cultural heritage from coastal hazards and sea level rise and other coastal threats

A4 Stage 2 & 3 Co-design approach & workshop.

Following the Stage 1 consultation, an Aboriginal Engagement Strategy was established by Council and Rhelm. Aboriginal Community engagement specialists Evolve Studios were engaged to undertake a 7-step training program with Council staff to improve their understanding of safe, respectful engagement with Traditional Owners. Over the course of 3 sessions, Aunty Munya and Carla Rogers stepped Council project staff through a series of learning exercises on safe and meaningful engagement with Traditional Owners. As a response to some of the values identified in Stage 1 by Aboriginal Community Stakeholders, a co-design approach between Aboriginal Community and Council was adopted to guide how the next stages of engagement will occur. Following the Evolve training sessions, financial assistance from Department of Planning and Environment was sought and received, allowing Council to begin planning a co-design workshop with Aboriginal Community. This was achieved using Evolves Songlines Pathways© and through the workshop, an engagement pathway was established for stages 2-4 of the CMP.

A4-1 Stage 2 & 3 Engagement Co-design workshop key messages and outcomes:

The co-design workshop was attended by representatives from the Local Aboriginal Land Councils of Batemans Bay, Wagonga and Mogo, as well as a representative from the Yuin Native Title Claimants and Walbunja Elders. Council staff and Rhelm staff were also in attendance and the workshop was led by Evolve Studios.

Key values identified through the workshop are captured in the table below. These were used to shape engagement across the remaining stages of the CMP.

A4-2 Core values of Co-design

- There is genuine opportunity for the Community to contribute to decision-making and shape outcomes – that outcomes are not pre-determined
- Let Traditional Owners have a say in determining the meeting place and time
- Ensure the experience is worthwhile and enjoyable for community.
- The agency has clearly defined what's negotiable (on the table for discussion) and what isn't (off the table for discussion). The below table outlines these:

What are the negotiables and non-negotiables for this project?	Negotiables: • How to improve access to Country • Input into coastal management options being considered for inclusion in the CMP: e.g. what might the cultural impacts be, are there opportunities for Aboriginal people that could be incorporated into the options • Identification and development of additional options to be considered for inclusion in the CMP • How Aboriginal people want to be involved and / or engaged with when coastal management actions are being implemented (e.g. how to identify and involve the appropriate knowledge holder)	Non-Negotiables: • A CMP will be prepared and certified • Coastal protection works will need to go ahead in some places • Other coastal management actions will go ahead (e.g. coastal use and coastal environment actions) • Decisions that arise from Aboriginal engagement not necessarily negotiable (e.g. Knowledge holders may inform the Council team of issues and risks, but ultimately Council or another Agency will be the decision maker) • Project timing and budget will sometimes not be negotiable and this will impact the engagement and collaboration possible
How will the list of negotiable items for this project be of interest to the Community?	• Help the Community understand how they engage with the CMP preparation • Help the Community understand how they will be engaged with in the future • Understand where the limit of their decision-making power will be	
Potential benefits of effective engagement	• Optimise government investment by ensuring programs are targeted to the needs identified by the community • Building community and government capacity to identify and realise shared objectives • Empowering community ownership and buy-in to solutions and reforms	
2.3 Outcomes:	• **Consult:** When identifying options recommended in the CMP – i.e. provide feedback early • **Involve**: When developing options directly related to Aboriginal community, i.e. suggestions for options to include additional details and feedback as they are formed • **Consult**: When implementing coastal management actions – cultural considerations and managing impacts • **Involve:** When implementing Aboriginal Community coastal management actions.	

A5 Stage 3 Engagement Meetings on Country, Eurobodalla Coastal Stories film project

Council staff hosted a series of meetings undertaken in a manner guided and designed by our Aboriginal community representatives and knowledge holders through the Songlines Pathways© workshop. These meetings were in small groups, took place on Country at locations chosen by community and allowed Council staff to discuss the impacts of known coastal hazards, vulnerabilities and opportunities to investigate through the CMP. Discussions around actions and coastal management priorities were held at the following locations chosen by Aboriginal Community:

- Broulee Island
- Fullers Headland

Council staff also coordinated with Department of Planning and Environment to capture footage of interviews held at some of these sessions. These videos were screened during public exhibition at 2 Eat, Meet & Yarn events, and made available online through the Open Coast CMP webpage.

The three short films capture the views of Traditional Owners around connection to Country, being engaged and involved in coastal management and their perspectives on working alongside local and state government.

A5-1: Key messages from meetings on country & Eurobodalla Coastal Stories film project

- Eurobodalla's Aboriginal community want to be engaged by all levels of government but there is distrust of government motives.
- There needs to be more recognition of the important role Aboriginal people play in management of sea country and the coast and their right to practice cultural activities
- State and Local Government strategies around coastal and sea management will need to consider any future cultural plans (such as sea country plans) in coming years.
- An optimism for working together with Council more closely into the future.
- There are issues of access to important sites being restricted by government bodies, which reduces communities ability to manage these sites.
- A number of sites identified by community require protection and should be considered as part of EGC4_E. At the request of stakeholders, the locations of these have not been disclosed in the document but made aware to Council staff and can be addressed through implementation of EGC4_E.

A5-2 Stage 3 Eat, Meet Yarn sessions

Council staff followed up on these meetings on country with a series of informal BBQ's where community were invited to "Eat, Meet and Yarn" with Council staff. The events were intended to establish familiarity with Council staff and projects, the CMP process and provide an opportunity during stages 3 and 4 of the CMP to have input into the CMP process.

BBQ's were held on the banks of Wagonga Inlet (Narooma), Bhundoo (Clyde River) and at Mogo, and provided an informal, relaxed format for conversation around opportunities and values to be included in the CMP, as well as a review of the draft CMP actions identified for different areas of the Eurobodalla Coastline that had been raised by Aboriginal Community throughout the process.

During public exhibition, an additional two sessions were held to discuss the final CMP and provide an opportunity to comment on the draft CMP. These latter sessions also included public screenings of the three videos prepared over the course of this CMP as part of the Eurobodalla Coastal Stories film project undertaken by the Department of Planning and Environment and supported by Council.

Across all 5 events an estimated 42 attendees participated from the Eurobodalla Aboriginal Community, including stakeholders from Wallaga Lake, Tilba, Narooma, Moruya, Mogo, Broulee and Batemans Bay.

Figure A-1. Flyer distributed for one of the five "Eat, Meet & Yarn" events held during preparation of the draft CMP

A5-3 Key messages from Eat, Meet Yarn Sessions

- Government engagement with community needs to consider all stakeholders, not just LALC's.
- A willingness to see more celebration of traditional cultural art into a range of Council projects beyond the draft CMP, such as wooden carvings for the Wagonga Living Shoreline and signage for the Coastal Headlands Walk.
- Cultural tourism and recognition partnerships with Council would be a positive step towards better recognition of Aboriginal connection to land.

- The highest priority for many was to see a better response for the protection of heritage sites at risk of impact from climate change, storms and inappropriate use of the coastal zone.

A5-4 Stage 3 consultation: actions relevant to consultation (See table 3-8 of the Open Coast CMP and update to Coastal Zone Emergency Action Subplan (See section 5.21 of Appendix H - Coastal Zone Emergency Action Subplan).

- EGC4_F: Improve access to Country in the coastal zone through the establishment of an Access to Country Plan
- EGC4_E. Support local Aboriginal Communities manage cultural heritage from coastal hazards and sea level rise and other coastal threats
- EGC4_A: Identify opportunities for and undertake cultural burning in the coastal zone
- EGC4_G: Identify and use Aboriginal place names in the coastal zone
- EGC4_I: Prepare an Aboriginal Seasonal Calendar
- EGC4_B - Support DPI Fisheries with the implementation of Initiative 4 of the Marine Estate Management Strategy: Partner with Aboriginal people for the protection of Aboriginal cultural values
- Appendix H - Coastal Emergency Action Subplan (CZEAS): Consultation with Aboriginal community highlights that the Eurobodalla Coastline has significant Aboriginal cultural heritage sites. This includes extensive coastal middens, burial sites and artefacts and other cultural aspects and values that are of importance to the Aboriginal community. The coastal risks associated with beach erosion and cliff instability can impact these sites. The CZEAS has been updated to include provisions allowing Council and NSW Government to assist LALC's in protecting these sites from the impacts of coastal storm events.

Supporting this CMP:

- Three short films were produced featuring interviews with local Aboriginal knowledge holders, elders, representatives from the Fishing Rights Group and LALC representatives. Each film explored different themes but all focused on the spiritual connection to country, responsibility for country and the importance of being consulted by government agencies including Council.
- Three films are available on Council's YouTube channel and are titled:
    - Connections
    - Millenia
    - Improving Participation

Attachment B

Previous Stakeholder and Community Engagement

B1 Eurobodalla 2030 Community Survey (undertaken 2010)

The Eurobodalla community survey was undertaken prior to the CZMP project establishment in 2010. The key message from residents in 2010 was the preservation, protection and maintenance of the natural environment, especially the coastal and marine environments. Although it was recognised that growth and development of the region was important, it was communicated that this should not be done at the expense of the natural environment. Participants also expressed their desire to retain rural lands.

The question was asked “what do you value the most?” and of the 1400 respondents, over 40% said the beaches, coast and marine environments. The second most valued aspect was the natural environment, with 27% of the total. When asked what their vision of the future entailed, the most frequent response was that growth and development of area is carefully controlled. This clearly highlights the community’s awareness of the delicate balance between managing resources and the environment and allowing for community development.

B2 Stage 3 CMP Engagement – 2017 & 2018

Council has previously conducted consultation activities over the course of the Coastal Management Program to understand the ways in which people use and value the coast, and to provide information about the results of detailed coastal process, hazard and risk studies undertaken to date. The majority of this consultation was around coastal hazard identification and management and took place in 2017-2018. Council staff noted the following lessons were learned through this process:

- Care must be taken to use engaging and open language that is “easily digestible”
- In particular, residents are not familiar with the way risk and uncertainty are managed in a planning process
- A need to ensure that management responses are clearly linked to a vision for the coast and specific objectives that are widely shared by the broader community
- A need to ensure several different types of engagement options are available – including online, individual and group/community face to face

The summary of the consultation undertaken in 2017-2018 as part of the CMP process is provided in **Table B-1.**

Table B-1 Previous CMP Engagement 2017-2018

Date	Activity	Stakeholder Group
14 June 2018	Mail out	Owners of property in an area identified as at risk from coastal hazards
23 July 9:00am-10:00am	Small working groups	Owners of property in an area identified as at risk from coastal hazards
23 July 10:30-12:30	Small working groups	Local NGO’s
23 July 1:00pm- late	Small working groups	Owners of property in an area identified as at risk from coastal hazards
24 July 7:00-8:00 am	Open forum	Batemans Bay Business chamber
24 July 10:00am-3:00pm	Community drop-in session Batemans Bay	All residents

Date	Activity	Stakeholder Group
24 July 5:00 – 8:00pm	Private discussions	Owners of property in an area identified as at risk from coastal hazards
25 July 10:00am-2:00pm	Private discussions	Owners of property in an area identified as at risk from coastal hazards
25 July 6:00am-8:00pm	Community drop-in session - Broulee	All residents
26 July	Private discussions	Owners of property in an area identified as at risk from coastal hazards
26 July 3:00pm-7:00pm	Community drop-in session - Batemans Bay	All residents
27 July 10:00am-2:00pm	Community drop-in session - Narooma	All residents

B2-2 Summary by location and meeting type

The individual meetings involved some 21 people through direct discussions with residents from suburbs identified in the 2017 Coastal Hazard Assessment; Surfside, Long Beach, Tomakin and Broulee. Some important findings from these discussions with individuals include:

- Aspirations and expectations vary considerably between localities
- Diversity of views within each locality – not a universally accepted response
- Coastal processes are not generally well understood, although many people have observed changes on local beaches for the many years they have lived there.
- Waterfront private property owners are generally more motivated to participate in public discussion
- Limited understanding of how risk is defined and calculated. Some unwillingness to accept advice about risk.
- Waterfront property owners feeling entitled to a higher level of service (including coastal protection works) than rest of community due to belief they make a higher contribution to rates
- Views expressed that the community should pay in full to protect private properties
- A high level of anxiety about the impact of publicly available coastal hazard information on private property values, including properties in short term high risk area for beach erosion and properties in longer term risk areas for recession and tidal inundation

B2-1 General drop-in sessions

General consultation with the broader community included targeted workshops, open drop-in sessions and opportunity for on-line comment. These sessions were held at Batemans Bay (2), Broulee (1) and Narooma (1). Some important findings from these discussions include:

- Public access to beaches was the most consistent issue raised
- Condition of existing tracks and access paths
- Preserve natural coast
- Protect dunes
- Private property should not be subsidised
- Impact on wetlands through implementation of Rural lands strategy and proposed amendment to the LEP
- Excellent oral history of past flooding and ocean inundation was conveyed at the Batemans Bay session.

- A wide range of other comments were also noted by respondents – but in smaller numbers. Some important comments included:
- Storm water function at Hanging Rock
- Picnic facilities at beaches and coastal reserves
- Condition and maintenance of existing rock wall near marine rescue in Batemans Bay
- Management of coastal lake entrances to prevent die back of old growth trees

B2-3 Summary of feedback and concerns recorded through affected landowners engagement

Diverse views and aspirations were expressed over a five day period of engagement with residents noted as "affected" by coastal hazards. A summary of the outcomes of this engagement is below:

- Access to beaches, community facilities and condition of dunes is key concern for wider community
- Protection of property and maintaining property value are important to waterfront property owners
- People value their coastal lifestyle at the community scale. This can include their attitude to beach access, views and dune vegetation
- Most people accept there is a risk from coastal hazards at some locations and that these risks will change over time
- Not all residents accept the risks exist. This is in part associated with understanding of coastal processes and hazards, and acceptance (or not) of the need to consider the impact of climate change in long term planning
- Misconception about the scale and application of the interim council policy relating to development consents, especially triggers for planned retreat.

B2-4 Limitations of consultation

The consultation was targeted towards property owners with dwellings on land identified as being at risk or potentially at risk in the future from coastal hazards. These property owners were contacted directly by mail and advised about the forthcoming engagement activities. The only individual stakeholders offered private consultation were owners of waterfront properties, many of whom are non-residents. These views therefore are not considered wholly representative of the broader Eurobodalla community.

B2-4-1 Long Beach

- Residents along Bay Road do not want any works to occur and prefer a "wait and see" approach.
- Strong objection to planting trees on public foreshore areas by some
- Limited acceptance of risk identified by the 2017 Coastal Hazard Assessment.
- Differences between aspirations of residents at eastern and western ends of beach. Residents along Bay Street felt existing protection (a buried rock wall) is sufficient.

B2-4-2 Tomakin

- Residents identified a storm water drain as an issue, from both coastal hazard and coastal amenity perspectives. The consensus was that the beach is generally a safe and protected beach enjoyed by young families and older people.

- A desire for alternatives to manage erosion from storm water outlet during high discharge events. Some suggestions included moving the drain (redesigning the stormwater system for the area), or as a minimum an investigation of the feasibility of alternatives as an action of the CMP.
- Location of council water and sewer assets on the council reserve on the ocean side of houses means a joint response and contribution from council to protect these assets will be required.
- Disappointment that council support for a community funded walkway to improve access to the beach was withdrawn on grounds of being susceptible to coastal erosion.
- Options such as beach scraping should be considered. Support from residents to maintain and improve density of dune vegetation over time.
- Varying levels of acceptance of impacts from coastal hazards – some residents were not as concerned as they had owned property for a very long time and had enjoyed them realising things could change in the future

B2-4-3 Broulee

- Identified a desire to preserve the dunes – possibly use beach scraping and sand bags (during and immediately after beach erosion events).
- Maintaining dune vegetation was identified as a good short to medium term option – it was noted that care needs to be taken when managing weeds on dunes to ensure native vegetation is not damaged/killed.
- Requested an improved headland pathway between north Broulee and mossy point – Locals re-iterated that it is important to consider actions that will benefit whole community.

B2-4-4 Surfside

- Some Surfside residents wanted engineered coastal protection works paid in full by the ratepayers (Council and State Government). Specifically, these works are to protect private property, and are to be constructed on public land.
- Residents also want to see ongoing beach nourishment to maintain a sandy beach
- Impact on private property values are the primary concern, for properties affected by short and long term erosion or inundation
- Notable rejection of the risk identified in the 2017 Coastal Hazard Assessments. The residents do not accept the hazard analysis or the input information used.

B2-5 Summary of the comments received from NGO groups (meetings and online)

B2-5-1 Batemans Bay Business Chamber

- Acknowledgement and acceptance of risks from coastal hazards, affecting the CBD area. Businesses are aware of the disruption caused by wave overtopping and tidal inundation
- Suggested major engineered works such as building additional walls in the centre of the Bay to create a better channel and prevent wave energy entering inner Bay area
- Businesses raised concerns about the impact of the new bridge construction and changes to lease/licensing arrangements affecting specific on-water businesses
- Commented that dredging of navigation channels has been of little benefit – channel quickly refills with sand

B2-5-2 Eurobodalla Coastal Alliance

- The consensus was a rejection of the 2017 WRL report and findings.
- A desire to see planned retreat removed as an option, as well as a review of conditions of consent that relate to coastal hazards and risks removed
- There is a belief by some that Surfside is owed a rockwall funded by the local and state government due to the perception that erosion of the northern shoreline is exclusively driven by foreshore works on the southern side of the bay, as well as the original Batemans Bay bridge.

B2-5-3 Coastwatchers

- Identified a desire to see environmental health and access improved through CMP, and don’t wish to see amenity or access lost through hard solutions (e.g rock walls)
- Preference for strengthening dunes systems; have been involved in a number of landcare projects to contribute to this. Soft solutions preferred to hard.

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Appendix B

CMP Stage 2 Vulnerability Assessments

Eurobodalla Open Coast Coastal Management Program

Stage 2: Vulnerability Assessments

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Document Control

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02	01 December 2021	Updated Final	Emma Maratea	-
03	21 January 2022	Updated to include Cullendulla Creek Inundation Modelling	Luke Evans	Emma Maratea
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Acknowledgements

Acknowledgement of Traditional Owners

Eurobodalla Shire Council recognises Aboriginal people as the original inhabitants and custodians of all land and water in the Eurobodalla and respects their enduring cultural and spiritual connection to it.

Acknowledgment of Financial Assistance

Eurobodalla Shire Council has prepared this document with financial assistance from the NSW Government through its Coastal and Estuary Grants Program. This document does not necessarily represent the opinions of the NSW Government or the NSW Department of Planning, Industry and Environment (DPIE).

Executive Summary

Eurobodalla Shire Council with the assistance of the NSW Government is preparing a Coastal Management Program (CMP) for the Eurobodalla Coastline, in accordance with the provisions of the NSW Coastal Management Act 2016 (CM Act).

The NSW Coastal Management Manual (the manual) specifies five stages of preparing a CMP (**Figure E-1**).

Eurobodalla Shire Council has recently completed Stage 1 of the CMP process (Scoping Study) (Rhelm, 2021), which established the context for management, identified key risks and outlined the forward program for subsequent CMP stages and associated studies/tasks, as well as developed a community engagement strategy to communicate the values and issues of the CMP.

This report presents Stage 2 of the program, which addresses and fills knowledge gaps identified in Stage 1, and in doing so builds upon on the coastal vulnerability information for the Eurobodalla coastline.

The Stage 2 additional studies completed and presented in this document are:

- Erosion assessments at key risk locations identified in Stage 1 (**Section 4**)
- Geotechnical assessments at key locations identified in Stage 1 (**Section 4.1**)
- Coastal inundation assessments at key risk locations identified in Stage 1 (**Section 5**)
- Conceptual sediment transport analysis of Batemans Bay (**Section 6**).

In addition, a series of community working groups were undertaken (24th – 25th August) to present the draft findings of the Stage 2 assessments.

The next stage of preparation of the CMP is the Stage 3 Options Assessment, during which options for managing identified risks from coastal hazards and other issues affecting the Eurobodalla coastline will be investigated.

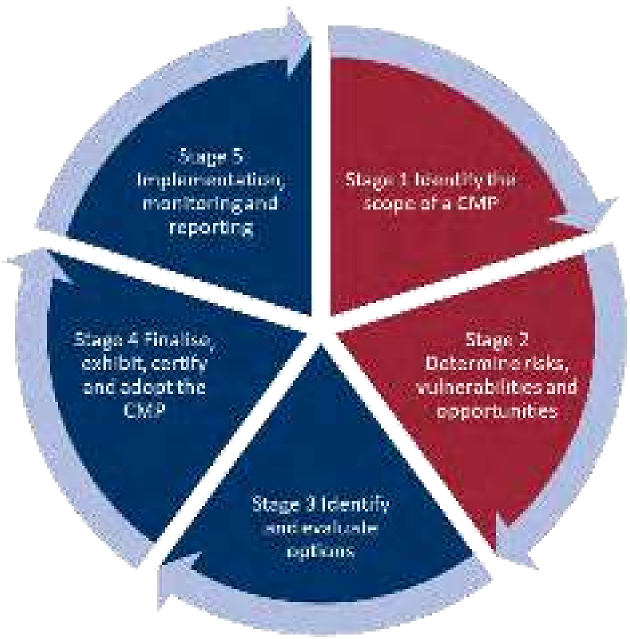

Figure E-1-1 The Five Stages of a CMP (Adapted from OEH, 2018a)

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Acronyms and Abbreviations

AHD	Australian Height Datum
CM Act	NSW *Coastal Management Act 2016*
CMP	Coastal Management Program
CZMP	Coastal Zone Management Plan
DPIE	NSW Department of Planning, Industry and Environment
ESC	Eurobodalla Shire Council
km^2	Square kilometres
m^2	Square metres
m^3	Cubic metres
m/s	Metres per second
m^3/s	Cubic metres per second
MSL	Mean Sea Level
NSW	New South Wales
OEH	Former NSW Office of Environment and Heritage
PoM	Plan of Management
WRL	Water Research Laboratory

Glossary*

Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level.
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.
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
Climate change	A process that 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.
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 hazard	Coastal hazards, as defined by the CM Act, include beach erosion, shoreline recession, coastal lake or watercourse entrance instability, coastal inundation, coastal cliff or slope instability, tidal inundation, and 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). In the case of an estuary, coastal inundation may be caused by a combination of processes including high tides, storm surge and wave run-up onto the foreshore.
Coastal processes	Coastal processes are the set of mechanisms that operate at the land-water interface. These processes incorporate sediment transport and are governed by factors such as tide, wave and wind energy.
Coastal Zone	The coastal zone, as defined by the CM Act, means the area of land comprised of the following coastal management areas: (a) the coastal wetlands and littoral rainforests area, (b) the coastal vulnerability area, (c) the coastal environment area, (d) the coastal use area.
Design storm event	A significant event to be considered in the planning process.

Development	As defined in the *Environmental Planning and Assessment Act 1979*. New development refers to development of a completely different nature to that associated with the former land use, e.g. the urban subdivision of an area previously used for rural purposes. New developments involve re-zoning and typically require major extensions of existing urban services, such as roads, water supply, sewerage and electric power. Infill development refers to the development of vacant blocks of land that are generally surrounded by already developed properties and is permissible under the current zoning of the land. Conditions such as minimum floor levels may be imposed on infill development. Redevelopment refers to rebuilding in an area, e.g., as urban areas age, it may become necessary to demolish and reconstruct buildings on a relatively large scale. Redevelopment generally does not require either re-zoning or major extensions to urban services.
Estuary	The CM Act defines an estuary 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.
Extreme Ocean Water Level	The highest elevation reached by the sea/ocean as recorded by a tide gauge during a given period (after MHL, 2018).
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.
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'.
Flood	A general and temporary condition of partial or complete inundation of normally dry land areas, including inundation as a result of sea/ocean storms and other coastal processes or catchment flows.

Flood risk
Potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk is divided into three types, existing, future and continuing risks as described below:

- Existing flood risk is the risk a community is exposed to as a result of its location on the floodplain.
- Future flood risk is the risk a community may be exposed to as a result of new development on the floodplain.
- Residual flood risk is the risk a community is exposed to after floodplain risk management measures have been implemented.

Geographical information system (GIS)
A system of software and procedures designed to support the management, manipulation, analysis and display of spatially referenced data.

High Tide
The maximum height reached by a rising tide. The high water is due to the periodic tidal forces and the effects of meteorological, hydrologic, and/or oceanographic conditions.

Mean Sea Level (MSL)
MSL is a measure of the average height of the sea or ocean's surface such as the halfway point between the mean high tide and the mean low tide. At present, mean sea level is approximately equivalent to 0 mAHD (reported as 0.03 mAHD in MHL, 2019).

Probability
A statistical measure of the expected frequency or occurrence of flooding.

Risk
The chance of something happening that will have an impact on objectives, usually measured in terms of a combination of the consequences of an event and likelihood of occurrence.

Sea level rise
A rise in the level of the sea surface that has occurred or is projected to occur in the future, as measured from a point in time. The rise can be reported as a global mean or as measured at a specific point or estimated for a specific part of the sea or ocean.

Shoreline
The intersection between the sea and the land. The line delineating the shoreline is often approximated as the Mean High Water Mark, however, the definition can vary depending on the application.

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.

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. For planning controls, it is defined as the land that is inundated up to the level of Highest Astronomical Tide (HAT).
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	Waves resulting from the action of the wind on the surface of the water.

*Many of the glossary terms here are derived or adapted from the *Coastal Management Glossary* (OEH, 2018d).

1 Introduction

The NSW Coastal Management Manual (the manual) specifies five stages of preparing a CMP (**Figure E-1**).

Eurobodalla Shire Council has recently completed Stage 1 of the CMP process (Scoping Study) (Rhelm, 2021), which established the context for management, identified key risks and outlined the forward program for subsequent CMP stages and associated studies/tasks, as well as develop a community engagement strategy to communicate the values and issues of the CMP. This report presents Stage 2 of the program, which addresses and fills knowledge gaps identified in Stage 1, and in doing so builds upon on the coastal vulnerability information for the Eurobodalla coastline.

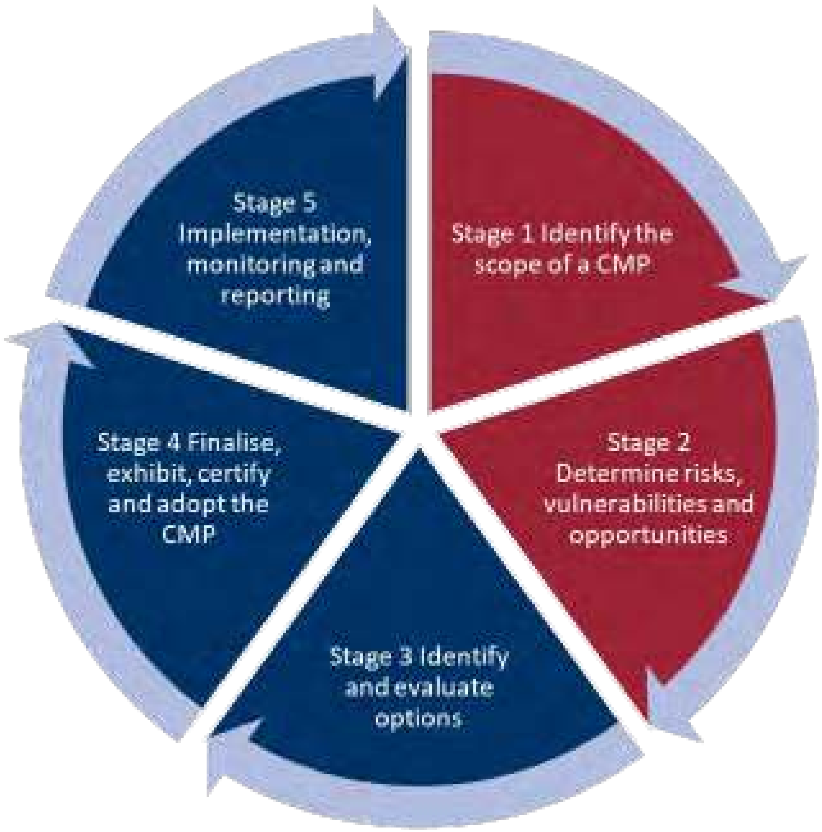

Figure 1-1 The Five Stages of a CMP (Adapted from OEH, 2018a)

The primary outcomes of this Stage 2 report, is to identify, analyse and evaluate risks and opportunities to support decision-making in Stage 3 and 4 of the CMP. As a result the Stage 2 additional studies were designed to reflect the scale and complexity of the management responses required in each coastal management area.

The outcomes of the Stage 2 report will be used in the CMP to:

- refine the mapping of coastal hazards
- provide context and data to support the identification and evaluation of management options in Stage 3
- quantify the nature and extent of exposure to coastal hazards and threats to public and private assets (both natural and built)

- understand the factors that contribute to coastal vulnerability and to current and future risks for the coastline
- understand the range of potential future scenarios.

The Stage 2 additional studies completed and presented in this document are:

- Erosion assessments at key risk locations identified in Stage 1 (**Section 4**)
- Geotechnical assessments at key locations identified in Stage 1 (**Section 4.1**)
- Coastal inundation assessments at key risk locations identified in Stage 1 (**Section 5**)
- Conceptual sediment transport analysis of Batemans Bay (**Section 6**).

In addition, a series of community working groups were undertaken (24th – 25th August) to present the draft findings of the Stage 2 assessments, with feedback examined and incorporated.

2 Community and Stakeholder Engagement

Community engagement in Stage 2 occurred primarily through community working groups. These working groups were established through registration of interest. Council sought registrations of interest through:

- Invitations issued to all relevant registered community groups, clubs and associations
- Invitations issues to all community members who had previously registered their interest in the CMP via Council's webpage
- Media release issued 16th July 2021
- Social media update on Council's Facebook Page 21st July 2021.

There were 52 registrations of interest for the working groups, resulting in five working groups with locality focus.

Due to COVID restrictions, the working groups were undertaken virtually using a combination of Microsoft Teams for voice and camera interactions, and an interactive online whiteboard (Miro) for presentation of project information and collaboration by participants.

The workshops were run over the 24th and 25th August 2021.

The working group session format was structured around:

- Presenting coastal hazard risks identified in the Stage 2 vulnerability assessments and getting feedback from participants on experiences with and concerns regarding these risks
- Input from participants on key coastal management issues, both local and regional
- Input from participants on coastal management actions they would like Council to consider in the CMP.

Council's CEMAC were also presented with an abridged version of the coastal hazard risks and opportunities across the LGA and given an overview of the sediment transport model.

The outcomes of the working groups have been used to inform:

- This Stage 2 report
- The identification of options for managing identified risks from coastal hazards and other issues affecting the Eurobodalla coastline (to be investigated in Stage 3 of the CMP).

A summary of the key outcome themes is provided in **Figure 2-1**.

Tourism opportunities such as coastal walks.

Property protection to be included in the CMP Vision Statement

ICOLL entrance management to be reviewed. Durras raised as priority review.

Protection of trees in urban and bushland areas

Dune management: protection of vegetation, recovery following erosion events, unrestricted pedestrian access. Revegetation attempts of dune at Long Beach has had mixed response from community.

How will **equitable distribution of funding and resources** be achieved?

Water quality issues in creeks and drains discharging to beaches and coast. Sewer impacts on swimming beaches (e.g. Broulee Head)

Weed management

Protection of intertidal species under sea level rise

Potential additional data and issues to be considered in sediment transport assessment.

All abilities access to beaches and foreshore

The CMP needs to provide **localised values, risks and recommendations**

Increased tourism: impacts on facilities (e.g. parking, bike tracks, boat ramps), need for education to reduce environmental impacts (e.g. litter, trampling of dune vegetation)

CMP recommendations should include **adaptation pathways** with triggers not just single solutions.

Erosion protection priority location identified by community at Surfside (west and east of Pinnacle Point) and Cullendulla. Management options suggested included groynes, nourishment (on and off shore), offshore reefs, break walls, reclaimed land.

Figure 2-1 Community Working Group Outcome Themes

3 Outcomes of Stage 1

3.1 First Pass Risk Assessment

The Scoping Study (Rhelm, 2021) considered threats to the coastal zone across a range of planning timeframes and pathways. A first-pass risk assessment process was applied to better understand the severity of known threats in the study area, at present and in the future.

A key input to the first pass risk assessment was an understanding of the exposure of the entire Eurobodalla coastline against the coastal hazard threats relevant to the open coast. To achieve this, the coastline was separated into smaller coastal compartments, a total of 46 each with similar foreshore character, and the exposure of each coastal compartment was then estimated based on available coastal hazard information (such as beach erosion, shoreline recession and coastal inundation mapping from within WRL, 2017 and SMEC, 2010; coastal cliff and slope instability from ACT Geotechnical 2012; coastal processes and contextual information from over 40 years of existing studies). Where no existing data or study was available, a screening level estimate of the erosion, recession and inundation exposure was developed to identify potential coastal risks that would warrant further investigation. This screening level hazard exposure was interpreted with observations made by the study team during the site visits (16th – 18th March 2021) to provide a first pass assessment of the risk profile against the 10 coastal hazard threats.

The first pass risk assessment of coastal hazards provided guidance for each location as to whether:

- Additional data or analysis is required in Stage 2 of the CMP to better define the risk prior to undertaking Stage 3- identification and evaluation of management options.
- No additional hazard analysis is required in Stage 2 as data is sufficient. There are however identified management issues relating to coastal hazards that will require addressing through the assessment of management options in Stage 3.
- The coastal hazard risk is sufficiently low that no further assessment of risk or risk management is required at that location.

The Scoping Study (Rhelm, 2021) presents the forward plan for Stages 2 to 5 of the CMP, this included the Stage 2 Assessments summarised in **Table 3-1** and presented in this document.

Table 3-1 Stage 2 Assessments from First Pass Risk Assessment

Location	Coastal Hazard	Stage 2 Assessment
Maloneys Beach	Erosion	Deterministic erosion hazard lines for 2100.
Long Beach	Erosion	Deterministic erosion hazard lines for 2100. 2021 geotechnical analysis to be considered.
	Coastal Inundation (Beaches)	Map wave runup and bore propagation extents for the beaches. Refine mapping of inundation using recent LIDAR and consideration of hydraulic connectivity.
	Inundation (Creek Entrances)	Hydraulic modelling of lake connection to the beach for 100 Year ARI (Present Day and 2100).
Cullendulla Beach	Inundation (Creek Entrances)	Hydraulic modelling of Cullendulla Creek for 1 Year ARI, 20 Year ARI, 100 Year ARI (Present Day, 2050, 2065 and 2100).
Surfside	Erosion	Deterministic erosion hazard lines for 2100. 2021 geotechnical analysis to be considered.
	Coastal Inundation (Beaches)	Map wave runup and bore propagation extents for the beaches. Refine mapping of inundation using recent LIDAR and consideration of hydraulic connectivity.
	Inundation (Creek Entrances)	Hydraulic modelling of Surfside Creek for HHWS, 1 Year ARI, 20 Year ARI, 100 Year ARI (Present Day, 2050, 2065 and 2100). Coincidence design flood events for 20 Year ARI Rainfall / 100 Year ARI Coastal (Present Day, 2050, 2065 and 2100).
Wharf Road	Erosion	No additional assessment required – BMT WBM (2017) lines reproduced in the map set for completeness (Map Series RH-04-01)
	Coastal Inundation (Beaches)	Map wave runup and bore propagation extents for the beaches. Refine mapping of inundation using recent LIDAR and consideration of hydraulic connectivity.
Batemans Bay CBD	Coastal Inundation (Beaches)	Map wave runup and bore propagation extents for the beaches. Refine mapping of inundation using recent LIDAR and consideration of hydraulic connectivity.
	Inundation (Creek Entrances)	Hydraulic modelling of Water Gardens for HHWS, 1 Year ARI, 20 Year ARI, 100 Year ARI (Present Day, 2050, 2065 and 2100). Coincidence design flood events for 20 Year ARI Rainfall / 100 Year ARI Coastal (Present Day, 2050, 2065 and 2100).
Boat Harbour	Coastal Inundation (Beaches)	Map wave runup and bore propagation extents for the beaches. Refine mapping of inundation using recent LIDAR and consideration of hydraulic connectivity.
	Inundation (Creek Entrances)	Hydraulic modelling of Hanging Rock Creek for HHWS, 1 Year ARI, 20 Year ARI, 100 Year ARI (Present Day, 2050, 2065 and 2100). Coincidence design flood events for 20 Year ARI Rainfall / 100 Year ARI Coastal (Present Day, 2050, 2065 and 2100).

Location	Coastal Hazard	Stage 2 Assessment
Corrigans Beach	Coastal Inundation (Beaches)	Map wave runup and bore propagation extents for the beaches. Refine mapping of inundation using recent LIDAR and consideration of hydraulic connectivity.
	Inundation (Creek Entrances)	Hydraulic modelling of Joes Creek for HHWS, 1 Year ARI, 20 Year ARI, 100 Year ARI (Present Day, 2050, 2065 and 2100). Coincidence design flood events for 20 Year ARI Rainfall / 100 Year ARI Coastal (Present Day, 2050, 2065 and 2100).
Caseys Beach	Erosion	No additional assessment required – WRL (2017) lines reproduced in the map set for completeness (Map Series RH-04-01)
	Coastal Inundation (Beaches)	Map wave runup and bore propagation extents for the beaches. Refine mapping of inundation using recent LIDAR and consideration of hydraulic connectivity.
	Inundation (Creek Entrances)	Hydraulic modelling of Shortbeach Creek for HHWS, 1 Year ARI, 20 Year ARI, 100 Year ARI (Present Day, 2050, 2065 and 2100). Coincidence design flood events for 20 Year ARI Rainfall / 100 Year ARI Coastal (Present Day, 2050, 2065 and 2100).
Malua Bay	Erosion	Deterministic erosion hazard lines for 2100.
	Coastal Inundation (Beaches)	Map wave runup and bore propagation extents for the beaches. Refine mapping of inundation using recent LIDAR and consideration of hydraulic connectivity.
	Inundation (Creek Entrances)	Hydraulic modelling of Reedy Creek for HHWS, 1 Year ARI, 20 Year ARI, 100 Year ARI (Present Day, 2050, 2065 and 2100). Coincidence design flood events for 20 Year ARI Rainfall / 100 Year ARI Coastal (Present Day, 2050, 2065 and 2100).
Barlings Beach	Erosion	No additional assessment required – WRL (2017) lines reproduced in the map set for completeness (Map Series RH-04-01)
Tomakin Cove	Erosion	Deterministic erosion hazard lines for 2100. 2021 geotechnical analysis to be considered.
	Coastal Inundation (Beaches)	Map wave runup and bore propagation extents for the beaches. Refine mapping of inundation using recent LIDAR and consideration of hydraulic connectivity.
Broulee	Erosion	No additional assessment required – WRL (2017) lines reproduced in the map set for completeness (Map Series RH-04-01)
	Inundation (Creek Entrances)	Hydraulic modelling of Candlagen Creek for HHWS, 1 Year ARI, 20 Year ARI, 100 Year ARI (Present Day, 2050, 2065 and 2100). Coincidence design flood events for 20 Year ARI Rainfall / 100 Year ARI Coastal (Present Day, 2050, 2065 and 2100).

3.2 Outcomes from Existing Studies

The *Eurobodalla Coastal Hazard Assessment* (WRL, 2017) and *Eurobodalla Shire Coastal Hazards Scoping Study* (SMEC 2010) were the primary contemporary studies utilised. The Eurobodalla Coastal Hazard Assessment (WRL, 2017) undertook a hazard assessment for current and future beach erosion, shoreline recession, first-pass coastal inundation, and geotechnical hazards at 17 high priority beaches (WRL 2017). Maximum wave runup levels were calculated for an additional 16 beaches in the *Eurobodalla Shire Coastal Hazards Scoping Study* (SMEC 2010).

'Bathtub analysis' for coastal inundation hazards was mapped at the 17 high priority beaches (WRL, 2017).

Future tidal inundation scenarios and TUFLOW model establishment has been undertaken for:

- Broulee Beach (Candlagen Creek) as part of the Tomakin, Mossy Point, Broulee Flood Study (WMA Water 2017)
- Long Beach Lagoon, Surfside Creek, Water Gardens, Hanging Rock Creek, Joes Creek, Shortbeach Creek as part of the Batemans Bay Urban Creeks Flood Study (Rhelm, 2021).

This Stage 2 report provides updated hazard information for high risk locations or to fill data gaps not previously included in prior studies.

The first pass risk assessment and forward plan undertaken in Stage 1 of the CMP (Rhelm, 2021) identified studies to be completed in Stage 2.

For the purposes of preparing a CMP consistent with the Manual that extends from 2022 to 2032 the timeframes undertaken in the Eurobodalla Coastal Hazard Assessment (WRL, 2017), consistent with Councils adopted Interim Coastal Hazard Adaptation Code have been utilised. These values (adjusted to present day sea level) are:

- Present Day
- 2050 (i.e. 22cm increase in sea level)
- 2065 (i.e. 33cm increase in sea level)
- 2100 (i.e. 71cm increase in sea level).

These values as documented in the Stage 1 (scoping study) report (Rhelm, 2021) are deemed adequate and appropriate for the preparation of the CMP. This includes both the fast-tracked Stage 2 components and those undertaken in this study.

3.3 Sediment Compartments

The Coastal Management Manual (OEH, 2018) recommends the use of sediment compartments as a framework for considering coastal processes to analyse coastal hazards. Sediment compartments are defined as an area of coast that behaves in a broadly homogenous way with respect to sediment transport processes, sources and sinks (Thom, et al., 2018).

Eurobodalla Shire is identified within two primary coastal sediment compartments and six secondary sediment compartments (Geoscience Australia 2015), listed below and shown **in Appendix 1.** https://d28rz98at9flks.cloudfront.net/76502/76502_2.pdf : (Geoscience Australia 2015 and mapped 2016)

- Beecroft Head to Wasp Head (south Durras) (NSW 08/23)

  - Lake Tabourie coast – Warden Head to Wasp Head (NSW8.06/102), (Durras Beach is at the far southern end of this secondary compartment)
- Wasp Head to Cape Howe (NSW 09/24)
  - Murramarang - Wasp Head to Three Islet Point (NSW 9.01/103)
  - Batemans Bay – Three Islet Point to South Head (Mosquito Bay) (NSW9.02/104)
  - Moruya River – South head (Mosquito Bay) to Bingie Bingie Point (NSW 9.03/105)
  - Eurobodalla coast - Bingie Bingie Point to Cape Dromedary (NSW 9.04/106)
  - Mount Dromedary Coast – Cape Dromedary to Goalen Head (NSW9.05/107). Most of this compartment is in Bega Valley Shire LGA.

This area experiences some northward sediment transport in line with the predominant south-easterly wave direction, however, for the most part the beach systems tend to be part of closed sediment boundaries. This means little if any sediment sharing or transport occurs between the secondary compartments (Short, 2020). The primary compartment is exposed to storms, including east coast lows (extra-tropical cyclones) as well as climate variations due to the El Niño Southern Oscillation (ENSO).

4 Beach Erosion and Shoreline Recession Assessment

Beach erosion and shoreline recession at several key ESC beaches were defined within the Eurobodalla Coastal Hazard Assessment (WRL, 2017) and Eurobodalla Shire Coastal Hazards Scoping Study (SMEC 2010). The Coastal Hazard Assessment (WRL, 2017) provides detailed calculation of erosion and recession using both deterministic and probabilistic methods. For the purposes of identifying coastal areas most at risk, the probabilistic approach within WRL (2017) was considered conservative and a consistent description of vulnerability was required across all beaches. As a result, deterministic hazard lines were recalculated at five beaches where probabilistic lines were previously defined. Further, consideration of recently acquired geotechnical data was incorporated into the hazard line redefinition.

The deterministic method applies a single value with a defined probability of occurrence for each parameter; namely annual shoreline recession/accretion, sea level rise and storm demand; where the single value represents the best estimation based on available data. In comparison, the probabilistic method utilises a range of possible values defined by a probability density function (PDF) that allows all variables to randomly vary over the pre-defined range and repeatedly combine these randomly sampled values, known as a Monte-Carlo simulation. The result is a range of possible shoreline responses, each with a defined likelihood. The adopted shoreline response is then selected based on the target risk profile (e.g. the 1% encounter probability).

Adopting the alternate approaches across the study area has the potential to bias any management options (Stage 3 of the CMP) to beaches where erosion vulnerability is defined by the probabilistic approach. Further, for the purposes of identifying management responses, the 100-year ARI is considered appropriate for the planning periods under consideration. As a result, deterministic hazard lines were redefined at the following beaches:

- Long Beach
- Surfside
- Malua Bay
- Tomakin Cove
- Broulee Beach

Hazard lines at all other locations (Maloneys Beach, Wharf Road, Caseys Bay, and Barlings Beach) were adopted from either WRL (2017), SMEC (2010) or BMT WBM (2009).

4.1 Geotechnical Assessment to refine beach erosion and shoreline recession

Many locations along the Eurobodalla coastline are characterised by rock headlands and nearshore rock outcrops. The presence of rock has the potential to limit the amount of coastal erosion along a particular shoreline if located at elevations that would be subject to erosive processes during coastal storm conditions and also has the potential to cause shoreline realignment when exposed in storms or as it emerges on a receding beach or as sea levels rise. Geotechnical investigations were commissioned to identify the presence and vertical elevation of competent rock at three locations, where the observable presence of rock has the potential to limit the currently defined erosion hazard exposure. These sites included Long Beach, Surfside and Tomakin Cove as recommended in the Eurobodalla Coastal Hazard Assessment (WRL, 2017) and via community consultation.

The scope of the commissioned geotechnical investigations involved:

- Stage 1 – Desk study

- Stage 2 – Non-intrusive field investigation
  - Engineering geological field mapping
  - Geophysical investigations
- Stage 3 – Compilation of a simplified geotechnical model.

The full description of geotechnical investigations and the findings are presented in **Appendix A**.

The primary purpose of undertaking the geotechnical investigations was to better understand the geological properties of key foreshore areas and update the assumptions made in the coastal hazard modelling and calculations such as scour potential (depth and distance landward).

The scour level of coastal erosion is generally adopted as -1mAHD, which aligns with observed eroded beach profiles following historic severe erosion events along the NSW coast, and is the value adopted in the Eurobodalla Coastal Hazard Assessment (WRL, 2017) for the calculation and mapping of coastal erosion extents. While the presence of rock was identified through all areas where geotechnical investigations were completed, the level of competent bed rock that underlies developed areas is below the adopted coastal erosion scour level of -1mAHD within WRL (2017) and hence will not have an influence on the erosion extents developed in WRL (2017).

At Long Beach, there exists a low crested sea wall that extends from the culvert structure at the end of Fauna Ave. Given the identified level of competent rock and the observed profile of the sea wall, the wall is unlikely to be founded on bed rock

4.2 Shoreline Recession Assessment

Location specific shoreline recession estimates at several key ESC beaches were assessed by WRL (2017). The detailed calculation of shoreline recession was based on long-term shoreline position trends and recession due to sea level rise (SLR).

The underlying shoreline movement was calculated based on analysis of photogrammetry data at each beach compartment, as summarised in Appendix C of WRL (2017). Recession due to SLR was estimated using the Bruun Rule, that requires an estimate of the active beach profile out to the closure depth and SLR. The Bruun Rule is a widely used method to estimate the magnitude of shoreline recession of a sandy beach in response to changes in sea level.

To produce deterministic vulnerability areas, the upper estimates long-term recession were adopted from WRL (2017, Table 6-1) for coastal planning purposes along with the mode value of the Bruun factor. The adopted values and the resulting deterministic estimates of shoreline recession are summarised in **Table 4-1**.

This approach adopts a conservative position in relation to future shoreline recession as a result of sea level rise, considered appropriate for coastal planning in the context of uncertainties present. Such uncertainties include the use of the Bruun Rule, which assumes a long, sandy beach with no effect from headlands and no exposed rock or erosion resistant substrate and the potential for the wider presence of bed rock to cause realignment as it emerges on a receding beach or as sea levels rise. These future impacts are extremely difficult to predict and must be based on assumptions of the beach behaviour. Where known or obvious, the presence of underlying bedrock was taken into account in the Bruun factor estimates within WRL (2017) and the subsequent work completed in this Stage 2 assessment. Future information showing emergence of rock or presence of near surface rock, beyond what has been identified within the geotechnical assessments to date, may warrant reassessment of predicted hazard lines.

Table 4-1 Adopted values of Shoreline Recession for Deterministic Erosion Hazard Definition from WRL (2017)

Beach	Section	WRL D_{50} (mm)	Storm Erosion		Recession Due to SLR			Underlying Recession			Total Recession (m)	
			Storm Demand (m^3/m beach)*	Swash Elevation (mMSL)	Bruun Factor	2050 (m)	2100 (m)	Trend (m/yr)	2050 (m)	2100 (m)	2050	2100
Long Beach	East	0.24	70	2	20	-4.4	-14.2	0.07	2.3	5.8	-2.1	-8.4
	Central	0.24	100	2	20	-4.4	-14.2	-0.08	-2.6	-6.6	-7.0	-20.8
	West	0.24	120	2	20	-4.4	-14.2	0.07	2.3	5.8	-2.1	-8.4
Surfside Beach (East)	North	0.25	50	1	25	-5.5	-17.8	-0.13	-4.3	-10.8	-9.8	-28.5
	South	0.25	60	1	25	-5.5	-17.8	0.07	2.3	5.8	-3.2	-11.9
Surfside Beach (West)	Central	0.21	20	1	20	-4.4	-14.2	0	0	0	-4.4	-14.2
Malua Bay	Central	0.34	120	2	30	-6.6	-21.3	-0.18	-5.9	-15.0	-12.5	-36.2
Tomakin Cove	Central	0.19	90	1	25	-5.5	-17.8	-0.08	-2.6	-6.6	-8.1	-24.4
Broulee Beach	North	0.21	110	2	30	-6.6	-21.3	-0.03	-1.00	-2.5	-7.6	-23.8
	Central	0.21	90	2	30	-6.6	-21.3	0.12	4.0	10.0	-2.6	-11.3
	South	0.21	70	1	30	-6.6	-21.3	0.12	4.0	10.0	-2.6	-11.3

* defined as m^3/m of beach above 0mMSL

4.3 Beach Erosion Assessment

Beach erosion extents along beach compartments were defined in WRL (2017) through site specific estimates of the storm demand from numerical modelling (waves and sediment transport) and consensus review from coastal engineering experts. The landward extent of erosion was then defined by calculating the Zone of Slope Adjustment (ZSA) and Zone of Reduced Foundation Capacity (ZRFC) as per the methodology of Nielsen et. al. (1992) and as summarised in Appendix G of WRL (2017). As per WRL (2017), all erosion extent calculations were undertaken volumetrically based on measured beach cross sections at regular intervals along the beach compartment (e.g. photogrammetry data). In this way the variability in the dune crest along a beach compartment, where present, is captured based on available data. Values for swash elevation, scour level and the angle of repose, along with the beach profile dataset for each compartment, was applied consistent with those adopted in WRL (2017). However, the Mcleod's Beach (Surfside West) analysis completed in Stage 2 adopted a photogrammetry profile of a conservative present-day beach position, where 0 mAHD and dune elevation is similar to present levels.

The adopted parameters for the development of deterministic erosion extents, including the estimated landward distance of the ZSA and ZRFC, are summarised in **Table 4-2**. The consensus values for storm demand, from Table 6-1 in WRL (2017), were adopted.

Table 4-2 Deterministic values for ZSA and ZRFC at beaches previously mapped by WRL (2017) using the probabilistic method

Beach	Section	Photogrammetry Date	Storm Demand (m^3/m beach)*	ZSA Distance from the mean shoreline position (m)	ZRFC Distance from ZSA (m)
Long Beach	East	27/11/2014	70	63.2	9.0
	Central	27/11/2014	100	59.4	9.7
	West	27/11/2014	120	66.8	8.7
Surfside Beach (East)	North	27/11/2014	50	63.2	9.0
	South	27/11/2014	60	47.1	4.5
Mcleod's Beach	Central	21/06/1942	20	41.1	3.8
Malua Bay	Central	28/11/2014	120	66.8	5.2
Tomakin Cove	Central	23/11/2014	90	52.1	3.7
Broulee Beach	North	23/11/2014	110	73.4	5.6
	Central	23/11/2014	90	70.0	7.9
	South	23/11/2014	70	55.2	6.4

Data from the geotechnical assessment was considered in the determination of the erosion hazard lines, however as noted in **Section 4.1** the level of competent bed rock was found to be below the erosion scour level and hence would not influence the landward extent of the calculated erosion. The values for ZSA and ZRFC assume the full profile is erodible above the adopted scour level of -1mmAHD.

At Long Beach, there exists a low crested sea wall that extends from the culvert structure at the end of Fauna Ave. Given the identified level of competent rock and the observed profile of the sea wall, the wall is unlikely to be founded on bed rock, be constructed to contemporary engineering standards including material utilised and design and therefore reliably provide protection during a storm event. As such, updated erosion hazard lines at Long Beach do not account for the presence of the seawall.

4.4 Beach Erosion Mapping

The 100 Year ARI erosion extents for existing, 2050 and 2100 sea levels are shown in **Map Series RG-04-01**. The erosion extents demonstrate the landward extent of the Zone of Reduced Foundation Capacity (ZRFC) following an extreme coastal event with the inclusion of future estimated shoreline recession. Mapping of coastal hazard lines to identifies areas prone to coastal hazards and provides general guidance for coastal planning.

These maps can be supplemented with the work done by WRL (2017), for completeness, the relevant WRL (2017) deterministic erosion maps have been included in **Appendix C**. WRL (2017) probabilistic mapping has not been included in **Appendix C**. Guidance to the mapping is provided in **Table 4-3**.

Table 4-3 Beach Erosion Map List

Location	Erosion Risk	Map Location
Maloneys Beach	Revised deterministic erosion / recession 2017, 2100	Map Series RG-04-01
	Deterministic erosion / recession 2050, 2065	Appendix C
Long Beach	Revised deterministic erosion / recession 2017, 2100	Map Series RG-04-01
Surfside	Revised deterministic erosion / recession 2017, 2100	Map Series RG-04-01
Wharf Road	SMEC (2010) deterministic erosion / recession 2017, 2100	Map Series RG-04-01
Sunshine Bay	Revised deterministic erosion / recession 2017, 2100	Map Series RG-04-01
	Deterministic erosion / recession 2050, 2065	Appendix C
Malua Bay	Revised deterministic erosion / recession 2017, 2100	Map Series RG-04-01
Guerilla Bay (South)	Deterministic erosion / recession 2017, 2050, 2065 and 2100	Appendix C
Barlings Beach	Revised deterministic erosion / recession 2017, 2100	Map Series RG-04-01
	Deterministic erosion / recession 2050, 2065	Appendix C
Tomakin Cove	Revised deterministic erosion / recession 2017, 2100	Map Series RG-04-01
Broulee	Revised deterministic erosion / recession 2017, 2100	Map Series RG-04-01

5 Coastal Inundation Assessment

The flooding of coastal land may be driven by a variety of factors, including:

- Tidal inundation or nuisance flooding;
- Flooding from storm tides;
- Permanent inundation due to subsidence; and
- Changes in tidal range or sea level.

Risks from coastal flooding include:

- habitability of low-lying coastal land, including public health and maintaining public infrastructure such as stormwater and sewerage systems
- tenure of permanently inundated land
- contamination of soils and groundwater by salt water
- change of ecological character and spatial extent of coastal wetlands
- loss of access and isolation of coastal settlements
- loss of foreshore recreational access and opportunities
- increase in flooding upstream due to increased ocean and estuary tail-water levels.

The Stage 1 First Pass Risk Assessment identified high risk locations for updated and further inundation assessment and mapping. The details are provided in **Section 3.2**.

The additional assessment included:

- **Coastal inundation of beaches:** review coastal water levels against recent LIDAR and revision of mapping to only map hydraulically connected areas (**Section 5.2**).
- **Wave impact zone:** map for high risk beaches for 100 Year ARI ocean storm for existing and 2100 conditions (**Section 5.2**).
- **Creek entrance modelling:** undertake hydraulic modelling of the propagation of relevant coastal water levels into selected coastal creeks (**Section 5.3**).
- **Economic damages assessment:** assess the economic damage of potential future inundation to existing private properties (**Section 5.5**).

5.1 Existing Inundation Assessment (WRL, 2017)

Coastal inundation is the intrusion of sea water into coastal areas and is predominantly caused by elevated coastal water levels, and large co-incident waves. WRL (2017) performed detailed analysis to calculate the 'quasi-static' still water level for each beach for the 100-year ARI likelihood, which includes the 100-year ARI extreme water level, flood contribution, bay wind setup and wave setup.

To determine wave exposure areas, WRL (2017) calculated wave runup using empirical equations from Shand et al. (2011). For locations where the wave runup level exceeds the dune crest, the wave will propagate inland, with the distance dependent on runup elevation, crest elevation and backshore slope (WRL, 2017). WRL (2017) calculated bore propagation extent exceeded by 2% of wave bores at the peak of the storm event, with the wave runup extent set to be this distance from the dune crest.

This same approach has been adopted in this Stage 2 study (**Section 5.2**). The resulting maps identify separately the areas only affected by waves (i.e. the wave wash will be temporary) rather than by elevated coastal water levels (and in some cases also waves). See **Section 5.3** for more details.

5.2 Refined Coastal Inundation Assessment

5.2.1 Beach Compartments

Mapping of tidal and coastal inundation on beaches was reviewed as part of the Stage 2 at those locations identified as requiring more detailed information from the Stage 1 Risk Assessment.

Further recent high resolution LiDAR data across both foreshore and nearshore areas of the study area has allowed improved mapping of tidal and storm tide extents to be developed in addition to the utilisation of more advanced modelling techniques. LiDAR data at 1 m resolution from 2011, and 5 m resolution topographic and bathymetric datasets from 2018 were utilised provide more detail (Spatial Services NSW, (2011) and Department of Planning, Industry and Environment, 2018 respectively).

Peak still water level extents, resulting from tides and storm surge (including wave setup), were developed with consideration of flow paths and hydraulically connected areas. That is, if no hydraulic connection was identified, then the area was not considered at risk of inundation. This assumption should be reassessed if further information becomes available.

Tidal and coastal storm inundation was mapped for High High Water Solstice Springs (HHWSS), the 1 Year ARI (63% AEP), 20 Year ARI and 100 Year ARI events at the 2017, 2050, 2065 and 2100 planning periods, as per WRL (2017, Table 7-1).

Table 5-1 and **Table 5-2** presents the adopted coastal inundation parameters for each beach, from WRL (2017) Table 8-3 and Table 8-5.

Table 5-1 Tidal inundation input values (WRL, 2017)

Planning Period	HHWSS (mAHD)	63% AEP (mAHD)
2017	0.92	1.22
2065	1.25	1.55
2100	1.63	1.93

Table 5-2 Coastal Inundation input parameters for selected beaches at risk of coastal inundation under the 100 Year ARI event

Beach	Section	Total Still Water Level (inclusive of wave setup) (mAHD) (2017)	Total Still Water Level (inclusive of wave setup) (mAHD) (2100)	Wave Runup Level (mAHD)	Bore Propagation Distance (m)
Maloneys Beach	East	2.01	2.72	6.3	17.1
	West	2.13	2.84	6.7	15.7
Long Beach	East	2.14	2.85	4.9	13.0
	Central	2.31	3.02	5.3	9.6
	West	2.28	2.99	5.6	10.6
Surfside East	North	2.33	3.04	4.6	12.7
	South	2.36	3.07	4.7	13.2

Beach	Section	Total Still Water Level (inclusive of wave setup) (mAHD) (2017)	Total Still Water Level (inclusive of wave setup) (mAHD) (2100)	Wave Runup Level (mAHD)	Bore Propagation Distance (m)
Surfside West	-	2.10	2.77	2.7	9.1
Wharf Road	Dune Areas	2.14	2.61	3.0	9.9
	Seawall Areas	2.14	2.61	5.2	16
CBD	West	2.13	2.83	4.8	15.6
	Central	2.04	2.74	5.0	16.3
	East	2.22	2.93	5.0	16.3
Corrigans Beach	North	2.23	2.94	5.4	17.2
	South	1.82	2.52	3.0	9.5
Caseys Beach	North	2.10	2.81	5.0	9.4
	Central	1.70	2.41	4.9	9.0
	South	1.83	2.05	4.1	12.9
Malua	-	2.93	3.64	5.9	16.4
Tomakin Cove	-	1.97	2.68	4.6	7.3

It is noted that the consideration of future predicted sea level rise is based on ESC's sea level rise policy and planning framework (ESC, 2014; Whitehead & Associates, 2014) and has been applied as a constant increase to the coastal water levels. This approach does not include any future changes in beach geometry (that may influence exposure), incident wave conditions (from increased storminess or more intense wave conditions) or changes in rainfall and flooding, that may occur under future climate conditions. Prediction of such changes are uncertain and therefore cannot be included in the assessment at this time.

5.2.2 Creek Entrances

Within the study area, seven locations were identified as containing entrances or structures that may influence the inland propagation of the incoming coastal surge. These locations were:

- Northern Batemans Bay (Long beach, Surfside, Wharf road)
- Batemans Bay CBD (including Water Gardens)
- Boat Harbour (including Hanging Rock Creek)
- Corrigans Beach (including Joes Creek)
- Sunshine Bay/ Caseys Beach (including Shortbeach Creek)
- Malua Beach (including Reedy Creek)
- Broulee Beach (Candlagan Creek).

In order to accurately define the coastal inundation in these regions, hydraulic models were developed to define the extent of coastal flooding. The development and outputs of these models are discussed below.

5.2.2.1 Hydraulic Model Set Up

Hydraulic models for Long Beach, Surfside, Batemans Bay CBD, Boat Harbour, Corrigans Beach and Sunshine Bay were developed as part of the Batemans Bay Urban Creeks Flood Study (Rhelm, 2021).

Additional flood models for assessing coastal inundation at Malua Beach and Broulee Beach were developed as part of this study.

TUFLOW model parameters were adopted from the Batemans Bay Flood Study in order to ensure consistency across the models. Full details of the existing models are available in the Flood Study (Rhelm, 2021). Details of the Malua and Broulee models are provided in **Table 5-3** and **Table 5-4**.

Table 5-3 TUFLOW Inundation Model Parameters

Model Parameter	Details
Model Area	The model boundary was set at the 10mAHD contour, to ensure that the model boundary is beyond the extent of coastal flooding influence.
DEM	For the existing models, no changes were made to the DEM developed as part of the flood study. For Malua and Broulee, the model DEM was developed primarily with the 2018 5m topographic and bathymetric data collected as part of the NSW Marine LiDAR project. In regions of the model where this data was not available, the 2011 1m topographic data collected by NSW Spatial Services was adopted.
Structures	The full details of structures included in those areas discharging to Batemans Bay are detailed in the Flood Study (Rhelm, 2021). For the Malua and Broulee models, bridge structures were included at: • Beach Road crossing of Candlagan Creek • George Bass Drive crossing of Candlagan Creek • George Bass Drive crossing of Reedy Creek The bridge crests were taken from the LiDAR data, and the bridge deck depth and the location of any piers or abutments were taken from photographic data.
Roughness	Roughness zones were discretised based on aerial imagery and land use data. The roughness values adopted were taken from the Batemans Bay Urban Creeks Flood Study (Rhelm, 2021) to ensure consistency. The values adopted are shown in Table 5-4.
Catchment Inflows	Catchment inflows were excluded from these model runs, to assess the influence of catchment driven inundation only.
Entrance Condition	For the purposes of this assessment, all entrances were assumed to be fully open, to define the worst-case scenario of coastal inundation.
Downstream Boundary	A time varying tidal boundary was applied to each model area. The development of the downstream boundary is discussed in detail in Section 5.2.2.2.

Table 5-4 Adopted Roughness Values

Land Use	Manning's 'n'
Open space	0.035
Neighbourhood Centre (including building footprint)	0.250
Mixed Use (including building footprints)	0.200
Low Density Residential (including building footprints)	0.150
Recreation	0.040
Dense vegetation	0.080
Light vegetation	0.045
Medium Vegetation	0.060
Roads / Carparks	0.020

5.2.2.2 Downstream Boundary Conditions

For the hydraulic model, a dynamic tidal timeseries of the downstream coastal water level boundary condition was developed as follows:

- A representative predicted spring tide was selected based on the measured water levels at the Princess Jetty tide gauge
- A design peak storm surge was then selected for the desired ARI
- The selected peak storm surge was then added to the predicted tide, scaling up and down over a 48-hour period. This is consistent with the guidance in OEH (2015) that applied a similar method using a scaled May 1974 event.

Coastal water level timeseries were calculated for Batemans Bay, Malua Bay Beach and Broulee Beach, for the HHWS tide and 1, 20 and 100 Year ARI events Existing (2017), 2050, 2065 and 2100 planning periods.

The peak static coastal water levels for Batemans Bay, Malua Bay Beach and Broulee (North) were adopted from the Eurobodalla Coastal Hazard Assessment (WRL, 2017). Each value incorporates tide level (excluding setup and flood), flood contribution, wind setup and wave setup, to provide a total still water level (SWL). The design total SWLs is therefore the highest inundation level reached over the period of the storm.

For the 2050, 2065 and 2100 scenario, a sea level rise of 0.22, 0.33 and 0.71 m respectively was applied as a constant to the coastal water level timeseries.

The adopted ocean water levels are summarised in **Table 5-5**.

Table 5-5 Peak Ocean Levels for Inundation Assessment (mAHD)

Location	1 year ARI			20 Year ARI			100 Year ARI		
	2017	2065	2100	2017	2065	2100	2017	2065	2100
Long Beach	0.92	1.25	1.63	2.18	2.17	2.55	2.31	2.64	3.02

Location	1 year ARI			20 Year ARI			100 Year ARI		
	2017	2065	2100	2017	2065	2100	2017	2065	2100
Surfside	1.08	1.41	1.79	2.18	2.51	2.89	2.36	2.69	3.07
CBD	1.09	1.42	1.8	2.08	2.69	3.07	2.22	2.55	2.93
Boat Harbour	1.18	1.51	1.89	2.08	2.41	2.79	2.21	2.54	2.92
Corrigans	0.82	1.15	1.53	2.09	2.42	2.8	2.23	2.56	2.94
Caseys Beach	0.98	1.31	1.69	2.04	2.42	2.8	2.08	2.43	2.81
Malua	1.28	1.61	1.99	2.73	2.37	2.75	2.93	3.26	3.64
Broulee	0.97	1.3	1.68	1.93	2.23	2.61	2.2	2.53	2.91

5.2.3 Coincident Flooding

An assessment of coincident flooding arising from catchment rainfall events coupled with ocean flood events was undertaken for:

- Long Beach
- Surfside
- CBD
- Boat Harbour
- Corrigans Beach
- Sunshine Bay
- Malua Bay
- Broulee.

Each catchment was assessed for:

- 20 year ARI rainfall event with a 100 year ARI ocean event (for 2017, 2050, 2065 and 2100 ocean levels); and,
- PMF rainfall event with a 100 year ARI ocean event (for 2017, 2050, 2065 and 2100 ocean levels).

The results of the assessment are shown in Map Series RG-05-04.

The results show that predicted future changes in the downstream ocean level have little influence over the broader catchment flood behaviour but do have an impact in low lying lands. The changes in the downstream reaches of the catchments are driven by changes in the ocean level, and these extents are similar to those shown in Map Series RG-05-02 for coastal inundation, as the contributing rainfall does not offer a significant additional volume when compared to the bay or ocean downstream.

At the edge of the coastal inundation extent, where the driver of peak levels changes from ocean levels to catchment runoff, there are only minor changes in flood extent. These changes are due to the reduced capacity of the discharging systems as a result of the higher tailwater in future scenarios.

In the upstream reaches, beyond the influence of the ocean flood, there were no changes observed, as would be expected given the rainfall adopted was the same for all planning horizons.

5.3 Coastal Inundation Results

Tidal inundation figures are presented in **Map Series RG-05-01**.

The results of the coastal inundation assessment (1, 20 and 100 Year ARI events) are shown in **RG-05-02**.

100 Year ARI inundation depths area shown for the existing and 2100 scenarios for key inundation risk locations in **Map Series RG-05-03**.

The inundation extents associated with the coincidence of catchment and coastal flooding is provided in **Map Series RG-05-04**.

These maps can be supplemented with the work done by WRL (2017), for completeness, the relevant WRL (2017) deterministic erosion maps have been included in **Appendix C**. Guidance to the mapping is provided in **Table 5-6**.

Table 5-6 Coastal Inundation Map List

Location	Inundation Risk	Map Location
South Durras	HHWSS (2017, 2050, 2065, 2100)	Appendix C
	1, 20 and 100 Year ARI Inundation (2017, 2050, 2065, 2100)	Appendix C
Cookies Beach	HHWSS (2017, 2050, 2065, 2100)	Appendix C
	1, 20 and 100 Year ARI Inundation (2017, 2050, 2065, 2100)	Appendix C
Maloneys Beach	HHWSS (2017, 2050, 2065, 2100)	Appendix C
	1, 20 and 100 Year ARI Inundation (2017, 2050, 2065, 2100)	Appendix C
Long Beach	HHWSS (2017, 2100): Very little difference between 2017 and 2100 inundation extents resulted in 2050 and 2065 scenarios not being assessed	Map Series RG-05-01
	1, 20 and 100 Year ARI Inundation (2017, 2050, 2065, 2100)	Map Series RG-05-02
	Coincident Inundation (2017, 2050, 5065, 2100) – 20 Year ARI Catchment & 100 Year ARI Ocean – PMF Catchment & 100 Year ARI Ocean	Map Series RG-05-04
Cullendulla Beach	HHWSS (2017, 2050, 2065, 2100)	Appendix C
	1, 20 and 100 Year ARI Inundation (2017, 2050, 2065, 2100)	Map Series RG-05-02
Surfside and Wharf Road	HHWSS (2017, 2050, 2065, 2100)	Map Series RG-05-01
	1, 20 and 100 Year ARI Inundation (2017, 2050, 2065, 2100)	Map Series RG-05-02
	Coincident Inundation (2017, 2050, 5065, 2100) – 20 Year ARI Catchment & 100 Year ARI Ocean – PMF Catchment & 100 Year ARI Ocean	Map Series RG-05-04
CBD	HHWSS (2017, 2050, 2065, 2100)	Map Series RG-05-04
	1, 20 and 100 Year ARI Inundation (2017, 2050, 2065, 2100)	Map Series RG-05-02
	Coincident Inundation (2017, 2050, 5065, 2100) – 20 Year ARI Catchment & 100 Year ARI Ocean – PMF Catchment & 100 Year ARI Ocean	Map Series RG-05-04
Boat Harbour	HHWSS (2017, 2050, 2065, 2100)	Map Series RG-05-01
	1, 20 and 100 Year ARI Inundation (2017, 2050, 2065, 2100)	Map Series RG-05-02

Location	Inundation Risk	Map Location
	Coincident Inundation (2017, 2050, 5065, 2100) – 20 Year ARI Catchment & 100 Year ARI Ocean – PMF Catchment & 100 Year ARI Ocean	Map Series RG-05-04
Corrigans Beach	HHWSS (2017, 2050, 2065, 2100)	Map Series RG-05-01
	1, 20 and 100 Year ARI Inundation (2017, 2050, 2065, 2100)	Map Series RG-05-02
	Coincident Inundation (2017, 2050, 5065, 2100) – 20 Year ARI Catchment & 100 Year ARI Ocean – PMF Catchment & 100 Year ARI Ocean	Map Series RG-05-04
Caseys Bay	HHWSS (2017, 2050, 2065, 2100)	Map Series RG-05-01
	1, 20 and 100 Year ARI Inundation (2017, 2050, 2065, 2100)	Map Series RG-05-02
	Coincident Inundation (2017, 2050, 5065, 2100) – 20 Year ARI Catchment & 100 Year ARI Ocean – PMF Catchment & 100 Year ARI Ocean	Map Series RG-05-04
Sunshine Bay	HHWSS (2017, 2050, 2065, 2100)	Map Series RG-05-01
	1, 20 and 100 Year ARI Inundation (2017, 2050, 2065, 2100)	Map Series RG-05-02
	Coincident Inundation (2017, 2050, 5065, 2100) – 20 Year ARI Catchment & 100 Year ARI Ocean – PMF Catchment & 100 Year ARI Ocean	Map Series RG-05-04
Malua Bay	HHWSS (2017, 2050, 2065, 2100)	Map Series RG-05-01
	1, 20 and 100 Year ARI Inundation (2017, 2050, 2065, 2100)	Map Series RG-05-02
	Coincident Inundation (2017, 2050, 5065, 2100) – 20 Year ARI Catchment & 100 Year ARI Ocean – PMF Catchment & 100 Year ARI Ocean	Map Series RG-05-04
Guerilla Bay (South)	HHWSS (2017, 2050, 2065, 2100)	Appendix C
	1, 20 and 100 Year ARI Inundation (2017, 2050, 2065, 2100)	Appendix C
Barlings Beach	HHWSS (2017, 2050, 2065, 2100)	Appendix C
	1, 20 and 100 Year ARI Inundation (2017, 2050, 2065, 2100)	Appendix C
Tomakin Cove	HHWSS (2017, 2100): Very little difference in risk between 2017 and 2100 inundation extents resulted in 2050 and 2065 scenarios not being assessed	Map Series RG-05-01
	1, 20 and 100 Year ARI Inundation (2017, 2050, 2065, 2100)	Map Series RG-05-02
Broulee	HHWSS (2017, 2050, 2065, 2100)	Map Series RG-05-01
	1, 20 and 100 Year ARI Inundation (2017, 2050, 2065, 2100)	Map Series RG-05-02
	Coincident Inundation (2017, 2050, 5065, 2100) – 20 Year ARI Catchment & 100 Year ARI Ocean – PMF Catchment & 100 Year ARI Ocean	Map Series RG-05-04

6 Batemans Bay Conceptual Sediment Transport Model

The technical brief for the CMP requested a review of a suite of investigations relating to the Batemans Bay bridge assessments and the implications for coastal processes and hazards along the northern shorelines of Batemans Bay. The aim was to identify the predominant causes of coastal erosion and inundation, including consideration of previous works and their contribution to current risk exposure. Batemans Bay has a history of changing coastal landscapes that have occurred due to natural variability and human development. A focus on sediment transport processes allows the drivers for the dynamic coastal formations to be identified and then what management measures are required if needed.

To this end a conceptual sediment transport model was developed of Inner Batemans Bay, which has integrated analysis of available datasets and findings from relevant studies to provide a cohesive conceptual model of key processes. An expanded summary of the conceptual model development is provided in **Appendix B**.

6.1 Existing Data and Studies

The following primary datasets have been considered in the development of the conceptual model:

- Metocean data (wave and tide data)
- Historical aerial imagery (from 1949 to present)
- Historical photographs (from 1898 to present)
- Historical navigation charts (between 1864 and 1931)
- Bathymetric survey, most notably the high-resolution nearshore LiDAR data covering the entire Inner Bay at 5m resolution (OEH, 2018)
- Rainfall data and flooding records from 1860s to present
- Photogrammetry (sourced from the NSW Beach Profile Database, DPIE 2021)
- Previous model outputs of wave, current and sediment transport models (including WEL, 2017; WBM, 2000)
- Community understanding (extensive community consultation outputs).

In addition, a number of existing studies exist that have assessed and quantified key coastal processes, including:

- WRL (2017), Eurobodalla Coastal Hazard Assessment. WRL Technical Report 2017/09, October 2017
- BMT WBM (2009), Wharf Road Coastal Hazard Assessment and Hazard Management Plan, Report prepared for Eurobodalla Shire Council
- WBM Oceanics (2000), Batemans Bay/Clyde River Estuary Processes Study – Water Quality and Sedimentation Components, Report prepared for Eurobodalla Shire Council.

A review of prior studies and research reveals that competing processes occur within the bay, often dominating in cycles that can stretch over decadal timescales. WBM (2000) completed field sampling of surface sediments within the Inner Bay and identified that sediments are predominantly lithic sands with a higher proportion of angular (fluvial) quartz compared to well rounded (marine) quartz. The predominance of fluvially derived sediments indicates flood events are the significant contributor of sediment to the Bay.

6.2 Beach Compartment Scale

The conceptual model was developed by first considering processes at the beach compartment scale and then across Inner Batemans Bay wholistically.

Corrigans Beach

Significant and rapid accretion of the Southern Shoreline was observed following construction of the 1,300m long training wall along the CBD (completed 1905), with an additional extension having been constructed in 1991 (of ~150m in length).

The sediment accretion at Corrigans Beach is driven by northward longshore transport (driven by waves) that is trapped on the southern side of the training wall. The supply of sediment to this compartment appears to be predominantly from the ebb tide shoal at the end of the Clyde River channel with the sediment being predominantly lithic sands of fluvial origin with only minor marine sand content (WBM, 2000).

Figure 6-1 shows a snapshot of navigation chart and aerial imagery between 1899 and 1981 that demonstrates the rapid accretion of land behind the training wall.

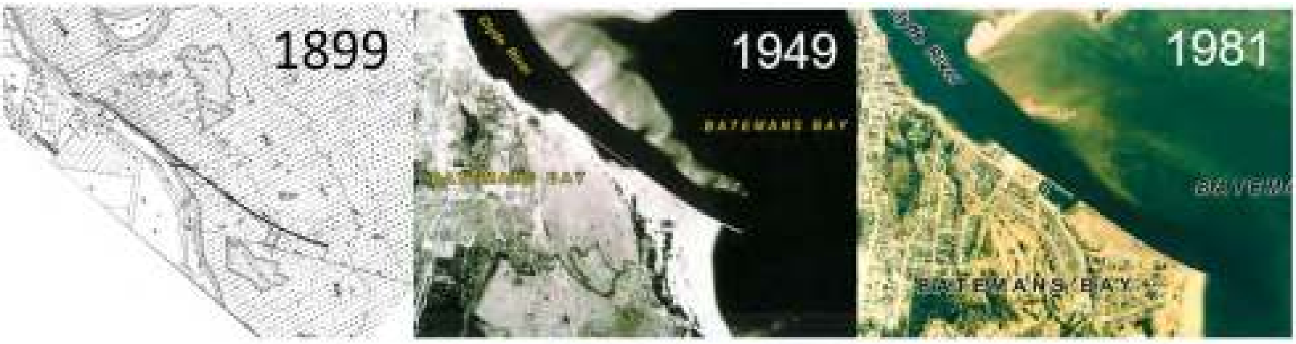

Figure 6-1 Rapid accretion of land behind the training wall at Corrigans Beach

Cullendulla Beach

Cullendulla Beach is an embayed shoreline that stretches between Square Head and Hawks Nest Headland, with a notable chenier plains feature, and more recent beach ridges, that are variably spaced which is a function of the variable rate of falling sea level over the last ~6000 years. . More recently, under stable and/or rising sea levels an ongoing recession of the shoreline has been observed in the photogrammetry data. Since sea levels have stabilised (over the last ~1000 years) the seaward progression of the beach ridge system has slowed, and the current position of the shoreline is such that it is exposed to greater wave energy during storm events than was historically the case. The observed recession is driven by elevated coastal conditions (water levels and waves) that moves sediment in an easterly direction away from Hawks Nest Headland.

The compartment is relatively protected from incident waves with a significant flood delta having developed in the lee of Square Head, fed by flood flows from Cullendulla Creek. The embayment appears to be an isolated sediment compartment that feeds sediment into the Inner Bay via the flood delta however with no clear transport pathways from the Inner Bay back in to the Cullendulla compartment. This lack of sediment supply to the western end of the compartment generates the observed ongoing recessional trend.

Cullendulla Embayment is shown in **Figure 6-2** with Chenier Plains feature behind the beach and flood shoal extending from Cullendulla Creek in the lee of Square Head.

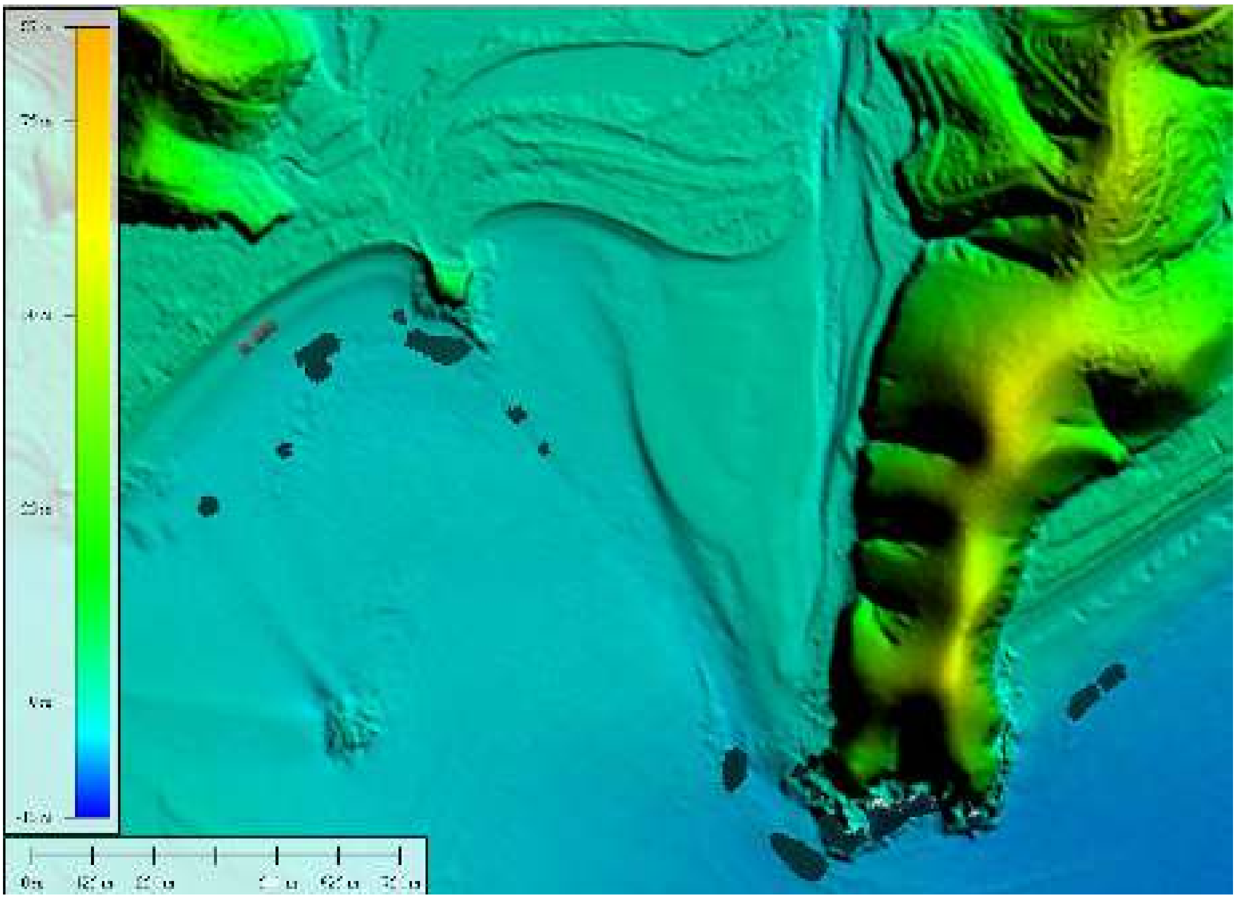

Figure 6-2 Surveyed terrain data of the Cullendulla Embayment

Surfside East

Surfside Beach

The Surfside Beach shoreline (east of Pinnacle Point) appears to be a relatively stable shoreline, that fluctuates in response to severe coastal storms, with no discernible long-term trend in shoreline position.

Low to negligible net longshore transport is predicted as the shoreline is generally in alignment with incident waves, with a trend toward southwest transport predominantly driven by elevated coastal conditions. Onshore transport is likely from nearshore bars, when the configuration of the bars allows.

The yearly mean shoreline position is shown in **Figure 6-3** along Surfside Beach between 1988 and 2019, indicating a relatively stable shoreline position.

Figure 6-3 Yearly Mean Shoreline Position (approximately 0mMSL)- Surside Beach

Mcleods Beach / Wharf Road

The formation, location and change of sand shoals off Wharf Road and Surfside is shown to occur over decadal timescales, however significant changes can occur in the short-term, particularly during large catchment flood events and large coastal storm events.

River flows are the major influence on re-working of the Wharf Road shoreline and nearshore shoals, with large flows close to the beach and across the shoals leading to scour during major flood events. The predominant driver of sand shoal re-working over decadal timescales is the occurrence and frequency of flood events, where correlation between the disappearance of sand shoals and major floods has been identified.

After a flood event and corresponding breakthrough or re-working of the shoals has occurred, wave induced sediment transport during ambient and elevated offshore swell replenishes the Wharf Road shoreline over time. In addition, the longshore transport from east to west along Mcleod's Beachand Wharf Road beaches is driven by wave-induced currents at the shoreline and a flood tide inequality in the tidal flows.

The highly dynamic nature of this area, with large changes in the shoreline position and shoal formation, is considered a natural process governed by the contest between fluvial flows and coastal processes. Interrogation of historical chart, aerial and survey data identifies similar coastal landforms (in terms of shape and extent of the shoreline and shoals) extending from the Wharf Road area in both 1864 and 1981, well before and after the construction of the training wall along the CDB, respectively (**Figure 6-5**).

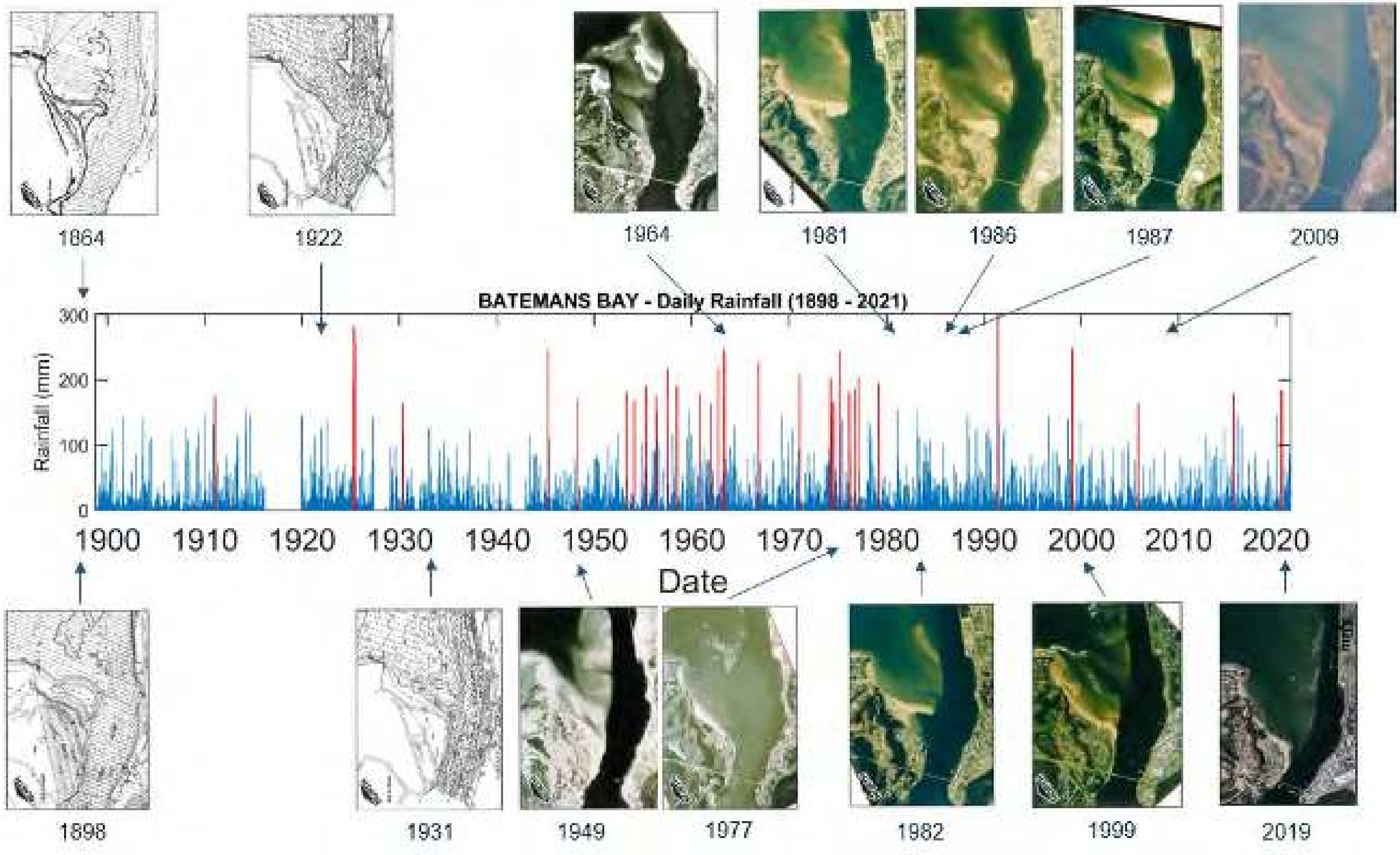

Figure 6-4 Timeline of Rainfall and the Wharf Road Shoreline and Nearshore Shoals indicating correlation between Clyde River Flood Flows and Nearshore Landform. Red lines indicate the top 30 daily rainfall totals.

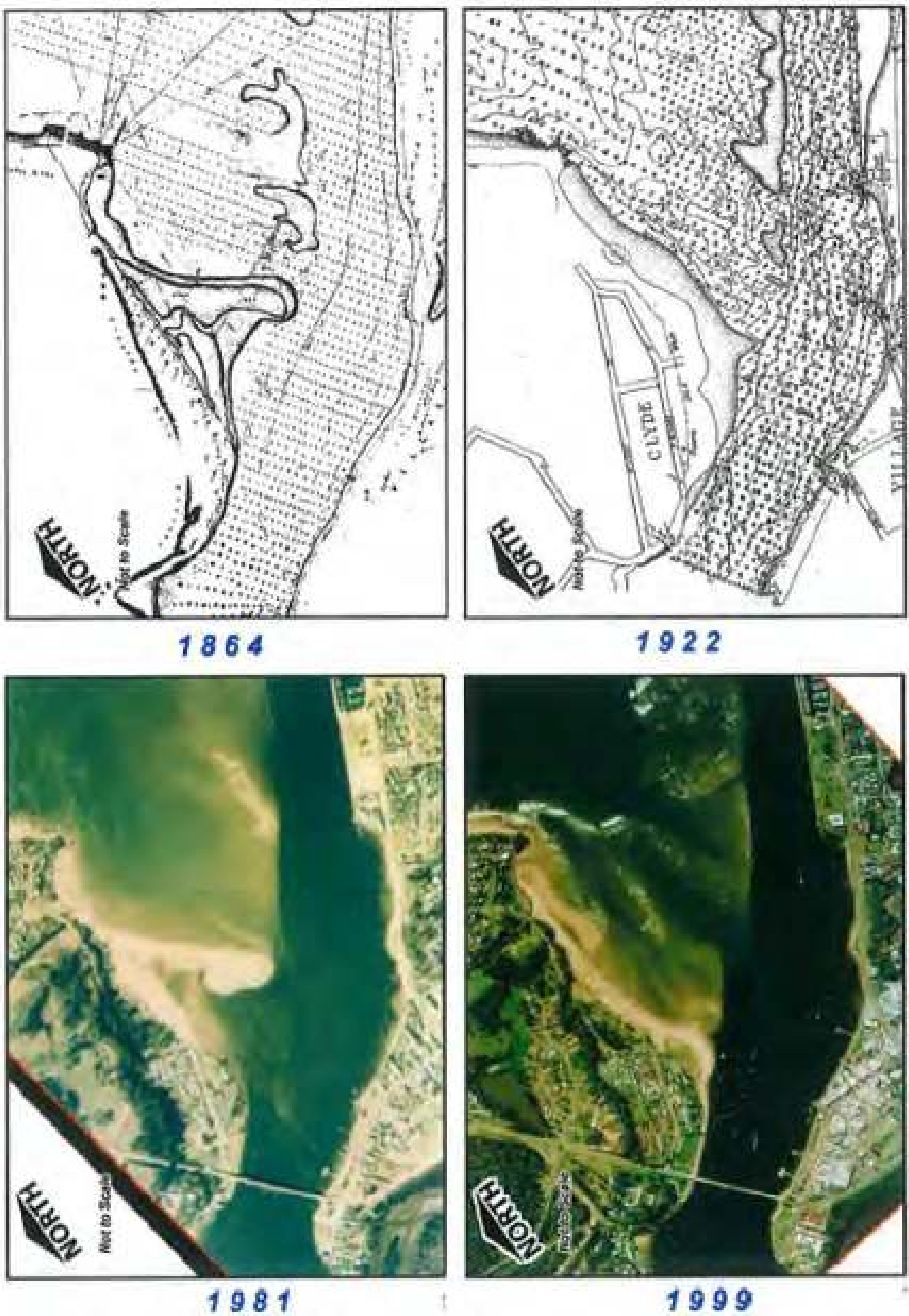

Figure 6-5 Shoreline and Shoal Formations along Wharf Road in 1864 (top left), 1922 (top right), 1981 (bottom left) and 1999 (bottom right) demonstrating the dynamic and recurrent nature of landforms along Wharf Road and Mcleod's Beach

Clyde River Channel and Entrance Shoal

With the construction of the training wall along the CBD at the start of the 20th century, a seaward migration of the entrance shoal by approximately 700m has occurred. This has resulted in an elongation of the ebb tide / flood flow delta.

The indicative positions of the flow delta feature at the end of the Clyde River Channel are shown in **Figure 6-6** in 1899 and 2019.

The delta feature is a contributor to the onshore transport of sediment towards the northern shoreline areas, and while the morphology of this feature has been modified over the last century which would impact the rate of northerly transport from the shoal, the volume of sediment available on the northern side of the Clyde River channel would have been only marginally affected.

Figure 6-6 Clyde River channel flow delta feature in 1899 (left) and 2019 (right)

6.3 Inner Batemans Bay Conceptual Model

The analysis, compilation and interpretation of the available data and studies has culminated in the development of the conceptual sediment transport model across the Inner Batemans Bay area, as presented in **Figures 6.7 to 6.9**. The conceptual model is presented to identify the key processes that drive sediment transport throughout the bay and is not intended as a quantitative assessment of sediment transport or shoreline change. Three regimes are identified:

- Ambient conditions (**Figure 6-7)**, where sediment transport is dominated by waves (average) and tidal currents.
- Coastal Storm conditions (**Figure 6-8**), where sediment transport is dominated by larger waves and elevated water levels (causing shoreline erosion) and storm induced circulations (e.g. rips).
- Catchment Flood conditions (**Figure 6-9**), where sediment transport is dominated by significant flows out of the Clyde River, Creeks and ICOLL entrances.

The three regimes may or may not occur in combination with each other, depending on the climatic and coastal conditions at the time.

In general, the morphology of the Batemans Bay shoreline and seabed is a result of conflicting coastal and fluvial processes. Of note is the identification of flood dominated and coastal dominated regions that extend from Pinnacle Point. These provide an approximate delineation of areas that are dominated by flood or coastal processes over decadal timescales, noting that both flood and coastal processes are at work throughout the Inner Bay.

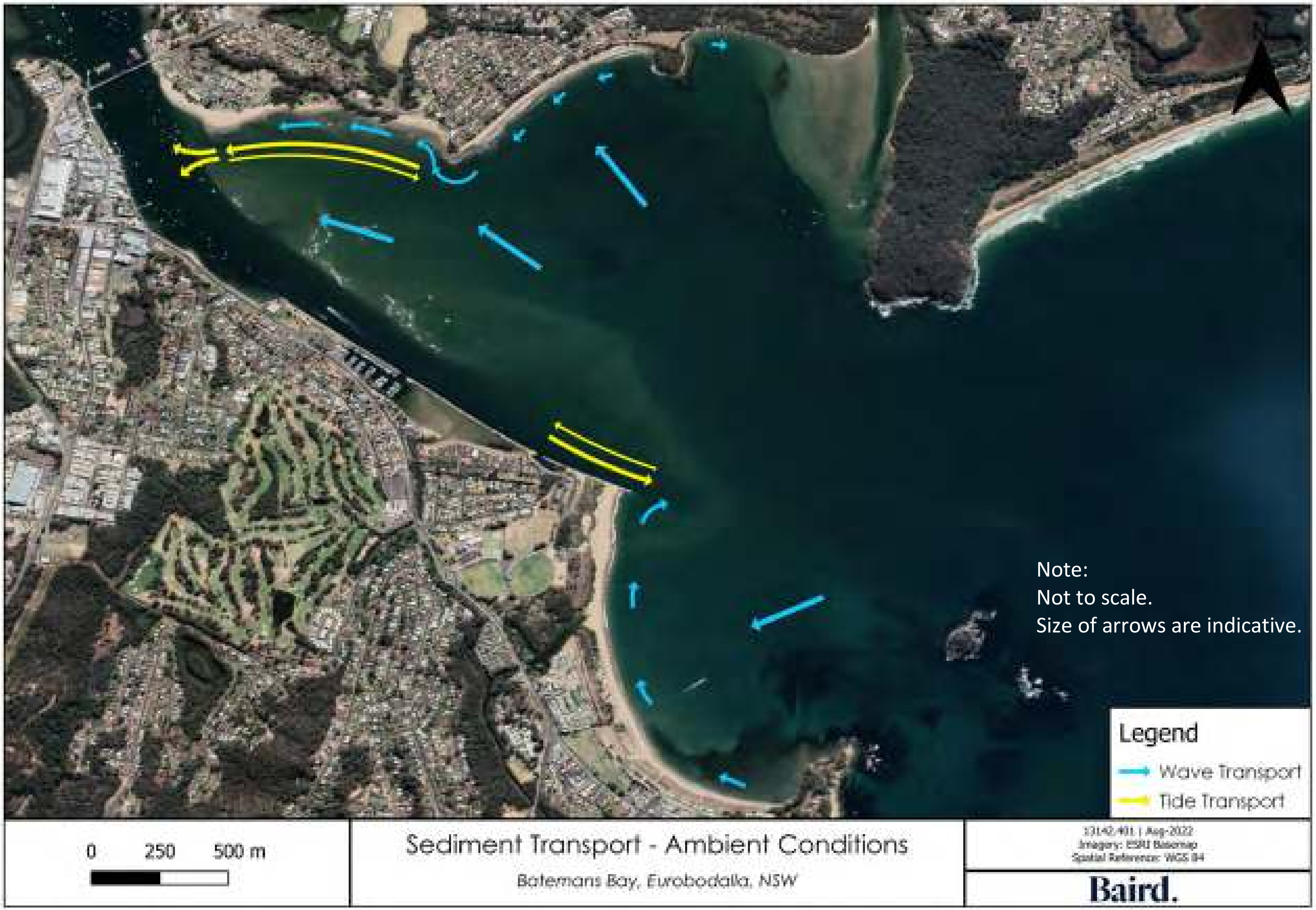

Figure 6-7 Conceptual sediment transport model of inner Batemans Bay under ambient conditions

Figure 6-8 **Conceptual sediment transport model of inner Batemans Bay under coastal storm conditions**

Figure 6-9 Conceptual sediment transport model of inner Batemans Bay under catchment flood conditions

6.4 Influence of Historic Works on the Shorelines of Batemans Bay

Since its construction in the early 20th century, the training wall along the CBD has resulted in a large transformation of the embayment of Batemans Bay. Most notably the significant and rapid accretion of the Southern Shoreline to form Corrigans Beach, caused by the entrapment of northward longshore transport (driven by waves) on the southern side of the training wall, scouring of the Clyde River channel and seaward movement of the entrance bar.

However, the direct impact of this structure on the northern side of the bay is less evident. A seaward migration of the Clyde entrance shoal by approximately 700m has occurred, resulting in an elongation of the ebb tide / flood flow delta. The change in morphology of this feature would have influenced the rate of transport towards the northern shoreline areas however, the volume of sediment available on the northern side of the Clyde River channel would have been only marginally affected.

A review of available historical data suggests that the landform (shoreline position) and nearshore shoal features along the northern shorelines of Batemans Bay are dynamic and dominated by the magnitude and frequency of flood flows. That is, the dominant driver for an accreted shoreline position is the time since the last major flood in the Clyde River and/or coastal storm conditions, with coastal processes (waves and tides under average seasonal conditions) acting to replenish this area with sand between flood and coastal events.

The similarity in the shape and extent of the shoreline and shoals at times well before and after the construction of the training wall along the CDB (e.g. 1864 and 1981, see Figure 6-5) suggests that the construction of these works has not removed the ability of the area to be replenished with sand should climatic conditions allow.

This analysis does not disregard the influence of historic works on the shorelines of Batemans Bay; however, highlights the fact that the assessment of management options within the Inner Bay during Stage 3 must adequately consider the naturally dynamic processes that are the principal driver for observed shoreline change, particularly along the northern shoreline areas.

7 Moving on to Stage 3

The Stage 2 assessments contained in this document along with the previous coastal vulnerability assessments (WRL, 2017 and SMEC, 2010) and previous and ongoing engagement with the community and stakeholders will assist Council and community to understand the complexity of the issues and risks affecting the environmental, social and economic assets and values in each coastal management area.

During Stage 3 Council will identify and evaluate management options and actions that can be implemented to reduce vulnerability and risks. These actions will help build the community's resilience and ability to adapt to change.

The CM Manual identifies three levels of risk that direct the level of detail required in Stage 3 options assessment, as shown in **Figure 7-1**. The outcomes of each of the vulnerability assessments undertaken in this Stage 2 assessment (**Section 4 and 5**) are categorised against these three levels of risk to provide the framework and approach for Stage 3 (**Table 7-1**).

As described in **Section 3.1** the locations included in this Stage 2 assessment are those considered to have potential high risk or significant data gaps. However, it is acknowledged that previous vulnerability assessments were undertaken by WRL (2017) for a number of other low risk locations. The inundation and erosion maps for these locations have been included in **Appendix C** and will be considered in the development and assessment of management options in Stage 3. These location have not been included in **Table 7-1**. The erosion assessment undertaken by SMEC (2010) has been replicated in the mapping contained within this Stage 2 report, and as such is not included in **Appendix C**.

The Stage 3 options assessment will also consider the vulnerability and recommendations made in the *Geotechnical Slope Instability Risk Assessment* under taken for Batemans Bay by ACT Geotechnical of Engineers Pty Ltd in 2012.

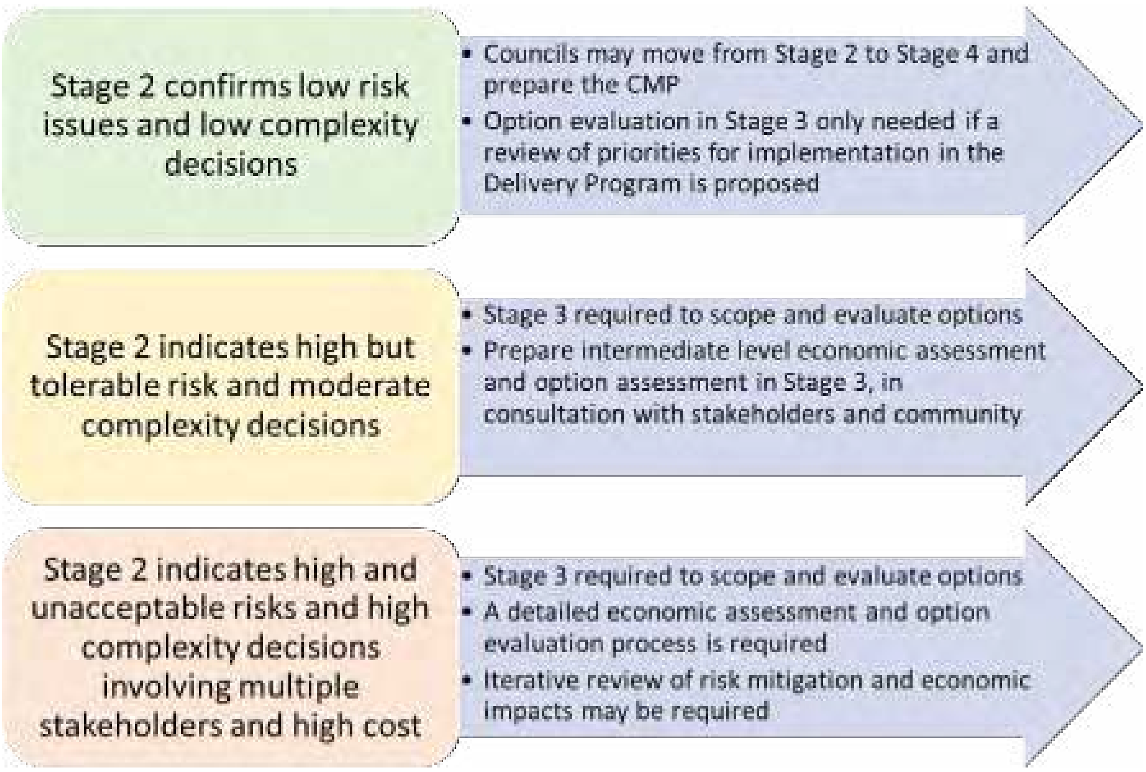

Figure 7-1 Outcomes of the hazards studies (Figure B2.29 in the CM Manual)

Table 7-1 Outcomes of Hazards Studies

Location	Description	Outcomes of the hazards studies as per Figure B2.29 in the CM Manual (See Figure 7-1)
Maloneys Beach	Potential future erosion risk to road	Stage 2 indicates low risk issues and low complexity decisions.
	100 Year ARI inundation could threaten Northcove Road.	Stage 2 indicates low risk issues and low complexity decisions.
Long Beach	Erosion risk under existing and future conditions threatens public land, roadways and private property at the eastern end of Long Beach.	Stage 2 indicates high but tolerable risk and moderate complexity decisions.
	100 Year ARI inundation impacts several private properties and Bay Road	Stage 2 indicates low risk issues and low complexity decisions.
Surfside	Existing erosion risk is limited to beach front and public land. Future (2100) erosion risk threatens private properties.	Stage 2 indicates high but tolerable risk and moderate complexity decisions.
	Future (2100) 1 Year ARI inundation risk threatens low lying properties and several roads.	Stage 2 indicates high but tolerable risk and moderate complexity decisions.
	Existing and Future (2100) 100 Year ARI inundation threatens large number of private properties and roads within Surfside.	Stage 2 indicates high but tolerable risk and moderate complexity decisions.
Wharf Road	Erosion risk to private properties seaward of Wharf Road to be managed under Wharf Road CZMP. Erosion risk to Wharf Road and adjacent infrastructure (e.g. Sewer) under existing and future (2100) conditions.	Stage 2 indicates high but tolerable risk and moderate complexity decisions.
	Future (2100) tidal inundation risk to a small section of Wharf Road to associated impacts on drainage.	Stage 2 indicates low risk issues and low complexity decisions.
	Future (2100) 1 Year ARI and Existing and Future (2100) 100 Year ARI inundation threatens large number of private properties and Wharf Road.	Stage 2 indicates high but tolerable risk and moderate complexity decisions.

Location	Description	**Outcomes of the hazards studies as per Figure B2.29 in the CM Manual** (See Figure 7-1)
Batemans Bay CBD	Future (2100) 1 Year ARI inundation risk to Clyde Street and a section of North Street.	Stage 2 indicates high but tolerable risk and moderate complexity decisions.
	Existing 100 Year ARI inundation risk threatens portions of the CBD including properties and roads. Future (2100) 100 Year ARI inundation risk significantly increases in depth and extent, with a larger number of properties and roads impacted.	Stage 2 indicates high but tolerable risk and moderate complexity decisions.
Boat Harbour	Future (2100) tidal risk and 1 Year ARI inundation risk to Beach Road and Herarde Street (and adjacent private properties).	Stage 2 indicates high but tolerable risk and moderate complexity decisions.
	Future (2100) tides also threaten large residential areas westward of Corrigans Beach.	Stage 2 indicates high and unacceptable risks and high complexity decisions, involving multiple stakeholders and high cost.
	Existing and Future (2100) 100 Year ARI inundation risk poses significant risk to private and public land include roads and other assets.	Stage 2 indicates high but tolerable risk and moderate complexity decisions.
Corrigans Beach	Existing and Future (2100) 100 Year ARI inundation risk poses significant risk to private and public land include roads and other assets.	Stage 2 indicates high but tolerable risk and moderate complexity decisions.
Caseys Beach	*Not assessed in this Stage 2 assessment, however, previous studies indicate a high erosion risk to foreshore assets (including roads) and potentially adjoining private properties.*	Stage 2 indicates high and unacceptable risks and high complexity decisions, involving multiple stakeholders and high cost.
	Future (2100) tidal and 1 Year ARI inundation risk to properties adjoining the lower reaches of Short Beach Creek.	Stage 2 indicates low risk issues and low complexity decisions.
	Existing and Future (2100) 100 Year ARI inundation risk poses risk to private properties adjoining the lower reaches of Short Beach Creek, Sunshine Bay Public School and Pleasurelea Tourist Park.	Stage 2 indicates high but tolerable risk and moderate complexity decisions.
Sunshine Bay	Existing erosion risk to public carpark. Future (2100) erosion risk to public carpark and private property.	Stage 2 indicates high but tolerable risk and moderate complexity decisions.

Location	Description	Outcomes of the hazards studies as per Figure B2.29 in the CM Manual (See Figure 7-1)
Malua Bay	Existing erosion risk to public land and roadway. Future (2100) erosion risk to private properties at northern end of beach.	Stage 2 indicates high but tolerable risk and moderate complexity decisions.
	Future (2100) 100 Year ARI inundation risk to private properties.	Stage 2 indicates low risk issues and low complexity decisions.
Barlings Beach	Future (2100) erosion risk to Barlings Beach Holiday Park.	Stage 2 indicates high but tolerable risk and moderate complexity decisions.
Tomakin Cove	Future (2100) erosion risk to private property	Stage 2 indicates high but tolerable risk and moderate complexity decisions.
Broulee	Future (2100) erosion risk to roadway and private properties at northern end of beach	Stage 2 indicates high but tolerable risk and moderate complexity decisions.
	Existing and future (2100) 100 Year ARI inundation risk (shallow) to a small number of properties on Candlagan Drive.	Stage 2 indicates low risk issues and low complexity decisions.

8 References

ACT Geotechnical Engineers Pty Ltd (2012). *Geotechnical Slope Instability Risk Assessment*. Prepared on behalf of Umwelt Australia Pty Ltd as an input to the CZMP

BMT WBM (2009). *Wharf Road Coastal Hazard Assessment and Hazard Management Plan.* Report prepared for Eurobodalla Shire Council.

Department of Planning, Industry and Environment (2021). NSW Beach Profile Database. Hosted by the Water Research Laboratory, University of New South Wales (UNSW). www.nswbpd.wrl.unsw.edu.au.

Eurobodalla Shire Council (2014). Minutes: Ordinary Meeting of Council, 25 November 2014.

Nielsen, A F, Lord, D B and Poulos, H G (1992). Dune Stability Considerations for Building Foundations, Australian Civil Engineering Transactions, The Institution of Engineers, Australia, Volume CE34, Number 2, p. 167 – 174.

OEH (2015). Floodplain Risk Management Guide: Modelling the Interaction of Catchment Flooding and Oceanic Inundation in Coastal Waterways, November.

Rhelm (2021). *Eurobodalla LGA Open Coast CMP Scoping Study.* Prepared for Eurobodalla Shire Council

Shand, R., Shand, T.D, McComb, P. and Johnson, D. (2011). Evaluation of empirical predictors of extreme run-up using field data. *20th Australasian Coasts and Ports Conference Sept 2011*.

Short, A.D. 2020. Australian coastal systems: beaches, barriers and sediment compartments, *Coastal Research Library 32*. Switzerland: Springer.

SMEC (2011), *Eurobodalla Shire Coastal Hazards Scoping Study*. Report prepared for Eurobodalla Shire Council.

Thom, B.G., I. Eliot, M. Eliot, N. Harvey, D. Rissik, C. Sharples, A.D. Short, and C.D. Woodroffe. 2018. National sediment compartment framework for Australian coastal management. *Ocean & Coastal Management* 154: 103–120.

WBM Oceanics (2000). *Batemans Bay/Clyde River Estuary Processes Study – Water Quality and Sedimentation Components*. Report prepared for Eurobodalla Shire Council.

Whitehead & Associates (2014). South Coast Regional Sea Level Rise Policy and Planning Framework. Report prepared for Eurobodalla Shire and Shoalhaven City Councils, Final, October.

Water Research Laboratory (2017). *Eurobodalla Coastal Hazard Assessment*. WRL Technical Report 2017/09. Report prepared for Eurobodalla Shire Council. October.

9 Model Assumptions and Limitations

Coastal hazard extents presented in this report have been developed using modelling and analysis completed within the Eurobodalla Coastal Hazard Assessment (WRL, 2017). The Coastal Hazard Assessment (WRL, 2017) provides detailed calculations of erosion and recession; using photogrammetry analysis and numerical erosion modelling; and coastal wave levels, wave runup and overtopping; using data analysis, numerical modelling and empirical techniques. The assumptions and limitations of the adopted methodologies are outlined in WRL (2007) which is reproduced in **Appendix D** of this report.

Remapping of coastal hazard extents for some locations, as described in Sections 4 and 5, was completed as part of this Stage 2 report. The mapping methodology adopted is consistent with that applied in WRL (2017), noting that recent high resolution LiDAR data across both foreshore and nearshore areas of the study area has allowed improved mapping of tidal and storm tide extents to be developed with consideration of hydraulic connectivity of foreshore areas to the coast.

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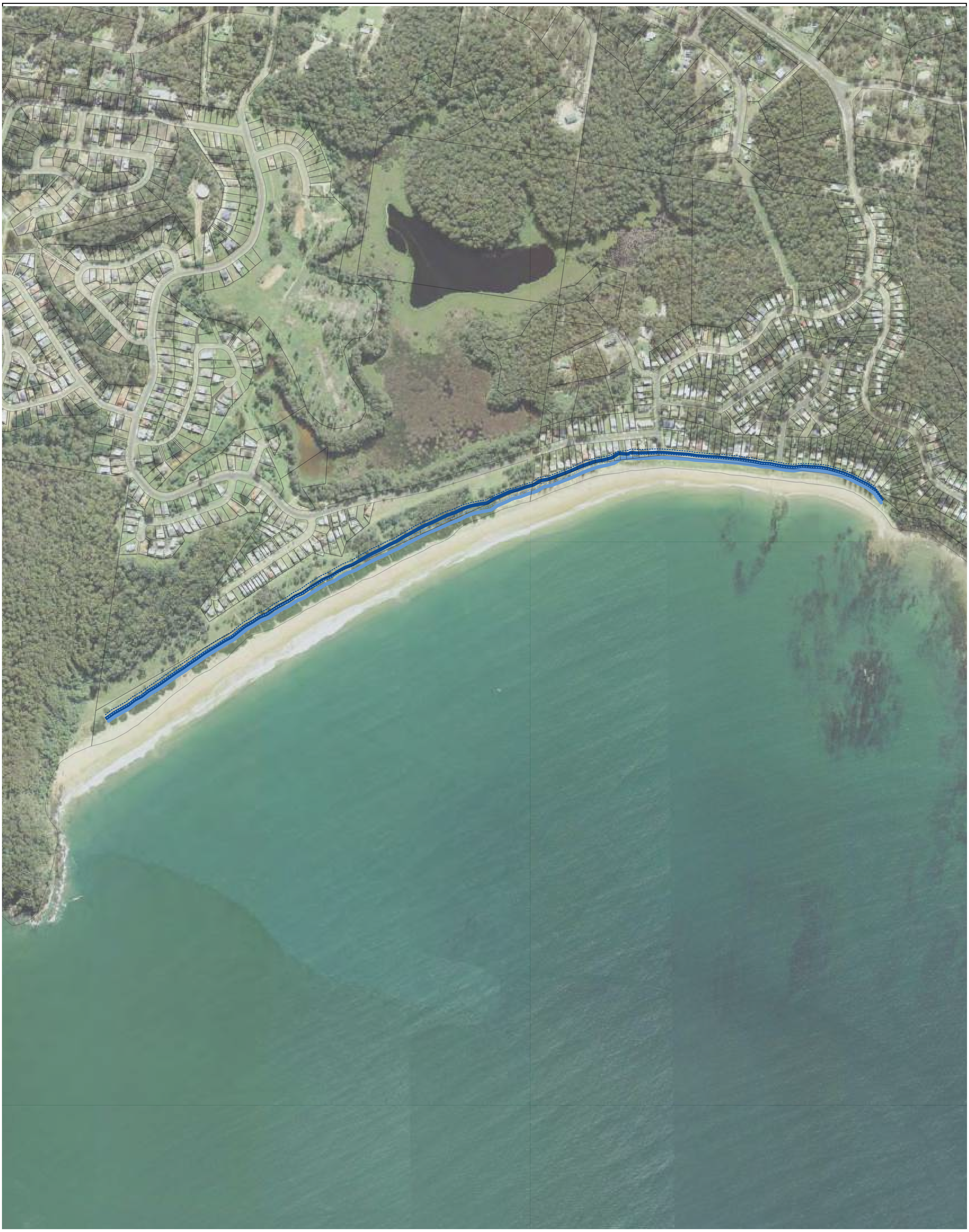
Scale : 1:0@A3
Date : 22 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

60 0 60 120 180 m

Legend
- Erosion Hazard Line 2017
- Reduced Foundation Capacity 2017
- Erosion Hazard Line 2100
- Reduced Foundation Capacity 2100

RG-04-01
Stage 2 Assessments
Erosion Risk
Maloneys Beach



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Revision : B
Created by : LRE
Coordinate System : MGA 94

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Legend

- Erosion Hazard Line 2017
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- Erosion Hazard Line 2100
- Reduced Foundation Capacity 2100

RG-04-01
Stage 2 Assessments
Erosion Risk
Long Beach

Scale : 1:2500@A3
Date : 22 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

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80 0 80 160 240 m

Legend
Erosion Hazard Line 2017
Reduced Foundation Capacity 2017
Erosion Hazard Line 2100
Reduced Foundation Capacity 2100

RG-04-01
Stage 2 Assessments
Erosion Risk
Surfside

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Scale : 1:0@A3
Date : 22 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend

- Erosion Hazard Line 2017
- Reduced Foundation Capacity 2017
- Erosion Hazard Line 2100
- Reduced Foundation Capacity 2100

Note:
Wharf Road hazard lines taken from the Eurobodalla Shire Coastal Hazards Scoping Study (SMEC, 2010)

RG-04-01
Stage 2 Assessments
Erosion Risk
Wharf Road

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Scale : 1:0@A3
Date : 22 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

20 0 20 40 60 m

Legend
Erosion Hazard Line 2017
Reduced Foundation Capacity 2017
Erosion Hazard Line 2100
Reduced Foundation Capacity 2100

RG-04-01
Stage 2 Assessments
Erosion Risk
Sunshine Bay

Scale : 1:1500@A3
Date : 22 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

30 0 30 60 90 m

Legend
- Erosion Hazard Line 2017
- Reduced Foundation Capacity 2017
- Erosion Hazard Line 2100
- Reduced Foundation Capacity 2100

RG-04-01
Stage 2 Assessments
Erosion Risk
Malua Bay

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Scale : 1:0@A3
Date : 22 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

90 0 90 180 270 m

Legend
Erosion Hazard Line 2017
Reduced Foundation Capacity 2017
Erosion Hazard Line 2100
Reduced Foundation Capacity 2100

RG-04-01
Stage 2 Assessments
Erosion Risk
Barlings Beach

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Scale : 1:1000@A3
Date : 22 November 2021
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20 0 20 40 60 m

Legend
- Erosion Hazard Line 2017
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- Erosion Hazard Line 2100
- Reduced Foundation Capacity 2100

RG-04-01
Stage 2 Assessments
Erosion Risk
Tomakin Cove

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Scale : 1:5000@A3
Date : 22 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

RG-04-01
Stage 2 Assessments
Erosion Risk
Broulee

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Scale : 1:8000@A3
Date : 16 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

100 0 100 200 300 m

Legend

- HHWSS Tidal Inundation Existing
- HHWSS Tidal Inundation 2050
- HHWSS Tidal Inundation 2065
- HHWSS Tidal Inundation 2100

Note:
Only 2017 and 2100 were assessed at Long Beach to show the range of risk.

RG-05-01
Stage 2 Assessments
Tidal Inundation
Long Beach

Scale : 1:7500@A3
Date : 16 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

100 0 100 200 300 m

Legend
HHWSS Tidal Inundation Existing
HHWSS Tidal Inundation 2050
HHWSS Tidal Inundation 2065
HHWSS Tidal Inundation 2100

RG-05-01
Stage 2 Assessments
Tidal Inundation
Surfside

Scale : 1:3500@A3
Date : 16 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

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80 0 80 160 240 m

Legend
HHWSS Tidal Inundation Existing
HHWSS Tidal Inundation 2050
HHWSS Tidal Inundation 2065
HHWSS Tidal Inundation 2100

RG-05-01
Stage 2 Assessments
Tidal Inundation
CBD

Scale : 1:6000@A3
Date : 16 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94
Rhelm
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100
0
100
200
300 m
Legend
HHWSS Tidal Inundation Existing
HHWSS Tidal Inundation 2050
HHWSS Tidal Inundation 2065
HHWSS Tidal Inundation 2100
RG-05-01
Stage 2 Assessments
Tidal Inundation
Boat Harbour

Scale : 1:6500@A3
Date : 16 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

100 0 100 200 300 m

Legend
- HHWSS Tidal Inundation Existing
- HHWSS Tidal Inundation 2050
- HHWSS Tidal Inundation 2065
- HHWSS Tidal Inundation 2100

RG-05-01
Stage 2 Assessments
Tidal Inundation
Corrigans Beach

Scale : 1:4000@A3
Date : 16 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

90 0 90 180 270 m

Legend

- HHWSS Tidal Inundation Existing
- HHWSS Tidal Inundation 2050
- HHWSS Tidal Inundation 2065
- HHWSS Tidal Inundation 2100

RG-05-01
Stage 2 Assessments
Tidal Inundation
Sunshine Bay

Scale : 1:1500@A3
Date : 16 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

30 0 30 60 90 m

Legend
- HHWSS Tidal Inundation Existing
- HHWSS Tidal Inundation 2050
- HHWSS Tidal Inundation 2065
- HHWSS Tidal Inundation 2100

RG-05-01
Stage 2 Assessments
Tidal Inundation
Malua Bay

Scale : 1:0@A3
Date : 16 November 2021
Revision : B
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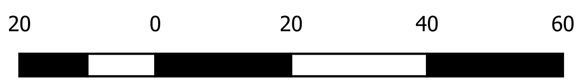
Coordinate System : MGA 94



Legend
- HHWSS Tidal Inundation Existing
- HHWSS Tidal Inundation 2050
- HHWSS Tidal Inundation 2065
- HHWSS Tidal Inundation 2100

Note:
Only 2017 and 2100 were assessed at Tomakin to show the range of risk.

RG-05-01
Stage 2 Assessments
Tidal Inundation
Tomakin

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Scale : 1:0@A3
Date : 16 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

200 0 200 400 600 m

Legend
- HHWSS Tidal Inundation Existing
- HHWSS Tidal Inundation 2050
- HHWSS Tidal Inundation 2065
- HHWSS Tidal Inundation 2100

RG-05-01
Stage 2 Assessments
Tidal Inundation
Broulee

Note:
Only 2017 and 2100 were assessed at Long Beach to show the range of risk.

Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework.

100 0 100 200 300 m

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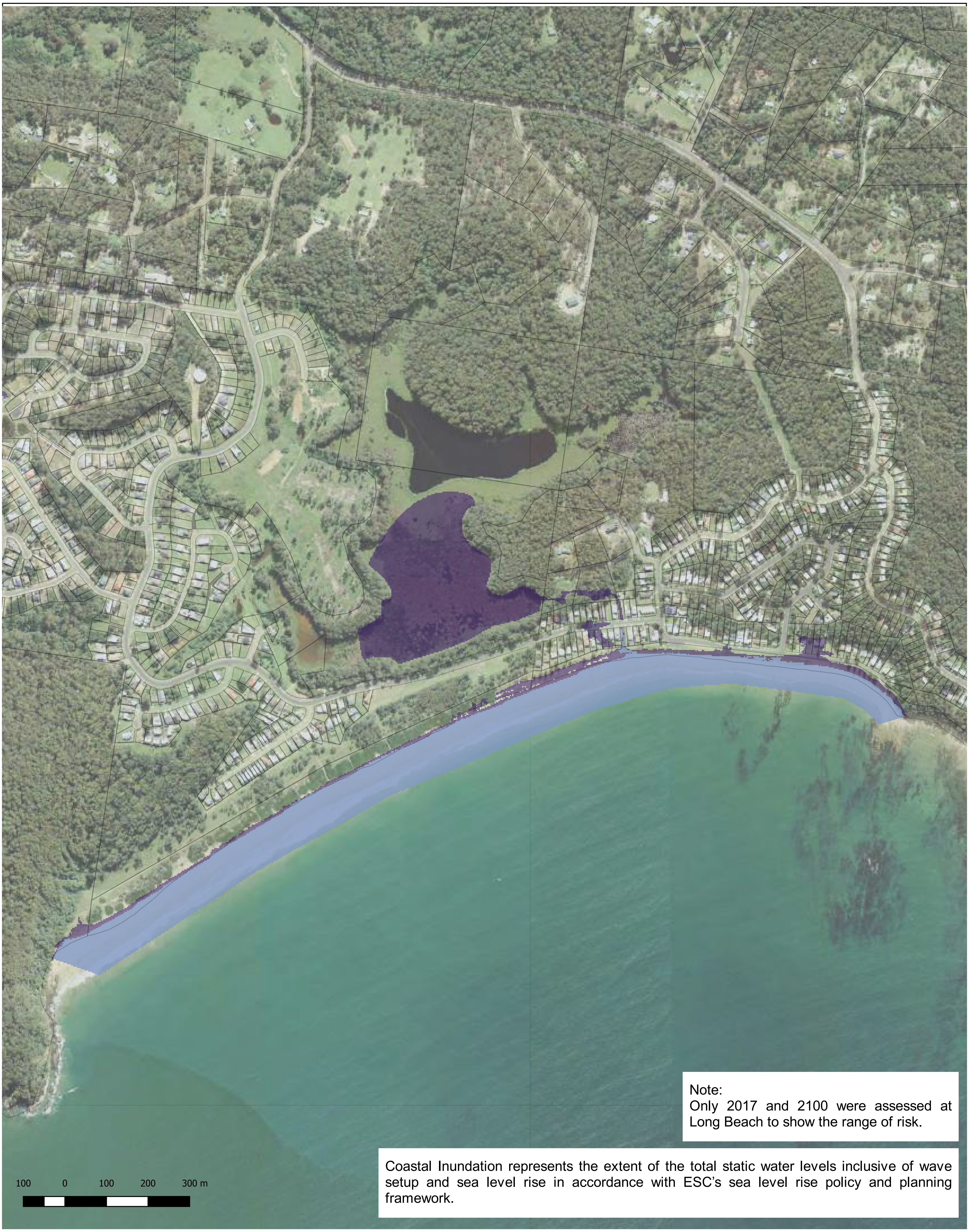
Scale : 1:8000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend
- Coastal Inundation 1yr ARI 2017
- Coastal Inundation 1yr ARI 2050
- Coastal Inundation 1yr ARI 2065
- Coastal Inundation 1yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 1 year ARI
Long Beach



Note:
Only 2017 and 2100 were assessed at Long Beach to show the range of risk.

Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework.

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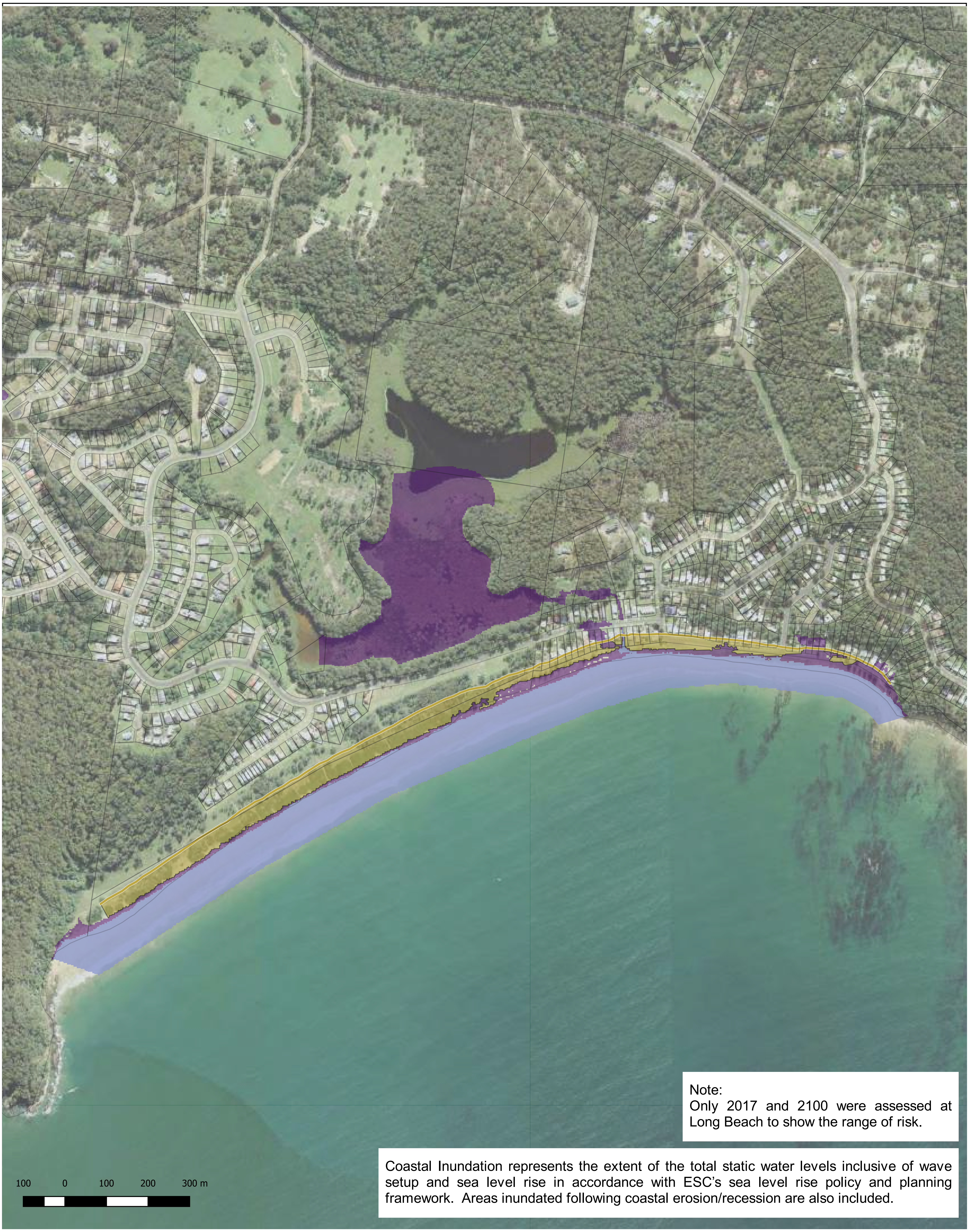
Scale : 1:8000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend
- Coastal Inundation 20yr ARI 2017
- Coastal Inundation 20yr ARI 2050
- Coastal Inundation 20yr ARI 2065
- Coastal Inundation 20yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 20 year ARI
Long Beach



Note:
Only 2017 and 2100 were assessed at Long Beach to show the range of risk.

Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework. Areas inundated following coastal erosion/recession are also included.

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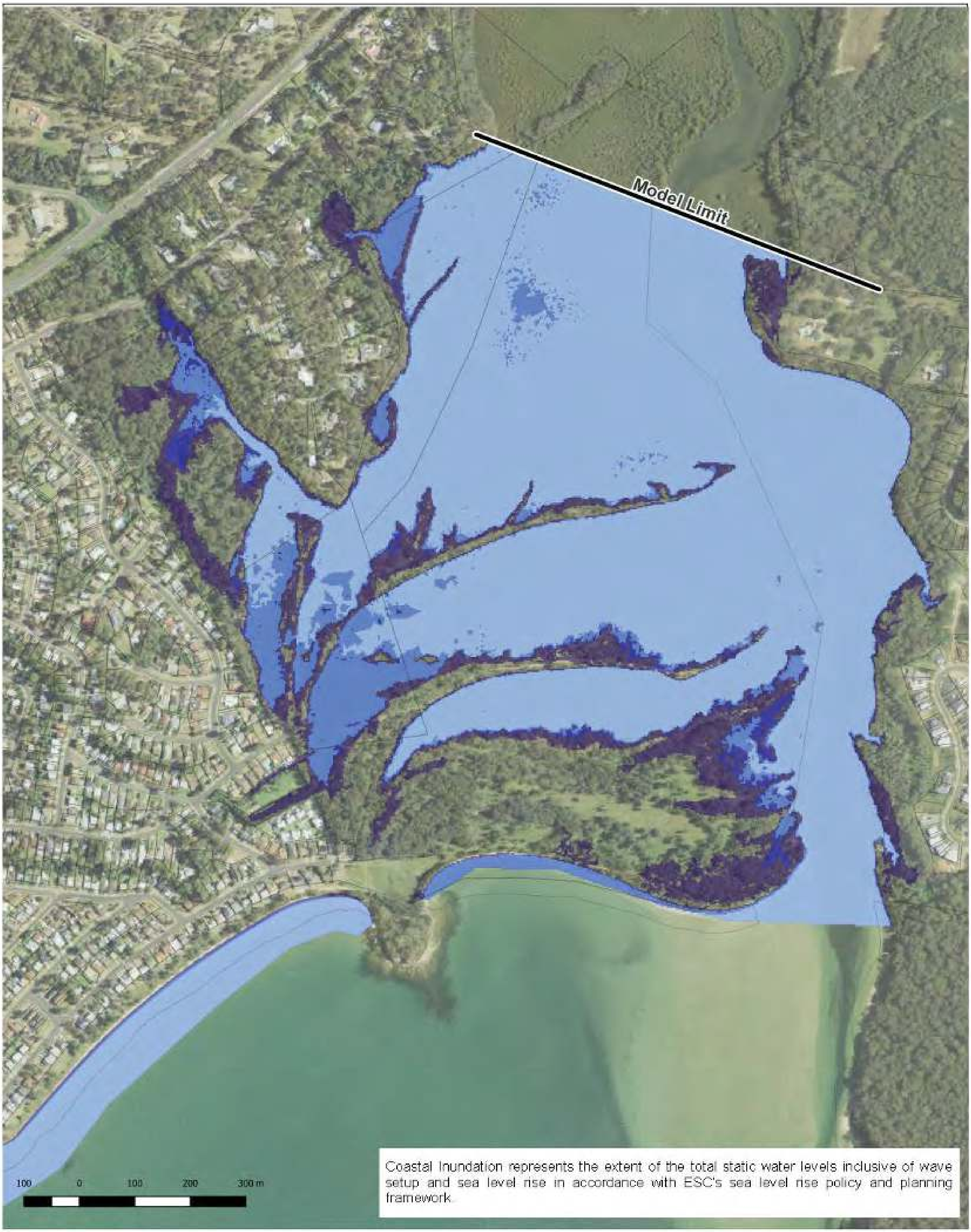
Scale : 1:8000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend

- Coastal Inundation 100yr ARI 2017
- Coastal Inundation 100yr ARI 2050
- Coastal Inundation 100yr ARI 2065
- Coastal Inundation 100yr ARI 2100
- Wave Runup Extent 100 year ARI 2017
- Wave Runup Extent 100 year ARI 2100
- Additional Area Affected by Wave Runup 2017
- Additional Area Affected by Wave Runup 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 100 year ARI
Long Beach



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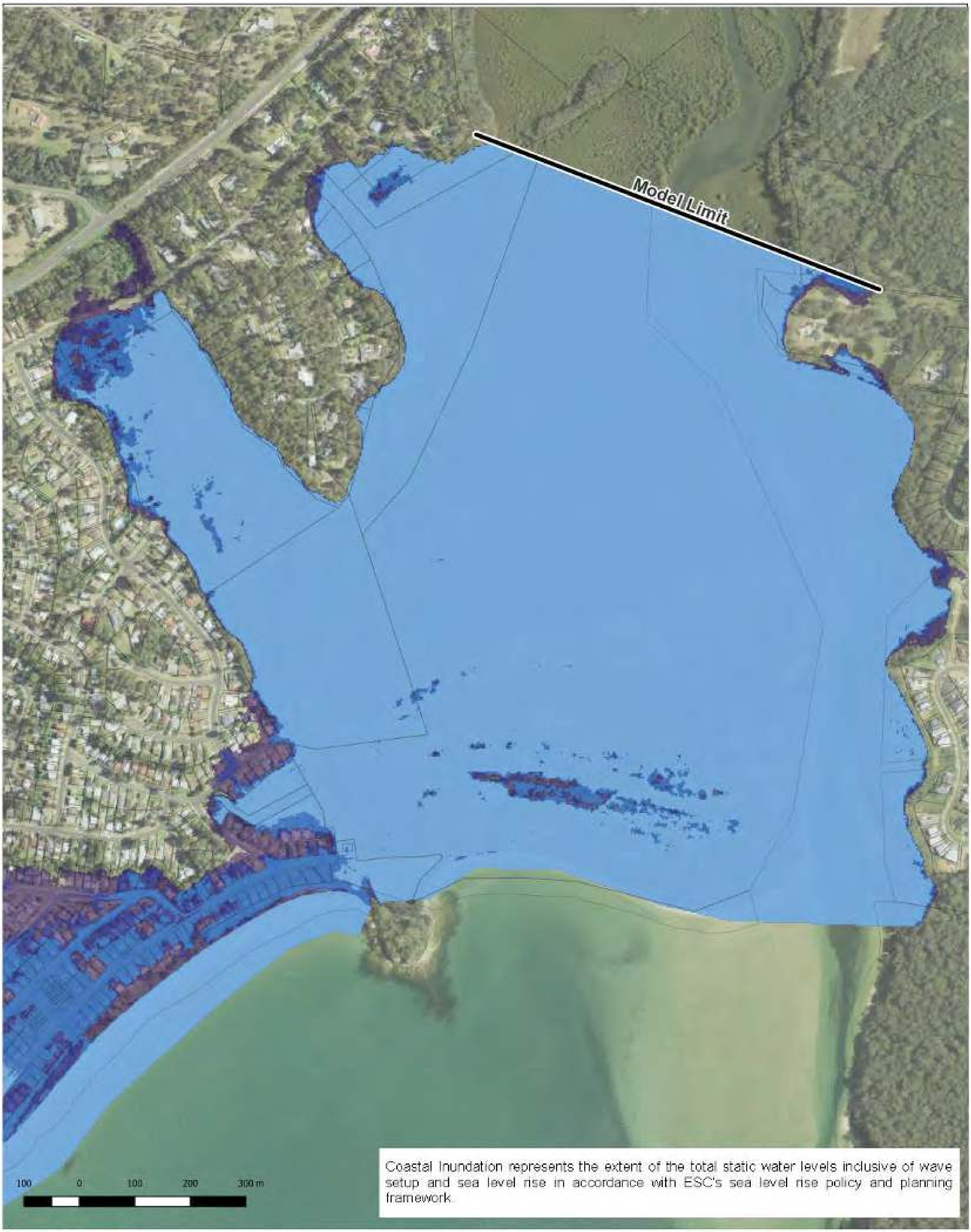
Scale : 1:5000@A3
Date : 18 November 2021
Revision : B
Created by : LMB
Coordinate System : MGA94

Legend

- Coastal Inundation 1yr ARI 2017
- Coastal Inundation 1yr ARI 2050
- Coastal Inundation 1yr ARI 2065
- Coastal Inundation 1yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 1 year ARI
Cullendulla



Rhelm

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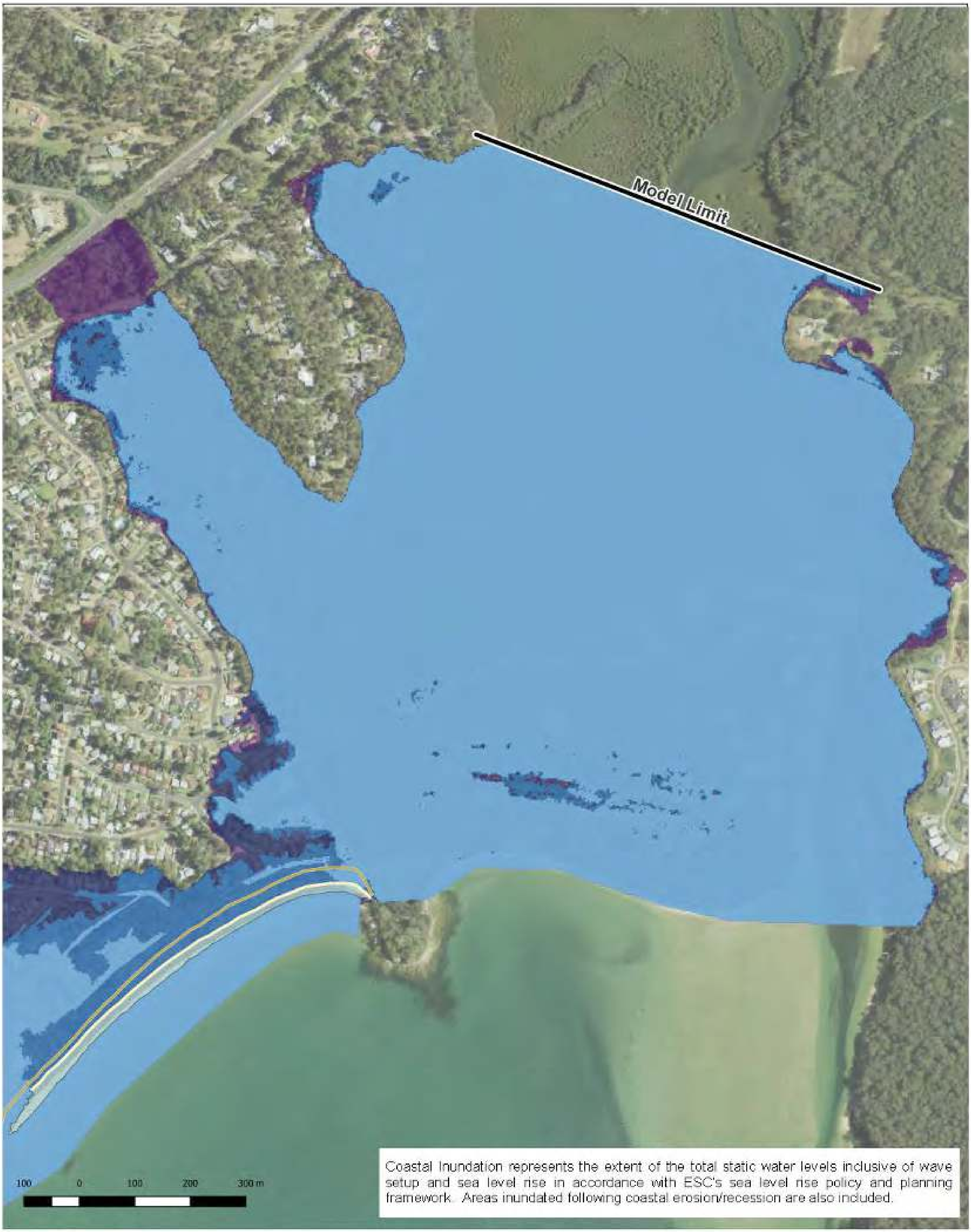
Date : 18 November 2021
Revision : B
Created by : LRB
Coordinate System : MGA 94

Legend

- Coastal Inundation 20yr ARI 2017
- Coastal Inundation 20yr ARI 2050
- Coastal Inundation 20yr ARI 2065
- Coastal Inundation 20yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 20 year ARI
Cullendulla



Rhelm

Scale : 1:5000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA94

Legend

- Coastal Inundation 100yr ARI 2017
- Coastal Inundation 100yr ARI 2050
- Coastal Inundation 100yr ARI 2065
- Coastal Inundation 100yr ARI 2100
- Wave Runup Extent 100 year ARI 2017
- Wave Runup Extent 100 year ARI 2100
- Additional Area Affected by Wave Runup 2017
- Additional Area Affected by Wave Runup 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 100 year ARI
Cullendulla

Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework.

Rhelm
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Scale : 1:8000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend
- Coastal Inundation 1yr ARI 2017
- Coastal Inundation 1yr ARI 2050
- Coastal Inundation 1yr ARI 2065
- Coastal Inundation 1yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 1 year ARI
Surfside

Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework.

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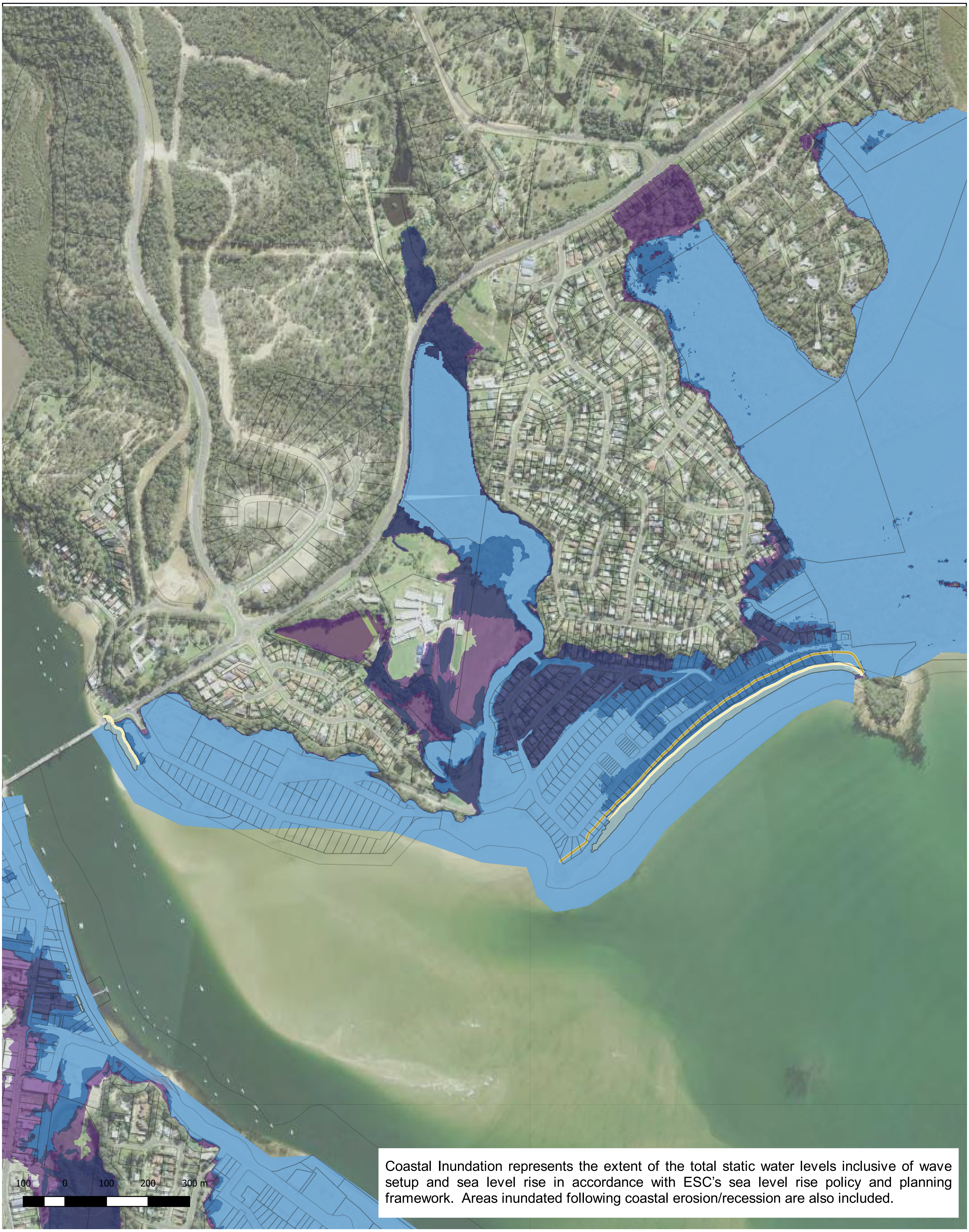
engineering | environmental | economics | engagement

Scale : 1:8000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend

- Coastal Inundation 20yr ARI 2017
- Coastal Inundation 20yr ARI 2050
- Coastal Inundation 20yr ARI 2065
- Coastal Inundation 20yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 20 year ARI
Surfside



Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework. Areas inundated following coastal erosion/recession are also included.

Rhelm

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Scale : 1:8000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend

- Coastal Inundation 100yr ARI 2017
- Coastal Inundation 100yr ARI 2050
- Coastal Inundation 100yr ARI 2065
- Coastal Inundation 100yr ARI 2100
- Wave Runup Extent 100 year ARI 2017
- Wave Runup Extent 100 year ARI 2100
- Additional Area Affected by Wave Runup 2017
- Additional Area Affected by Wave Runup 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 100 year ARI
Surfside

Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework.

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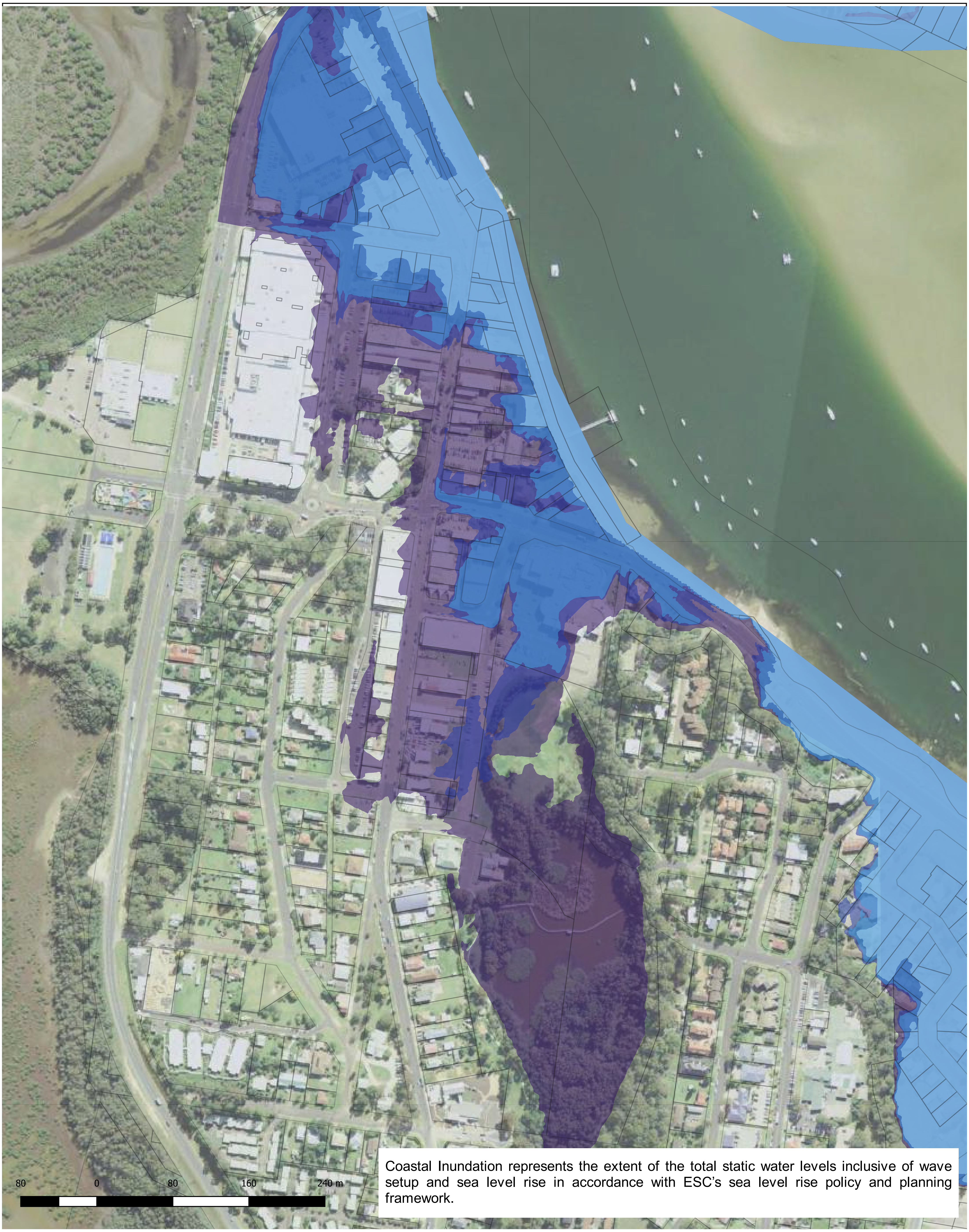
Scale : 1:3500@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend

- Coastal Inundation 1yr ARI 2017
- Coastal Inundation 1yr ARI 2050
- Coastal Inundation 1yr ARI 2065
- Coastal Inundation 1yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 1 year ARI
CBD



Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework.

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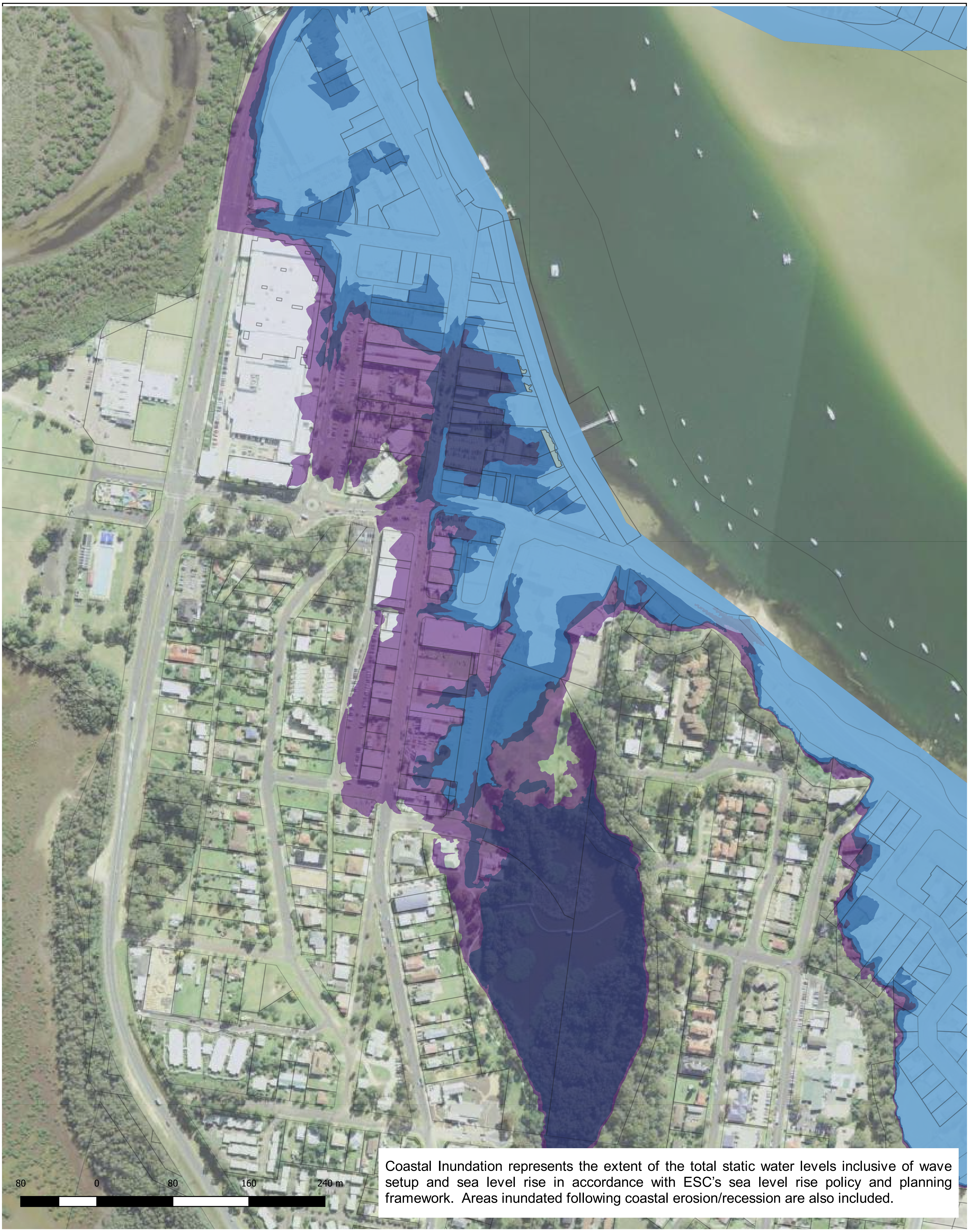
Scale : 1:3500@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend
- Coastal Inundation 20yr ARI 2017
- Coastal Inundation 20yr ARI 2050
- Coastal Inundation 20yr ARI 2065
- Coastal Inundation 20yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 20 year ARI
CBD



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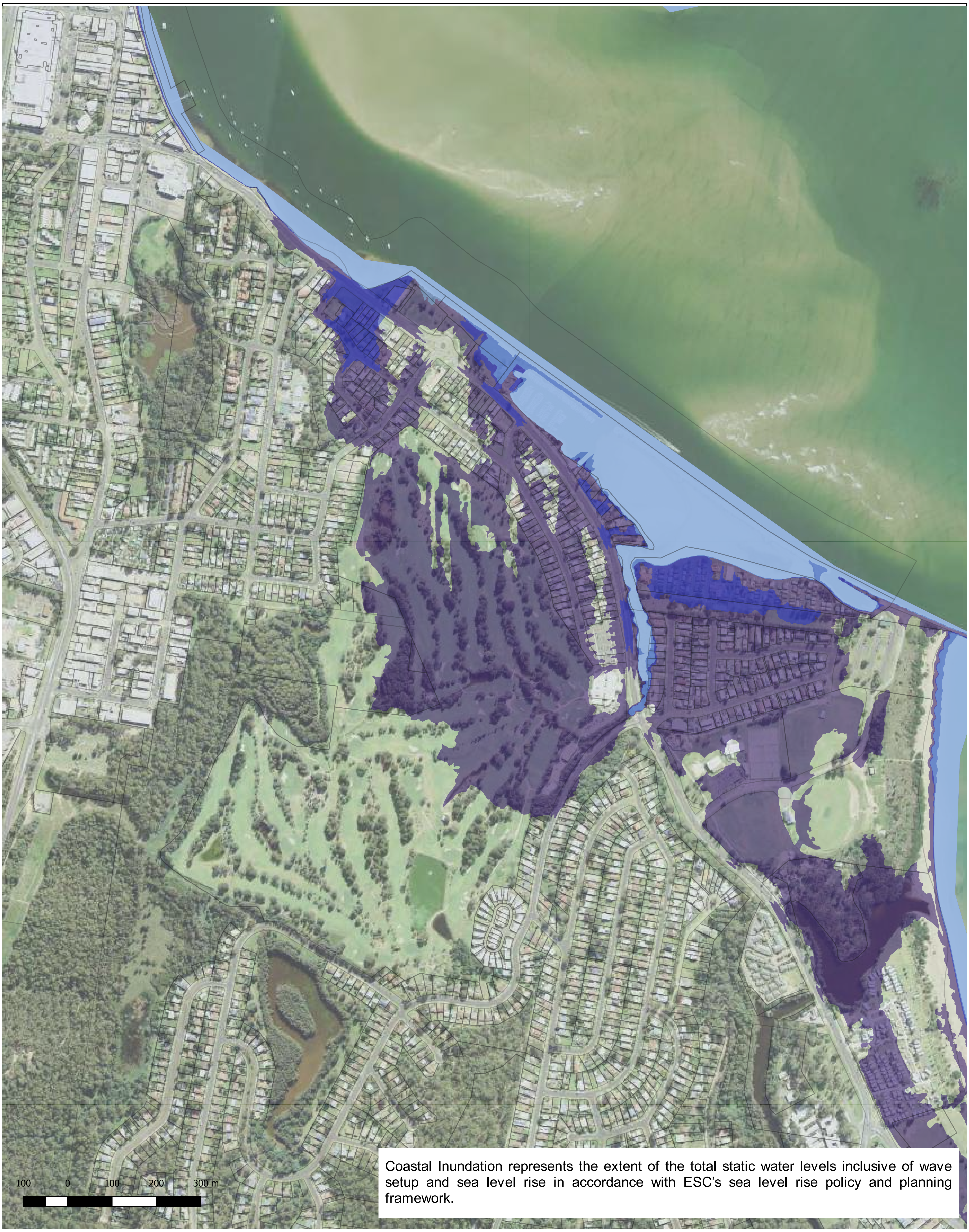
Scale : 1:3500@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend

- Coastal Inundation 100yr ARI 2017
- Coastal Inundation 100yr ARI 2050
- Coastal Inundation 100yr ARI 2065
- Coastal Inundation 100yr ARI 2100
- Wave Runup Extent 100 year ARI 2017
- Wave Runup Extent 100 year ARI 2100
- Additional Area Affected by Wave Runup 2017
- Additional Area Affected by Wave Runup 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 100 year ARI
CBD



Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework.

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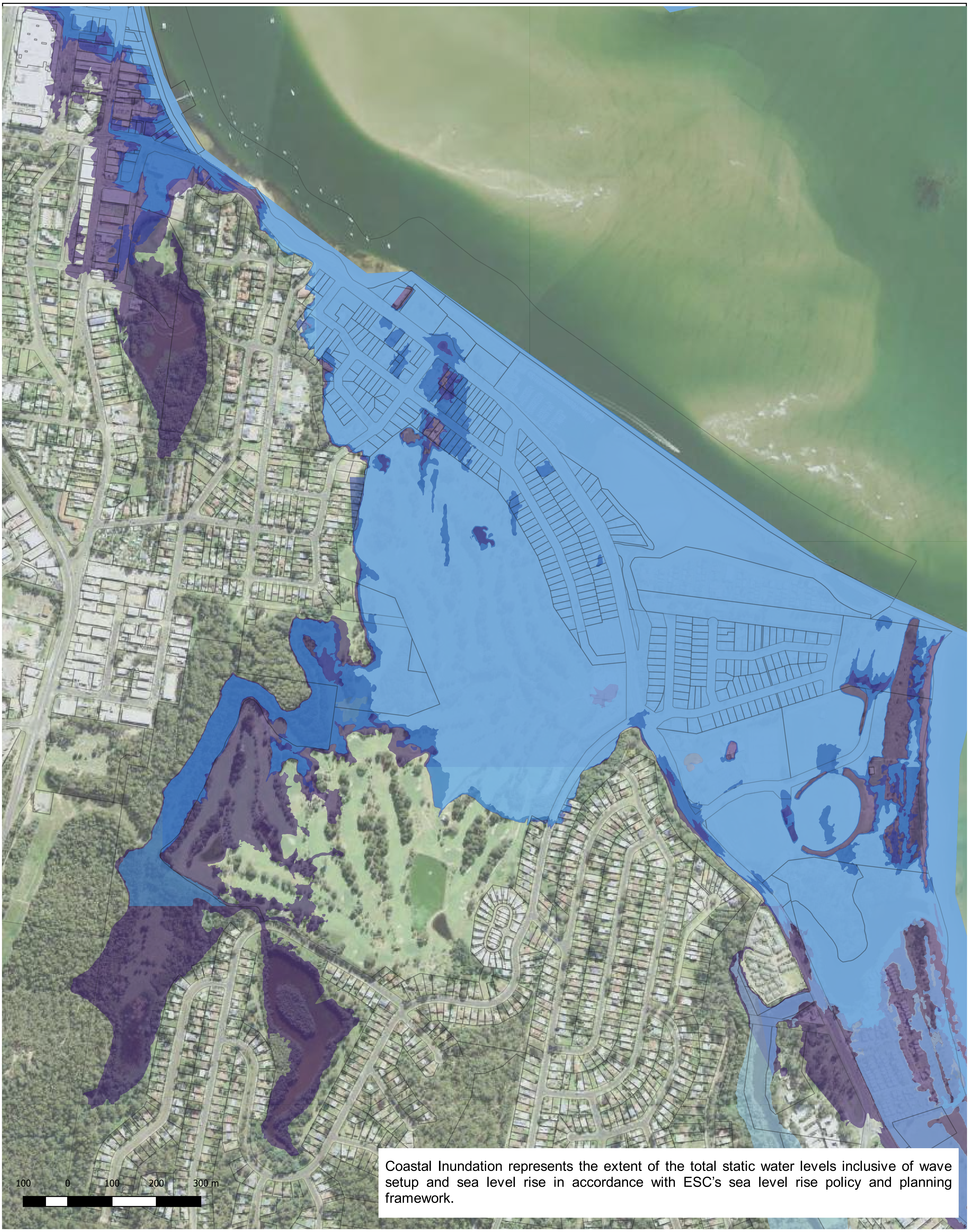
Scale : 1:7500@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend
- Coastal Inundation 1yr ARI 2017
- Coastal Inundation 1yr ARI 2050
- Coastal Inundation 1yr ARI 2065
- Coastal Inundation 1yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 1 year ARI
Boat Harbour



Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework.

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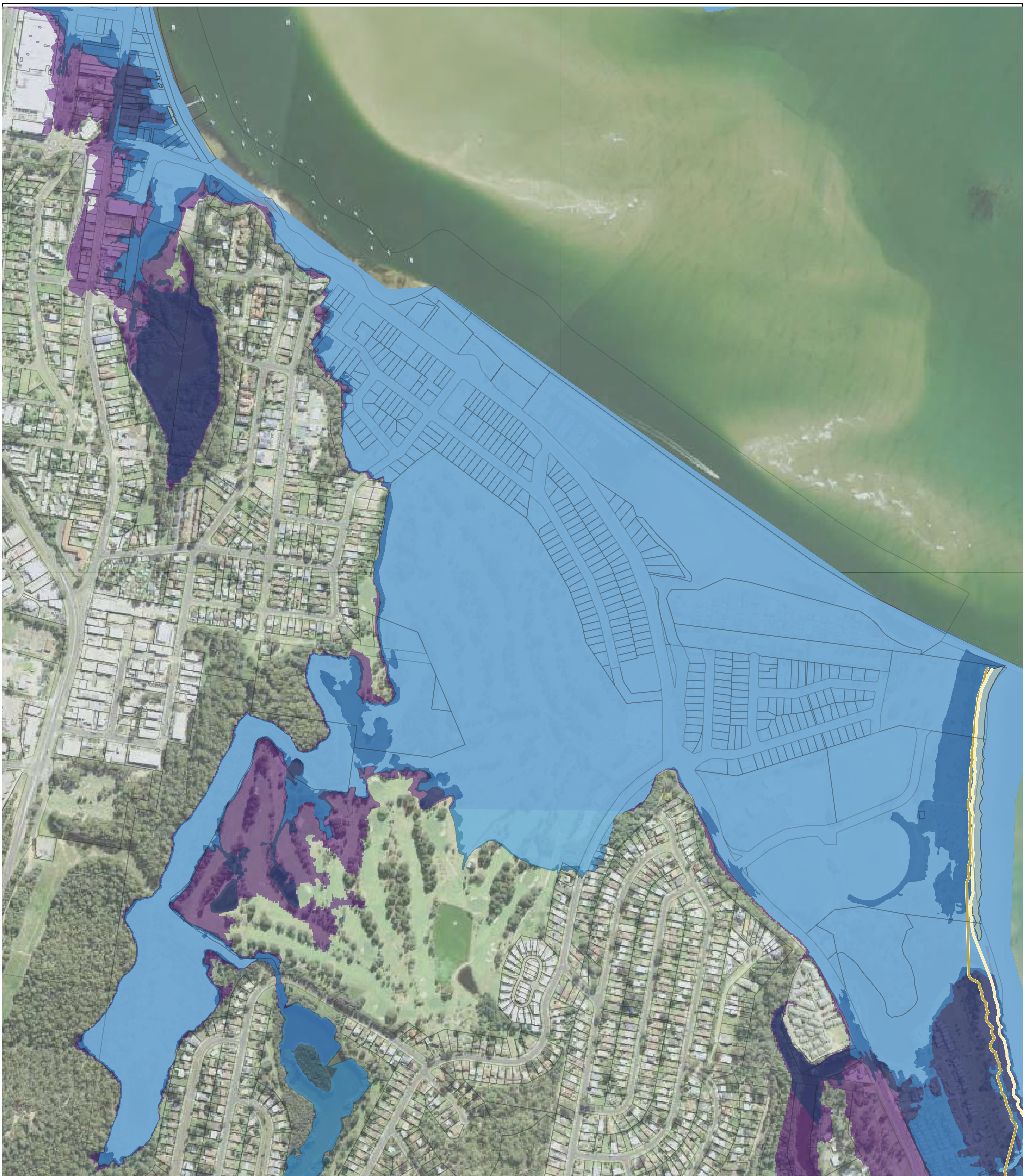
Scale : 1:7500@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend
- Coastal Inundation 20yr ARI 2017
- Coastal Inundation 20yr ARI 2050
- Coastal Inundation 20yr ARI 2065
- Coastal Inundation 20yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 20 year ARI
Boat Harbour



Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework. Areas inundated following coastal erosion/recession are also included.

Rhelm
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Scale : 1:7500@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend
- Coastal Inundation 100yr ARI 2017
- Coastal Inundation 100yr ARI 2050
- Coastal Inundation 100yr ARI 2065
- Coastal Inundation 100yr ARI 2100
- Wave Runup Extent 100 year ARI 2017
- Wave Runup Extent 100 year ARI 2100
- Additional Area Affected by Wave Runup 2017
- Additional Area Affected by Wave Runup 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 100 year ARI
Boat Harbour

Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework.

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Scale : 1:7000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend

- Coastal Inundation 1yr ARI 2017
- Coastal Inundation 1yr ARI 2050
- Coastal Inundation 1yr ARI 2065
- Coastal Inundation 1yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 1 year ARI
Corrigans Beach

Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework.

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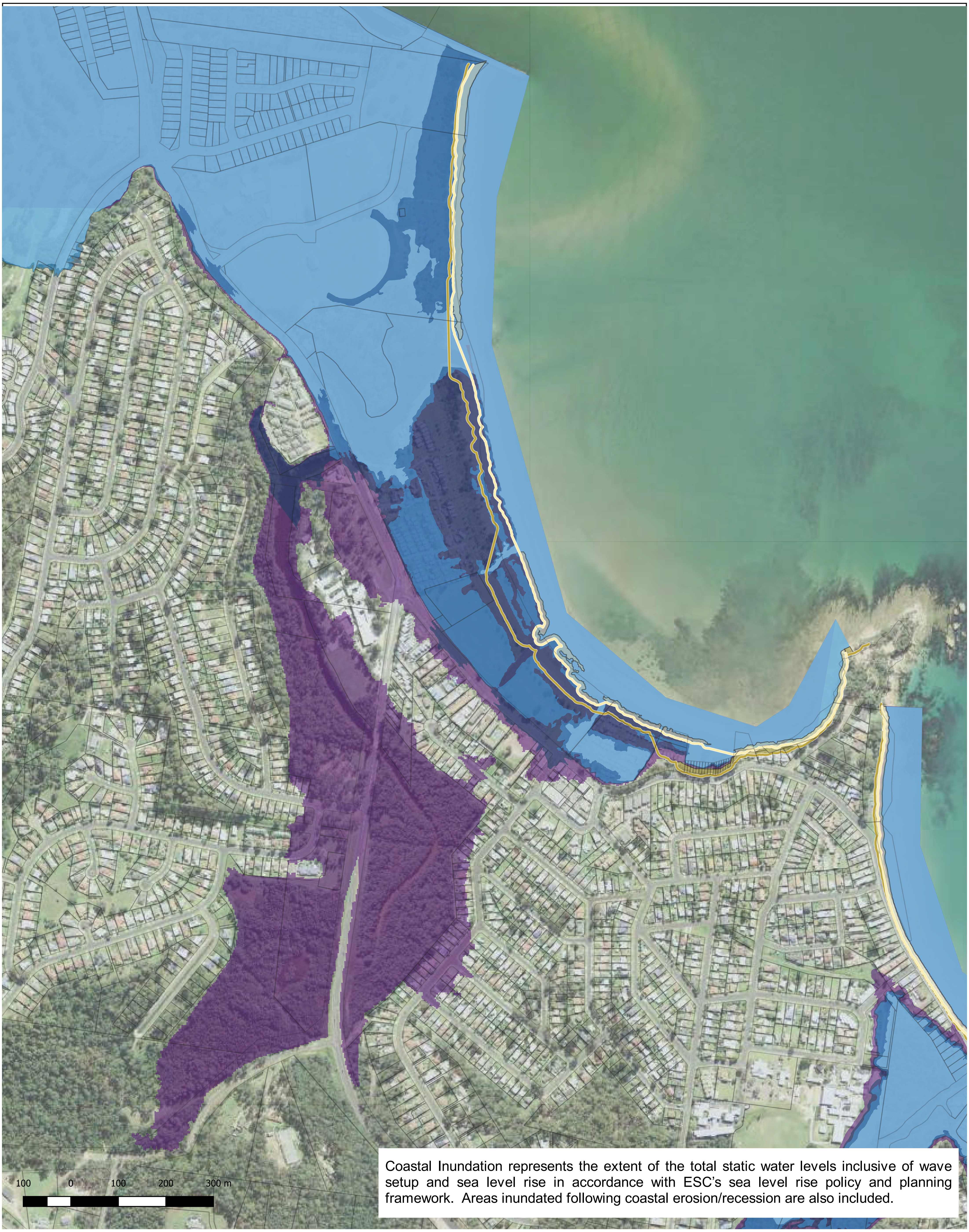
Scale : 1:7000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend

- Coastal Inundation 20yr ARI 2017
- Coastal Inundation 20yr ARI 2050
- Coastal Inundation 20yr ARI 2065
- Coastal Inundation 20yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 20 year ARI
Corrigans Beach



Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework. Areas inundated following coastal erosion/recession are also included.

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Scale : 1:7000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend

- Coastal Inundation 100yr ARI 2017
- Coastal Inundation 100yr ARI 2050
- Coastal Inundation 100yr ARI 2065
- Coastal Inundation 100yr ARI 2100
- Wave Runup Extent 100 year ARI 2017
- Wave Runup Extent 100 year ARI 2100
- Additional Area Affected by Wave Runup 2017
- Additional Area Affected by Wave Runup 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 100 year ARI
Corrigans Beach

Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework.

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Scale : 1:5500@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend

- Coastal Inundation 1yr ARI 2017
- Coastal Inundation 1yr ARI 2050
- Coastal Inundation 1yr ARI 2065
- Coastal Inundation 1yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 1 year ARI
Sunshine Bay

Rhelm
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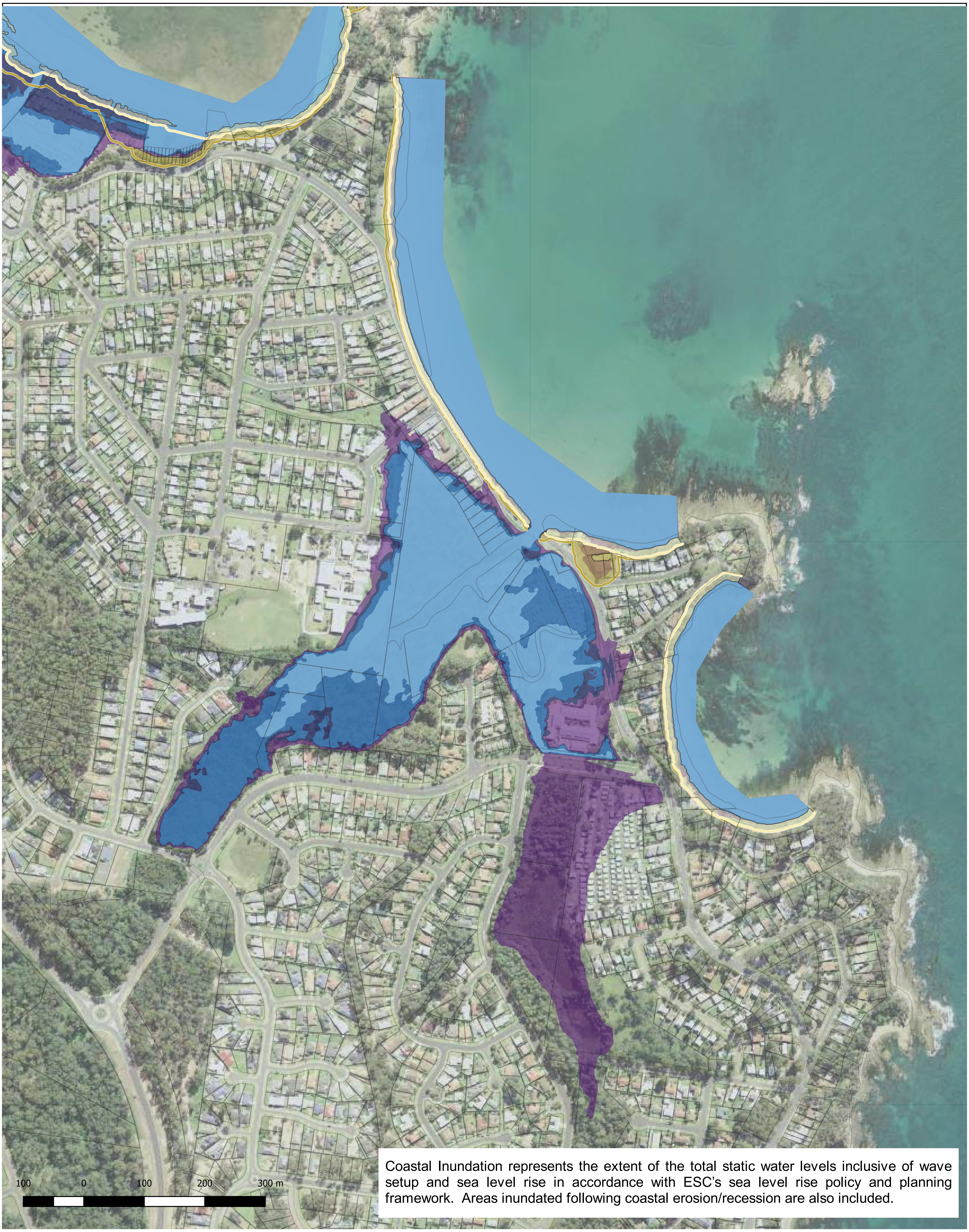
Scale : 1:5500@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend
- Coastal Inundation 20yr ARI 2017
- Coastal Inundation 20yr ARI 2050
- Coastal Inundation 20yr ARI 2065
- Coastal Inundation 20yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 20 year ARI
Sunshine Bay



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Scale : 1:5500@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend

- Coastal Inundation 100yr ARI 2017
- Coastal Inundation 100yr ARI 2050
- Coastal Inundation 100yr ARI 2065
- Coastal Inundation 100yr ARI 2100
- Wave Runup Extent 100 year ARI 2017
- Wave Runup Extent 100 year ARI 2100
- Additional Area Affected by Wave Runup 2017
- Additional Area Affected by Wave Runup 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 100 year ARI
Sunshine Bay

Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework.

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Scale : 1:4000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend
- Coastal Inundation 1yr ARI 2017
- Coastal Inundation 1yr ARI 2050
- Coastal Inundation 1yr ARI 2065
- Coastal Inundation 1yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 1 year ARI
Malua Bay

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Scale : 1:4000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend

- Coastal Inundation 20yr ARI 2017
- Coastal Inundation 20yr ARI 2050
- Coastal Inundation 20yr ARI 2065
- Coastal Inundation 20yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 20 year ARI
Malua Bay

Rhelm
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Scale : 1:4000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend

- Coastal Inundation 100yr ARI 2017
- Coastal Inundation 100yr ARI 2050
- Coastal Inundation 100yr ARI 2065
- Coastal Inundation 100yr ARI 2100
- Wave Runup Extent 100 year ARI 2017
- Wave Runup Extent 100 year ARI 2100
- Additional Area Affected by Wave Runup 2017
- Additional Area Affected by Wave Runup 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 100 year ARI
Malua Bay

Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework.

Rhelm
engineering | environmental | economics | engagement

Scale : 1:1500@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend
- Coastal Inundation 1yr ARI 2017
- Coastal Inundation 1yr ARI 2050
- Coastal Inundation 1yr ARI 2065
- Coastal Inundation 1yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 1 year ARI
Tomakin

Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework.

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engineering | environmental | economics | engagement

Scale : 1:1500@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend

- Coastal Inundation 20yr ARI 2017
- Coastal Inundation 20yr ARI 2050
- Coastal Inundation 20yr ARI 2065
- Coastal Inundation 20yr ARI 2100

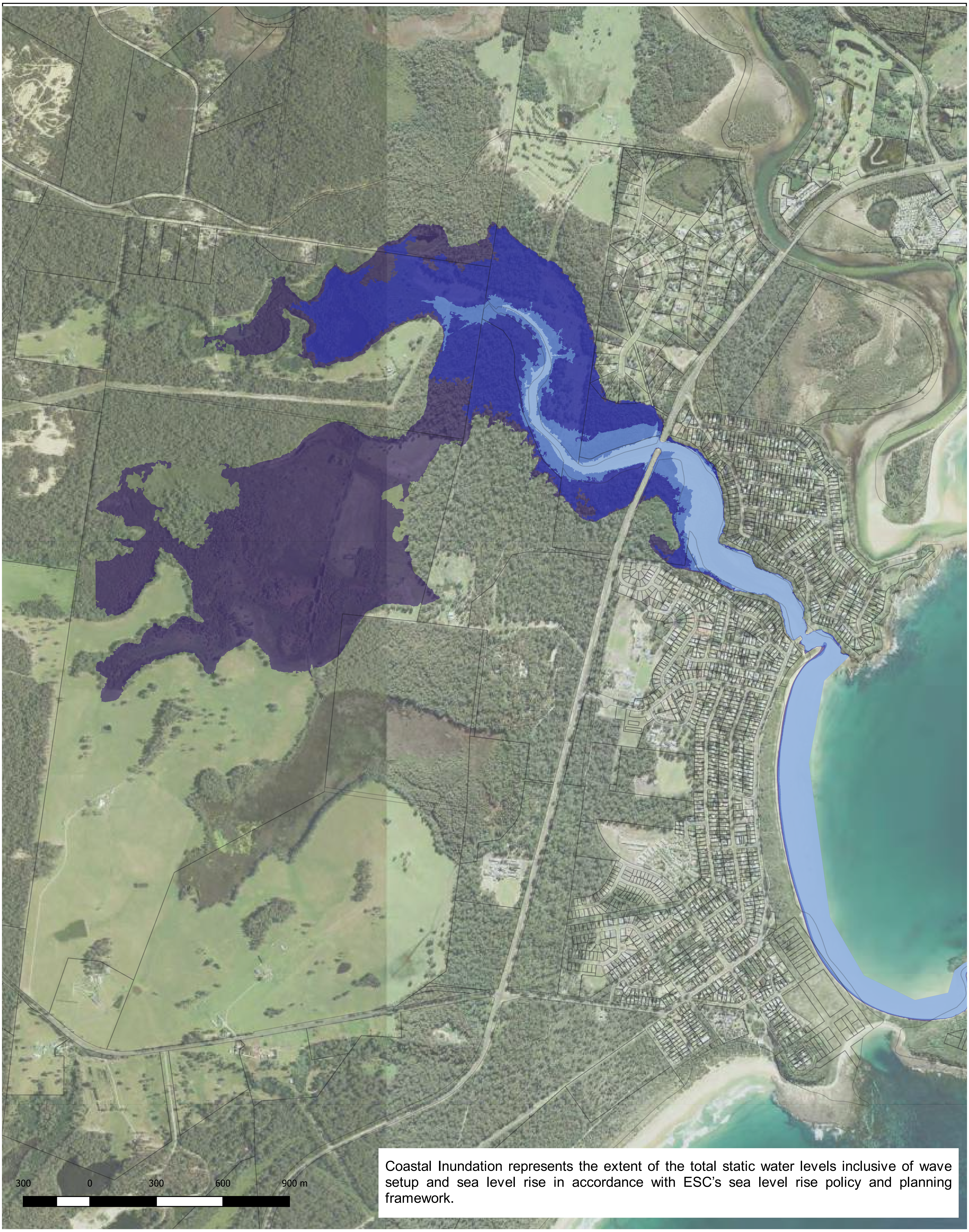
RG-05-02
Stage 2 Assessments
Coastal Inundation - 20 year ARI
Tomakin

Rhelm
engineering | environmental | economics | engagement

Scale : 1:1500@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend
- Coastal Inundation 100yr ARI 2017
- Coastal Inundation 100yr ARI 2050
- Coastal Inundation 100yr ARI 2065
- Coastal Inundation 100yr ARI 2100
- Wave Runup Extent 100 year ARI 2017
- Wave Runup Extent 100 year ARI 2100
- Additional Area Affected by Wave Runup 2017
- Additional Area Affected by Wave Runup 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 100 year ARI
Tomakin



Rhelm

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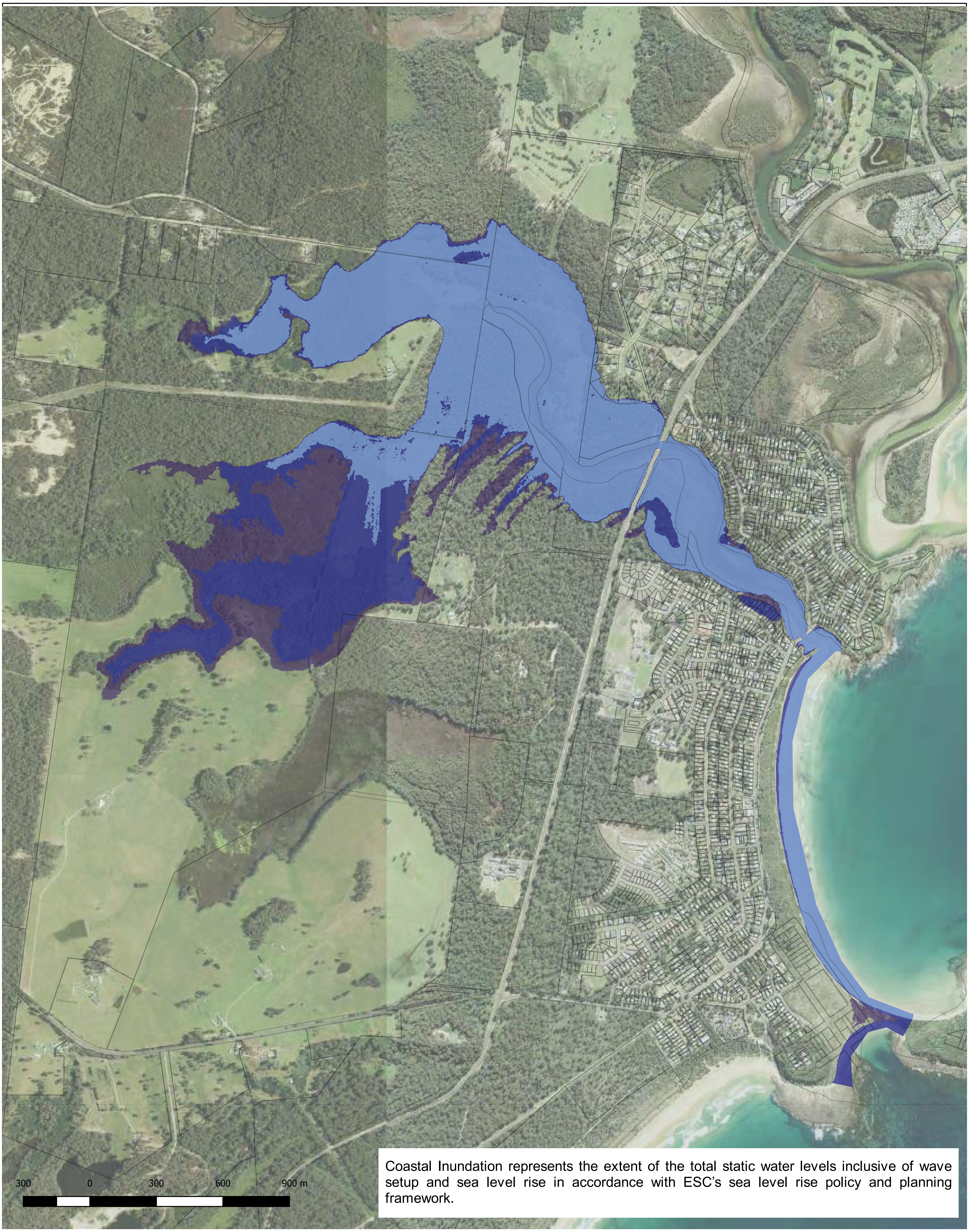
Scale : 1:15000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend

- Coastal Inundation 1yr ARI 2017
- Coastal Inundation 1yr ARI 2050
- Coastal Inundation 1yr ARI 2065
- Coastal Inundation 1yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 1 year ARI
Broulee



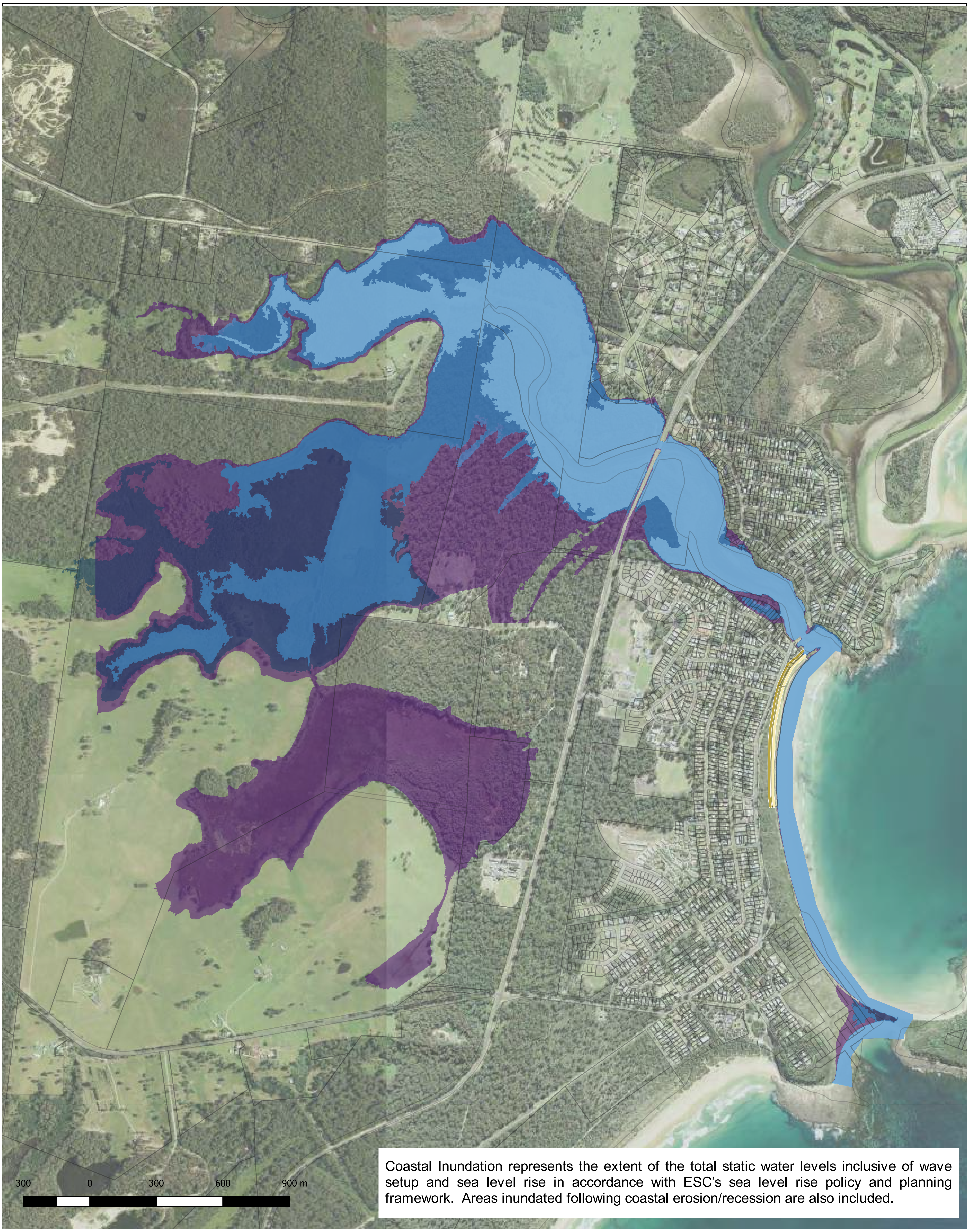
Rhelm
engineering | environmental | economics | engagement

Scale : 1:15000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend

- Coastal Inundation 20yr ARI 2017
- Coastal Inundation 20yr ARI 2050
- Coastal Inundation 20yr ARI 2065
- Coastal Inundation 20yr ARI 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 20 year ARI
Broulee



Coastal Inundation represents the extent of the total static water levels inclusive of wave setup and sea level rise in accordance with ESC's sea level rise policy and planning framework. Areas inundated following coastal erosion/recession are also included.

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Scale : 1:15000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend
- Coastal Inundation 100yr ARI 2017
- Coastal Inundation 100yr ARI 2050
- Coastal Inundation 100yr ARI 2065
- Coastal Inundation 100yr ARI 2100
- Wave Runup Extent 100 year ARI 2017
- Wave Runup Extent 100 year ARI 2100
- Additional Area Affected by Wave Runup 2017
- Additional Area Affected by Wave Runup 2100

RG-05-02
Stage 2 Assessments
Coastal Inundation - 100 year ARI
Broulee

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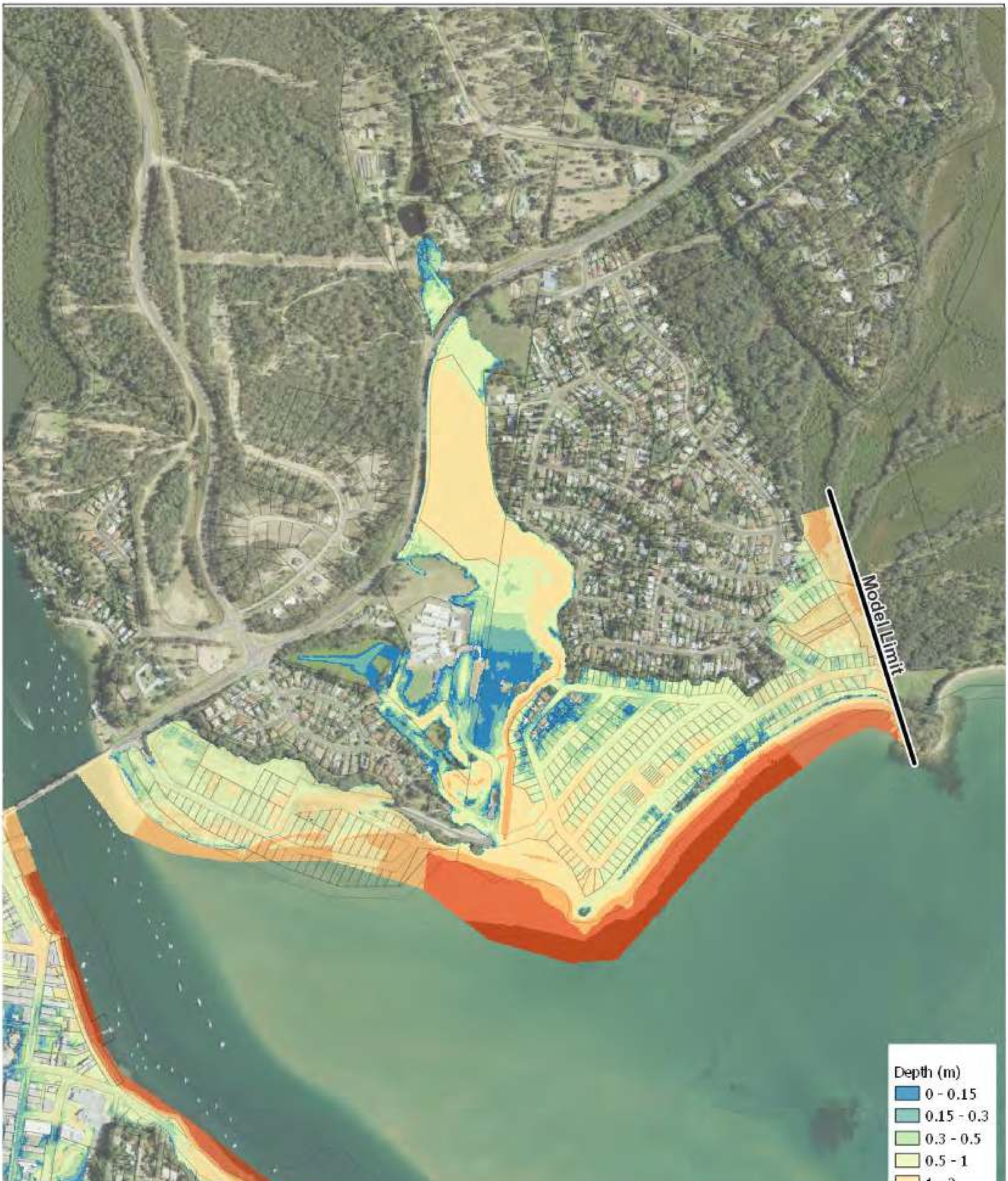
Scale : 1:8000@A3
Date : 22 November 2021
Revision : A
Created by : LRE
Coordinate System : MGA 94

RG-05-03
Stage 2 Assessments
Coastal Inundation Depths
2017 100 year ARI
Surfside



Rhelm

Scale : 1:5000@A3
Date : 22 November 2021
Revision : A
Created by : LRB
Coordinate System : MGA94

RG-05-03
Stage 2 Assessments
Coastal Inundation Depths
2100 100 year ARI
Surfside

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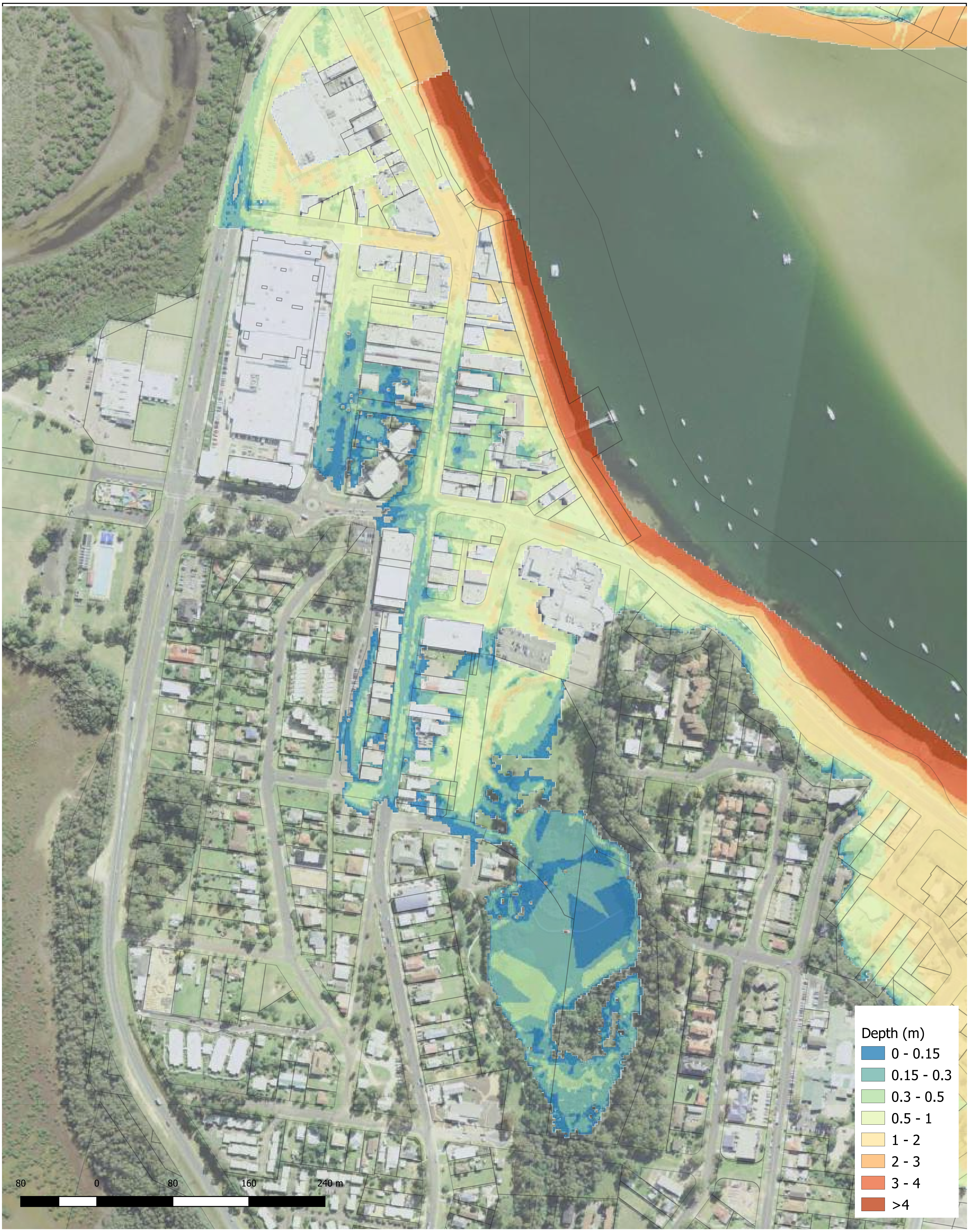
Scale : 1:3500@A3
Date : 22 November 2021
Revision : A
Created by : LRE
Coordinate System : MGA 94

RG-05-03
Stage 2 Assessments
Coastal Inundation Depths
2017 100 year ARI
CBD



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Scale : 1:3500@A3
Date : 22 November 2021
Revision : A
Created by : LRE
Coordinate System : MGA 94

RG-05-03
Stage 2 Assessments
Coastal Inundation Depths
2100 100 year ARI
CBD

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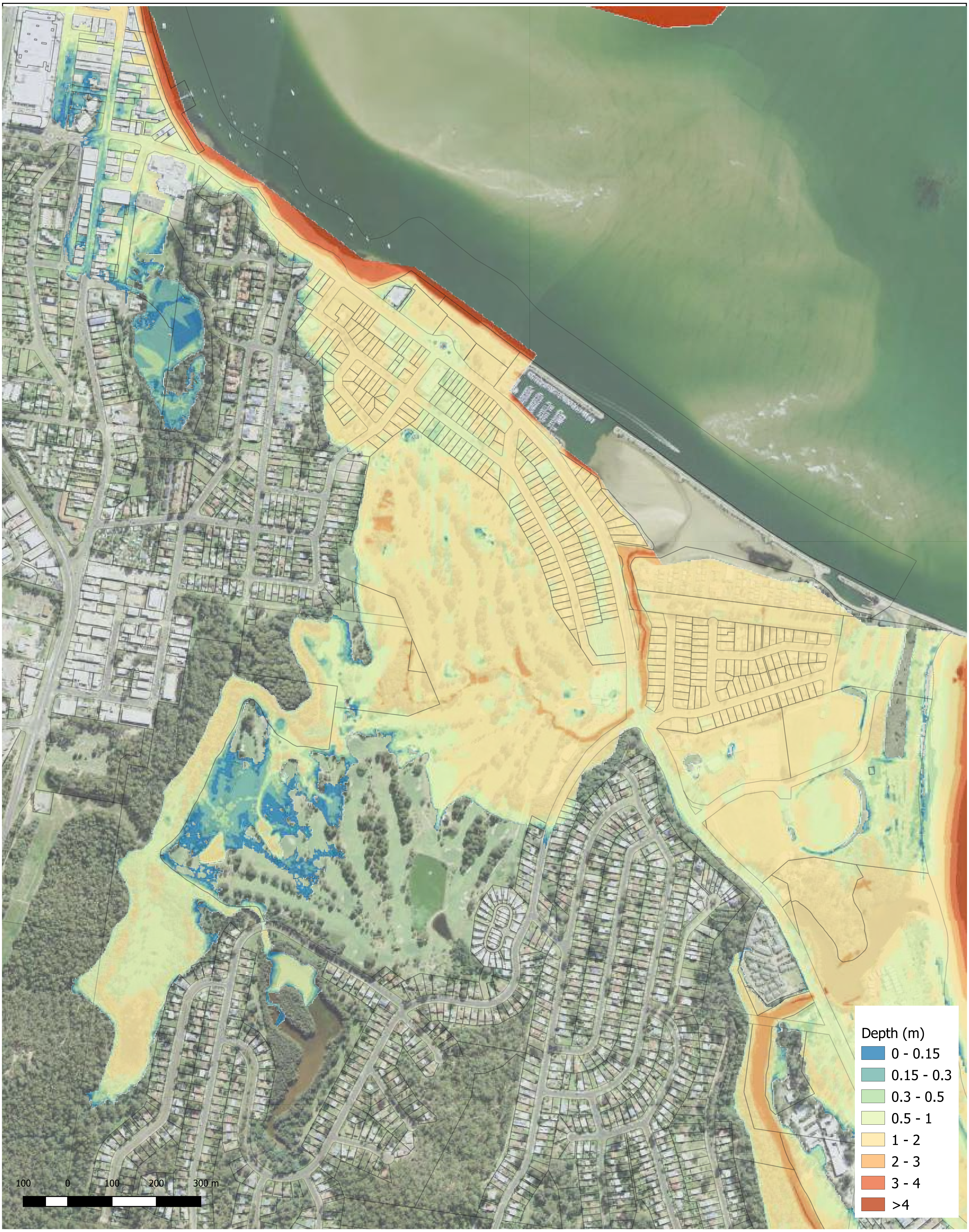
Scale : 1:7500@A3
Date : 22 November 2021
Revision : A
Created by : LRE
Coordinate System : MGA 94

RG-05-03
Stage 2 Assessments
Coastal Inundation Depths
2017 100 year ARI
Boat Harbour



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Scale : 1:7500@A3
Date : 22 November 2021
Revision : A
Created by : LRE
Coordinate System : MGA 94

RG-05-03
Stage 2 Assessments
Coastal Inundation Depths
2100 100 year ARI
Boat Harbour

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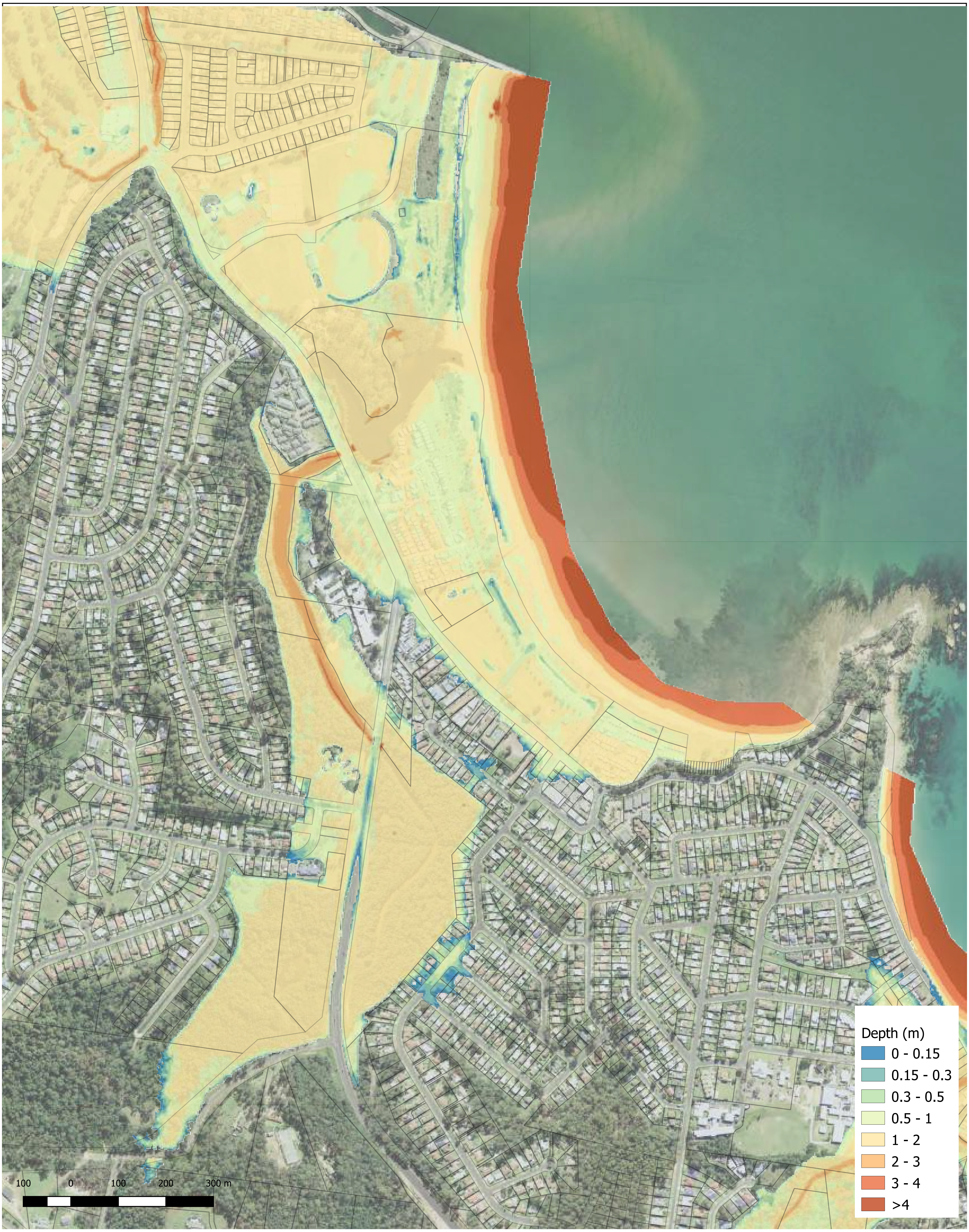
Scale : 1:7000@A3
Date : 22 November 2021
Revision : A
Created by : LRE
Coordinate System : MGA 94

RG-05-03
Stage 2 Assessments
Coastal Inundation Depths
2017 100 year ARI
Corrigans Beach



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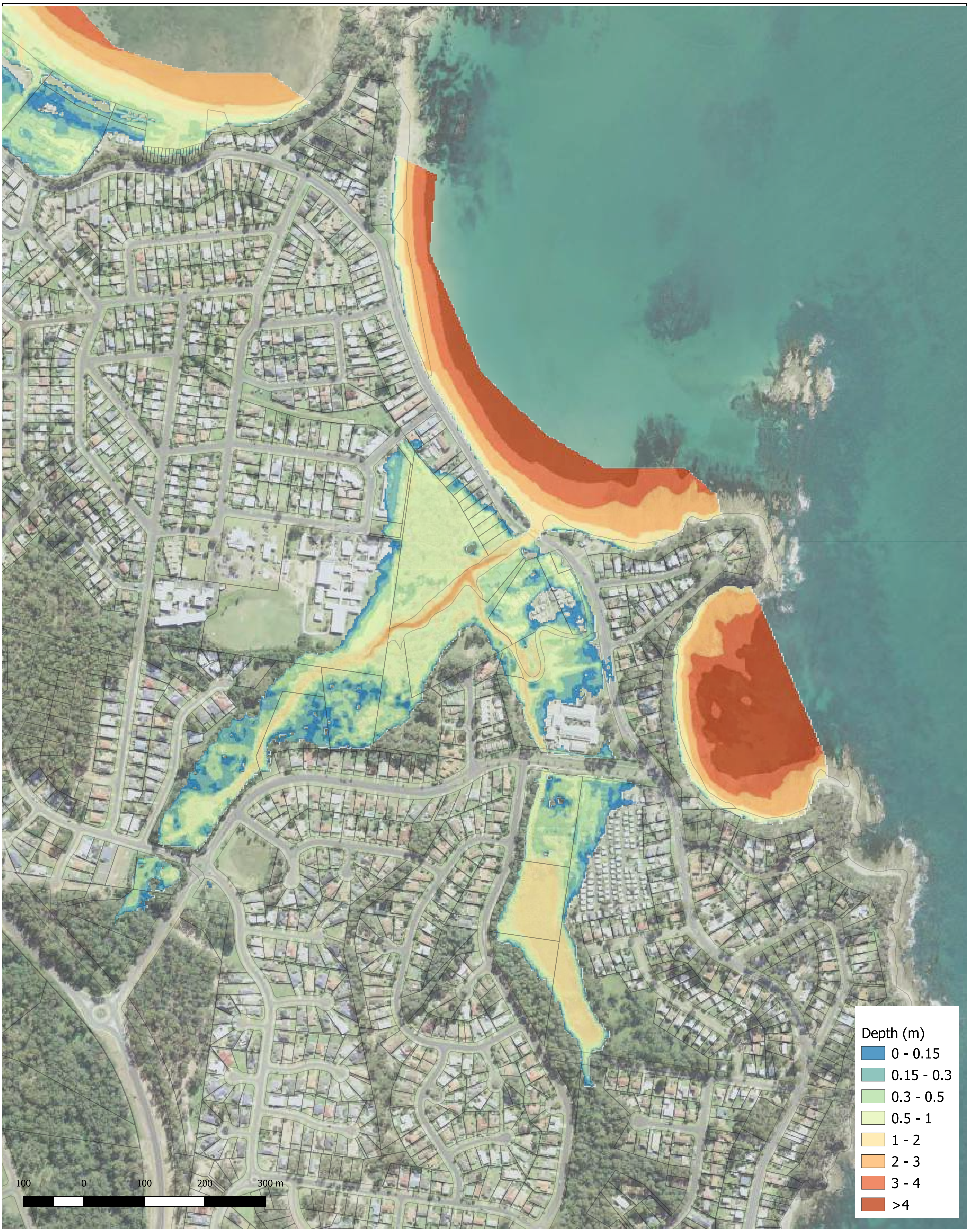
Scale : 1:7000@A3
Date : 22 November 2021
Revision : A
Created by : LRE
Coordinate System : MGA 94

RG-05-03
Stage 2 Assessments
Coastal Inundation Depths
2100 100 year ARI
Corrigans Beach



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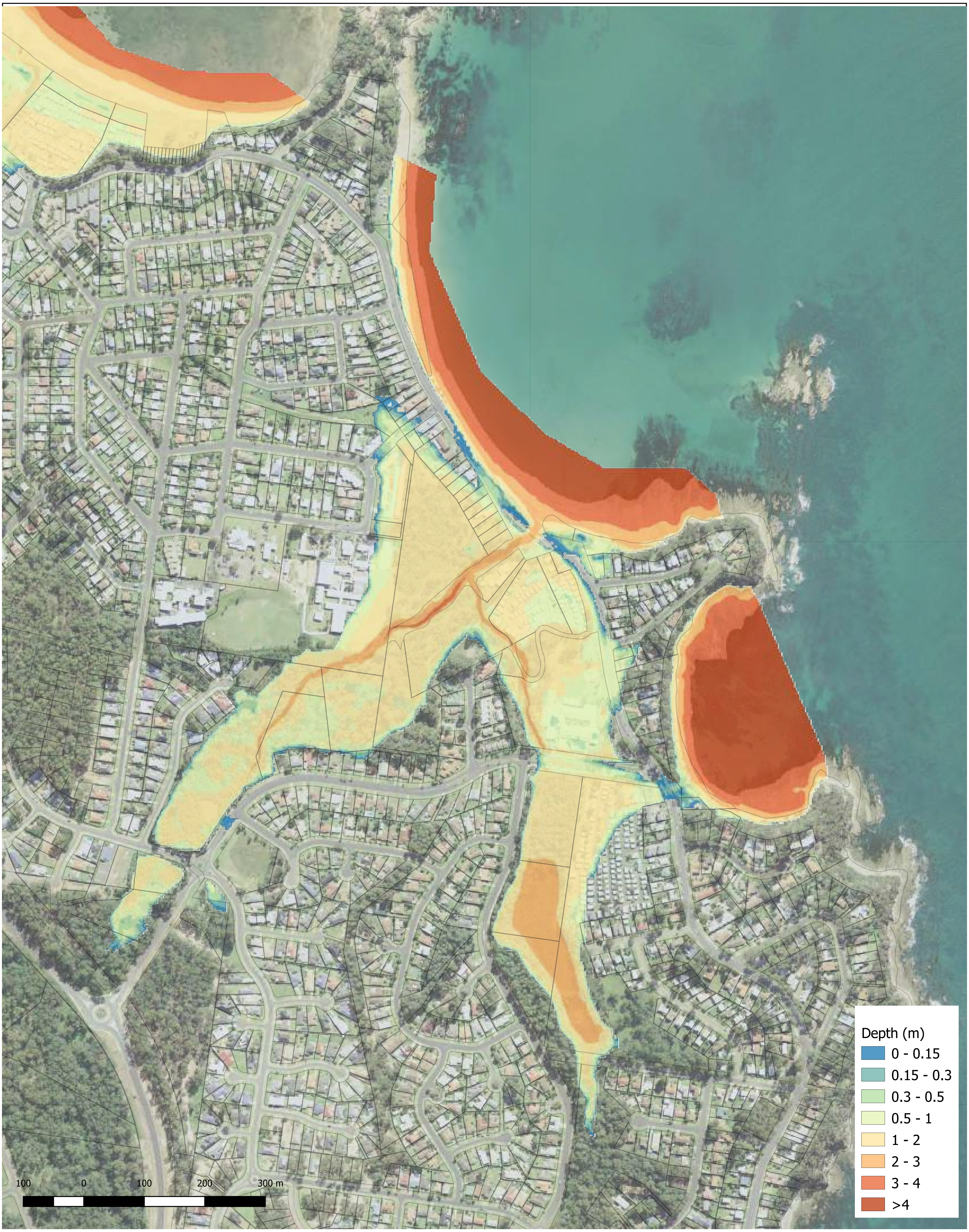
Scale : 1:5500@A3
Date : 22 November 2021
Revision : A
Created by : LRE
Coordinate System : MGA 94

RG-05-03
Stage 2 Assessments
Coastal Inundation Depths
2017 100 year ARI
Sunshine Bay



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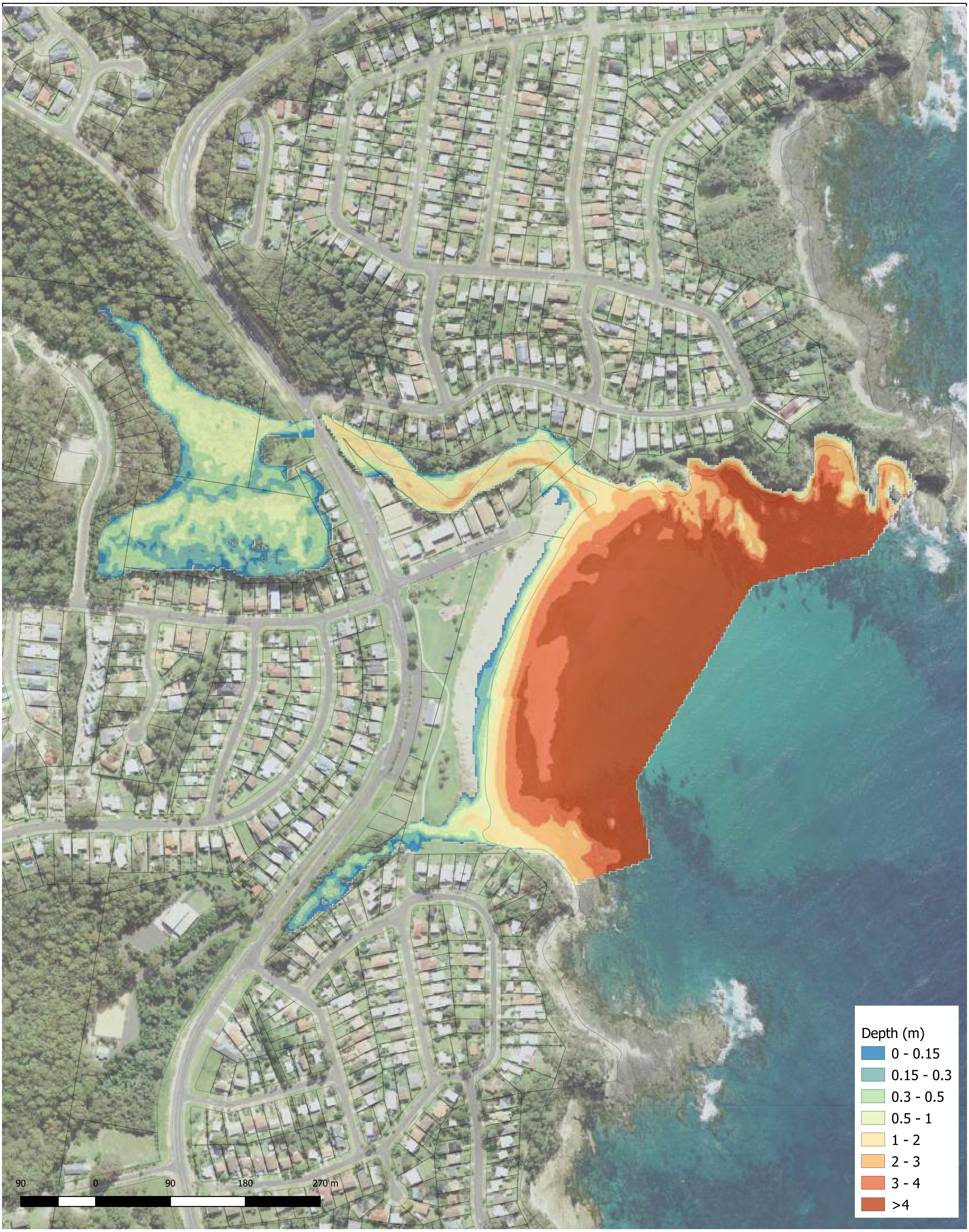
Scale : 1:5500@A3
Date : 22 November 2021
Revision : A
Created by : LRE
Coordinate System : MGA 94

RG-05-03
Stage 2 Assessments
Coastal Inundation Depths
2100 100 year ARI
Sunshine Bay



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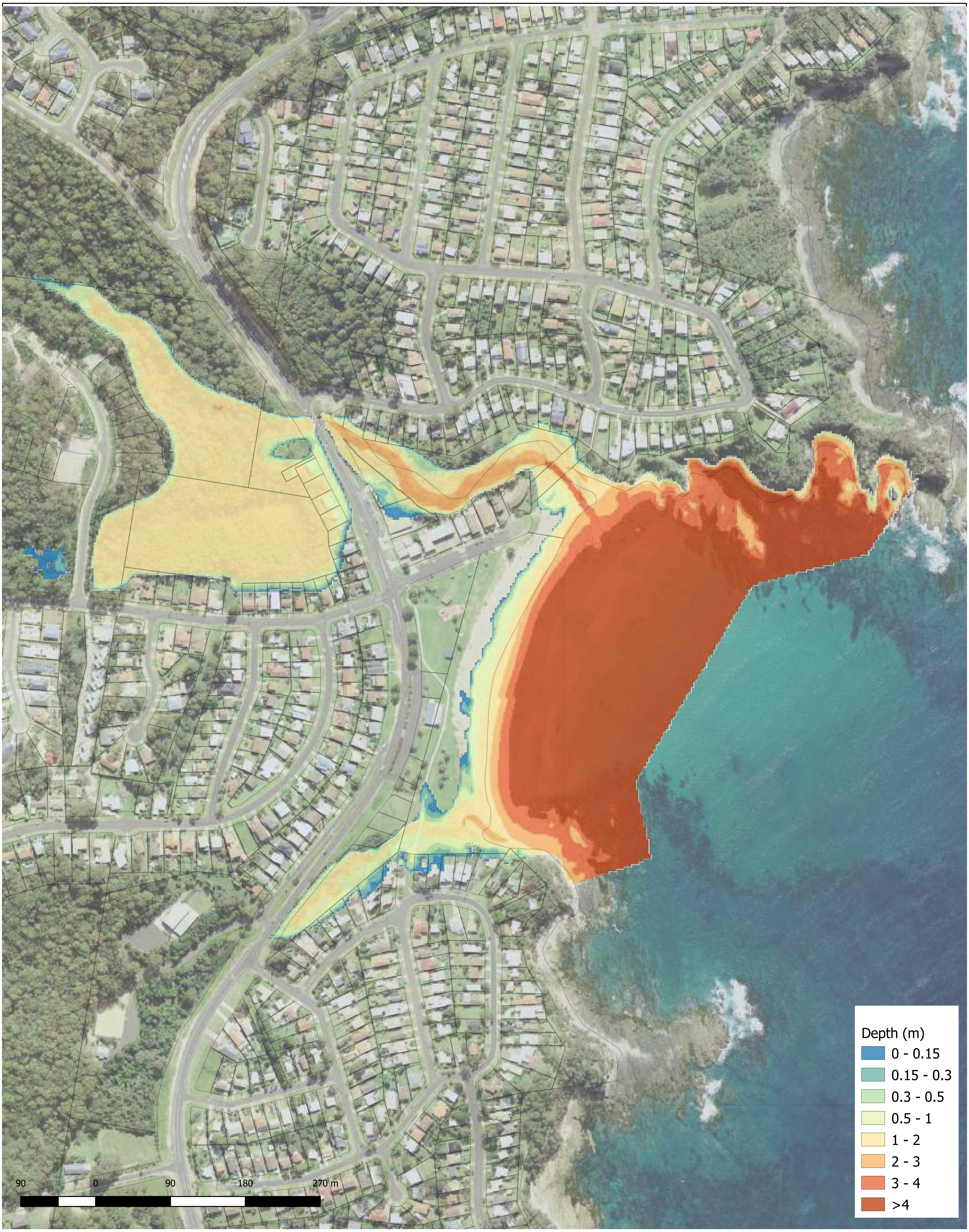
Scale : 1:4000@A3
Date : 22 November 2021
Revision : A
Created by : LRE
Coordinate System : MGA 94

RG-05-03
Stage 2 Assessments
Coastal Inundation Depths
2017 100 year ARI
Malua Bay



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Scale : 1:4000@A3
Date : 22 November 2021
Revision : A
Created by : LRE
Coordinate System : MGA 94

RG-05-03
Stage 2 Assessments
Coastal Inundation Depths
2100 100 year ARI
Malua Bay

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Scale : 1:8000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend

- Coincident Inundation with 100yr ARI 2017 Ocean
- Coincident Inundation with 100yr ARI 2050 Ocean
- Coincident Inundation with 100yr ARI 2065 Ocean
- Coincident Inundation with 100yr ARI 2100 Ocean

RG-05-04
Stage 2 Assessments
Coincident Inundation
20 Year ARI Catchment / 100 year ARI Ocean
Long Beach

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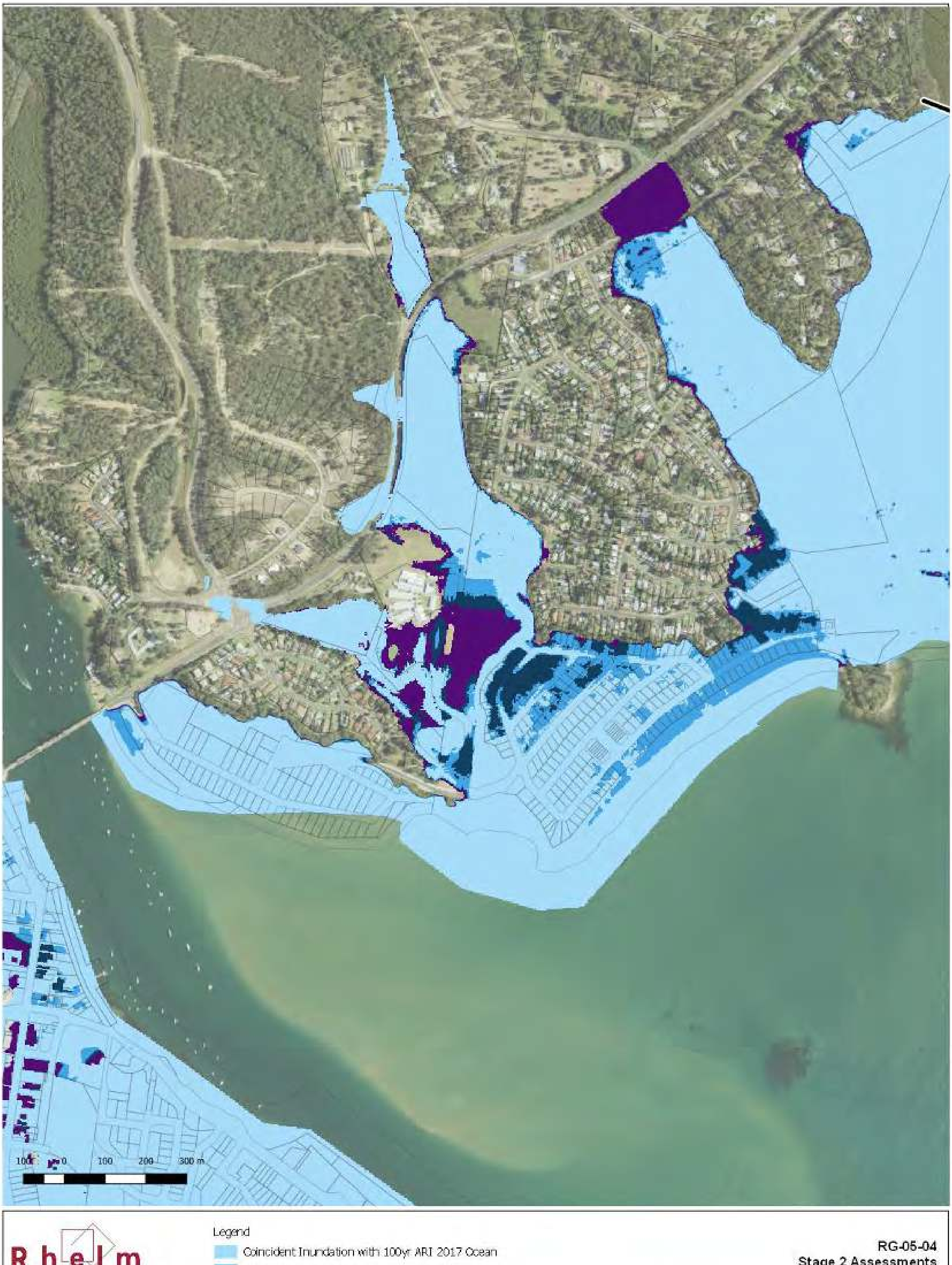
Scale : 1:8000@A3
Date : 18 November 2021
Revision : B
Created by : LRE
Coordinate System : MGA 94

Legend
- Coincident Inundation with 100yr ARI 2017 Ocean
- Coincident Inundation with 100yr ARI 2050 Ocean
- Coincident Inundation with 100yr ARI 2065 Ocean
- Coincident Inundation with 100yr ARI 2100 Ocean

RG-05-04
Stage 2 Assessments
Coincident Inundation
PMF Catchment / 100 year ARI Ocean
Long Beach



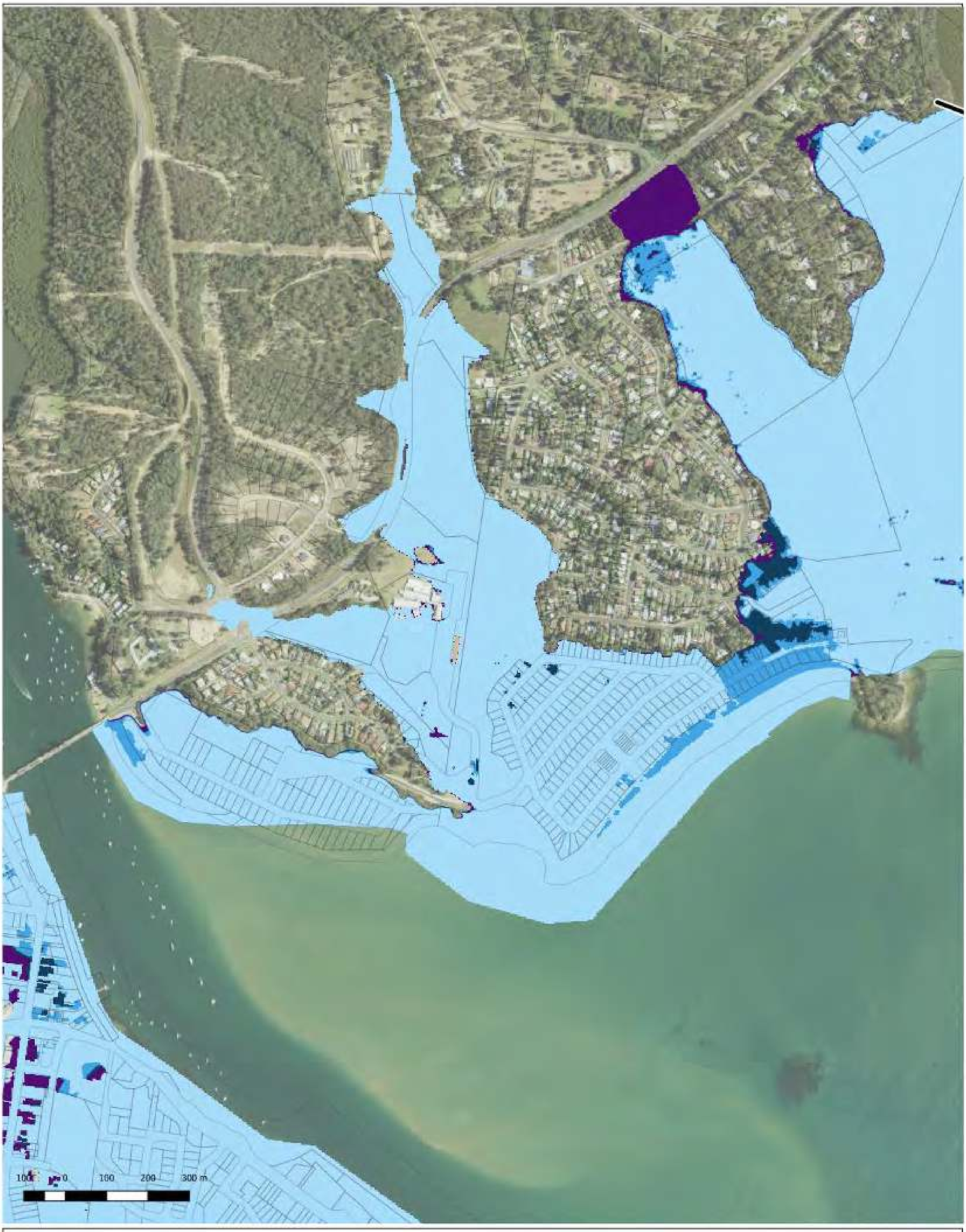
Rhelm

Scale : 1:8000@A3
Date : 18 November 2021
Revision : B
Created By : LRB
Coordinate System : MGA 94

Legend

- Coincident Inundation with 100yr ARI 2017 Ocean
- Coincident Inundation with 100yr ARI 2050 Ocean
- Coincident Inundation with 100yr ARI 2065 Ocean
- Coincident Inundation with 100yr ARI 2100 Ocean

RG-05-04
Stage 2 Assessments
Coincident Inundation
20 Year ARI Catchment / 100 year ARI Ocean
Surfside



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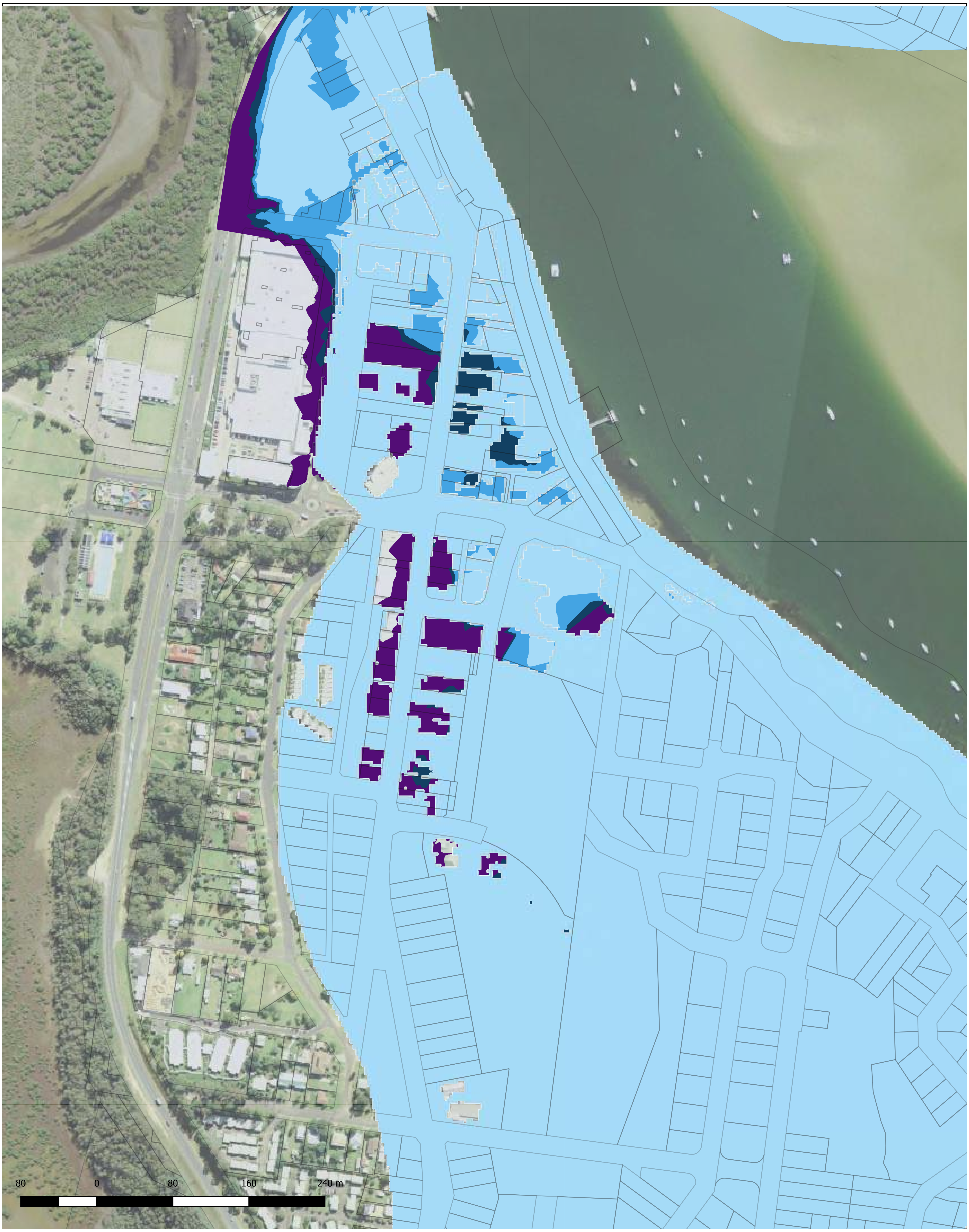
Scale : 1:8000@A3
Date : 18 November 2021
Revision : B
Created by : LRB
Coordinate System : MGA94

Legend

- Coincident Inundation with 100yr ARI 2017 Ocean
- Coincident Inundation with 100yr ARI 2050 Ocean
- Coincident Inundation with 100yr ARI 2065 Ocean
- Coincident Inundation with 100yr ARI 2100 Ocean

RG-05-04
Stage 2 Assessments
Coincident Inundation
PMF Catchment / 100 year ARI Ocean
Surfside



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Coincident Inundation
20 Year ARI Catchment / 100 year ARI Ocean
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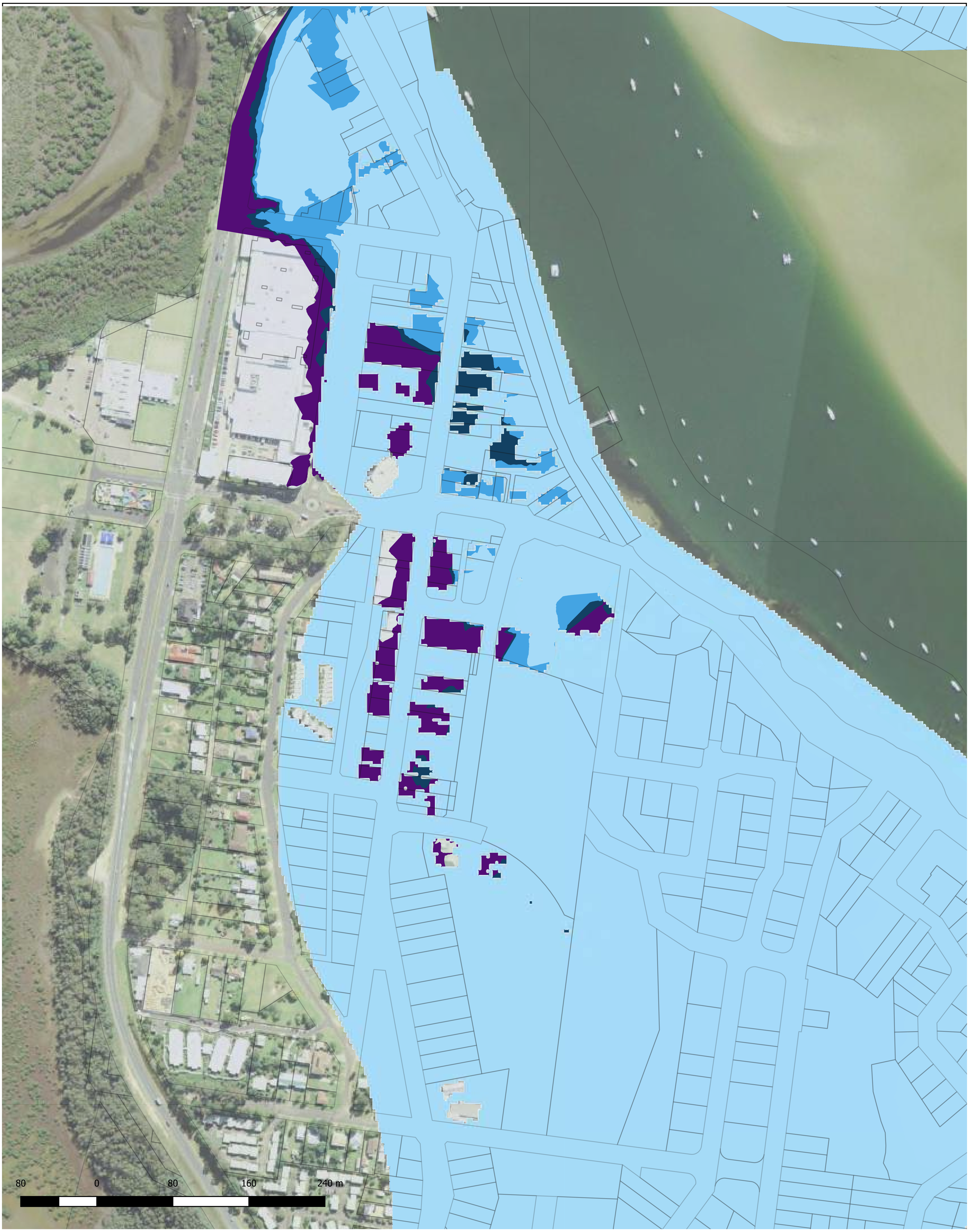

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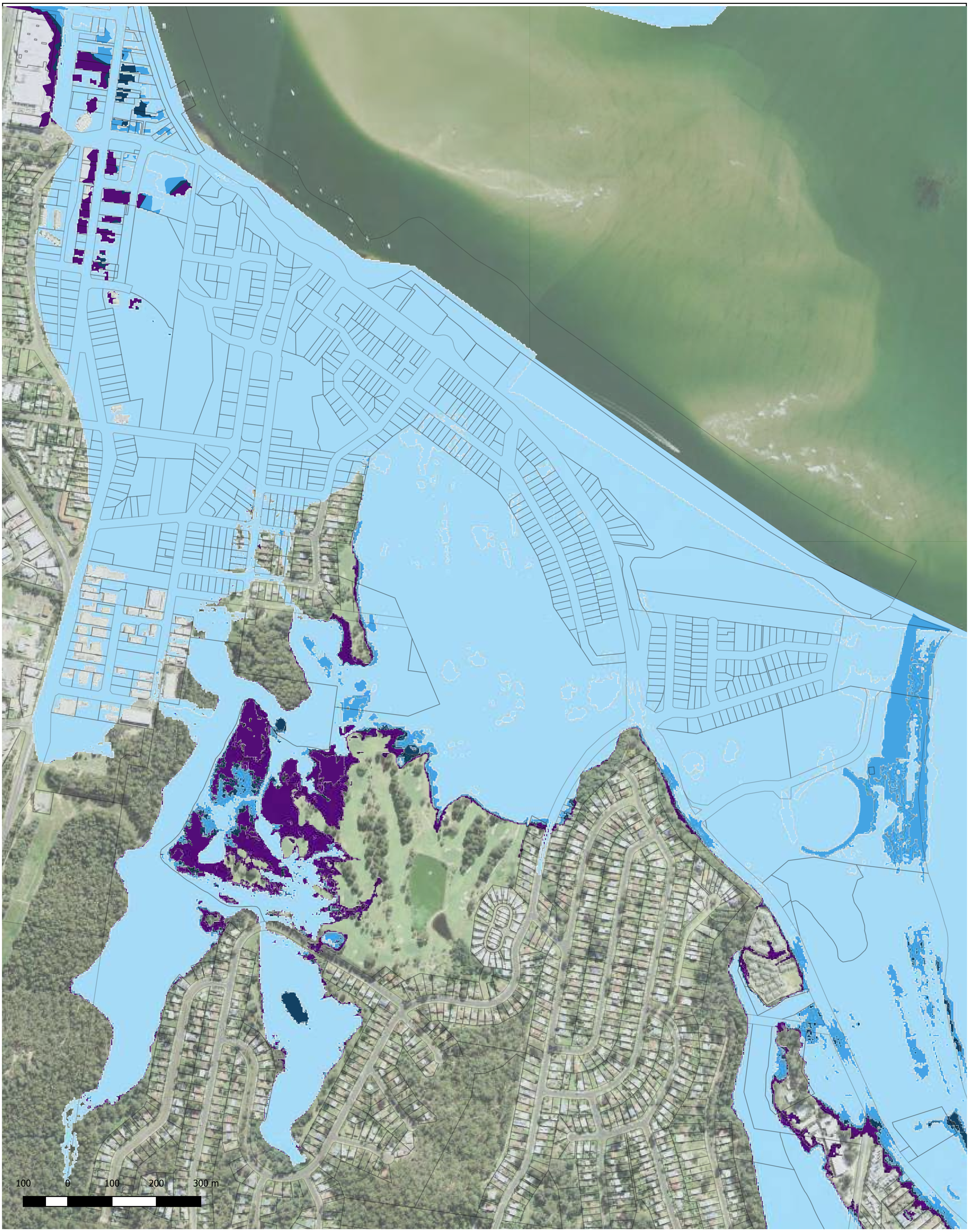

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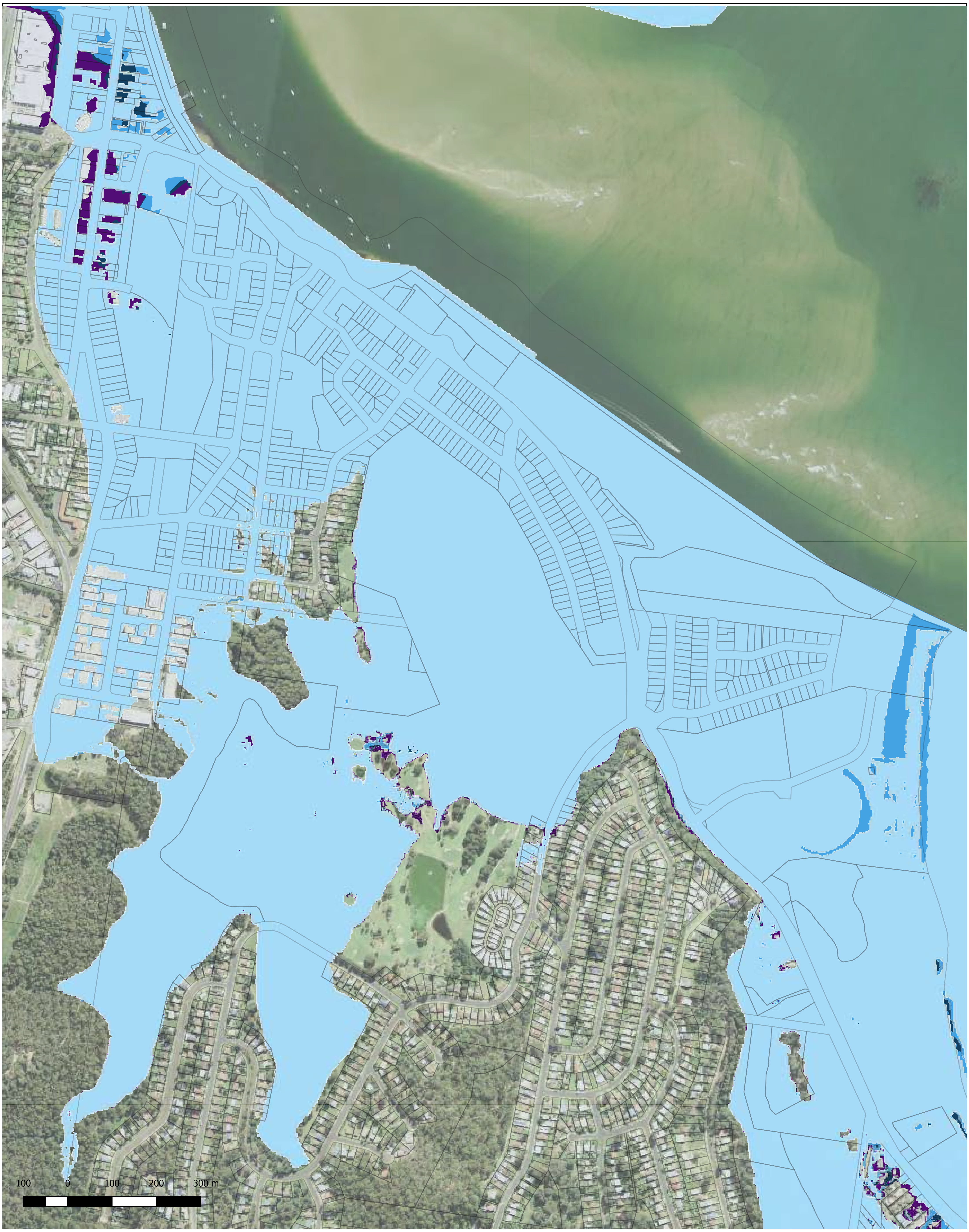
RG-05-04
Stage 2 Assessments
Coincident Inundation
20 Year ARI Catchment / 100 year ARI Ocean
Boat Harbour



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Stage 2 Assessments
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PMF Catchment / 100 year ARI Ocean
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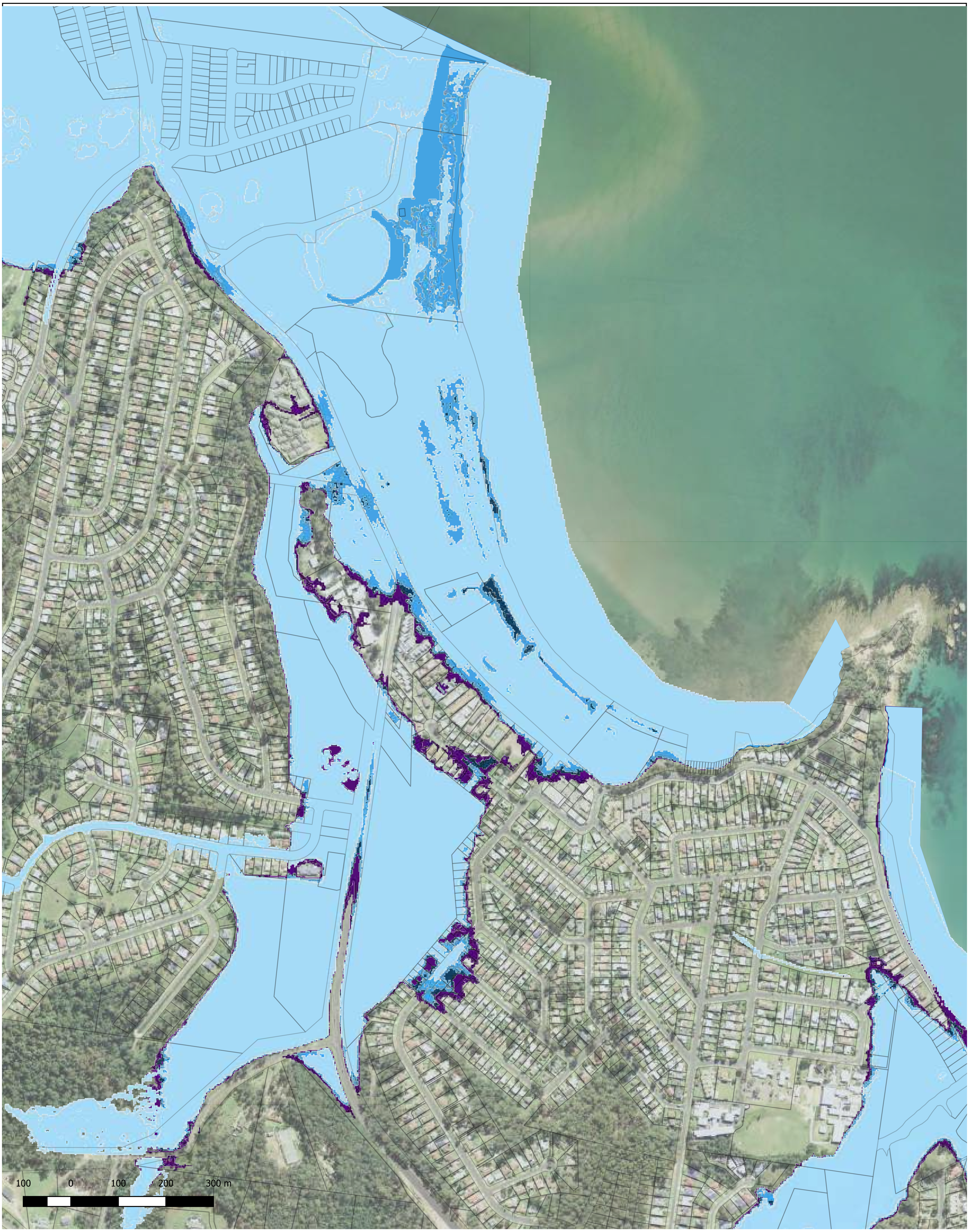

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Stage 2 Assessments
Coincident Inundation
20 Year ARI Catchment / 100 year ARI Ocean
Corrigans Beach

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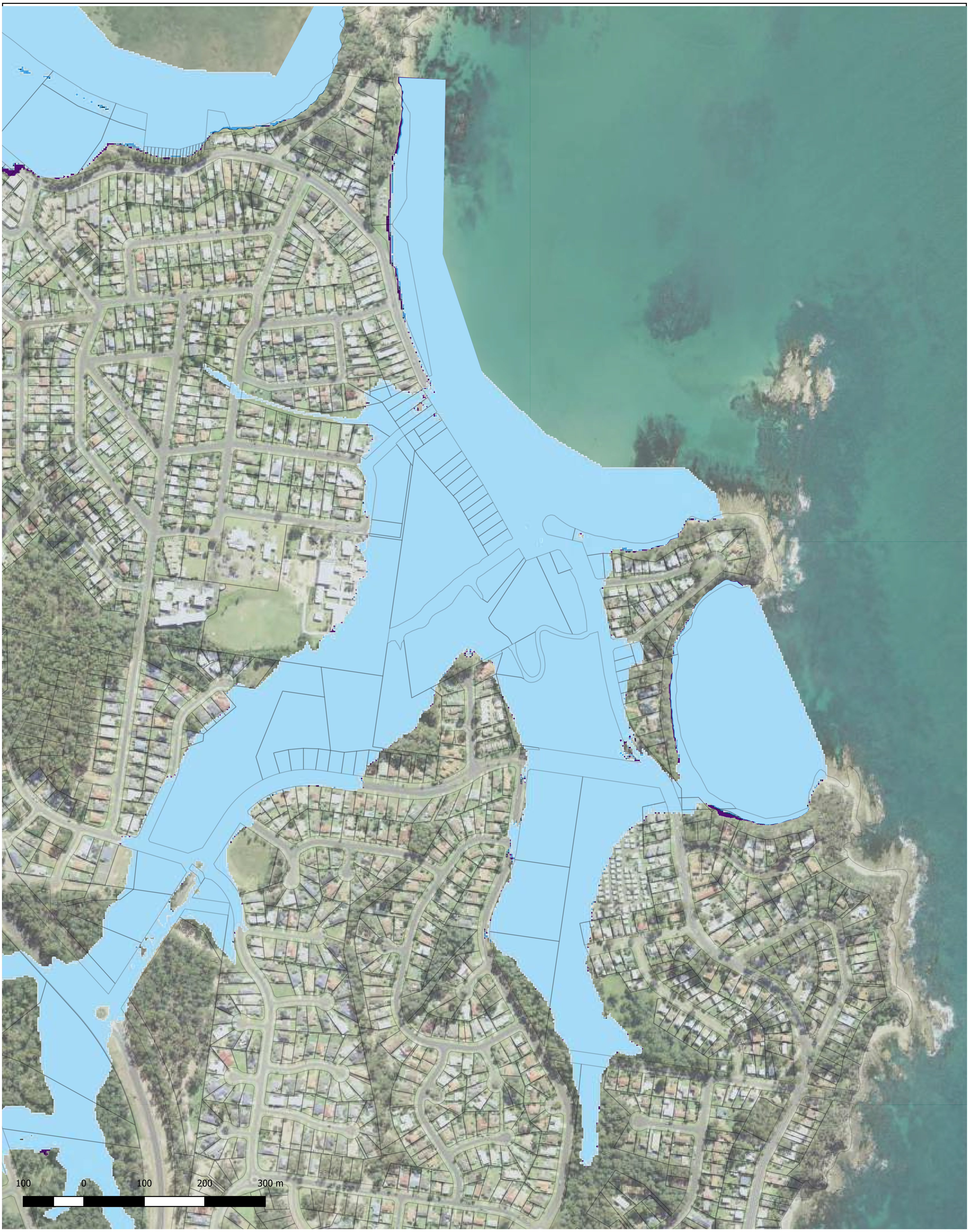
RG-05-04
Stage 2 Assessments
Coincident Inundation
20 Year ARI Catchment / 100 year ARI Ocean
Sunshine Bay



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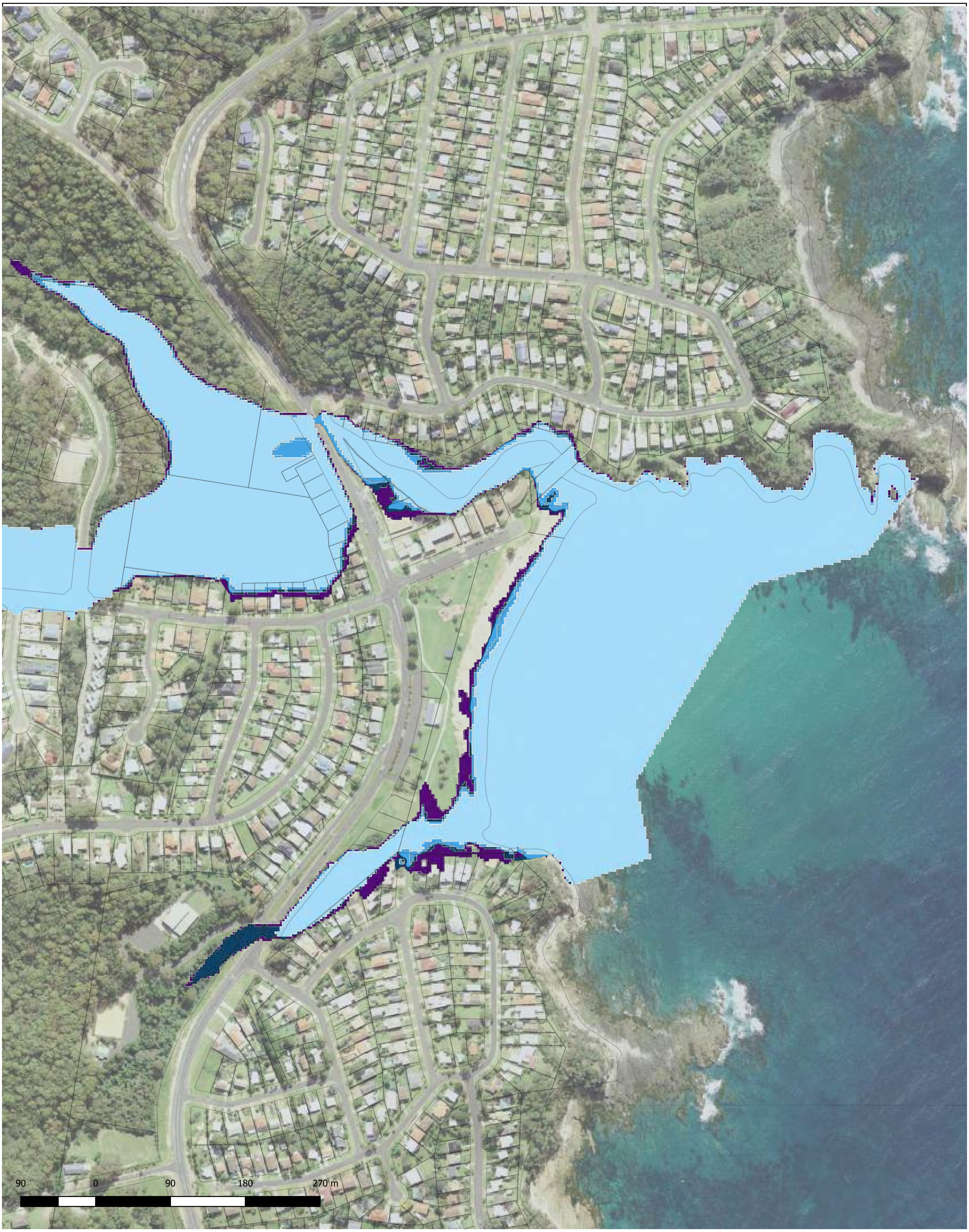
RG-05-04
Stage 2 Assessments
Coincident Inundation
PMF Catchment / 100 year ARI Ocean
Sunshine Bay



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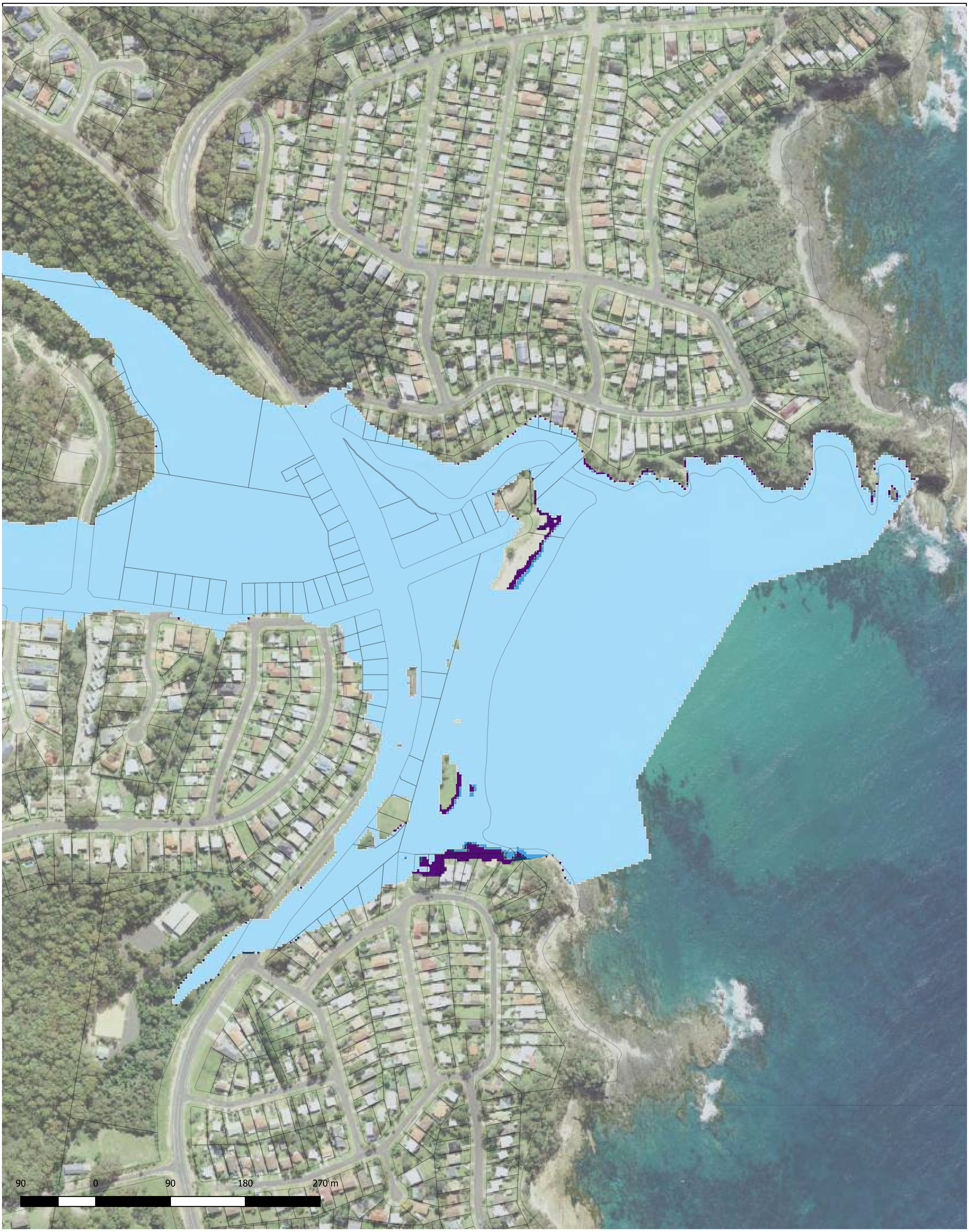
Stage 2 Assessments
Coincident Inundation
20 Year ARI Catchment / 100 year ARI Ocean
Malua Bay



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Malua Bay

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Stage 2 Assessments
Coincident Inundation
20 Year ARI Catchment / 100 year ARI Ocean
Tomakin

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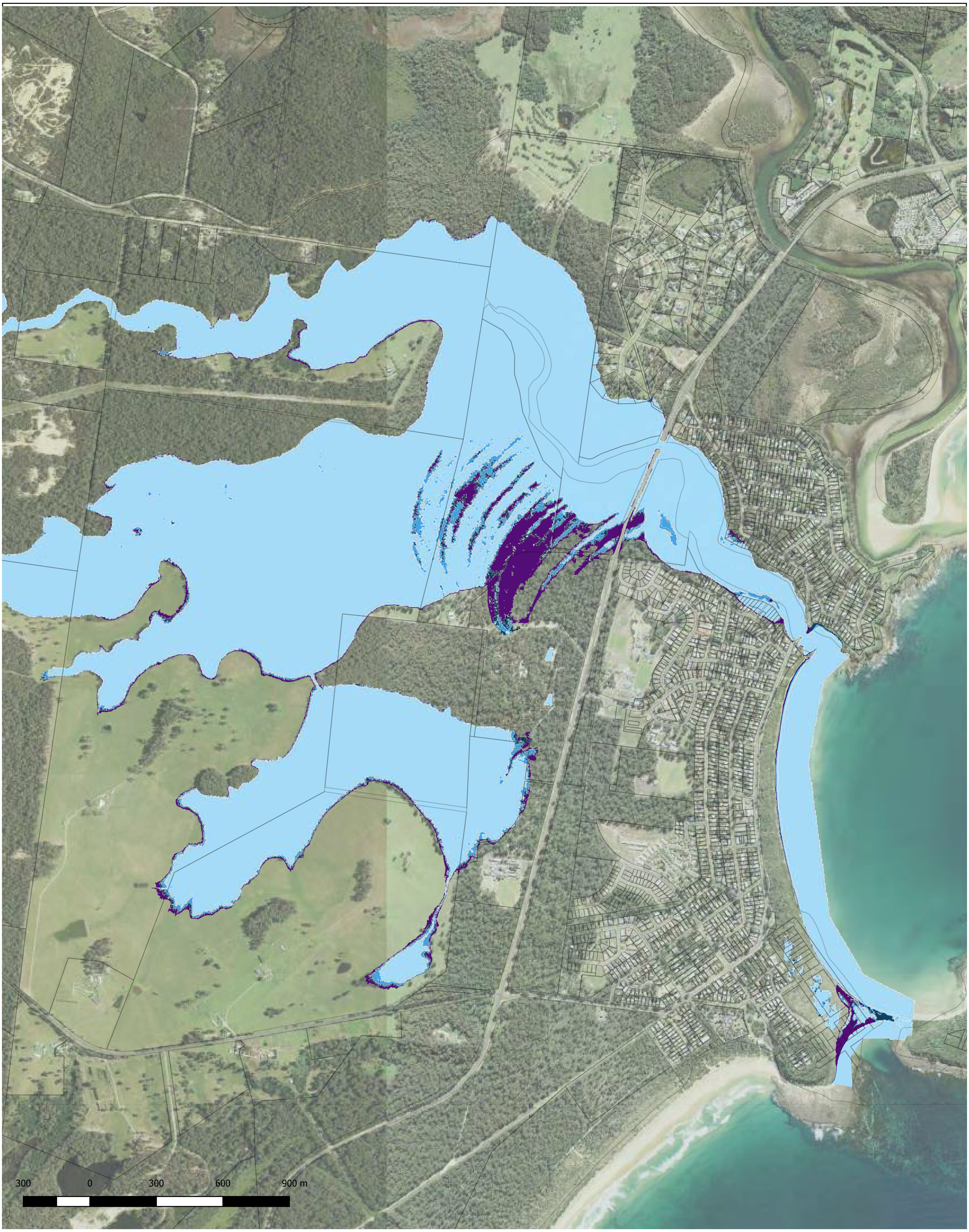

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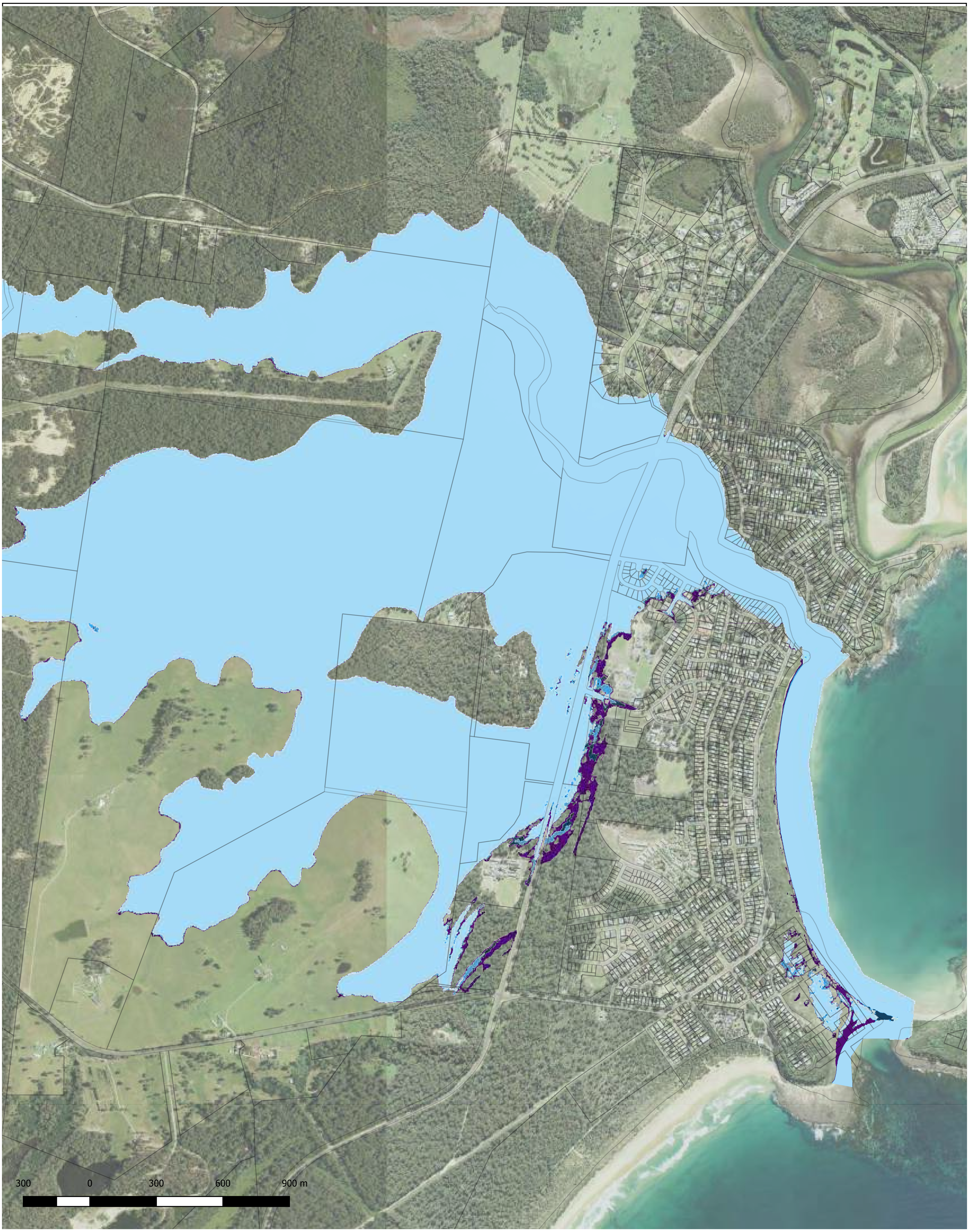
RG-05-04
Stage 2 Assessments
Coincident Inundation
20 Year ARI Catchment / 100 year ARI Ocean
Broulee



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RG-05-04
Stage 2 Assessments
Coincident Inundation
PMF Catchment / 100 year ARI Ocean
Broulee

Appendix A

Geotechnical Investigation Report (PSM, 2021)

Eurobodalla's Open Coast Coastal Management Plan

Geotechnical Investigation Report

PSM4238-005R REV 1 1 December 2021

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1. Introduction

This report presents the results of geotechnical services undertaken to support development of the Eurobodalla Shire Council's (Council) Open Coast Coastal Management Plan (CMP). Pells Sullivan Meynink (PSM) was engaged by Rhelm Pty Ltd (Rhelm) to undertake the geotechnical services component of work. Rhelm have been engaged by Council to finalise the Eurobodalla's Open Coast CMP as per the technical brief[1].

The geotechnical services requested relate to the investigation of three beach sites along the Eurobodalla Shire Council coast, namely, Long Beach, Surfside, and Tomakin (the sites). Results of the geotechnical investigation will be used as input for the probabilistic erosion and recession estimates within the Vulnerability Assessment stage of the open coast CMP.

This document presents the results of a desk-study and geotechnical investigation of the sites. A preliminary geotechnical model of each site is provided. Suggestions for further investigations are provided.

2. Scope of Work

The scope of work was set by Council and comprised:

- Stage 1 – Desk study
- Stage 2 – Non-Intrusive Field Investigation:
  - Engineering geological field mapping
  - Geophysical investigations.
- Stage 3 - Compilation of a simplified geotechnical model.

3. Desk Study

3.1 Introduction

A desk study forms the basis for the conceptual model of a site and considers geology, geomorphology, hydrogeology and surface processes. The conceptual models formulated for the sites in this study focus on the following:

- Coastal processes and interactions
- Review of possible subsurface conditions underlying the site based on an assessment of the terrain and landforms, and
- Identification of data gaps.

As part of the desk study, the following data and documents were reviewed:

- Geological maps and associated notes
- Geographical information systems (GIS) data, and
- Available elevation data including LiDAR and bathymetry.

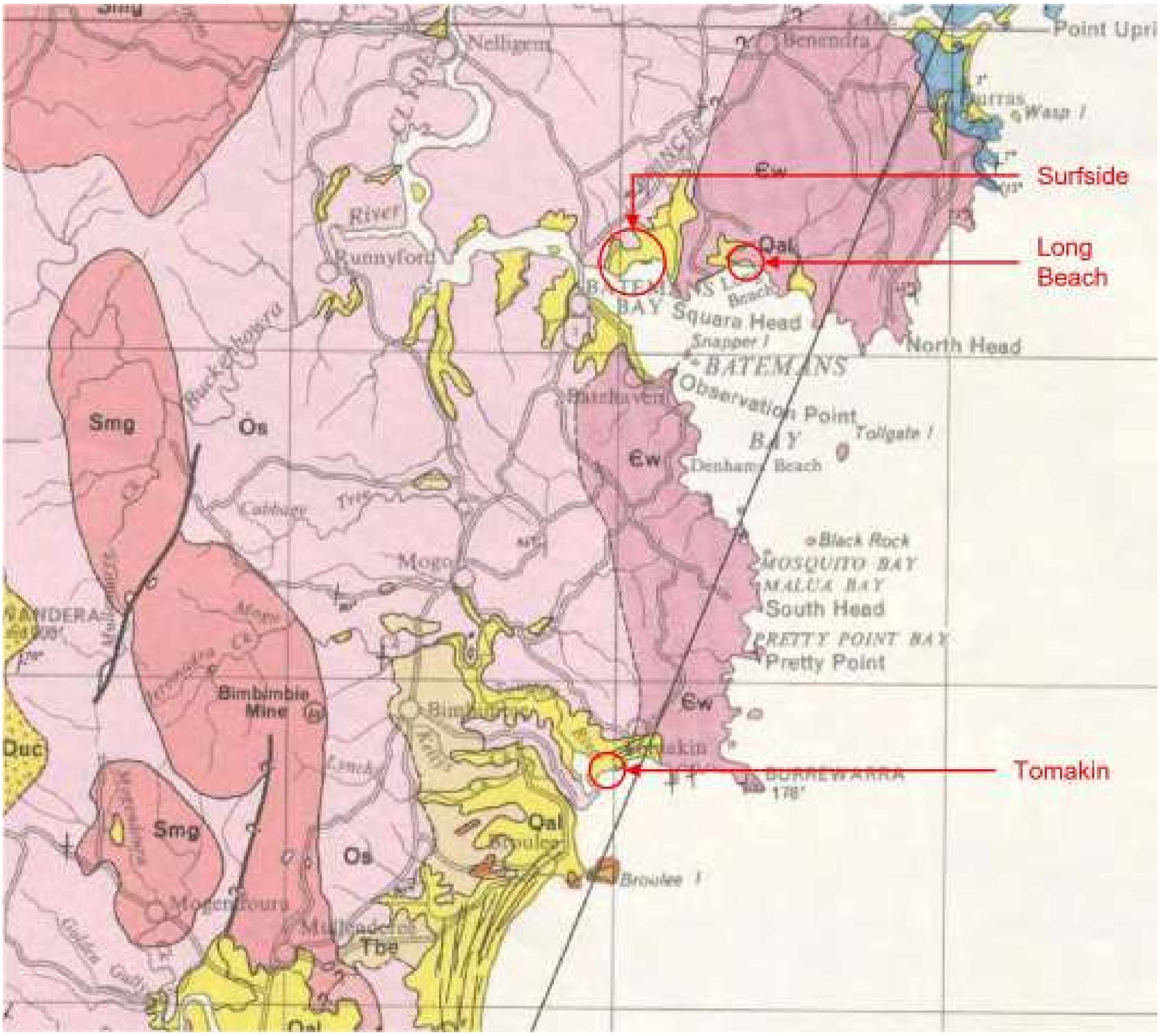
The aim of the resultant conceptual model was to guide the field mapping program, and subsequently be tested and validated against the on-site observations. Figures from the desk study are presented in Appendix A and discussed below.

3.2 Geological Setting

The 1:250,000 Ulludulla Geological Map shows that the basement geology underlying the sites encompasses rocks of the Lachlan Orogen, and described as follows, Inset 1:

- Adaminaby Group, (Os) – siltstone, claystone, sandstone, quartzite, chert
- Wagonga Group, (Ɛw) – chert, conglomerate, agglomerate, slate, sandstone, phyllite.

[1] Eurobodalla Shire Council Technical Brief: Eurobodalla's Open Coast CMP; brief issued July 2020



Inset 1: **Ulludulla 1:250,000 (Rose, 1966). The site locations are approximated by the red circles and associated annotations.**

Both the Adaminaby and Wagonga Groups form part of the Narooma Accretionary Complex. The rocks of the Adaminaby Group have been folded along meridional axes and dips of the bedding rarely exceed 70°. The folding in these rocks has produced a slaty cleavage and bedding has substantially been obscured. Sediments of the Wagonga Group generally dip sub-vertically and strike north-south. The geological maps shows that the basement rocks are overlain by thick Quaternary deposits (Qal).

3.3 Terrain Evaluation

3.3.1 Overview

Development of a conceptual model for the sites is based on a remote sensing assessment of the terrain using GIS methods. Terrain evaluation is a form of engineering geomorphology that uses principles of mapping and classification to sub-divide the landscape into a series of smaller and more detailed hierarchical groups, typically comprising (from largest to smallest):

- Land systems
- Land facets, and
- Land elements.

These groups are assigned physical attributes based on the geomorphological processes that formed them and the underlying bedrock geology. It is a particularly useful technique where there is limited sub-surface geotechnical data.

Terrain evaluation aims to develop a conceptual engineering geological model of a site to understand the spatial distribution and relationship between each identified land facet as well as to infer the extent, thickness and engineering geological characteristics of sub-surface materials.

3.3.2 Terrain Classification

Digital elevation models (DEMs) were generated from LiDAR and bathymetry data obtained from public repositories[2], and were used to undertake the terrain mapping and classification. The mapped terrain classification plans for each respective site are shown in Insets 2 to 4, and all terrain classification figures included in Appendix A.

Three broad land systems are identified across the sites:

- Estuarine – drowned valley system comprising tidal rivers depositing into saline waters
- Marine – shoreline systems comprising sediments deposited by wind, wave, and tidal processes
- Uplands – general geomorphic system at higher elevations than the coastal plain, comprising weathered bedrock overlain by surficial deposits predominantly deposited by mass wasting processes (i.e., gravity).

A total of eight land facets are identified across the sites. Table 1 presents a description of the landforms and their anticipated engineering geological characteristics.

3.4 Publicly Available Data

Publicly available sources were reviewed to identify potential data that may supplement the conceptual models. The most useful public source was WaterNSW through their real-time data website[3]. The WaterNSW database was reviewed for borehole records proximal to each of the sites, particularly with regards to drillers logs if available.

Where boreholes contained drillers logs with notes on the materials encountered during drilling, these were used to inform the conceptual model. It is important to note that drillers logs are not technical logs, are often subjective and are based on the operator's experience. For the purposes of informing the conceptual models, the drillers logs are therefore considered as being anecdotal and assessed as having a low confidence.

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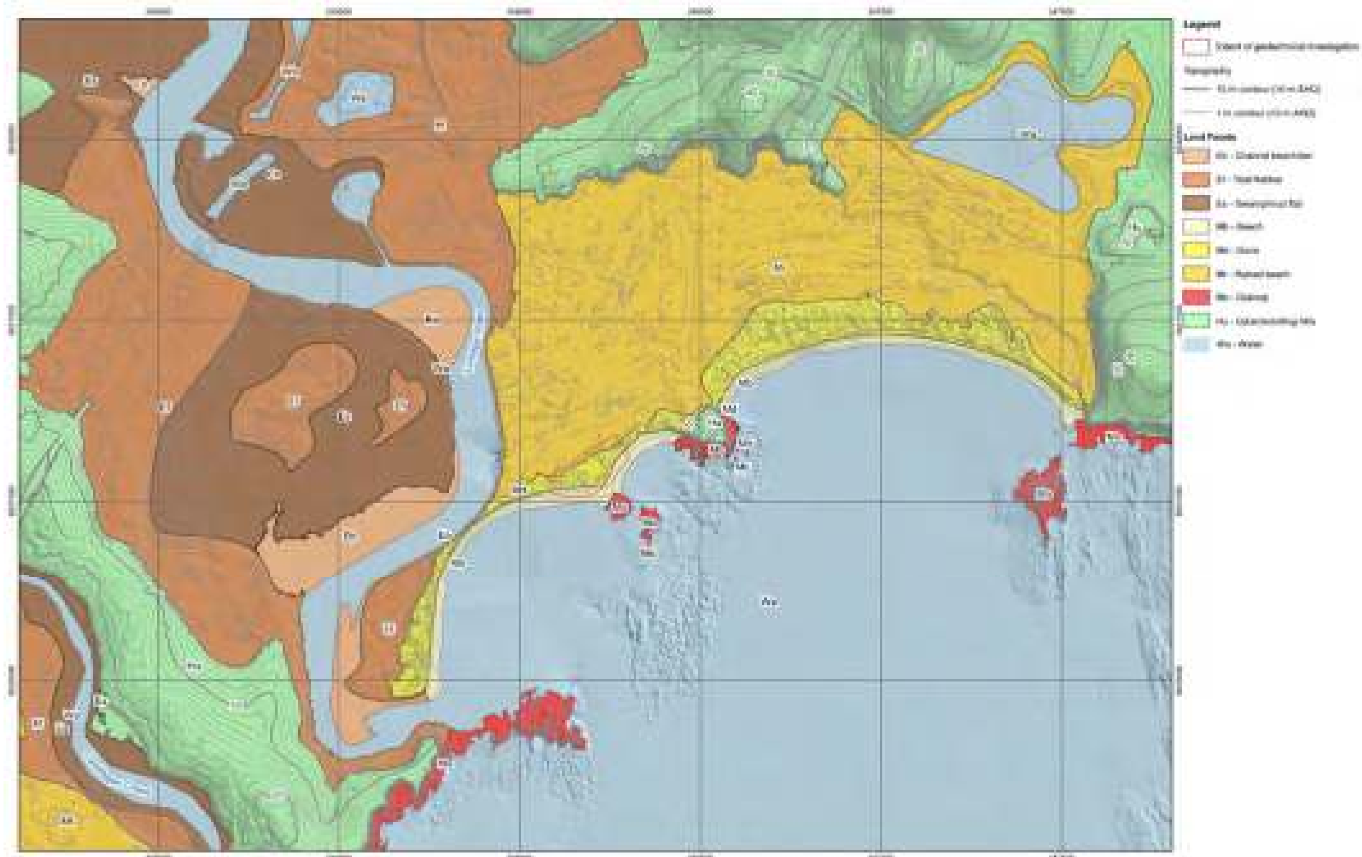
[2] Elvis – Elevation and Depth – Foundation Spatial Data, *https://elevation.fsdf.org.au/*

[3] WaterNSW Real Time Data, *https://realtimedata.waternsw.com.au/*

Inset 2: Terrain classification for Surfside.

Inset 3: Terrain classification for Long Beach.



Inset 4: Terrain classification for Tomakin.

Table 1 – Identified land systems and facets.

Land System	Land Facet	Symbol	Description and Anticipated Characteristics
Estuarine	Channel beach/bar	Eb	Sub-tidal bars and beaches within, and on the flanks of, active channels. Deposits typically several to tens of metres thick comprising sand with minor fines.
	Tidal flat/bar	Ef	Sub- to supratidal low slopes that are vegetated. Deposits typically several to tens of metres thick comprising sands, silts, and clays.
	Swamp/mud flat	Es	Intertidal low slopes that are waterlogged. Deposits typically several to tens of metres thick comprising clays and silts with minor sand.
Marine	Beach	Mb	Swash zone gently sloping towards coast. Typically, several to tens of metres thick comprising well-sorted sand.
	Dune	Md	Supra-tidal and back-of-beach, with rounded, shallow to moderate slopes. Typically, several metres thick comprising aeolian (wind-deposited) sands and minor silts.
	Raised beach	Mr	Perched behind beach/dune, with moderate ascending slope flanking seaward side, flat on top, and moderate descending slopes flanking landward side. Can also be terraced. Typically, several to tens of metres thick comprising well-sorted sand with minor silts and gravels.
	Intertidal outcrop	Mo	Intertidal wave-cut platform, shore platform, or coastal bench. Typically, flat but depends on underlying geology, comprising weathered bedrock and weathered subcrop covered by sand.
Uplands	Rolling hills	Hu	Terrestrial system at higher elevations, comprising concave footslopes, convex upper slopes and rounded ridges. Weathered bedrock overlain by colluvium of varying thickness.

4. Non-Intrusive Geotechnical Investigation

4.1 Introduction

The non-intrusive geotechnical investigation comprised:

- Field mapping – consisting of a site walk-over and engineering geological mapping undertaken between the 16th and 18th June 2021
- Geophysical surveys – undertaken during the week beginning 21st June 2021.

As intrusive investigations were not undertaken as originally planned, the results obtained from the non-intrusive fieldwork are the only data that is used to progress the conceptual models formulated during the desk study to observational engineering geological models.

4.2 Engineering Geological Field Mapping

4.2.1 Overview

Geotechnical ground-based mapping of exposures and geomorphological features was carried out to delineate and describe the various natural and man-made materials found in the study areas. Although this mapping focused on the study areas specifically, the regional area surrounding each site was also considered to understand the larger engineering geological setting. Field mapping sheets are attached in Appendix B.

Observations from the mapping campaign serves to inform the engineering geological models and understand the geotechnical character of the surficial soils and bedrock. Additionally, these observations compliment the non-intrusive geophysical investigations, with the aim of comparing the observed surficial materials with the geophysical profile.

Inset 5 presents an example of an observed outcrop, which was used to inform the likely bedrock profile in this geology. In this instance, the observed variability in the top of bedrock was noted as being a significant geotechnical characteristic that could be inferred to occur at depth below the soil profile.

Inset 5: Example of variability in the bedrock:soil interface (~4 m vertical drop over ~2 m horizontal) identified during the mapping campaign. In this example at Surfside North, the variable rock:soil interface is controlled by bedding structure in the rock.

4.2.2 Observed Geotechnical Units

The materials observed during the mapping campaign can largely be categorised into three geotechnical units:

- Marine/littoral deposits
- Colluvium, and
- Turbiditic bedrock.

A typical description of each geotechnical unit and associated land facets from the terrain classification is presented in Table 2 as observed during the mapping. It is expected there will likely be some variability in the geotechnical character of the units presented, however, without the benefit of the intrusive investigations, it is not possible to provide information on the nature of the geotechnical variability in each unit.

Table 2 – Typical geotechnical units and descriptions as observed in the mapping.

Geotechnical Unit	Associated Land Facets	Typical Material Description
Marine/littoral deposits	Mb – Beach Md – Dune Mr – Raised Beach	Sand, light brown, non-plastic with silt (variable proportions), slightly moist to wet, loose to medium dense, well graded.
Colluvium	Hu – Uplands	Silty gravel, low plasticity, with sand, moist, loose, poorly graded
Turbiditic bedrock	Hu – Uplands Mo – Outcrop	Turbidite (sequence of sandstone, siltstone, claystone, sandstone, chert), fine to medium grained, pale orange, brown, grey, very low to low strength, highly weathered.

4.3 Geophysical Surveys

4.3.1 Overview

Geophysical surveys were undertaken to investigate the possible distribution of material and depth to bedrock based on the observed seismic velocities. It is important to note that any geophysical investigation is an indirect method of testing the sub-surface conditions. Intrusive investigations are routinely used to ground truth and calibrate the results of geophysical investigations, which only measures the geophysical properties of the sub-surface.

4.3.2 Seismic Refraction (SRF) Survey

The seismic survey report is attached in Appendix C with the results summarised as follows:

- Marked seismic velocity contrasts were identified, increasing with depth, and providing a reasonable seismic profile across each SRF traverse
- Significantly higher velocities observed in the profile were attributed to seismic velocities associated with bedrock, although there is uncertainty in this assumption without testing from drilling
- Smaller differences in the seismic velocities in the upper profile were attributed to a possible shallow groundwater table, whereby the seismic velocities of saturated sediments (i.e., below the water table) are typically higher than dry sediments (i.e., above the water table)
- There is a degree of ambiguity in the measured seismic velocities and associated material interpretations for some layers at the Tomakin and Long Beach sites. This includes some ambiguity in the seismic velocities recorded in the vicinity of the buried seawall at Long Beach.

Overall, the results obtained from the SRF are considered reasonable for the purposes of this CMP.

5. Preliminary Engineering Geological Model

5.1 Surfside South

Based on the desk study and field mapping for Surfside South, the expected ground conditions for each land facet existing across the site comprises, Figure 1:

- Beach, dune and raised beach facets:
  - Marine/littoral deposits
  - Approximately 5 to 15 m thick, thinning out towards adjacent intertidal outcrop and rolling hill facets.
- Intertidal outcrop facets:
  - Turbiditic bedrock
  - Becoming sub-crop overlain by thin (<1 m) marine/littoral deposits adjacent to beach, dune, and raised beach facets.
- Rolling hills facets:
  - Colluvium of <1 m thickness

  - Underlain by turbiditic bedrock.

The seismic section is reproduced in Figure 2, and indicates that seismic layer 2 (2,200 – 2,800 m/s) is interpreted as possibly being bedrock. Levels of this layer vary approximately between 2.3 m depth in the southeast and deepens to approximately 8 m depth towards the northwest. It is noted that this interpretation is based on typical seismic velocities only and is therefore assessed as having a low confidence.

Groundwater is expected to be close to or otherwise at surface, with several waterlogged areas noted during the field mapping. Seismic velocities of layer 1 (1,500 – 1,500 m/s) are also interpreted as being saturated sand.

5.2 Surfside North

Expected ground conditions for each land facet present at Surfside North comprises, Figure 3:

- Beach, dune and raised beach facets:
  - Marine/littoral deposits
  - At least 4 m thick (possibly up to tens of metres), and thinning out towards intertidal outcrop and rolling hill facets.
- Intertidal outcrop facet:
  - Turbiditic bedrock
  - Becoming subcrop overlain by thin (<1 m) marine/littoral deposits adjacent to beach, dune, and raised beach facets.
- Rolling hills facets:
  - Colluvium of <1 m thickness
  - Underlain by turbiditic bedrock.

The seismic section is reproduced in Figure 4, and indicates that seismic layer 3 (1,950 – 2,200 m/s) is interpreted as possibly being bedrock. Levels of this layer vary approximately between 3.5 m to 6 m depth. This interpretation is based on typical seismic velocities only and is again assessed as having a low confidence.

Groundwater is expected to be shallow, with several waterlogged areas noted during the field mapping. Seismic velocities of layer 2 (1,100 – 1,350 m/s) are also interpreted as being partially saturated to saturated sand.

5.3 Long Beach

Based on the desk study and field mapping undertaken at Long Beach, the expected ground conditions for each land facet within the area of interest comprises, Figure 5:

- Beach, dune and raised beach facets:
  - Marine/littoral deposits
  - Approximately 2 m thick in the centre of the study area (based on mapped intertidal sub-crop)
  - Thickening to several metres towards the west and east.

The location of the seawall structure at Long Beach is fairly evident at surface, being approximately 280 m in extent, as annotated in Figure 5. However, without the sub-surface intrusive investigations the depth of the seawall and its foundation conditions are not known.

The seismic section is reproduced in Figure 6 and indicates that seismic layer 4 (1,900 – 2,300 m/s) is possibly interpreted as bedrock. Levels of this layer vary approximately between 5 m to 11 m depth. Above this, the velocities associated with seismic layer 3 (1,700 – 1,950 m/s) are ambiguous and the possible materials are uncertain. The seismic velocities of this layer may either be indicative of weathered bedrock or a coarse grained soil such as gravel/sandy gravel with boulders. Intrusive investigations would be required to confirm the material type and geotechnical condition.

Groundwater is expected to be shallow, due to the proximity to the shoreline. Seismic velocities of layer 2 (600 – 1,450 m/s) are interpreted as being partially saturated sand.

5.4 Tomakin

Expected ground conditions for each land facet present within the study area at Tomakin comprises, Figure 7:

- Beach, dune and raised beach facets:
  - Marine/littoral deposits
  - At least 6 m thick (possibly up to tens of metres).

The seismic section is reproduced in Figure 8 and indicates that seismic layer 4 (2,000 – 2,100 m/s) is possibly interpreted as bedrock. Levels of this layer vary approximately between 7 m to 10 m depth. The velocities associated with seismic layer 3 (1,550 – 1,650 m/s) are ambiguous and the possible materials are uncertain. The seismic velocities of this layer may either be indicative of weathered bedrock or dense to very dense sand/gravel. Intrusive investigations are required to confirm the material type and geotechnical condition.

Groundwater is expected at moderate depths of approximately 5 to 6 m. The seismic velocities of layer 2 (600 – 950 m/s) are interpreted as being partially saturated sand at depths of 2.5 to 4 m.

6. Discussion and Recommendations

6.1 Qualifications

The work undertaken and presented in this report has provided a preliminary understanding of the geotechnical conditions at each of the four sites. The ground profile is inferred from the terrain classification, field mapping, and the seismic survey results, which includes interpretations of the possible sub-surface geological materials based on the seismic velocities only. Geophysical surveys are an indirect method of testing the sub-surface conditions and are routinely ground-truthed and calibrated by intrusive investigations. Without intrusive investigations, such as drilling and test pitting, the degree of confidence in the interpreted subsurface conditions based on the geophysical results is lower compared to interpretations that would include such intrusive investigation data. Further Investigations

To address the above qualifications and improve the preliminary engineering geological models for the sites, intrusive investigations are suggested. The amount of sub-surface geotechnical investigations can be optimised with the benefit of the work to date and to fit within the environmental and archaeological constraints of undertaking intrusive investigations. In summary the quantum of sub-surface work that could be undertaken in the future includes:

- A total of 5 no. machine-augered holes across the sites:
  - 2 no. at Surfside
  - 2 no. at Long Beach
  - 1 no. at Tomakin.
- Two (2) no. machine excavated test pits at Long Beach only, to assess the foundation conditions of the buried seawall.

Intrusive investigations would allow for the ground truthing of the geophysical results, in particular to associate the seismic velocities directly with material drilled or excavated and sampled from the sub-surface. This would allow for confirmation of the interpreted geological materials with the aim to resolve the uncertainties around ambiguous seismic velocity layers and expected variability in the sub-surface profile.

7. Closure

We trust this report provides the information you require for the CMP. We would be happy to answer any questions that may arise.

Yours Sincerely

M J Eggers

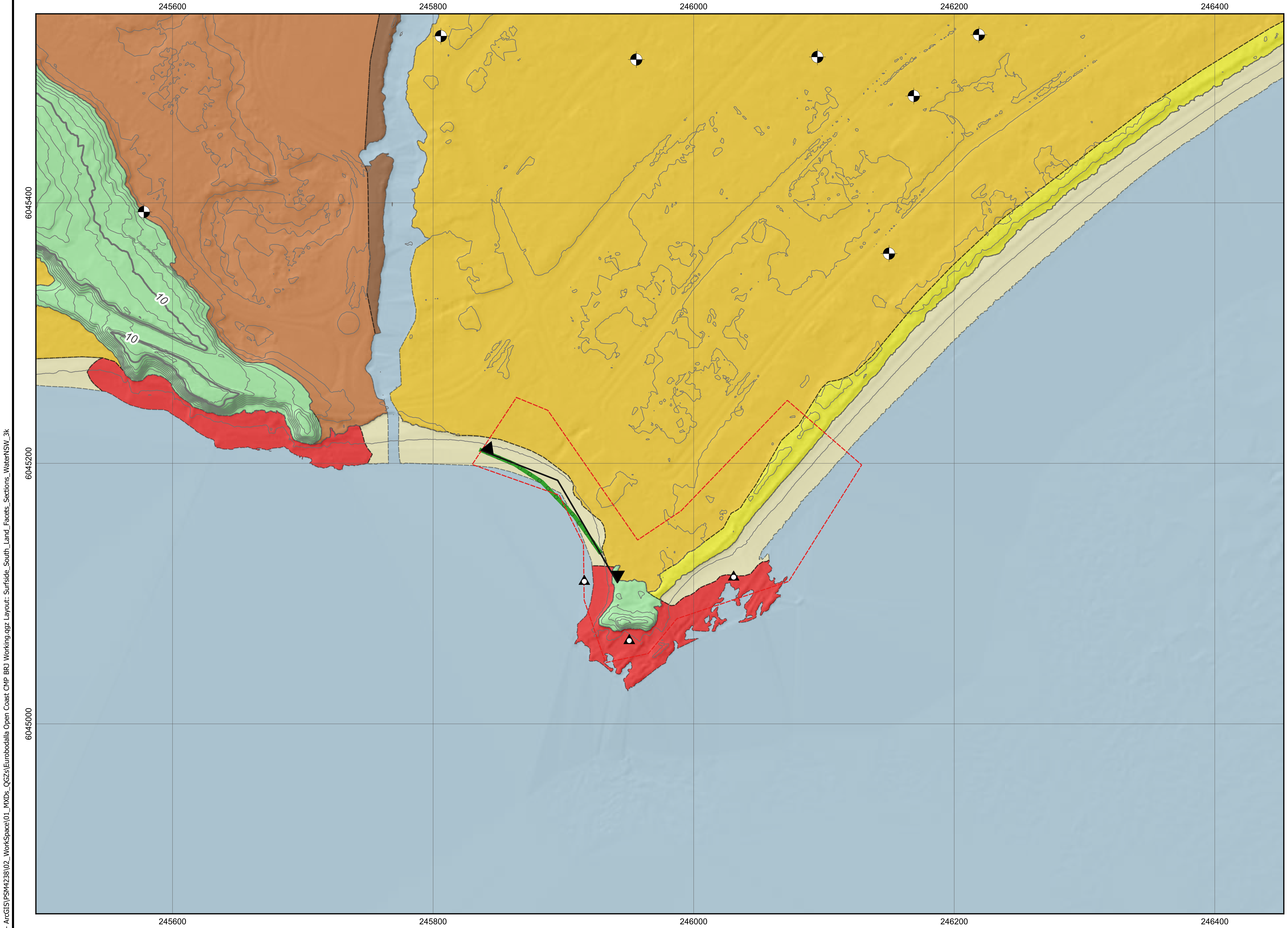
BRENDON JONES
SENIOR ENGINEERING GEOLOGIST

MARK EGGERS
CHIEF ENGINEERING GEOLOGIST

8. References

Rose G., 1966, Ulladulla 1:250 000 Geological Sheet SI/56-13, 1st edition, Geological Survey of New South Wales, Sydney

List of Figures:



Legend

Geotechnical Investigation

- Extent of geotechnical investigations
- Seismic traverse
- Mapping locality
- Long section

Topography

- 10 m contour
- 1 m contour

Land Facet

- Ef - Tidal flat/bar
- Es - Swamp/mud flat
- Mb - Beach
- Md - Dune
- Mr - Raised beach
- Mo - Outcrop
- Hu - Uplands/rolling hills
- Wa - Water

WaterNSW Borehole Database

- No drillers log available

NOTES:
1. DEM generated from LiDAR and bathymetry data obtained from elevation.fsd.org.au
2. WaterNSW borehole database - drillers logs are not technical logs and can be subjective. Assessed as low confidence.

N

Scale 1:3,000

0 25 50 75 100 m

Map Projection:
GDA2020 / MGA zone 56
EPSG:7856

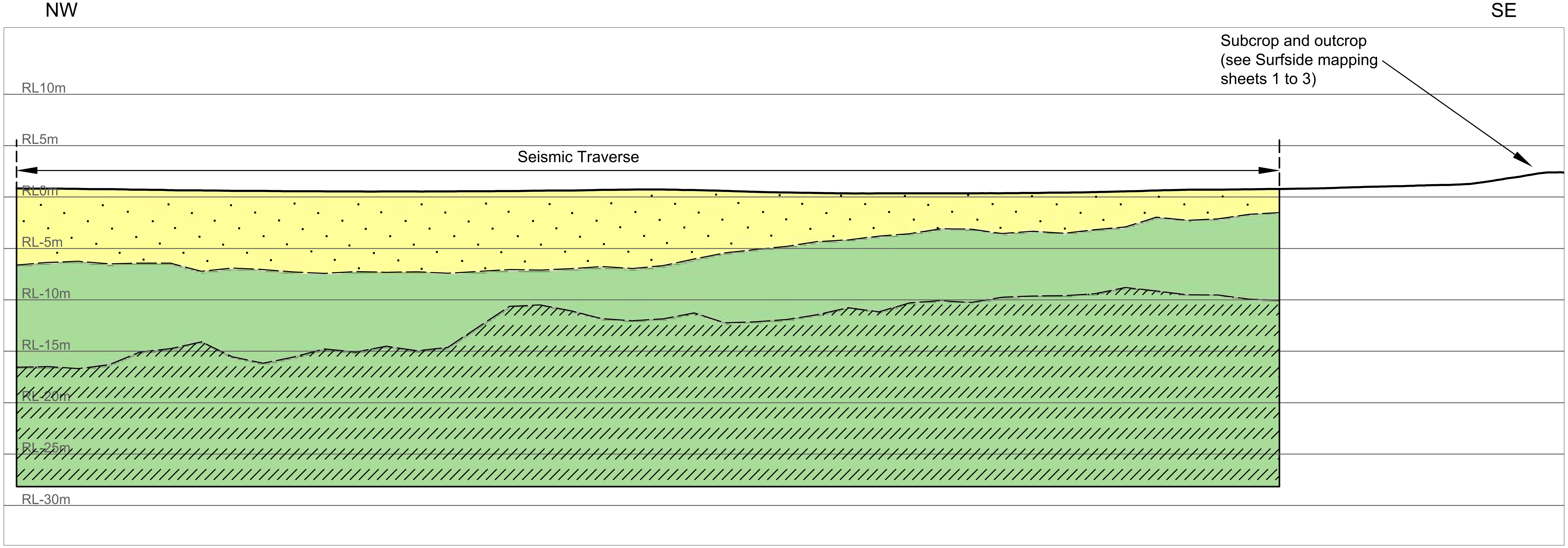
PSM

Created By: BRJ	Revision: A		
Date: 09 Aug 2021	Paper Size: A3	PSM4238-005R	Figure 1

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

SURFSIDE SOUTH PLAN

C:\Users\Brendon.Jones\Pells Sullivan Meynink\GIS - ArcGIS\PSM4238\02_WorkSpace\01_MXDs_QGZs\Eurobodalla Open Coast CMP BRJ Working.qgz Layout: Surfside_South_Land_Facets_Sections_WaterNSW_3k

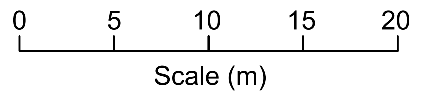


Legend	Seismic velocity (m/s)	Possible materials based on interpreted seismic velocities only[1]
(yellow, dotted)	1500 - 1500	Sand, medium dense to dense, saturated
(green)	2200 - 2800	Rock, highly to moderately weathered, moderate to high strength
(green, hatched)	2800 - 3500	Rock, slightly weathered to fresh, high to very high strength

——— Ground surface

– – – – Interpreted seismic refractor boundary

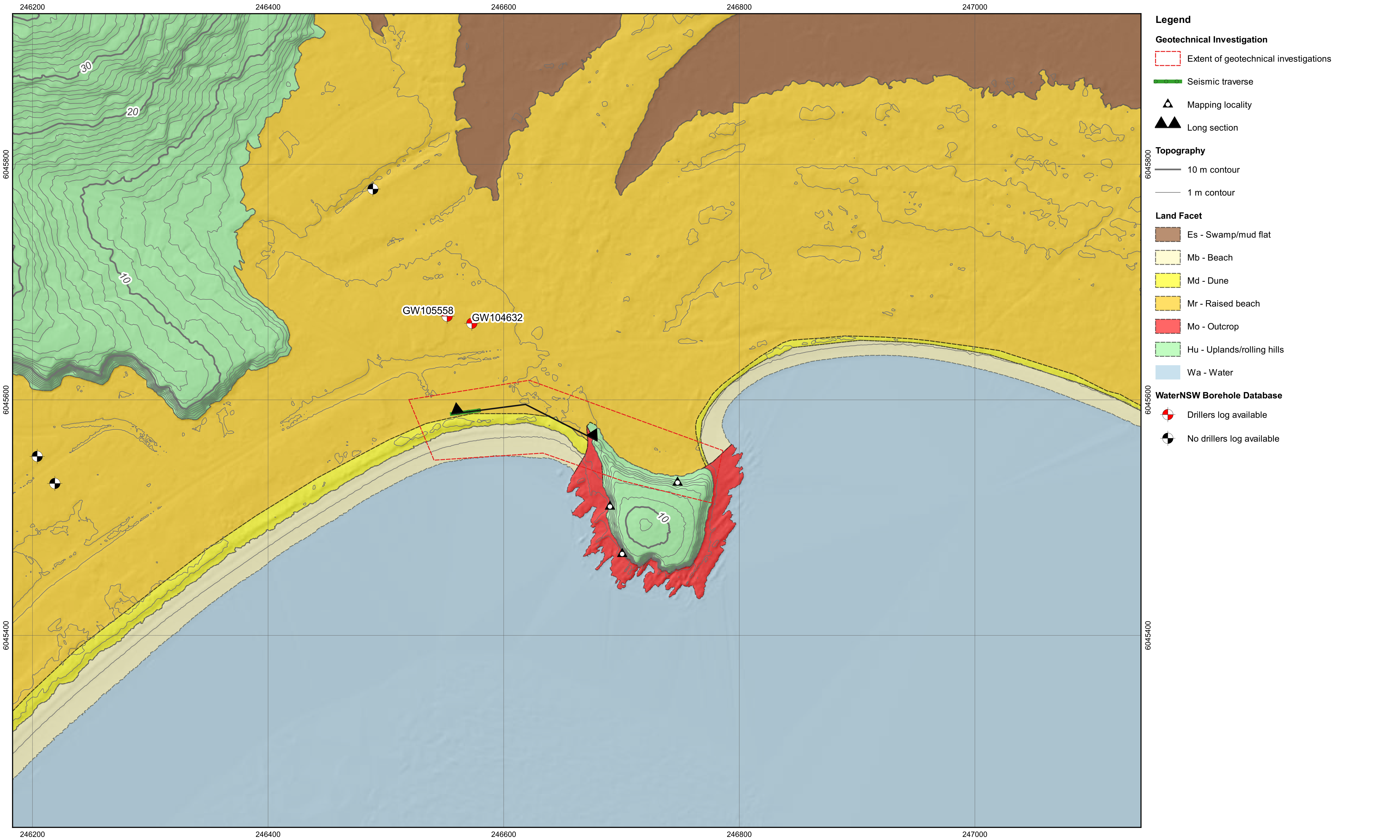
Notes:
1. Geological material interpretations based on seismic velocities only, assessed as low confidence, and require confirmation from drilling.



Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

SURFSIDE SOUTH CROSS-SECTION

PSM4238-005R	Figure 2



NOTES:
1. DEM generated from LiDAR and bathymetry data obtained from elevation.fsd.org.au
2. WaterNSW borehole database - drillers logs are not technical logs and can be subjective. Assessed as low confidence.

N

Scale 1:3,000

0 25 50 75 100 m

Map Projection:
GDA2020 / MGA zone 56
EPSG:7856

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

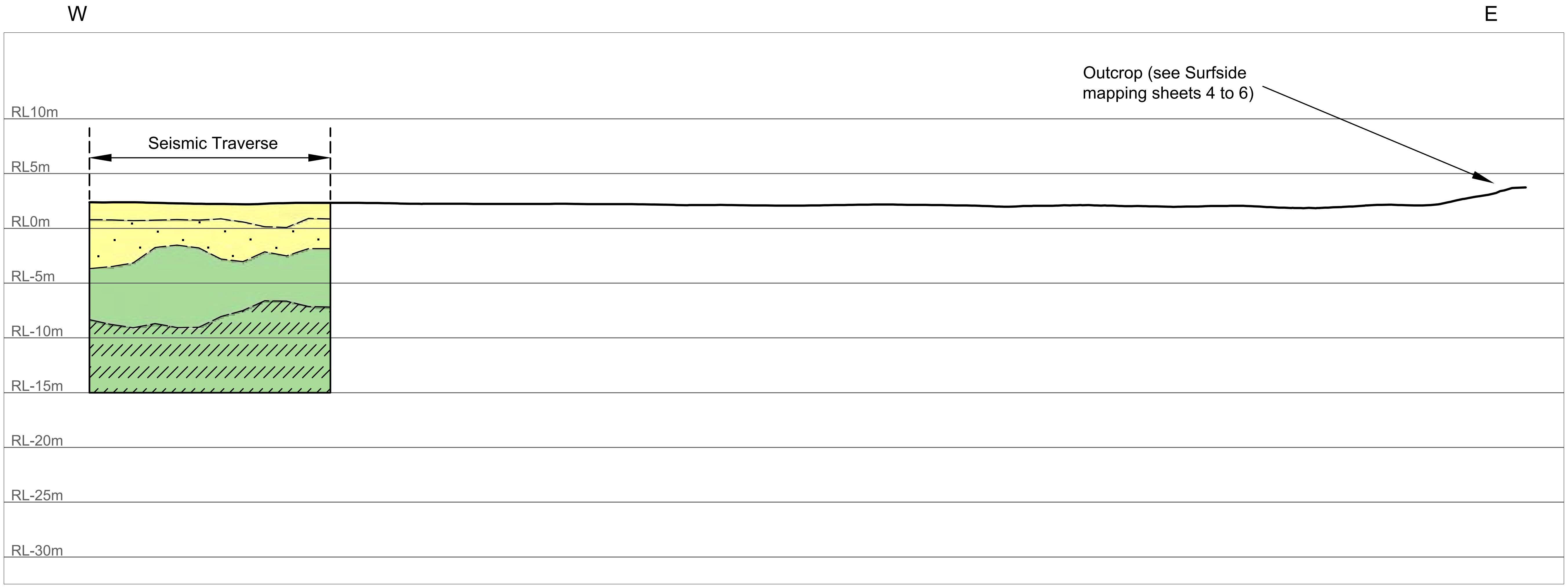
SURFSIDE NORTH PLAN

P S M

Created By: BRJ	Revision: A
Date: 09 Aug 2021	Paper Size: A3

PSM4238-005R

Figure 3



Legend	Seismic velocity (m/s)	Possible materials based on interpreted seismic velocities only[1]
	300 - 350	Sand, medium dense to dense, dry
	1100 - 1350	Sand, medium dense to dense, partially saturated to saturated
	1950 - 2200	Rock, extremely to highly weathered, low to moderate strength
	2250 - 2400	Rock, highly to slightly weathered, moderate to high strength

Ground surface

Interpreted seismic refractor boundary

Notes:
1. Geological material interpretations based on seismic velocities only, assessed as low confidence, and require confirmation from drilling.

0 5 10 15 20
Scale (m)

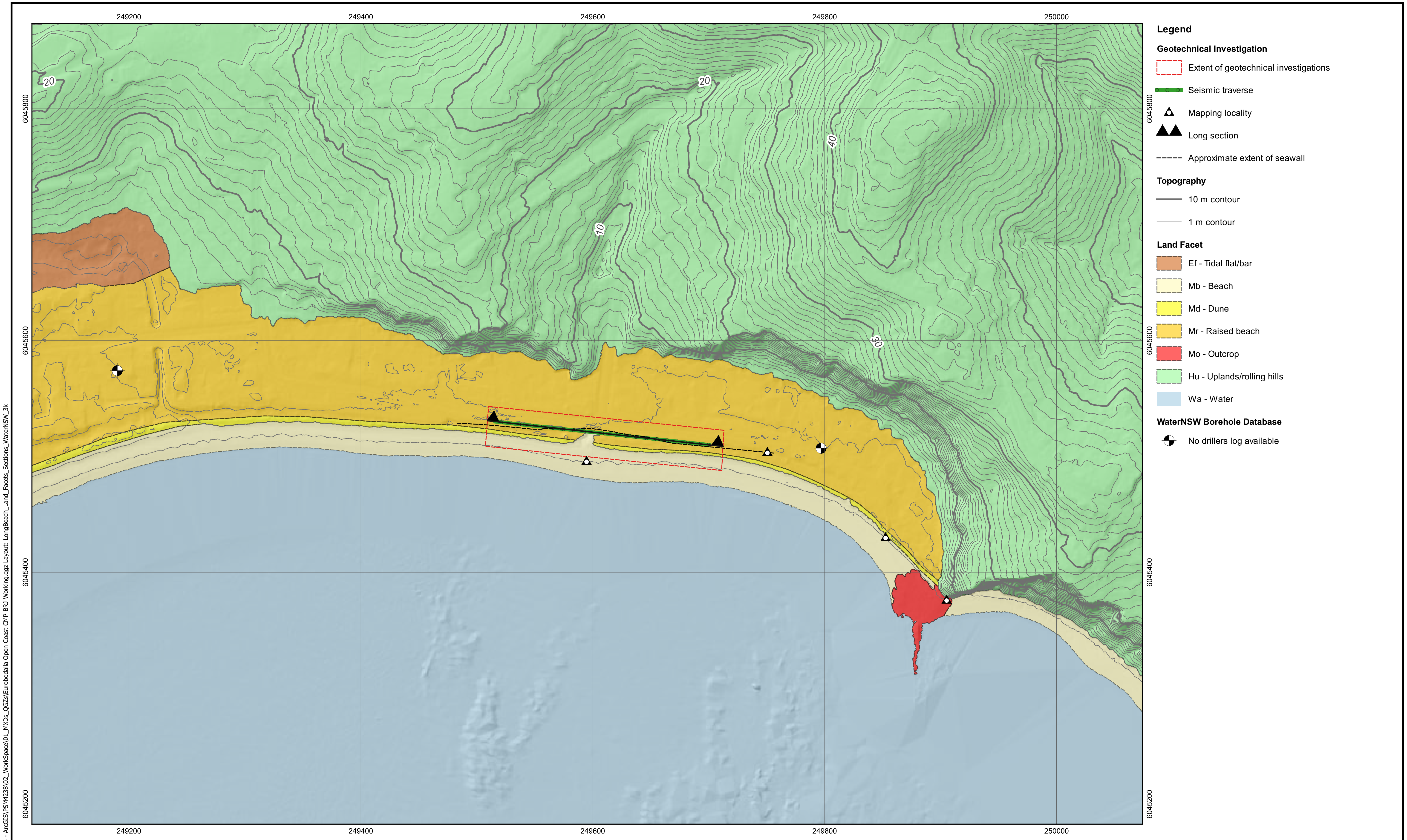
PSM

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

SURFSIDE NORTH CROSS-SECTION

PSM4238-005R

Figure 4



C:\Users\Brendon.Jones\Pells Sullivan Meynink\GIS - ArcGIS\PSM4238\02_WorkSpace\01_MXDs_QGZs\Eurobodalla Open Coast CMP BRJ Working.qgz Layout: LongBeach_Land_Facets_Sections_WaterNSW_3k

NOTES:
1. DEM generated from LiDAR and bathymetry data obtained from elevation.fsd.org.au
2. WaterNSW borehole database - drillers logs are not technical logs and can be subjective. Assessed as low confidence.

Scale 1:3,000

0 25 50 75 100 m

N

Map Projection:
GDA2020 / MGA zone 56
EPSG:7856

PSM

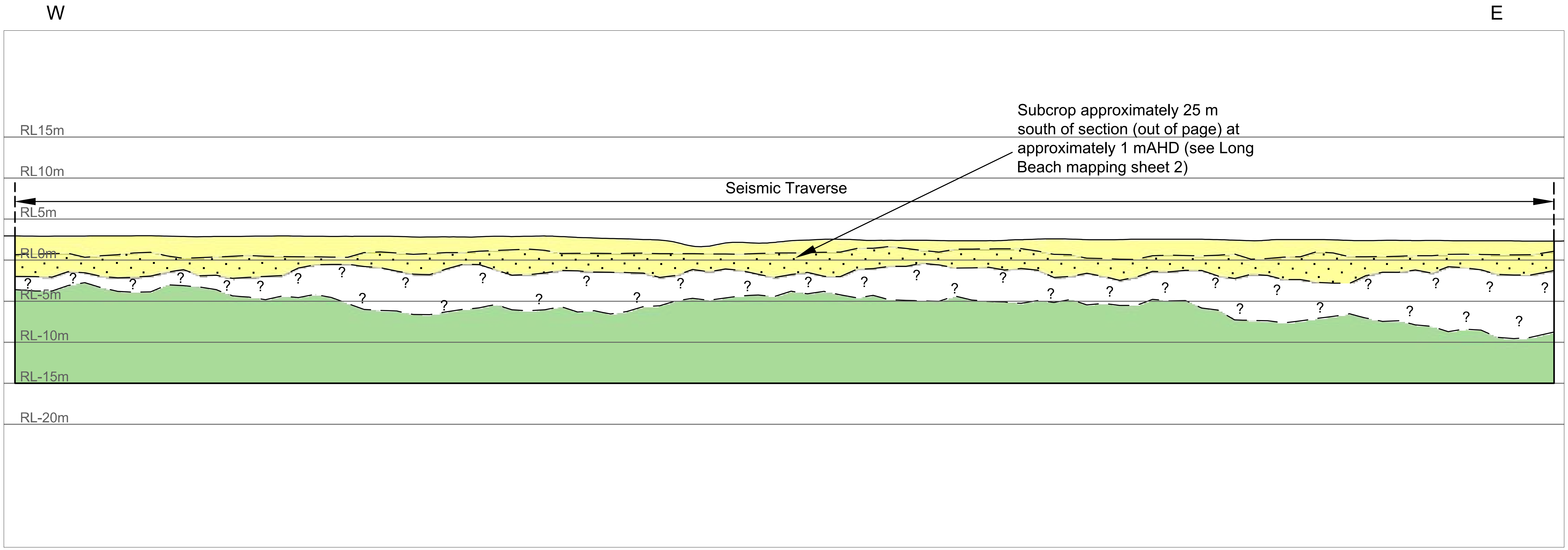
Created By: BRJ	Revision: A
Date: 10 Aug 2021	Paper Size: A3

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

LONG BEACH PLAN

PSM4238-005R

Figure 5



Legend	Seismic velocity (m/s)	Possible materials based on interpreted seismic velocities only[1]
	300 - 450	Sand, medium dense to dense, dry
. ·	600 - 1450	Sand, medium dense to dense, partially saturated
?	1700 - 1950	Uncertain (ambiguous seismic velocities)
	1900 - 2300	Rock, moderately to slightly weathered, medium to high strength

—— Ground surface

– – – – Interpreted seismic refractor boundary

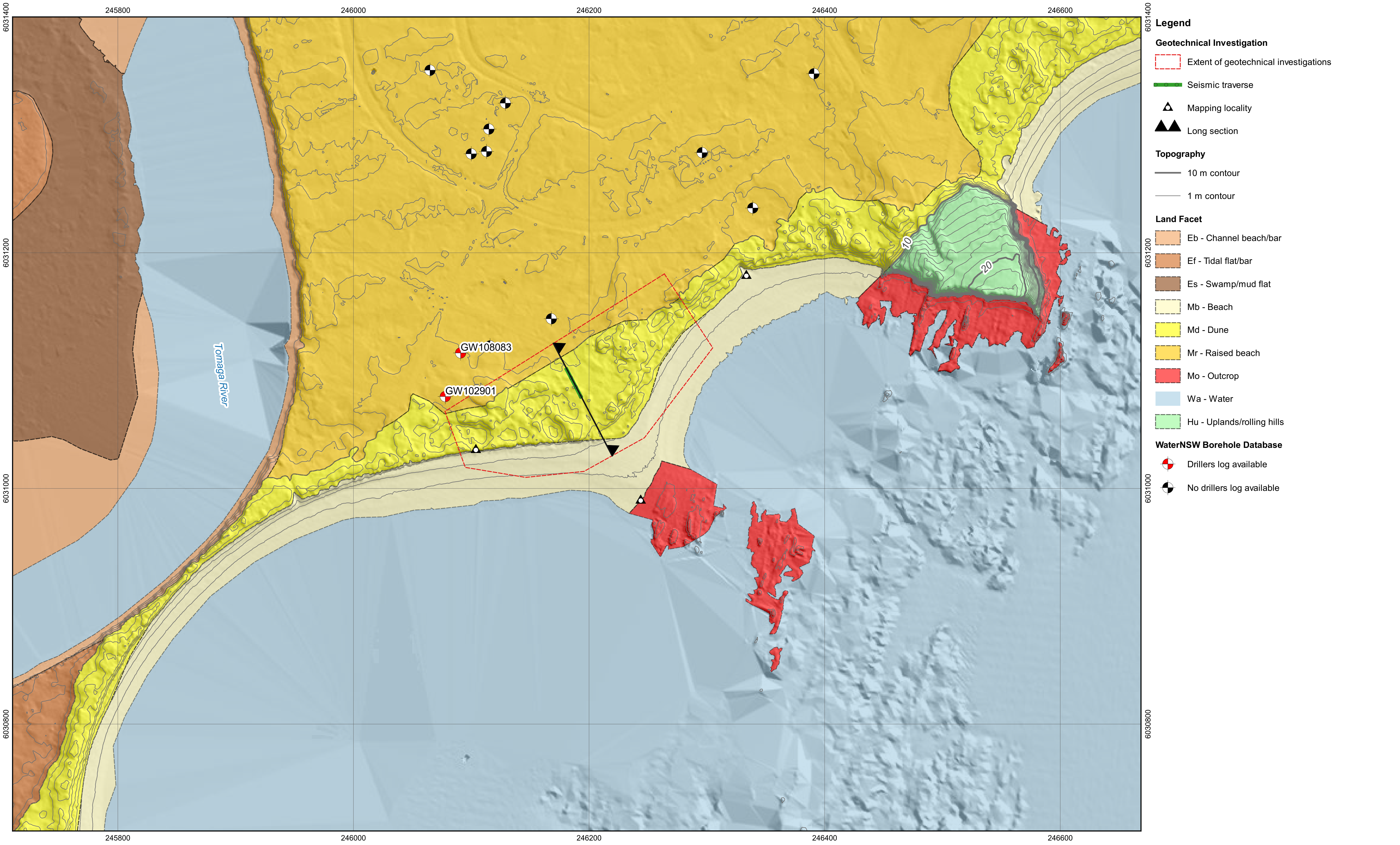
Notes:
1. Geological material interpretations based on seismic velocities only, assessed as low confidence, and require confirmation from drilling.

0 5 10 15 20
Scale (m)

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

LONG BEACH CROSS-SECTION

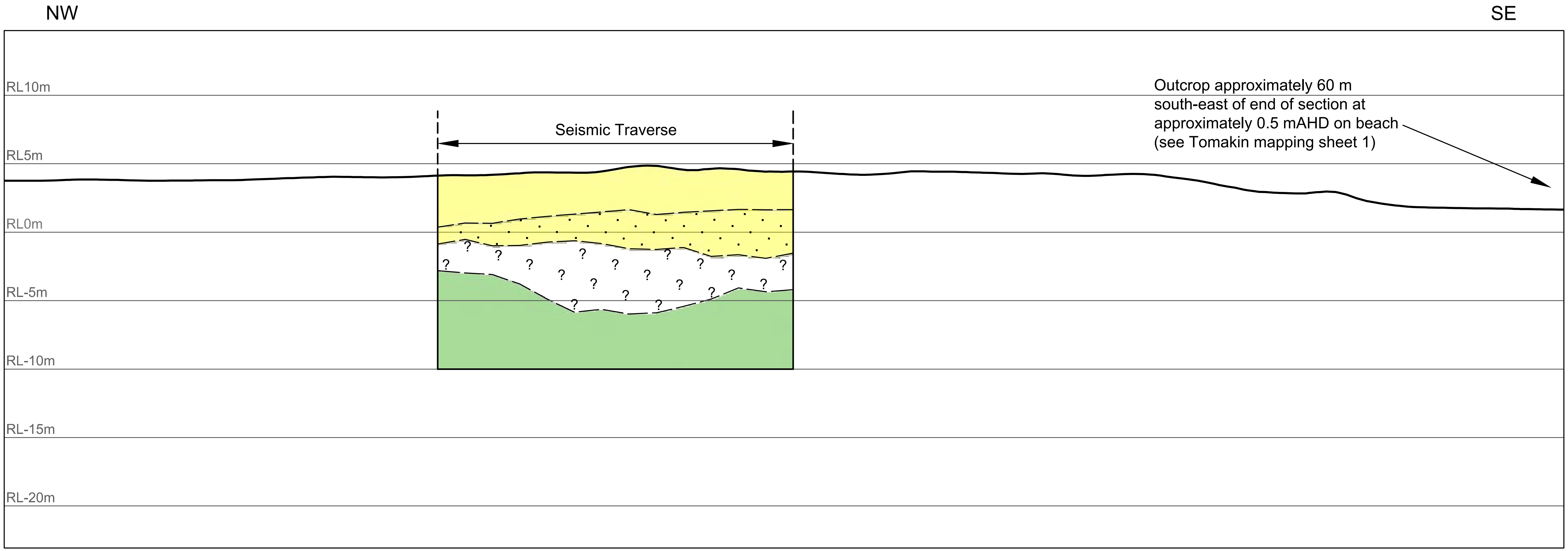
PSM4238-005R	Figure 6



C:\Users\Brendon.Jones\Pells Sullivan Meynink\GIS - ArcGIS\PSM4238\02_WorkSpace\01_MXDs_QGZs\Eurobodalla Open Coast CMP BRJ Working.qgz Layout: Tomakin_Land_Facets_Sections_WaterNSW_3k

NOTES:
1. DEM generated from LiDAR and bathymetry data obtained from elevation.fsd.org.au
2. WaterNSW borehole database - drillers logs are not technical logs and can be subjective. Assessed as low confidence.

Created By: BRJ	Revision: A	Eurobodalla Shire Council Eurobodalla CMP - Open Coast Geotechnical Investigation TOMAKIN PLAN	
Date: 09 Aug 2021	Paper Size: A3	PSM4238-005R	Figure 7



Legend	Seismic velocity (m/s)	Possible materials based on interpreted seismic velocities only[1]
	350	Sand, medium dense to dense, dry
. ·	600 - 950	Sand, medium dense to dense, partially saturated
?	1550 - 1650	Uncertain (ambiguous seismic velocities)
	2000 - 2100	Rock, highly to slightly weathered, medium to high strength

——— Ground surface

– – – – Interpreted seismic refractor boundary

Notes:
1. Geological material interpretations based on seismic velocities only, assessed as low confidence, and require confirmation from drilling.

0 2 4 6 8 10
Scale (m)

PSM

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

TOMAKIN CROSS-SECTION

PSM4238-005R

Figure 8

Appendix A
Desk-Study Figures

NOTES:
1. Imagery dated 1/04/2021

Scale 1:10,000

0 100 200 300 400 m

Map Projection:
GDA2020 / MGA zone 56
EPSG:7856

Created By: BRJ	Revision: A		
Date: 29 Jun 2021	Paper Size: A3	PSM4238-005R	Figure A1

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

AERIAL IMAGE:
SURFSIDE (1:10,000)

NOTES:
1. DEM generated from LiDAR and bathymetry data obtained from elevation.fsd.org.au
2. Point clouds from LiDAR and bathymetry data merged and interpolated with triangulation network method.

Scale **1:10,000**

N

0 100 200 300 400 m

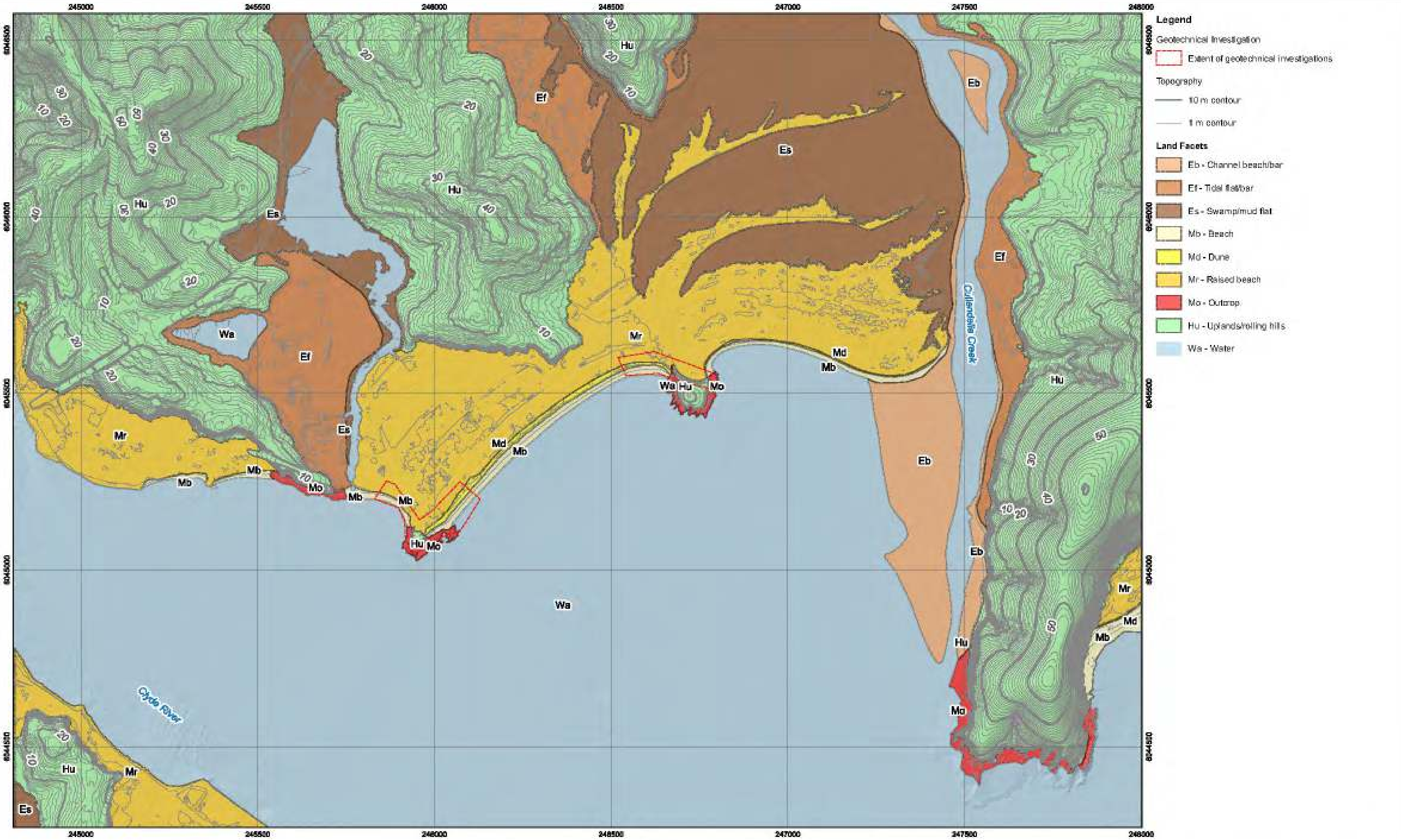
Map Projection: GDA2020 / MGA zone 56 EPSG:7856

P	S	M	Created By: BRJ	Revision: A
			Date: 29 Jun 2021	Paper Size: A3

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

DIGITAL ELEVATION MODEL:
SURFSIDE (1:10,000)

PSM4238-005R | Figure A2



NOTES:
1. DEM generated from LiDAR and bathymetry data obtained from elevation.fsd.org.au

Scale 1:10,000

N

0 100 200 300 400 m

Map Projection:
GDA2020 / MGA zone 56
EPSG:7856

P S M

Created By: BRJ

Revision: A

Date: 28 Jun 2021

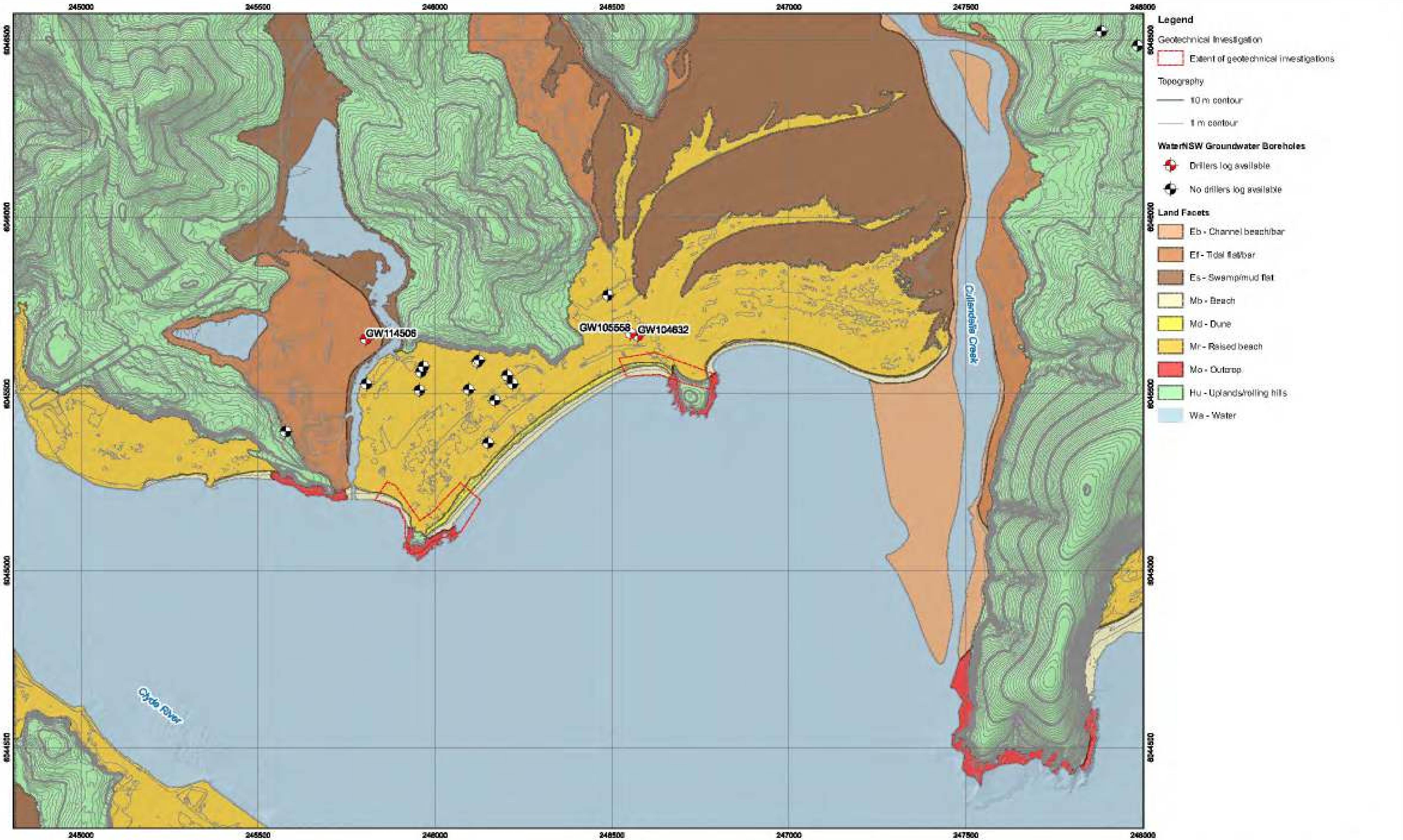
Paper Size: A3

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

TERRAIN CLASSIFICATION:
SURFSIDE (1:10,000)

PSM4238-005R

Figure A3



NOTES:
1. Groundwater bore information obtained from realtimedata.waternsw.com.au

Scale 1:10,000

N

0 100 200 300 400 m

Map Projection:
GDA2020 / MGA zone 56
EPSG:7856

P S M

Created By: BRJ

Revision: A

Date: 08 Jul 2021

Paper Size: A3

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

WaterNSW GROUNDWATER BOREHOLE DATABASE: SURFSIDE

PSM4238-005R

Figure A4

NOTES:
1. Imagery dated 1/04/2021

Scale 1:10,000

0 100 200 300 400 m

Map Projection:
GDA2020 / MGA zone 56
EPSG:7856

Created By: BRJ	Revision: A
Date: 29 Jun 2021	Paper Size: A3

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

AERIAL IMAGE:
LONG BEACH (1:10,000)

PSM4238-005R

Figure A5

NOTES:
1. DEM generated from LiDAR and bathymetry data obtained from elevation.fsd.org.au
2. Point clouds from LiDAR and bathymetry data merged and interpolated with triangulation network method.

N

Scale 1:10,000

0 100 200 300 400 m

Map Projection:
GDA2020 / MGA zone 56
EPSG:7856

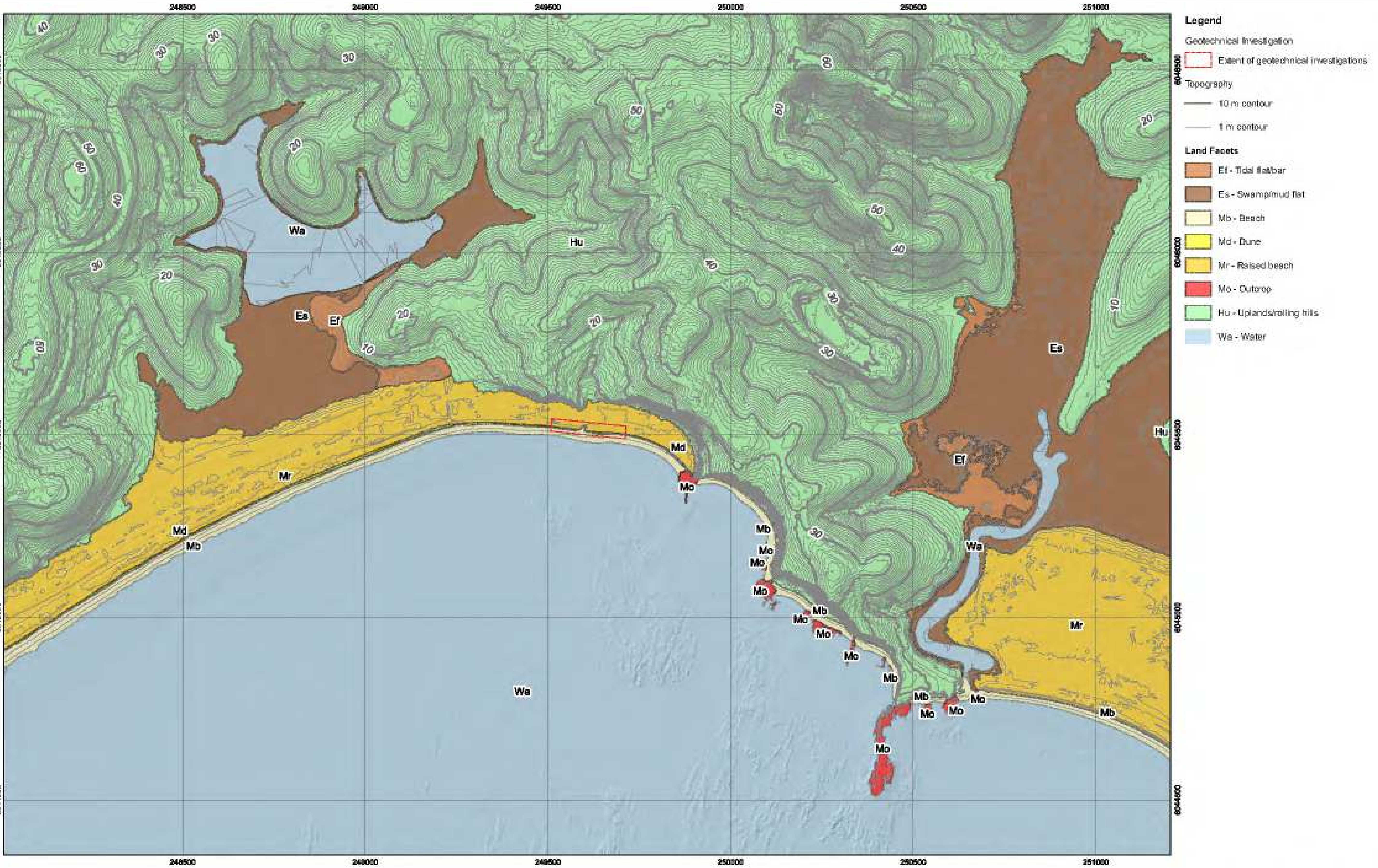
P S M

Created By: BRJ	Revision: A
Date: 29 Jun 2021	Paper Size: A3

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

DIGITAL ELEVATION MODEL:
LONG BEACH (1:10,000)

PSM4238-005R	Figure A6



NOTES:
1. DEM generated from LiDAR and bathymetry data obtained from elevation.fsd.org.au

Scale 1:10,000

0 100 200 300 400 m

Map Projection:
GDA2020 / MGA zone 56
EPSG:7856

Created By: BRJ

Revision: A

Date: 30 Jun 2021

Paper Size: A3

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

TERRAIN CLASSIFICATION:
LONG BEACH (1:10,000)

PSM4238-005R

Figure A7

NOTES:
1. Groundwater bore information obtained from realtimedata.waternsw.com.au

Scale 1:10,000

0 100 200 300 400 m

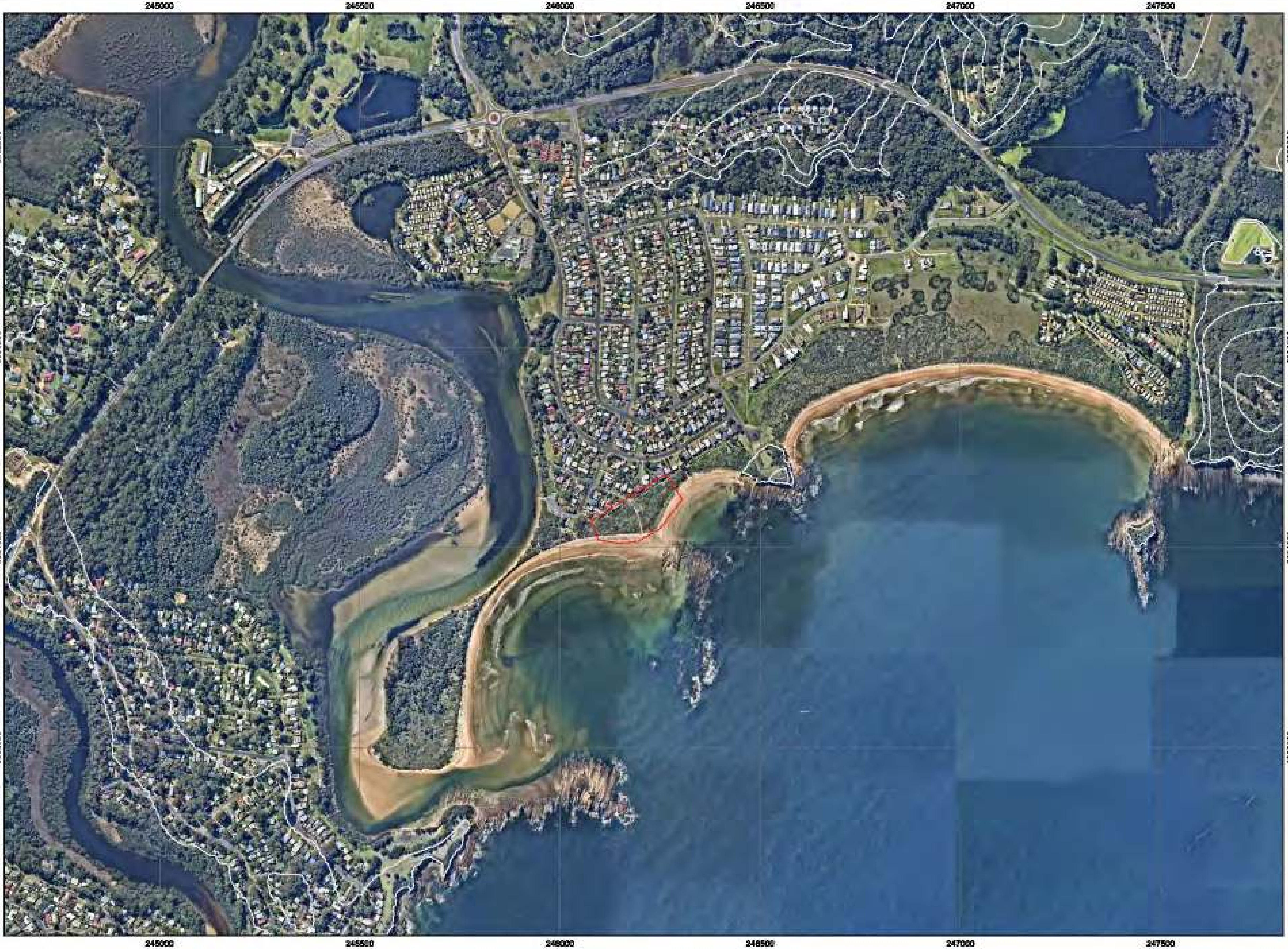
Map Projection: GDA2020 / MGA zone 56 EPSG:7856

Created By: BRJ	Revision: A
Date: 30 Jun 2021	Paper Size: A3

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

WaterNSW GROUNDWATER BOREHOLE DATABASE: LONG BEACH

PSM4238-005R | Figure A8



NOTES:
1. Imagery dated 1/04/2021

Scale 1:10,000

0 100 200 300 400 m

Map Projection:
GDA2020 / MGA zone 56
EPSG:7856

Created By: BRJ

Revision: A

Date: 29 Jun 2021

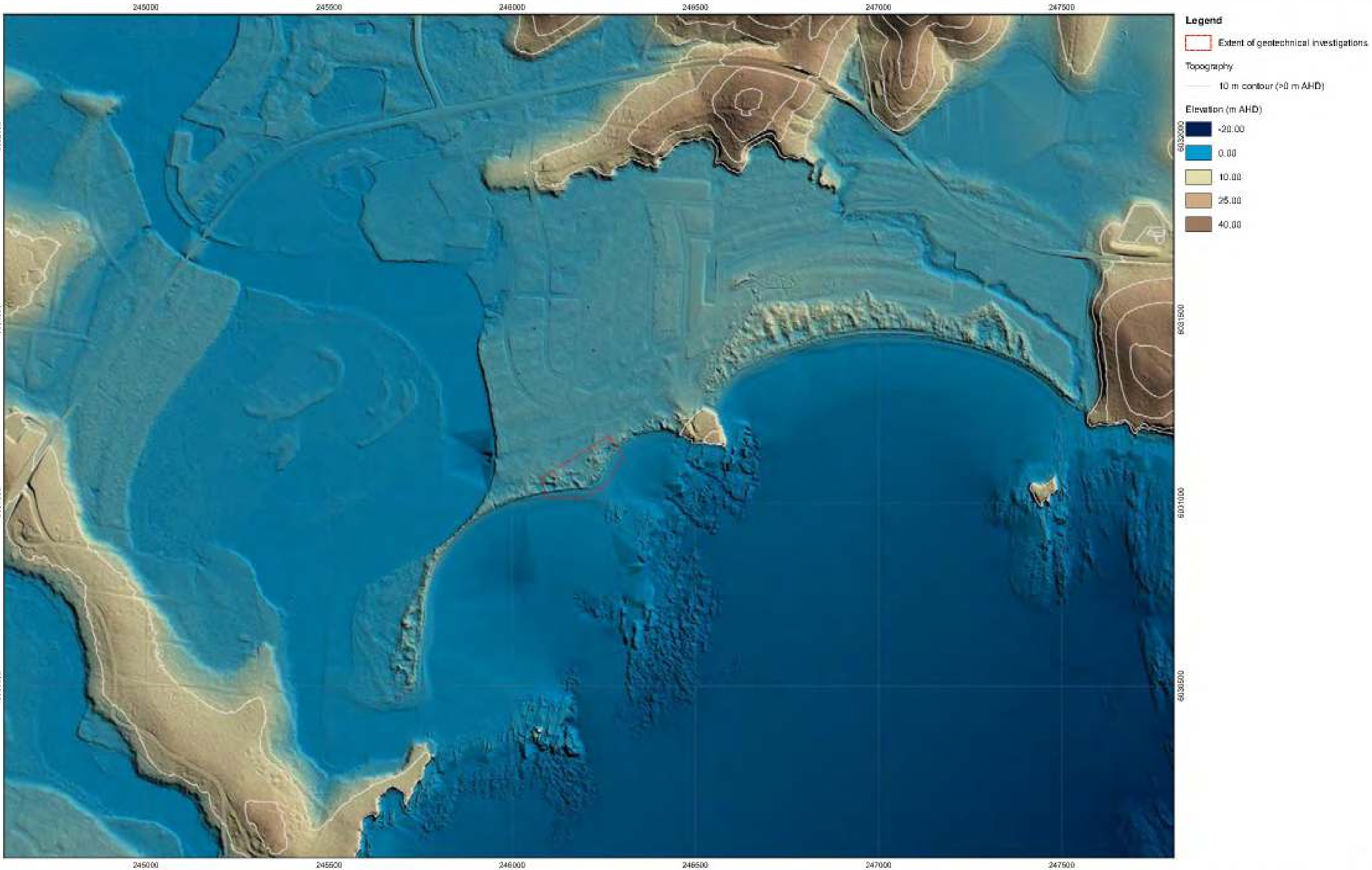
Paper Size: A3

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

AERIAL IMAGE:
TOMAKIN (1:10,000)

PSM4238-005R

Figure A9



NOTES:
1. DEM generated from LiDAR and bathymetry data obtained from elevation.fsd.org.au
2. Point clouds from LiDAR and bathymetry data merged and interpolated with triangulation network method.

Scale 1:10,000

0 100 200 300 400 m

Map Projection: GDA2020 / MGA zone 56 EPSG:7856

Created By: BRJ

Revision: A

Date: 29 Jun 2021

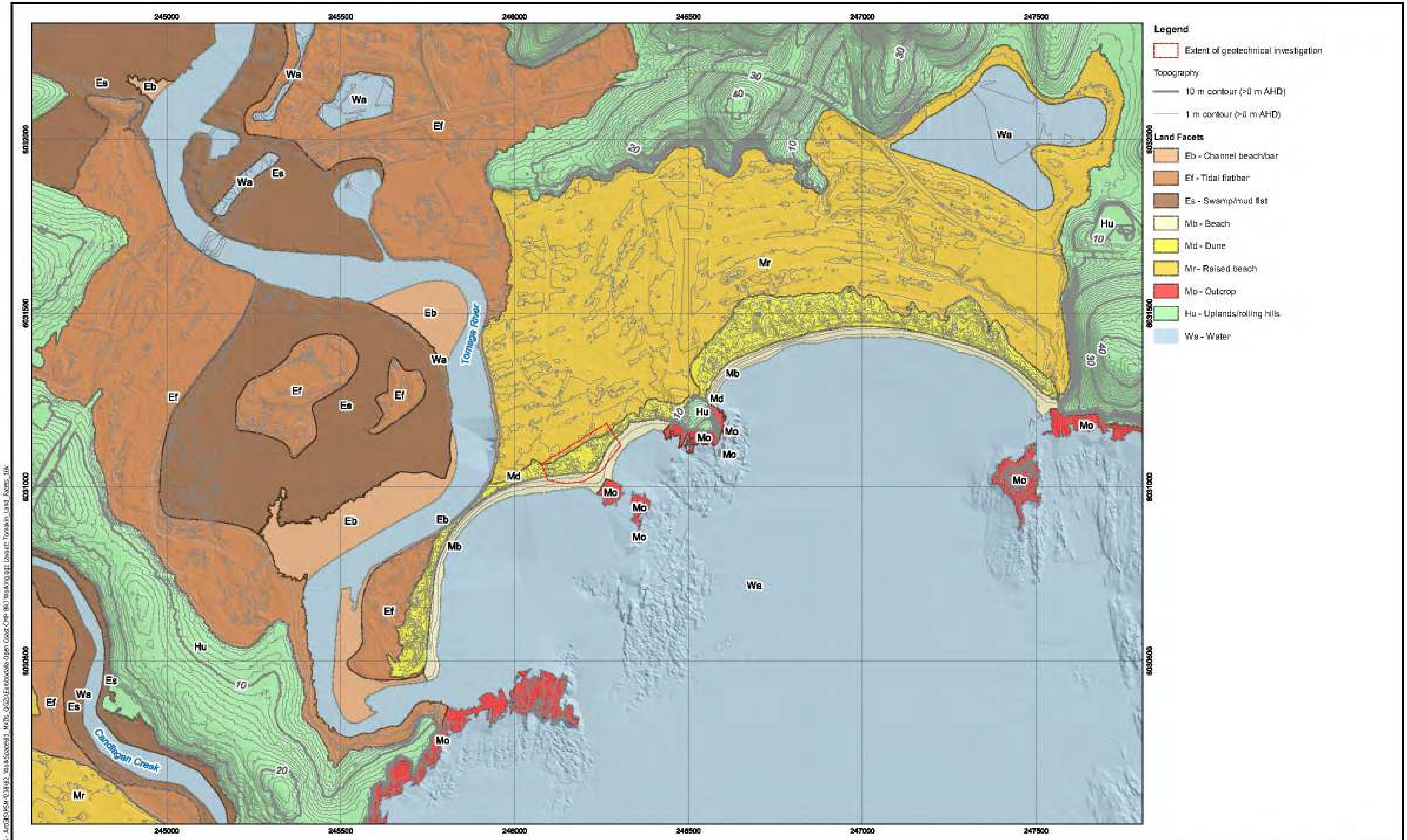
Paper Size: A3

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast Geotechnical Investigation

DIGITAL ELEVATION MODEL: TOMAKIN (1:10,000)

PSM4238-005R

Figure A10



NOTES:
1. DEM generated from LiDAR and bathymetry data obtained from elevation.fsd.org.au

Scale 1:10,000

0 100 200 300 400 m

Map Projection:
GDA2020 / MGA zone 56
EPSG:7856

Created By: BRJ

Revision: A

Date: 29 Jun 2021

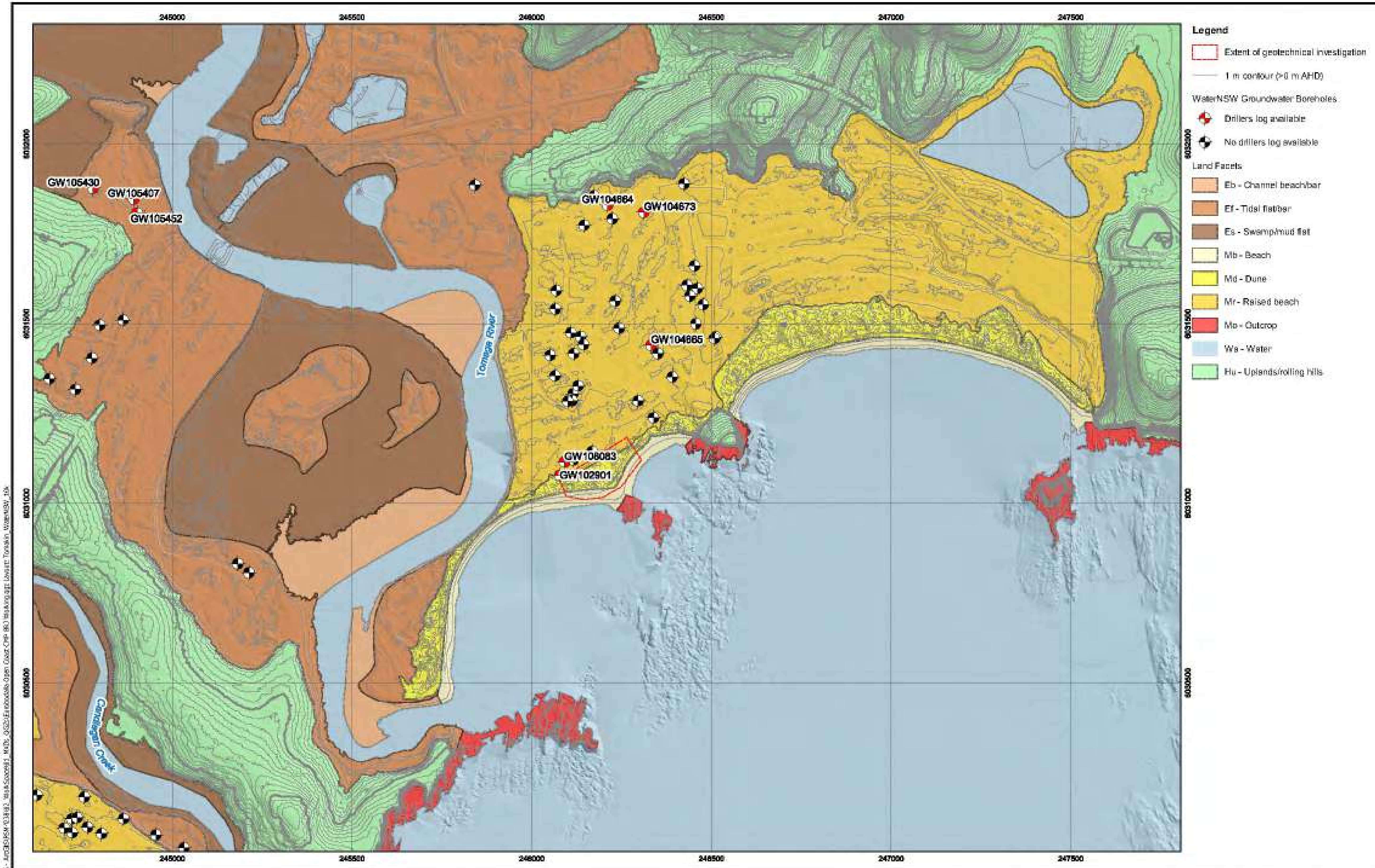
Paper Size: A3

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

TERRAIN CLASSIFICATION:
TOMAKIN (1:10,000)

PSM4238-005R

Figure A11



NOTES:
1. Groundwater bore information obtained from realtime.waternsw.com.au

Scale 1:10,000

N

0 100 200 300 400 m

Map Projection:
GDA2020 / MGA zone 56
EPSG:7856

P S M

Created By: BRJ

Revision: A

Date: 30 Jun 2021

Paper Size: A3

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

WaterNSW GROUNDWATER
BOREHOLE DATABASE:
TOMAKIN

PSM4238-005R

Figure A12

Appendix B
Field Mapping Sheets

NOTES:
1. DEM generated from LiDAR and bathymetry data obtained from elevation.fsd.org.au

Scale 1:3,000

0 25 50 75 100 m

Map Projection: GDA2020 / MGA zone 56 EPSG:7856

Created By: BRJ

Revision: A

Date: 28 Jun 2021

Paper Size: A3

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

TERRAIN CLASSIFICATION: SURFSIDE SOUTH (1:3,000)

PSM4238-005R

Figure B1

Eurobodalla CMP
PSM4238

Title: Surfside 1
Logged by: BRJ   Date / Time: 17/06/2021   Sheet 1 of 1

Viewing direction	NW	Comments

Elevation m (RL)

CHAINAGE

MATERIAL/MASS DESCRIPTION

Mapped Unit	Lithology	Weathering	Est. Strength	Colour	Fracture Spacing	Inferred GSI	Soil Description / Other Observations
A							SAND, light brown, trace silt, non-plastic, wet, very loose, uniform, marine
B	Sandstone	HW	L	Brown	10-30mm		Outcrop flanked by subcrop covered by marine sands
C							
D							

DEFECTS

ID	Type	Dip	Dip Dir. (Mag)	Roughness	Infill	Thickness (mm)	Spacing (m)	Shape	Persistence/ Termination
	BP	85	097	Rough	CN		0.1-0.3	CU	
	BP	71	099	Rough	CN		0.1-0.3	CU	
	BP	89	128	Rough	CN		0.1-0.3	CU	
	BP	88	309	Rough	CN		0.1-0.3	CU	
	BP	89	311	Rough	CN		0.1-0.3	CU	
	BP	76	313	Rough	CN		0.1-0.3	CU	
	BP	58	321	Rough	CN		0.1-0.3	CU	

Eurobodalla CMP
PSM4238

Title Surfside 2
Logged by BRJ Date / Time 17/06/2021 Sheet 1 of 1

PSM

Viewing direction	SW	Comments

Elevation m (RL)

CHAINAGE

MATERIAL/MASS DESCRIPTION

Mapped Unit	Lithology	Weathering	Est. Strength	Colour	Fracture Spacing	Inferred GSI	Soil Description / Other Observations
A							SAND, light brown, wet, very loose, uniform, marine
B	Sandstone	HW	L	Brown	10-30cm		Outcrop and subcrop covered by marine sands
C							
D							

DEFECTS Bedding parting (BP) orientation averaged from several readings

ID	Type	Dip	Dip Dir. (Mag)	Roughness	Infill	Thickness (mm)	Spacing (m)	Shape	Persistence/ Termination
	BP	89	288	Rough	CN		0.1-0.3	CU	

Eurobodalla CMP
PSM4238

Title Surfside 3
Logged by BRJ Date / Time 17/06/2021 Sheet 1 of 1

PSM

Viewing direction	NW	Comments

Elevation m (RL)

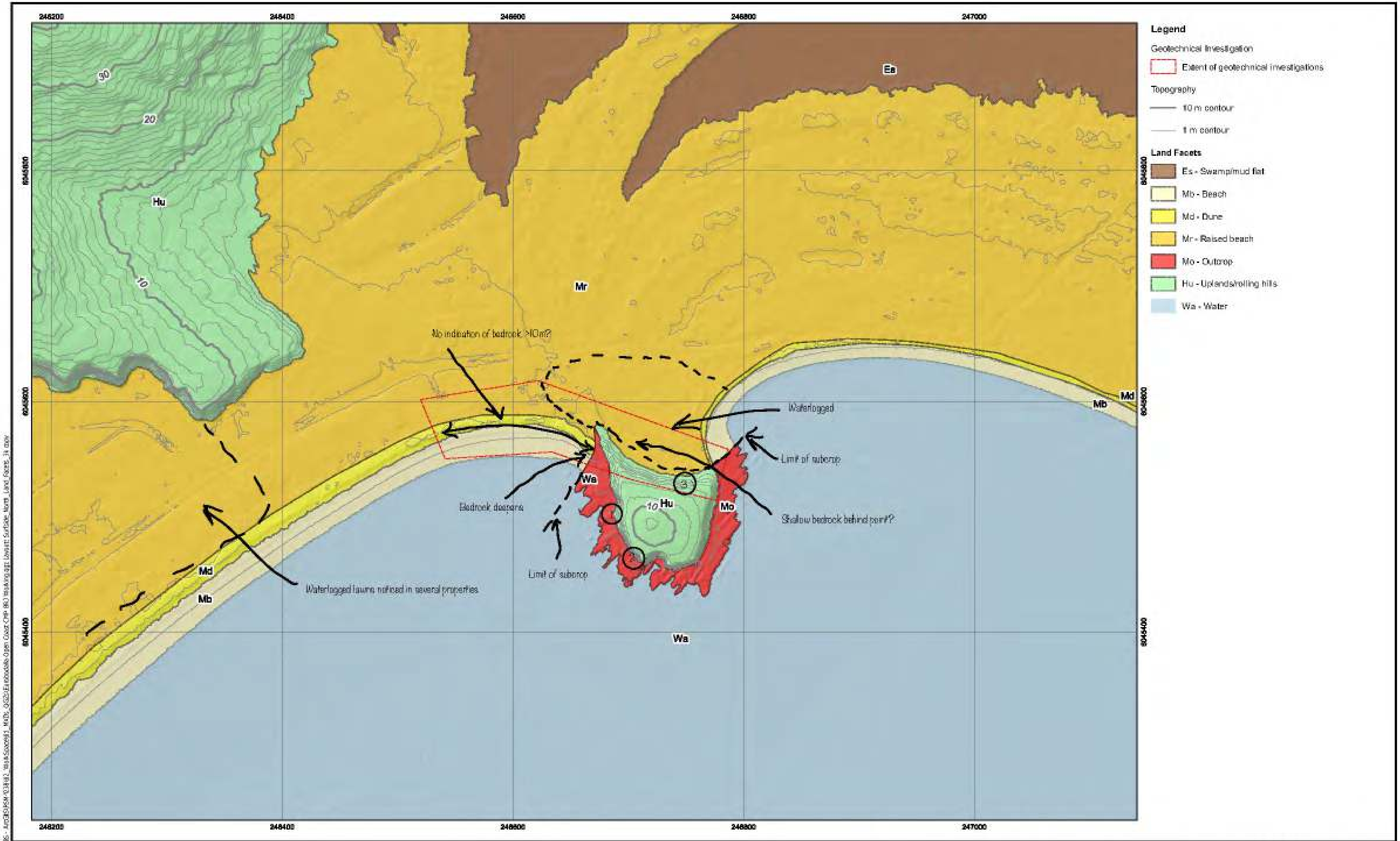
CHAINAGE

MATERIAL/MASS DESCRIPTION

Mapped Unit	Lithology	Weathering	Est. Strength	Colour	Fracture Spacing	Inferred GSI	Soil Description / Other Observations
A							SANDY SILT, low plasticity, dark brown, with clay and gravel, moist, loose poorly graded, colluvium
B							SAND, light brown, trace silt, non-plastic, moist, very loose, marine
C	Sandstone	HW	L	Brown	10-30cm		
D							SAND, light brown, minor gravel, non-plastic, moist, very loose, marine

DEFECTS

ID	Type	Dip	Dip Dir. (Mag)	Roughness	Infill	Thickness (mm)	Spacing (m)	Shape	Persistence/ Termination
	BP	85	113	Rough	CA		0.1-0.3	CU	



NOTES:
1. DEM generated from LiDAR and bathymetry data obtained from elevation.fsd.org.au

Scale 1:3,000

0 25 50 75 100 m

Map Projection: GDA2020 / MGA zone 56 EPSG:7856

Created By: BRJ

Revision: A

Date: 28 Jun 2021

Paper Size: A3

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

TERRAIN CLASSIFICATION: SURFSIDE NORTH (1:3,000)

PSM4238-005R

Figure B2

Eurobodalla CMP
PSM4238

Title Surfside 4

Logged by BRJ Date / Time 17/06/2021 Sheet 1 of 1

P S M

Viewing direction	SE	Comments

Elevation m (RL)

CHAINAGE

MATERIAL/MASS DESCRIPTION

Mapped Unit	Lithology	Weathering	Est. Strength	Colour	Fracture Spacing	Inferred GSI	Soil Description / Other Observations
A							SILTY SAND, low plasticity, with clay and gravel, moist, loose, poorly graded colluvium
B	Interbedded Sandstone/ Siltstone	HW/MW	L	Grey	0.1-0.2		Pockets of unit A
C							SILTY GRAVEL, low plasticity, with sand, moist, loose, poorly graded colluvium
D	Interbedded Sandstone/ Siltstone	MW	L	Brown	0.1-0.3		

DEFECTS

ID	Type	Dip	Dip Dir. (Mag)	Roughness	Infill	Thickness (mm)	Spacing (m)	Shape	Persistence/ Termination
	BP	47	309						
	BP	54	304						
	BP	53	315	Rough	SA			[illegible]	
	BP	86	119						
	BP	84	120						

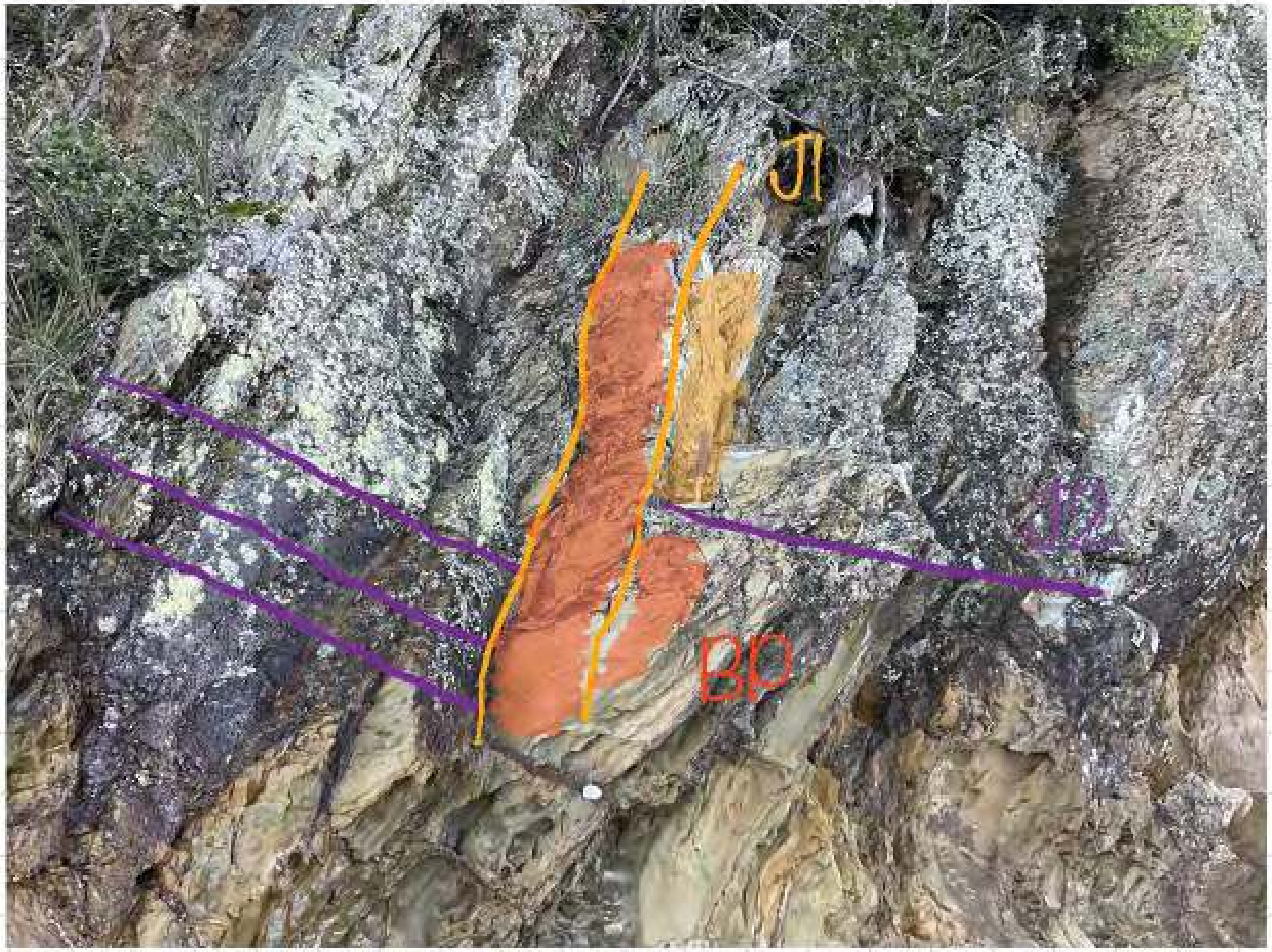
Eurobodalla CMP
PSM4238

Title: Surfside 5
Logged by: BRJ   Date / Time: 17/06/2021   Sheet 1 of 1

P S M

Viewing direction		Comments

Elevation m (RL)



CHAINAGE

MATERIAL/MASS DESCRIPTION

Mapped Unit	Lithology	Weathering	Est. Strength	Colour	Fracture Spacing	Inferred GSI	Soil Description / Other Observations
A	Interbedded Sandstone/ Siltstone	HW	L	Brown			
B							
C							
D							

DEFECTS

ID	Type	Dip	Dip Dir. (Mag)	Roughness	Infill	Thickness (mm)	Spacing (m)	Shape	Persistence/ Termination
	BP	75	283						
	BP	81	296						
	BP	84	295						
	BP	85	293	Rough	CA			CU	
	J1	75	189						
	J1	74	182						
	J1	85	178						
	J2	39	104						

Eurobodalla CMP
PSM4238

Title Surfside 6
Logged by BRJ Date / Time 17/06/2021 Sheet 1 of 1

Viewing direction		Comments

Elevation m (RL)

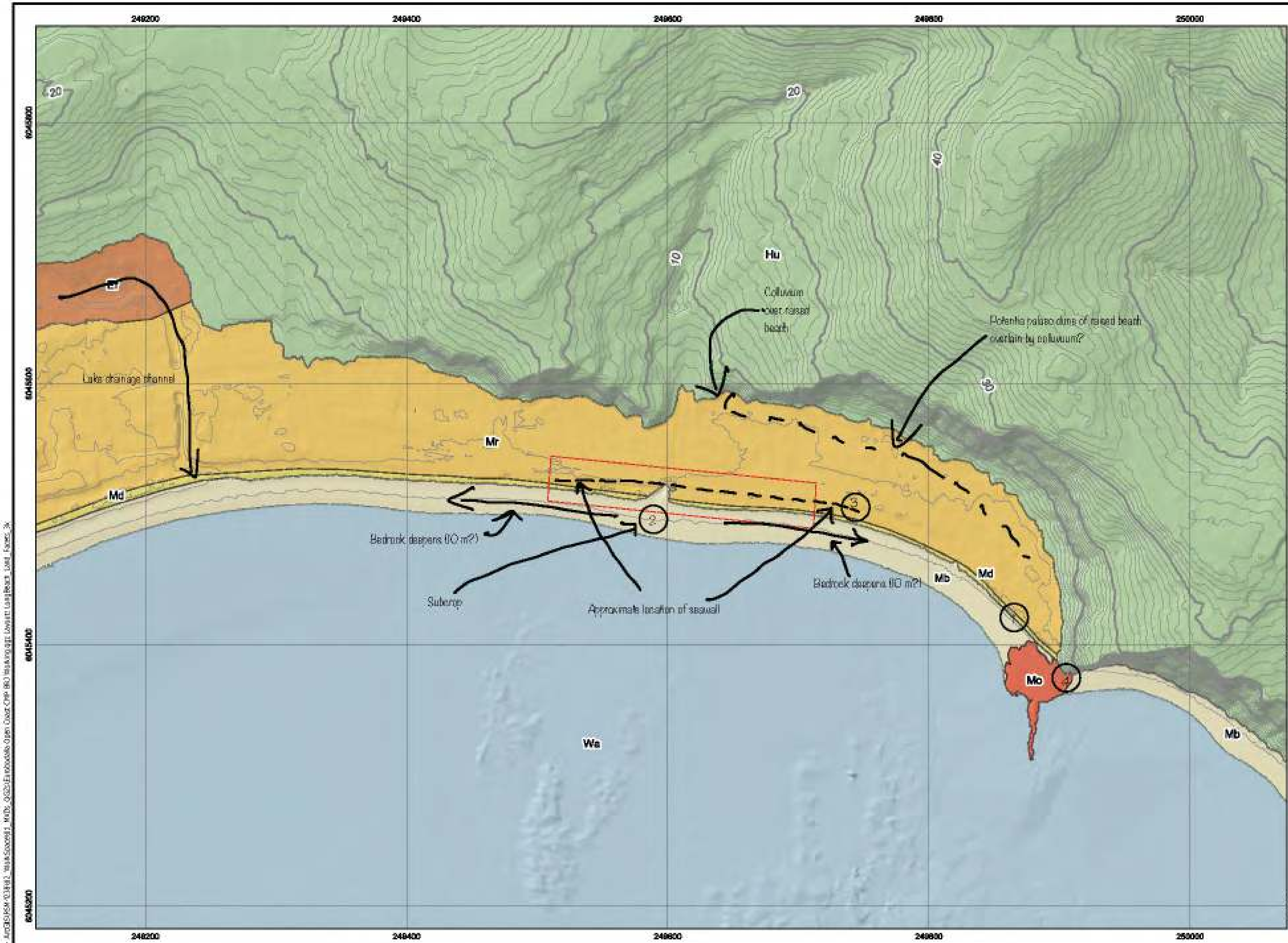
CHAINAGE

MATERIAL/MASS DESCRIPTION

Mapped Unit	Lithology	Weathering	Est. Strength	Colour	Fracture Spacing	Inferred GSI	Soil Description / Other Observations
A							SILTY SAND, low plasticity, with clay and gravel, moist, loose, poorly graded colluvium
B	Siltstone	CW/HW	VL	Pale orange	0.1-0.2		
C							
D							

DEFECTS

ID	Type	Dip	Dip Dir. (Mag)	Roughness	Infill	Thickness (mm)	Spacing (m)	Shape	Persistence/ Termination



Legend

Geotechnical Investigation

- Extent of geotechnical investigations

Topography

- 10 m contours
- 1 m contours

Land Facets

- Ef - Tidal flat/bar
- Mb - Beach
- Md - Dune
- Mr - Raised beach
- Mo - Outcrop
- Hu - Uplands/rolling hills
- Wa - Water

NOTES:
1. DEM generated from LiDAR and bathymetry data obtained from elevation.fsdf.org.au

Scale 1:3,000

0 25 50 75 100 m

Map Projection: GDA2020 / MGA zone 56 EPSG:7856

Created By: BRJ	Revision: A		
Date: 30 Jun 2021	Paper Size: A3		

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

TERRAIN CLASSIFICATION:
LONG BEACH (1:3,000)

PSM4238-005R | Figure B3

Eurobodalla CMP
PSM4238

Title Long Beach 1
Logged by BRJ Date / Time 17/06/2021 Sheet 1 of 1

PSM

Viewing direction	NE	Comments	Eastern end of Long Beach

Elevation m (RL)

CHAINAGE

MATERIAL/MASS DESCRIPTION

Mapped Unit	Lithology	Weathering	Est. Strength	Colour	Fracture Spacing	Inferred GSI	Soil Description / Other Observations
A							SILT, low plasticity, dark brown with minor sand and gravel, moist, very soft, homogenous, colluvium
B							CLAY, medium plasticity, light brown mottled yellow, with gravel, moist, very soft, homogenous, residual
C							SAND, light brown, wet, very loose, uniform, marine (deposited adjacent to terrestrial profile)
D							

DEFECTS

ID	Type	Dip	Dip Dir. (Mag)	Roughness	Infill	Thickness (mm)	Spacing (m)	Shape	Persistence/ Termination

Eurobodalla CMP
PSM4238

Title Long Beach 2
Logged by BRJ   Date / Time 17/06/2021   Sheet 1 of 1

PSM

Viewing direction	W	Comments	Mid-Long Beach below intersection of Bay Road and Fauna Avenue

Elevation m (RL)

CHAINAGE

MATERIAL/MASS DESCRIPTION

Mapped Unit	Lithology	Weathering	Est. Strength	Colour	Fracture Spacing	Inferred GSI	Soil Description / Other Observations
A							SAND, light brown, wet, very loose, uniform, marine
B	Sandstone	HW	L	Brown			Scattered subcrop covered by marine sands
C							
D							

DEFECTS

ID	Type	Dip	Dip Dir. (Mag)	Roughness	Infill	Thickness (mm)	Spacing (m)	Shape	Persistence/ Termination

Eurobodalla CMP
PSM4238

Title Long Beach 3
Logged by BRJ Date / Time 17/06/2021 Sheet 1 of 1

PSM

Viewing direction	W	Comments Mid-Long Beach.

Elevation m (RL)

CHAINAGE

MATERIAL/MASS DESCRIPTION

Mapped Unit	Lithology	Weathering	Est. Strength	Colour	Fracture Spacing	Inferred GSI	Soil Description / Other Observations
A							Boulders, dark grey, with sand (matrix), possible sea wall?
B							SAND, light brown and grey, with gravel moist, very loose, poorly graded, possibly marine reworked with uncontrolled fill?
C							
D							

DEFECTS

ID	Type	Dip	Dip Dir. (Mag)	Roughness	Infill	Thickness (mm)	Spacing (m)	Shape	Persistence/ Termination

Eurobodalla CMP
PSM4238

Title: Longbeach 4
Logged by: BRJ   Date / Time: 17/06/2021   Sheet 1 of 1

PSM

Viewing direction	NE	Comments

Elevation m (RL)

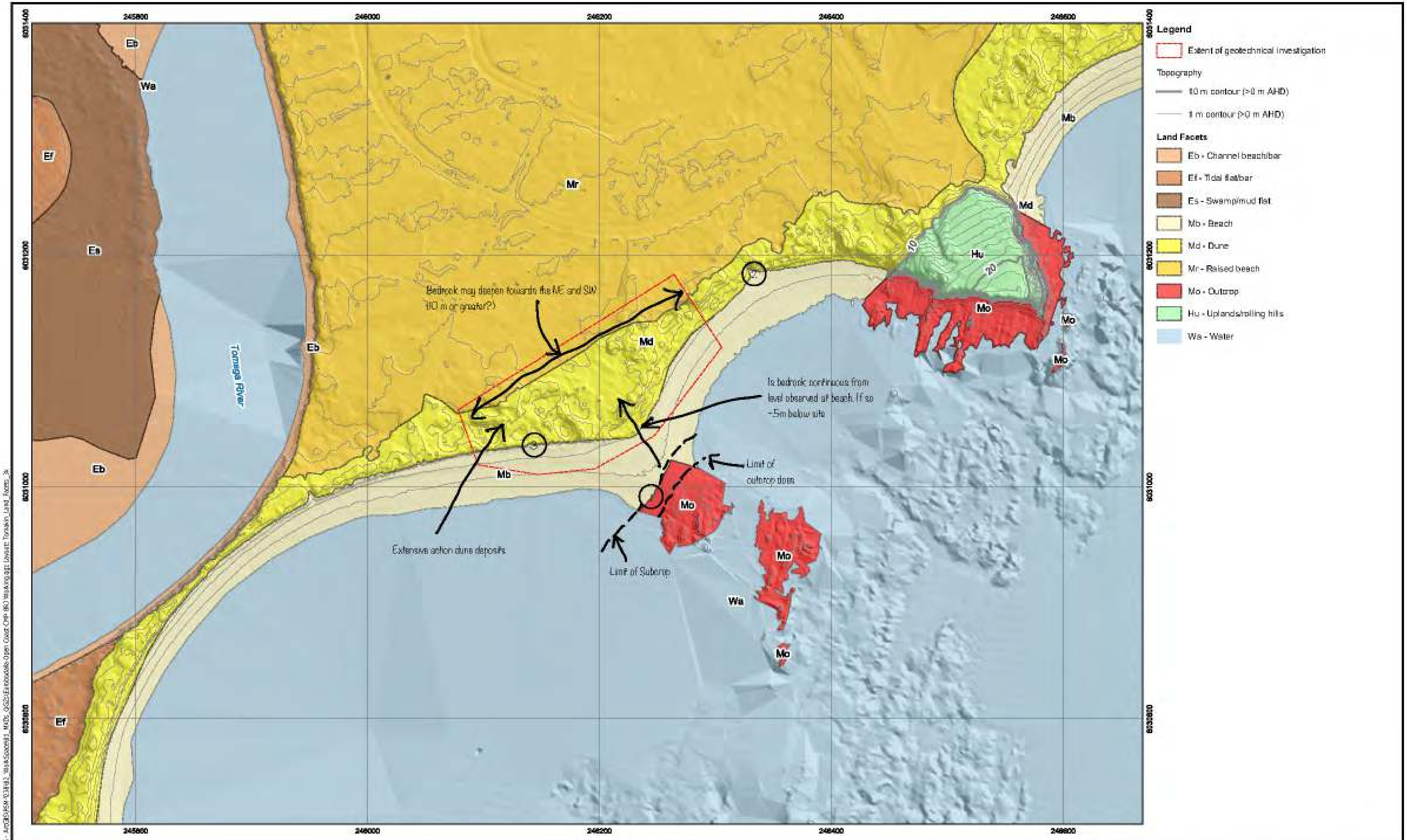
CHAINAGE

MATERIAL/MASS DESCRIPTION

Mapped Unit	Lithology	Weathering	Est. Strength	Colour	Fracture Spacing	Inferred GSI	Soil Description / Other Observations
A	Interbedded Sandstone/ Siltstone	HW	L	Light Brown			Fine grained sandstone with minor chert. Very oxidised and leached throughout outcrop
B	Basalt	HW	M	Dark Brown			Very oxidised
C							
D							

DEFECTS

ID	Type	Dip	Dip Dir. (Mag)	Roughness	Infill	Thickness (mm)	Spacing (m)	O0Shape	Persistence/ Termination
	BP	73	251						
	BP	81	253						



NOTES:
1. DEM generated from LiDAR and bathymetry data obtained from elevation.fsd.org.au

Scale 1:3,000

0 50 100 m

Map Projection: GDA2020 / MGA zone 56 EPSG:7856

PSM

Created By: BRJ

Revision: A

Date: 29 Jun 2021

Paper Size: A3

Eurobodalla Shire Council
Eurobodalla CMP - Open Coast
Geotechnical Investigation

TERRAIN CLASSIFICATION:
TOMAKIN (1:3,000)

PSM4238-005R

Figure B4

Eurobodalla CMP
PSM4238

Title Tomakin 1
Logged by BRJ   Date / Time 17/06/2021   Sheet 1 of 1

Viewing direction	S	Comments

Elevation m (RL)

CHAINAGE

MATERIAL/MASS DESCRIPTION

Mapped Unit	Lithology	Weathering	Est. Strength	Colour	Fracture Spacing	Inferred GSI	Soil Description / Other Observations
A							Sand, light brown, trace silt, non-plastic, very loose, uniform, marine
B	Sandstone	HW	L	Brown			Subcrop of sandstone covered by marine sands
C	Sandstone	HW	L	Brown			
D							

DEFECTS

ID	Type	Dip	Dip Dir. (Mag)	Roughness	Infill	Thickness (mm)	Spacing (m)	Shape	Persistence/ Termination
	BP	75	097						

Eurobodalla CMP
PSM4238

Title: Tomakin 2
Logged by: BRJ Date / Time: 17/06/2021 Sheet 1 of 1

PSM

Viewing direction	NW	Comments

Elevation m (RL)

CHAINAGE

MATERIAL/MASS DESCRIPTION

Mapped Unit	Lithology	Weathering	Est. Strength	Colour	Fracture Spacing	Inferred GSI	Soil Description / Other Observations
A							Silty sand, low plasticity, loose poorly graded, topsoil
B							Sand, light brown, trace silt, non-plastic, loose, marine
C							
D							

DEFECTS

ID	Type	Dip	Dip Dir. (Mag)	Roughness	Infill	Thickness (mm)	Spacing (m)	Shape	Persistence/ Termination

Eurobodalla CMP
PSM4238

Title Tomakin 3
Logged by BRJ Date / Time 17/06/2021 Sheet 1 of 1

Viewing direction	NE	Comments

Elevation m (RL)

CHAINAGE

MATERIAL/MASS DESCRIPTION

Mapped Unit	Lithology	Weathering	Est. Strength	Colour	Fracture Spacing	Inferred GSI	Soil Description / Other Observations
A							Sand, light brown, non-plastic, with silt, loose, Marine (Aeolian dune)
B							Sand, light brown, non-plastic, loose, well graded, Marine (beach)
C							
D							

DEFECTS

ID	Type	Dip	Dip Dir. (Mag)	Roughness	Infill	Thickness (mm)	Spacing (m)	O0Shape	Persistence/ Termination

Appendix C
Geophysical Survey Report

Report
prepared for

Pells Sullivan Meynink

On behalf of

Eurobodalla Shire Council

SEISMIC REFRACTION SURVEY
Batemans Bay, NSW

June 2021 ETS Report No ET524.01

Report prepared by:
Earth Technology Solutions Pty Ltd
ABN 12 078 325 658
35 O'Keefe Crescent
Eastwood NSW 2122

Ph: 02 9804 1752

TABLE OF CONTENTS

1.0 INTRODUCTION

At the request of Pells Sullivan Meynink (PSM) on behalf of Eurobodalla Shire Council, seismic refraction testing was completed at sites at Surfside, Long Beach and Tomakin, NSW.

The seismic survey was undertaken as part of an investigation for sediment erosion at these sites. The objective of the seismic study was to provide the subsurface seismic velocity distribution to assist the assessment of the bedrock profile and general subsurface conditions at each site.

A single seismic refraction line was completed at each site as close as possible to the indicated preferred positions, given any minor site and access constraints. A site plan is provided in Figure 1 which shows the location of each seismic line on aerial photographs of the sites.

The coordinates of the start and end points of each of the seismic lines, are listed in section 4.0, and are also shown on the interpreted seismic sections.

The fieldwork was carried out from the 22nd to 24th June 2021. The seismic data acquisition was carried out in accordance with the standard engineering seismic practice as described below.

2.0 EQUIPMENT

2.1 Seismograph

Geometrics STRATAVISOR 48 channel engineering seismographs were used. This unit has internal calibration, paper printer and hard and floppy disc drive capability. A sampling interval of 0.064 milliseconds was used and typically a record length of 120 millisecond.

2.2 Geophones

The geophones used for the survey were Geospace GS11D, with a natural resonant frequency of 8Hz. A rigid coupling with the ground was obtained with 75mm tapered spikes on the geophone base. The seismic refraction testing was completed using a linear array of up to 48 geophones, connected via two 24 channel multi-core cables to the seismograph.

2.3 Seismic Source

A triggered 14lb sledge hammer impacting an aluminium strike plate was used as the seismic source. A number of impacts were stacked until sufficient quality seismic data was achieved. Typically between 5 and 15 impacts were required, depending on the position within the spread and the level of background noise.

In general the background noise was relatively low with minimal traffic, and relatively low wave energy. The data acquisition at the Surfside site was impacted by some heavy vehicles on the adjacent Wharf Road, however sufficient breaks in traffic at this site enabled very good quality data to be acquired.

3.0 FIELD PROCEDURES

3.1 Geophone and Source Point Configurations

A 3m geophone spacing was used with a source spacing of 9m for the Surfside profile, whilst at the remaining sites a 2m geophone spacing and 12m shot spacing was considered more appropriate. The end source points were generally external - undertaken 1.5m beyond the end geophone. Typically 3 to 4 offset source points were used for each spread at approximately 13m, 25m, and 45m from the end shots were access permitted.

Generally access for the offset source points was very good. Typically 15 to 20 seismic source positions were used for each full spread resulting in reversed coverage seismic data with source-receiver offsets of over 150m.

3.2 Positioning

The seismic lines were positioned based on the lines indicated on aerial photo plans provided by PSM. Some minor repositioning of some of the seismic lines were required to avoid surface features.

Generally the ground surfaces were relatively flat. Surface elevations along each seismic line were surveyed by the seismic crew and tied in to adjacent State Survey Marks to allow reduction to AHD. Positioning along the lines during the seismic survey was maintained using 100m tapes along the ground surface.

3.3 Records and Documentation

All seismic data were recorded on hard drive and copied to field computer. A complete set of seismic data and field records has been archived.

4.0 SUMMARY OF SEISMIC LINES COMPLETED

A summary of the seismic refraction work completed is provided below.

Line	Start & End	Distance	Position: MGA56 & AHD(m)		
			Easting	Northing	Elevation
Surside (South)	Start	0m	245837	6045210	1.2
	End	123m	245928	6045132	0.8
Surfside (North)	Start	0m	246579	6045591	2.4
	End	24m	246556	6045588	2.3
Long Beach	Start	0m	249700	6045510	2.3
	End	184m	249516	6045530	2.6
Tomakin	Start	0m	246193	6031078	4.2
	End	26m	246181	6031101	4.1

5.0 INTERPRETATION PROCEDURES

The digital seismic records were examined and the first arrival times were determined using REFRACT2006 software. Generally the data was considered of good to very good quality signal to noise.

The seismic data were interpreted using the interpretation program REFRACT 2006, which is based on the Intercept Time Method and the Reciprocal Method in accordance with accepted engineering seismic practice.

Following manual identification and editing of the travel-times of the first arrival seismic energy. As the seismic source was surface impacts no shot depth corrections were required. Reciprocal time checks were determined automatically and edited manually to reduce any reciprocal time errors. The interpretation continued with segmentation of the T-X graph to identify individual layers. Velocity analysis followed using the computed Minus-Time Graph, derived from the reverse overlapped phantomed data for each layer. Least squares fitted lines were manually selected from each refractor, allowing identification of lateral velocity changes along the profile, and the velocities were computed.

The time depths and layer thicknesses, which were computed automatically, were checked, edited to remove any obvious errors, and any highly irregular layer surfaces manually smoothed.

The final output of the seismic refraction method is an interpreted seismic section, which is a 2 dimensional representation of the earth beneath the survey line. Discrete layers of differing seismic velocity were interpreted with measured lateral velocity variations indicated within each layer.

The surface elevations along each seismic line as measured by the project surveyor were input into REFRACT 2006 to allow reduction of the interpreted seismic sections to AHD.

6.0 RESULTS

The interpreted seismic sections for each of the seismic refraction lines completed are provided in Figures 2 to 5. The seismic lines for Surfside (south) and Long Beach are presented at a natural scale of 1:500 (A3) and at 1:250 (A3) for the shorter lines at Surfside (North) and Tomakin. The distance shown on the x-axis is the distance along the line from the start of each seismic line.

The interpreted seismic sections were also provided to PSM in .DXF format as output by REFDRAW, to enable inclusion of these seismic sections with other geotechnical data if required.

Typically three to four layers of differing seismic velocity were interpreted with interpreted seismic velocities range from 300m/s in the surface layer to 3500m/s at depth.

As with all seismic methods, seismic refraction has some inherent limitations in effectively representing subsurface conditions in all geological environments. Some of these issues are presented in Appendix A – Guide to the Use of Interpreted Seismic Sections. This offers some general information on the seismic refraction method including the precision and accuracy of results and the possible effects of violations of the assumptions on which the method and interpretation procedure is based.

A brief summary of the interpreted seismic velocity ranges for each seismic layer identified, and the key points and limitations of the seismic interpretations are provided for each seismic line. A general geological interpretation for each seismic layer is provided based solely on the seismic velocity range and general site observations. The interpretations should be correlated with any available geological mapping and borehole information where possible.

Surfside South (Figure 2)

The seismic line at Surfside was positioned along the beach at approximately the high tide mark. The work was undertaken at or near low tide.

There is some evidence in the seismic travel-time data of velocity increase with depth within Seismic Layers 2 and 3.

The following geological interpretations have been based on the interpreted seismic velocities obtained in comparison with previous seismic surveys. The results obtained are summarised below in terms of a generally layered earth.

Layer	Seismic Velocity (m/s)	General Geological Interpretation (Based on seismic velocity ranges)
1	1500–1550	Saturated SAND Medium Dense to Dense
2	2200–2800	HW to MW ROCK, Moderate to High strength.
3	2800–3500	SW to Fresh ROCK, High to Very High strength.

The bedrock profile (Seismic Layer 2) is interpreted at a level varying from approximately RL-1.5m (approx 2.3m depth) in the South East of the seismic line and deepens to generally RL -6m (approx 8m depth) towards the North West.

Surfside North (Figure 3) adjacent to Cullendulla Reserve

Seismic Layers 2 and 3 are relatively thin, and the velocities of these layers are based on limited data (hatched areas on the interpreted seismic sections)

The following geological interpretations have been based on the interpreted seismic velocities obtained in comparison with previous seismic surveys with borehole correlations and the results obtained are summarised below in terms of a generally layered earth.

Layer	Seismic Velocity (m/s)	General Geological Interpretation (Based on seismic velocity ranges)
1	300–350	Dry SAND, Medium Dense to Dense
2	1100-1350	Partially saturated to saturated SAND, M Dense to Dense
3	1950–2200	EW to HW ROCK, Low to Moderate strength.
4	2250–2400	HW to SW ROCK, Moderate to High strength.

The bedrock profile (Seismic Layer 3) is interpreted at a level varying from approximately RL-1.5m to RL-3m (approx 3.5m to 6m depth).

Long Beach (Figure 4)

There is some evidence in the seismic travel-time data of velocity increase with depth within Seismic Layer 4.

The following geological interpretations have been based on the interpreted seismic velocities obtained and the results obtained are summarised below in terms of a generally layered earth.

Layer	Seismic Velocity (m/s)	General Geological Interpretation (Based on seismic velocity ranges)
1	300-450	Dry SAND, Medium Dense to Dense
2	600–1450	Partially saturated to saturated SAND M Dense to Dense
3	1700–1950	Highly Fractured EW to MW ROCK, Moderate to High strength, or potentially very Dense SAND /GRAVEL with ROCK boulders.
4	1900–2300	MW to SW ROCK, Moderate to High strength.

The seismic velocities of Layer 3 are not unambiguously indicative of a ROCK profile and could potentially represent very dense saturated SAND/GRAVEL. However given the nature of the highly fractured and weathered rock reefs visible on the adjacent headland and just offshore from that section of the beach, it is considered that this layer represents highly fractured and/or weathered rock.

Seismic Layer 3 is interpreted at a level varying from approximately RL-0.5m to RL-2.5m (approx 3.5m to 5m depth).

Tomakin (Figure 5)

The following geological interpretations have been based on the interpreted seismic velocities obtained in comparison with previous seismic surveys.

Layer	Seismic Velocity (m/s)	General Geological Interpretation (Based on seismic velocity ranges)
1	350	Dry SAND, Medium Dense to Dense
2	600–950	Partially saturated SAND M Dense to Dense
3	1550–1650	Highly Fractured EW to MW ROCK, Moderate to High strength, or potentially Dense to very DENSE SAND /GRAVEL.
4	2000–2100	EW to MW ROCK, Low to Moderate strength.

Again the seismic velocities of Layer 3 are not unambiguously indicative of a ROCK profile and could potentially represent dense saturated SAND or GRAVEL. However given the highly fractured and weathered rock reef visible immediately offshore from this section of the beach, it is considered that this layer represents highly fractured and/or weathered rock or at least a significant concentration of ROCK boulders. This layer varies from approximately 2m to 4m thick.

Seismic Layer 4 is interpreted at a level varying from approximately RL-3m to RL-5.5m (approx 7m to 9.5m depth).

7.0 CONCLUSIONS

Seismic refraction testing was successfully completed along the designated profiles and the seismic data acquired is considered generally of good quality. This seismic study has generally delineated 4 layers of differing seismic velocity within the shallow subsurface with interpreted seismic velocities range from 300m/s in the surface layer to 3500m/s at depths of up to 15m.

Whilst these seismic velocity ranges are indicative of and consistent with a range of material from dry SAND through to Fresh High strength ROCK and a general interpretation based on the interpreted seismic velocity ranges have are provided. There is some ambiguity of the geological interpretation of Seismic Layer 3 at Long Beach and Tomakin due to the intermediate seismic velocities obtained.

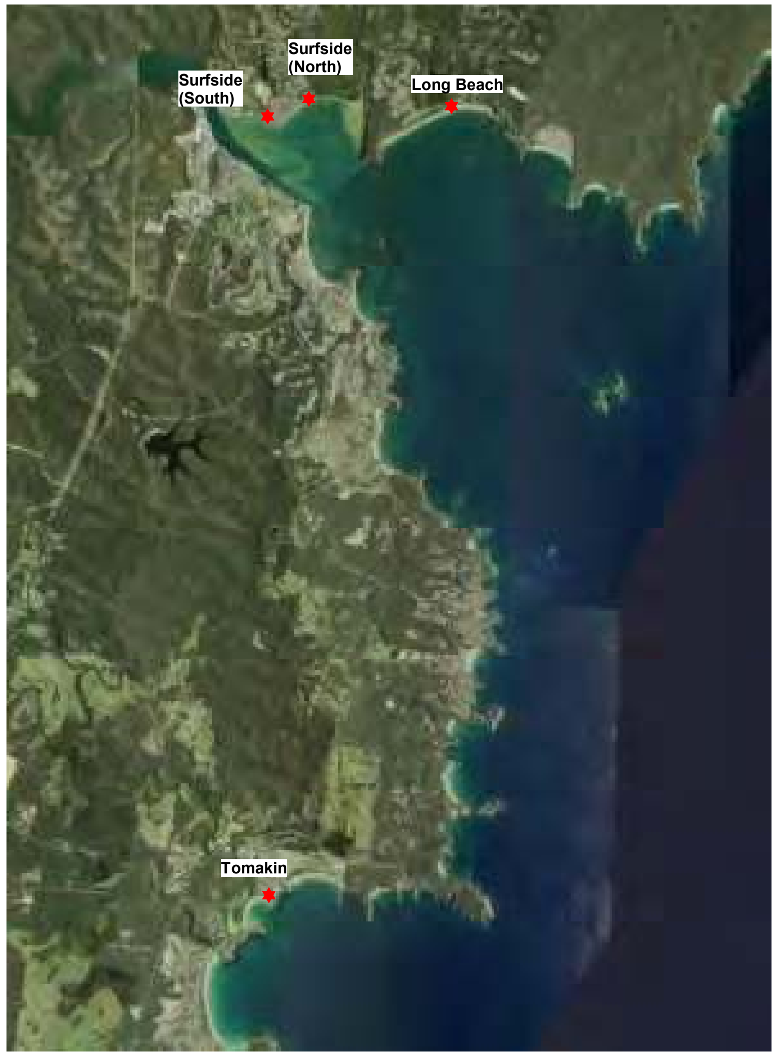
This seismic information should be correlated, where possible, with any boreholes or other geotechnical information, to increase the understanding of the subsurface conditions. Appendix A – Guide to the Use of Interpreted Seismic Sections is provided to offer some general information on the seismic refraction method including the precision and accuracy of results and should be read before using the seismic sections.

Surfside Beach (South)

Surfside Beach (North - adjacent Cullendulla Reserve)

N

Overall Site Plan



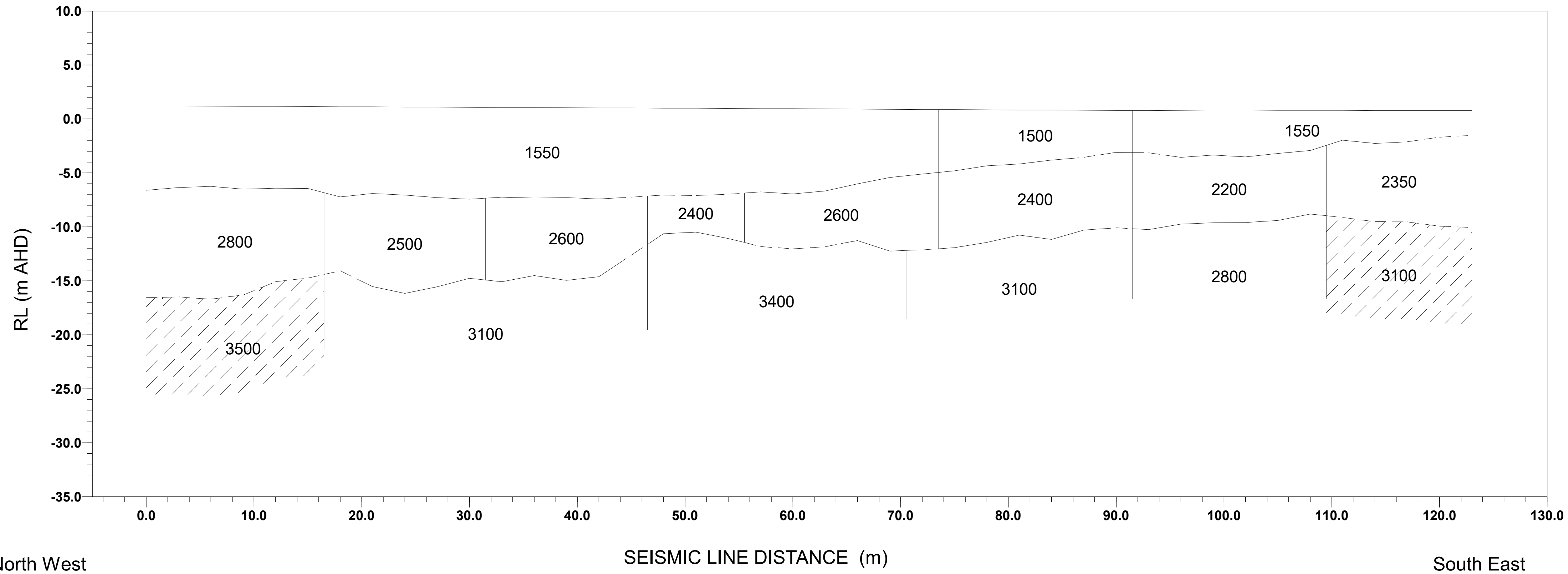
Long Beach

Tomakin

Location of Seismic Lines and coordinates of End Points

Pells Sullivan Meynink / Eurobodalla Shire Council Seismic Refraction Survey Selected Sites, Batemans Bay, NSW Site Plan - Showing Location of Seismic Lines	Earth Technology Solutions Pty Ltd ABN 12 078 325 628 Job No.: ET524.1 Date: 29/06/21 **ETS** **Figure 1**

INTERPRETED SEISMIC SECTION : SURFSIDE (SOUTH)



North West
0m (start)
E: 245837mE
N: 6045210mN RL: 1.2m AHD

South East
123m (end)
E: 245928mE
N: 6045132mN RL: 0.8m AHD

Scale H 1:500 (@ A3)
V 1:500

LEGEND

Seismic velocity (m/s) and interpreted refractor boundary based on reciprocal method minus time and time depths 1800

Seismic velocity (m/s) based on reciprocal method minus times, interpreted refractor boundary based on reciprocal method time depths (solid line) or limited data* [(2), (3)] (dashed line) 1800

Seismic velocity based on limited data* [(1), (3)] (hatched area) and the value of the hatched area is the same as the adjacement minus times velocity 1800

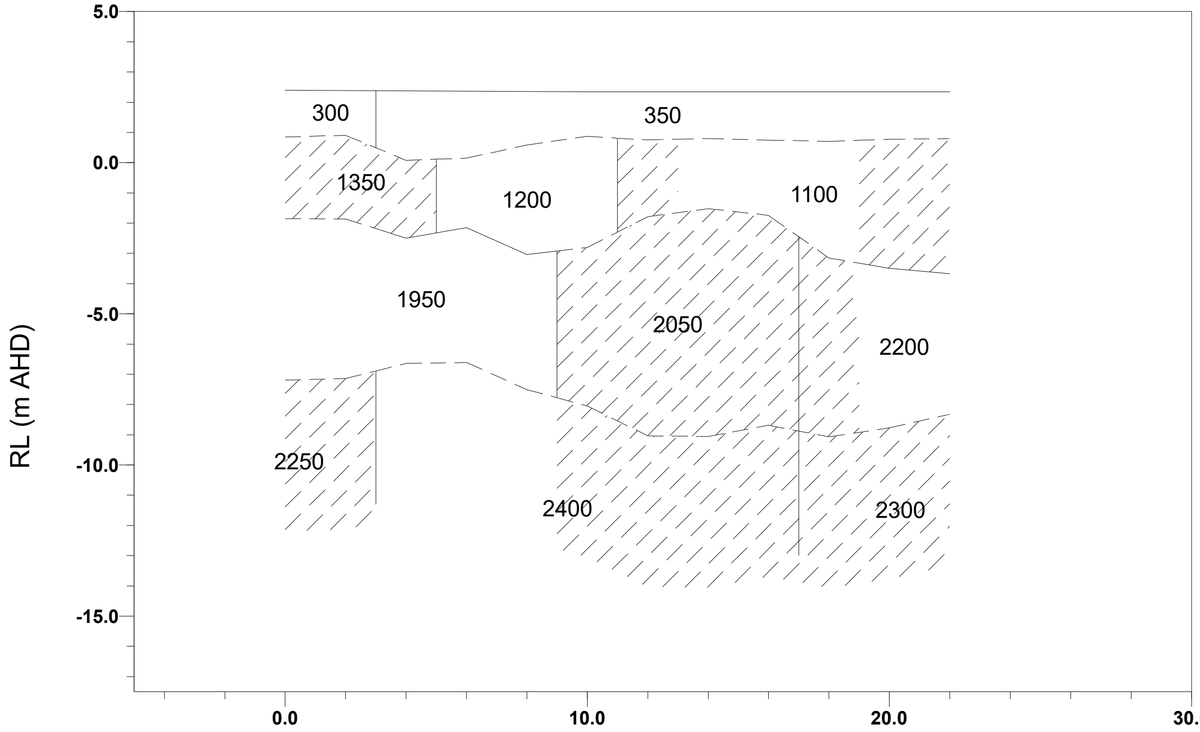
Seismic velocity (m/s) based on limited data* [(1), (3)] (hatched area) and interpreted refractor boundary based on limited data* [(1), (2) & (3)] (dashed line) 1800

Lateral seismic velocity boundary ....

* NB - Limited data includes harmonic mean velocity (1), interpolated time depth (2) or edited data (3)

EARTH TECHNOLOGY SOLUTIONS PTY LTD ABN 12 078 325 658			ETS
AUTHORISED : PF	Pells Sullivan Meynink / Eurobodalla Shire Council SEISMIC REFRACTION SURVEY Interpreted Seismic Section SURFSIDE BEACH (South)		
DATE : 29 June 2021			
DRAWN BY PF FOR ETS	REPORT ET524/ 1	SCALE H 1:500 @ A3	Figure No. 2

INTERPRETED SEISMIC SECTION : SURFSIDE (NORTH)



East
0m (start)
E: 246579mE
N: 6045591mN RL: 2.4m AHD

West
22m (end)
E: 246556mE
N: 6045588mN RL: 2.3m AHD

Scale H 1:250 (@ A3)
V 1:250

LEGEND

Seismic velocity (m/s) and interpreted refractor boundary based on reciprocal method minus time and time depths 1800

Seismic velocity (m/s) based on reciprocal method minus times, interpreted refractor boundary based on reciprocal method time depths (solid line) or limited data* [(2), (3)] (dashed line) 1800

Seismic velocity based on limited data* [(1), (3)] (hatched area) and the value of the hatched area is the same as the adjacement minus times velocity 1800

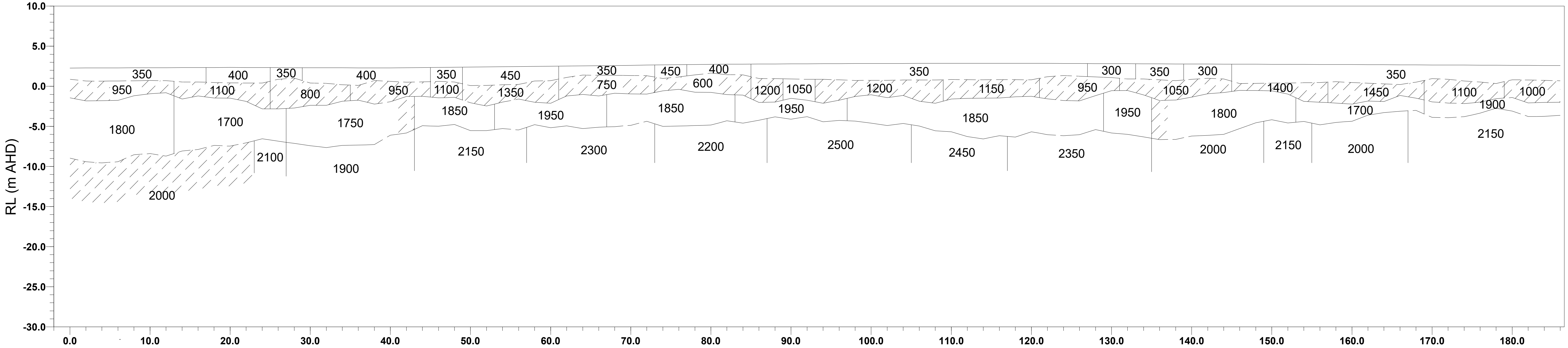
Seismic velocity (m/s) based on limited data* [(1), (3)] (hatched area) and interpreted refractor boundary based on limited data* [(1), (2) & (3)] (dashed line) 1800

Lateral seismic velocity boundary ....

* NB - Limited data includes harmonic mean velocity (1), interpolated time depth (2) or edited data (3)

EARTH TECHNOLOGY SOLUTIONS PTY LTD ABN 12 078 325 658			ETS
AUTHORISED : PF	Pells Sullivan Meynink / Eurobodalla Shire Council SEISMIC REFRACTION SURVEY Interpreted Seismic Section Surfside Beach (North) near Cullendulla Reserve		
DATE : 29 June 2021			
DRAWN BY PF FOR ETS	REPORT ET524/ 1	SCALE H 1:500 @ A3	Figure No. 3

INTERPRETED SEISMIC SECTION : LONG BEACH



SEISMIC LINE DISTANCE (m)

East
0m (start)
E: 249700mE
N: 6045510mN RL: 2.3m AHD

West
184m (end)
E: 249516mE
N: 6045530mN RL: 2.6m AHD

Scale H 1:500 (@ A3)
V 1:500

LEGEND

Seismic velocity (m/s) and interpreted refractor boundary based on reciprocal method minus time and time depths 1800

Seismic velocity (m/s) based on reciprocal method minus times, interpreted refractor boundary based on reciprocal method time depths (solid line) or limited data* [(2), (3)] (dashed line) 1800

Seismic velocity based on limited data* [(1), (3)] (hatched area) and the value of the hatched area is the same as the adjacement minus times velocity 1800

Seismic velocity (m/s) based on limited data* [(1), (3)] (hatched area) and interpreted refractor boundary based on limited data* [(1), (2) & (3)] (dashed line) 1800

Lateral seismic velocity boundary ....

* NB - Limited data includes harmonic mean velocity (1), interpolated time depth (2) or edited data (3)

EARTH TECHNOLOGY SOLUTIONS PTY LTD
ABN 12 078 325 658
ETS

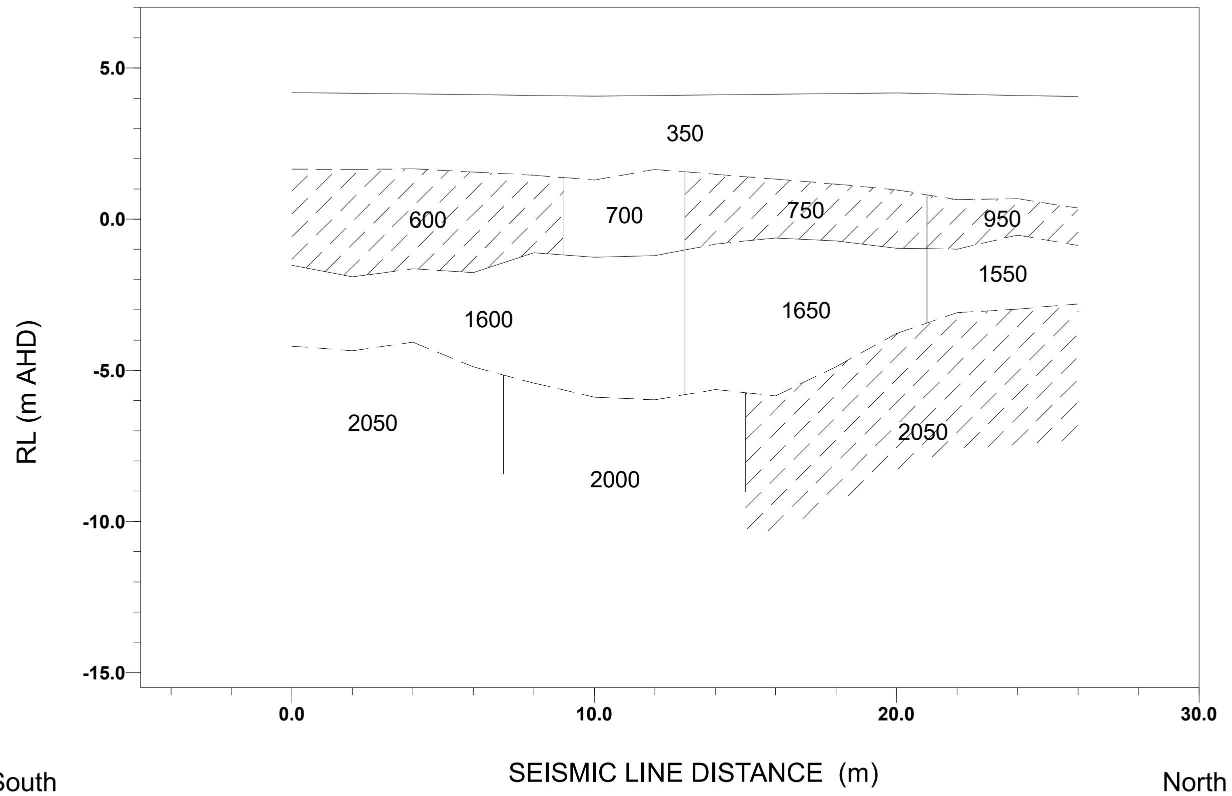
AUTHORISED : PF

DATE : 29 June 2021

Pells Sullivan Meynink / Eurobodalla Shire Council
SEISMIC REFRACTION SURVEY
Interpreted Seismic Section
LONG BEACH

DRAWN BY PF FOR ETS	REPORT ET524/ 1	SCALE H 1:500 @ A3	Figure No. 4

INTERPRETED SEISMIC SECTION : TOMAKIN



South
0m (start)
E: 246193mE
N: 6031078mN RL: 4.2m AHD

North
26m (end)
E: 246181mE
N: 6031101N RL: 4.1m AHD

Scale H 1:250 (@ A3)
V 1:250

LEGEND

Seismic velocity (m/s) and interpreted refractor boundary based on reciprocal method minus time and time depths 1800

Seismic velocity (m/s) based on reciprocal method minus times, interpreted refractor boundary based on reciprocal method time depths (solid line) or limited data* [(2), (3)] (dashed line) 1800

Seismic velocity based on limited data* [(1), (3)] (hatched area) and the value of the hatched area is the same as the adjacement minus times velocity 1800

Seismic velocity (m/s) based on limited data* [(1), (3)] (hatched area) and interpreted refractor boundary based on limited data* [(1), (2) & (3)] (dashed line) 1800

Lateral seismic velocity boundary ....

* NB - Limited data includes harmonic mean velocity (1), interpolated time depth (2) or edited data (3)

EARTH TECHNOLOGY SOLUTIONS PTY LTD ABN 12 078 325 658		ETS	
AUTHORISED : PF	Pells Sullivan Meynink / Eurobodalla Shire Council SEISMIC REFRACTION SURVEY Interpreted Seismic Section Tomakin		
DATE : 29 June 2021			
DRAWN BY PF FOR ETS	REPORT ET524/ 1	SCALE H 1:500 @ A3	Figure No. 5

APPENDIX A

A1 GUIDE TO THE USE OF INTERPRETED SEISMIC SECTIONS

The results of seismic refraction surveys are presented as vertical sections beneath the line of traverse. These sections show a two-dimensional distribution of seismic velocities, which have been interpreted from first arrival travel time data obtained in the field.

The following general summary is intended to assist in the understanding of the interpreted seismic sections provided.

A1.1 Methods Of Interpretation

First arrival travel times obtained for individual source locations representing the arrival at individual detectors of seismic waves which have travelled through the earth via least-time paths are determined interactively from the digital seismic field records. These times are plotted against distance from the source, as travel-time curves. These times are examined, reviewed and edited as necessary.

Further quantitative seismic interpretation, aimed at providing subsurface depth and velocity information, is carried out using the intercept time or reciprocal methods as appropriate. The interpretation method applied is determined by the field procedure used, the nature of the subsurface at the site, and by the objectives of the seismic study.

The interpretation provides a simplified seismic picture of the subsurface and depends on a number of assumptions about its nature. The major assumptions are:

i) The subsurface essentially consists of a series of discrete uniform layers which may vary laterally in velocity,
ii) The boundaries between these layers are distinct. For the simpler methods of interpretation, these boundaries are also assumed to be planar, but can be highly irregular,
iii) The seismic velocities of successive layers increase with depth,
iv) Each layer is of sufficient thickness to critically refract energy, and to produce a refracted wave arrival at the surface of sufficient energy to be detected as a first arrival.

These assumptions demonstrate requirements of the interpretation procedure for ideal conditions of which all of the requirements are unlikely to be fulfilled in reality. The extent to which each assumption is valid may vary from site to site and within a site. Consequently, at all sites, interpreted seismic sections are a simplification of the actual subsurface velocity distribution. The degree of simplification depends on the interpretative method used, the amount of data available for analysis and the extent to which the basic assumptions are violated at a site.

Some violations of the basic assumptions, such as diffractions from large irregularities, and non-critical refractions, may be observed in the seismic data or may be undetectable. Consequently the interpretation process is partly subjective; other interpretations of the data are possible and may differ considerably from the interpretation presented.

The effects of common violations of the assumptions are discussed in Section A1.3, below. Other effects, which may be relevant to the understanding of the seismic sections, are discussed in Section A1.4.

It should be noted that, at a given site, these effects can occur in virtually any combination and that, as a result, even highly complex subsurface conditions may give rise to relatively simple-looking seismic sections.

A1.2 <u>Precision And Accuracy Of Results</u>

A given seismic velocity does not necessarily uniquely determine the engineering properties of an earth material, even for the one rock type. For example a medium strength rock may have the same seismic velocity as a mixture of extremely low strength rock, and boulders or corestones of very high strength rock.

Moreover a relatively small proportion of extremely low strength material can dramatically lower the composite seismic velocity. For example a material composed of 50% boulders with seismic velocity 4000 m/s, and 50% of material with seismic velocity 800 m/s, then the composite velocity is lowered to 1333 m/s.

Interpreted velocities are usually shown on the seismic sections to the nearest 50 or 100 m/s. Interpreted velocities, as a measure of the actual field velocities, are not regarded as being accurate to better than ± 10%, but can be independently calibrated using drilling or excavation.

Calculated layer thickness' are subject to a similar level of experimental error. This has a cumulative effect on interpreted depths to deeper interfaces. For example, the interpreted depth to the base of the first layer defined is often considered accurate to better than ± 10%, however depths to deeper layers may not be accurate to better than ± 30% (Dampney and Whiteley, 1978).

These experimental errors are inherent in the procedure and must be taken into account in any use which is made of the seismic sections e.g., in estimating the volume of material represented by each layer in a proposed excavation.

A1.3 Effects Of Violation Of Assumptions

A1.3.1 Assumption of Discrete, Uniform Layers.

The most common problems are:
i) continuous increase in velocity with depth.
ii) inhomogeneity below the scale of resolution of the survey.

The first of these occurs in many geological settings, particularly in sediments, or highly weathered sedimentary rocks. It can be allowed for in a number of ways but contributes to the uncertainty in depth calculations based on constant layer velocity. Often the seismic sections show the "average" velocity of the layer.

For the second type of problem, under ideal conditions a refraction study can resolve features as small as 1.5-2 times the geophone spacing. In general, however, the practical limit of resolution is 2-3 times this spacing although the presence of inhomogeneity may be observable from the travel time curves, without more detailed interpretation being possible.

Calculated seismic velocities are averages which represent the bulk properties of the interpreted layers. It is possible for this averaging to conceal major, local variations in velocity on a scale up to at least twice the geophone spacing. The likely nature of these variations depends on the geological setting of the site but clearly boulder conditions and rapid lateral changes in weathering or lithology would be among the difficult sites.

A1.3.2 Assumptions of Distinct Boundaries

Real geological boundaries, especially those related to weathering, are often gradational and/or irregular. The seismic method inevitably disguises gradation and smoothes irregularity. The importance of this varies from site to site, but it is common for interpreted seismic boundaries to appear at an intermediate level somewhere between the limits of gradation. For example, if there is an irregular boundary between fresh and highly weathered rock, the interpreted boundary frequently appears at a level some metres below the highest points at which fresh rock is found.

A1.3.3 Assumption of Increasing Velocity with Depth

This assumption may be violated for a number of different reasons and such violations (termed velocity reversals, or velocity inversions) often cannot be detected from the travel time data alone. It may be possible (in some, but not all cases) to infer them from the geological setting, from borehole information, or from surface-to-borehole seismic. If the inversion layers do not persist laterally their effect may also be observable on the travel-time data.

In general, it is not possible to allow for a velocity inversion in the interpretation unless there is an independent means of estimating both the thickness and the velocity of the layer. If an undetected velocity reversal is present, all calculated depths below the reversal will be in error. In particular, depths to underlying high velocity layers may be significantly over-estimated. Areas where strong layers overlay weaker layers, for example, a basalt flow overlying sediments or weathered rock, or sandstone overlying coal, are sites where these problems sometimes occur.

A1.3.4 Assumption of Detectability

Two main types of violation occur:

i) When a layer is too thin to transmit the seismic wave.
ii) When a layer transmits the wave but is not detected because waves from a deeper, higher velocity layer reach the detector first.

The first type of problem may occur in many geological settings and means that relatively thin, higher velocity layers may occur undetected within lower velocity materials. “Thin” in this context is defined in terms of seismic detectability and can imply thickness of the order of 1-1.5m. The effect cannot be detected from the surface seismic refraction data alone, but <u>may</u> be inferred from borehole information, surface mapping or surface-to-borehole seismic. If such a layer were thick enough to be detected, it would form a velocity reversal (see Section A1.3.3).

The second type of problem (termed a hidden layer or blind zone) <u>may</u> be inferred from the geological setting, borehole data or sometimes from the seismic refraction data. If it is not detected, it also results in erroneous depth calculations in the interpreted section; normally the calculated depth to deeper interfaces is underestimated. In theory, between every pair of layers there could be a hidden layer (or blind zone), whose maximum thickness may be calculated for a range of intermediate velocities.

A1.4 Other Factors

Other common factors may lead to differences between the surface seismic refraction model and reality. While not strictly due to assumptions made in interpretation, they should still be taken into account, if the site conditions dictate, in any further use of the interpreted sections. These factors are:

i) Three-dimensional effects
ii) Effect of water
iii) Anisotropy

A1.4.1 Three-dimensional effects

The interpreted sections are two-dimensional representations and only apply to a narrow zone below the line of traverse typically 5 -10m either side of the seismic line. However, the real subsurface is three-dimensional and as a result significant lateral variations in conditions can occur without being detected, even within a short distance to the side of a traverse. If seismic signals originating from such features are obtained, they may result in the interpreted sections containing features, which are non-existent, displaced from their true position or shown with incorrect velocities. This problem is most common in sites with irregular topography, boulders and highly irregular rock masses.

In some cases three-dimensional effects may be observed by using cross seismic spreads at right angles to the main profile, or additional parallel seismic lines, or from other information.

A1.4.2 Effect of Water

The presence of water can greatly increase the field velocity of materials which have low velocities in the dry condition. The effect is most pronounced in soils or unconsolidated materials and is due to the difference in seismic velocity between air and water (340 m/s and 1470 m/s, respectively). It may however occur to a significant degree in materials with dry velocities as high as 2000-2500m/s. The change is not related to the normal trends of change in material properties with velocity.

Less frequently, it is possible for water saturation to cause a decrease in field velocity, most commonly in low velocity materials where highly expansive clay minerals are present and the material is unconfined. In the marine environment the presence of gas in otherwise water-saturated sediments can lower velocities below that in water.

Velocity changes due to the presence of a water table cannot normally be distinguished from the seismic data alone. The effect <u>may</u> be inferable from the geological setting and the interpreted velocities, but can only be confirmed by drilling.

A1.4.3 Anisotropy

Field velocities may vary with the direction of the seismic line. Usually if the velocity measured in different directions agree to within ± 10% the condition is treated as isotropic. Anisotropy is most common in steeply dipping sediments or metasediments but can occur in other settings. When measured across strike, the velocity is an average for the different materials present. Along strike the higher velocity of the fresher or more competent materials is measured. This effect may be detectable from cross spreads which show a markedly higher or lower velocity than longitudinal traverses. However it may not be detected, depending on the relative orientations of the traverses and the strike of the subsurface materials.

A more subtle form of anisotropy occurs in many sedimentary rocks where the vertical velocity differs from the horizontal velocity. Normally seismic refraction studies provide information on the horizontal velocities which are commonly higher than the vertical velocities. The possible effects of anisotropy are similar to those discussed above in section A1.3

A1.5 References

Dampney, CNG and Whiteley, RJ (1978). Velocity determination and error analysis for the seismic refraction method. Geophysical Prospecting, 28, pp. 1-17.

Dobrin, MG (1976). Introduction to geophysical prospecting. 3rd edition. McGraw-Hill,New York.

Hawkins, LV (1961). The reciprocal method of routine shallow seismic refraction investigations. Geophysics, 26(6), pp. 806-19.

Leung, T.M., Win, M.A., Walker, C.S., & Whiteley, R.J., 1997. A Flexible Algorithm for Seismic Refraction Interpretation Using Program REFRACT, from McCann, D.D., Eddleston, M., Fenning, P.J. & Reeves, G.M (eds), 1997, *Modern Geophysics in Engineering Geology*. Geological Society Engineering Special Publication No. 12, pp 399-407

Appendix B

Conceptual Sediment Transport Model – Batemans Bay

Inner Batemans Bay
Conceptual Sediment Transport Model

Eurobodalla Open Coast Coastal Management Program - Stage 2: Vulnerability Assessments

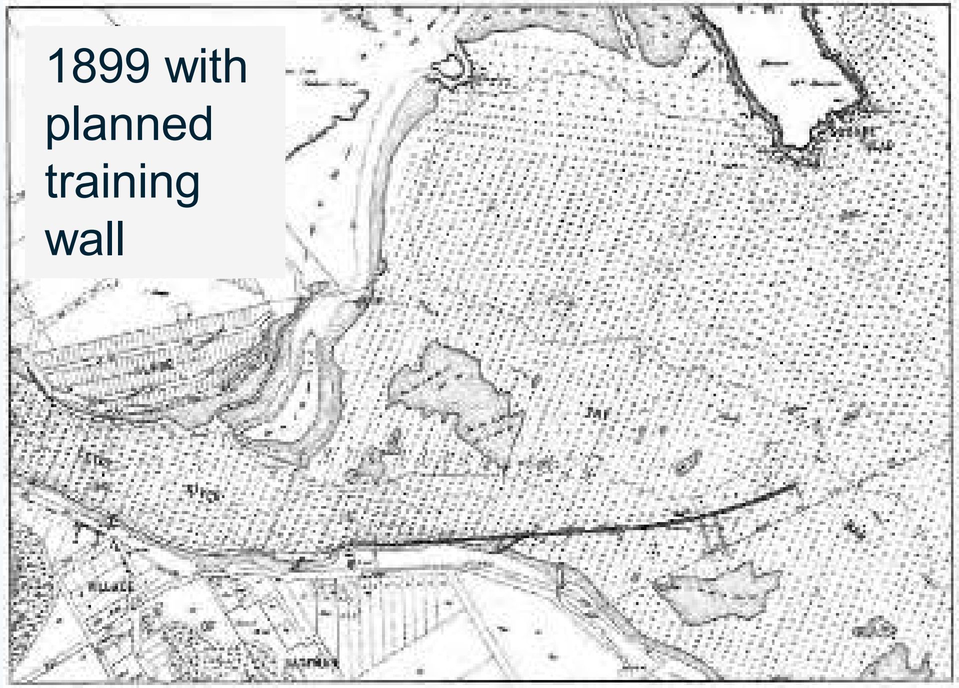
Baird.
Innovation Engineered.

Rhelm
engineering | environmental | economics | engagement

baird.com

Historical Timeline

- Development
  - 1899 to 1905 – Training wall constructed (low crested structure)
  - 1950s – Princes Highway Bridge constructed
  - circa 1950s/60s – Training wall upgraded (higher crest)
  - circa 1960s/70s – Construction of Seawalls (various) including at Wharf Road
  - 1989 – Extension of training wall
- Dredging
  - Regular dredging of the entrance shoal up until early 1950s (then 1957-8, 1961-2, 1964)
  - Recent dredging of entrance shoal included 2013, 2016 and 2020
- Nourishment
  - Dredged spoil typically placed on Corrigans (up until 60s)
  - Dune Nourishment at Northern Surfside East, circa 1996
  - Nourishment at Surfside West, 2016
  - Nourishment of shoal offshore of Surfside, 2020

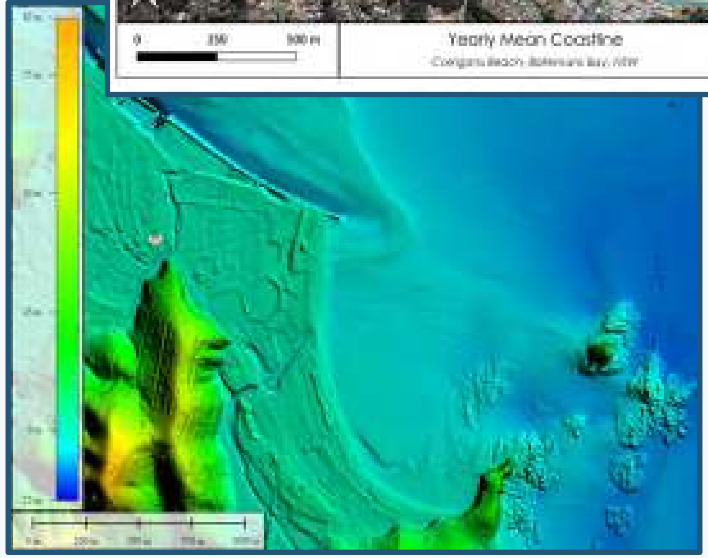


Sediments in the Inner Bay

- WBM (2000) completed field sampling of surface sediments
- The sediments of inner Batemans Bay are:
  - Predominantly lithic sands
  - Higher proportion of angular (fluvial) quartz compared to well rounded (marine) quartz
  - Carbonate content increased further out into the Bay
- The predominance of fluvially derived sediments indicates flood events are the significant contributor of sediment to the Bay
- Annual average fluvial sand supply is estimated to be in excess of 22,000m^3 per year (WBM, 2000).

Corrigans Beach

- History
  - 1899 to 1905 – Training wall constructed (low crested)
  - circa 1950s/60s – Training wall upgraded (~+2mAHD crest)
  - 1991 – Extension of training wall
  - Significant accretion has occurred (~8,000m^3 /year since 1942)
- Sediment Transport
  - Accretion due to construction of training wall and subsequent upgrade and extension
  - Training wall (both pre- and post- upgrade) was an effective trap of bed load sediment transport (the principal mechanism of sediment transport/morphological change since 1900)
  - Longshore sediment movement of fluvially supplied sediments to the north, minor bypassing of training wall back into the shoal

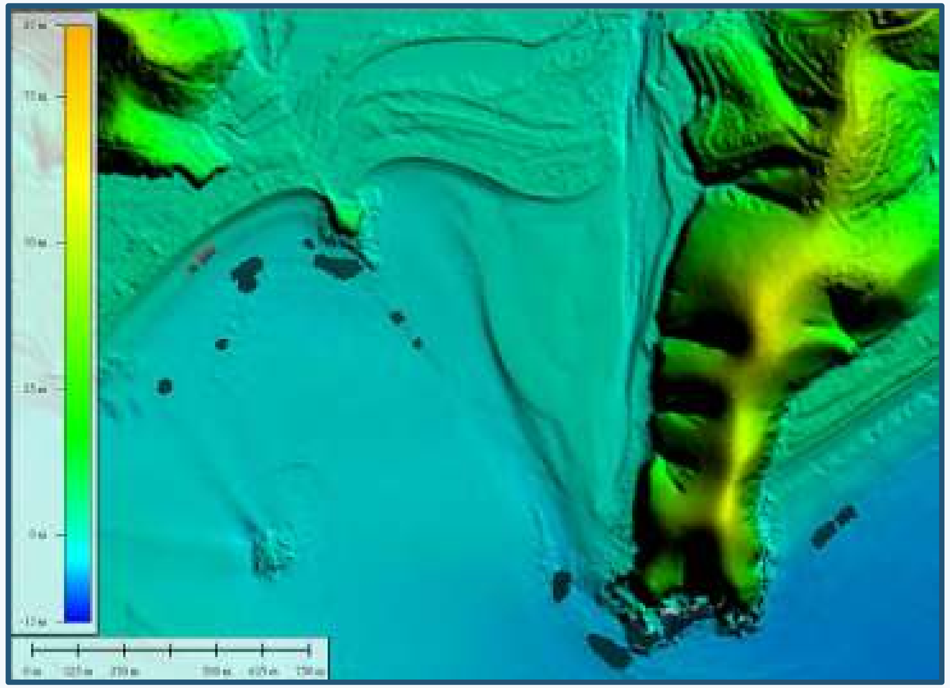


Original training wall

Upgraded training wall

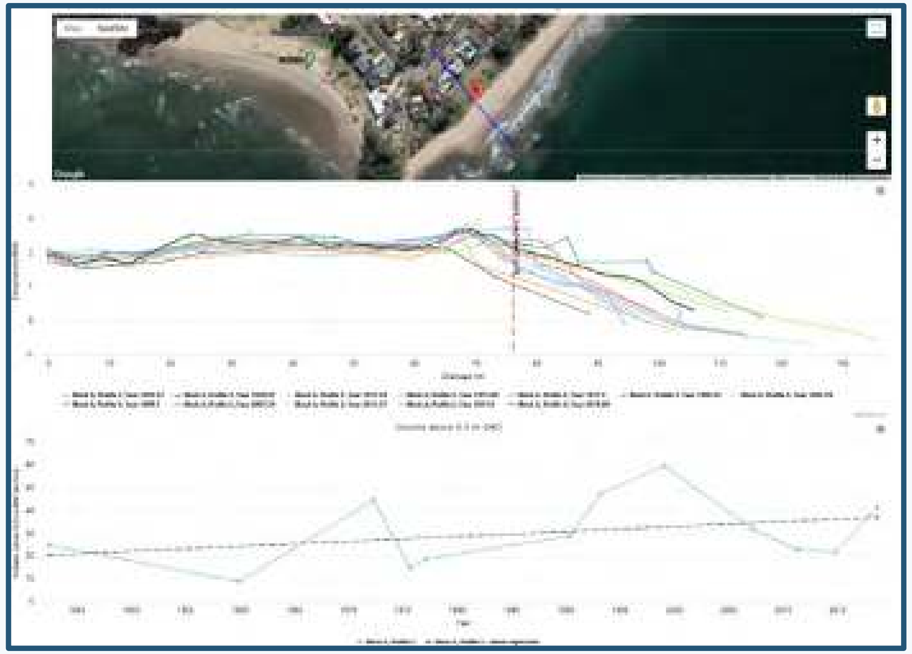
Cullendulla Beach

- History
  - Embayed by Square Head and Hawk's Nest Head.
  - Chenier Plains to the rear (variably spaced - a function of the variable rate of falling sea level over ~6000 yrs).
  - Significant flood delta (Square Head Shoal) from Cullendulla Creek fed by flood flows/runoff. Protected from incident waves.
  - Limited human interference.
- Sediment Transport
  - Eastern longshore transport.
  - Ongoing recession at the western end (90 m between 1942 to 2018) following end to seaward progression of the beach ridge system after stable/rising sea levels over the last ~1000 years.
  - No direct mechanism of fluvial sediment from Cullendulla Creek to reach the adjacent shoreline to the west.



Surfside East

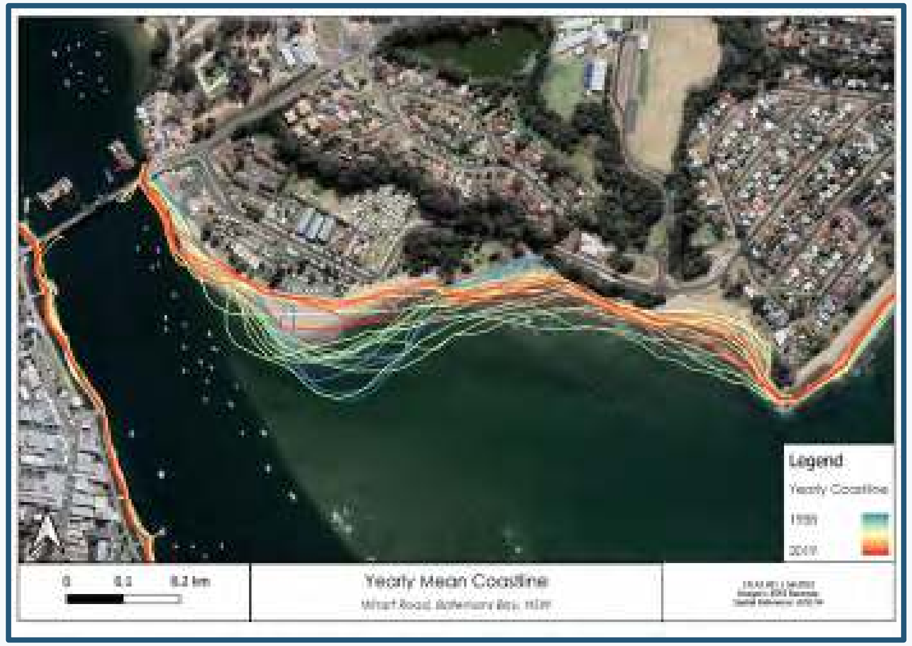
- History
  - Surfside development, circa 1940s
  - Sand nourishment at Northern End (1996) – ~12,000m^3
- Low to negligible net longshore transport (shoreline in alignment with incident waves)
- Limited transfer of sand to/from Cullendulla Beach
- Onshore transport likely from nearshore bars (when configuration allows)
- Otherwise marginal SW transport (Nth to Sth)
- Generally dynamically stable
  - Marginal recession trend at northern end
  - Marginal accretion trend at southern end

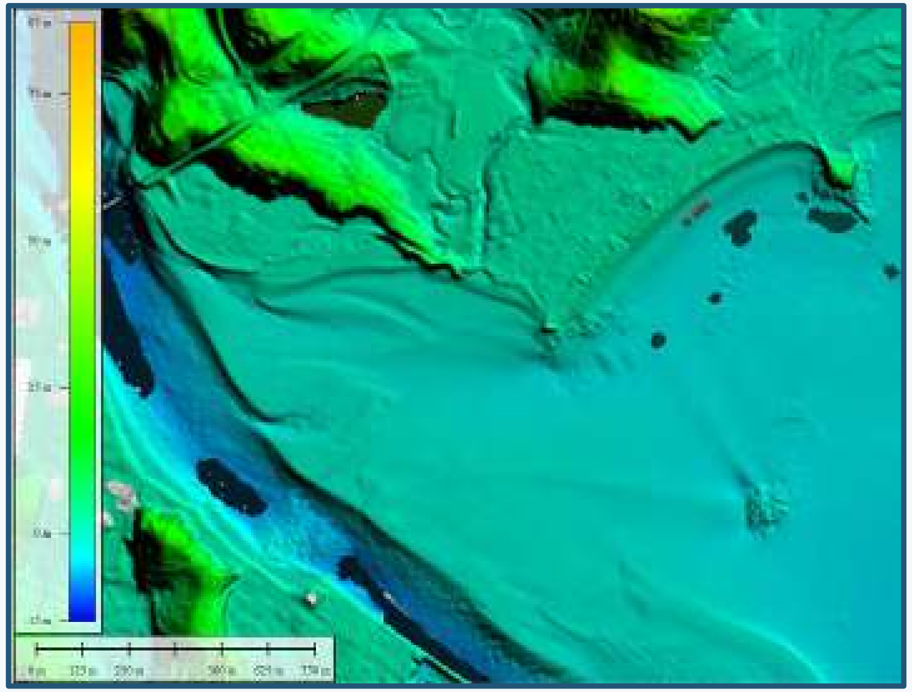


Surfside West / Wharf Road

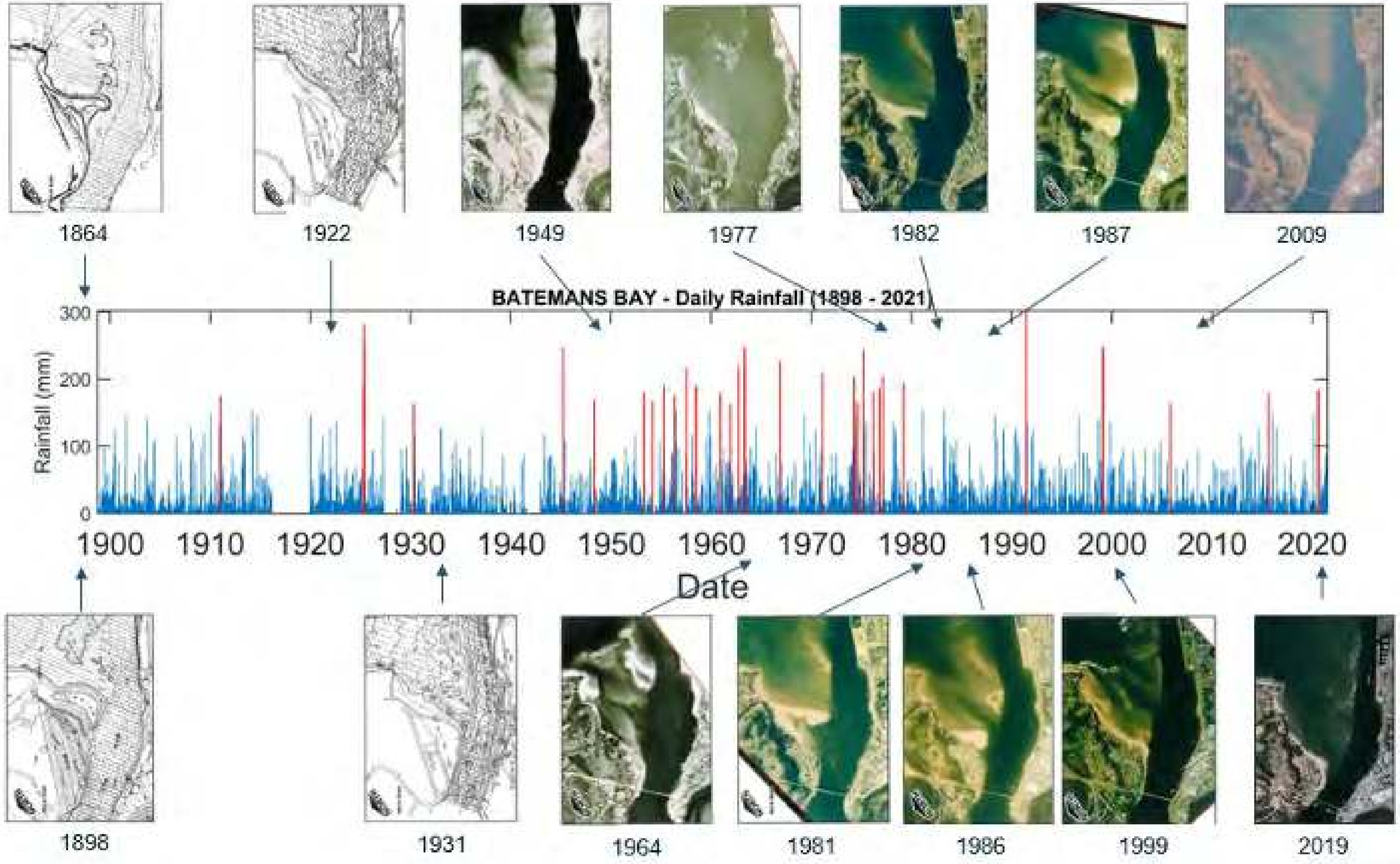
- Surfside West History
  - Natural creek line channelized with culvert at western end (circa 1950s)
  - Dynamic fluctuating shoreline

- Wharf Road History
  - Located along a 400 m stretch of active coastline with considerable instability.
  - Residential allotments created in the 1800s during an accreted phase has meant that many allotments are now below the high water mark.
  - A seawall was constructed in the 1960s/1970s at the North West end.





Rainfall and Flooding



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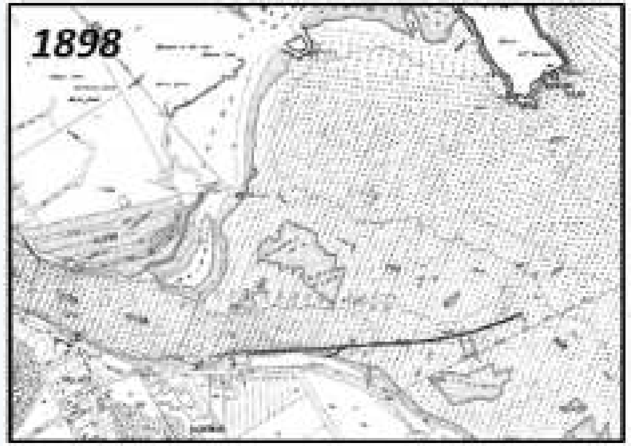
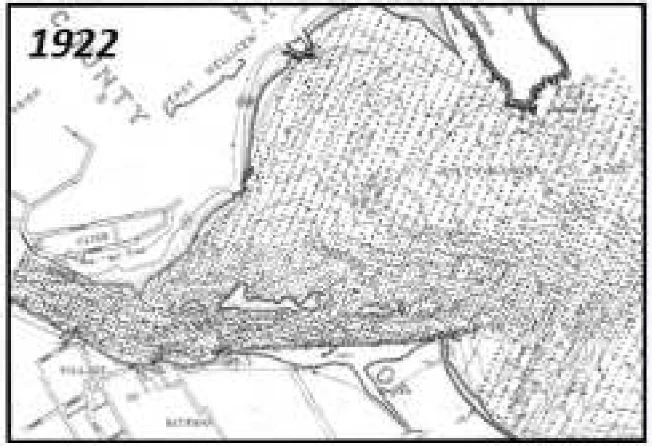
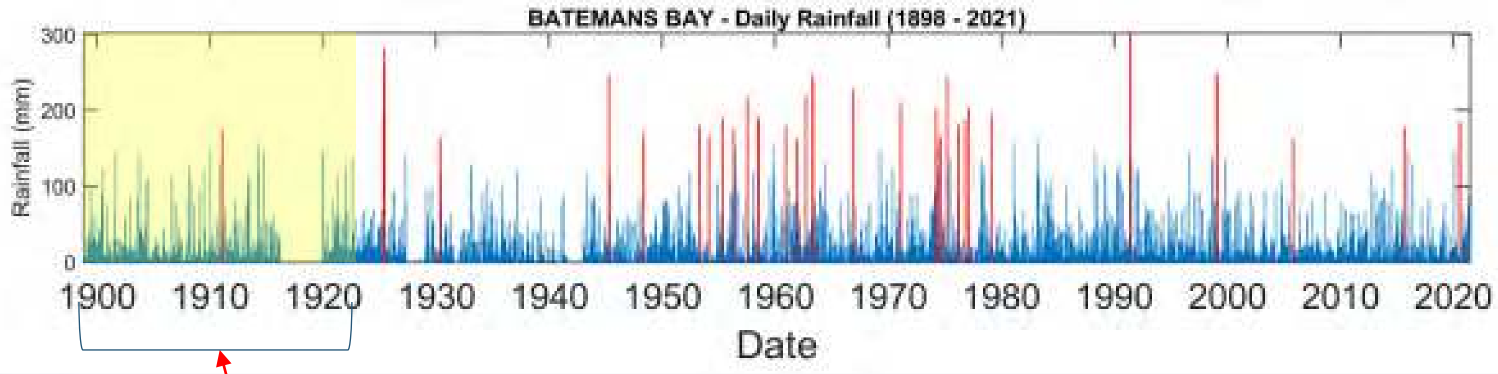
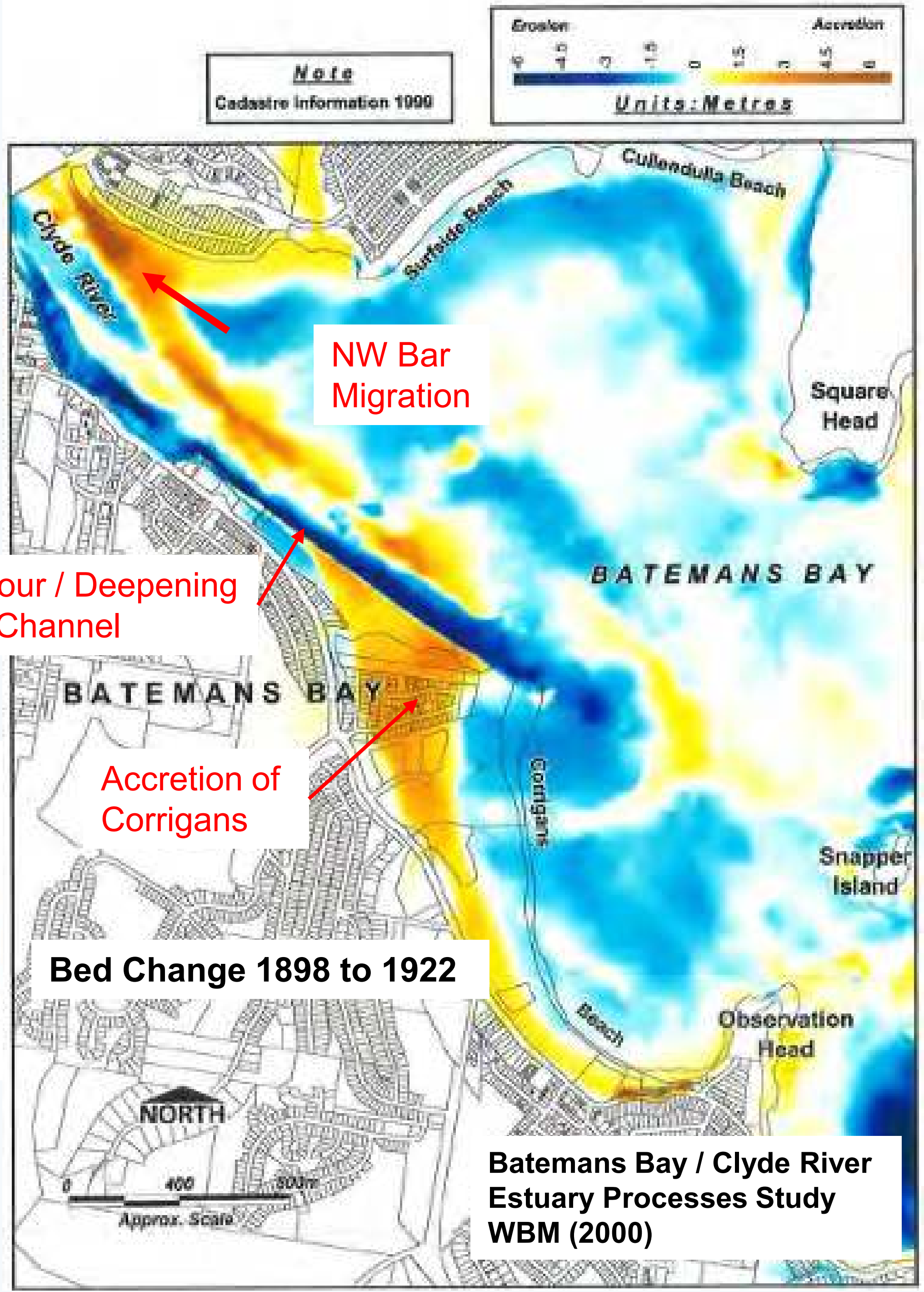
Low Rainfall Period







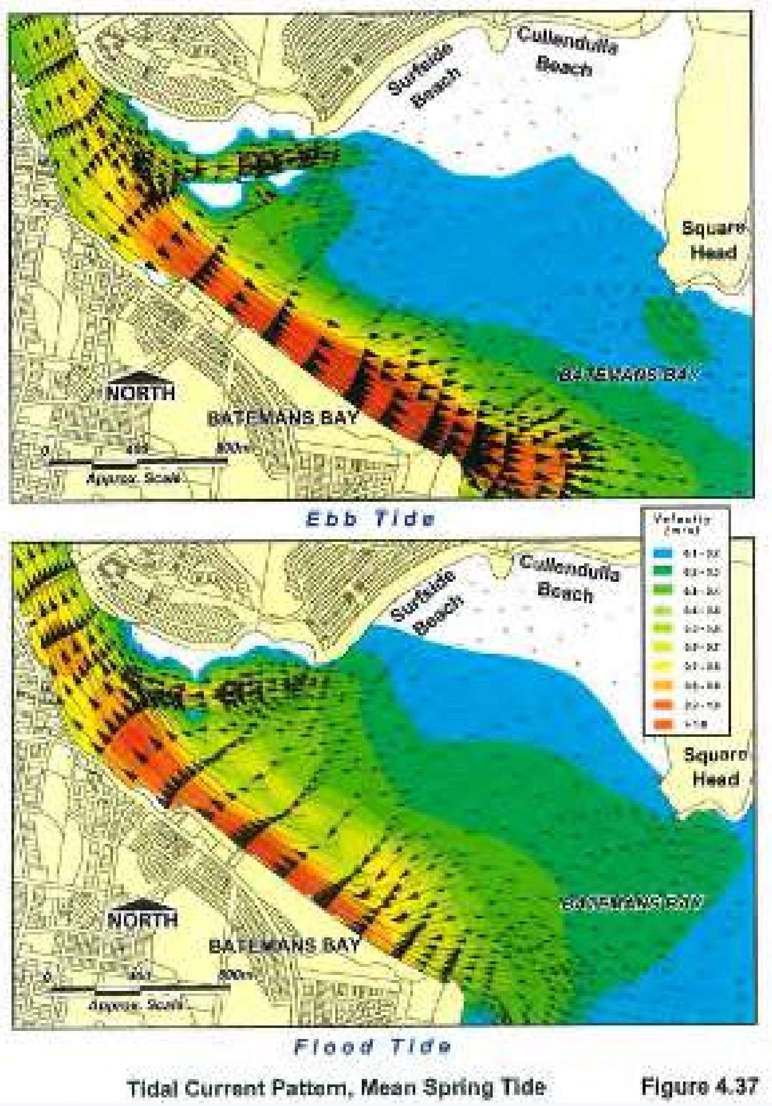
Low Rainfall period



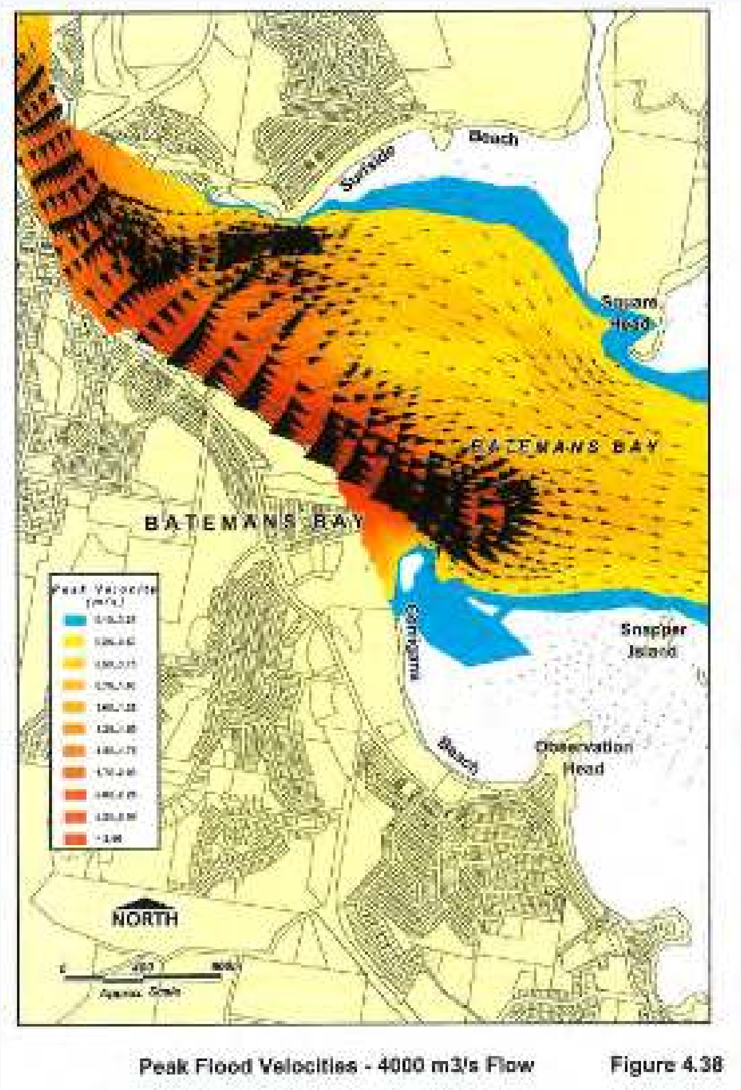
Batemans Bay / Clyde River Estuary Processes Study WBM (2000)

Surfside West / Wharf Road

- Tide
  - Tidal flows generate currents across Wharf Road/Surfside in excess of 0.5m/s (dependent on shoal configuration)
  - Would hinder onshore transport of sediment from nearshore shoals when present
- Flood
  - Flood flows generate currents across Wharf Road/Surfside in excess of 2m/s
  - Will drive significant sediment transport through area
  - Flow structure dependent on shoal configuration prior to flood and flood magnitude



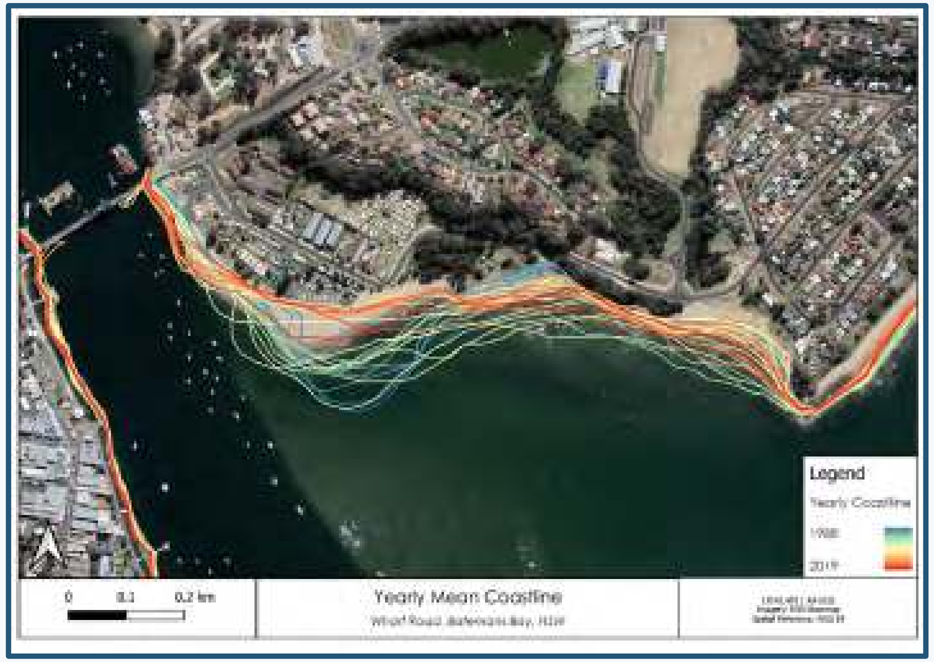
WBM (2000)

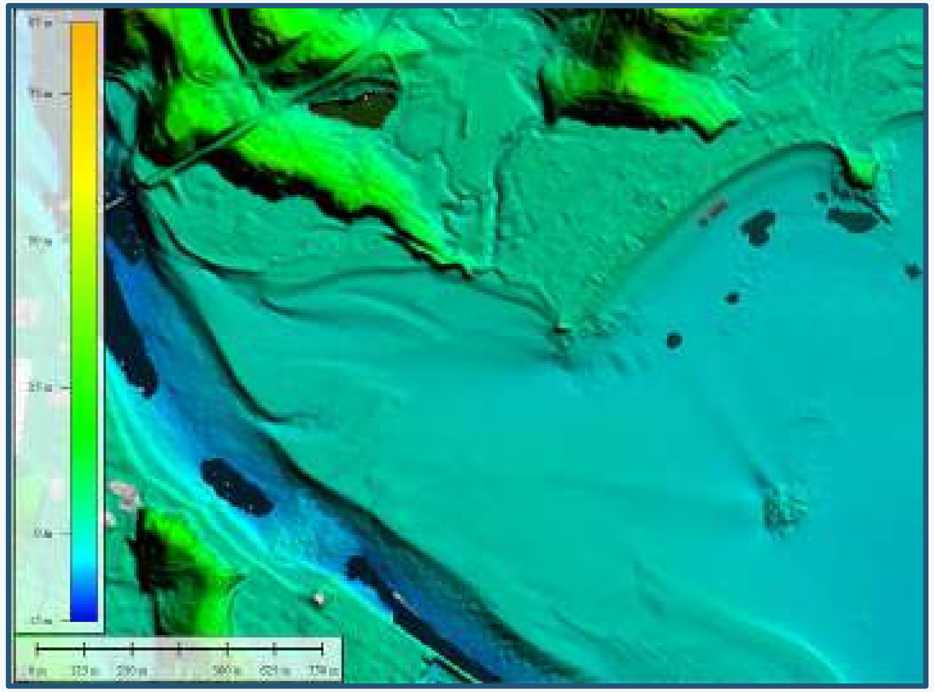


WBM (2000)

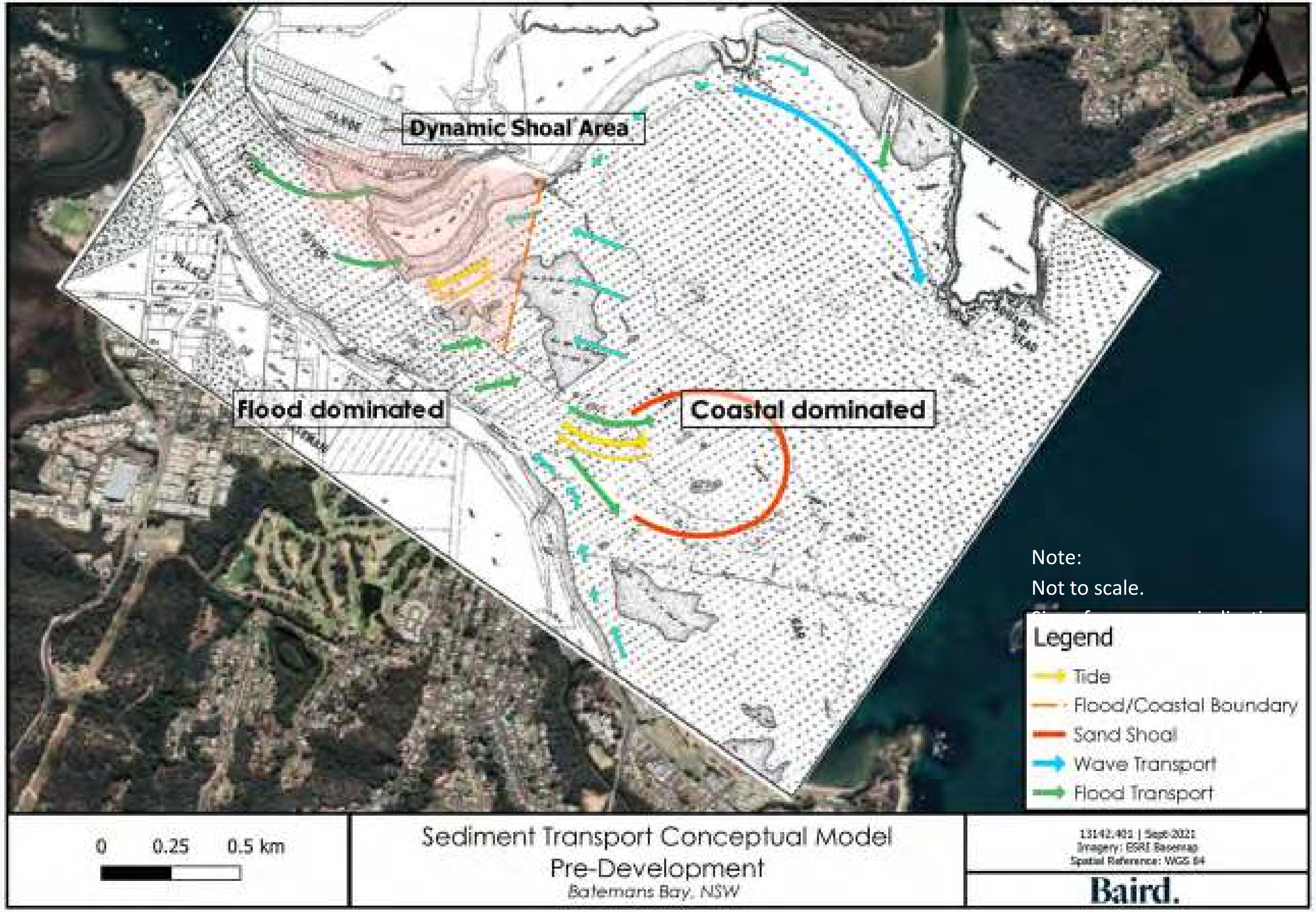
Wharf Road

- Sediment Transport
  - Clyde River flood events are the major influence on re-working the Wharf Road beach and shoal, with large flows close to the beach and across the shoals leading to scour
  - Wave induced transport during ambient and elevated offshore swell, which replenish Wharf Rd shoreline from the shoal (over time)
  - Longshore transport is to the west along the beach, predominantly from wave driven currents and a flood tide inequality (flood > ebb currents).

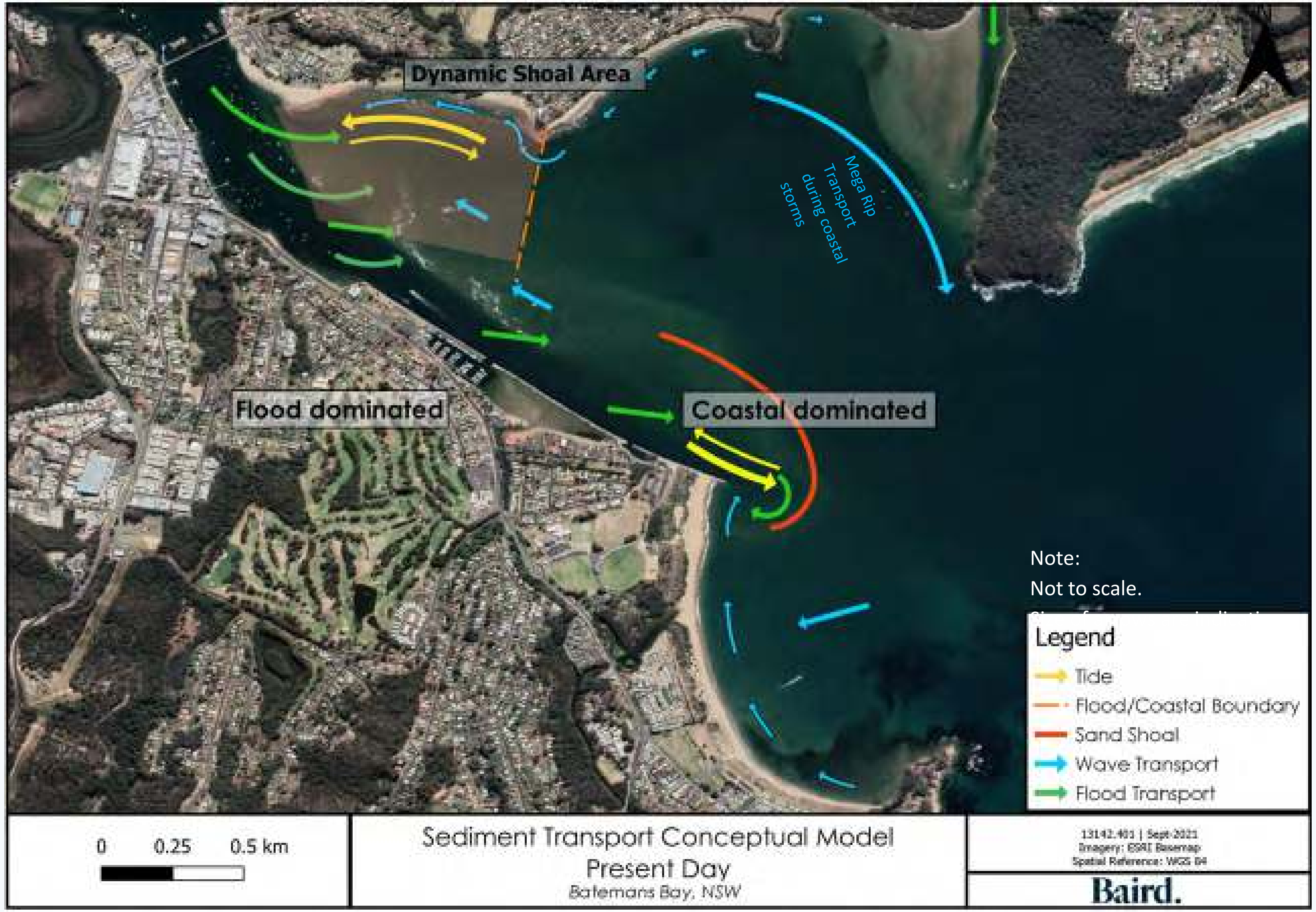




Sediment Transport Concept Models – Pre-Training Wall



Sediment Transport Concept Models – Present Day



Appendix C

WRL (2017) Coastal Hazard Maps

Note 1: Landward movement of the shoreline could be limited by the presence of bedrock.
Note 2: The shoreline could potentially move landward of the hazard lines in the watercourse entrance instability region due to lowering of the beach profile from entrance scouring.

Maloneys Beach
Deterministic erosion/recession hazard lines

2017
2050
2065
2100

Watercourse instability region

Figure I.1

Note 1: Landward movement of the shoreline could be limited by the presence of bedrock.
Note 2: Areas landward of the bedrock (non-erodible) line could be subject to coastal cliff or slope instability hazards which are beyond the scope of this study.

Sunshine Bay
Deterministic erosion/recession hazard lines

2017
2050
2065
2100
Bedrock (non-erodible)

Figure I.12

Note 1: Landward movement of the shoreline could be limited by the presence of bedrock.
Note 2: The shoreline could potentially move landward of the hazard lines in the watercourse entrance instability region due to lowering of the beach profile from entrance scouring.

Guerilla Bay (south)
Deterministic erosion/recession hazard lines

2017
2050
2065
2100

Watercourse instability region

Figure I.17

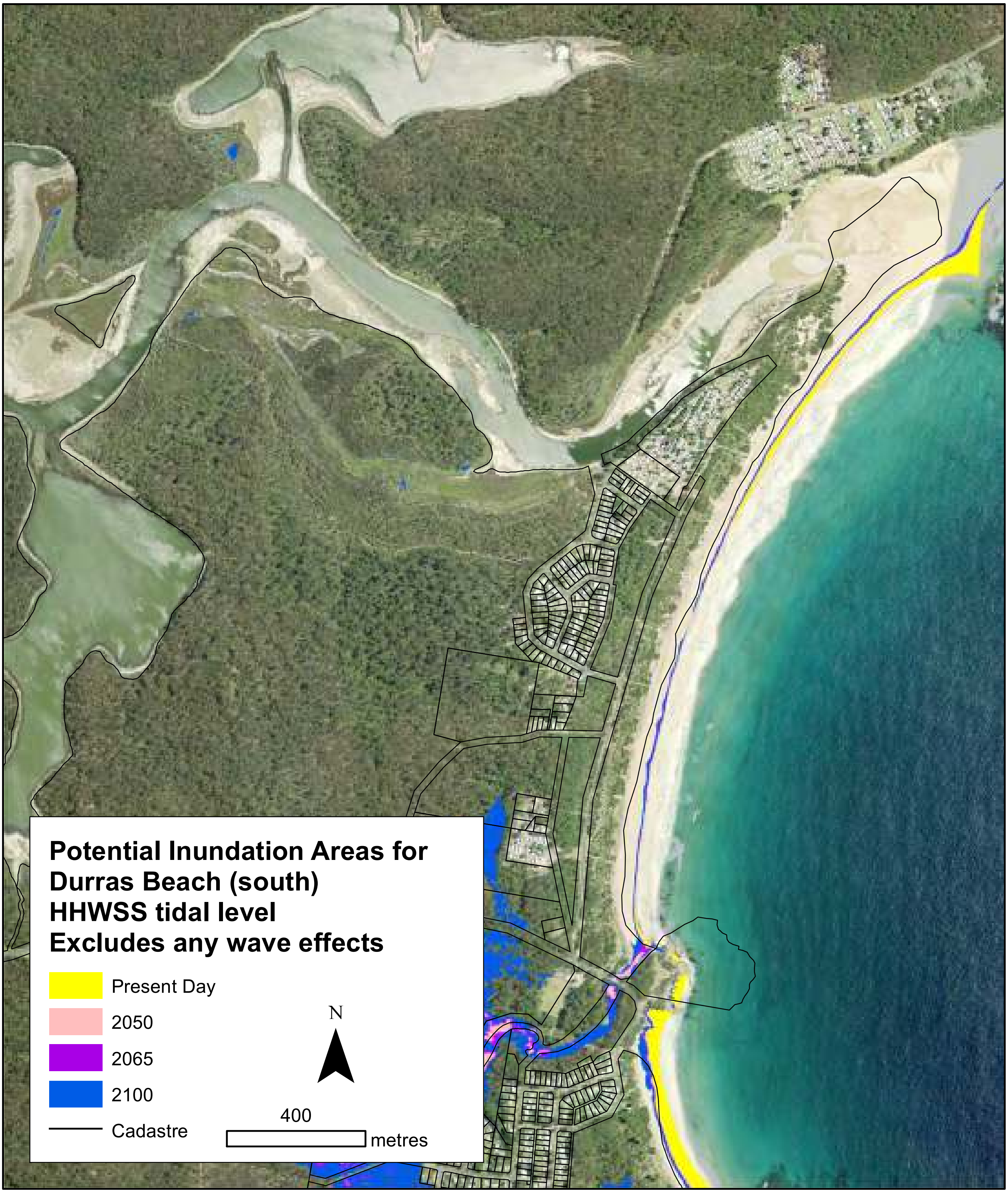
Note 1: Landward movement of the shoreline could be limited by the presence of bedrock.
Note 2: The shoreline could potentially move landward of the hazard lines in the watercourse entrance instability region due to lowering of the beach profile from entrance scouring.
Note 3: Hazard lines do not extend to the western end of the beach as this is the limit of available photgrammetry.

Barlings Beach
Deterministic erosion/recession hazard lines

2017
2050
2065
2100

Watercourse instability region

Figure I.18



Inundation areas are mapped based on the most recent year of LIDAR data available (2011). The mapping has been based on the ground elevation (the "all ground" LIDAR layer) and does not consider flow paths, flow velocities or loss of flow momentum. It does not include allowance for future landward recession of the beach face and assumes that the crest level of the seawall (if present) and the topography remain as they were from the 2011 LIDAR data. By 2050, 2065 or 2100 both of these assumptions may not be valid. Should the seawall/dune be allowed to fail then the landward extent of inundation may increase. WRL is not responsible for the accuracy of the LIDAR data. Local surveys by a registered surveyor are recommended to determine local inundation extents.

Figure K.1

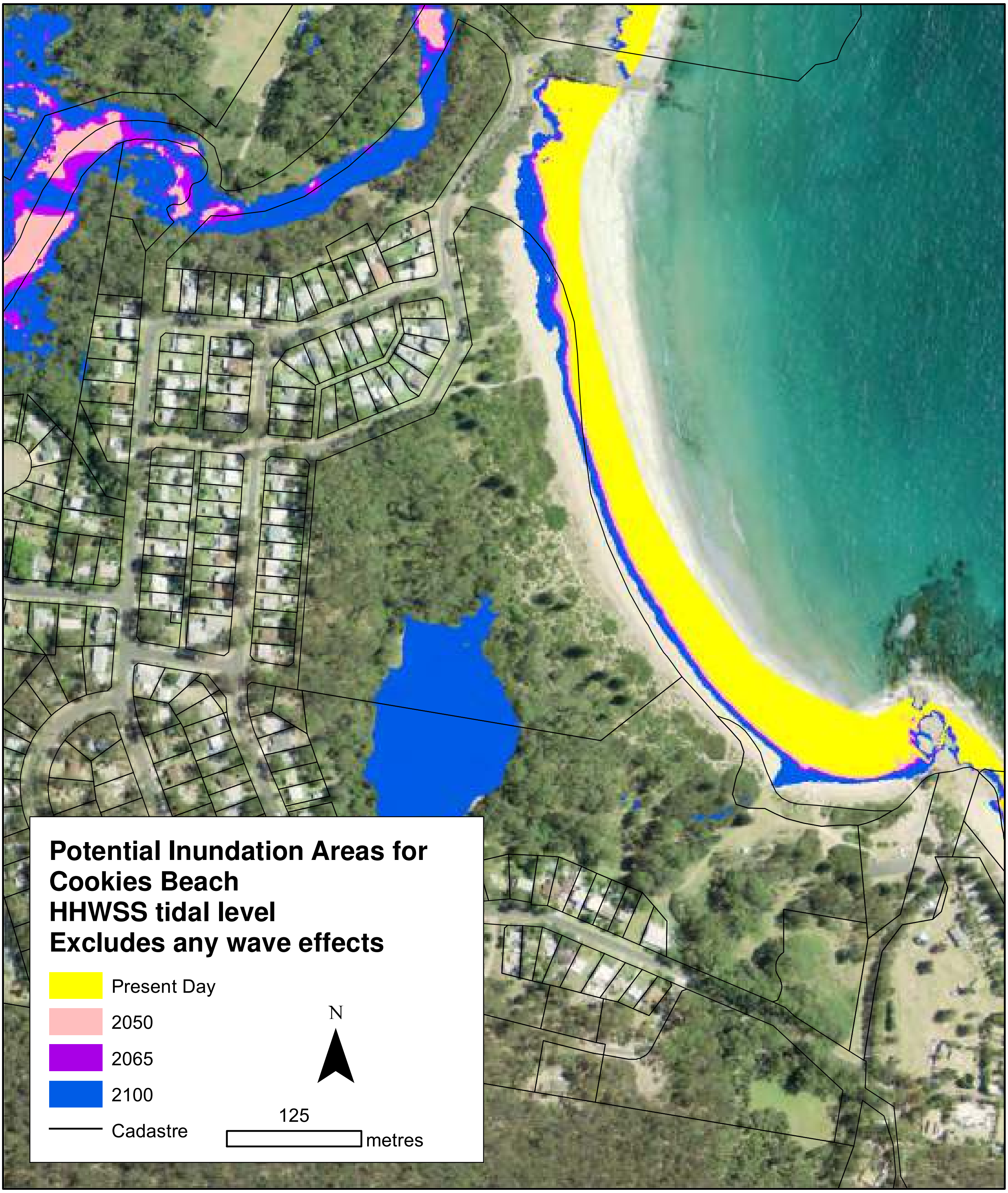


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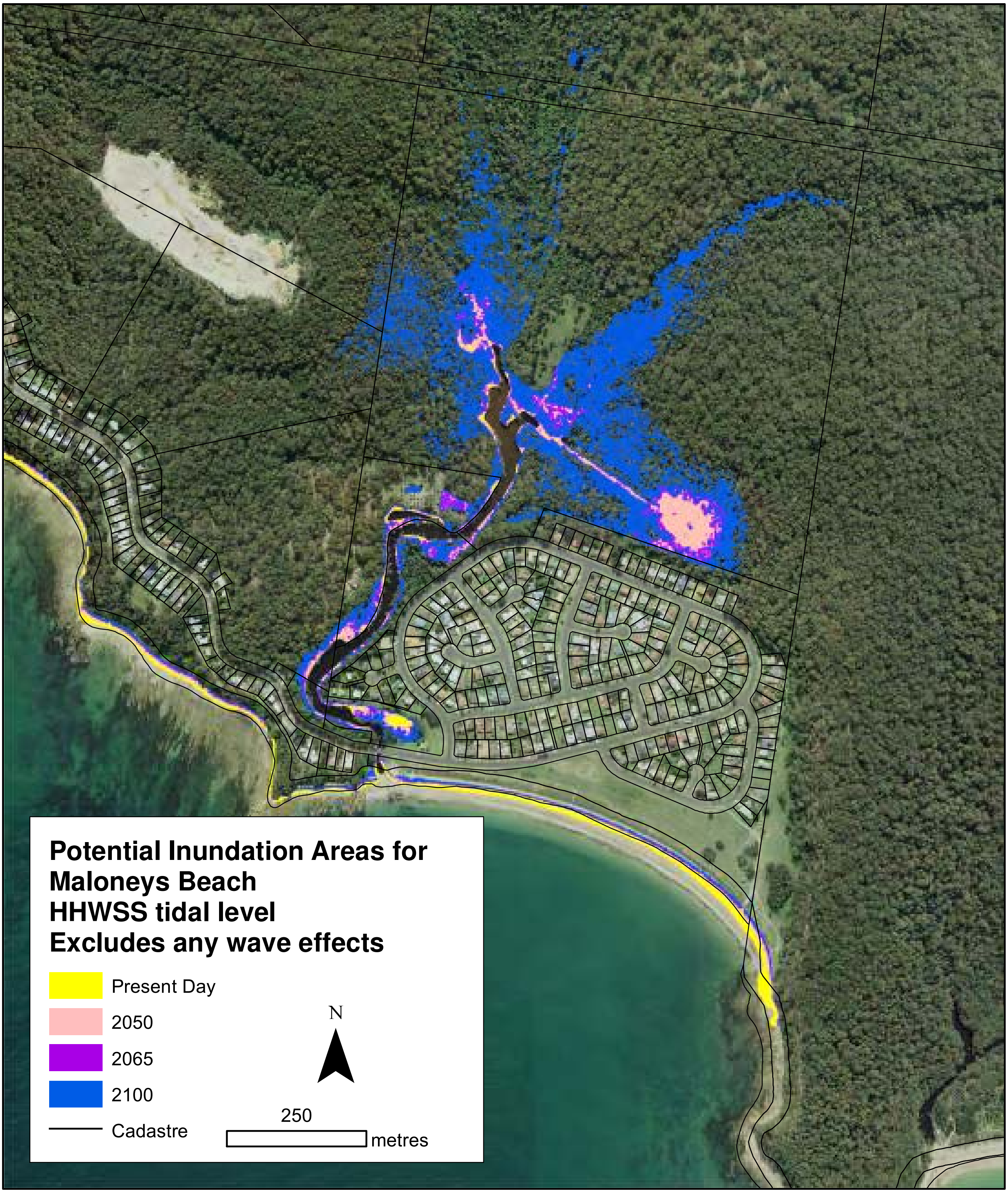
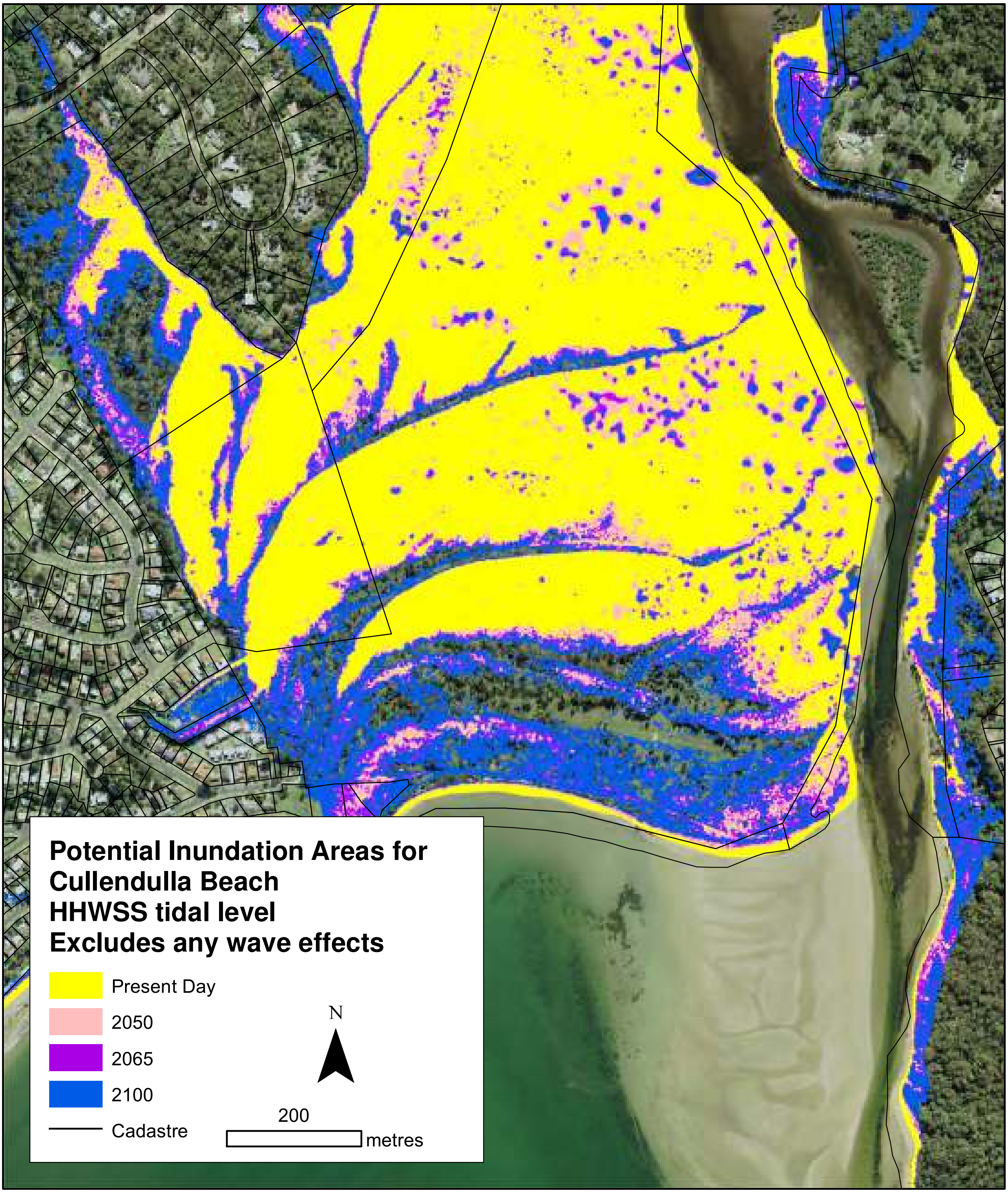
Figure K.2



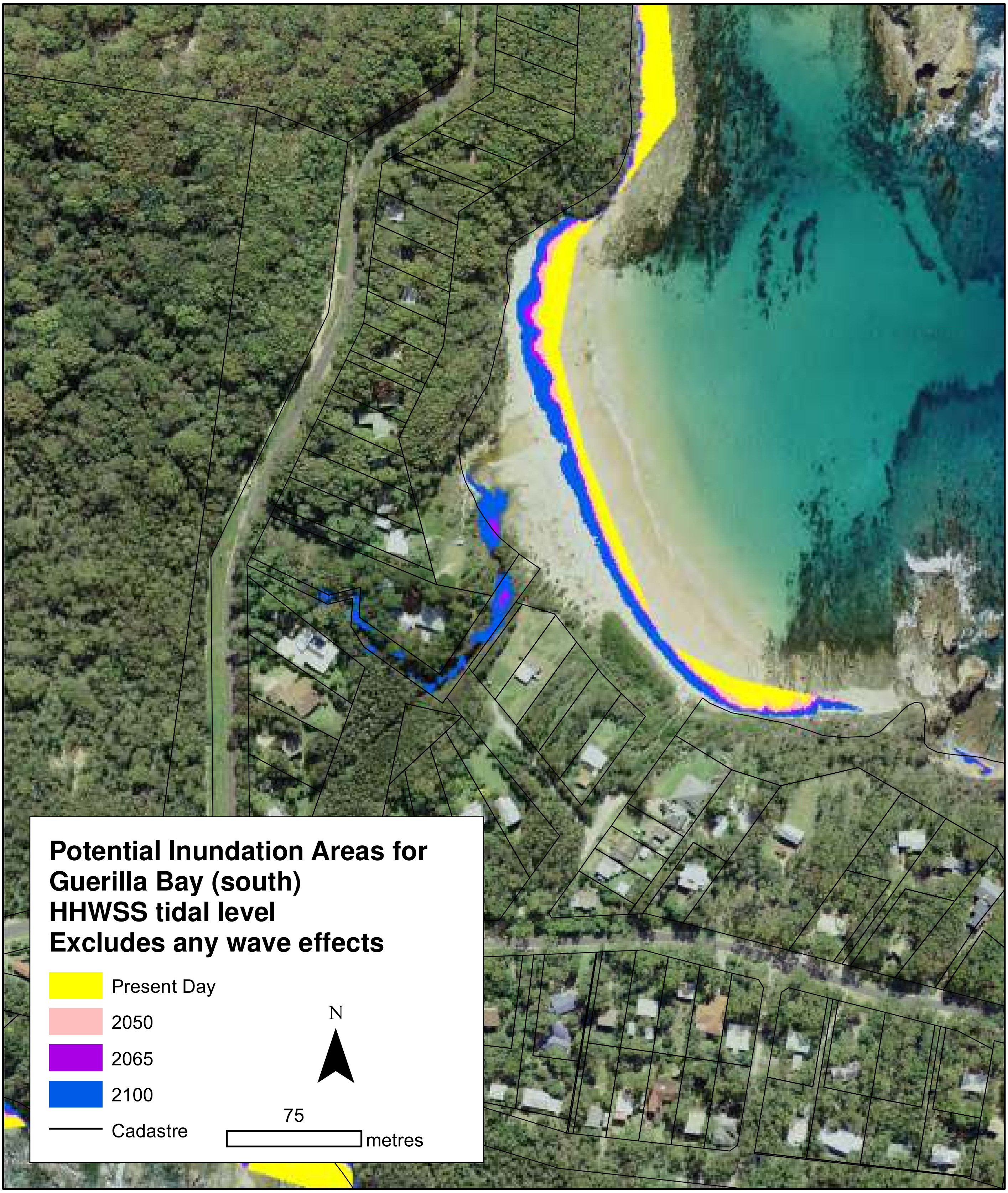
Inundation areas are mapped based on the most recent year of LIDAR data available (2005). The mapping has been based on the ground elevation (the "all ground" LIDAR layer) and does not consider flow paths, flow velocities or loss of flow momentum. It does not include allowance for future landward recession of the beach face and assumes that the crest level of the seawall (if present) and the topography remain as they were from the 2005 LIDAR data. By 2050, 2065 or 2100 both of these assumptions may not be valid. Should the seawall/dune be allowed to fail then the landward extent of inundation may increase. WRL is not responsible for the accuracy of the LIDAR data. Local surveys by a registered surveyor are recommended to determine local inundation extents.

Figure K.3



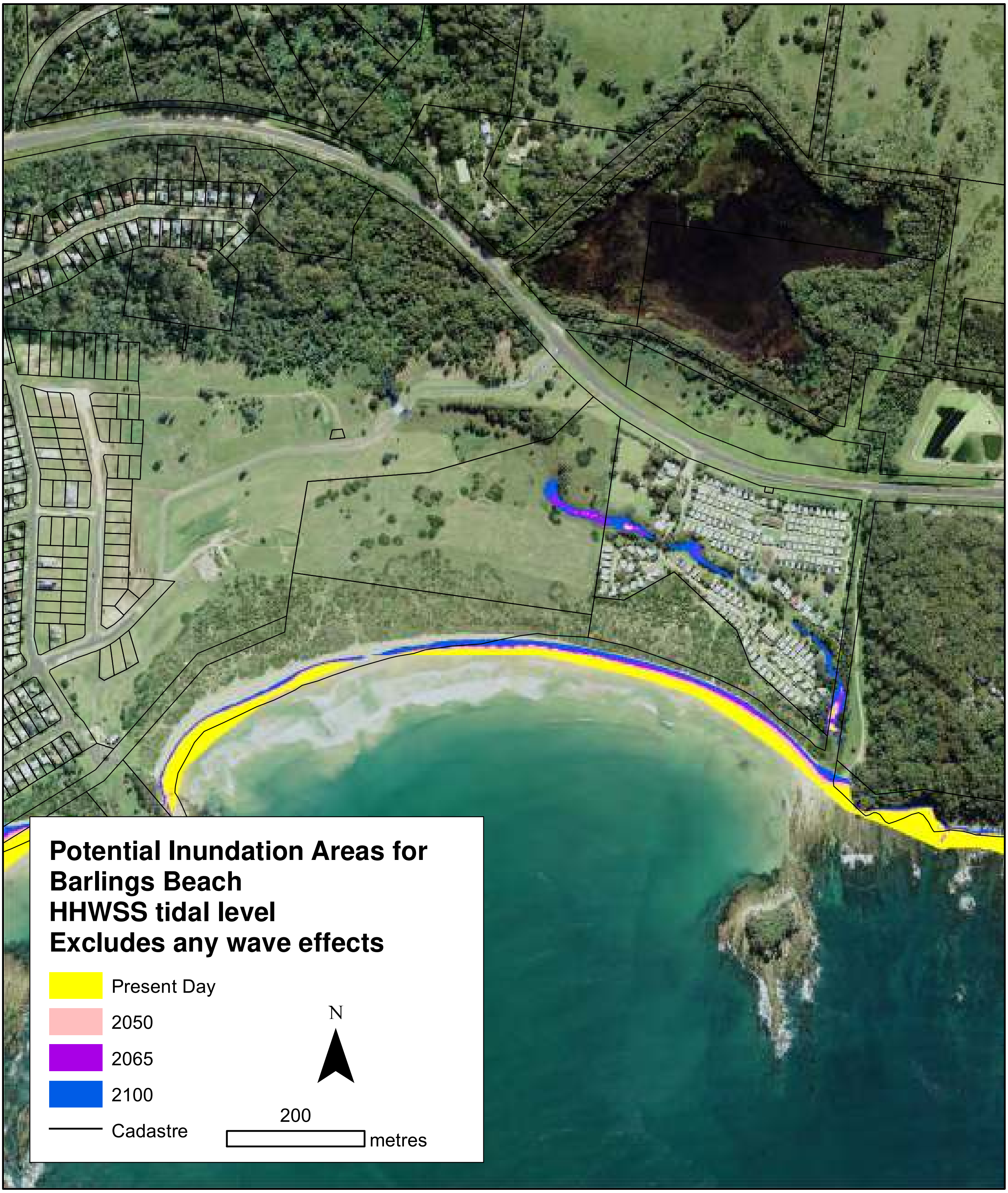
Inundation areas are mapped based on the most recent year of LIDAR data available (2005). The mapping has been based on the ground elevation (the "all ground" LIDAR layer) and does not consider flow paths, flow velocities or loss of flow momentum. It does not include allowance for future landward recession of the beach face and assumes that the crest level of the seawall (if present) and the topography remain as they were from the 2005 LIDAR data. By 2050, 2065 or 2100 both of these assumptions may not be valid. Should the seawall/dune be allowed to fail then the landward extent of inundation may increase. WRL is not responsible for the accuracy of the LIDAR data. Local surveys by a registered surveyor are recommended to determine local inundation extents.

Figure K.7



Inundation areas are mapped based on the most recent year of LIDAR data available (2011). The mapping has been based on the ground elevation (the "all ground" LIDAR layer) and does not consider flow paths, flow velocities or loss of flow momentum. It does not include allowance for future landward recession of the beach face and assumes that the crest level of the seawall (if present) and the topography remain as they were from the 2011 LIDAR data. By 2050, 2065 or 2100 both of these assumptions may not be valid. Should the seawall/dune be allowed to fail then the landward extent of inundation may increase. WRL is not responsible for the accuracy of the LIDAR data. Local surveys by a registered surveyor are recommended to determine local inundation extents.

Figure K.16



Inundation areas are mapped based on the most recent year of LIDAR data available (2011). The mapping has been based on the ground elevation (the "all ground" LIDAR layer) and does not consider flow paths, flow velocities or loss of flow momentum. It does not include allowance for future landward recession of the beach face and assumes that the crest level of the seawall (if present) and the topography remain as they were from the 2011 LIDAR data. By 2050, 2065 or 2100 both of these assumptions may not be valid. Should the seawall/dune be allowed to fail then the landward extent of inundation may increase. WRL is not responsible for the accuracy of the LIDAR data. Local surveys by a registered surveyor are recommended to determine local inundation extents.

Figure K.17

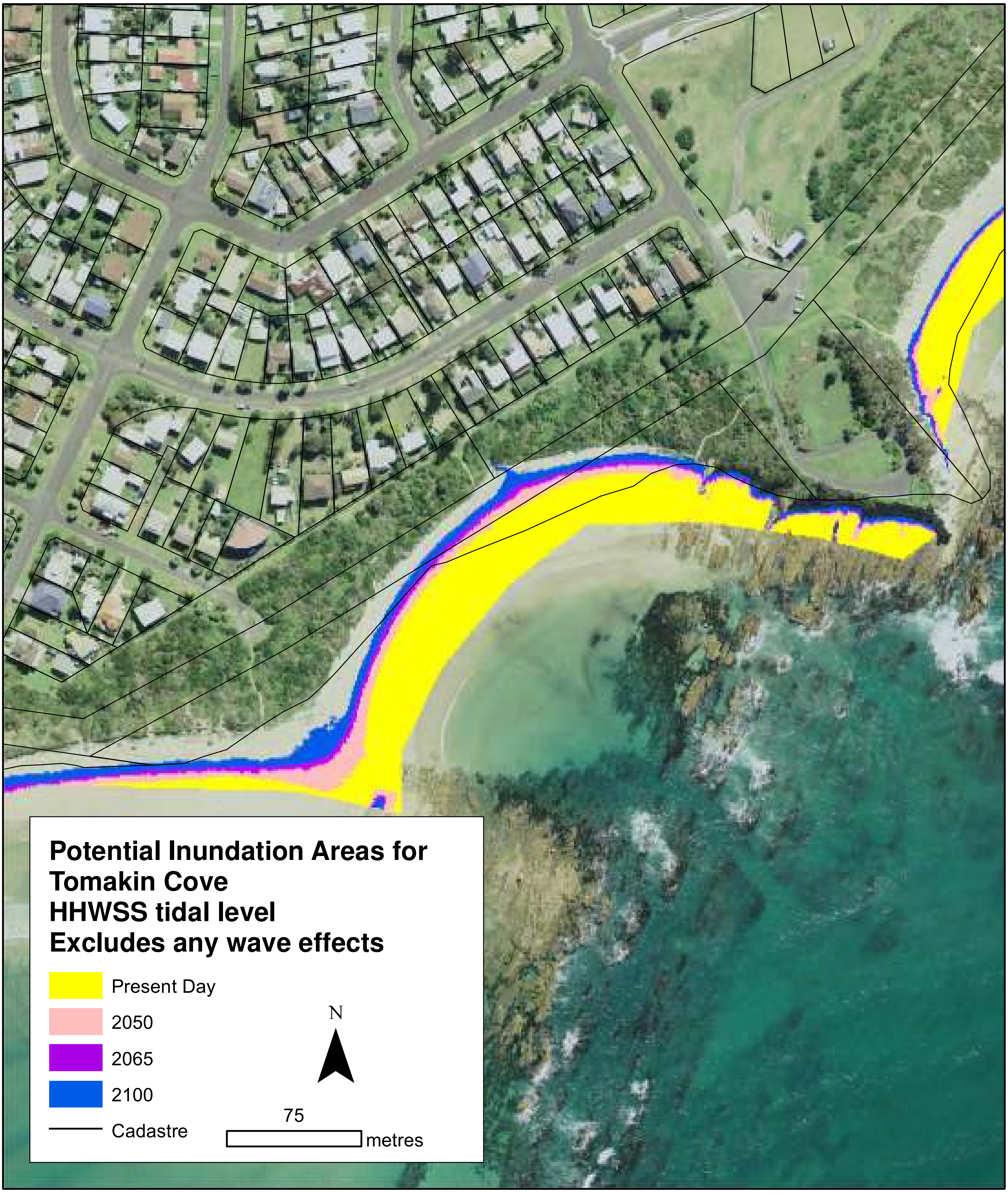


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Figure K.18

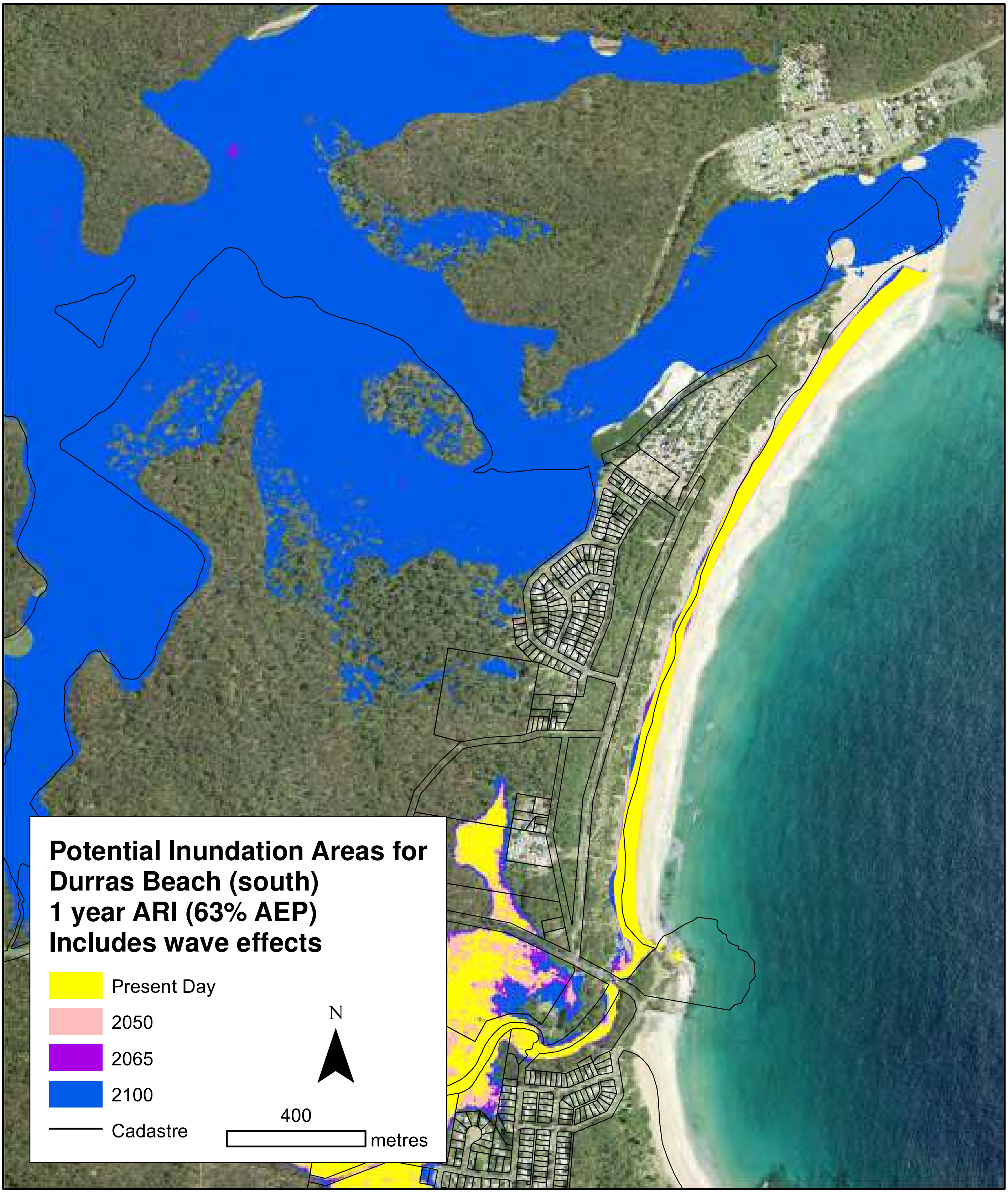

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Figure L.1

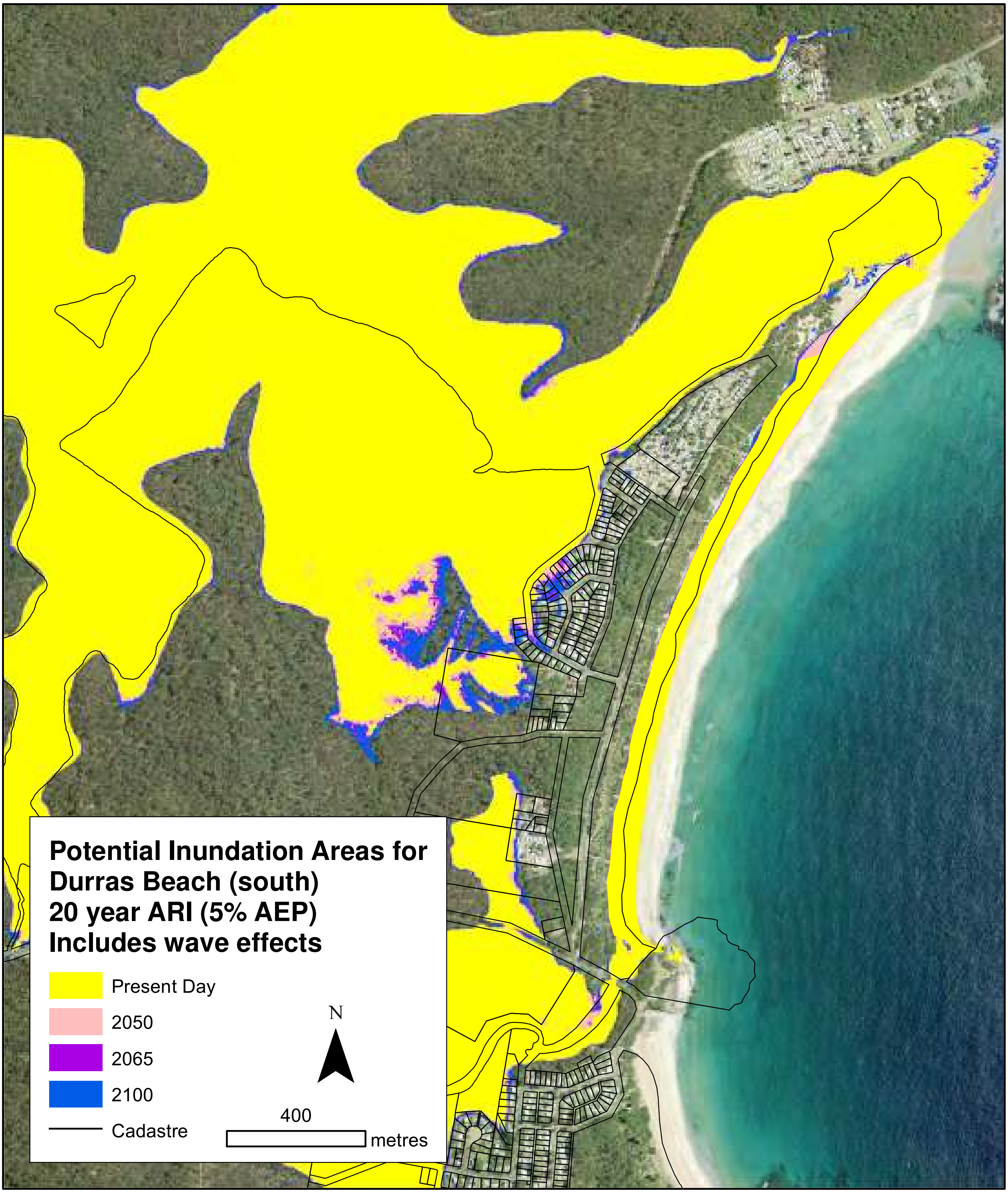

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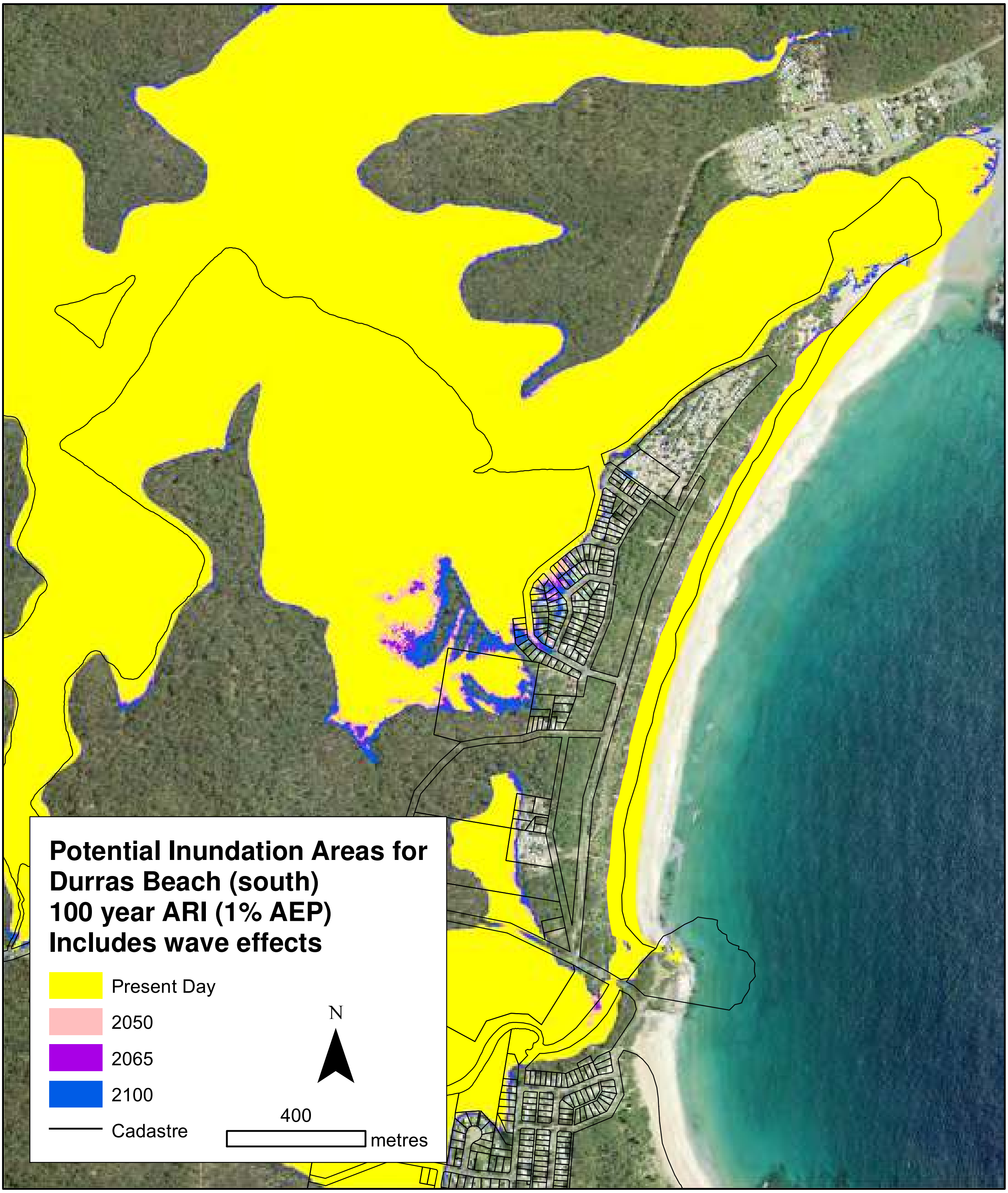
Figure L.2



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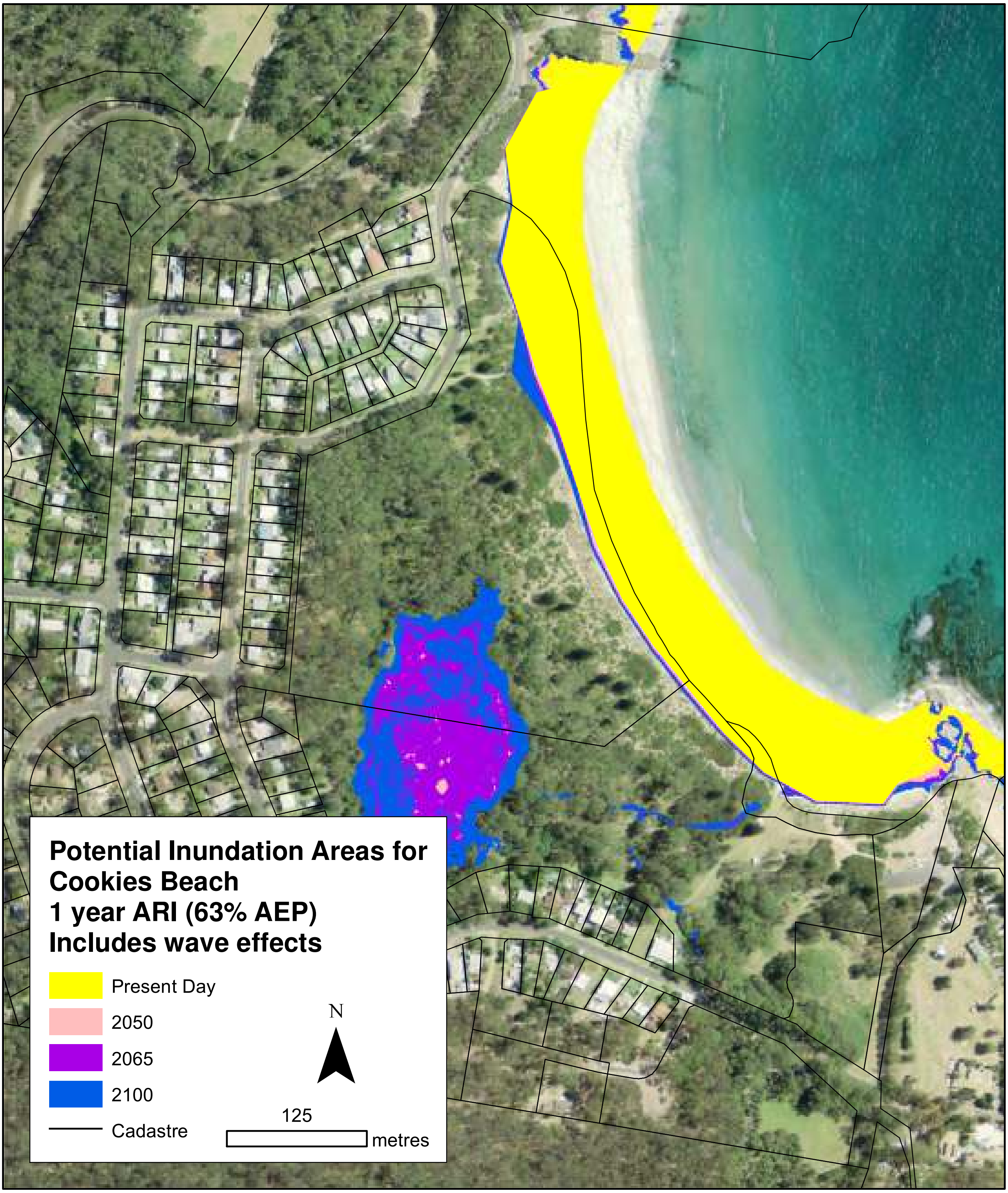

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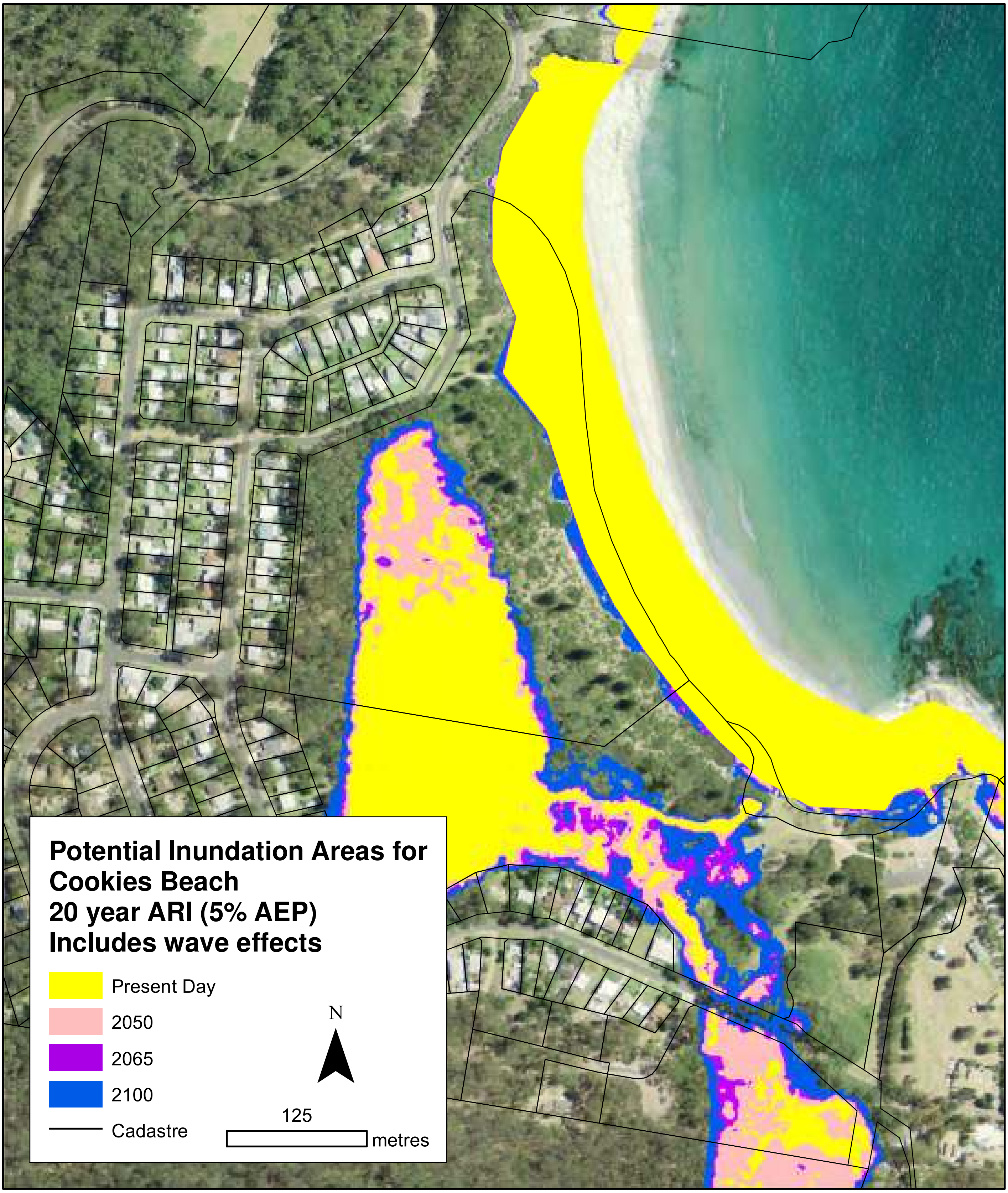

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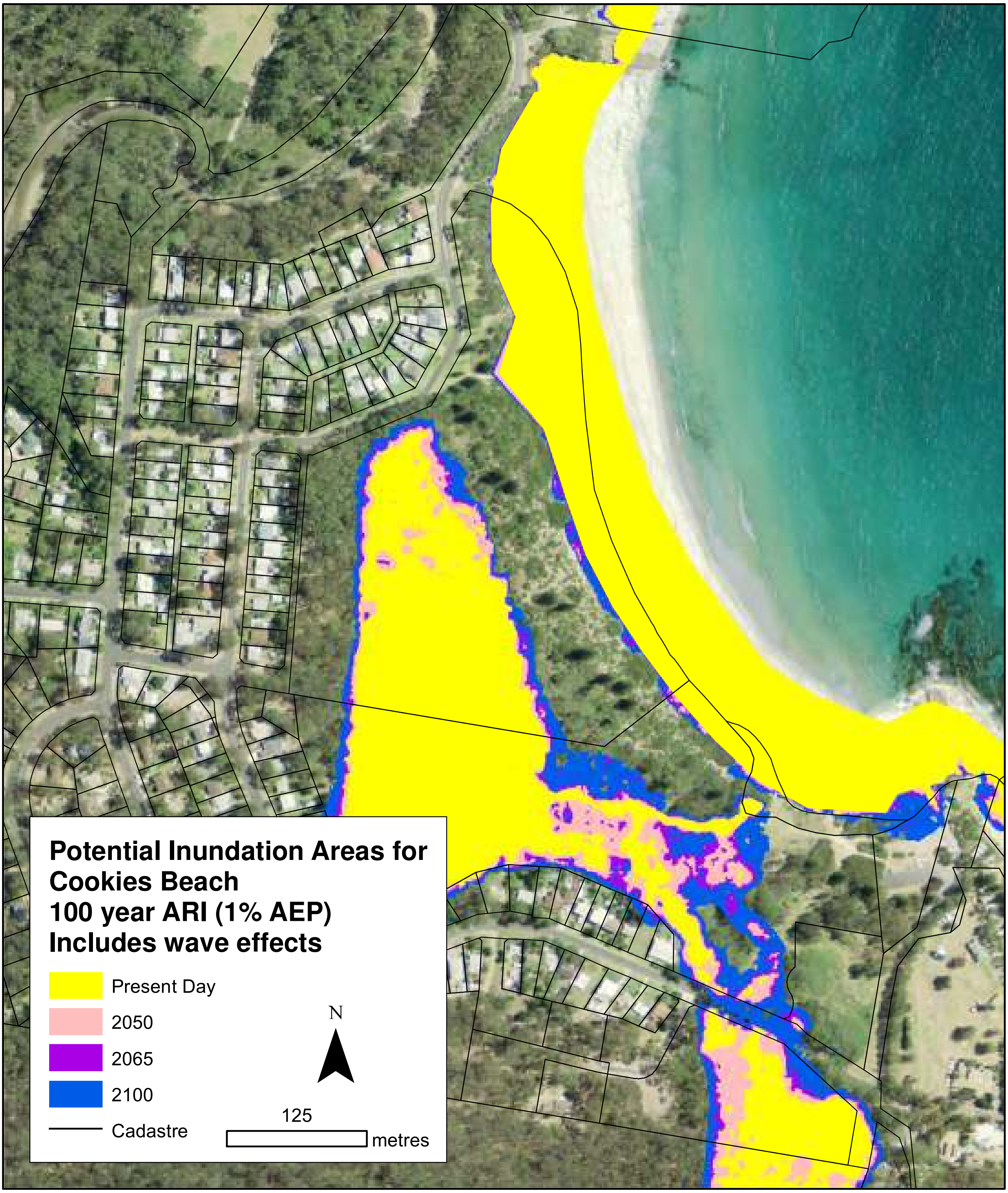

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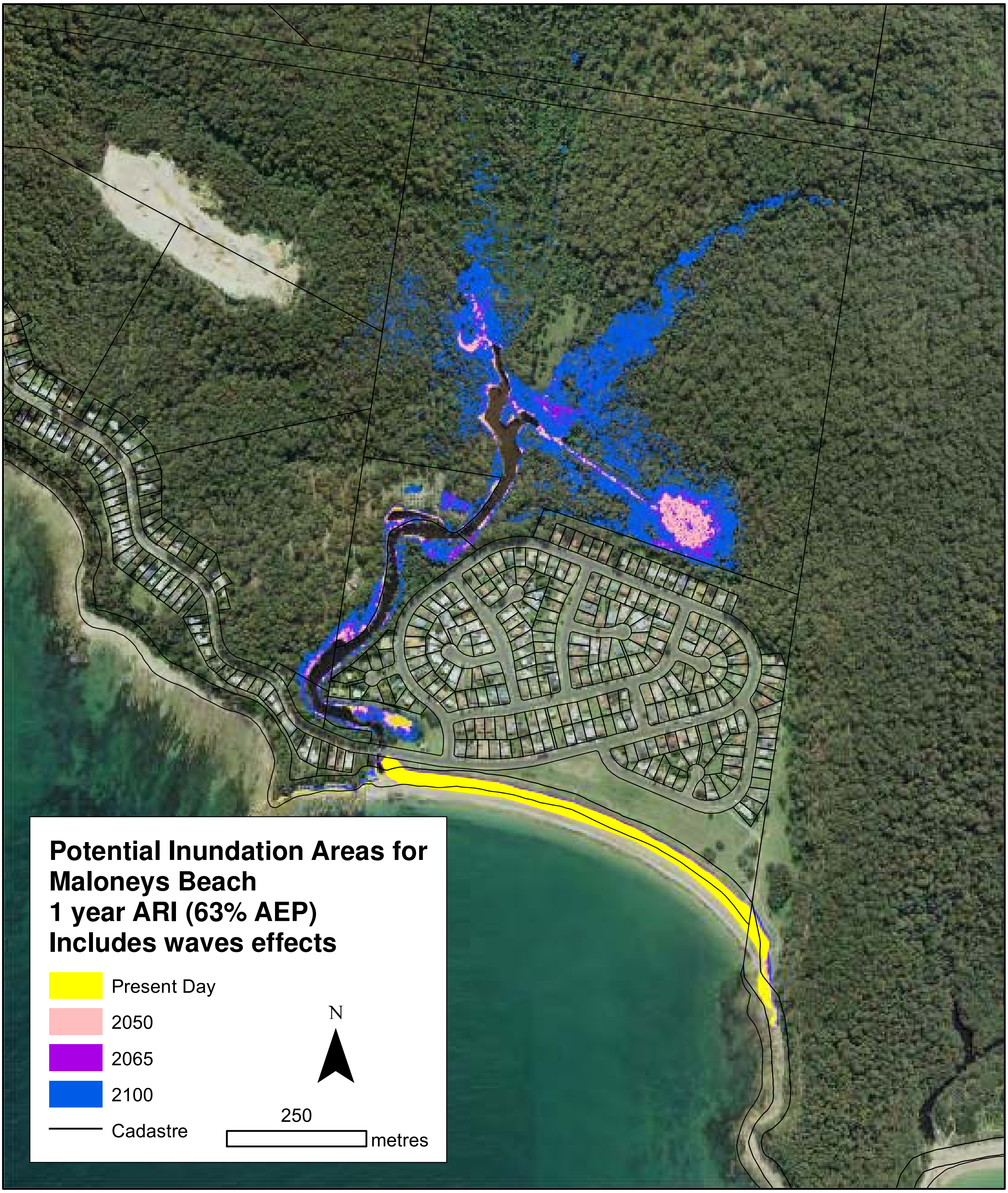

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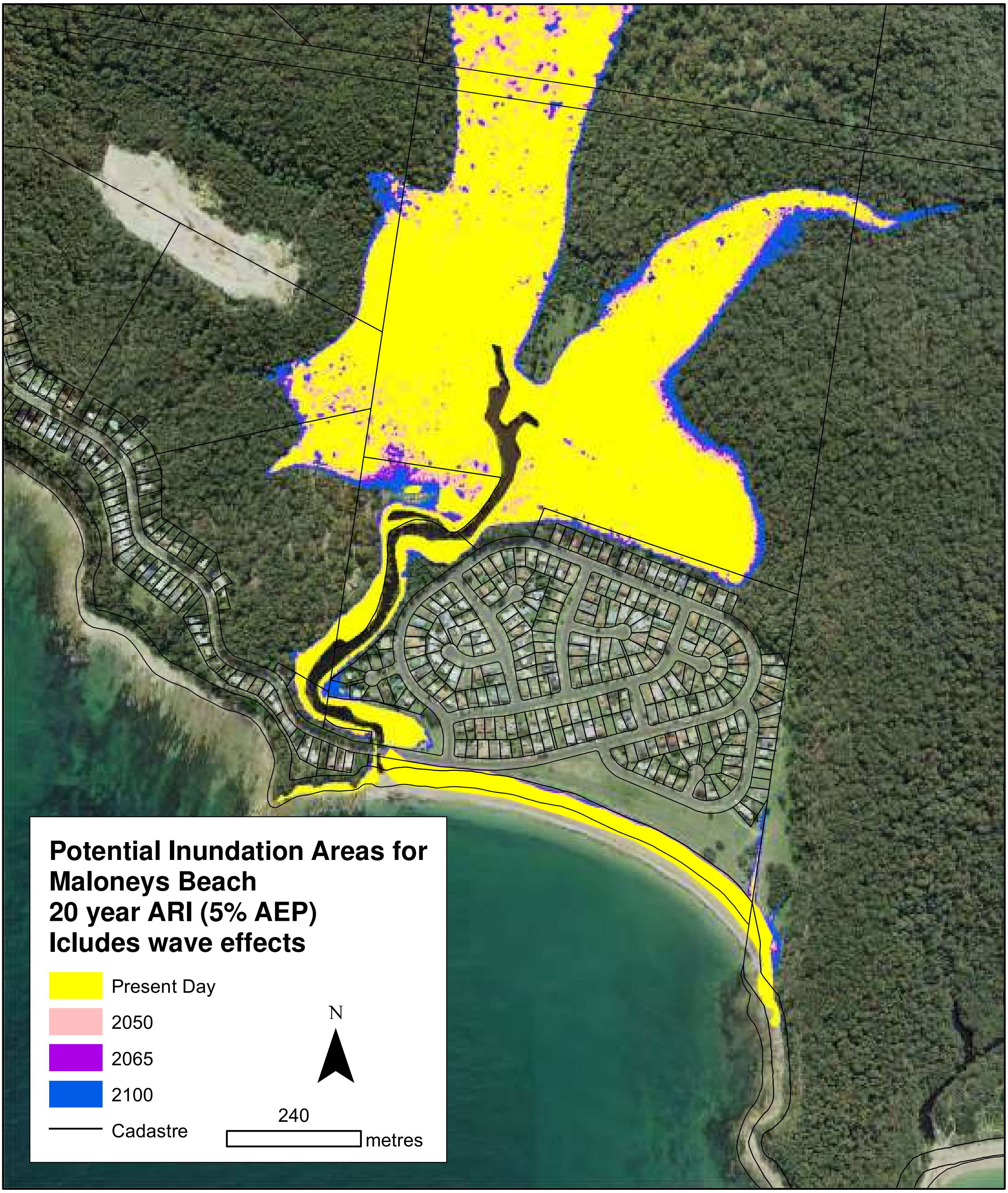

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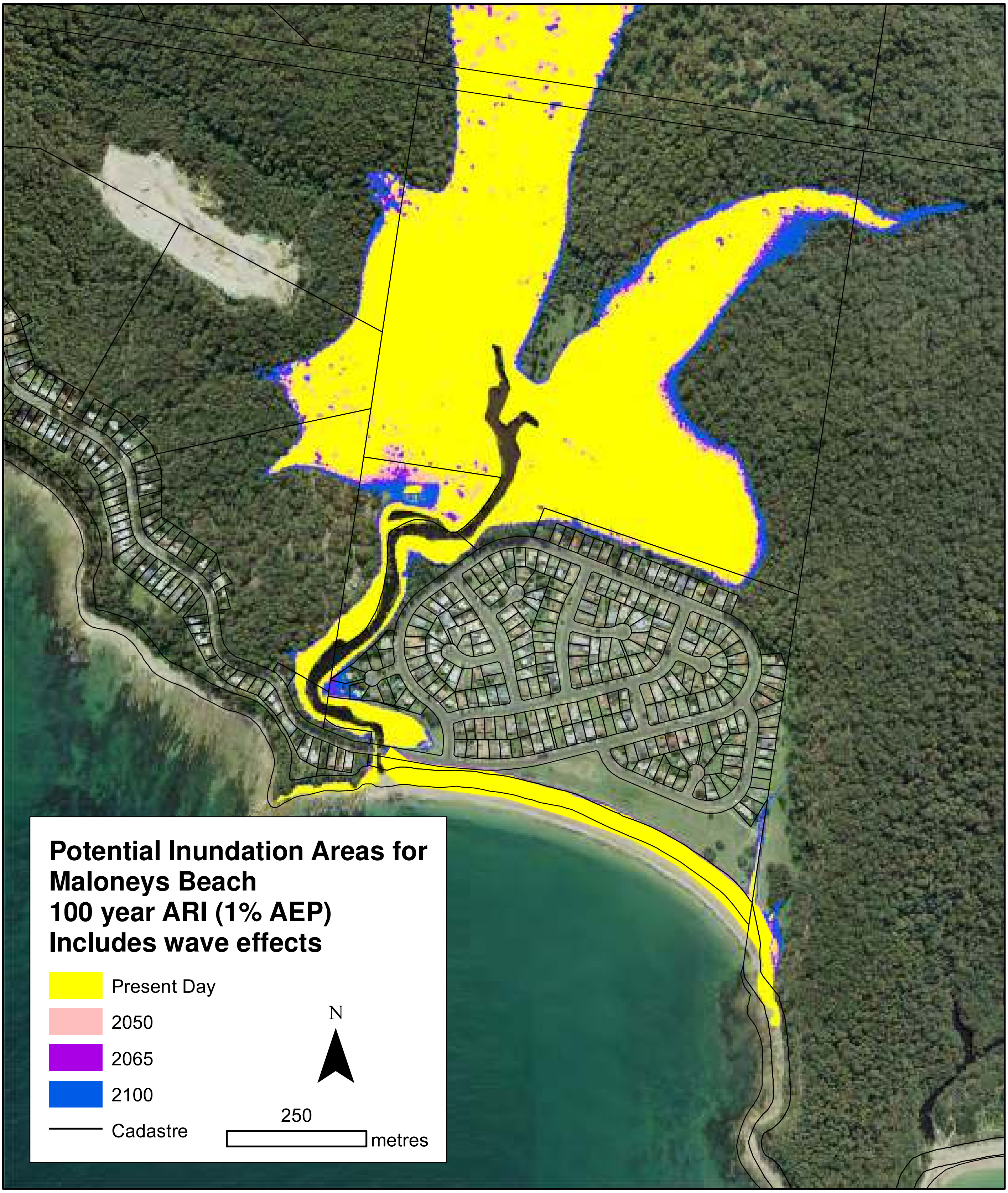

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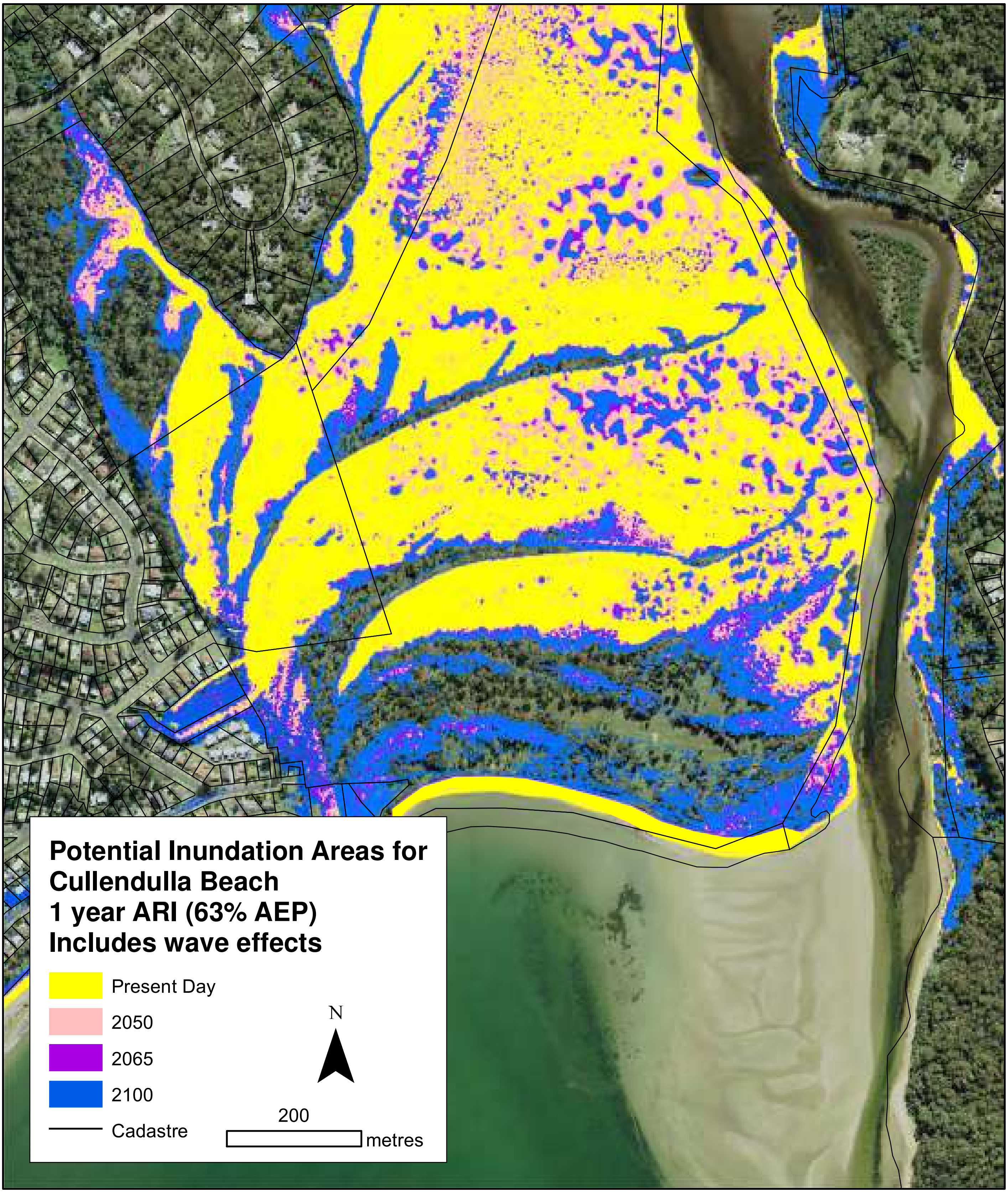

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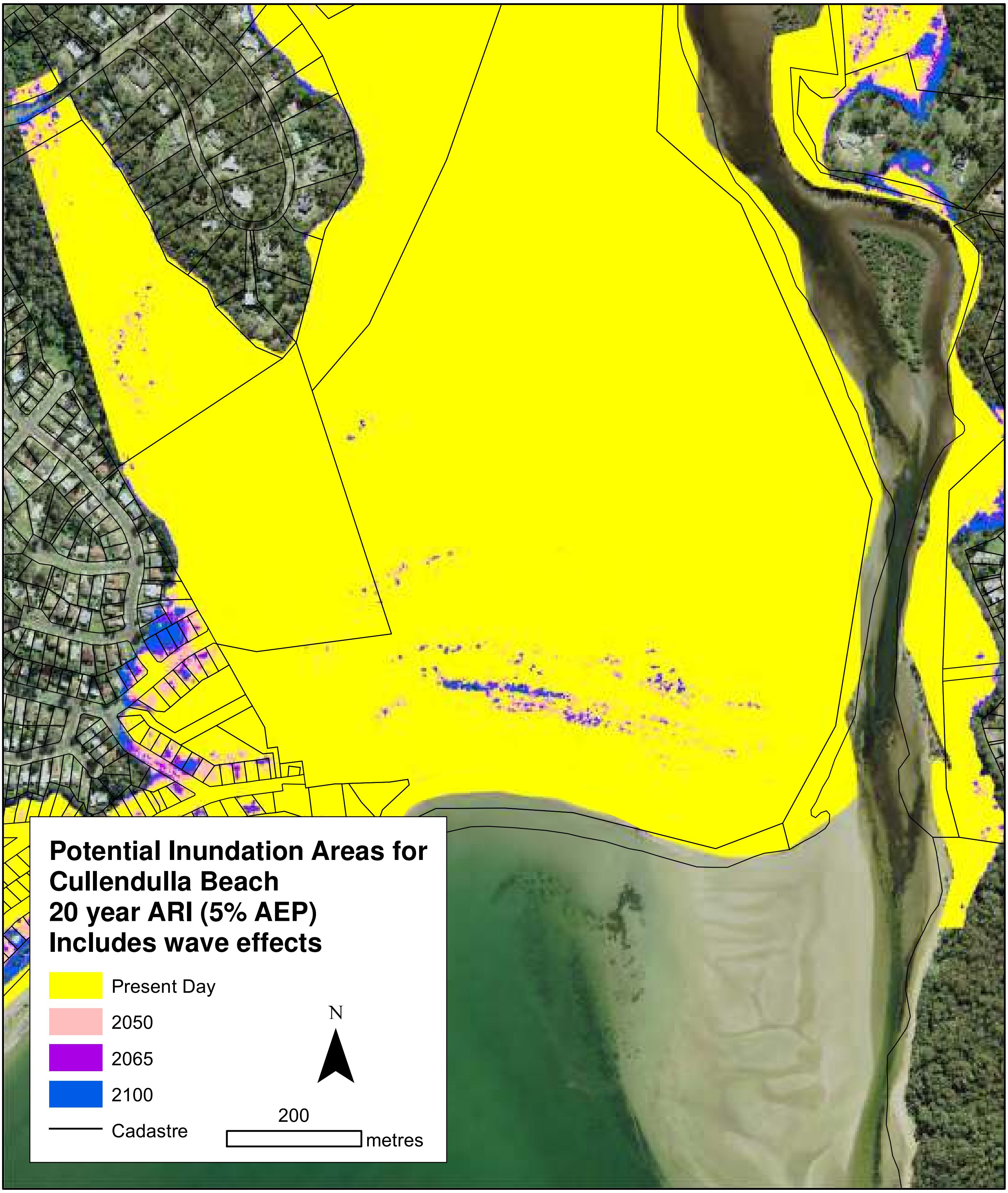

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Figure L.20

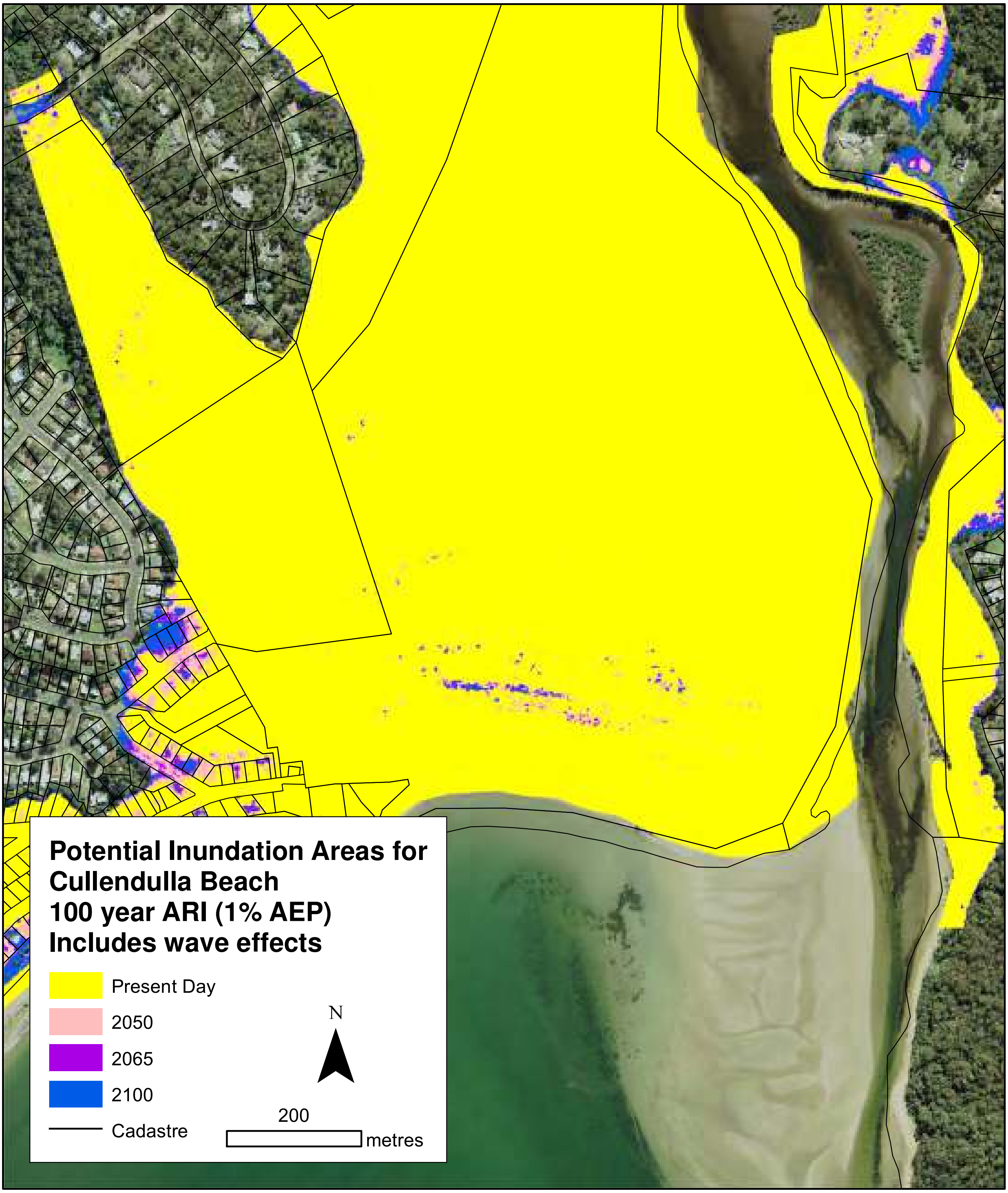

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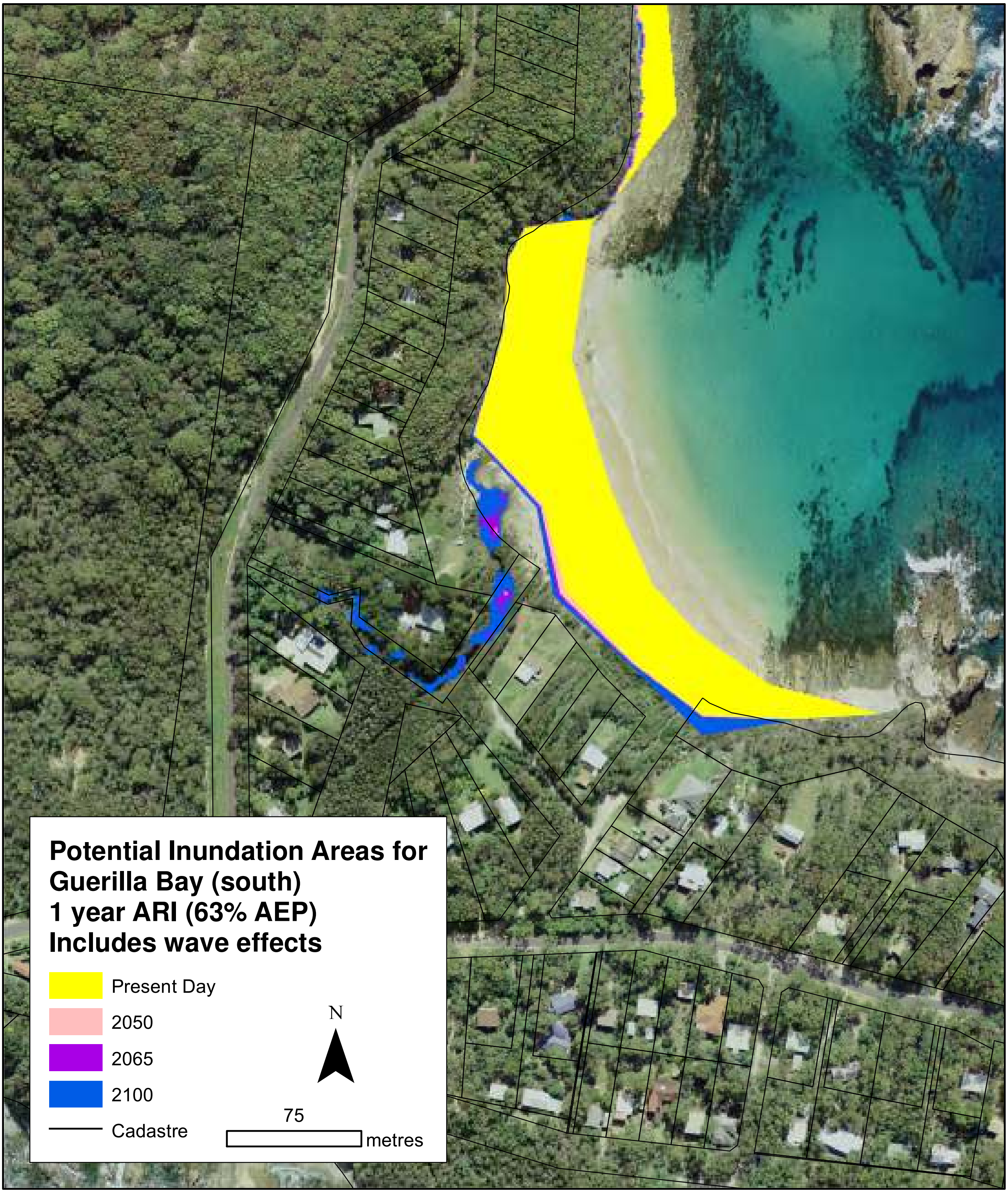
Figure L.21



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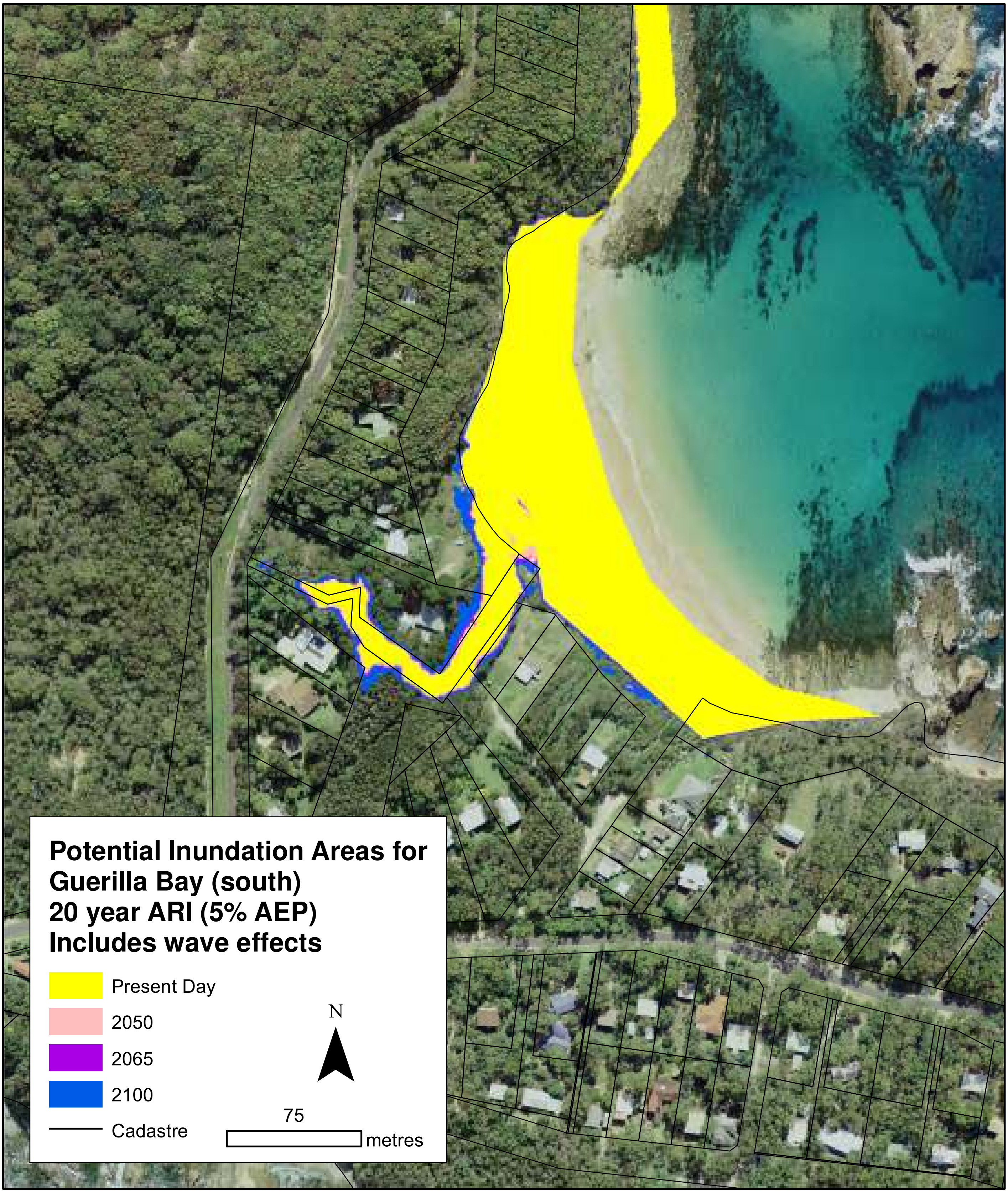

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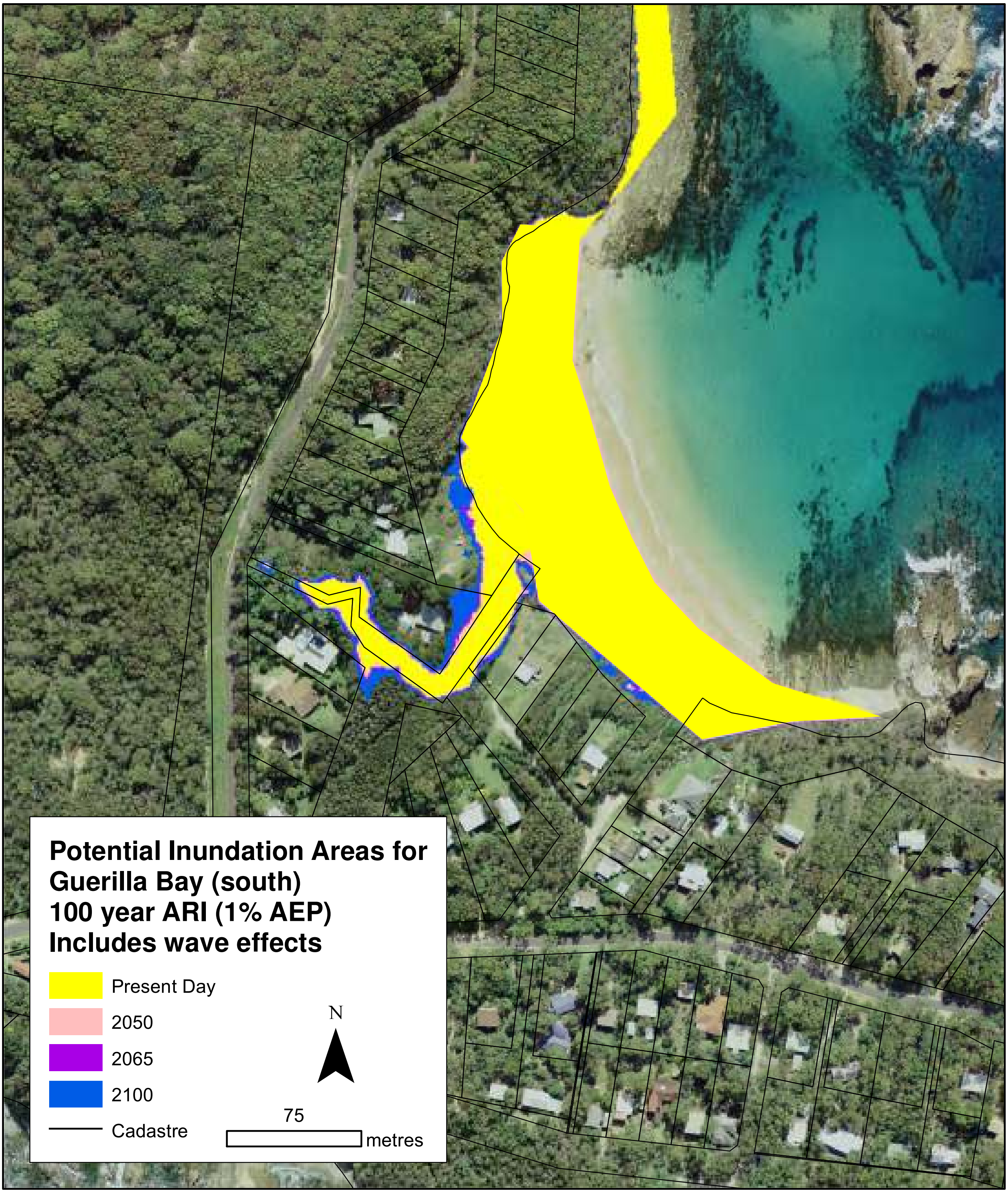

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Figure L.48

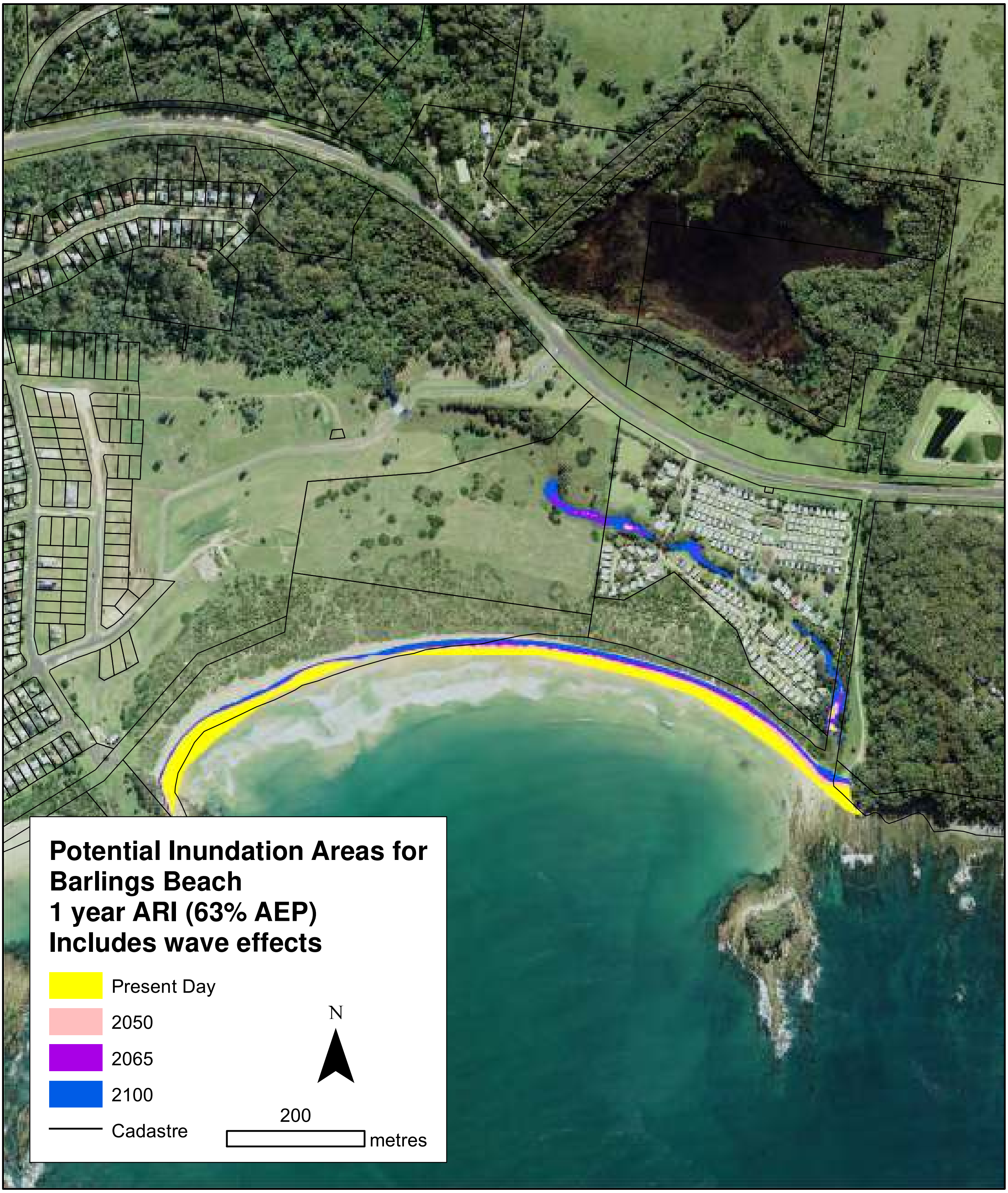

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Figure L.49

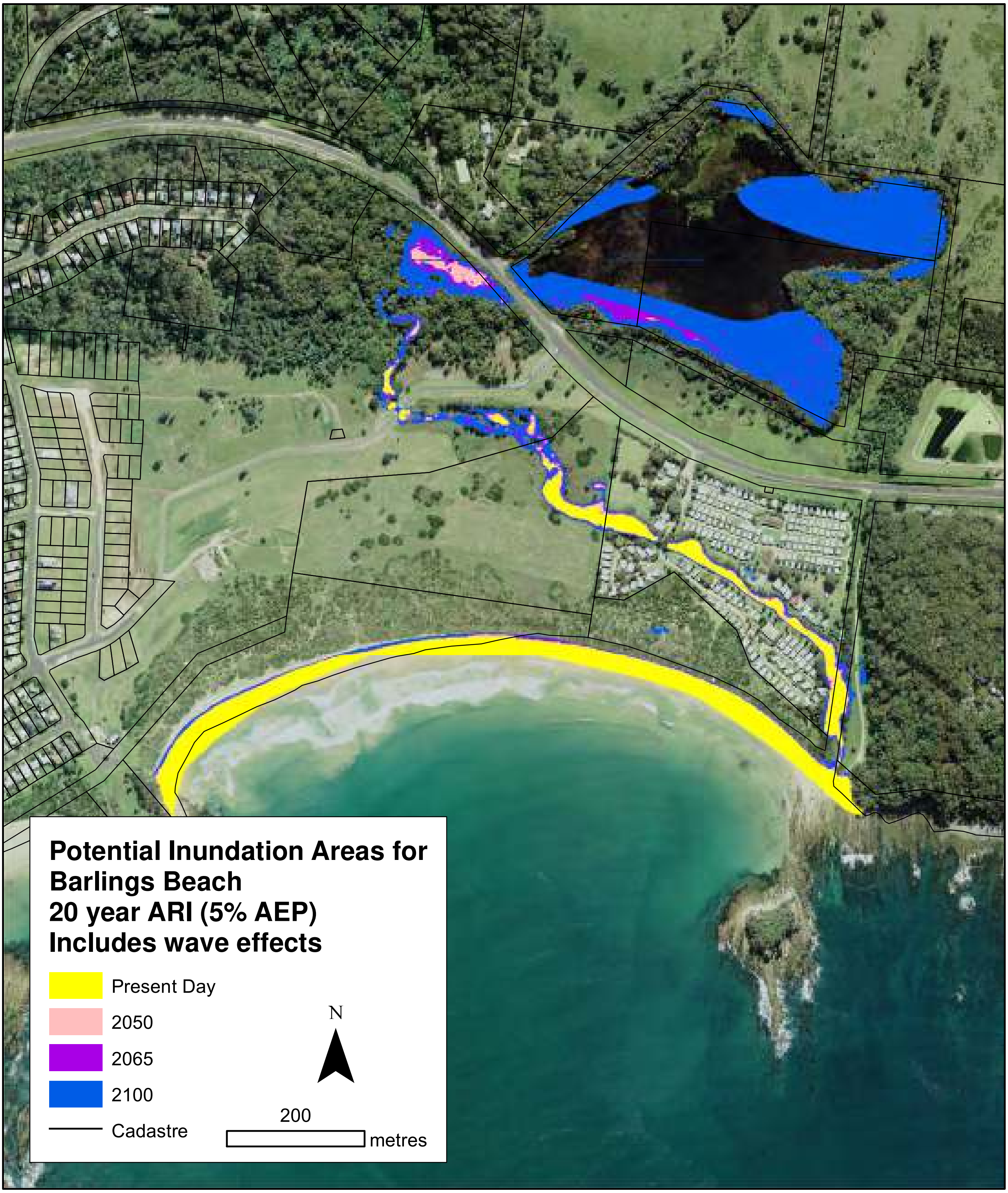

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Figure L.50

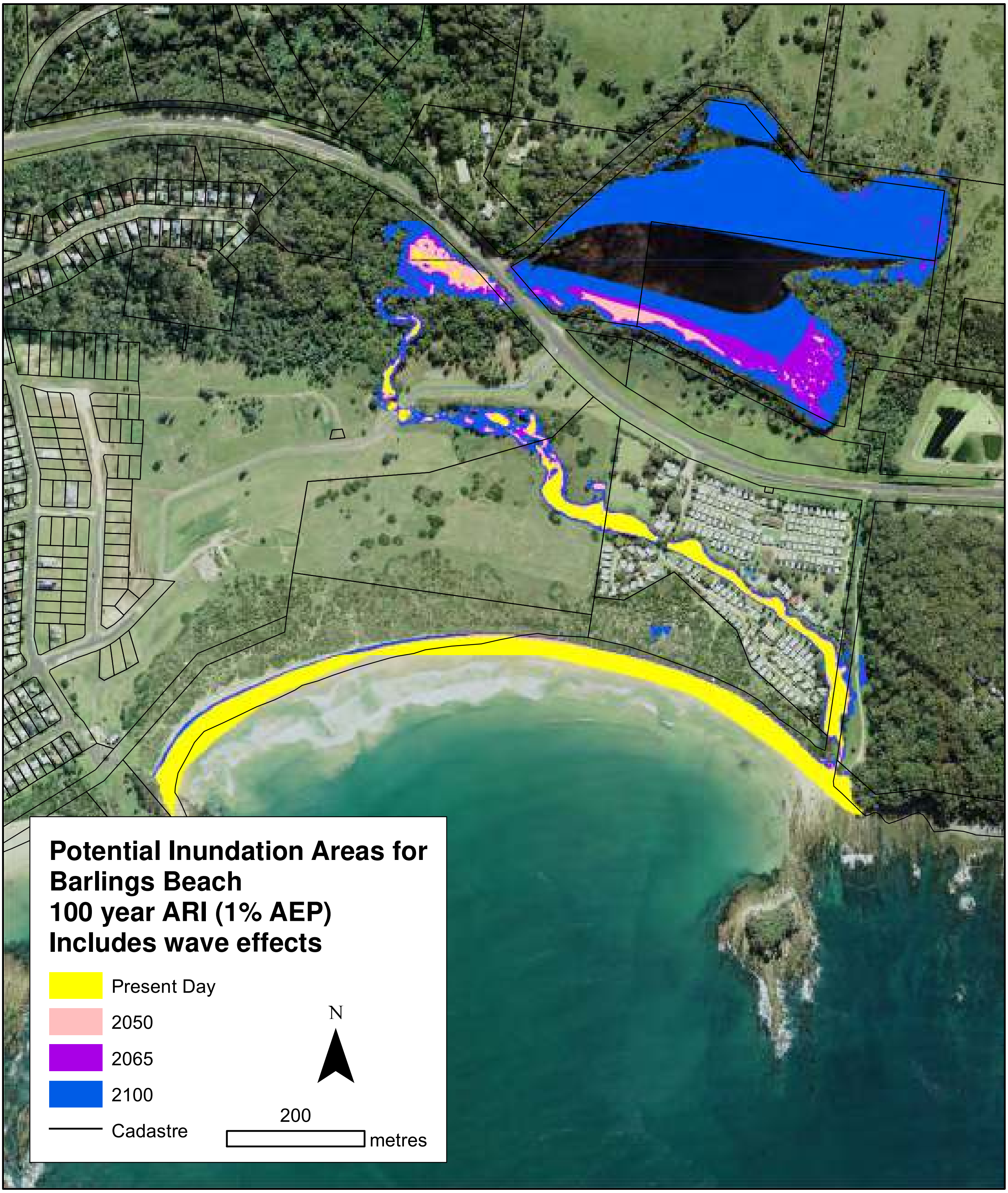

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Figure L.51

Appendix D

Assumption and Limitations: Section 10 from WRL (2017)

10. Assumptions and Limitations

10.1 Introduction

The methodology applied in this report for the Eurobodalla Coastal Hazard Assessment was developed in consultation with Eurobodalla Shire Council and the NSW Office of Environment and Heritage (NSW OEH), and considers the following documents:

- NSW Coastal Management Act (2016) ;
- *Draft* NSW Coastal Management Manual (OEH, 2016);
- Coastal Risk Management Guide (DECCW, 2010);
- ESC sea level rise policy and planning framework (ESC, 2014;Whitehead & Associates, 2014);
- NSW Coastline Management Manual (NSW Government, 1990).

The assumptions and limitations applicable to the analysis and the data used in this study are described below.

10.2 Site Inspections

A visual assessment of the dunes and seawalls allowed general and qualitative observations of the present seawall conditions. A detailed stability assessment was not part of the scope of works and a geotechnical investigation was not undertaken for this study. Representative crest levels and foreshore geometry were estimated by experienced coastal engineers, however, in some locations these levels vary along the dune or seawall.

10.3 Sea Level Rise

The sea level rise projections adopted in this investigation were based ESC's sea level rise policy and planning framework (ESC, 2014). No further reassessment of these benchmarks was undertaken by WRL. These locally adjusted sea level rise benchmarks are based on projections from the IPCC and actual sea level rise may be higher or lower than these benchmarks over the planning period. The IPCC reviews and revises sea level projections at generally 5-7 year intervals, with the most recent revision (Assessment Report 5) being in 2013/14, and Assessment Report 6 due in 2021/2022.

10.4 Water Levels and Wave Climate

For erosion modelling purposes, a Mean High Water Spring (MHWS) tide time series was assumed, to which a tidal anomaly was added, such that the peak water level corresponded to the 100 year ARI storm surge water level. For modelling purposes the peak in predicted tide and tidal anomaly was assumed to coincide with the peak wave height of the storm.

The nearshore wave climate around the beaches of Eurobodalla Shire was determined using a numerical wave propagation model (SWAN version 41.10). The model inputs were offshore boundary conditions and bathymetric data. Offshore boundary conditions relied on extreme wave and wind statistics analysis undertaken by WRL (Shand et al., 2011) for the Australian Climate Change Adaptation Research Network for Settlements and Infrastructure (ACCARNSI). Bathymetric data was obtained from NSW OEH, NSW RMS and AHS. Data collection and analysis was undertaken by reputable organisations, however, minor survey errors are possible. Some temporal change in the seabed after surveys is almost certain which adds further uncertainty to the impacts of coastal hazards.

10.5 Beach Erosion and Recession

The volumes of storm erosion adopted in this study were informed by two methods undertaken by WRL: analysis of photogrammetry and numerical SBEACH erosion modelling.

For beaches where photogrammetry was available in 1972 and 1975 (Surfside Beach (East), Barlings Beach and Tomakin Cove) the maximum storm demand estimated from photogrammetry is considered a reasonable representation of the erosion that occurred due to the May-June 1974 storm sequence. However, the maximum storm demands estimated at the other beaches are considered to be an underestimate because the available photogrammetry dates do not capture the pre- and post-storm-sequence (i.e. beach recovery has occurred following the erosion event).

The SBEACH model has previously been calibrated and validated at numerous places around Australia. For this study, SBEACH was calibrated nearby to the study area against measured erosion at Bengello Beach. The sand grain size modelled at each beach was equivalent to the sediment samples acquired during the site inspections. Based on the experience of this report's authors, their engineering judgement, and consultation with OEH for this project, it was elected to model "design" erosion volumes using 2 x 100 year ARI storm events to account for storm clusters. Note that the Western Australian *Statement Of Planning Policy No. 2.6 (*Western Australian Planning Commission, 2003), specifies 3 x design storms to simulate clusters. Note also that changes to coastal geomorphology since 2014/2015 (when the majority of topographic and nearshore bathymetric survey data was recorded) will not be fully captured. The SBEACH model was calibrated under two separate conditions – aiming to achieve the maximum storm erosion observed at a single profile at Bengello Beach in 1974 (170 m^3/m above 0 m AHD) and, over the four (4) modelled profiles, to achieve the average erosion observed across the whole beach over the same period (95 m^3/m above 0 m AHD). These two target values were established because it is not known whether the singe profile maximum volume coincided with a rip-head embayment (three-dimensional dynamic formations like rip-heads are not included in SBEACH). Since SBEACH calibration was based on a high energy calibration location with a low beach slope, modelled erosion volumes at beaches with steep slopes may be over-predicted. WRL considers that this is likely to be the case at Maloneys Beach and Guerilla Bay (south).

The rates of recession adopted in this study ultimately relied on the analysis of temporal data sets of beach profile fluctuations. These were obtained using photogrammetric data made available by the OEH and ESC. The accuracy of this information rests with OEH and Jacobs (for photogrammetry data commissioned directly by ESC), however, photogrammetric analysis is undertaken to best current practice by skilled and experienced staff. The temporal resolution of the dataset limits the accuracy and reliability of the estimates.

Future shoreline recession as a result of sea level rise was estimated using the Bruun rule and the NSW Government's *Coastal Risk Management Guide* (DECCW, 2010). The limitations of this methodology are well recognised (Ranasinghe et al., 2007) and were taken into consideration. However, no robust and scientifically recognised alternative currently exists. Where known or obvious, the presence of underlying bedrock shelves was taken into account in the initial Bruun factor estimates in this study. However, there may be bedrock present in other areas where it is not visible.

10.6 Wave Runup and Overtopping

Best practice empirical prediction methods based on the most current published literature (Cox and Machemehl, 1986; Mase, 1989; FEMA, 2005 and EurOtop, 2016) were applied to estimate wave overtopping extents and runup levels at the dunes and seawalls. Statistical and data uncertainties related to these methodologies are discussed in the referenced literature (Shand et al., 2011 and EurOtop, 2016). The effect of wind on overtopping rates was not considered. Site specific physical modelling is the only available method offering greater certainty than the methods used.

10.7 Mapping of Coastal Hazard Lines

Mapping of coastal hazard lines was produced to provide general guidance for coastal planning and to identify areas prone to coastal hazards. Mapping was undertaken using state-of-the-art methodologies. Mapping was based on the most recent photogrammetry profiles for each beach (generally 2014, except 2011 for Barlings Beach and Broulee Beach). The limitations of the temporal and spatial resolution of the available photogrammetry data applies to the mapping. Site specific investigations and surveys are encouraged to overcome such limitations. WRL is not responsible for the accuracy of the photogrammetry data.

10.8 Modelling and Mapping of Coastal Inundation Zones

Mapping of coastal inundation zones was produced to provide general guidance for coastal planning and to identify areas prone to coastal inundation. Mapping was undertaken using state-of-the-art methodologies. Assessment of coastal inundation was performed using a combination of three methods at each beach section:

- A “bathtub” method was employed to map the extent of “quasi-static” inland inundation;
- If the dune or seawall crest level exceeds the “quasi-static” water level, the extent of the wave runup was estimated based on elevation using the Mase (1989) method for dunes and EurOtop (2016) for seawalls; and
- If the runup elevation exceeds the crest level, the Cox and Machemehl (1986) method, as adjusted by FEMA (2005), was used to estimate the landward propagation distance of wave bores.

Mapping of inland inundation assumed that topography remains as it was from the 2005 and 2011 LiDAR data provided by NSW LPI and did not consider flow paths, flow velocities, loss of flow momentum or wave propagation into creek areas. No changes were made to isolated “quasi-static” inundated areas that appear to be hydraulically disconnected; further detailed hydraulic modelling considering localised effects would be required to eliminate or confirm their validity. A qualitative check indicated that the LiDAR data was consistent with the observed land forms, however, WRL is not responsible for the accuracy of the LiDAR data.

Mapping of runup and overtopping wave bores was based on the 2011 or 2014 photogrammetry data or 2005 LiDAR data and did not include any allowance for future landward recession. Mapping of runup and overtopping was only undertaken along the crest of the dune or seawall along each beach section; it was not mapped inside watercourse entrances, inside the Batemans Bay Boat Harbour, at rock platforms or cliffed regions.

Appendix C

Long List of Options and Feasibility Assessment

ID	Threat		Management Option	Option Type	Location	Current Risk (2021)	Future Risk (2100)	Source of Option	Reduces risk	Statutory and policy compliance	Engineering feasibility	Adaptive	Outcome of Feasibility Assessment
All_A	All	All	Through the Monitoring & Evaluation program, make the recommendation for the employment of a Coastal / Estuary officer to be employed full time to undertake the actions identified in Council's Coastal Management Programs.	Active intervention	All	NA	NA	Council	Yes	Yes	NA	Yes	Council to pursue this option outside of the CMP actions
CD1_A	CD Threat 1	Coastal development resulting in loss of plant and animal species (habitat disturbance or loss)	Snapper Island Penguin monitoring program	Alert	Snapper Island, Batemans Bay	Medium	High	Environmental Services	Yes	Yes	Yes	Yes	Proceed to viability assessment
CD1_B	CD Threat 1	Coastal development resulting in loss of plant and animal species (habitat disturbance or loss)	Dune vegetation management. Prioritise the northern end of the beach to mitigate erosion risk to the road and private properties.	Active intervention	Broulee	Medium	High	Community Working Groups	Yes	Yes	Yes	Yes	Proceed to viability assessment
CD1_C	CD Threat 1	Coastal development resulting in loss of plant and animal species (habitat disturbance or loss)	Weed management at Potato Point Headland	Active intervention	Potato Point	Medium	High	Council	Yes	Yes	Yes	Yes	Proceed to viability assessment
CD2_A	CD Threat 2	Water pollution from urban stormwater and treated effluent discharge	Investigate source of water quality issues at Surf Beach and develop management plan	Alert	Surf Beach & Broulee	Low	Medium	Community Working Groups Engagement with Mogo LALC	Yes	Yes	Yes	Yes	Proceed to viability assessment
CD2_B	CD Threat 2	Water pollution from urban stormwater and treated effluent discharge	Investigate impact of stormwater outlet / stormwater overflow on water quality at Broulee Head and provide recommendations	Alert	Broulee	Low	Medium	Community Working Groups	Yes	Yes	Yes	Yes	Do not proceed: combined with option CD2_A
CD2_C	CD Threat 2	Water pollution from urban stormwater and treated effluent discharge	Update Council's sediment and erosion control guidelines to ensure alignment with NSW water quality objectives (in relation to impact on coastal receiving waters)	Alert	All	Low	Medium	Community Working Groups	No	Yes	NA	Yes	A review of Council's relevant guidelines indicate that they align with the NSW Warine WQ Objectives.
CD2_D	CD Threat 2	Water pollution from urban stormwater and treated effluent discharge	Identify high risk locations with regards to urban drainage impacts on marine water quality. Consider installation of water quality improvement devices (e.g. GPTs) at key locations to improve receiving water quality.	Active intervention	All	Low	Medium	Community Working Groups, Environmental Services	Yes	Yes	TBC	Yes	Proceed to Viability Assessment
CD3_A	CD Threat 3	Pollution of water, beach sand and other habitat areas with litter, solid waste, marine debris and microplastics	Access improvements, weed and rubbish control on public land adjacent to Wharf Road	Active intervention	Wharf Road	Low	Medium	Wharf Road CZMP	Yes	Yes	Yes	Yes	Combined with CH1_M (property acquisition)
CD3_B	CD Threat 3	Pollution of water, beach sand and other habitat areas with litter, solid waste, marine debris and microplastics	Beach watch monitoring program for water quality at recreational beaches - Continued Program	Alert	All	Low	Medium	Umwelt Internal Discussion Paper (2018)	Yes	Yes	NA	Yes	Proceed to Viability Assessment
CD3_C	CD Threat 4	Coastal development encroaching onto natural coastal processes to exacerbate hazard impacts	Support DPI-Fisheries in preparing a *Marine Vegetation Strategy* to identify priority areas for the protection of healthy mangrove and saltmarsh areas and rehabilitation of degraded areas.	Alert	All	Medium	High	Community Working Groups	Yes	TBC	TBC	Yes	Proceed to Viability Assessment
CDA_A	CH Threat (All)	Coastal Hazards	Property Planning Controls	Planning for change	Active intervention	Medium	High	Stage 2 Coastal Hazard Mapping	-	-	-	-	Do not proceed as individual options. Combined into LGA wide option - should have consistent approach for all development in vulnerable locations.
CDA_B	CH Threat (All)	Coastal Hazards	Property Planning Controls	Planning for change	Long Beach	Medium	Extreme	Stage 2 Coastal Hazard Mapping	-	-	-	-	Do not proceed as individual options. Combined into LGA wide option - should have consistent approach for all development in vulnerable locations.
CDA_C	Ch Threat (All)	Coastal Hazards	Property Planning Controls	Planning for change	Surfside / Wharf Road	Extreme	Extreme	Stage 2 Coastal Hazard Mapping	-	-	-	-	Do not proceed as individual options. Combined into LGA wide option - should have consistent approach for all development in vulnerable locations.
CDA_D	CH Threat (All)	Coastal Hazards	Property Planning Controls	Planning for change	Batemans Bay: Princes Highway to Corrigans	Extreme	Extreme	Stage 2 Coastal Hazard Mapping	-	-	-	-	Do not proceed as individual options. Combined into LGA wide option - should have consistent approach for all development in vulnerable locations.
CDA_E	CH Threat (All)	Coastal Hazards	Property Planning Controls	Planning for change	Corrigans Beach	Medium	High	Stage 2 Coastal Hazard Mapping	-	-	-	-	Do not proceed as individual options. Combined into LGA wide option - should have consistent approach for all development in vulnerable locations.
CDA_F	CH Threat (All)	Coastal Hazards	Property Planning Controls	Planning for change	Caseys Beach	High	Extreme	Stage 2 Coastal Hazard Mapping	-	-	-	-	Do not proceed as individual options. Combined into LGA wide option - should have consistent approach for all development in vulnerable locations.
CDA_G	CH Threat (All)	Coastal Hazards	Property Planning Controls	Planning for change	Malua Bay	Low	High	Stage 2 Coastal Hazard Mapping	-	-	-	-	Do not proceed as individual options. Combined into LGA wide option - should have consistent approach for all development in vulnerable locations.
CDA_H	CH Threat (All)	Coastal Hazards	Property Planning Controls	Planning for change	Tomakin	Medium	High	Stage 2 Coastal Hazard Mapping	-	-	-	-	Do not proceed as individual options. Combined into LGA wide option - should have consistent approach for all development in vulnerable locations.
CDA_I	CH Threat (All)	Coastal Hazards	Property Planning Controls	Planning for change	Broulee Beach & Broulee Island	Low	High	Stage 2 Coastal Hazard Mapping	-	-	-	-	Do not proceed as individual options. Combined into LGA wide option - should have consistent approach for all development in vulnerable locations.
CH1_A	CH Threat 1	Beach Erosion	Supported dune recovery following erosion events: restricting access to eroded location to minimise further disturbance, sand scraping, revegetation.	Active intervention	South Durras	Low	Low	Community Working Groups	TBC	Yes	Yes	Yes	Proceed to Viability Assessment
CH1_B	CH Threat 1	Beach Erosion	Northcove Road Upgrade: - Raise road as part of option to also provide resilience to inundation from waves and catchment flooding. - Include additional culvert cells to provide capacity for catchment flod flows (raised invert to minimise disturbance on existing tidal flow) - Seawall to tie into road upgrade to protect against coastal erosion	Active intervention	Maloneys Beach	None	Medium	Stage 2 Coastal Hazard Mapping	Yes	Yes	TBC	Yes	Proceed to Viability Assessment
CH1_C	CH Threat 1	Beach Erosion	Dune management for coastal hazard protection: nourish, build low dunes and vegetate	Active intervention	Long Beach	Medium	Extreme	Council Area Based Actions	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CH1_D	CH Threat 1	Beach Erosion	Low rock wall to protect public infrastructure: Bay Road	Active intervention	Long Beach	Medium	Extreme	Council Area Based Actions	Yes	Yes	TBC	Yes	Proceed to Viability Assessment

ID	Threat		Management Option	Option Type	Location	Current Risk (2021)	Future Risk (2100)	Source of Option	Reduces risk	Statutory and policy compliance	Engineering feasibility	Adaptive	Outcome of Feasibility Assessment
CH1_E	CH Threat 1	Beach Erosion	Staged construction of low rock wall to protect all private properties and council assets.	Active intervention	Long Beach	Medium	Extreme	Council Area Based Actions	Yes	Yes	TBC	Yes	Proceed to Viability Assessment
CH1_F	CH Threat 1	Coastal Inundation	Relocate assets	Avoid risk	Cullendulla	TBC	TBC	Batemans Bay Coastline Hazard Management Plan (2001)	TBC	Yes	TBC	Yes	Combined into LGA wide option
CH1_G	CH Threat 1	Beach Erosion	Beach nourishment	Active intervention	Cullendulla	Unknown	Unknown	Batemans Bay Coastline Hazard Management Plan (2001)	TBC	Yes	TBC	Yes	Combined with option CH1_L
CH1_H	CH Threat 1	Beach Erosion	Revetment running parallel to the shoreline at Surfside Beach, combined with beach nourishment	Active intervention	Surfside	Low	High	GHD Stage 2 (March 2020)	TBC	Yes	TBC	Yes	Proceed to Viability Assessment
CH1_I	CH Threat 1	Beach Erosion	Offshore low-crest breakwaters in front of Surfside Beach, combined with beach nourishment	Active intervention	Surfside	Low	High	GHD Stage 2 (March 2020)	TBC	Yes	TBC	Yes	Proceed to Viability Assessment
CH1_J	CH Threat 1	Beach Erosion	Nourishment with vegetation stabilisation (grasses)	Active intervention	Surfside	Low	High	Stage 2 Coastal Hazard Mapping	Yes	Yes	TBC	Yes	Combined with option CH1_ZA
CH1_K	CH Threat 1 & 4	Beach Erosion and Coastal Inundation	Wharf Road Protection: - Priority works at exposed corner of Wharf Road - Seawall raising infront of Big4, include walkway along top - Opportunistic raising of the remainder of Wharf Road as maintenance works are undertaken or funding becomes available to maintain access during inundation events - trigger based protection of sewer line and remainder of Wharf Road from erosion: triggered by erosion event (this component may form part of CZEAS)	Active intervention	Surfside / Wharf Road	Medium	High	Stage 2 Coastal Hazard Mapping	Yes	Yes	TBC	Yes	Proceed to Viability Assessment
CH1_L	CH Threat 1	Beach Erosion	Undertake regular nourishment at Surfside when dredging is undertaken in Batemans Bay / Clyde River. Sand to be placed at locations identified in this CMP.	Active intervention	Surfside / Wharf Road	Medium	High	Stage 2 Coastal Hazard Mapping	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CH1_M	CH Threat 1	Beach Erosion	Apply for the NSW government to purchase private properties at Wharf Road to assure current and future generations have public access to the foreshore and beaches. Upon successful implementation undertake site remdiation and clean up, including removal of illegal coastal protection structures.	Avoid risk	Wharf Road	Extreme	Extreme	Wharf Road CZMP	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CH1_N	CH Threat 1	Beach Erosion	Investigate options for the relocation or improved protection of water and sewer mains at Wharf Road and prioritise against other infrastructure in the shire.	Avoid risk	Wharf Road	Medium	High	Wharf Road CZMP	-	-	-	-	Combined into LGA wide review of water a sewer mains at risk from Coastal Hazards - to better allow for prioritisation across LGA
CH1_O	CH Threat 1	Beach Erosion	Investigate opportunities to track sediment movement in Batemans Bay using LiDAR flown with a drone	Alert	Batemans Bay	See hazards assessment	See hazards assessment	Umwelt Internal Discussion Paper (2018)	No	No	NA	Yes	Unlikely to produce an outcome that will reduce coastal risks
CH1_P	CH Threat 1	Beach Erosion	Upgrade existing coastal protection works at Caseys Beach to reduce likelihood of damage from wave overtopping during storm events. The design should incorporate a walkway in line with the proposal in the REF for Caseys Beach which aligns with the Coastal Headland Walk	Active intervention	Batehaven	High	High	Council	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CH1_Q	CH Threat 1	Beach Erosion	Sand nourishment post erosion event - Malua Bay	Active intervention	Malua Bay	Low	High	Stage 2 Coastal Hazard Mapping	Yes	Yes	TBC	Yes	Proceed to Viability Assessment
CH1_R	CH Threat 1	Beach Erosion	Private land acquisition - Malua Bay	Avoid risk	Malua Bay	Low	High	Stage 2 Coastal Hazard Mapping	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CH1_S	CH Threat 1	Beach Erosion	Sand nourishment post erosion event - Tomakin	Active intervention	Tomakin	Low	High	Stage 2 Coastal Hazard Mapping	Yes	Yes	TBC	Yes	Proceed to Viability Assessment
CH1_T	CH Threat 1	Beach Erosion	Trigger based stabilisation of sand spit to rocky outcrop at Tomakin Cove	Active intervention	Tomakin	Low	High	Stage 2 Coastal Hazard Mapping	TBC	Yes	TBC	Yes	Proceed to Viability Assessment
CH1_U	CH Threat 1	Beach Erosion	Offshore reef / wave dissipation - Tomakin Cove	Active intervention	Tomakin	Low	High	Stage 2 Coastal Hazard Mapping	TBC	Yes	TBC	Yes	Proceed to Viability Assessment
CH1_V	CH Threat 1	Beach Erosion	Private land acquisition - North end of Broulee	Avoid risk	Broulee	Low	High	Stage 2 Coastal Hazard Mapping	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CH1_W	CH Threat 1	Beach Erosion	Prioritise vegetation management on dune at northern end of beach	Active intervention	Broulee	Low	High	Stage 2 Coastal Hazard Mapping	Yes	Yes	Yes	Yes	Combined with option CD1_B
CH1_X	CH Threat 1	Beach Erosion	Beach Nourishment, One tree Beach	Active intervention	Tuross Heads	Unknown	Unknown	Tuross / Coila CMP	TBC	Yes	TBC	Yes	Proceed to Viability Assessment
CH1_Y	CH Threat 1	Beach Erosion	Sewage pump stations and reticulation infrastructure on frontal dunes/waterfront reserves – coastal protection works or relocation upon renewal	Active intervention	All	See hazards assessment	See hazards assessment	Umwelt Internal Discussion Paper (2018)	Yes	Yes	TBC	Yes	Proceed to Viability Assessment
CH1_Z	CH Threat 1	Beach Erosion	Confirm locations of stormwater outlets in the immediate coastal erosion hazard area and identify any risk from coastal hazards to the outlets.	Alert	All	See hazards assessment	See hazards assessment	Umwelt Internal Discussion Paper (2018)	Yes	Yes	TBC	Yes	Proceed to Viability Assessment
CH1_ZA	CH Threat 1	Beach Erosion	Groyne fields, combined with beach nourishment	Active intervention	Surfside	Extreme	Extreme	GHD Stage 2 (March 2020)	TBC	Yes	TBC	Yes	Proceed to Viability Assessment
CH10_A	CH Threat 10	Coastal Cliff Instability	Check structural stability and drainage arrangements at properties between Beach Road and the Corrigan's Beach Headland; dwellings north of Bronte Crescent at Caseys Beach Headland and properties close to the cliff at Long Beach.	Alert	Corrigans Beach, Caseys Beach, Long Beach	Unknown	Unknown	Umwelt Internal Discussion Paper (2018)	-	-	-	-	Replaced with updated options below
CH10_B	CH Threat 10	Coastal Cliff Instability	Management of cliff instability at south end of Malua Bay	Active intervention	Malua Bay	Unknown	Unknown	Community Working Groups	-	-	-	-	Replaced with updated options below
CH10_C	CH Threat 10	Coastal Cliff Instability	Conduct periodic inspections of the slopes of the cliffs and bluffs at Corrigans Headland, Sunshine Bay, Caseys Beach Headland and Long Beach Headland to identify evidence of instability, such as loose rock, mantle creep, stormwater incision, tension cracks or leaning or fallen trees.	Alert	Corrigans Headland, Sunshine Bay, Caseys Beach Headland and Long Beach Headland	Medium	High	ACT Geotechnical Engineers Pty Ltd (2012)	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CH10_D	CH Threat 10	Coastal Cliff Instability	A check of the structural stability of the dwellings and retaining structures between Beach Road and the coastal reserve at the SW end of Corrigan's Beach Headland, those north of Bronte Crescent near the cliff edge at Casey's Beach Headland, those close to the cliff edge at Long Beach Headland and those close to the slope at the rear of the dwellings in Bay Road, Long Beach.	Alert	Corrigans Beach, Caseys Beach, and Long Beach	Medium	High	ACT Geotechnical Engineers Pty Ltd (2012)	No	Yes	Yes	Yes	Council have advised that this is not required
CH10_E	CH Threat 10	Coastal Cliff Instability	Maintain or improve native vegetation cover on steep slopes on coastal cliffs and bluffs. This may also involve weed management and use of matting/geotextile to protect the surface from erosion as well as control weeds.	Active intervention	Priority to those affected by geotechnical hazards, and accessible.	Medium	High	ACT Geotechnical Engineers Pty Ltd (2012)	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CH10_F	CH Threat 10	Coastal Cliff Instability	Prepare community and landholder information about the potential impacts of slope instability hazards and why some slopes on the shore of Batemans Bay and elsewhere in the Shire are affected by geotechnical hazards.	Alert	All	Medium	High	Umwelt Internal Discussion Paper (2018)	No	Yes	Yes	Yes	Not considered high priority. Do not proceed to viability assessment

ID	Threat		Management Option	Option Type	Location	Current Risk (2021)	Future Risk (2100)	Source of Option	Reduces risk	Statutory and policy compliance	Engineering feasibility	Adaptive	Outcome of Feasibility Assessment
CH10_G	CH Threat 10	Coastal Cliff Instability	Installation of safety and warning signs: - Install general warning signs along the base of the headlands at Corrigans, Caseys and Long Beaches to warn walkers of the potential hazards. - Fences and warning signs be installed along the top of steep slopes where a risk exists of persons falling over the edge.	Alert	All	Medium	High	ACT Geotechnical Engineers Pty Ltd (2012)	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CH10_H	CH Threat 10	Coastal Cliff Instability	Rip-rap be placed along the base of slopes where active erosion is occurring or likely to occur with a rise in sea level . Matting should also be placed upslope to support the establishment and maintenance of suitable vegetation to prevent further erosion.	Active intervention	All	Medium	High	ACT Geotechnical Engineers Pty Ltd (2012)	Yes	Yes	Yes	Yes	Combined with CH10_E
CH10_I	CH Threat 10	Coastal Cliff Instability	Install and maintain a surface dish drain at the top of slopes to divert water away from slopes that are being eroded or have the potential to be so.	Active intervention	All	Medium	High	ACT Geotechnical Engineers Pty Ltd (2012)	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CH10_J	CH Threat 10	Coastal Cliff Instability	The caves at the cliff base on the western side of Corrigan's Beach Headland and northern side of Casey's Beach Headland be filled with rip-rap and the slope above stabilised with vegetation, or alternatively the caves could be deliberately collapsed in a controlled manner.	Active intervention	Corrigans Beach, Caseys Beach	Medium	High	ACT Geotechnical Engineers Pty Ltd (2012)	No	Yes	Yes	Yes	Council have advised that this is not required
CH10_K	CH Threat 10	Coastal Cliff Instability	Coloured shotcrete or similar material to blend in with the environment be applied to the interior of the cave at the base of the cliff at Corrigan's Beach Headland and the undercut upper cliff at Casey's Beach Headland to prevent further weathering and erosion. Alternatively, the cave can be fenced off or meshed, and be regularly monitored (say every 6 months) and any loose rock(s) removed.	Active intervention	Corrigans Beach, Caseys Beach	Medium	High	ACT Geotechnical Engineers Pty Ltd (2012)	No	Yes	Yes	Yes	Council have advised that this is not required
CH10_L	CH Threat 10	Coastal Cliff Instability	If necessary, chain wire be placed over the slope immediately behind the dwelling very close to the slope in Bay Road, Long Beach.	Active intervention	Long Beach	Medium	High	ACT Geotechnical Engineers Pty Ltd (2012)	No	Yes	Yes	No	Do not proceed to viability
CH9_A	CH Threat 9	Dune Slope Instability	Prepare frontal dune management plan for dunes seaward of caravan parks and camping grounds, and foreshore reserves to optimise resilience of the dunes as protection for temporary land uses and enhance ecological connectivity.	Alert	Murramarang Nature Resort. Beach reserves at Maloneys Beach, Long Beach, Surfside Corrigans (include Clyde View Holiday Park) Malua Bay reserve	Medium	High	Umwelt Internal Discussion Paper (2018), ESC Environmental Division	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CH4_A	CH Threat 4	Coastal Inundation	Management of un-named ICOLL / Wetland to protect against coastal inundation (stabilise dune so breakout doesn't occur)	Active intervention	South Durras	Unknown	Unknown	Community Working Groups	TBC	Yes	TBC	Yes	Proceed to Viability Assessment
CH4_B	CH Threat 4	Coastal Inundation	Beach nourishment	Active intervention	Long Beach	Medium	High	Batemans Bay Coastline Hazard Management Plan (2001)	-	-	-	-	Combined with dune management option for erosion hazard protection
CH4_C	CH Threat 4	Coastal Inundation	Beach reshaping and nourishment to raise the dune to prevent overtopping during major storms	Active intervention	Surfside Beach	Extreme	Extreme	Batemans Bay Coastline Hazard Management Plan (2001)	-	-	-	-	Combined into the revetment wall and flood levee options
CH4_D	CH Threat 4	Coastal Inundation	Flood levee to protect against stormsurge inundation from creek / estuary (surf side creek and Cullendulla)	Active intervention	Surfside	Extreme	Extreme	Stage 2 Coastal Hazard Mapping	TBC	Yes	TBC	Yes	Proceed to Viability Assessment
CH4_F	CH Threat 4	Coastal Inundation	Wharf Road Raising	Avoid risk	Wharf Road	Low	High	Stage 2 Coastal Hazard Mapping	Yes	Yes	TBC	Yes	Combined with option CH1_K
CH4_G	CH Threat 4	Coastal Inundation	Flood gates on stormwater outlets	Active intervention	Wharf Road Batemans Bay to Batehaven	Varied	Varied	Stage 2 Coastal Hazard Mapping	TBC	Yes	TBC	No	Proceed to Viability Assessment
CH4_H	CH Threat 4	Coastal Inundation	Upgrading and raising the rock wall along the western section of Wharf Road	Active intervention	Wharf Road	Low	High	Batemans Bay Coastline Hazard Management Plan (2001)	TBC	Yes	TBC	Yes	Proceed to Viability Assessment
CH4_I	CH Threat 4	Coastal Inundation	Reshaping and additional rock are required to repair the existing training wall	Active intervention	Batemans Bay CBD	Medium	High	Batemans Bay Coastline Hazard Management Plan (2001)	TBC	Yes	TBC	Yes	Proceed to Viability Assessment
CH4_J	CH Threat 4	Coastal Inundation	Seawall raising	Active intervention	Batemans Bay CBD	Medium	High	Stage 2 Coastal Hazard Mapping	TBC	Yes	TBC	Yes	Combined with CH4_K
CH4_K	CH Threat 4	Coastal Inundation	Seawall raising. See CBD masterplan for proposed extent. Install wave return barriers (e.g. curved capping) on the sea wall protecting the Batemans Bay foreshore, to reduce impact of wash-over in short to medium term.	Active intervention	Batemans Bay to Batehaven	Medium	High	Umwelt Internal Discussion Paper (2018)	TBC	Yes	TBC	TBC	Proceed to Viability Assessment
CH4_L	CH Threat 4	Coastal Inundation	Gradually raise the road level of Beach Road (its entire length), through routine maintenance.	Avoid risk	Batemans Bay to Batehaven	High	Extreme	Stage 2 Coastal Hazard Mapping	Yes	Yes	TBC	Yes	Proceed to Viability Assessment
CH4_M	CH Threat 4	Coastal Inundation	Adaptation pathway through filling and asset raising	Planning for change	Batemans Bay: Corrigans area	Extreme	Extreme	Stage 2 Coastal Hazard Mapping	TBC	TBC	TBC	Yes	Proceed to Viability Assessment
CH4_N	CH Threat 4	Coastal Inundation	Construction of a levee around the caravan park area	Active intervention	Hanging Rock	Extreme	Extreme	Batemans Bay Coastline Hazard Management Plan (2001)	Yes	Yes	No	Yes	Do not proceed due to drainaige impacts and feasibility issues associated with access across the levee
CH4_O	CH Threat 4	Coastal Inundation	Construction of a levee around all of the Hanging Rock subdivision	Active intervention	Hanging Rock	Extreme	Extreme	Batemans Bay Coastline Hazard Management Plan (2001)	Yes	Yes	No	Yes	Do not proceed due to drainaige impacts and feasibility issues associated with access across the levee
CH4_P	CH Threat 4	Coastal Inundation	Levee / flood barrier along foreshore and flood gates at Marina Entrance	Active intervention	Batemans Bay	Extreme	Extreme	Stage 2 Coastal Hazard Mapping	Yes	Yes	No	Yes	Do not process to viability assessment due to engineering constraints
CH4_Q	CH Threat 4	Coastal Inundation	There are a significant number of properties impacted by both coastal and catchment flooding between Hanging Rock Creek and Joes Creek. A flood refuge should be established to allow safe evacuation of homes in the event of flooding. The refuge should be set above PMF Catchment and 100 Year ARI Coastal Inundation flood levels.	Emergency Response	Batemans Bay	Extreme	Extreme	Stage 2 Coastal Hazard Mapping	Yes	Yes	Yes	Yes	To be considered as part of Floodplain Risk Management Program
CH4_R	CH Threat 4	Coastal Inundation	Raising of George Bass Drive	Avoid risk	Batehaven	Extreme	Extreme	Stage 2 Coastal Hazard Mapping	Yes	Yes	TBC	Yes	Proceed to Viability Assessment
CH4_S	CH Threat 4	Coastal Inundation	Emergency Response Plan - Big4 Batemans Bay Beach Resort	Emergency Response	Batemans Bay	Extreme	Extreme	Stage 2 Coastal Hazard Mapping	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CH4_T	CH Threat 4	Coastal Inundation	Offshore reef for wave dissipation - Caseys Beach	Active intervention	Batehaven	High	Extreme	Stage 2 Coastal Hazard Mapping	TBC	Yes	TBC	Yes	Proceed to Viability Assessment
CH4_U	CH Threat 4	Coastal Inundation	Emergency Response Plan - Beachcomber Holiday Park	Emergency Response	Potato Point	Medium	High	Site inspections	Yes	Yes	Yes	Yes	Combined with CH4_S
CH4_V	CH Threat 4	Coastal Inundation	Access road raising - Beachcomber Holiday Park	Avoid risk	Potato Point	Medium	High	Site inspections	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CH5_A	CH Threat 5	Tidal Inundation	Implement a program to monitor groundwater response to sea level rise to determine scope of the hazard and risk to Surfside and existing governance and planning practices.	Alert	Surfside	Low	Medium	Council Area Based Actions	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CH8_A	CH Threat 8	Entrance Management	Management of un-named ICOLL / Wetland to restore natural opening and closing regime	Active intervention	South Durras	Medium	High	Community Working Groups	TBC	Yes	Yes	Yes	Proceed to Viability Assessment

ID	Threat		Management Option	Option Type	Location	Current Risk (2021)	Future Risk (2100)	Source of Option	Reduces risk	Statutory and policy compliance	Engineering feasibility	Adaptive	Outcome of Feasibility Assessment
CH8_B	CH Threat 8	Entrance Management	Review of ICOLL EMP	Active intervention	South Durras, Surfside, Joes Creek, Short Beach, Wimbie Beach, Kianga, Little Lake (Narooma), Mummaga, Nangudga Lake	Medium	High	- Council - Community Working Groups	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CH8_C	CH Threat 8	Entrance Management	ICOLL Entrance Management Policy - engagement and finalisation	Active intervention	Congo, Potato Point, Lake Brou, Lake Mummaga, Corunna Lake	Medium	High	NPWS	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CH9_A	CH Threat 9	Dune Slope Instability	Dune stability management (rabbit impacts)	Active intervention	Rosedale Beach	Unknown	Unknown	Community Working Groups	TBC	Yes	Yes	Yes	Proceed to Viability Assessment
CH9_B	CH Threat 9	Dune Slope Instability	Drainage infrastructure to manage erosion of dune caused by stormwater runoff at the end of Knowlman Road	Active intervention	Rosedale Beach	Unknown	Unknown	Community Working Groups	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CHALL_A	CH Threats (All)	All	Prepare a preliminary coastal risk assessment for national parks along the ESC coast, to understand the scope of coastal process, hazard and risk issues and timeframes of potential impacts	Alert	National Parks	Varied	Varied	Umwelt Internal Discussion Paper (2018)	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
CH14_A	CH Threats 1 and 4	Beach Erosion and Coastal Inundation	Review design and resilience of ocean boat ramps, in relation to safety and impact of storm conditions	Planning for change	TBC	Varied	Varied	Umwelt Internal Discussion Paper (2018)	no	Yes	Yes	Yes	No boat ramps in hi risk location (for erosion risk)
CH14_B	CH Threats 1 and 4	Beach Erosion and Coastal Inundation	Assess resilience of surf club buildings to storm events, to provide input to emergency response preparedness and a surf club adaptation plan	Planning for change	TBC	Varied	Varied	Umwelt Internal Discussion Paper (2018)	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
	NA	#N/A	Manage risk to life at unsafe beaches (e.g. Rosedale) - possibly signage?	Active intervention	Rosedale Beach	Unknown	Unknown	Community Working Groups	No	Yes	Yes	Yes	There already is signage. Council is not supportive of additional signage.
CHO_A	Opportunity	#N/A	Opportunities for historical swimming site at Moruya Heads	Alert	Moruya Heads	NA	NA	Community Working Groups	No	TBC	NA	Yes	Proceed to Viability Assessment
CHO_B	Opportunity	#N/A	Consider a ESC coast event/festival to promote tourism opportunities, specifically linked to coastal values Or Integrate with existing festivals such as Narooma Oyster Festival, River of Art and Bay Paddle Challenge	Active intervention	All	NA	NA	Umwelt Internal Discussion Paper (2018)	NA	Yes	NA	Yes	Proceed to Viability Assessment
RA1_A	RA Threat 1	Conflict over resource access and use (e.g. beach users and dog walkers)	Manage user conflicts at Bingie Dreaming Track	Active intervention	Congo	Low	Medium	Community Working Groups	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
RA2_A	RA Threat 2	Habitat (physical) and wildlife disturbance (e.g. from overuse, overcrowding, foreshore development, commercial and recreational fishing methods, etc)	Dune vegetation protection	Active intervention	South Durras	Medium	High	Community Working Groups	Yes	Yes	Yes	Yes	Combine with CH9_A
RA2_B	RA Threat 2	Habitat (physical) and wildlife disturbance (e.g. from overuse, overcrowding, foreshore development, commercial and recreational fishing methods, etc)	Dune vegetation management - Rosedale Beach	Active intervention	Rosedale Beach	Medium	High	Community Working Groups	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
RA2_C	RA Threat 2	Habitat (physical) and wildlife disturbance (e.g. from overuse, overcrowding, foreshore development, commercial and recreational fishing methods, etc)	Manage access along spit at Tomakin Beach to reduce impacts on vegetation and spit stability	Active intervention	Tomakin	Medium	High	Community Working Groups, Council	No	Yes	Yes	Yes	Planting, signage, access restriction has been undertaken numerous time and doesn't work as people continue to walk around at high tide and get blocked, sending them over the top. The management of the spit will be assessed through a seperate Management plan for Tomaga Spit (seperate project).
RA2_D	RA Threat 2	Habitat (physical) and wildlife disturbance (e.g. from overuse, overcrowding, foreshore development, commercial and recreational fishing methods, etc)	Consolidate pedestrian access across dunes	Active intervention	Broulee	Medium	High	Community Working Groups	Yes	Yes	Yes	Yes	Combine with RA2_B
RA2_E	RA Threat 2	Habitat (physical) and wildlife disturbance (e.g. from overuse, overcrowding, foreshore development, commercial and recreational fishing methods, etc)	Shorebird management across Eurobodalla: Using our shorebird layer, identify shorebird nesting sites and target these sites for pest control.	Active intervention	All	Medium	High	Environmental Services	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
RA2_F	RA Threat 2	Habitat (physical) and wildlife disturbance (e.g. from overuse, overcrowding, foreshore development, commercial and recreational fishing methods, etc)	Provide direction, funding and support for community involvement in on ground works along the ESC coast – through Coastcare/Landcare projects.	Active intervention	All	Medium	High	Umwelt Internal Discussion Paper (2018)	Yes	Yes	Yes	Yes	Combine with CH9_A
RA2_G	RA Threat 2	Habitat (physical) and wildlife disturbance (e.g. from overuse, overcrowding, foreshore development, commercial and recreational fishing methods, etc)	Conduct follow up work on weeds of National Significance in coastal reserves – e.g. from Corrigans Beach to Mosquito Bay (2014-15) and then in coastal reserves further south.	Active intervention	All	Medium	High	Umwelt Internal Discussion Paper (2018)	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
RA3_A	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Develop a 'round the bay' coastal walk and cycleway for Batemans Bay	Active intervention	Batemans Bay Foreshore	Medium	Medium	Umwelt Internal Discussion Paper (2018)	Yes	Yes	Unknown	Yes	Proceed to Viability Assessment
RA3_B	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Bridge crossing at Cullendulla Creek to link the area up with Murramarrang walk and Coastal Headland walk	Active intervention	Cullendulla	Medium	Medium	Council - Tourism / planning	Yes	Yes	Unknown	Yes	Proceed to Viability Assessment
RA3_C	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Monitor usage of marina berths and swing moorings in Batemans Bay, including courtesy moorings Monitor changes in the condition of sea grass beds at or around swing moorings and in the Batemans Bay marina	Alert	Batemans Bay	Medium	Medium	Umwelt Internal Discussion Paper (2018)	No	Yes	NA	Yes	Unclear what threat this option was looking to address. Without further detail provided in Umwelt (2018) unable to progress to Viability Stage
RA3_D	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Subject to outcomes of DI-Land and Water Minor Ports Strategy development, promote Batemans Bay as a suitable area for visiting yachts.	Active intervention	Batemans Bay	Medium	Medium	Umwelt Internal Discussion Paper (2018)	No	Yes	NA	Yes	Unclear what threat this option was looking to address. Without further detail provided in Umwelt (2018) unable to progress to Viability Stage
RA3_E	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Continue maintenance and upgrade of the Batemans Bay public wharf	Active intervention	Batemans Bay	Medium	Medium	Umwelt Internal Discussion Paper (2018)	No	Yes	Yes	Yes	Unclear what threat this option was looking to address. Without further detail provided in Umwelt (2018) unable to progress to Viability Stage
RA3_F	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Improve facilities for tourism at Corrigans Beach, in line with EDELS 2011 and Royal Haskoning 2015. This includes: •Improved & all-levels inclusive disabled access •Facilities for kayaks and SUPs •Courtesy moorings and short term berths in Batemans Bay •Improved trailer parking •Sewage pump out facility •Deep water marina berths for visiting yachts	Active intervention	Corrigans	Medium	Medium	Umwelt Internal Discussion Paper (2018), 'ESC Environmental Service	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
RA3_G	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Upgrade beach reserve infrastructure at Malua Bay, including toilet block, picnic shelters	Active intervention	Malua Bay	Medium	Medium	Umwelt Internal Discussion Paper (2018)	Yes	Yes	Yes	Yes	Proceed to Viability Assessment

ID	Threat		Management Option	Option Type	Location	Current Risk (2021)	Future Risk (2100)	Source of Option	Reduces risk	Statutory and policy compliance	Engineering feasibility	Adaptive	Outcome of Feasibility Assessment
RA3_H	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Provide a walking path from Malua Bay to McKenzies Beach.	Active intervention	Malua Bay to McKenzies Beach	Medium	Medium	Umwelt Internal Discussion Paper (2018)	Yes	Yes	TBC	Yes	This option is covered by BMP's Coastal walk plan
RA3_I	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Provide basic public toilet facilities at McKenzies Beach.	Active intervention	McKenzies Beach	Medium	Medium	Umwelt Internal Discussion Paper (2018)	Yes	Yes	TBC	Yes	Proceed to Viability Assessment
RA3_J	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Look at parking options at McKenzies Beach	Alert	McKenzies Beach	Medium	Medium	Community Working Groups / Umwelt (2018)	Yes	Yes	TBC	Yes	Proceed to Viability Assessment
RA3_K	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Review and upgrade access paths and public toilets, showers etc. at One Tree Beach (Tuross), to enhance safety and amenity.	Active intervention	Tuross Lake	Medium	Medium	Umwelt Internal Discussion Paper (2018)	Yes	Yes	TBC	Yes	Proceed to Viability Assessment
RA3_L	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Improving access and providing protection of midden sites along Mummaga Headland by formalising access on the south/eastern side of headland, and revegetating the sections of exposed midden and cliff face that are being used as informal tracks	Active intervention	Dalmeny	Medium	Medium	Site inspections, Wagonga LALC	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
RA3_M	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Coastal walk opportunity: Mystery Bay to Narooma	Active intervention	Mystery Bay	Medium	Medium	Community Working Groups	TBC	TBC	TBC	Yes	There is no desire by Council to formalise this coastal walk (there is already an informal walk). Area has a number of Aboriginal culturally significant sites.
RA3_N	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Investigate, prioritise and improve beach access in key beach locations (particularly ensuring disability inclusive access to beaches). Aligns with *Draft Marine Park Management Plan* (action 5.4c)	Active intervention	All	Medium	Medium	Council	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
RA3_O	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Continue to promote existing coastal walks such as coastal walks in Murramarang National Park, Broulee Island, Bingie Dreaming, Mystery Bay to 1080 Beach, Mangrove walk at Cullendulla Creek, Durras discovery and Banksia Walk at Burrewarra Point, Mill Bay Board walk at Narooma.	Alert	All	Medium	Medium	Umwelt Internal Discussion Paper (2018)	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
RA3_P	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Provision of lifeguard services at most popular beaches and work with SLSA for weekend coverage of other beaches, across the peak summer visitor season	Active intervention	All	Medium	Medium	Umwelt Internal Discussion Paper (2018)	Yes	Yes	Yes	Yes	Not suitable for inclusion in the CMP
RA3_Q	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Upgrade parking, fencing, lookouts and interpretation in reserves on coastal headlands around Batemans Bay.	Active intervention	All	Medium	Medium	Umwelt Internal Discussion Paper (2018)	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
RA3_R	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Prepare a beach reserve asset audit for the whole coast, to identify the adequacy, suitability and safety of toilet blocks, picnic tables/shade shelters, and coastal access stairs and paths	Alert	All beach reserves	Medium	Medium	Umwelt Internal Discussion Paper (2018)	Yes	Yes	Yes	Yes	Already completed by Council
RA6_A	RA Threat 6	Active recreational use (recreational boating, motorised watercraft, camping etc) - recreational activities needing associated infrastructure	Monitor usage and impacts of high usage on bike tracks between Broulee Head and Moruya Heads	Alert	Bengello Beach	Medium	High	Community Working Groups	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
RA6_B	RA Threat 6	Active recreational use (recreational boating, motorised watercraft, camping etc) - recreational activities needing associated infrastructure	Implement Mystery Bay Campground Management Plan to mitigate impacts of overcrowding and inappropriate use / access (e.g. loss of vegetation and habitat, litter, disturbance of cultural sites)	Active intervention	Mystery Bay	Medium	High	Community Working Groups	Yes	Yes	Yes	Yes	Management Plan already in place and implemented
EGC2_A	EGC Threat 2	Insufficient community and visitor awareness of the values and threats to the coastal environment, and lack of engagement with managing this environment	Increase community awareness of importance of dunes for habitat and erosion protection	Alert	All	Medium	High	Community Working Groups	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
EGC2_B	EGC Threat 2	Insufficient community and visitor awareness of the values and threats to the coastal environment, and lack of engagement with managing this environment	Community awareness and consultation program on the value of coastal reserves, linked to update of plans of management for reserves to align with the CMP. Target encroachment of private uses onto public reserves and clearing of native vegetation on reserves, adjacent to residences – to maintain views or for other private benefit.	Alert	All	Medium	High	Umwelt Internal Discussion Paper (2018)	Yes	Yes	Yes	Yes	Not necessary or realistic actions – Council don't have the resources to dedicate to this & don't see it as a priority. Community are pretty well informed on coastal processes.
EGC2_C	EGC Threat 2	Insufficient community and visitor awareness of the values and threats to the coastal environment, and lack of engagement with managing this environment	Community awareness and education programs about coastal processes, coastal hazards and coastal change, including climate change and sea level rise	Planning for change	All	Medium	High	Umwelt Internal Discussion Paper (2018)	Yes	Yes	Yes	Yes	Not necessary or realistic actions – Council don't have the resources to dedicate to this & don't see it as a priority. Community are pretty well informed on coastal processes.
EGC3_A	EGC Threat 3	Insufficient or inappropriate governance and management of the coastal environment	Monitoring of coastal environment for reporting in council's state of the environment reports and/or annual reports	Alert	All	Medium	High	Umwelt Internal Discussion Paper (2018)	Yes	No	Yes	Yes	Council doesn't do SoE reporting
EGC3_B	EGC Threat 3	Insufficient or inappropriate governance and management of the coastal environment	Work with relevant State Agencies to strengthen shared and consistent management of coastal land.	Planning for change	TBC	Medium	High	Umwelt Internal Discussion Paper (2018)	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
EGC3_C	EGC Threat 3	Insufficient or inappropriate governance and management of the coastal environment	Community satisfaction surveys	Alert	All	Medium	High	Umwelt Internal Discussion Paper (2018)	No	Yes	Yes	Yes	Already in place
EGC3_D	EGC Threat 3	Insufficient or inappropriate governance and management of the coastal environment	Use this information to update plans of management for the reserved lands and highlight assets (natural or built) within the reserves that need changed management to mitigate coastal risks.	Planning for change	All	Medium	High	Umwelt Internal Discussion Paper (2018) Stage 2 Hazards Study	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
EGC3_E	EGC Threat 3	Insufficient or inappropriate governance and management of the coastal environment	Update plans of management for coastal national parks, including review of current arrangements for access, interactions between national parks and adjoining lands for recreation and tourism (include maintenance of access infrastructure), weed species; address or foreshadow when necessary any coastal hazard risks.	Planning for change	National Parks	Medium	High	Umwelt Internal Discussion Paper (2018)	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
EGC3_F	EGC Threat 3	Insufficient or inappropriate governance and management of the coastal environment	Maintenance of State Agency owned coastal assets to engineering and safety standards	Active intervention	TBC	Medium	High	Taskforce meeting	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
EGC4_A	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Opportunities for cultural burning	Active intervention	All	High	Extreme	Council	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
EGC4_B	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Development and implementation of Aboriginal cultural resource use agreements, Sea Country plans or other planning tools i	Active intervention	All	High	Extreme	Aboriginal engagement	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
EGC4_C	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Support Aboriginal cultural tourism opportunities	Alert	All	High	Extreme	Aboriginal engagement	Yes	Yes	Yes	Yes	Proceed to Viability Assessment

ID	Threat		Management Option	Option Type	Location	Current Risk (2021)	Future Risk (2100)	Source of Option	Reduces risk	Statutory and policy compliance	Engineering feasibility	Adaptive	Outcome of Feasibility Assessment
EGC4_D	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Aboriginal coastal management - youth education opportunities	Alert	All	High	Extreme	Aboriginal engagement	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
EGC4_E	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Support local Aboriginal Communities manage cultural heritage from coastal hazards and sea level rise and other coastal threats	Active intervention	All	High	Extreme	DPE, NPWS & Aboriginal engagement	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
EGC4_F	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Improve access to Country	Active intervention	All	High	Extreme	DPE	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
EGC4_G	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Identify and use Aboriginal place names	Active intervention	All	High	Extreme	DPE	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
EGC4_H	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Review, update and implement PoM for Aboriginal Place at Barlings Beach	Active intervention	Barlings Beach	High	Extreme	Traditional Owners	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
EGC4_I	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Collaborate with the Local Aboriginal Community to prepare an Aboriginal Seasonal Calendar to showcase traditional land management, food & medicine practices and deeper understanding of the land & climate.	Active intervention	All	High	Extreme	Traditional Owners	Yes	Yes	Yes	Yes	Proceed to Viability Assessment
EGC4_J	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Manage access issues and erosion at targeted sites of significant value to Aboiriginal Community as identified by the LALC's	Active intervention	Tilba Beach, Nangudga, Broulee	High	Extreme	Traditional Owners	Yes	Yes	Yes	Yes	Proceed to Viability Assessment

Appendix D

Option Viability Assessment

ID	Threat		Management Area	Management Option	Supporting statement	Option Type	Location	Current Risk (2021)	Future Risk (2100)	Level of assessment	Lead Agency	Partners	Funding Source	Capital Cost	Timing	Recurrent Annual Costs
CD1_A	CD Threat 1	Coastal development resulting in loss of plant and animal species (habitat disturbance or loss)	Coastal Environment Area	Snapper Island Penguin monitoring program	The penguins local to Batemans Bay are found only on islands, where there were no cats, foxes, dogs or humans. About 15 percent of this population live on Snapper Island. Council's sustainability team and Landcare volunteers undertake work on Snapper Island, clearing environmental weeds and plastic pollution and providing additional nesting opportunities for the little penguins. This option recommends ongoing monitoring of the Penguin colony on Snapper Island.	Alert	Snapper Island, Batemans Bay	Medium	High	MCA Only	Council	NA	Council, C&E Grants, NSW Environmental Trust	$9,000	Year 1 and ongoing	$9,000
CD1_B	CD Threat 1	Coastal development resulting in loss of plant and animal species (habitat disturbance or loss)	Coastal Environment Area	Dune vegetation management - northern end of Broulee beach	Dune vegetation management to prioritise the northern end of the beach to mitigate erosion risk to the road and private properties.	Active intervention	Broulee	Medium	High	MCA Only	Council	DPE	Council, C&E Grants, NSW Environmental Trust, Coastcare Grants	$10,000	Year 2 to 4 and ongoing	$10,000
CD1_C	CD Threat 1	Coastal development resulting in loss of plant and animal species (habitat disturbance or loss)	Coastal Environment Area	Weed management in coastal areas	Council staff identified significant weed growth along many of the coastal headlands within the LGA.	Active intervention	All	Medium	High	MCA Only	Council	DPE, LLS	Council, C&E Grants, NSW Environmental Trust, Coastcare Grants	$10,000	Year 2 to 4 and ongoing	$10,000
CD2_A	CD Threat 2	Water pollution from urban stormwater and treated effluent discharge	Coastal Use Area	Investigate source of water quality issues at Surf Beach	Water quality issues have been identified by the community (through the community working groups) and by Mogo LALC. It was suspected that the issues were a result of landfill leachate / runoff, stormwater or sewer overflow. Investigation was carried out including water quality testing, which confirmed no bacterial contamination at Broulee, but examination of Surf Beach is ongoing.	Alert	Surf Beach & Broulee	Low	Medium	MCA Only	Council	DPE, DPI, Tranditional Owners	Council, C&E Grants, NSW Environmental Trust	$15,000	Year 2 to 4 and ongoing	$0
CD2_D	CD Threat 2	Water pollution from urban stormwater and treated effluent discharge	Coastal Environment Area	The CMP identified high risk locations with regards to urban drainage impacts on marine water quality. Consider installation of water quality improvement devices (e.g. GPTs) at key locations to improve receiving water quality. Consideration should be given to Actions 2.3c and 2.3d in the *Marine Park Management Plan*.	See option details and analysis in CMP	Active intervention	All	Low	Medium	MCA Only	ESC	DPE	Council, C&E Grants, NSW Environmental Trust	$50,000	Year 2 to 4	$1,000
CD3_B	CD Threat 3	Pollution of water, beach sand and other habitat areas with litter, solid waste, marine debris and microplastics	Coastal Environment Area	Beach watch monitoring program for water quality at recreational beaches - Continued Program	The Beachwatch Program, in partnership with DPE, is undertaken every year from the start of November to the end of March, with five samples collected each month from 11 popular beaches.	Alert	Cookies Beach Caseys Beach Surf Beach Malua Bay Broulee North South Broulee Beach Shelley Beach Tuross Main Beach Brou Beach Narooma shark net Narooma Main Beach	Low	Medium	MCA Only	ESC	DPE	Council	$10,000	Year 1 and ongoing	$10,000
CD3_C	CD Threat 4	Coastal development encroaching onto natural coastal processes to exacerbate hazard impacts	Coastal Wetlands and Litteral Rainforests Area	Support DPI-Fisheries in preparing a *Marine Vegetation Strategy* to identify priority areas for the protection of healthy mangrove and saltmarsh areas and rehabilitation of degraded areas.	The Marine Vegetation Strategy methodology and its estuary specific application, focuses on increasing the resilience of intertidal macrophyte systems to sea-level rise and other threats and risks in ways that maintain, and maximise, the social, cultural and economic values these systems provide to the community well-being. DPI Fisheries is expecting to commence a strategy for Eurobodalla in mid-2022. The community engagement undertaken as part of this CMP identified protection of intertidal macrophyte ecosystems under climate change and urban pressures as a key community issue.	Alert	All	Medium	High	MCA Only	ESC	DPI, DPE	Council	$0	Year 2 to 4	$0
CHA_A	CH Threats All	All CH Threats	Coastal Vulnerability Area	Property Development Planning Controls	See Section 5.4 of CMP	Planning for change	Coastal Vulnerability Area	High	High	MCA Only	ESC	DPE	Council	$0	Year 1 and ongoing	$0
CH1_A	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Supported dune recovery following erosion events.	Supported dune recovery following erosion events. This may be achieved through restricting access to eroded locations to minimise further disturbance, sand scraping, revegetation. Any scraping and grooming methodologies should consider the finding of Action 1.3c in the *Marine Park Management Plan*.	Active intervention	South Durras	Low	Low	MCA Only	ESC	DPE, DPI	Council, C&E Grants	Dependant on magnitude of erosion event.		
CH1_B	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Northcove Road erosion protection and flood proofing	See option details and analysis in CMP	Active intervention	Maloneys Beach	None	Medium	MCA and CBA	ESC	DPE, DPI	Council, C&E Grants, Floodplain Management Grants	$1,900,000	Year 5 to 10	$19,000
CH1_Ba	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Northcove Road erosion protection and flood proofing - Investigation and design only	The analysis undertaken of the full implementation of the works as part of the CMP identified that the existing risk was not significant, and as a result the coast benefit analysis did not support the implementation of erosion and flood proofing within the CMP 10 year plan. However, a future need for these works was identified, as a result the investigation and design works are required as an outcome of the CMP.	Planning for change	Maloneys Beach	None	Medium	MCA and CBA	ESC	DPE, DPI	Council, C&E Grants, Floodplain Management Grants	$200,000	Year 2 to 4	$0
CH1_C	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Dune management for coastal hazard protection	Dune management for coastal hazard protection: nourish, build low dunes and vegetate	Active intervention	Long Beach	Medium	Extreme	MCA Only	ESC	DPE, DPI	Council, C&E Grants	$800,000	Year 2 to 4	$20,000
CH1_D	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Low rock wall to protect public infrastructure: Bay Road (Stage 1)	See option details and analysis in CMP	Active intervention	Long Beach	Medium	Extreme	MCA and CBA	ESC	DPE, DPI, Tranditional Owners	Council, C&E Grants, Crown Reserves Improvement Fund	$2,250,000	After Year 10	$450
CH1_E	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Low rock wall to protect private properties and council assets (Stage 2)	See option details and analysis in CMP	Active intervention	Long Beach	Medium	Extreme	MCA and CBA	ESC	DPE, DPI, Tranditional Owners	Council, C&E Grants, Crown Reserves Improvement Fund	$1,750,000	After Year 10	$350
CH1_DE	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Low rock wall to protect public infrastructure: Bay Road (Stage 1 and 2) - Investigation and Design Only	The analysis undertaken of the full implementation of the works as part of the CMP identified that the existing risk was not significant, and as a result the coast benefit analysis did not support the implementation of erosion and flood proofing within the CMP 10 year plan. However, a future need for these works was identified, as a result the investigation and design works are required as an outcome of the CMP.	Active intervention	Long Beach	Medium	Extreme	MCA and CBA	ESC	DPE, DPI, Tranditional Owners	Council, C&E Grants, Crown Reserves Improvement Fund	$200,000	Year 2 to 4	$0
CH1_H	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Revetment running parallel to the shoreline at Surfside Beach, combined with beach nourishment	See option details and analysis in CMP	Active intervention	Surfside	Low	High	MCA Only	ESC	DPE, DPI, Tranditional Owners, TfNSW (MIDO)	Council, C&E Grants, Crown Reserves Improvement Fund, Coastal Protection Service Charge	$5,000,000	After Year 10	$20,000
CH1_I	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Offshore low-crest breakwaters in front of Surfside Beach, combined with beach nourishment	See option details and analysis in CMP	Active intervention	Surfside	Low	High	NA	NA	NA	NA	NA	NA	NA

ID	RA Threat 1	RA Threat 2	RA Threat 3	RA Threat 4	RA Threat 5	RA Threat 6	RA Threat 7	CD Threat 1	CD Threat 2	CD Threat 3	CD Threat 4	EGC Threat 1	EGC Threat 2	EGC Threat 3	EGC Threat 4	CH Threat 1	CH Threat 2	CH Threat 4	CH Threat 5	CH Threat 8	CH Threat 9	CH Threat 10							59
	Medium	High	Medium	Medium	Medium	High	High	High	Medium	Medium	High	High	High	High	Extreme	Extreme	Extreme	Extreme	High	High	Low	Medium							
	2	3	2	2	2	3	3	3	2	2	3	3	3	3	4	4	4	4	3	3	1	2	Threat Mitigation Score	Social Benefit Score	Environmental Benefit Score	Acceptability Score	Total Score	Adjusted for Cost Score	Include in CMP / CZEAP
CD1_A	1	1	0	0	1	1	0	0	0	1	0	2	1	2	0	0	0	0	0	0	0	0	6	0	2	2	**10**	**5**	CMP
CD1_B	2	2	0	0	1	0	0	2	0	0	1	0	0	0	0	2	2	1	0	0	2	0	15	0	1	2	**18**	**9**	CMP
CD1_C	0	1	0	0	0	0	0	2	0	0	0	0	0	2	0	1	0	0	0	0	1	1	6	0	2	2	**10**	**5**	CMP
CD2_A	0	0	0	0	0	0	0	0	2	1	0	1	0	1	1	0	0	0	0	0	0	0	4	1	2	2	**9**	**5**	CMP
CD2_D	0	0	0	0	0	0	0	~~1~~	~~2~~	~~2~~	~~0~~	~~0~~	~~0~~	~~0~~	~~0~~	0	0	0	0	0	0	0	3	**0**	**1**	**1**	**5**	**3**	No
CD3_B	0	0	0	0	0	0	0	1	2	2	0	1	0	1	0	0	0	0	0	0	0	0	4	1	2	2	**9**	**5**	CMP
CD3_C	0	0	0	0	0	0	0	2	0	0	2	1	0	2	0	0	0	0	0	0	0	0	5	0	2	0	**7**	**7**	CMP
CHA_A	0	0	0	0	0	0	0	1	0	0	2	1	0	1	0	2	2	2	2	2	2	2	23	0	0	0	**23**	**23**	CMP
CH1_A	Works only in response to an erosion event - for inclusion in CZEAP																						0	0	1	1	**2**	**2**	CZEAP
CH1_B	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	2	2	2	1	1	0	0	16	2	0	2	**20**	**5**	CZEAP
CH1_Ba	Outcome of CH1_H Analysis																												CMP
CH1_C	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	2	2	2	1	0	2	0	16	0	0	1	**17**	**6**	CZEAP
CH1_D	Works not required within 10 Year CMP Business Plan. For consideration in CZEAP (i.e. triggered by erosion event), or in CMP review																						0	0	0	1	**1**	**#VALUE!**	CZEAP
CH1_E	Works not required within 10 Year CMP Business Plan. For consideration in CZEAP (i.e. triggered by erosion event), or in CMP review																						0	0	0	1	**1**	**0**	CZEAP
CH1_DE	See CH1_D and CH1_E																												CMP
CH1_H	Erosion risk does not trigger the need for option within the 10 Year CMP Business Plan																						0	**0**	**-2**	**0**	**-2**	**-1**	No
CH1_I	Ruled out as part of engineering viability assessment - see description																						0	**0**	**0**	**0**	**0**	**0**	No

ID	Threat		Management Area	Management Option	Supporting statement	Option Type	Location	Current Risk (2021)	Future Risk (2100)	Level of assessment	Lead Agency	Partners	Funding Source	Capital Cost	Timing	Recurrent Annual Costs
CH1_Ka	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Wharf Road Protection Stage 1: Priority works at exposed corner of Wharf Road	See option details and analysis in CMP	Active intervention	Wharf Road	Medium	High	MCA and CBA	DPE	ESC	Election Commitment	$2,100,000	Year 1	$21,000
CH1_Kb	CH Threat 4	Coastal Inundation	Coastal Vulnerability Area	Wharf Road Protection Stage 2: Inundation protection. Seawall raising in front of Big4, seawall along Wharf Road.	See option details and analysis in CMP	Active intervention	Wharf Road	Medium	High	MCA and CBA	DPE	ESC	Council, C&E Grants	$5,900,000	Year 2 to 4	$29,000
CH1_Kc	CH Threat 4	Coastal Inundation	Coastal Vulnerability Area	Raise Wharf Road level	Opportunistic raising of Wharf Road as road upgrade works are undertaken or funding becomes available to maintain access during inundation events.	Active intervention	Wharf Road	Medium	High	MCA Only	ESC	DPE	Council, C&E Grants	$50,000	Year 5 to 10	$0
CH1_Kd	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Trigger based protection of sewer line and remainder of Wharf Road from erosion: triggered by erosion event (this component may form part of CZEAS)	See option details and analysis in CMP	Active intervention	Wharf Road	Medium	High	MCA Only	ESC	DPE, DPI	Council, C&E Grants	$1,000,000	After Year 10	$20,000
CH1_L	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Undertake regular nourishment at Surfside when dredging is undertaken in Batemans Bay / Clyde River. Sand to be placed at locations identified in this CMP.	See option details and analysis in CMP	Active intervention	Surfside / Wharf Road	Medium	High	MCA and CBA	TfNSW (MIDO)	ESC, DPE, DPI	Council, C&E Grants, Coastal Lands Protection Scheme	$35,000	Year 1 and ongoing	$3,500
CH1_M	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Apply for the NSW government to purchase private properties at Wharf Road to assure current and future generations have public access to the foreshore and beaches.	See option details and analysis in CMP	Avoid risk	Wharf Road	Extreme	Extreme	MCA and CBA	DPE	ESC	Council, C&E Grants, Coastal Lands Protection Scheme	$11,000,000	Year 1	$40,000
CH1_P	CH Threat 1 & 4	Beach Erosion and Coastal Inundation	Coastal Vulnerability Area	Upgrade existing coastal protection works at Caseys Beach	See option details and analysis in CMP	Active intervention	Batehaven	High	High	MCA and CBA	ESC	DPE, DPI	Council, C&E Grants	$7,900,000	Year 2 to 4	$79,000
CH1_Q	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Sand nourishment post erosion event - Malua Bay	See option details and analysis in CMP	Active intervention	Malua Bay	Low	High	MCA Only			Council, C&E Grants	$278,000	NA	NA
CH1_R	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Private land acquisition - Malua Bay	There are three to four properties that may be affected by beach erosion and shoreline recession at the eastern end of Kuppa Avenue. This option considers the suitability of acquiring these properties and returning the land to public reserve.	Avoid risk	Malua Bay	Low	High	MCA Only	ESC	DPE	Council, C&E Grants, Coastal Lands Protection Scheme	$4,000,000	After Year 10	$0
CH1_S	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Sand nourishment post erosion event - Tomakin	See option details and analysis in CMP	Active intervention	Tomakin	Low	High	MCA Only			Council, C&E Grants	$115,000	NA	NA
CH1_T	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Trigger based stabilisation of sand spit to rocky outcrop at Tomakin Cove	See option details and analysis in CMP	Active intervention	Tomakin	Low	High	MCA Only			Council, C&E Grants	NA	NA	NA
CH1_U	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Offshore reef / wave dissipation - Tomakin Cove	See option details and analysis in CMP	Active intervention	Tomakin	Low	High	MCA Only	ESC	DPE, DPI	Council, C&E Grants	$5,000,000	NA	$5,000
CH1_V	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Private land acquisition - North end of Broulee	See option details and analysis in CMP	Avoid risk	Broulee	Low	High	MCA and CBA	ESC	DPE	Council, C&E Grants, Coastal Lands Protection Scheme	$4,000,000	Year 5 to 10	$0
CH1_X	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Repurposing of dredged sand from Tuross Estuary for beach Nourishment, One tree Beach	Council currently dredges adjacent to Lavender Bay Boat ramp for navigation purposes. This options recommends placement of the dredges material on One Tree Beach.	Active intervention	Tuross Heads	Unknown	Unknown	MCA Only	ESC	DPE	Council, Rescuing our Waterways	$20,000	Year 5 to 10	$0
CH1_Y	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Identify and monitor sewage pump stations and reticulation infrastructure at risk - include in future works plans (works to be assessed as part of CMP review)	See option details and analysis in CMP	Active intervention	Long Beach Malua Bay Broulee	See hazards assessment	See hazards assessment	MCA Only	ESC	NA	Council	$0	Year 1 and ongoing	$0
CH1_Z	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Monitor stormwater assets in erosion areas	See option details and analysis in CMP	Alert	All	See hazards assessment	See hazards assessment	MCA Only	ESC	NA	Council	$0	Year 1 and ongoing	$0
CH1_ZA	CH Threat 1	Beach Erosion	Coastal Vulnerability Area	Culvert Extension / Groyne, combined with beach nourishment	See option details and analysis in CMP	Active intervention	Surfside	Extreme	Extreme	MCA and CBA	ESC	DPE	Election Commitment for initial funding C&E Grant, Council for ongoing maintnenance	$3,600,000	Year 2 to 4	$72,000
CH10_C	CH Threat 10	Coastal Cliff Instability	Coastal Vulnerability Area	Conduct periodic inspections of the slopes of the cliffs and bluffs	Respond to incoming customer requests regarding the stability of cliffs and bluffs at Corrigans Headland, Sunshine Bay, Caseys Beach Headland and Long Beach Headland to identify evidence of instability, such as loose rock, mantle creep, stormwater incision, tension cracks or leaning or fallen trees.	Alert	Corrigans Headland, Sunshine Bay, Caseys Beach Headland and Long Beach Headland	Medium	High	MCA Only	ESC	NA	Council	$0	Year 1 and ongoing	$0
CH10_E	CH Threat 10	Coastal Cliff Instability	Coastal Vulnerability Area	Maintain or improve native vegetation cover on steep slopes on coastal cliffs and bluffs.	Maintain or improve native vegetation cover on steep slopes on coastal cliffs and bluffs. This may also involve weed management and use of matting/geotextile to protect the surface from erosion as well as control weeds. Include maintenance of access track vegetation (access priority)	Active intervention	Priority to those affected by geotechnical hazards, and accessible.	Medium	High	MCA Only	ESC	DPE EES	Council, C&E Grants, NSW Environmental Trust, Coastcare Grants	$15,000	Year 1 and ongoing	$15,000
CH10_G	CH Threat 10	Coastal Cliff Instability	Coastal Vulnerability Area	Installation of safety and warning signs relating to cliff instability	- Install general warning signs along the base of the headlands at Corrigans, Caseys and Long Beaches to warn walkers of the potential hazards. - Fences and warning signs be installed along the top of steep slopes where a risk exists of persons falling over the edge.	Alert	All	Medium	High	MCA Only	ESC	DPE EES	Council, C&E Grants	$10,000	Year 1 and ongoing	$0
CH10_I	CH Threat 10	Coastal Cliff Instability	Coastal Vulnerability Area	Surface dish drain	Install and maintain a surface dish drain at the top of slopes to divert water away from slopes that are being eroded or have the potential to be so.	Active intervention	All	Medium	High	MCA Only	ESC	DPE EES	Council, C&E Grants	$20,000	Year 5 to 10	$1,000

ID	RA Threat 1	RA Threat 2	RA Threat 3	RA Threat 4	RA Threat 5	RA Threat 6	RA Threat 7	CD Threat 1	CD Threat 2	CD Threat 3	CD Threat 4	EGC Threat 1	EGC Threat 2	EGC Threat 3	EGC Threat 4	CH Threat 1	CH Threat 2	CH Threat 4	CH Threat 5	CH Threat 8	CH Threat 9	CH Threat 10	Threat Mitigation Score	Social Benefit Score	Environmental Benefit Score	Acceptability Score	Total Score	Adjusted for Cost Score	Include in CMP / CZEAP
	Medium	High	Medium	Medium	Medium	High	High	High	Medium	Medium	High	High	High	High	Extreme	Extreme	Extreme	Extreme	High	High	Low	Medium							59
	2	3	2	2	2	3	3	3	2	2	3	3	3	3	4	4	4	4	3	3	1	2							
CH1_Ka	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	1	0	0	0	14	1	0	2	17	4	CMP
CH1_Kb	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2	2	2	1	0	0	0	14	2	0	2	18	5	CMP
CH1_Kc	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	1	0	0	0	8	1	0	2	11	6	CMP
CH1_Kd	Works not required within 10 Year CMP Business Plan. For consideration in CZEAP (i.e. triggered by erosion event), or in CMP review																						NA	NA	NA	NA	NA	NA	CZEAP
CH1_L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	1	0	0	1	0	21	1	0	2	24	12	CMP
CH1_M	1	0	0	0	0	0	0	2	0	0	2	0	0	0	0	2	2	2	2	0	0	0	44	2	0	2	48	12	CMP
CH1_P	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	2	1	0	0	0	0	23	1	0	2	26	7	CMP
CH1_Q	Works not required within 10 Year CMP Business Plan. For consideration in CZEAP (i.e. triggered by erosion event), or in CMP review																						NA	NA	NA	NA	NA	NA	CZEAP
CH1_R	Erosion risk does not trigger the need for option within the 10 Year CMP Business Plan																						NA	NA	NA	NA	NA	NA	No
CH1_S	Works not required within 10 Year CMP Business Plan. For consideration in CZEAP (i.e. triggered by erosion event), or in CMP review																						NA	NA	NA	NA	NA	NA	CZEAP
CH1_T	Works not required within 10 Year CMP Business Plan. For consideration in CZEAP (i.e. triggered by erosion event), or in CMP review																						NA	NA	NA	NA	NA	NA	CZEAP
CH1_U	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	8	0	0	0	8	2	No
CH1_V	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	2	1	1	0	0	0	0	22	0	0	0	22	6	No
CH1_X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	16	0	0	0	16	8	CMP
CH1_Y	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	2	2	2	0	0	0	33	0	0	0	33	33	CMP
CH1_Z	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	2	0	0	0	0	0	19	0	0	1	20	20	CMP
CH1_ZA	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	0	12	2	0	2	16	4	CMP
CH10_C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	1	5	5	CMP
CH10_E	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	2	13	2	2	2	19	6	CMP
CH10_G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	1	5	5	CMP
CH10_I	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	8	0	1	2	11	6	CMP

ID	Threat		Management Area	Management Option	Supporting statement	Option Type	Location	Current Risk (2021)	Future Risk (2100)	Level of assessment	Lead Agency	Partners	Funding Source	Capital Cost	Timing	Recurrent Annual Costs
CH9_A	CH Threat 9	Dune Slope Instability	Coastal Vulnerability Area	Prepare frontal dune management plans	Prepare frontal dune management plan for dunes seaward of caravan parks and camping grounds, and foreshore reserves to optimise resilience of the dunes as protection for temporary land uses and enhance ecological connectivity. Target locations to include Murramarang Nature Resort, beach reserves at Maloneys Beach, Long Beach, Surfside, Corrigans (include Clyde View Holiday Park) and Malua Bay Reserve.	Alert	Murramarang Nature Resort, beach reserves at Maloneys Beach, Long Beach, Surfside, Corrigans (include Clyde View Holiday Park) and Malua Bay	Medium	High	MCA Only	ESC	NPWS, DPE	Council, C&E Grants, NSW Environmental Trust, Coastcare Grants	$80,000	Year 2 to 4	$5,000
CH4_A	CH Threat	Coastal Inundation	Coastal Vulnerability Area	Management of un-named ICOLL / Wetland to protect against coastal inundation (stabilise dune so breakout doesn't occur)	Management of un-named ICOLL / Wetland to protect against coastal inundation (stabilise dune so breakout doesn't occur)	Active intervention	South Durras	Unknown	Unknown	MCA Only	NA	NA	NA	NA	NA	NA
CH4_D	CH Threat 4	Coastal Inundation	Coastal Vulnerability Area	Flood levee to protect against stormsurge inundation from creek / estuary (surf side creek and Cullendulla)	See option details and analysis in CMP	Active intervention	Surfside	Extreme	Extreme	MCA and CBA	ESC	DPE	Election Commitment for design and construct C&E Grant, Council for ongoing maintnenance	$4,200,000	Year 1	$42,000
CH4_G	CH Threat 4	Coastal Inundation	Coastal Vulnerability Area	Flood gates on stormwater outlets	See option details and analysis in CMP	Active intervention	Wharf Road Batemans Bay to Batehaven	Varied	Varied	MCA Only	ESC	DPE	Council, C&E Grants	$100,000	Year 2 to 4	$5,000
CH4_I	CH Threat 4	Coastal Inundation	Coastal Vulnerability Area	Reshaping and additional rock are required to repair the existing training wall	Reshaping and additional rock are required to repair the existing training wall	Active intervention	Batemans Bay CBD	Medium	High	MCA Only	ESC	DPE	Council, C&E Grants	$200,000	Year 2 to 4	$0
CH4_K	CH Threat 4	Coastal Inundation	Coastal Vulnerability Area	Seawall Raising and wave return barriers	See option details and analysis in CMP	Active intervention	Batemans Bay to Batehaven	Medium	High	MCA and CBA	ESC	DPE	Council, C&E Grants	$10,500,000	Year 5 to 10	$105,000
CH4_L	CH Threat 4	Coastal Inundation	Coastal Vulnerability Area	Gradually raise the road level of Beach Road (its entire length), through routine maintenance.	During regular road resurfacing / maintenance look to raise level of road incrementally in consideration of coastal inundation levels to provide safe and permanent access during storm events.	Avoid risk	Batemans Bay to Batehaven	High	Extreme	MCA Only	ESC	DPE	Council, C&E Grants	$100,000	Year 5 to 10	$0
CH4_M	CH Threat 4	Coastal Inundation	Coastal Vulnerability Area	Adaptation plan for low lying areas to be impacted by tidal inundation under sea level rise	See option details and analysis in CMP	Planning for change	Batemans Bay: Corrigans area	Extreme	Extreme	MCA Only	ESC	DPE	Council, C&E Grants	$150,000	Year 2 to 4	$0
CH4_R	CH Threat 4	Coastal Inundation	Coastal Vulnerability Area	Raising of George Bass Drive	During regular road resurfacing / maintenance look to raise level of road incrementally in consideration of coastal inundation levels to provide safe and permanent access during storm events.	Avoid risk	Batehaven	Extreme	Extreme	MCA Only	ESC	NA	Council, C&E Grants	$100,000	Year 5 to 10	$20,000
CH4_S	CH Threat 4	Coastal Inundation	Coastal Vulnerability Area	Emergency Response Plan	In partnership with SES, prepare an Emergency Response Plan to address flood risk to Big4 Batemans Bay Beach Resort from coastal storm inundation.	Emergency Response	Big4 Batemans Bay Beach Resort Beachcomber Holiday Park	Extreme	Extreme	MCA Only	SES	ESC, DPE	Council and SES existing staff resources	$0	Year 1 and ongoing	$0
CH4_T	CH Threat 4	Coastal Inundation	Coastal Vulnerability Area	Offshore reef for wave dissipation - Caseys Beach	See option details and analysis in CMP	Active intervention	Batehaven	High	Extreme	MCA Only	ESC	DPE, Marine Park	NA	NA	NA	NA
CH4_V	CH Threat 4	Coastal Inundation	Coastal Vulnerability Area	Access road raising - Beachcomber Holiday Park	There is a low lying section of the access road to Beachcomber Holiday Park. Road levels should be raised at this location to improve access and evacuation access during a coastal storm event.	Avoid risk	Potato Point	Medium	High	MCA Only	ESC	NA	Council, C&E Grants	$100,000	Year 2 to 4	$0
CH5_A	CH Threat 5	Tidal Inundation	Coastal Vulnerability Area	Implement a program to monitor groundwater response to sea level rise to determine scope of the hazard and risk to Surfside and existing governance and planning practices.	Implement a program to monitor groundwater response to sea level rise to determine scope of the hazard and risk to Surfside and existing governance and planning practices.	Alert	Surfside	Low	Medium	MCA Only	ESC	DPE	Council, C&E Grants	$250,000	Year 2 to 4	$20,000
CH8_A	CH Threat	Entrance Management	Coastal Wetlands and Litteral Rainforests Area	Management of un-named ICOLL / Wetland to restore natural opening and closing regime	Management of un-named ICOLL / Wetland to restore natural opening and closing regime	Active intervention	South Durras	Medium	High	MCA Only	ESC	DPE, DPI	NA	NA	NA	NA
CH8_B	CH Threat	Entrance Management	Coastal Wetlands and Litteral Rainforests Area	Review of ICOLL EMP	Council to review it's existing Estuary Entrance Management Plans in consultation with local Aboriginal Knowledge Holders and look for opportunities to involve cultural practices and knowledge in estuary management. The review should consider the template for ICOLL entrance management being developed under the *Marine Park Management Plan (action 1.3f).*	Active intervention	South Durras, Surfside, Joes Creek, Short Beach, Wimbie Beach, Kianga, Little Lake (Narooma), Nangudga Lake	Medium	High	MCA Only	ESC	DPE, Marine Parks, DPI	Council, C&E Grants	$150,000	Year 2 to 4	$0
CH8_C	CH Threat 8	Entrance Management	Coastal Wetlands and Litteral Rainforests Area	ICOLL Entrance Management Policy - engagement and finalisation	Draft Estuary Management Plans to be put through consultation with relevant agencies and community before finalisation and adoption by NPWS.	Active intervention	Congo, Potato Point, Lake Brou, Lake Mummaga, Corunna Lake	Medium	High	MCA Only	NPWS	DPE, ESC. Marine Parks, DPI	NPWS, C&E Grants	$20,000	Year 1	$0
CH9_A	CH Threat 9	Dune Slope Instability	Coastal Environment Area	Dune stability management (rabbit impacts)	Community engagement identified rabbits are causing instability of the dunes directly through burrows and indirectly through associated loss of vegetation.	Active intervention	Rosedale Beach	Unknown	Unknown	MCA Only	ESC	NA	Council, C&E Grants, NSW Environmental Trust, Coastcare Grants	$5,000	Year 2 to 4	$2,000
CH9_B	CH Threat 9	Dune Slope Instability	Coastal Vulnerability Area	Manage erosion on dunes	Erosion management of dune caused by stormwater runoff, access and possibly wave impacts at the end of Knowlman Road. Existing coir logs are in place and could be upgraded and enhanced with fencing to limit access and planting.	Active intervention	Rosedale Beach	Unknown	Unknown	MCA Only	ESC	NA	Council, C&E Grants, NSW Environmental Trust, Coastcare Grants	$20,000	Year 1	$0
CHALL_A	CH Threats (All)	All	Coastal Vulnerability Area	NPWS Coastal Hazard Assessment	NPWS to undertake taregtted coastal risk assessments to better understand coastal risks identified in the CMP Scoping Studyfirst pass risk assessment	Alert	National Parks	Varied	Varied	MCA Only	NPWS	ESC	NPWS, C&E Grants	$60,000	Year 2 to 4	$0
CH14_B	CH Threats 1 and 4	Beach Erosion and Coastal Inundation	Coastal Vulnerability Area	Review of Surf Clubs coastal hazard risk	See option details and analysis in CMP	Planning for change	Malua Bay	Varied	Varied	MCA Only	ESC	NA	Council	$0	Year 2 to 4	$0
CHO_A	Opportunity	#N/A	Coastal Use Area	Opportunities for historical swimming site at Moruya Heads	During site inspections and engagement with the community, it was identified that the historical swimming site at Moruya Heads could provide for opportunities for recreational usage or porribly just historical education. Council staff to work with the local community to investigate opportunities for this site.	Alert	Moruya Heads	NA	NA	MCA Only	ESC	DPE	Council	$0	Year 2 to 4	$0
CHO_B	Opportunity	#N/A	Coastal Use Area	Coastal values to promote tourism opportunities through a community event	Consider a ESC coast event/festival to promote tourism opportunities, specifically linked to coastal values Or Integrate with existing festivals such as Narooma Oyster Festival, River of Art and Bay Paddle Challenge	Active intervention	All	NA	NA	MCA Only	ESC	NA	NPWS, C&E Grants	$100,000	Year 2 to 4	$10,000
RA1_A	RA Threat 1	Conflict over resource access and use (e.g. beach users and dog walkers)	Coastal Use Area	Manage user conflicts at Bingie Dreaming Track and Shark Bay / Broulee Island track	The community reported conflicts between pedestrian and 4WD users of and around the Bingie Dreaming Track. This option proposed that Council, NPWS and local Aboriginal Knowledge Holders to identify key issues and develop management approaches. This should consider the recommendations of the Draft Tuross and Coila Lakes Estuaries CMP (installation of bollards, formalisation of a carpark to limit vehicle access, and retaining the existing Bingie Dreaming Track as a walking track only).	Active intervention	Congo	Low	Medium	MCA Only	ESC / NPWS	LALC	Council	$0	Year 2 to 4	$0

ID	RA Threat 1	RA Threat 2	RA Threat 3	RA Threat 4	RA Threat 5	RA Threat 6	RA Threat 7	CD Threat 1	CD Threat 2	CD Threat 3	CD Threat 4	EGC Threat 1	EGC Threat 2	EGC Threat 3	EGC Threat 4	CH Threat 1	CH Threat 2	CH Threat 4	CH Threat 5	CH Threat 8	CH Threat 9	CH Threat 10							59
	Medium	High	Medium	Medium	Medium	High	High	High	Medium	Medium	High	High	High	High	Extreme	Extreme	Extreme	Extreme	High	High	Low	Medium							
	2	3	2	2	2	3	3	3	2	2	3	3	3	3	4	4	4	4	3	3	1	2	Threat Mitigation Score	Social Benefit Score	Environmental Benefit Score	Acceptability Score	Total Score	Adjusted for Cost Score	Include in CMP / CZEAP
CH9_A	0	1	0	0	0	0	0	1	0	0	1	1	0	1	0	2	2	1	1	0	2	0	40	0	1	1	**42**	**14**	CMP
CH4_A	Not viable																							0	0	0	**0**	**NA**	No
CH4_D	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	2	2	0	0	0	28	0	0	2	**30**	**8**	CMP
CH4_G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	14	0	0	1	**15**	**5**	CMP
CH4_I																							0	0	0	1	**1**	**0**	No
CH4_K	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	1	0	0	0	19	1	0	2	**22**	**6**	CMP
CH4_L	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	14	0	0	0	**14**	**7**	No
CH4_M	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	14	0	0	2	**16**	**5**	CMP
CH4_R	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	11	0	0	0	**11**	**4**	No
CH4_S	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	8	0	0	2	**10**	**10**	CMP
CH4_T	Not viable																						NA	NA	NA	NA	NA	NA	No
CH4_V	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	8	1	0	2	**11**	**6**	CMP
CH5_A	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	9	0	0	1	**10**	**3**	No
CH8_A	Not viable																						NA	NA	NA	NA	NA	NA	No
CH8_B	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	0	0	-1	-1	2	0	0	11	1	1	2	**15**	**5**	CMP
CH8_C	0	0	0	0	0	0	0	0	1	0	0	1	0	1	1	0	0	-1	-1	2	0	0	11	0	0	2	**13**	**7**	CMP
CH9_A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	6	0	1	2	**9**	**5**	No
CH9_B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	6	0	2	2	**10**	**5**	CMP
CHALL_A	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	24	0	0	1	**25**	**13**	CMP
CH14_B	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	2	2	1	1	0	0	0	28	0	0	0	**28**	**28**	CMP
CHO_A	0	-1	1	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	2	0	2	**1**	**1**	No
CHO_B	0	1	0	0	1	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	17	2	0	2	**21**	**7**	CMP
RA1_A	2	0	0	1	1	1	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0	0	25	1	1	1	**28**	**28**	CMP

ID	Threat		Management Area	Management Option	Supporting statement	Option Type	Location	Current Risk (2021)	Future Risk (2100)	Level of assessment	Lead Agency	Partners	Funding Source	Capital Cost	Timing	Recurrent Annual Costs
RA2_B	RA Threat 5	Passive recreational use (swimming, surfing, bush walking, etc)	Coastal Environment Area	Dune vegetation management - Rosedale Beach	The dune vegetation at Rosedale Beach is being impacted by unregulated pedestrian access and in some cases illegal clearing of vegetation. This option proposes an annual strategy to target these actions, replace vegetation, where possible, and install barriers and / or signage.	Active intervention	Rosedale Beach	Low	Medium	MCA Only	ESC	DPE	Council, C&E Grants, NSW Environmental Trust, Coastcare Grants	$5,000	Year 2 to 4 and ongoing	$5,000
RA2_E	RA Threat 2	Habitat (physical) and wildlife disturbance (e.g. from overuse, overcrowding, foreshore development, commercial and recreational fishing methods, etc)	Coastal Environment Area	Shorebird management across Eurobodalla	Target shorebird nesting sites for pest control. Monitoring and education program to protect shorebirds.	Active intervention	All	Medium	High	MCA Only	NPWS	ESC,DPE,DPI	NPWS	$0	Year 1 and ongoing	$0
RA2_G	RA Threat 2	Habitat (physical) and wildlife disturbance (e.g. from overuse, overcrowding, foreshore development, commercial and recreational fishing methods, etc)	Coastal Wetlands and Litteral Rainforests Area & Coastal Environment Area	Management of weeds of National Significance in coastal reserves	Conduct follow up work on weeds of National Significance in coastal reserves Undertake engagement of ajoining landholders to reduce weed impacts on reserves.	Active intervention	All	Medium	High	MCA Only	NPWS	ESC,DPE,DPI	NPWS and Council existing staff resources	$0	Year 1 and ongoing	$0
RA3_A	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Coastal Use Area	Develop a 'round the bay' coastal walk and cycleway for Batemans Bay	Develop a 'round the bay' coastal walk and cycleway for Batemans Bay	Active intervention	Batemans Bay Foreshore	Medium	Medium	MCA Only	ESC	DPE	Council, C&E Grants, Crown Reserves Improvement Fund	$50,000	Year 2 to 4 and ongoing	$50,000
RA3_B	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Coastal Use Area	Bridge crossing at Cullendulla Creek to link the area up with Murramarrang walk and Coastal Headland walk	Would require NPWS approval to proceed.	Active intervention	Cullendulla	Medium	Medium	MCA Only	ESC	DPE / NPWS	Council, C&E Grants, Crown Reserves Improvement Fund	$2,000,000	Year 5 to 10	$0
RA3_F	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Coastal Use Area	Improve facilities for tourism at Corrigans Beach	Improve facilities for tourism at Corrigans Beach. Might include: improved & all-levels inclusive disabled access, facilities for kayaks and SUPs, improved trailer parking, sewage pump out facility.	Active intervention	Corrigans	Medium	Medium	MCA Only	TfNSW (MIDO)	ESC, DPE	Council, C&E Grants	$2,000,000	Year 2 to 4 and ongoing	$100,000
RA3_G	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Coastal Use Area	Upgrade beach reserve infrastructure at Malua Bay	Upgrade beach reserve infrastructure at Malua Bay, including toilet block, picnic shelters	Active intervention	Malua Bay	Medium	Medium	MCA Only	ESC	DPE	Council, C&E Grants	$250,000	Year 2 to 4 and ongoing	$0
RA3_I	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Coastal Use Area	Provide basic public toilet facilities at McKenzies Beach.	There are currently no public toilet facilities at the high usage McKenzies Beach.	Active intervention	McKenzies Beach	Medium	Medium	MCA Only	ESC	DPE	Council, C&E Grants	$300,000	Year 2 to 4 and ongoing	$0
RA3_J	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Coastal Use Area	Improve parking options at McKenzies Beach	Illegal parking and crowding along the road edge is a safety issue	Alert	McKenzies Beach	Medium	Medium	MCA Only	ESC	DPE	Council, C&E Grants	$100,000	Year 2 to 4 and ongoing	$0
RA3_K	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Coastal Use Area	Review and upgrade public facilities at One Tree Beach (Tuross)	Review and upgrade access paths and public toilets, showers etc. at One Tree Beach (Tuross), to enhance safety and amenity.	Active intervention	Tuross Lake	Medium	Medium	MCA Only	ESC	DPE	Council, C&E Grants	$300,000	Year 2 to 4 and ongoing	$0
RA3_L	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Coastal Use Area	Improving access and provide protection of midden sites along Mummaga Headland	Improving access and provide protection of midden sites along Mummaga Headland by formalising access on the south/eastern side of headland, and revegetating the sections of exposed midden and cliff face that are being used as informal tracks	Active intervention	Dalmeny	Medium	Medium	MCA Only	ESC	DPE	Council, C&E Grants, NSW Heritage Grant Program	$100,000	Year 1	$0
RA3_N	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Coastal Use Area	Improve beach access	Investigate, prioritise and improve beach access in key beach locations (particularly ensuring disability inclusive access to beaches). Aligns with *Draft Marine Park Management Plan* (action 5.4c)	Active intervention	All	Medium	Medium	MCA Only	ESC	DPE	Council, C&E Grants	$500,000	Year 5 to 10	$50,000
RA3_O	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Coastal Use Area	Continue to promote existing coastal walks such as coastal walks	Continue to promote existing coastal walks such as coastal walks in Murramarang National Park, Broulee Island, Bingie Dreaming, Mystery Bay to 1080 Beach, Mangrove walk at Cullendulla Creek, Durras discovery and Banksia Walk at Burrewarra Point, Mill Bay Board walk at Narooma.	Alert	All	Medium	Medium	MCA Only	ESC	DPE, NPWS	Council and NPWS existing staff resoucres	$0	Year 1	$0
RA3_Q	RA Threat 3	Poorly located, poorly maintained and/or inappropriate access and supporting facilities	Coastal Use Area	Upgrade facilities on coastal headlands	Upgrade parking, fencing, lookouts and interpretation in reserves on coastal headlands around Batemans Bay.	Active intervention	All	Medium	Medium	MCA Only	ESC	DPE	Council, C&E Grants, NSW Heritage Grant Program	$500,000	Year 2 to 4 and ongoing	$50,000
RA6_A	RA Threat 6	Active recreational use (recreational boating, motorised watercraft, camping etc) - recreational activities needing associated infrastructure	Coastal Use Area	Monitor bike tracks between Broulee Head and Moruya Heads	Monitor usage and impacts of high usage on bike tracks between Broulee Head and Moruya Heads. Engage with local Aboriginal Knowledge Holders to understand sensitive locations and impacts on LALC managed land.	Alert	Bengello Beach	Medium	High	MCA Only	ESC	DPE, NPWS	Council	$0	Year 1 and ongoing	$0
EGC2_A	EGC Threat 2	Insufficient community and visitor awareness of the values and threats to the coastal environment, and lack of engagement with managing this environment	Coastal Environment Area	High priority coastal protection signage strategy	High priority coastal protection signage strategy: where illegal ICOLL openings are occuring, where shorebird habiat is being disturbed, erosion hotspots.	Alert	All	Medium	High	MCA Only	ESC	DPE	Council, C&E Grants, NSW Environmental Trust	$20,000	Year 1 and ongoing	$0
EGC3_B	EGC Threat 3	Insufficient or inappropriate governance and management of the coastal environment	All	Work with relevant State Agencies to strengthen shared and consistent management of coastal land.	Ensure ongoing funtion of CEMAC, and ongoing representation of all Agencies listed as responsible or supporting CMP Actions	Planning for change	All	Medium	High	MCA Only	ESC	DPE, DPI, NPWS, LLS, Marine Parks	Council	$0	Year 1 and ongoing	$0
EGC3_D	EGC Threat 3	Insufficient or inappropriate governance and management of the coastal environment	Coastal Vulnerability Area	Update PoM for reserve lands to address coastal risk	Use the CMP information to update plans of management for the reserved lands and highlight assets (natural or built) within the reserves that need changed management to mitigate coastal risks.	Planning for change	All	Medium	High	MCA Only	ESC	NA	Council	$0	Year 1 and ongoing	$0
EGC3_E	EGC Threat 3	Insufficient or inappropriate governance and management of the coastal environment	All	Update PoM for NPWS to address coastal risk	Update plans of management for coastal national parks, including review of current arrangements for access, interactions between national parks and adjoining lands for recreation and tourism (include maintenance of access infrastructure), weed species; address or foreshadow when necessary any coastal hazard risks.	Planning for change	National Parks	Medium	High	MCA Only	NPWS	ESC	NPWS	$0	Year 1 and ongoing	$0
EGC3_F	EGC Threat 3	Insufficient or inappropriate governance and management of the coastal environment	TBC	Undertaken maintenance of State Agency owned coastal assets to engineering and safety standards	Several state agency owned assets are degraded as an outcome of exposure to the coastal environment. Management will be undertaken by state agencies to ensure these assets meet engaineering and safety standards.	Active intervention	TBC	Medium	High	MCA Only	Crown Lands / MIDO	NA	Crown Lands and MIDO	$100,000	Year 1 and ongoing	$100,000
EGC4_A	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Coastal Environment Area	Opportunities for cultural burning	Identify opportunities for and undertake cultural burning. Work closing with local Aboriginal Community to develop implement appropriately.	Active intervention	All	High	Extreme	MCA Only	ESC	NPWS, DPE, LLS	Council, C&E Grants, NSW Heritage Grant Program	$50,000	Year 1 and ongoing	$50,000

	RA Threat 1	RA Threat 2	RA Threat 3	RA Threat 4	RA Threat 5	RA Threat 6	RA Threat 7	CD Threat 1	CD Threat 2	CD Threat 3	CD Threat 4	EGC Threat 1	EGC Threat 2	EGC Threat 3	EGC Threat 4	CH Threat 1	CH Threat 2	CH Threat 4	CH Threat 5	CH Threat 8	CH Threat 9	CH Threat 10							59
	Medium	High	Medium	Medium	Medium	High	High	High	Medium	Medium	High	High	High	High	Extreme	Extreme	Extreme	Extreme	High	High	Low	Medium							
ID	2	3	2	2	2	3	3	3	2	2	3	3	3	3	4	4	4	4	3	3	1	2	Threat Mitigation Score	Social Benefit Score	Environmental Benefit Score	Acceptability Score	Total Score	Adjusted for Cost Score	Include in CMP / CZEAP
RA2_B	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	1	1	0	0	2	0	20	0	2	2	24	12	CMP
RA2_E	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	2	2	16	16	CMP
RA2_G	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	2	2	16	16	CMP
RA3_A	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	2	0	2	10	3	No
RA3_B	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	2	0	2	10	3	No
RA3_F	1	-1	2	0	0	-1	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-6	2	0	1	-3	-1	No
RA3_G	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	2	0	2	12	4	No
RA3_I	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	2	0	2	12	4	No
RA3_J	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	2	0	2	12	6	CMP
RA3_K	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	2	0	2	12	4	No
RA3_L	0	1	2	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	17	1	2	2	22	11	CMP
RA3_N	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	2	0	2	10	3	No
RA3_O	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	2	0	2	10	10	CMP
RA3_Q	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	2	0	2	11	4	No
RA6_A	0	0	1	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	12	0	1	2	15	15	CMP
EGC2_A	0	1	0	0	0	0	0	0	0	0	0	2	2	1	0	0	0	0	0	2	0	0	24	0	0	1	25	13	CMP
EGC3_B	1	1	1	1	1	1	1	1	1	1	1	2	1	2	0	1	1	1	1	0	1	1	60	0	0	0	60	60	CMP
EGC3_D	1	1	1	1	1	1	1	1	1	1	1	1	1	2	0	1	1	1	1	0	1	1	57	0	0	0	57	57	CMP
EGC3_E	1	1	1	1	1	1	1	1	1	1	1	1	1	2	0	1	1	1	1	0	1	1	57	0	0	0	57	57	CMP
EGC3_F	0	0	1	0	0	0	0	0	0	0	1	0	0	2	0	1	0	1	0	0	0	0	19	2	1	2	24	8	CMP
EGC4_A	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	11	1	2	2	16	5	CMP

ID	Threat		Management Area	Management Option	Supporting statement	Option Type	Location	Current Risk (2021)	Future Risk (2100)	Level of assessment	Lead Agency	Partners	Funding Source	Capital Cost	Timing	Recurrent Annual Costs
EGC4_B	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Coastal Environment Area	Development and implementation of Aboriginal cultural resource use agreements, Sea Country plans or other planning tools	Support development and implementation of Aboriginal cultural resource use agreements, Sea Country plans or other planning tools in accordance with the aspirations of local Aboriginal people to conserve cultural values, facilitate cultural use and conserve significant sites. Aboriginal cultural access, sites and economic opportunity have been impacted by government closures. There are many planning tools available to conserve and enhance Aboriginal cultural values for Sea Country. Preferred tools should be selected by local Aboriginal people according to their needs and aspirations. Mogo LALC have drafted a land and sea management plan that should be considered in this process.	Avoid risk	All	High	Extreme	MCA Only	DPI	Traditional Owners, ESC, DPE, LLS, NPWS	Council, C&E Grants, NSW Heritage Grant Program	$100,000	Year 1 and ongoing	$10,000
EGC4_C	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Coastal Use Area	Support Aboriginal cultural tourism opportunities in the coastal zone	Provide support to Aboriginal individuals or groups seeking to implement business opportunities to increase local and tourist awareness of Aboriginal culture in the Eurobodalla coastal area	Active intervention	All	High	Extreme	MCA Only	ESC	Traditional Owners, DPE, NPWS	Council, C&E Grants, NSW Heritage Grant Program	$30,000	Year 1 and ongoing	$30,000
EGC4_D	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Coastal Use Area	Embed traditional Aboriginal knowledge, wisdom and culture in strategic planning and pursue opportunities to promote Aboriginal culture and knowledge	Embed traditional Aboriginal knowledge, wisdom and culture in coastal management, including through engagement, training and employment of Aboriginal people.	Active intervention	All	High	Extreme	MCA Only	ESC	Traditional Owners, DPE, DPI, NPWS	Council, C&E Grants, NSW Heritage Grant Program	$20,000	Year 1 and ongoing	$20,000
EGC4_E	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Coastal Vulnerability Area	Support local Aboriginal Communities manage cultural heritage from coastal hazards and sea level rise and other coastal threats	Work with Traditional Owners to protect special Aboriginal cultural values and sites from the impacts of foreshore and riparian development, erosion, climate change, four wheel driving, domestic dogs and pedestrians. Education, infrastructure, rules and spatial management can protect important sites from specific threats where and when needed.	Active intervention	All	High	Extreme	MCA Only	DPE	Traditional Owners, ESC, DPI, NPWS	Council, C&E Grants, NSW Heritage Grant Program	$20,000	Year 1 and ongoing	$70,000
EGC4_F	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Coastal Use Area	Improve access to Country in the coastal zone	ESC and NPWS to work with Traditional Land Owners to establish an Access to Country Plan or Agreement, which would identify key locations on Country where access need to be retained, or established. Implementation of this plan may require minor on ground works, which have been allowed for in the option costing.	Active intervention	All	High	Extreme	MCA Only	ESC / NPWS	Traditional Owners, DPE	Council, C&E Grants, NSW Heritage Grant Program	$20,000	Year 1 and ongoing	$5,000
EGC4_G	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Coastal Use Area	Identify and use Aboriginal place names	Work with Traditional Owners to identify traditional Aboriginal names for key locations in the coastal area and include local Aboriginal language in coastal education material and signage.	Active intervention	All	High	Extreme	MCA Only	ESC	Traditional Owners, NPWS, DPE, LLS	Council, C&E Grants, NSW Heritage Grant Program	$0	Year 2 to 4	$0
EGC4_H	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Coastal Use Area	Review, update and implement PoM for Aboriginal Place at Barlings Beach	Engagement with Mogo LALC identified that the PoM is not being implemented as it is intended and the land is not being managed properly.	Active intervention	Barlings Beach	High	Extreme	MCA Only	ESC	Traditional Owners, DPE, LLS	Council, C&E Grants, NSW Heritage Grant Program	$5,000	Year 1 and ongoing	$5,000
EGC4_I	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Coastal Use Area	Prepare an Aboriginal Seasonal Calendar	Collaborate with the Local Aboriginal Community to prepare an Aboriginal Seasonal Calendar to showcase traditional land management, food & medicine practices and deeper understanding of the land & climate.	Active intervention	All	High	Extreme	MCA Only	ESC	Traditional Owners, DPE, LLS	Council, NSW Heritage Grant Program	$15,000	Year 1	$0
EGC4_J	EGC Threat 4	Insufficient involvement of Traditional Owners in the management of cultural heritage and use within the coastal environment	Coastal Use Area	Manage access issues and erosion at targeted sites of significant value to Aboiriginal Community as identified by the LALC's	Traditional owners are not satified with the current management of highly significant cultural sites. This option would improve management of these sites in consultation with Traditionbal Owners to protect Aborgibal Heritage	Active intervention	Tilba Beach, Nangudga, Broulee	High	Extreme	MCA Only	NPWS	Traditional Owners, DPE, ESC	Council, C&E Grants	$15,000	Year 1 and ongoing	$0

ID	RA Threat 1	RA Threat 2	RA Threat 3	RA Threat 4	RA Threat 5	RA Threat 6	RA Threat 7	CD Threat 1	CD Threat 2	CD Threat 3	CD Threat 4	EGC Threat 1	EGC Threat 2	EGC Threat 3	EGC Threat 4	CH Threat 1	CH Threat 2	CH Threat 4	CH Threat 5	CH Threat 8	CH Threat 9	CH Threat 10							59
	Medium	High	Medium	Medium	Medium	High	High	High	Medium	Medium	High	High	High	High	Extreme	Extreme	Extreme	Extreme	High	High	Low	Medium							
ID	2	3	2	2	2	3	3	3	2	2	3	3	3	3	4	4	4	4	3	3	1	2	Threat Mitigation Score	Social Benefit Score	Environmental Benefit Score	Acceptability Score	Total Score	Adjusted for Cost Score	Include in CMP / CZEAP
EGC4_B	1	1	0	0	0	1	1	1	1	0	0	1	0	1	2	0	0	0	0	0	0	0	30	1	2	2	**35**	**12**	**CMP**
EGC4_C	0	0	1	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	16	2	0	2	**20**	**7**	**CMP**
EGC4_D	0	1	1	0	0	0	1	0	0	0	0	1	1	2	2	1	0	0	0	1	0	0	35	2	0	2	**39**	**13**	**CMP**
EGC4_E	0	2	0	0	1	1	1	1	1	0	0	1	2	1	2	1	1	0	0	0	0	0	47	0	0	2	**49**	**16**	**CMP**
EGC4_F	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	11	2	0	2	**15**	**8**	**CMP**
EGC4_G	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	14	2	0	2	**18**	**18**	**CMP**
EGC4_H	0	0	0	0	0	0	0	0	0	0	0	2	0	2	2	0	0	0	0	0	0	0	20	2	2	2	26	13	**CMP**
EGC4_I	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	14	2	1	2	19	10	**CMP**
EGC4_J	0	0	0	0	0	0	0	0	0	0	0	2	0	2	2	0	0	0	0	0	0	0	20	2	2	2	26	13	**CMP**

Appendix E

Option Summary Sheets

CH1_B	Northcove Road Upgrade

Location(s): Maloneys Beach

Coastal threat(s) to be addressed: Beach Erosion and Coastal Inundation

Outcome of CMP Assessment
The existing erosion risk to Northcove Road is low and as such only the investigation and design of the Northcove Road upgrade is recommended for action in the CMP. This will allow the implementation of the works to be undertaken as part of a future CMP.

Option Description:

The Stage 2 Coastal Hazards Assessment determined that Northcove Road was at risk of coastal erosion impacting the road at both the 2017 and 2100 100-year ARI extents (**Figure 1**). While not identified as being within the direct erosion zone currently, the road runs through the zone of reduce foundation capacity and is therefore at risk of being structurally undermined following a large storm event.

Northcove Road and bridge at the western end of Maloneys Beach can also be inundated at both the 20-year and 100-year ARI, with the potential to cause access issues during severe coastal events. This is due to both coastal inundation, and coincident catchment flooding landwards of Northcove Road, and also wave run-up and overtopping of the roadway (**Figure 2**).

Consultation with the Maloney's community during the public exhibition of the Batemans Bay Urban Creeks Flood Study (Rhelm 2020) also saw this issue raised, with community suggesting the road needed to be upgraded, or an alternate route be provided.

Wave overtopping also has the potential to impact a significant length of the road, causing access issues during a coastal storm and potential damage to the road surface, requiring maintenance following a storm event.

To address these risks, road raising of a 100m-120m section of Northcove Road along with a vertical retaining structure with a wave return barrier at its crest has been conceptually designed to protect the public road from erosion and wave damages and to maintain continuous access to Maloneys Beach during severe coastal storms, as shown in **Figure 3**.

Figure 1 Maloneys Beach Erosion Extents

Figure 2 Maloneys Beach Inundation at 20-year ARI

Figure 3 Alignment and extent of Road Raising and retaining structure at Maloneys Beach

The conceptual design of the retaining structure has prioritised the following:

- Ensuring a small footprint so as to minimise the disturbance to the existing beach and dune areas
- Placing the structure outside of the area of direct coastal erosion to remove any influence of the structure on the nature and extent of coastal erosion.

A typical section for the retaining structure is presented in **Figure 4** which includes construction of a vertical wall on the seaward edge of the road alignment. The wall could comprise of reinforced concrete panels (as shown in **Figure 5**) or driven sheet pile (as shown in **Figure 6**) and would require approximately 5m embedment below the desired crest level, which could be reduced if ground anchoring was adopted. Based on current estimates the retaining wall would not be directly exposed to coastal hazards and hence scour protection is not required. The structure crest would be at a level consistent with the existing road surface (+5 to +5.5mAHD at eastern end) and would comprise a wave return barrier of varying height (example shown in **Figure 7**).

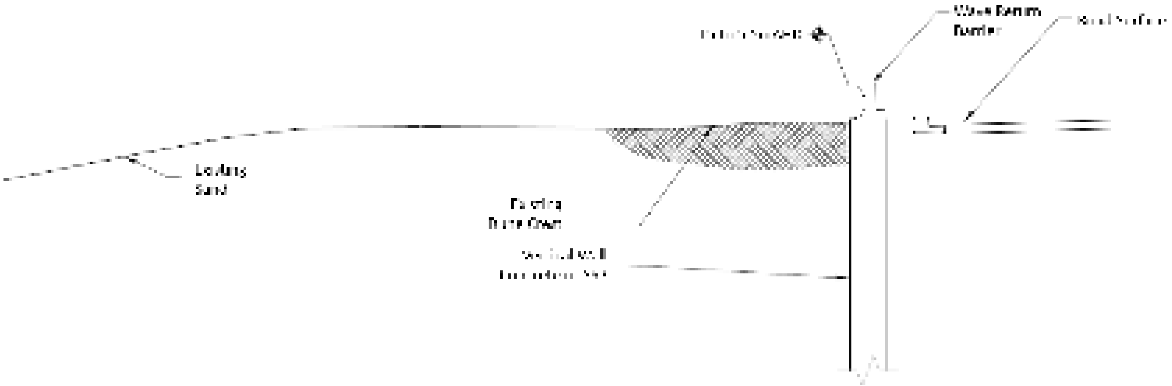


Figure 4 Typical section of a retaining structure with a wave return barrier at the crest

Figure 5 Example of Reinforced concrete wall for stabilisation of a section of the Great Ocean Road, Vic

Figure 6 Example of sheet pile wall with concrete capping beam and anchoring

Figure 7 Example of a concrete wall return barrier

The costed option comprises a sheet pile retaining wall of 5m embedment with a concrete wave return barrier of 1.2m height (Just East of Bridge) reducing in height to the east along the alignment of the wall. The image below provides an indication of the structure form (sheet pile with concrete capping beam), noting that following construction it would buried within the dune and not be at risk of exposure due to coastal erosion from 100year ARI event both now and at 2100.

Road raising could be incorporated into the design to also mitigate inundation associated with catchment flooding, and if undertaken would reduce the required height of the wave return barrier. This design would need to be optimised in consultation with the floodplain risk management program and may include upgrading of the culverts under the bridge.

CMP Assessment:

No detailed design of the retaining structure has been completed, however an assessment of wave runup and overtopping was performed using methods outlined in Eurotop (2018) to test the feasibility of the conceptual design and to ensure adequate protection of the roadway against overtopping, both under present day and future sea level rise scenarios

The following table summarises the results, noting an average overtopping rate of less than 25 L/s/m is targeted to reduce the risk to cars transiting near the crest (Eurotop, 2018).

Mean Overtopping Rates (q) for the 100year ARI coastal storm under sea level rise scenarios just east of the Northcove Road Bridge (road level of 2.8mAHD)

	Present	2050	2065	2100
q (L/s/m)	70	150	200	540

The required crest level of the wave return wall to reduce mean wave overtopping to an acceptable rate (i.e. 25 L/s/m) is presented in the table below.

Required Wave Return wall height (m above road level) to reduce risk to cars for the 100year ARI coastal storm under sea level rise scenarios

	Present	2050	2065	2100
Just East of Bridge (Northcove Road)	1m	1.2m	1.3m	1.7m
Maloneys Drive	0m	0.2m	0.3m	0.7m

Effectiveness and benefits:

- The retaining structure would provide structural support to road following severe storm erosion of Maloneys Beach and enable continued access to Maloneys Beach.
- If the crest level of the retaining structure is of sufficient height, coastal inundation and overtopping will be reduced to a tolerable level for the safe access of cars and will minimise road surface failures due to coastal processes.
- Road raising of Northcove Road would be required to manage the impact of catchment flooding on the road. This should be considered as part of the floodplain risk management process to attract appropriate funding mechanisms.
- The alignment of the road (and proposed wall) does not fall within the direct erosion hazard zone. The function of the proposed wall is to support the road that lies within the zone of reduced foundation capacity. As such, no need for nourishment post event or management of scour is considered in the development of this option.

Timing:

- The current inundation and erosion risk associated with coastal events, does not necessitate the need for immediate action (as shown in the Cost Benefit Assessment below). Therefore, the program of works includes the following:
    - Stage 1: Investigation and Design (Year 2 to 4)
    - Stage 2: Retaining structure (after current CMP timeframe; greater than 10 years unless triggered by a larger than predicted erosion event)
    - Stage 3: Wave return barrier (after current CMP timeframe; greater than 10 years unless triggered by a larger than predicted erosion event)
- A design life of ~50 years could reasonably be applied to the retaining structure and raised roadway, assuming wave overtopping is reduced to tolerable levels.

Cost Benefit Assessment

Costs: As above

Benefits:

This option derives benefits from avoided costs that arise from the closure of Northcove Road when exposed to modelled inundation events. Through coastal inundation modelling it was evident to see that the Northcove Road would be flooded and highly damaged for between 12 to 36 hours under major inundation events. Moreover, under events whereby erosion is predicted to occur on Northcove Road, a four week timeline is implemented. The avoidance of Northcove Road's closure results in the following benefits:

- **Avoided road resurfacing** is a benefit that would occur due to the proposed seawall that will shielding Northcove Road from inundation events. The value of this benefit was taken from the TfNSW Economic Parameters (2020) with the cost of \$143 m^2.
- **Avoided isolation** is a benefit that would occur due to the proposed sea wall's wave return structure. This would prevent costal inundation flooding of Northcove Road and allow for the sustained access for emergency evacuation or the continuation of normative activity by the residents of Maloneys beach (371 people) in an inundation or storm event.
- The cost of emergency access was derived from Batemans Bay hospitalisation rates for Eurobodalla residents and the triage severity of each visit and the cost of damages for which each case if untreated. These inputs were drawn from TfNSW's *Flood Risk Management Measures (2022)* and *flowinfo v 17 (2017).*
- The cost of ordinary activities was derived from the average cost per household per vehicular trip that would normally be undertaken and the cost of isolation (i.e. expenditure on goods and services that is no longer possible). These costs were derived from the averagely weekly spend per household for Eurobodalla and the average daily trips per household. This resulted in an avoided benefit of \$40.54 per trip and \$157 for each of the 257 households for each day of isolation. Given the uncertainty regarding level of disposable income, a 50% adjustment factor was applied to foregone daily expenditure to represent the cost of isolation.
- Additionally, a costing of \$71.43 per person affected by an isolation period is implemented, to account for the cost of potential mental health related therapy and loss of production that occur as a result of prolonged isolation. This costing is derived from Deloite (2016) 'The Economic Cost of Social Impacts of Natural Disasters', and is scaled by a factor of 0.1 to account for the relative severity of possible inundation events. **Avoided road replacement (erosion)** is a benefit that would occur as a result of constructing the proposed seawall, as it will reduce the probability of the road encountering erosion and having to be

reconstructed. The value of this benefit was taken from the TfNSW Economic Parameters (2020) with the cost of $3,429 per metre of a two-lane, flexible pavement road, where the road length is 205 metres. Additionally, there is an avoided cost of the temporary road which is required in the estimated two week period of road reconstruction. The value of avoiding this cost is derived from the pricing the anticipated 250 metres of metal temporary road sheeting which will allow for continued road access to properties along Northcove Road and access to from Maloneys Drive to Northcove Road. Over a four week period the cost per metre of the temporary road is $269, which totals to $134,500 per erosion event. The analysis assumes a 1% p.a. probability of road replacement within the first ten years, 2% p.a. for the next 30 years, and 3% p.a. subsequently.

Results:

The table below highlights that this option does not have a positive NPV and has a BCR well below 1 indicating that it is not economically feasible to implement at this point in time. This is primarily due to the small number of properties impacted by the isolation. However, this option may proceed based on unquantified benefits, or support from other funding mechanisms.

BCR		**NPV**	
0.75		-$438,864	
Benefit		**Costs**	
Access	$1,106,453	Capital Costs	$1,550,966
Erosion	$168,117	Maintenance Costs	$229,555
Resurfacing	$67,087		

CH1_D and CH1_E	Long Beach Coastal Erosion Protection Works

Location(s): Long Beach

Coastal threat(s) to be addressed: Beach Erosion and Coastal Inundation

Outcome of CMP Assessment
The Stage 1 (CH1_D) works (200m at eastern end of Long Beach) are recommended for inclusion in the CMP.

Costs:

In total, 530m of coastal erosion protection works are identified along the length of the Long Beach foreshore between Long Beach Road and the eastern end of Bay Road. There is an opportunity to stage the construction in two parts, with the first stage (CH1_D) focussing on the 200m length at the eastern end of the beach, which is at risk of coastal erosion under present conditions.

- CH1_D Phase 1: Investigation and design including environmental assessment for coastal erosion structure: $200,000
- CH1_D Phase 2: Construction of ≈ 200m coastal protection works and beach nourishment: $2,500,000
- CH1_D Phase 3: Maintenance and nourishment of beach: 1% of capital costs for structure maintenance plus $10,000 per year for nourishment, over life of structure
- CH1_E (Not recommended within the 10 year delivery of this CMP) Future Capital Cost in approximately 2050) : $3,500,000 (approximately 280m)

Option Description:

Construct a low crested revetment to protect Bay Road from coastal erosion impacts under present day and future sea level rise scenarios. The intention of this option is to preserve the foundation of Bay Road under severe coastal storm events.

CMP Assessment:

Deterministic calculation of coastal erosion extents based on storm demand identified that approximately 200m of Bay Road was at risk of erosion as a result of a 100year ARI storm event under present day sea levels. Under future projected sea level rise, the full length of Bay Road adjacent to the Long Beach foreshore (~530m in length) is at risk of erosion.

The erosion risk is shown in **Figure 1**. Further details are provided in the Stage 2 CMP Report (Rhelm, 2022).

Whilst coastal inundation does not pose a risk to the area under current sea levels, Bay Road and approximately 15 properties become increasing at risk of inundation from a 100 Year ARI storm as sea level rise.

The 100yr coastal inundation risk is shown in **Figure 2**. Further details are provided in the Stage 2 CMP Report (Rhelm, 2022).

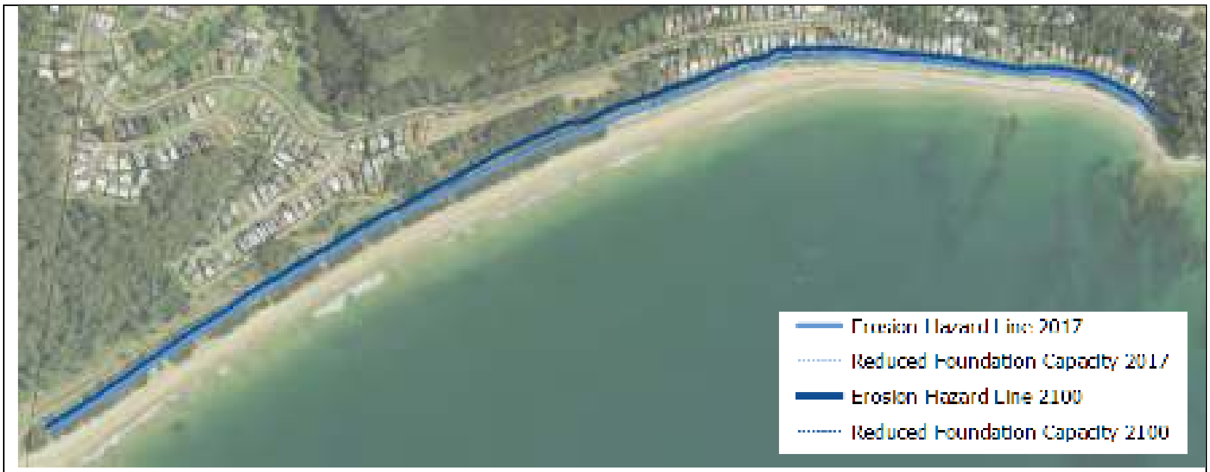


Figure 1 Long Beach Erosion Risk

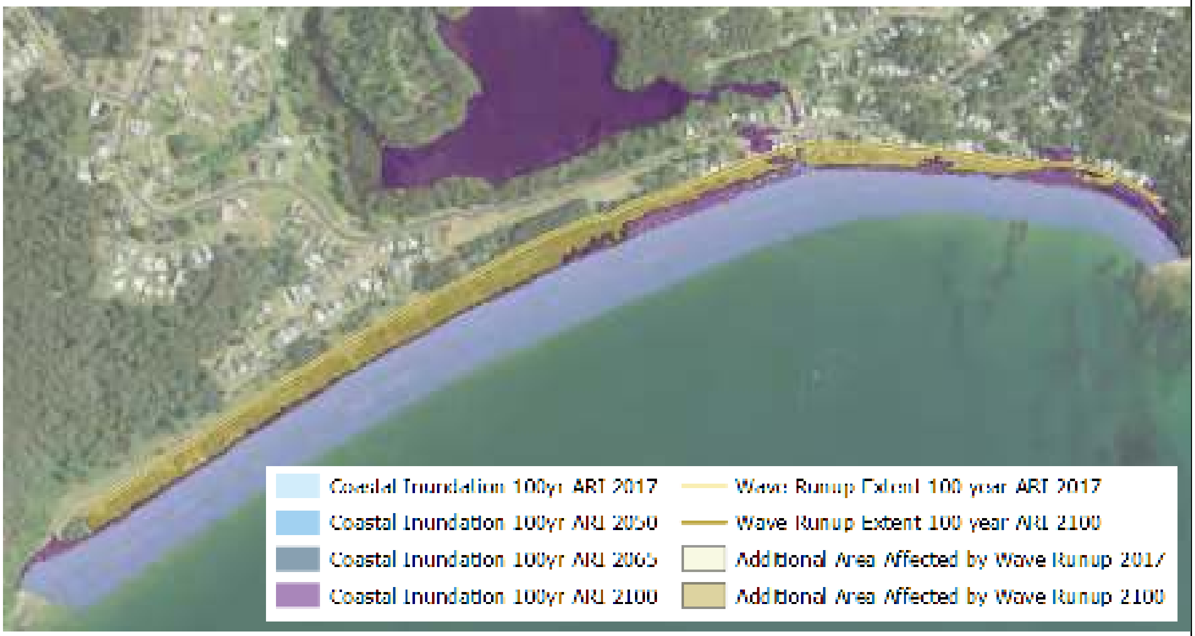


Figure 2 100yr ARI Coastal Inundation Risk

To address this risk a low crested rock revetment has been conceptually designed to protect the public road from being impacted by coastal erosion. However, a detailed investigation and the design process would be undertaken to determine the most suitable protection works. This would include engagement with the local community to inform the design.

Engagement with the local community during the preparation of the CMP, identified the following key issues for consideration as part of the design process:

- Minimising the crest level to not disturb the visual amenity and beach access
- Vegetation selection to consider access, amenity and bushfire risk, with a preference for low lying dune stabilisers (e.g. native grasses) to maintain dune cover of revetment
- Retaining the existing rock revetment as part of the short term, priority works
- Minimising the footprint of the coastal protection structure so as to minimise disturbance to the existing beach and dune areas
- A footpath is not necessarily preferred by the community along the stretch of works, and the absence of this design feature would allow for the structure to be place further back from the high tide mark, allowing better beach recovery between events

- Short term protection works such as geotextile containers may be more suitable for the protection of the Norfolk Pines, as they are nearing the end of life. More permanent long term coastal works could be constructed adjacent to Bay Road once the pines are no longer healthy.

A low crested revetment has been conceptually designed for the high priority works area as one approach that could be taken to protect the public road from being impacted by coastal erosion. The purpose of this design is to inform concept cost estimates in the CMP Business Plan and should not be considered the preferred design outcome.

A typical section for a revetment design is provided below and would remain buried below the dune system under normal beach conditions. The structure crest would be at a level consistent with the existing road surface (+2.8 to +3.2mAHD).

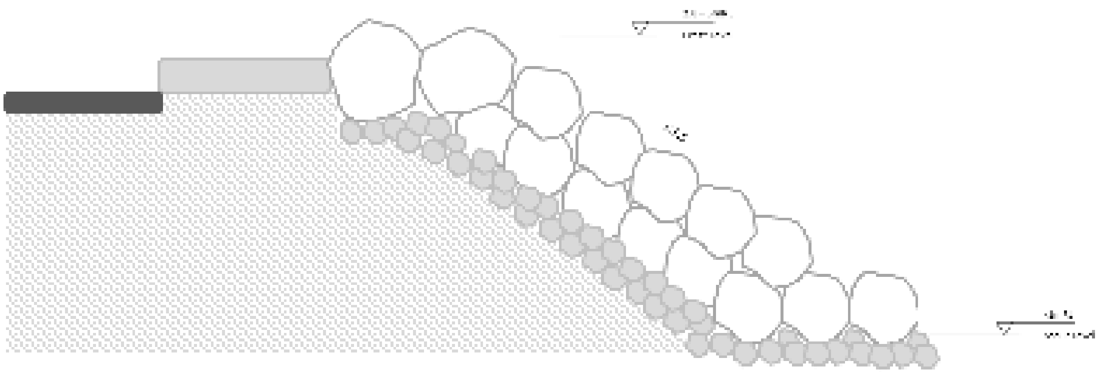


Figure 3 A typical cross section for low crested rock revetment at Long Beach

In addition to erosion protection to Bay Road the benefits of the proposed revetment would be a reduction in still water inundation as a result of elevated coastal water levels, with a crest level of +2.9mAHD providing protection for the 100year ARI still water level under sea level rise out to 2100.

Wave runup and overtopping of the revetment crest would occur, as is currently experienced across the dune crest, road and into properties. Under future sea level rise conditions, this wave run-up and overtopping may be significant with damage to the road surface likely. Estimates of wave overtopping under present day sea levels, indicate mean overtopping rates remain only marginally above tolerable limits for cars directly behind the crest (Eurotop, 2018). The presence of a concrete footpath that is integrated with the revetment, sets the road back from the revetment crest and will reduce the potential for damage to the road surface in the near term. Longer term wave overtopping would be significant.

While wave overtopping hazard would remain, the nature of the road, its limited use and the short duration of the overtopping hazard (at the peak of the tide), the risk does not warrant large scale coastal protection works in the near future, particularly when impacts to user amenity of the beach is considered.

Effectiveness:

- Highly effective for the protection of public assets from coastal erosion (Bay Road and carpark) against a 100-year ARI storm event in the present day and future sea level scenarios.
- Effective in reducing coastal inundation elevated water levels out to 2065

- Moderately effective in reducing the hazard associated with wave overtopping (risk to life and damage to road surface) under existing sea levels, with reducing effectiveness as sea levels rise.

Benefits:

- Preserves Bay Road from critical erosion damage and maintains access to the eastern end of Long Beach and for up to 14 foreshore properties.
- Management of coastal inundation of Bay Road.
- Provides opportunity to establish formal and controlled access to the beach across the dunes.
- Extends benefits of existing buried structure.

Disadvantages:

- Formalising a hard structure at the shoreline (in addition to the existing road surface) may exacerbate the potential for edge effect at the ends of the sea wall. The alignment and design of the structure would need to be considered to minimise these potential impacts.
- In future, as sea levels rise and shoreline recession is realised, beach nourishment will be required in front of the sea wall to preserve the beach width and public access.

Timing:

- Option for staging of works to target areas at higher risk.
- Initial 200m length of revetment, near Fauna Ave, would provide immediate protection to the section of road at risk of coastal erosion under present day sea levels.
- The remaining length of revetment along Bay Road, including the public carpark, would progressively become at risk of coastal erosion to 2065.
- With regular inspection and maintenance, the revetment could be expected to have a design life in excess of 50 years. Replacement of the footpath may be required over this timeframe.

Cost Benefit Assessment (Stage 1 Works Only)

Costs: as above

Benefits:

This option derives benefits from avoided costs that arise from the closure of Bay Road when exposed to modelled inundation events. Through coastal inundation modelling it was evident to see that the Bay Road would be flooded and highly damaged for between 12 to 36 hours under major inundation events. Moreover, inundation modelling provided evidence to suggest that sections of Bay Road and the beachfront carpark would need to be replaced in numerous scenarios, incurring a four week timeline for replacement works. Consecutive East Coast Low (ECL) storm events in early 2022 have exacerbated the susceptibility of Bay Road, with undercutting of the road visible from the beach in multiple locations. Avoidance of this costs provides the following benefits:

- **Avoided road resurfacing** is a benefit that would occur due to the proposed revetment that will shielding Bay Road from inundation events. The value of this benefit was taken from the TfNSW Economic Parameters (2020) with the cost of $143 per metre of road. Moreover, with the presence of the proposed wall the destruction of these sections of tarmac are avoided and so their complete replacement costs are avoided too. This is valued at $3,429 per m^2 of road and $8,853 per carpark space (TfNSW Economic Parameters, 2020).
- **Avoided road replacement (erosion)** is a benefit that would occur as a result of constructing the proposed revetment, as it will reduce the probability of the road encountering erosion and having to be reconstructed. The value of this benefit was taken

from the TfNSW Economic Parameters (2020) with the cost of $3,429 per metre of a two-lane, flexible pavement road, where the road length is 200 metres. Additionally, there is an avoided cost of the temporary road which is required in the estimated two week period of road reconstruction. The value of avoiding this cost is derived from the pricing the anticipated 435 metres of metal temporary sheeting which will allow for continued road access from residential driveways along Bay Road to connect to Long Beach Road. Over a four week period the cost per metre of the temporary road is $269, which totals to $260,930 per erosion event. The analysis assumes a 1% p.a. probabilityy of road replacement within the first ten years, 2% p.a. for the next 30 years, and 3% p.a. subsequently. It is noted that approximately 100m in length of the Long Beach Road is in poor condition and is currently failing from erosion which is underpinning the road. As a result, it is assumed that this section of the road will fail within one year of the assessment period, resulting in a complete replacement of that 100 m section.

- **Avoided Isolation (access)** is a benefit that can be included as the closure of Bay Road would deny vehicle access for up to 35 households along the Eastern side of Bay Road (depending on event severity). The avoided loss of daily trips via vehicle is valued at $40.54 per household. Given the uncertainty regarding level of disposable income, a 50% adjustment factor was applied to foregone daily expenditure to represent the cost of isolation. Additionally, a costing of $71.43 per person affected by an isolation period is implemented, to account for the cost of potential mental health related therapy and loss of production that occur as a result of prolonged isolation. This costing is derived from Deloite (2016) 'The Economic Cost of Social Impacts of Natural Disasters' and is scaled by a factor of 0.1 to account for the relative severity of possible inundation events.

Results:

The table below highlights that this option does not have a positive NPV and has a BCR well below 1 indicating that it is not economically feasible to implement at this point in time. This is primarily driven by the low likelihood of road failure in the period of economic assessment. However, if a large storm event did cause significant erosion of the beach and dune, and threaten the road, this option may increase in viability. This option has therefore been included as a 'recovery' action in the CZEAS.

The economic feasibility of this option should be reviewed with the CMP review in 10 year time based on sea level rise occurrence and updated projections of sea level rise and the impacts on beach erosion and recessions analysis.

CH1_D

BCR		NPV	
0.34		-$1,674,226	
Benefit		**Costs**	
Resurfacing	$458,214	**Capital Costs**	$2,204,004
Erosion	$332,488	**Maintenance Costs**	$326,209
Access	$65,286		

CH1_E

BCR		NPV	
0.39		-$2,130,397	
Benefit		**Costs**	
Resurfacing	$635,190	**Capital Costs**	$2,730,412
Erosion	$579,375	**Maintenance Costs**	$749,073
Access	$134,523		

Overtopping of Bay Road, Long Beach, 6 June 2012 (Mr Lindsay Usher) – from WRL, 2017

Overtopping of Bay Road, Long Beach, 4th April 2022 (Mr Cameron Whiting ESC)

Existing Revetment Structure East of Fauna Ave, Long Beach, 16 Mach 2021 (Baird Site Visit)

CH1_I	Offshore Breakwater and Beach Nourishment
Location(s): Surfside Beach	
Coastal threat(s) to be addressed: Beach Erosion	
Outcome of CMP Assessment This option is not recommended for inclusion in the CMP. The option: • Relatively expensive, and needs maintenance and periodic sand nourishment campaigns • Creates a navigation hazard. • The Stage 2 Coastal Hazard assessment identified that the transport of sand along the beach is generally low but travels from north to south under normal ambient conditions. An offshore breakwater would not impact these processes, and therefore does not mitigate the recessional trend at the northern end of the beach.	
Costs: Direct costings of the offshore breakwater were not undertaken as part of this options analysis. However, a similar design was the most-expensive option assessed in the Batemans Bay Independent Coastal Impact Assessment Stage 2 (2020), costed at approximately double the price of a revetment and beach nourishment. For beach nourishment, a capital cost of $35,000 per nourishment campaign is estimated, with no ongoing maintenance cost, to be repeated every 5-10 years (on average). It is assumed that the cost of nourishment does not include the dredging costs, as this cost would be borne by the agency responsible for maintaining navigable depths in the Clyde River and Batemans Bay. Therefore, the cost of dredged sand placement is estimated from the additional cost of transporting and placing the dredged material at Surfside. A cost of approximately $35,000 for placement of dredge material is based on a rate of $5/ m3. Maintenance Costs: N/A	
Option Description: The Stage 2 Coastal Hazards Assessment determined that Surfside Beach (East) was at risk of beach erosion and recession, with risks to public property and amenity at the 2017 planning level, and to private property by 2100 (**Figure 1**). To address these risks of severe beach erosion and recession, breakwaters located offshore Surfside have been identified as an option, in conjunction with beach nourishment. Breakwaters would reduce wave exposure during severe coastal storms by causing waves to break offshore, reducing wave energy reaching the beach. This would reduce long- and cross-shore sediment transport and thereby erosion. The breakwaters would not significantly impact sediment transport processes under benign conditions, if suitably located, allowing natural sediment circulation to continue. Beach nourishment would ensure sufficient sand volume to maintain beach width and amenity and provide a natural buffer for any erosion that occurs by increasing the sub-areal beach volume. Two potential breakwater configurations are presented in **Figure 2.** The yellow line indicates a solid breakwater of approximately 200 m in length, whilst the red line indicates two breakwaters, each approximately 70 m in length. For beach nourishment, the sub-aerial beach condition should be assessed, with a sufficient beach width of at least 30 m at the northern end. If beach width is less than 30 m, sediment should be placed according to the equilibrium profile shown in **Figure 3**. If beach width is greater than 30 m, target nourishment of the dune to achieve a target crest level of 2.55 mAHD (2050 100-year ARI Still Water Level, WRL (2017)), and 3.04 mAHD towards 2100 (2100 100-year ARI Still Water Level, SWL (2017)).	

Figure 1 Surfside Erosion Hazard Lines for 2017 and 2100 planning periods

Figure 2 Surfside Offshore Breakwaters, with two potential configurations

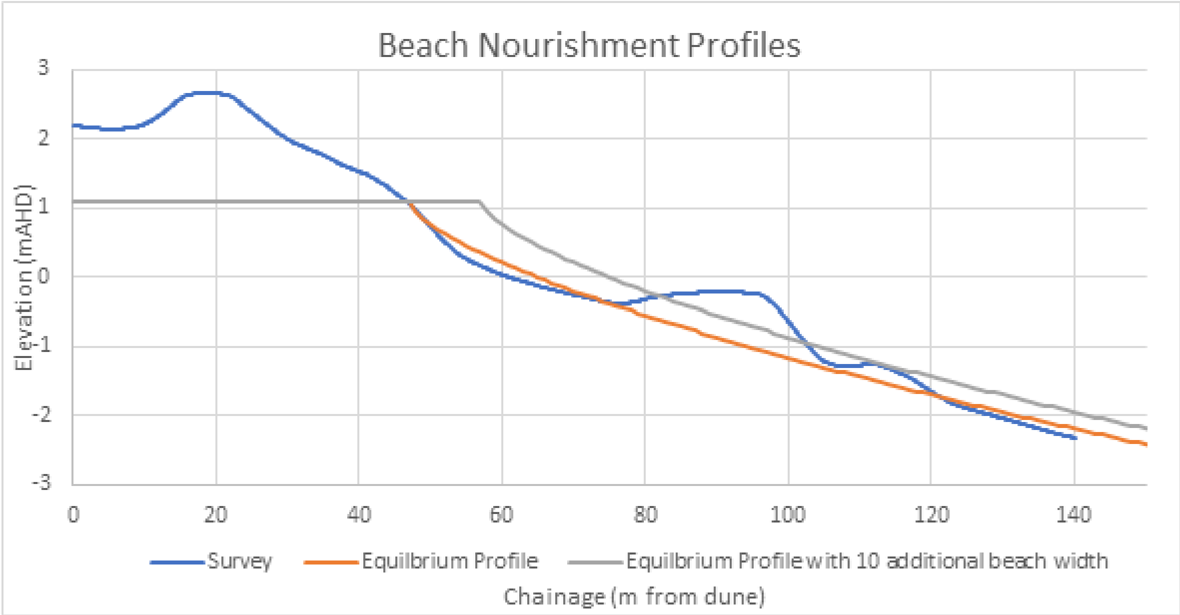


Figure 3 Surfside Beach Nourishment Profiles

Effectiveness and benefits:

- Effective at reducing erosion potential at Surfside.
- Has limited impedance on beach access and natural amenity.
- Provides an artificial reef.

Disadvantages:

- Is not a holistic coastal hazard management option; only addresses erosion, not tidal or coastal inundation.
- Relatively expensive, and needs maintenance and periodic sand nourishment campaigns
- Creates a navigation hazard.
- The Stage 2 Coastal Hazard assessment identified that the transport of sand along the beach is generally low but travels from north to south under normal ambient conditions. An offshore breakwater would not impact these processes, and therefore does not mitigate the recessional trend at the northern end of the beach.

Overall, this option is not recommended due to the lack of holistic hazard management, high costs and the ongoing maintenance required.

CH1_Ka	**Wharf Road Stage 1: Priority coastal protection works , remediation and reinstatement of beach for public use**

Location(s): Wharf Road, North Batemans Bay

Coastal threat(s) to be addressed: Coastal Erosion

Outcome of Detailed Assessment

This option is recommended for inclusion in the CMP to address existing and future coastal erosion and inundation risk to Wharf Road and surrounds areas. This action requires action CH_1 M (Acquisition of private property) to firstly occur with the following stages to enable public access and use of the beach: action will be undertaken in 3 phases:

1. Undertake site remediation assessment and investigation and design of coastal protection structure including reuse of onsite materials.
2. Complete coastal protection works identified in phase 1 and rehabilitation of beach to enable public use, improve amenity and environmental restoration outcomes. Renaming the rehabilitated beach to also be explored following community consultation.
3. Maintain and enhance coastal vegetation and beach for safe public use

Costs:

- Phase 1: Site remediation assessment and I&D for coastal protection structure: $200,000
- Phase 2: Construction of coastal protection works and beach rehabilitation: $2,200,000
- Phase 3: Maintenance and enhancement of beach and coastal vegetation: $ 60,0000 over 6 years ($10K per annum)

Maintenance costs of coastal protection works: 1% of capital costs annually over life of structure.

Option Description:

The corner of Wharf Road at North Batemans Bay was identified as being at extreme risk of coastal erosion and asset failure under existing conditions due its proximity to the existing shoreline. There currently exists a form of coastal protection along the road corner with quarry stones having been placed in an ad hoc manner (see Site Photo below). During site visits, an inspection of the area concluded that the structural integrity of the rock protection could not be relied upon, and the road and sewer is at risk of damage under extreme coastal conditions.

Figure 1. Site Photo of Wharf Road Corner and ad hoc rock protection (Site Visit: 16 March 2021)

Conceptual design of a seawall has been developed to address this risk, with the following objectives:

- Provide structural protection to Wharf Road against existing and future coastal erosion risk
- Limit the rate of wave overtopping to the roadway to maximise the duration of safe access along Wharf Road during elevated coastal storm conditions
- Tie in with existing coastal protection to the west, at the Easts Riverside Holiday Park
- Provide formal public access and connection from the Holiday Park to the beach and public open space to the east.

The option firstly requires that acquisition of the properties identified in the certified Wharf Road CZMP (action CH1_M in this CMP) is taken up by the landholders which is currently underway, and the beach area is returned to public open space.

Figure 2. The properties identified for voluntary acquisition by the NSW State Government, as identified in the Wharf Road CZMP

A typical section for the seawall design concept is presented in **Figure 2** and includes construction of a 3.0m wide crest at +3.5mAHD and 1 in 1.5 seawall slope that extends down to a toe level of -1 mAHD. Behind the crest of the seawall a concrete cut-off wall would reduce the permeability of structure (thereby providing a barrier to still water inundation). A footpath could also be integrated into the structure at detailed design. This footpath could occur at the crest of the structure to facilitate views or at the base of the structure cut-off wall in keeping with the existing road level as depicted in the image below.

The proposed design and cost estimates are for the coastal hazard protection purpose of the seawall only. Additional public benefits could be incorporated at the detailed design stage, such as viewing platforms, beach access and other amenity details.

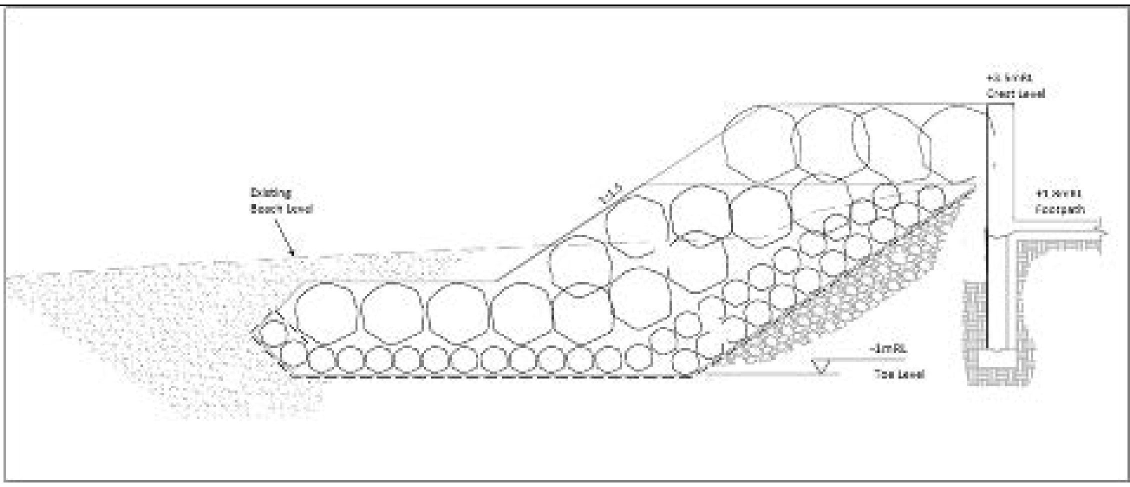


Figure 3. Typical Cross Section of Seawall Concept at Wharf Road Corner.

The alignment of the structure would run between the existing seawall that protects Holiday Park to the west and along approximately 85m of Wharf Road (100m in total length), as shown in **Figure 3**. Given the alignment of the seawall, the structure would block the natural drainage of the landside area, which is a low point in the area. As such drainage would need to be incorporated into the seawall design and may take the form of a pipe outlet through the structure with non-return value to inhibit the ingress of coastal waters during elevated sea level conditions.

Both the existing protection (see **Figure 1**) and from the unapproved structure to the east (see **Figure 5**) would be removed and armour stones could be reused as material for the new structure.

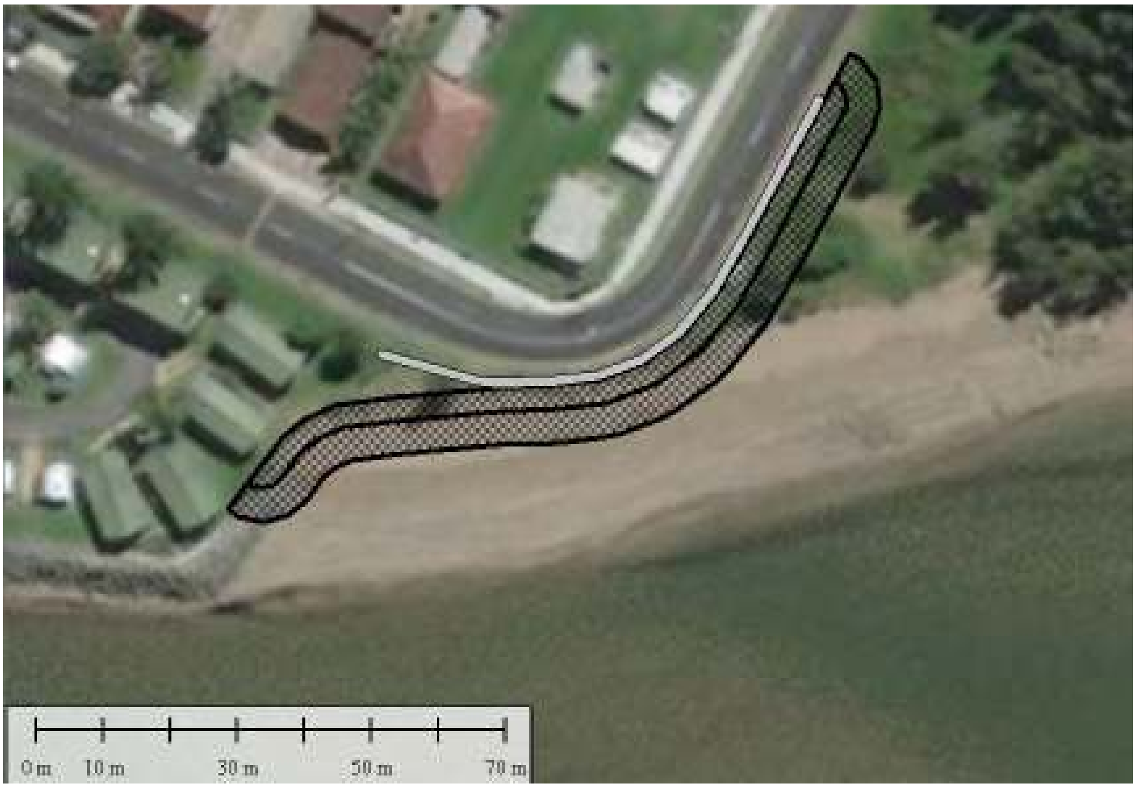


Figure 4. Alignment and footprint of Seawall Concept at Wharf Road Corner.

Figure 5. Photo and location of unapproved coastal protection structure at the Wharf Road subdivision.

CMP Assessment:

The seawall concept has been assessed as follows:

- Preliminary structural design – armour stone sizing and wave overtopping
- Shoreline response.

Preliminary structural design of the sea wall concept has considered a 100yr ARI design storm under present day and 2050 sea level conditions. These works are considered priority works for the area to address an extreme present-day risk. Options to address future risk under sea level rise scenarios need to consider coastal inundation of the wider area in a more wholistic manner and are considered in subsequent management options:

- Seawall raising in front of the holiday park and seawall along Wharf Road to provide inundation protection (Option CH1_Kb)
- Raising of Wharf Road surface levels (Option CH1_Kc)
- Trigger based protection of sewer line and remainder of Wharf Road from erosion (Option CH1_Kd).

A crest level of +3.5mAHD is established to reduce the rate of overtopping of the structure under severe coastal storm conditions. To meet a tolerable overtopping threshold of <50 L/s/m, a threshold for the safety of vehicles behind the crest (i.e. on Wharf Road), a crest elevation of +3.5mAHD with a crest width of 3m is required (based on wave overtopping calculations for rubble mound structures in Eurotop, 2018 under the 2100 scenario). Armour stone sizing of 3-4t is required to ensure stability under design wave conditions (using the empirical stability methods of van der Meer, 1988).

The removal of the unapproved coastal protection structure from the Wharf Road subdivision will have an influence on the shoreline shape to the east of Wharf Road corner. This shoreline has seen large fluctuations is beach width over relatively short periods of time, as shown in **Figure 6**, and is attributed to the balance between coastal processes (that supply sediment from east to west) and flood flows from Clyde River (that scour and rework sediments across the area).

In an accreted condition, the removal of the unapproved structure will not have an influence on the shoreline position, however in times of a more receded shoreline, a modified shoreline alignment would be expected. An assessment of the future vegetation line and shoreline positions without the presence of the unapproved structure is presented in **Figure 7**.

Figure 6. Shoreline positions in September 2018 accreted state (top) and September 2019 receded state (bottom).

Figure 7. Shoreline positions following removal of the unapproved coastal protection structure. Green is permanent vegetation line. Orange is the receded shoreline alignment. Yellow is the accreted shoreline position.

Benefits:

- The structure will provide protection to Wharf Road and maintain the road as a vital access way for the area.
- Provides the opportunity to establish formal connection between the existing developments and open space to the east (note that it is assumed voluntary acquisition of the Wharf Road subdivision is completed and the area is returned to public open space)

Effectiveness:

- The structure has been designed to address the existing extreme risk of damage to the Wharf Road corner. A correctly designed and constructed seawall will continue to provide effective protection against coastal erosion under future sea level rise scenarios.
- A seawall designed for present day conditions will reduce in effectiveness as sea level rises under future scenarios, as the associated wave overtopping rate under extreme coastal storms will increase. As such the effective crest of the seawall will need to be raised into the future in line with this increasing risk. This is considered as part of a staged management approach for the area (see Options CH1_Kb, Kc, Kd). The proposed crest level would provide effective protection from wave overtopping to the Wharf Road corner to 2040.

Timing:

- The seawall should be implemented as a high priority item to protect against an existing coastal erosion risk, with design and construction to commence in 'Year 1' of the CMP.
- The seawall, in its initial form, would have a limited lifespan (~20years) and form a foundation for further management works to address coastal inundation across the wider Wharf Road area.

Timing of these works, and associated works is outlined below.

2023
- Property acquisition (CH1_M)
- Stage 1 Wharf Road works (CH1_Ka) commenced

2024-2026
- Property acquisition (CH1_M) to continue
- Stage 2 Wharf Road works (CH1_Kb)

2027 Onwards
- Wharf Road incremental raising (CH1_Kc)

Cost Benefit Assessment

Costs: as above.

Benefits:

This option derives benefits from avoided costs that arise from the flooding and damages to Wharf Road under different modelled inundation events. Further benefit arises from the construction materials, which are sourced from the illegal foreshore protection structure. The removal of the groyne would allow for the build-up of more sand naturally, extending and widening the beach. As a result of the proposed works the following benefits are anticipated:

- **Avoided road replacement (erosion)** is a benefit that would occur as a result of constructing the proposed seawall, as it will reduce the probability of the road encountering erosion and having to be reconstructed. The value of this benefit was taken from the TfNSW Economic Parameters (2020) with the cost of $3,429 per metre of a two-lane, flexible pavement road, where the road length is 85 metres. The analysis assumes a 1% p.a. probability of road replacement within the first ten years, 2% p.a. for the next 30 years, and 3% p.a. subsequently.

Results:

The table below highlights that this option has a negative NPV and has a BCR of 0.03 indicating that the option not economically feasible to implement at this point in time.

BCR		NPV	
0.03		-$1,898,790	
Benefit		**Costs**	
Erosion	$68,572	**Capital Costs**	$1,714,226
		Maintenance Costs	$253,136

Inundation at Wharf Road, 6 June 2012 (Mr Dick Crompton) from WRL, 2017

Debris strewn across the beach from the dilapidated seawall, Wharf Road, 4th April 2022 (Mr Cameron Whiting, ESC)

C1_Kb	**Wharf Road Protection Stage 2: Inundation protection. Seawall raising in front of Holiday Park, seawall along Wharf Road**

Location(s): Wharf Road, North Batemans Bay

Coastal threat(s) to be addressed: Coastal Inundation

Outcome of CMP Assessment
This option is recommended for inclusion in the CMP to address existing erosion risk to Wharf Road and ensure the ongoing viability of this road.

Costs:

Stage 2 consists of raising 440m of existing seawall and installation of 250m of flood wall. The effectiveness of the option is reliant on the implementation of the Stage 1 seawall to provide a continuous protection from inundation around North Batemans Bay.

Seawall Capital Cost: $3,800,000

Flood Wall Capital Cost: $2,100,000

Maintenance Costs: 1% of capital costs annually over life of seawall. Negligible maintenance costs for flood wall.

Option Description:

The low-lying areas of North Batemans Bay along Wharf Road have been identified as being at risk of coastal inundation under a present day 100yrARI coastal water level, with inundation depth exceeding 1m in some areas. Inundation depth maps for the present day and including projected sea level rise out to 2100 are presented in **Figure 1**. Options to address the existing and future risk of coastal inundation across the wider area have been considered. Given the topography of the area, inundation protection will require a mix of structures to produce a continuous elevated barrier to repel coastal inundation from Batemans Bay.

Figure 1. 100year ARI Coastal Inundation Depth across Wharf Road area. Top: Present Day. Bottom: 2100.

The concept design for Stage 2 coastal inundation protection assumes the following:

- Stage 1 (Option CH1_Ka) includes the construction of a seawall that extends from the existing coastal protection to the west, at the Easts Riverside Holiday Park, and along 85m (approx.) of Wharf Road, providing protection to ensure tolerable wave overtopping rates to the year 2050.
- Opportunistic raising of Wharf Road will be implemented as maintenance works are undertaken or funding becomes available to maintain access during inundation events and act as flood control structure to the suburb over longer timeframes (Option CH1_Kc).
- Inclusion of tidal valves on stormwater outlets (Option CH4_G).

Conceptual design of Stage 2 protection of Wharf Road consists of the following:

- Raising of the existing seawall that fronts the Holiday Park (440m in length).
- Construct a flood wall along the seaward alignment of Wharf Road east of the Wharf Road corner, consisting of a Steel Sheet Pile wall (250m in length).

The alignment and extent of structures is presented in **Figure 2**. The flood protection would be constructed to a level that will prevent coastal still water inundation up to the year 2100 (for 100-year ARI immunity – crest level ~3mAHD) and will tie into the Stage 1 protection works (Option CH1_Ka). Wave overtopping of the holiday park would be reduced by the seawall raising, however would not be a targeted outcome of the works as this would reduce the amenity of the holiday park foreshore.

Figure 2 Alignment and extent of Stage 2 Inundation Protection of Wharf Road (Red: Raising of Seawall, Blue: Vertical SSP).

A concept seawall raising option has been designed that would leverage of the existing seawall as a foundation but increase the crest level to +3.0mAHD, above the 100-year ARI Storm Tide level in 2100. A typical section for the seawall raising design is presented in **Figure 3** and includes construction of a 1m wide crest and 1 in 2 seawall slope that is placed on top of the existing seawall armour layer (also 1 in 2 slope). At the back of the crest of the raised seawall a concrete cut-off wall would reduce the permeability of structure and neatly tie the seawall into the land behind.

A typical section for the flood wall along Wharf Road is presented in Figure 4 which includes installation of a vertical Steel Sheet Pile (SSP) structure on the seaward edge of the road alignment. The SSP panels could be concealed with capping and facia and would also provide structural support for future road raising works.

The proposed design and cost estimates are for the coastal hazard protection purpose of the seawall only. Additional public benefits could be incorporated at the detailed design stage, such as viewing platforms, beach access and other amenity details.

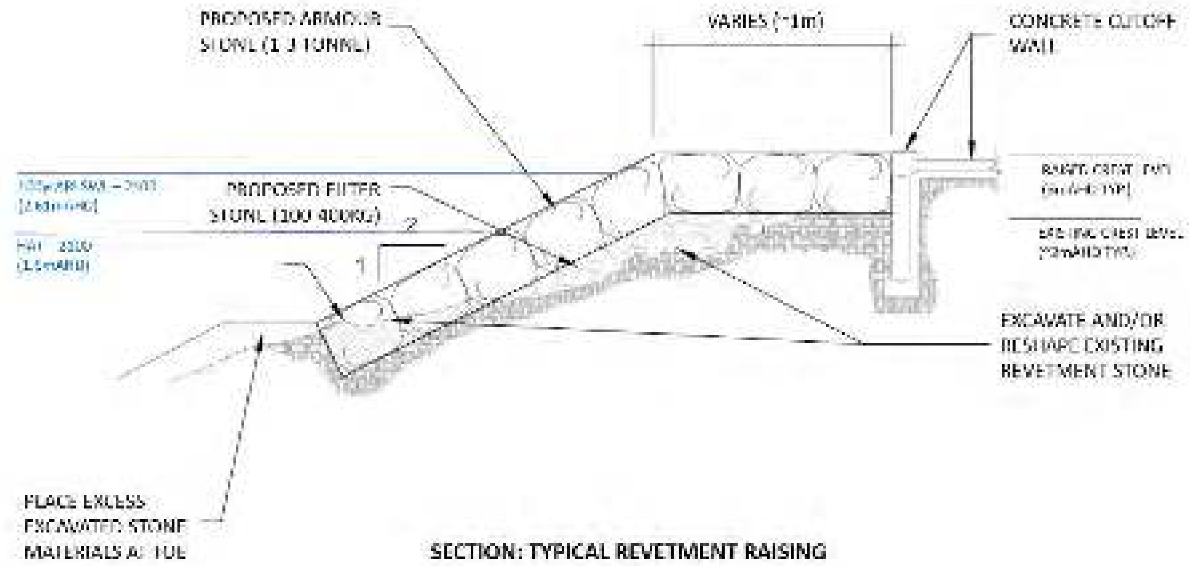


Figure 3 Typical cross section for raising of the Seawall fronting the Easts Riverside Holiday Park

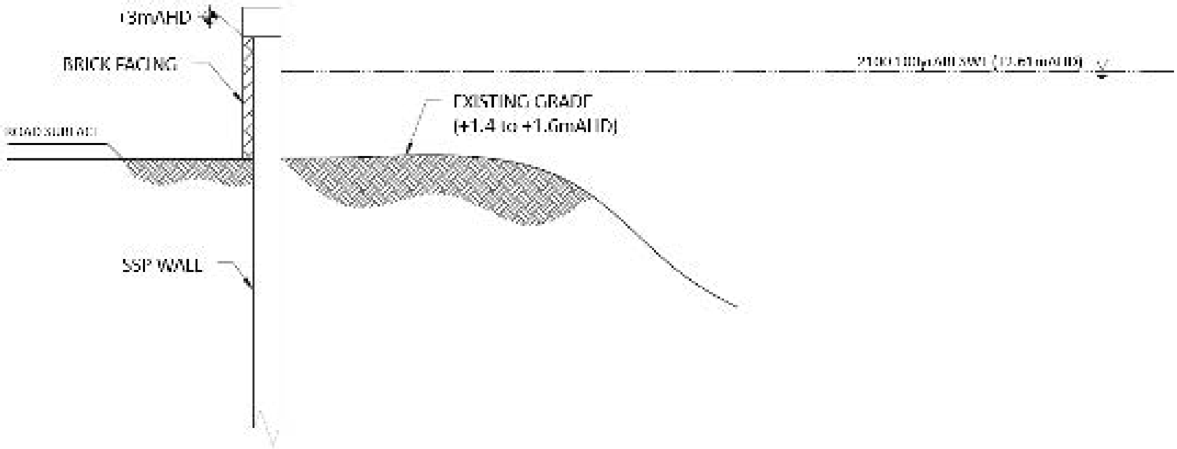


Figure 4 Typical cross section for SSP Wall along Wharf Road

Benefits:

- The structure will provide protection from coastal inundation to the North Batemans Bay area and maintain Wharf Road as a vital access way for the area.

Effectiveness:

- The conceptual design of the structure has been designed as three separate structures that together address the existing and future extreme risk of inundation to the North Batemans Bay area (out to 2100).
- The effectiveness of the option is reliant on the implementation of the Stage 1 seawall to provide a continuous protection from inundation around North Batemans Bay.
- Wave overtopping of the Holiday Park foreshore is not eliminated under future sea level rise scenarios by this option, as this would severely reduce the amenity of the foreshore. Rising sea levels may trigger a need for further protection against wave overtopping in the

future that would be solely targeted at reduction of overtopping hazard of the Holiday Park foreshore.

Timing:

- There is an existing inundation risk that would be eliminated through implementation of the coastal inundation protection.
- These works are seen as secondary priority to the Stage 1 seawall to protect against a severe coastal erosion risk of the Wharf Road corner.

Timing of these works, and associated works is outlined below.

2023
- Property acquisition (CH1_M)
- Stage 1 Wharf Road works (CH1_Ka)

2024-2026
- Stage 2 Wharf Road works (CH1_Kb)

2027 Onwards
- Wharf Road incremental raising (CH1_Kc)

Cost Benefit Assessment

Costs: As above

Benefits:

This option derives benefits from avoided costs that arise from the flooding and damages to Wharf Road and the surrounding caravan parks and mobile homes in North Batemans Bay under different modelled inundation events. The extension of the seawall to surround the entirety of the foreshore area from Korners Park to Surfside, would remove the potential for detrimental flooding under 1% or 5% AEP events. Further benefit arises from the walls construction materials, which will be partially sourced from an existing illegal structure, which is preventing natural sand build up in the bay. The removal of the groyne would allow for the build up of more sand naturally, extending and widening the beach.

As a result of the proposed works the following benefits are anticipated:

- **Avoided road resurfacing** is a benefit that would occur due to the proposed seawall that will shielding the entirety of Wharf Road from inundation events. The value of this benefit was taken from the TfNSW Economic Parameters (2020) with the cost of \$143m^2.
- **Avoided Property Damages** is a benefit that arises from protection of residential and commercial properties from coastal inundation events. The damages are calculated based on damage curves from the DPE and include maintenance, replacement and relocation costings. This is translated into an Average Annual Damage reading which summaries the potential damages in any given year, based on the severity and likelihood of the damages occurring.
- **Avoided isolation** is a benefit that would occur due to the proposed sea wall's wave return structure. This would prevent costal inundation flooding of Wharf Road and allow for the sustained access for emergency evacuation or the continuation of normative activity by the

residents and visitors of the caravan parks and North Batemans Bay (500 people) in an inundation or storm event.

- The cost of emergency access was derived from Batemans Bay hospitalisation rates for Eurobodalla residents and the triage severity of each visit and the cost of damages for which each case if untreated. These inputs were drawn from TfNSW's *Flood Risk Management Measures (2022)* and *flowinfo v 17 (2017).*
- The cost of ordinary activities was derived from the average cost per household per vehicular trip that would normally be undertaken and the cost of isolation (i.e. expenditure on goods and services that is no longer possible). These costs were derived from the averagely weekly spend per household for Eurobodalla and the average daily trips per household. This resulted in an avoided benefit of $40.54 per trip and $157 for each of the 229 households for each day of isolation. Given the uncertainty regarding level of disposable income, a 50% adjustment factor was applied to foregone daily expenditure to represent the cost of isolation.
- Additionally, a costing of $71.43 per person affected by an isolation period is implemented, to account for the cost of potential mental health related therapy and loss of production that occur as a result of prolonged isolation. This costing is derived from Deloite (2016) 'The Economic Cost of Social Impacts of Natural Disasters' and is scaled by a factor of 0.1 to account for the relative severity of possible inundation events.

Results:

The table below highlights that this option has a indicating NPV and has a BCR of less than 1 indicating that the option not economically feasible to implement at this point in time.

BCR		**NPV**	
0.76		-$1,270,166	
Benefit		**Costs**	
AAD	$2,638,439	**Capital Costs**	$4,816,157
Amenity	$967,733	**Maintenance Costs**	$483,273
Resurfacing	$423,092		

Inundation at Wharf Road, 6 June 2012 (Mr Dick Crompton) from WRL, 2017

Inundation at Wharf Road, 6 June 2012 (Mr Dick Crompton) from WRL, 2017

CH1_L	**Undertake nourishment at northern Batemans Bay beaches when dredging is undertaken in Batemans Bay / Clyde River as required for navigational purposes**

Location(s): Surfside Beach, Surfside Beach West (Dog Beach / Mcleods Beach), North Batemans Bay Beach (Wharf Road), Long Beach

Coastal threat(s) to be addressed: Beach Erosion

Outcome of CMP Assessment
Recommended for inclusion in the CMP due to benefits for beach amenity and asset protection at northern Batemans Bay.

Costs:

A capital cost of $500,000 per nourishment campaign, with no ongoing maintenance cost, to be repeated every 1 to 5 years (on average).

Option Description:

Protection of the existing Northern Batemans Bay shorelines by increasing the sub-areal beach volume through beach nourishment. Maintenance dredging of navigable areas of Batemans Bay produces a volume dredged material that is suitable for beach nourishment on adjacent shoreline areas.

Dredging of Batemans Bay and Clyde River has occurred on an infrequent basis since at least the early 1900s, with dredge spoil deposited at Corrigans Beach and Surfside throughout the century. Recent dredging and nourishment campaigns have occurred in 2013, 2016 and 2020. The 2020 campaign deposited sand offshore Surfside Beach, consisting of 10,000 m^3 of Clyde River sand. In 1996 12,000 m^3 of sand from navigational dredging was deposited on the northern end of Surfside Beach. This management action would redirect all dredged material to the Northern shorelines of Batemans Bay to increase the sub-areal beach volume of Surfside Beach, Surfside Beach West (Dog Beach), North Batemans Bay Beach (Wharf Road) and Long Beach.

Beach nourishment is opportunistic and would occur as and when dredge sediment from Batemans Bay /Clyde River becomes available.

Nourishment would be subject to environmental planning approvals and suitability of dredged material.

It is noted that DPI Fisheries will only support dredging and nourishment programs that are compliant with the Marine Estate Management Act and Fisheries Management Act and is not supportive of expanding these activities beyond existing channel maintenance programs in Batemans Bay. The rules relating to dredging and beach nourishment within a Marine Park can vary between zones and the Draft CMP needs to acknowledge the relevant Clauses of Marine Estate (Management Rules) Regulation 1999 to determine the permissibility of any proposed dredging activities.

Surfside Beach Nourishment

The 100 Year ARI storm demand at Surfside Beach is approximately 55m^3/m of beach length. Therefore, the volume of sand required to replace erosion after a 100 Year ARI event for the full 800m length of beach is approximately 50,000m^3.

However, if nourishment were to occur in response to navigation dredging within the Clyde River channel, it is estimated that placement of approximately 10,000m^3 of sand at the northern end of Surfside Beach (as shown on **Figure 1**), would result in approximately a 10m gain in beach width.

It should be noted placement of dredge material directly on the beach or marginally offshore (within 100m of shoreline as per **Figure 1**) is required to ensure nourishment of the beach is achieved. It has been shown offshore placement may not result in movement of sand to the beach shoreline particularly if it coincides with Clyde river flood flows.

Long Beach

The 100 Year ARI storm demand at Long Beach is approximately 90m^3/m of beach length. Therefore, the volume of sand required to replace erosion after a 100 Year ARI event for the full 1,000m length of beach is approximately 90,000m^3.

However, if nourishment were to occur in response to navigation dredging within the Clyde River channel, it is estimated that placement of approximately 15,000m^3 of sand at the eastern end of Long Beach (as shown on **Figure 2**), would result in approximately a 15m gain in beach width.

It should be noted placement of dredge material directly on the beach or marginally offshore (within 100m of shoreline) is required to ensure nourishment of the beach is achieved (as per **Figure 2**).

Surfside Beach West (Dog Beach / Mcleods Beach)

Placement of 5,000m^3 of sand in response to navigation dredging within the Clyde River channel, would result in a 15m gain in beach width.

It should be noted placement of dredge material directly on the beach or marginally offshore (within 50m of shoreline) is required to ensure nourishment of the beach is achieved (as per figure below). Placement heights if directly on the beach should be graded to ensure the dredge material is at least ½ meter lower than the foredune crest height to minimise sand loss by wind, over the foredune into property and onto the road.

Dune Nourishment

If beach width is greater than 30 m at all Northern Batemans Bay beaches when navigation dredging of the Clyde River channel occurs, targeted nourishment of the dune system at Surfside Beach or Surfside Beach West (Dog Beach / Mcleods Beach)) will be undertaken to achieve an elevated dune crest level to protect against coastal inundation under future climate change scenarios.

Figure 1 Surfside Beach Sand Nourishment

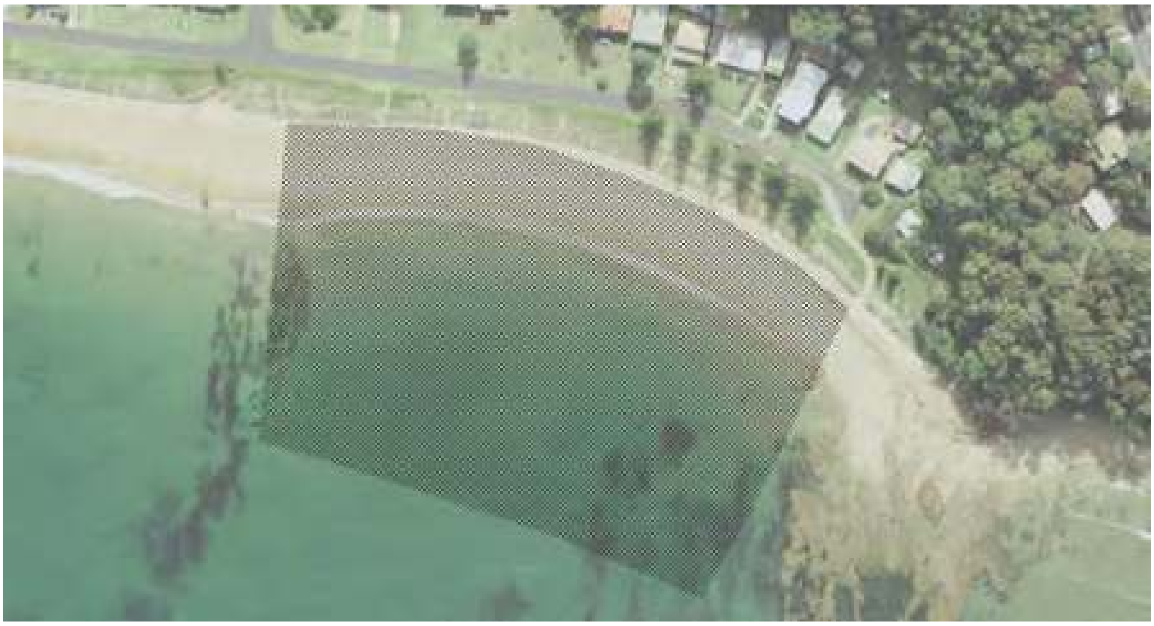


Figure 2 Long Beach Sand Nourishment

Figure 3 Surfside Beach West (Dog Beach / Mceods Beach) Nourishment

CMP Assessment:

The approximate volume needed to nourish the northern end of Surfside Beach is 7,000 m^3, based on a beach length of 400 m. This assumes the beach that has not recently been eroded due to storm action (i.e. similar profile to the survey profile in Figure 2). Additional sand may be needed if the beach profile is significantly more eroded. The volume and beach profile was based on an equilibrium beach slope using a profile scale parameter of 0.16 $m^{1/3}$ (Dean, 2002).

The coastal erosion assessment in the Stage 2 hazard study identified a storm demand of 50-60m^3/m of beach (equivalent to ~30m of beach width) at Surfside. Maintaining a beach width of greater than 30m, through nourishment will improve the capacity of the beach to accommodate large storm events and minimise the landward limit of storm erosion when it occurs.

Recession rates at Northern Surfside are estimated as -0.08m/year. Over a 10-year period (upper estimate between nourishment campaigns), a loss of <1m of the nourished beach width would be expected which should not undermine the effectiveness of the nourishment volume in protecting against coastal erosion.

Effectiveness:

- Moderate to high effectiveness, as it ensures natural processes are not disturbed unnecessarily, beach width, amenity and usability are maintained, and private property protected
- While the intent is to provide additional beach width as a buffer against storm demand and recession, these processes will drive a reduction in the nourished beach volume over time. The effectiveness of the option is reliant on regular nourishment and will deteriorate in effectiveness if dredging, and thereby nourishment, is very infrequent

Timing:

From present-day, on an on-going basis with a frequency of approximately 5-10 years.

Cost Benefit

Costs: The cost of this option, is considered to be the slight increase in costs associated with placing the dredged material on the northern shoreline rather than a more convenient offshore location. The reason for this is that the 'base case' against which this option is being assessed, also include the dredging operations.

Benefits:

The benefits of this option have been assessed for Surfside only, as the volume of dredge material available for the purpose of nourishment would likely only fulfil the requirements on one location of the three priority locations identified, per dredging program.

This option derives benefits from avoided loss of access and amenity to the eastern side of Surfside Beach during a storm event. Despite storm events affecting the length Surfside Beach, it has been deemed most cost effective to nourish the north-eastern corner as sand naturally moves on shore in a southwestern direction. Sand nourishment would prevent the large losses of sandy beach space after a storm or inundation event, which in turn produces the following benefit:

- **Preserved Amenity** is a benefit that is anticipated to occur from avoidance of sand loss after a storm event. This has been valued by assuming that post inundation events, the eastern half of the beach will be reduced in size by around 6000m^2 and so its use-value will decrease in following year by an estimated 50% whilst the beach naturally recovers with the help of nourishment.

No property damages have been included in this analysis, as the erosion hazard does pose a threat to properties within the 50 year economic assessment period.

Results:

The table below highlights that this option does not have a positive NPV and has a BCR well below 1 indicating that it is not economically feasible to implement at this point in time. However, it is acknowledged that this option may proceed for rationale other than economic factors.

BCR		NPV	
0.62		-$36,531	
Benefit		**Costs**	
Amenity	$60,604	**Capital Costs**	$97,134

CH1_M	**Property acquisition and restore land to safe public use area**
Location(s): Wharf Road, North Batemans Bay	
Coastal threat(s) to be addressed: • CH Threat 1 Beach Erosion • CH Threat 4 Coastal Inundation • CH Threat 5 Tidal Inundation • RA Threat 3 Poorly located, poorly maintained and/or inappropriate access and supporting facilities • CD Threat 4 Coastal development encroaching onto natural coastal processes to exacerbate hazard impacts	
Outcome of CMP Assessment This option is recommended for inclusion in the CMP to address a range of coastal risks associated with erosion and inundation and to achieve public benefits associated with improved access, public space and improved environmental outcomes.	
Costs: Property acquisition through the Coastal Lands Protection Scheme amounts to $4,000,000	
Option Description: Public ownership of beaches has long been a foundation of the coastal management approach in NSW. Public ownership of the beach at Wharf Road was a priority issue for the Wharf Road CZMP. Despite the zoning somewhat managing coastal risk without the need for land acquisition, it is considered appropriate to incorporate in this plan a priority action for the NSW Government to purchase the private property. This would return the areas of beach and the beach access to public ownership. The location of private lots for acquisition is shown Figure 1 below in pink. DPE-Planning will require the land to be free of debris and in an uncontaminated state as part of any condition of purchase. It is noted that Given the residual risk of unknown quantities of buried material being unearthed, it is likely that, even if cleaned up by the current owner(s), the sites may still require some remediation to make the land suitable for open space. Access to the existing and future Public reserve should be improved to a safe standard. As part of the site remediation, the illegal foreshore structures should be removed. The use of the rock contained within this structure should be considered for use in the Wharf Road Stage 1 Protection Works (CH1_Ka). Additional site improvements and opportunities can be explored (such as revegetation, biobanking and a recreational use plan), however, they would be additional to the core aspects of this option included in the CMP and completed under CH1_Ka.	

Figure 1: Properties identified for acquisition

Timing:

Voluntary acquisition of private lots should occur in 2023 – 2026 subject to private landowner decisions.

Remediation of public land should commence immediately, with remediation of future public land to occur following completion of property acquisition process and site contamination and remediation plan.

Cost Benefit Assessment

Costs: as above

Benefits:

This option derives benefits from anticipated creation of nearly 11,575m^2 of public beach and vegetated open space from the purchase of 42 lots from private owners. This will allow for greater access to the beach for the public increasing its use values. This results in the following benefit realisation:

- **Created Amenity** is a benefit that is anticipated to occur from the transition of private land to public reserve and beach area. This area is predicted to provide both non-use value and use value for local residents, with greater access to sheltered family friendly beach. The created amenity is estimated to be valued at $29.75 per m^2 annually.

Additional non-quantifiable benefits could include improved habitat and connection to Country opportunities.

Results:

The table below highlights that this option has a negative NPV and has a BCR of 0.62 indicating that the option is not economically feasible to implement at this point in time.

BCR		NPV	
0.62		-$1,224,824	
Benefit		**Costs**	
Amenity	$2,040,368	**Capital Costs**	$3,265,192

CH1_P	Casey Beach Seawall
Location(s): Caseys Beach	
Coastal threat(s) to be addressed: Beach Erosion and Coastal Inundation (from wave overtopping)	
Outcome of CMP Assessment This option is recommended for inclusion in the CMP to address existing coastal erosion risk and wave overtopping of Beach Road.	
Costs: In total, 535m of seawall proposed along the length of Beach Road. Two options have been considered in the assessment of this option: • Construct seawall to meet risk requirements out to 2065 (nominally a ~50year design life) • Construct rubble mound seawall to address present day risks, and retrofit a vertical crest wall in future (approximately 2035) Option 1: construct with crest wall (to address future risk to 2065) • Capital Cost: $7,900,000 • Maintenance Costs: 1% of capital costs over life of structure Option 2: construct without crest wall (rubble mound to address present day risk, including wave overtopping): • Capital Cost: $6,600,000 • Future Capital Cost (~2035): $3,400,000 • Maintenance Costs: 1% of capital costs over life of structure	
Option Description: Replacement of the existing coastal protection works at Caseys Beach to protect Beach Road and reduce the likelihood of damage from wave overtopping during storm events. There currently exists a proposed seawall design for Caseys that has been developed and approved by Council. Modification of the existing design would be required to ensure the proposed seawall design meets overtopping estimates under future sea level rise scenarios.	
CMP Assessment: The proposed seawall design (Aurecon, 2019) will provide adequate protection to ensure Beach Road is not impacted by coastal erosion and is adequately designed to withstand extreme coastal conditions. However, the crest level of the proposed design was limited to not exceed 1 armour stone (~1m) above the existing foreshore levels due to impacts on visual amenity (Aurecon, 2019). Wave overtopping of the existing seawall is a known issue, with damage to the road surface being experienced during extreme coastal events. The proposed design targeted an average overtopping rate of less than 50 L/s/m to reduce the risk of such damage and the proposed design is stated as achieving this rate under existing conditions (i.e. current mean sea level conditions) as confirmed during physical model testing of the seawall (WRL, 2019). Future sea level rise will increase the overtopping rates at the seawall. Wave runup and overtopping calculations for the proposed seawall design at Caseys Beach were performed using methods outlined in Eurotop (2018) and benchmarked against the physical model results (WRL, 2019) to provide an indication of rate over overtopping under future sea level rise scenarios. The following table summarises the results, noting an average overtopping rate of less than 50 L/s/m is targeted to reduce the risk of damage to the foreshore and road surface.	

Mean Overtopping Rates (q) for the 100year ARI coastal storm under sea level rise scenarios

	Present	2050	2065	2100
q (L/s/m)	47	98	121	324

Initial analysis suggests that the proposed crest level and seawall design does not adequately protect against overtopping under future sea level rise conditions (based on the 100-year ARI storm event) and could therefore result in road and infrastructure damage.

To manage the risk of future wave overtopping a modification of the seawall design will be required. A possible modification to the seawall design is presented in **Figure 1** below and incorporates a vertical wall directly behind the structure crest. A similar wave return barrier example is provided in **Figure 2**.

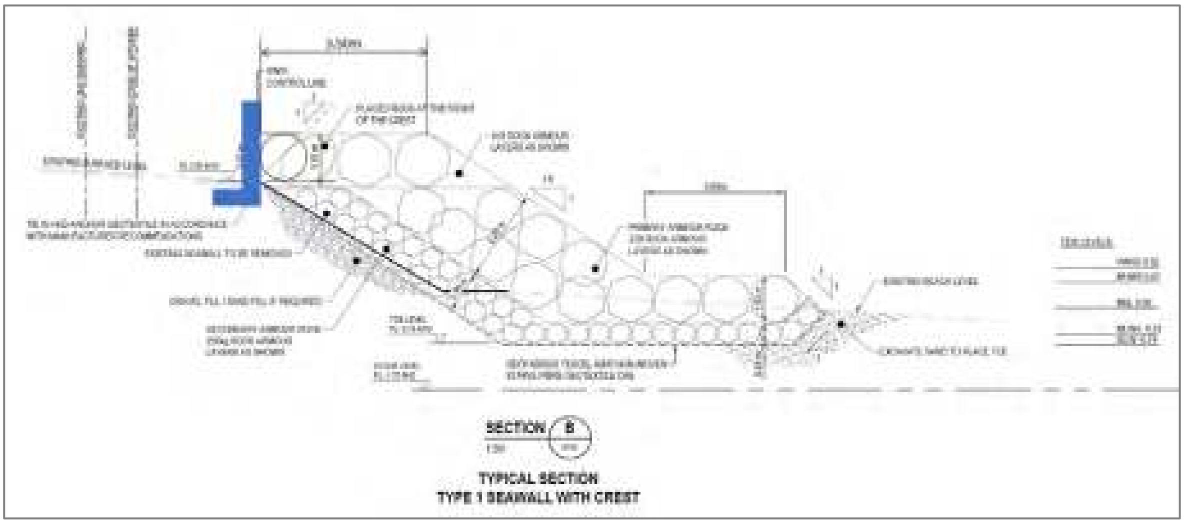


Figure 1 Seawall with Crest Typical Section

Figure 2 Example of wave return barrier, Port Kembla (from MHL, 2021)

Adopting a sea level rise over a reasonable structural design life (say to ~40 years to the year 2065), the required height of the vertical wall (above the existing foreshore level) to reduce mean wave overtopping to an acceptable rate (i.e. 50 L/s/m) is presented in the table below. If Option 2 is actioned, the suitable height of the vertical wall would be assessed in the next revision of the CMP.

Height of Vertical Crest Wall to reduce overtopping hazard for the 100year ARI coastal storm under sea level rise scenarios

	Present	2050	2065	2100
Wall Height* (m)	1.2	1.45	1.6	1.95

* above existing foreshore level of 2.8mRL to reduce overtopping rate to <= 50 L/s/m
^ assumes a 3.5m wide rubble mound crest in front of the vertical wall

Modifications to the proposed seawall design would need to subject to detailed design, including physical modelling if deemed required.

Beach nourishment to offset the increased footprint of the seawall should be considered to improve/restore beach width and amenity following the proposed seawall construction. This is not specifically included as part of this management option.

Reprofiling/raising of the road in conjunction with seawall crest raising may be desirable to ensure adequate drainage of the overtopped volume of water. Such works would need to consider access and drainage of private property along Beach Road.

Effectiveness:

- A correctly designed and constructed seawall will provide adequate protection to both undermining (from coastal erosion) and surface damage (from wave overtopping) to Beach Road and will ensure the safe use of the road and associated infrastructure under a greater range of coastal conditions.
- A seawall designed for present day conditions will reduce in effectiveness as sea level rises under future scenario, as the associated wave overtopping rate under extreme coastal storms will increase. As such the effective crest of the seawall will need to be raised into the future in line with this increasing risk. Should this be achieved then the seawall will be effective in protecting Beach Road from undermining and surface damage.

Timing:

- 2025. Identified as a priority option to manage an existing risk to undermining and damage of Beach Road.
- A design life of ~50 years could reasonably be applied to the coastal structure assuming the seawall design incorporates the vertical crest wall to protect against future sea level rise to 2065.
- The option could be staged to initially construct the rubble mound (rock) seawall and address the existing present day risk, with subsequent construction of a vertical crest wall to reduce the risk of wave overtopping under future sea level rise. Initial estimates indicate that by 2035 (SLR of 0.12m), an overtopping rate of 70 L/s/m would be expected under a 100 year ARI coastal event which meets the upper limit of tolerable overtopping rates for cars behind the crest in Eurotop (2018).

Cost Benefit Assessment

Costs: As above for both options

Benefits:

This option derives benefits from avoided costs that arise from the flooding and damages to waterfront properties on Beach Road and the Casey Beach Caravan Park. Additionally, the avoidance of road resurfacing costs as a result of water damage is another benefit which was included in the CBA modelling for this option. As a result of the proposed works the following benefits are anticipated:

- **Avoided road resurfacing** is a benefit that would occur due to the proposed seawall protecting Beach Road from wave runup and overtopping. The value of this benefit was taken from the TfNSW Economic Parameters (2020) with the cost of $143 per metre.
- **Avoided road replacement (erosion)** is a benefit that would occur as a result of constructing the proposed seawall, as it will reduce the probability of the road encountering erosion and having to be reconstructed. The value of this benefit was taken from the TfNSW Economic Parameters (2020) with the cost of $3429 per metre of a two-lane, flexible pavement road, where the road length is 535 metres. Additionally, there is an avoided cost of the temporary road which is required in the estimated two week period of road reconstruction. The value of avoiding this cost is derived from the pricing the anticipated 565 metres of metal temporary road sheeting which will allow for continued road access to properties along Beach Road. The temporary road will run adjacent to the existing road with connections to each property's driveway. Over a four-week period the cost per metre of the temporary road is $269, which totals to $303,970 per erosion event. The analysis assumes a 1% p.a. probability of road replacement within the first ten years, 2% p.a. for the next 30 years, and 3% p.a. subsequently.
- **Avoided isolation** is a benefit that would occur due to the proposed sea wall's wave return structure. This would prevent wave overtopping of Northcove Road and would mitigate against erosion damages to the road. Thus, allowing for the continuation of normative activity and emergency access for the residents of Caseys beach (371 people) 36 hours after an inundation or storm event.
- The cost of emergency access was derived from Batemans Bay hospitalisation rates for Eurobodalla residents and the triage severity of each visit and the cost of damages for which each case if untreated. These inputs were drawn from TfNSW's *Flood Risk Management Measures (2022)* and *flowinfo v 17 (2017).*
- The cost of ordinary activities was derived from the average cost per household per vehicular trip that would normally be undertaken and the cost of isolation (i.e. expenditure on goods and services that is no longer possible). These costs were derived from the averagely weekly spend per household for Eurobodalla and the average daily trips per household. This resulted in an avoided benefit of $40.54 per trip and $157 for each of the 38 households for each day of isolation. Given the uncertainty regarding level of disposable income, a 50% adjustment factor was applied to foregone daily expenditure to represent the cost of isolation.
- Additionally, a costing of $71.43 per person affected by an isolation period is implemented, to account for the cost of potential mental health related therapy and loss of production that occur as a result of prolonged isolation. This costing is derived from Deloite (2016) 'The Economic Cost of Social Impacts of Natural Disasters' and is scaled by a factor of 0.1 to account for the relative severity of possible inundation events.

Results:

The table below highlights that this option does not have a positive NPV and has a BCR well below 1 indicating that it is not economically feasible to implement at this point in time. However, the non-quantifiable benefits may be determined to add significantly to the low economic benefits, such as those associated with community expectations regarding continued and ongoing use of Beach Road during and following a storm event, and certainty of road use during high tourist demand periods.

Option 1 (CH1_Pa)

BCR		NPV	
0.15		-$6,321,984	
Benefit		**Costs**	
Resurfacing	$491,997	**Capital Costs**	$6,448,753
Erosion	$429,315	**Maintenance Costs**	$954,464
Access	$159,921		

Option 2(CH1_Pb)

BCR		NPV	
0.14		-$6,925,394	
Benefit		**Costs**	
Resurfacing	$491,997	**Capital Costs**	$6,798,445
Erosion	$429,315	**Maintenance Costs**	$1,208,182
Access	$159,921		

CH1_S	Sand nourishment post erosion event – Tomakin Cove

Location(s): Tomakin Cove

Coastal threat(s) to be addressed: Beach Erosion

Outcome of CMP Assessment

No viable source of sand can be identified at the time of CMP preparation. As such, this option is not recommended for inclusion in the CMP or CZEAS. Nourishment at Tomakin Cove could be considered in future CMPs if a suitable sand source can be identified.

Costs:

A capital cost of $115,000 per nourishment campaign, with no ongoing maintenance cost. This is a trigger-based nourishment and may be repeated after an extreme erosion event that results in 20-year to 100-year ARI erosion extents.

It is assumed that the cost of nourishment does not include the dredging costs, as dredging location and available sediment sources will have to be determined at the time of nourishment. A cost of approximately $115,000 for placement of dredge material is based on a rate of \$5/ m^3.

Option Description:

Sand nourishment of Tomakin Cove sub-aerial dune system after large beach erosion events to protect public infrastructure and private property.

CMP Assessment:

- The Stage 2 Coastal Hazards Assessment, in conjunction with WRL (2017), identified that Tomakin Cove has a 20-year ARI storm demand volume of 59 m^3/m, and 100-year ARI storm demand of 90 m^3/m.
- Deterministic calculation of zone of slope adjustment (ZSA) based on storm demand, underlying shoreline movement, beach slope and beach volume, revealed that large erosion events could have significant impacts on the following locations at the 2017 and 2100 planning periods (Attachment 1):
  - 2017 100-year ARI event: dune system that protects private property.
  - 2100 100-year ARI event: private property along Sunpatch Parade.
- WRL (2017) identified a small recessional trend of -0.03 m/year, exacerbated to -0.05 m/year when incorporating sea level rise. These values have been incorporated into the ZSA hazard lines.
- Nourishment of the beach face post event would allow the dune system to recover and thereby protect infrastructure for future erosion events. If the dune system was not nourished, the next erosion event could significantly impact private property and eradicate the dune system.
- Trigger-based sand nourishment of the beach to the 'Nourished Profile + 10m Beach Width' nourishment profile shown in Figure 1. This will form a small dune at 1.6 mAHD, the location of a small natural berm shown in the 'Non-eroded Profile'. The nourishment will also accrete the beach by 10 m to allow a greater buffer to form and therefore protect private property and assist in the recovery of the remaining dune.
- The equilibrium slope that is the basis of the nourished profile was calculated by using a profile scale parameter of 0.16 $m^{1/3}$ (Dean, 2002). This was performed so that the nourished profile was in line with the 'Non-eroded' profile extracted from 2022 photogrammetry of Tomakin Cove.

- Based on a beach length of 250 m, an approximate total nourishment volume requirement is 22,500 m^3. At a cost/m^3 of $5, the capital costs of placement are ~$115,000

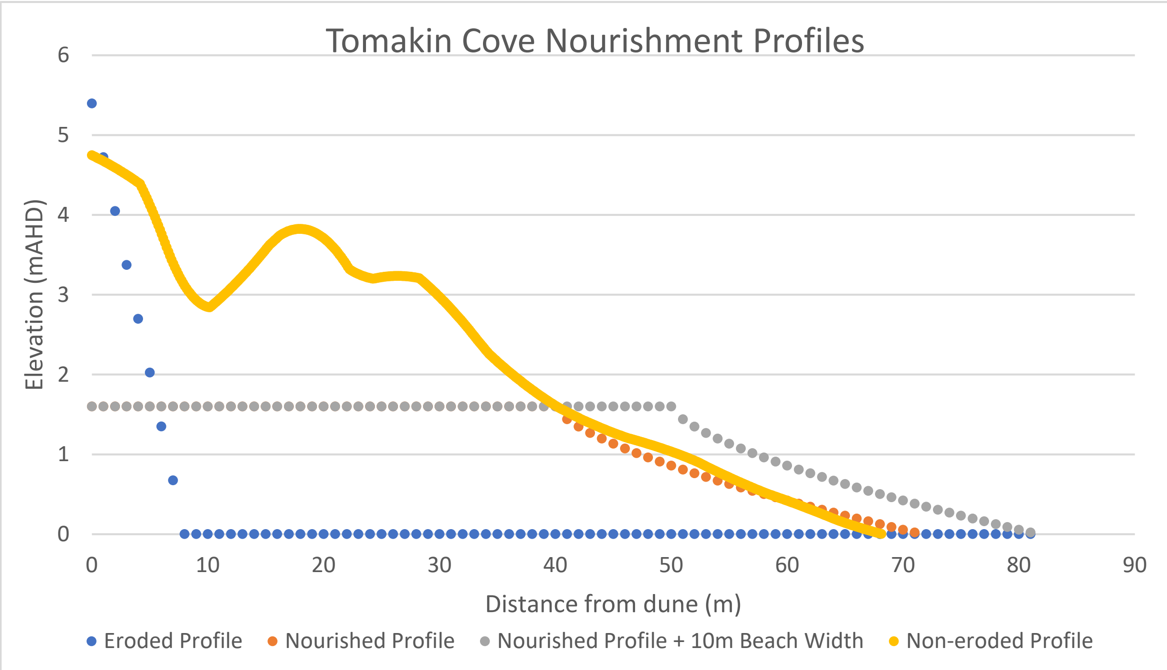


Figure 1 Beach Nourishment Profiles for Tomakin Cove

Effectiveness:

- Protection of private property at Sunpatch Parade from erosion – highly effective against a 100-year ARI storm event in the present day.
- For 2050, 2065 and 2100 planning periods, it is moderately effective in reducing impacts for private property. However, the dune must be in a nourished and healthy state with sufficient allowance for the requisite storm demand, to provide protection.
- A revision of nourishment amounts, and placement strategies may be warranted by 2050 to ensure that the impacts from sea level rise and associated landwards migration of the dune system are sufficiently accounted for and mitigated against to allow a consistently healthy dune buffer.

Timing:

- Trigger based following a large coastal erosion event

Attachment 1:

CH1_T	**Stabilisation of sand spit to rocky outcrop**
Location(s): Tomakin Cove	
Coastal threat(s) to be addressed: Beach Erosion	
Outcome of CMP Assessment This option is not recommended for inclusion in the CMP as it would not moderate the effects of sea level rise induced recession, with limited impact on the predicted 2100 Erosion Hazard Line.	
Costs: Not Costed	
Option Description: The rocky outcrop at the south-west end of Tomakin Cove provides significant protection to the cove from wave-induced erosion as it promotes the formation of a tombolo feature in its lee. If this tombolo was eroded, it would change the shape and sediment dynamics at Tomakin Cove, increasing long-shore sediment transport and erosion. This option would be triggered in the event of a severe erosion event, where the sand between the dune system and the rocky outcrop is eroded. The construction of a small seawall/groyne (located in red in **Attachment 1**) could be constructed, to promote the regrowth of the tombolo, reduce longshore sediment transport potential and maintain a protected embayment at Tomakin Cove. This would minimise the risk of a changed beach shape and increased wave exposure.	

CMP Assessment:
• The Stage 2 Coastal Hazards Assessment, in conjunction with WRL (2017), identified that Tomakin Cove has a 20-year ARI storm demand volume of 59 m^3/m, and 100-year ARI storm demand of 90 m^3/m.
• Deterministic calculation of zone of slope adjustment (ZSA) based on storm demand, underlying shoreline movement, beach slope and beach volume, revealed that large erosion events could have significant impacts on the following locations at the 2017 and 2100 planning periods (**Attachment 1**):
  ◦ 2017 100-year ARI event: dune system that protects private property.
  ◦ 2100 100-year ARI event: private property along Sunpatch Parade.
• WRL (2017) identified a small recessional trend of -0.03 m/year, exacerbated to -0.05 m/year when incorporating sea level rise. These values have been incorporated into the ZSA hazard lines.	

Effectiveness: • The construction of a rubble mound groyne structure would act as a sediment trap to allow natural processes to re-build the sand spit. This would maintain the existing embayment under existing conditions and reinforce and retain the natural erosion buffer provided by the dune system. • Would not moderate the effects of sea level rise induced recession, with limited impact on the predicted 2100 Erosion Hazard Line.	
Timing: • Trigger based following a large coastal erosion event that removed the sandspit to the rocky outcrop.	

Attachment 1:

CH1_U	Offshore Reef
Location(s): Tomakin Cove	
Coastal threat(s) to be addressed: Beach Erosion	

CMP Assessment Outcome

This option is not recommended for inclusion in the CMP as the existing risk to private property and dune systems is relatively low and does not justify the expense of an offshore reef. The option also does not provide adequate protection against recession caused by sea level rise. Further limitations are discussed below.

Costs:

No detailed design or costings have been performed for this option as the assessment did not identify suitable merits to warrant implementation.

Option Description:

Offshore reef located between the rocky outcrops at Tomakin to reduce wave-induced beach erosion.

CMP Assessment:

- The Stage 2 Coastal Hazards Assessment, in conjunction with WRL (2017), identified that Tomakin Cove has a 20-year ARI storm demand volume of 59 m^3/m, and 100-year ARI storm demand of 90 m^3/m.
- Deterministic calculation of zone of slope adjustment (ZSA) based on storm demand, underlying shoreline movement, beach slope and beach volume, revealed that large erosion events could have significant impacts on the following locations at the 2017 and 2100 planning periods (**Attachment 1**):
  - 2017 100-year ARI event: dune system that protects private property.
  - 2100 100-year ARI event: private property along Sunpatch Parade.
- WRL (2017) identified a small recessional trend of -0.03 m/year, exacerbated to -0.05 m/year when incorporating sea level rise. These values have been incorporated into the ZSA hazard lines.
- An offshore reef would be located between the rocky outcrops (**Figure 1**). This would provide an effective wave dissipation under coastal storms and reduce wave energy entering the cove, thereby significantly decreasing sediment transport and associated erosion of the beach face.
- However, it would not prevent sea level rise associated recession, thereby reducing effectiveness in the long-term.

Effectiveness/Benefits:

- Protection of private property at Sunpatch Parade from erosion – considered effective against a 100-year ARI storm event in the present day.
- For 2050, 2065 and 2100 planning periods, it is considered moderately effective (but reducing with time) in limiting impacts for private property.
- Act as an artificial reef and increase habitat.

Limitations:

- Would not prevent sea level rise associated recession, which is a key issue long terms at Tomakin Cove.
- Expensive to design, build and maintain.

- If the sandy spit to the rocky outcrop disappears, would not limit long-shore sediment transport and reduce effectiveness.

Figure 1 Tomakin Cove Offshore Breakwater Potential Location

Attachment 1:

CH1_V	Private land acquisition and restoration to public dune and beach

Location(s): Broulee

Coastal threat(s) to be addressed:

- CH Threat 1 Beach Erosion
- CH Threat 2 Shoreline Recession
- CD Threat 1 Coastal development resulting in loss of plant and animal species (habitat disturbance or loss)
- CD Threat 4 Coastal development encroaching onto natural coastal processes to exacerbate hazard impacts

CMP Assessment Outcome

This option is not recommended for inclusion in the CMP as there is no existing erosion risk to the subject properties and future erosion risk can be managed through implementation of development controls.

Costs:

- Capital costs for this option consists of an initial $4.8 million in capital costs to acquire the private properties and clear them to create public land.
- Maintenance costs for this option are $5,000 per year to maintain scrubland

Responsible agencies:

Eurobodalla Shire Council, supported by DPE and Crown Lands

Option Description:

Four properties seaward of Coronation Drive, Broulee will come under increasing risk from beach erosion and shoreline recession towards 2100.

This option assesses the merits of purchasing these properties and returning the land to public reserve. The viability of this option has to be weighed against the suitability of using development controls alone to manage the risk to property, assets and lives at this location.

Timing:

It has been assumed There is no existing erosion risk to the subject properties, however, properties from about 2075 are predicted to be at risk. If the dwellings on the properties were to be redeveloped, they could extend the life of the structure increasing likely future public expenditure costs for purchase and removal as well as potential amenity incursions in the interim. Therefore the economic analysis of this option assumes that the property purchase would occur within the next 10 years.

Cost Benefit Assessment

Costs: as above

Benefits:

This option derives benefits from anticipated creation of public coastal dune vegetation from the purchase of three lots from private owners. This isn't anticipated to create greater access to the beach for the public or substantial alter use values but does increase its non-use values for the creation of preservation of dune structures and scrubland ecosystems. This results in the following benefit realisation:

- **Created Amenity** is a benefit that is anticipated to occur from the transition of private land to public coastal dune vegetation area. This area is predicted to provide non-use value for local residents. The created amenity is estimated to \$5.83 per m^2 of scrubland.

There is no erosion risk to the properties within the 50 year economic analysis period, so benefits associated with hazard mitigation are not included.

The reduction in coastal erosion risk has not been included in the CBA as the benefits occur beyond the timeframe of the economic assessment.

Results:

The table below highlights that this option has a negative NPV and has a BCR well below 1 indicating that the option not economically feasible to implement. If opportunities to enhance the public utilisation of this area were identified, an improved economic feasibility may be realised.

BCR		NPV	
0.03		-\$3,841,417	
Benefit		**Costs**	
Amenity	\$137,221	**Capital Costs**	\$3,918,230
		Maintenance Costs	\$60,409

CH1_Y	**Sewage pump stations and reticulation infrastructure at risk to be include in future works plans**

Location(s): Long Beach, Malua Bay Beach and Broulee Beach

Coastal threat(s) to be addressed: Beach Erosion

Outcome of CMP Assessment

At-risk assets identified in this option assessment should be included in future works plans to incorporate management and/or protection measures when undertaking works (maintenance, upgrades, replacements, etc) on these assets. The CMP will include this reporting as an action.

Costs:

Monitoring only. Existing Council staff time and resources during the operational period of this CMP.

Option Description:

Council maintains a network of reticulation and sewer infrastructure, with a number of assets located along the coastline. The CMP identified which assets are at risk (both existing and future) of damage during erosion events. The identification of at-risk assets allows Council to incorporate management and/or protection measures when undertaking works (maintenance, upgrades, replacements, etc) on these assets.

CMP Assessment:

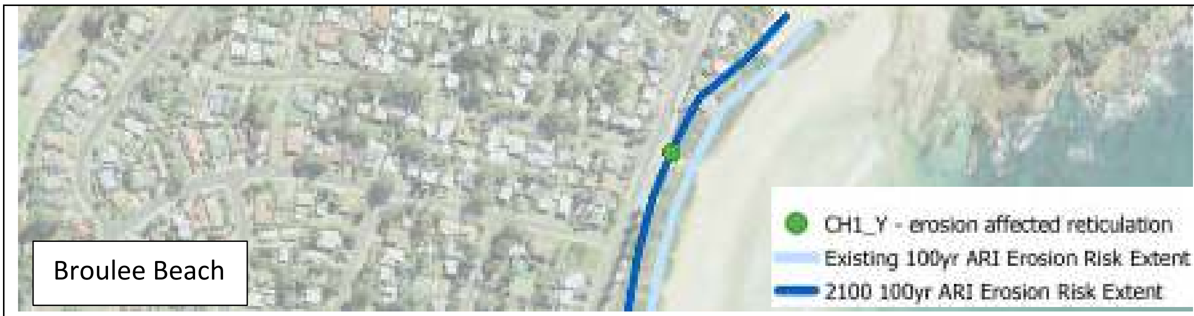
The Council data set for reticulation and sewer stations were overlaid on erosion risk zones for current and 2100 scenarios.

All sewer pump stations were found to be outside identified 2100 erosion hazard zones.

All reticulation assets were found to be outside the existing 1% AEP erosion risk zone. It should be noted however that some assets in Long Beach are only marginally outside this extent.

Reticulation assets become at risk to erosion damage in 2100 in Long Beach, Malua Bay Beach and Broulee Beach

The locations are shown below.



Effectiveness:

Early identification of reticulation assets that are expected to experience erosion risk in future years allows for proactive management measures to be implemented. The fact that no assets are currently at risk allows Council to incrementally address future risks for identified assets as required, to ensure that the network does not experience damage in large storm events.

Timing:

No structural works are required during the expected operational period of this CMP. However, it is recommended that Council review the assets expected to become at risk in future years, and to begin developing appropriate management strategies. This would allow management works to be undertaken when repair or replacements works are being undertaken on these assets in the future.

CH1_Z	Monitor stormwater assets in erosion areas

Location(s): Long Beach, Surfside, Malua Bay Beach, Tomakin Cove

Coastal threat(s) to be addressed: Beach Erosion.

Outcome of CMP Assessment

At-risk assets identified in this option assessment should be included in future works plans to incorporate management and/or protection measures when undertaking works (maintenance, upgrades, replacements, etc) on these assets. The CMP will include this reporting as an action.

Costs:

Existing Council staff and resources only.

No works required in next 10 years unless opportunity arises.

Responsible agencies: Eurobodalla Shire Council

Option Description:

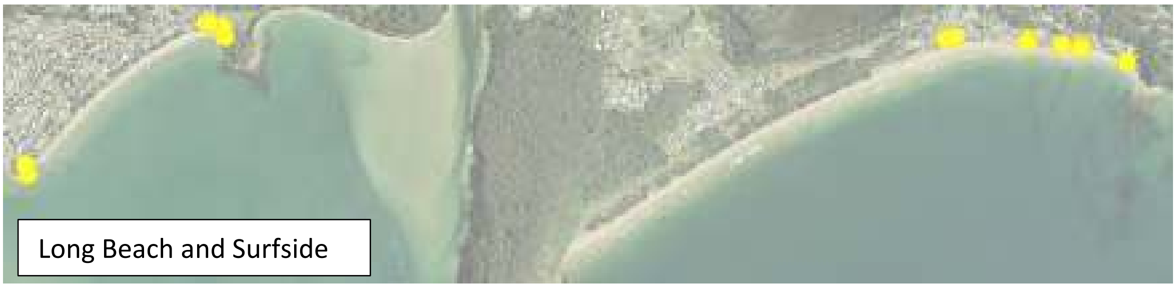
A number of locations have been assessed as at risk of erosion, under existing as well as future catchment conditions.

This option identifies stormwater assets currently within erosion risk zones, so that monitoring plans can be put in place to check the condition of these assets following large storm events.

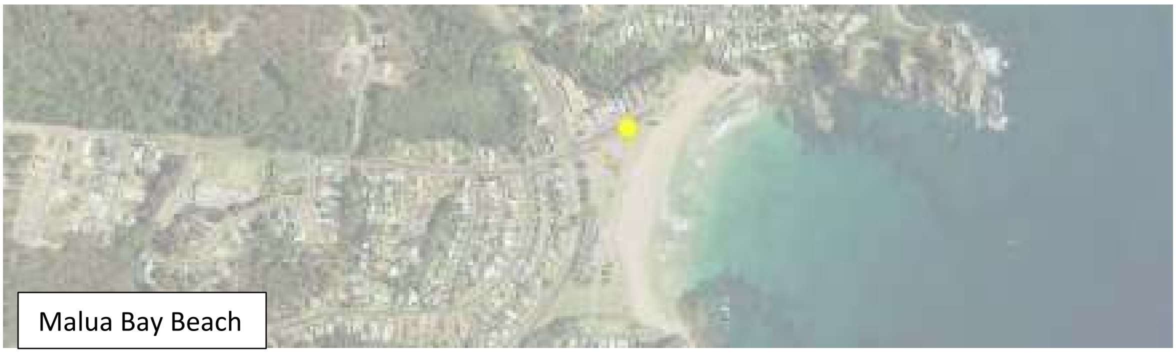
CMP Assessment:

Councils stormwater asset GIS data set was overlaid on the erosion hazard zones prepared as part of the Stage 2 works. Where assets were located within these zones, they were mapped for monitoring. The locations are shown in the figure below.

At risk assets were identified in Long Beach (9), Surfside (6), Malua Bay Beach (1), and Tomakin Cove (1).



Long Beach and Surfside



Malua Bay Beach

Effectiveness:

The implementation of a management plan for these assets would ensure that any damage to these assets is quickly noted and addressed following large storm events.

The plans could also be used to inform the future relocation and/or protection of these assets against beach erosion.

The plans would remain usable under future climate scenarios, and indeed would become more important as the frequency of significant events increases as a result of climate change.

Timing:

- The plans could be prepared and implemented as soon as resources permit.
- The plans would remain affective for the lifetime of each particular asset.

CH1_ZA	**Culvert Extension / Groyne and Beach Nourishment**

Location(s): Surfside West Beach (Dog Beach)

Coastal threat(s) to be addressed: Beach Erosion / Shoreline Recession

Outcome of CMP Assessment

The option is not recommended for inclusion in the CMP as the works result in:

- Likely increases in the frequency of Wharf Road overtopping from catchment flow.
- Minor increases in catchment flood levels upstream of Wharf Road.
- Significant alterations to the entrance of a Class 3 stream and Type 1 Fisheries habitat.
- Protrusion into a Habitat Protection Zone of Batemans Marine Park.

In addition, the protection of Wharf Road and the adjoining area from erosion can be achieved without the negative impacts above through the implementation of road and culvert protection works (option CH1_ZB) and a flood levee (option CH4_D). Beach amenity will also be protected through ongoing nourishment when sand is available from Clyde River navigation dredging operations (option CH1_L),

Costs:

The construction of the structure would be a single upfront capital cost with ongoing maintenance of the structure required. Maintenance would include that of both a coastal and drainage structure and nourishment as required.

Capital Cost: $3,600,000

Maintenance Costs: 2% of capital costs annually over life of structure

Design Life: 50 years

Option Description

Construct a culvert extension that would also function as a groyne structure to retain sand on Surfside West Beach (Dog Beach).

Surfside West Beach (Dog Beach) was identified as being a beach with high usage, however, is subject to large fluctuations in beach width as a result of the dynamic shoals between the Clyde River entrance and Pinnacle Point, as well as flood flows out of Surfside Creek that regularly reshape and erode the beach compartment.

To stabilise the beach compartment, a culvert extension has been assessed that would have a dual purpose of moving the Surfside Creek outlet away (offshore) of the beach face and also act as groyne to anchor the western end of Surfside West Beach (Dog Beach).

Figure 1 provides an indicative alignment of the structure, with an anticipated shoreline response. The structure would be approximately 90m long with its toe located below 0mAHD.

Figure 1. Indicative alignment of a culvert extension/groyne structure (black) at Macleod's beach with anticipated shoreline response (orange)

Surfside Creek drains to Batemans Bay via three culverts under Wharf Road, each with a diameter of 1.8m. The groyne structure would therefore need to accommodate the cross-sectional area of the culvert pipes through its trunk and provide adequate protection against damage from coastal storms (waves) and flood flows (from the Clyde River).

Figure 2 provides indicative cross sections along the groyne length and width and includes double armour stone layers across the structure slopes and crest, and a single armour layer around the toe to act as scour protection. The structure crest would be constructed at ~2.2mAHD, with a concrete path integrated to allow public access, tying in with the level of Wharf Road across the existing outlets, and allow suitable fall between the existing outlet inverts and the new outlet position. A flood gate could be added to the seaward end to reduce the ingress of elevated coastal water levels (subject to sediment dynamics at the outlet).

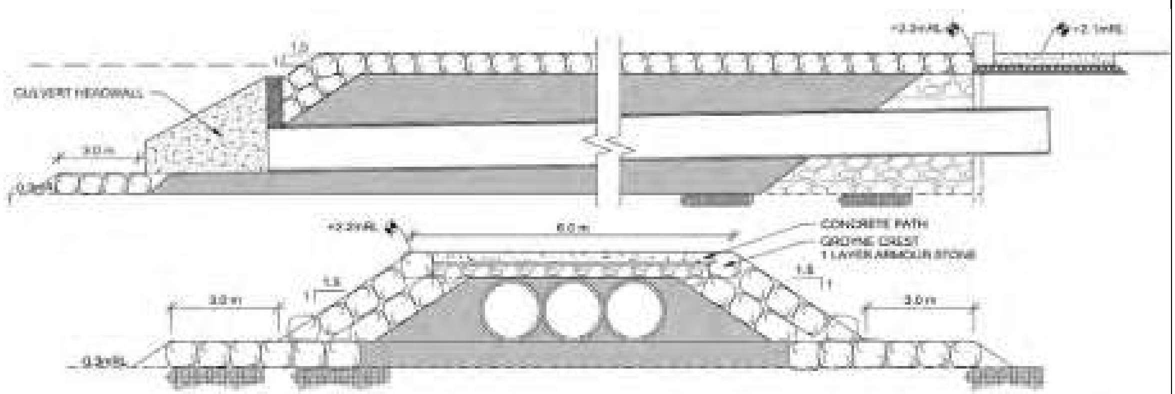


Figure 2. Indicative cross sections of a culvert extension/groyne structure at Macleod's beach

CMP Assessment

Structural design of the structure would include sizing of the armour stones on the side slopes and crest which would be sized to be stable under extreme coastal conditions and require 1-3t armour stones on the side slopes and 3-4t armour stones on the crest. Scour protection would consider wave action, but also peak flood flow velocities from the Clyde River, and require stones in range 750kg-1.5t. Detailed design and optimisation of the outlet structure (headstock), scour protection and foundation at the head would be required.

The capacity of the existing three culverts is estimated as 15 m^3/s of flow, which would be maintained under this groyne extension. This capacity is only achievable when water levels are below the culvert invert. As levels rise above the invert, the capacity of the culvert drops significantly. The capacity was assessed in the Batemans Bay Urban Creeks Flood Study (2021) as being sufficient for flood flows out of Surfside Creek up to the 5% AEP. In the 1% AEP the Flood Study found that flows broke out of the creek and flowed over Wharf Road immediately to the east of the culvert. As such, the groyne extension would be effective in diverting low magnitude flood flows away from Macleod's beach but would be overwhelmed under the 1% AEP flood. The invert level at the outlet would need to be raised and optimised based on coincident downstream (coastal) water level considerations.

The alignment and crest height would mean the structure acts as an effective trap for longshore sediments that travel in a westerly direction under ambient conditions. Further, it would afford the Macleod's beach compartment some protection from flood flows from the Clyde River by deflecting flows away from the shoreline. As such, a stable beach compartment width could be achieved between Pinnacle Point and the groyne structure. An assessment of the anticipated shoreline response to the presence of the groyne structure was completed using the parabolic beach shape equation (Evans and Hsu, 1989). The method estimates the expected static equilibrium shape of a beach between two controlling points and assumes a sandy beach with swell incident at the beach from a narrow directional band and where longshore sediment transport is largely driven by swell energy. The resulting anticipated shoreline alignment is presented in Figure 1.

The impacts to shorelines to the west of the structure are likely to be minimal as they consist of rocky outcrops with limited sub-aerial beach. The lack of notable beach width along Wharf Road is due to the oblique incident waves and resulting large longshore transport rates. The proposed structure would have limited and localised impacts to this incident waves along the length shoreline.

Preliminary flood modelling has been undertaken to assess the impacts of the proposed culvert extension. Modelling was undertaken for the 5% AEP and 1% AEP events. Results shown in **Figures 2 and 3**. For the full length culvert, minor upstream increases were observed in both AEP events. In the 1% AEP, the increases impacted properties between the creek and the eastern arm of Timbara Crescent.

Figure 2 - Flood Impacts 5% AEP

Figure 3 - Flood Impacts 1% AEP

Effectiveness:

The proposed structure has two principal objectives.

- *Diverting flows from Surfside Creek further offshore away from Macleod's shoreline*. The effectiveness of the structure to divert flood flows depends on the capacity of the culverts and the invert levels that can be achieved. In this regard the option is constrained by the existing creek outlet, particularly in terms of invert levels. Levels would need to optimised to ensure efficient drainage of creek flows and the interaction with tides and elevated coastal water level. As a result, the structure would be effective in diverting flood flows, but be ineffective when the coastal water levels are elevated (particularly beyond MHWS).
- *Trapping longshore transport to retain a stable beach compartment*. A structure in the order of 90m in length will provide an efficient trap for westerly longshore sediment. There may be a need for periodic nourishment of the beach compartment after severe coastal events, however the supply of westerly transport under ambient coastal driven conditions should be sufficient to maintain a full beach compartment and provide recovery of the beach volume after storm induced erosion.
- Sea level rise will reduce the effectiveness of the structure as an outlet for Surfside Creek, with increased sea levels reducing the effectiveness of the outflow. However, with a crest level above +2mAHD the structure will continue to act as an effective groyne.

Incorporation of a tidal gate could also be considered in the future and incorporated in current headstock design.

Benefit

The proposed structure would act to stabilise the Macleod's beach compartment, providing the following benefits:

- Increased protection against coastal storm induced erosion by maintaining a stable and wide beach profile.
- Provide for improved beach amenity. Community consultation noted that the beach is a popular spot and frequently used by the local community, it being easily accessible from Wharf Road.

The groyne structure also has the potential negative impacts:

- Increased frequency of Wharf Road overtopping from catchment flow.
- Increases in catchment flood levels upstream of Wharf Road.
- Significant alterations to the entrance of a Class 3 stream and Type 1 Fisheries habitat.
- Protrusion into a Habitat Protection Zone of Batemans Marine Park.

Timing: Medium priority works

Cost Benefit Assessment

Costs: as above

Benefits:

This option derives benefits from anticipated creation of over 4,000m^2 of beach from the entrapment of westerly longshore sediment by the 90m groyne. Due to this beach's popularity amongst local residents this beach extension is anticipated to create greater use value for the beach. As a result the following benefit is anticipated to be realised after the completion of works:

- **Created Amenity** is a benefit that is anticipated to occur from the build-up of sand along the Surfside bay area. This area is predicted to provide use value for local residents, with greater access to sheltered dog and family friendly beach. The created amenity is estimated to increase the use factor of the beach by 5%. This is valued at $29.75 per m^2 per year for the created beach area.

The build-up of sand is also likely to provide future erosion protection to the properties located at McClouds Beach. However, the erosion risk to these properties occurs beyond the timeframe of the economic assessment.

Results:

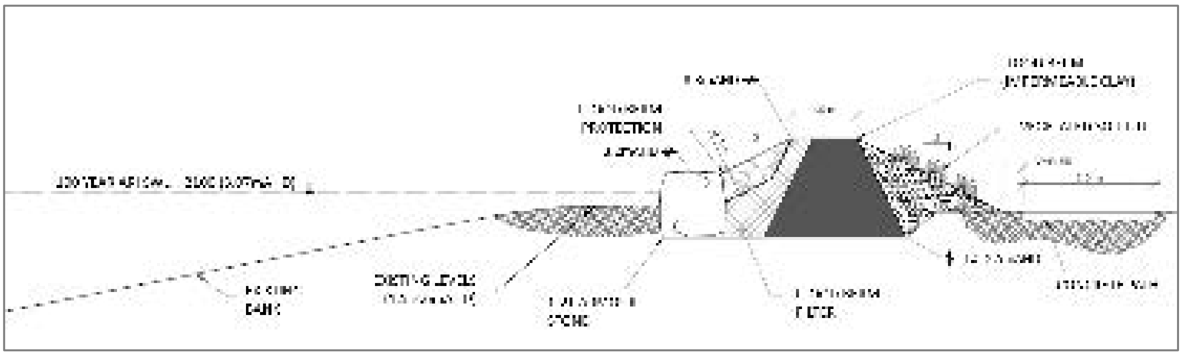
The table below highlights that this option has a positive NPV and has a BCR of 1.36 indicating that the option economically feasible to implement at this point in time.

BCR		NPV	
1.03		$132,414	
Benefit		**Costs**	
Amenity	$3,940,978	**Capital Costs**	$2,938,672
		Maintenance Costs	$869,891

CH4_D	Surfside Coastal Inundation Levee
Location(s): Surfside	
CMP Assessment Outcome Stage 1 of this option is recommended for inclusion in the CMP. The works are recommended to be undertaken over two phases.	
Coastal threat(s) to be addressed: Coastal Inundation	
Costs: In total, 1200m of Coastal Inundation Levee is required to protect Surfside from flooding to the 2100 100-year ARI coastal flood level. The costs of each stage to progressively construct and raise Coastal Inundation Levee are: • Investigation and Design (costs included in Stage 1 below) • Stage 1: 300m of levee with crest level of +2.5mAHD. Capital cost: $3,100,000 • Stage 2: Raise Stage 1 levee to crest level of +2.8mAHD and construct further 630m of levee to same level. Dune management to ensure the dune crest level is at or above 2.8mAHD. Capital Cost: $5,300,000 • Stage 3: Raise Stage 1 and 2 levee to crest level of +3.3mAHD and undertake dune management to ensure dune crest height is also at 3.3mAHD. This stage has not been costed as part of the CMP assessment; it falls outside of the cost benefit analysis time period. Maintenance Costs: 1% of capital costs per annum over life of structure	
Option Description: The urban regions of the Surfside subcatchment adjacent to the bay are low lying and at risk of inundation in coastal storm events. Development is currently affected in the 20-year ARI coastal storm event, and affectation and associated risks increases in the future due to sea level rise exacerbating flood levels. The option would see the staged construction of a Coastal Inundation Levee to protect the low-lying residential precinct adjacent to the bay. The levee is proposed to be constructed in stages, as illustrated below. The first stage would see a levee constructed along the western boundary of the precinct in order to protect the region from inundation in a 100-year ARI ocean storm. This stage could be undertaken in two phases, the first being the 150m closest to the foreshore, and the second phase, which involves integration with Wharf Road undertaken as part of the Floodplain Risk Management Plan for Surfside to optimise the design for dual benefits associated with catchment flood protection. By 2065, to ensure this protection remains despite raising sea levels, the levee height would be increased, its length extended along the western boundary, and a second levee on the eastern boundary added to protect against flooding from Cullendulla. Minor dune stabilisation works would also be required along isolated regions to infill existing low points along the dune to the proposed levee level. By 2100, when sea levels are projected to be higher again, the full length of both eastern and western levees will require further raising, and additional works will be required along the full length of the bay-side dune to build it up to the levee level.	

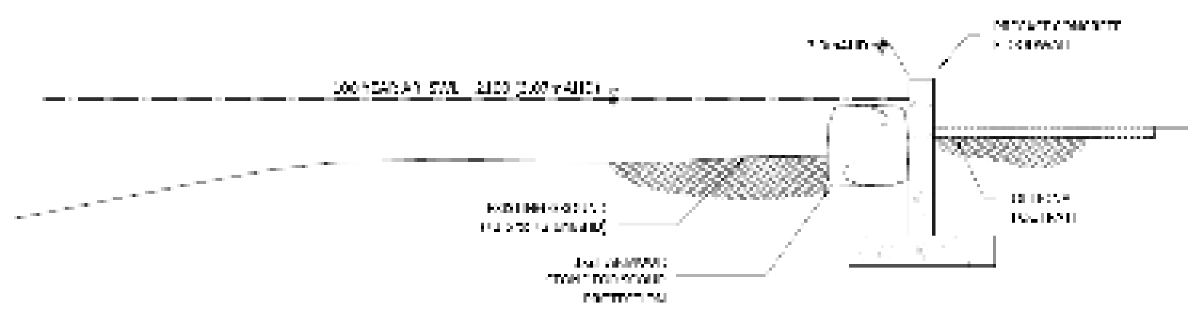
Whilst the option has been developed in response to ocean flooding, it will also protect the region from catchment driven flood events.

A concept design for a Coastal Inundation Levee is presented in the cross-section figure below. The levee effectively consists of an impermeable core with armouring on the flood prone side and a vegetated slope on the protected side.



The horizontal footprint of the Coastal Inundation Levee will be dependent on crest level targeted and existing ground level. Existing ground levels along the first stage of levee vary between 1.5 and 2mAHD, such that a Coastal Inundation Levee with height of 0.5-1m and width (at the base) of 3 to 5m would be required to achieve a crest level of +2.5mAHD. Increasing the crest height to +3.3mAHD (above the 2100 100year ARI ocean flood level) would require a levee height of 1.3 to 1.8m with a width of up to 8m.

Where such a footprint is not feasible or desired an alternate structure type could be constructed, consisting of a vertical wall (precast concrete flood walls or SSP) to provide the same protection with reduced footprint. Such an option is schematised in the Figure below.



CMP Assessment:

A provisional flood damages assessment was undertaken for the 100-year ARI ocean flood depths. All properties were identified from the aerial and an indicative ground level sampled for each based on LiDAR data. As property survey was not available, it was assumed that all property floor levels were 0.3m above ground level.

Residential damage curves were generated based on the curves prepared by the Department of Natural Resources (now DPIE) in 2007. The curves estimate flood damages for standard residential properties based on the extent of over floor flooding. The damage curves are calculated based on an assumed floor area of 240m^2, and a warning time of 0-hours.

The over floor flooding depths in the 100-year ARI was determined based on the modelled flood level, the sampled ground level, and the assumed 0.3m floor height. The assessment was done for the existing, 2065, and 2100 100-year ARI flood events. The estimated damages for these events was:

- $2,525,000 in the existing scenario
- $14,910,000 in the 2065 scenario
- $33,950,000 in the 2100 scenario

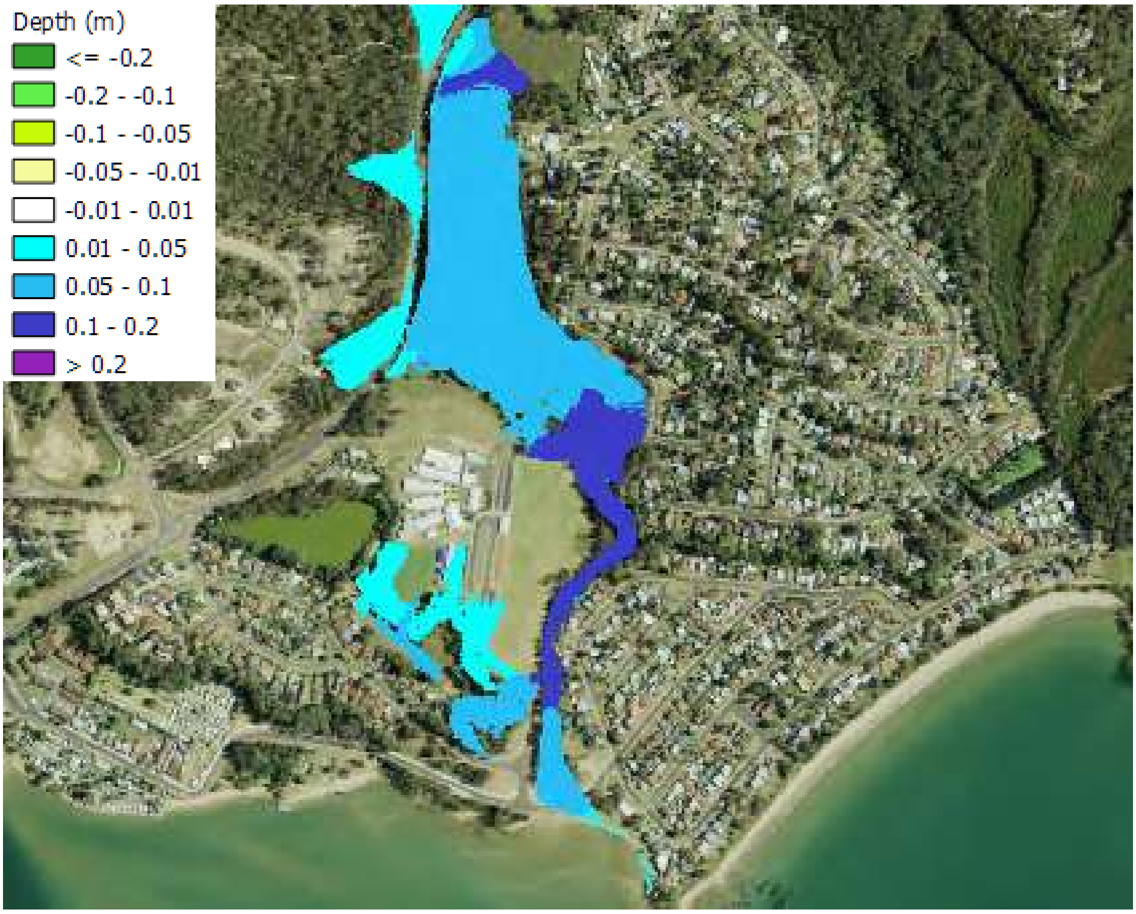
Higher damages in future events are due to sea level rise which increases both the extent of inundation and the flood depths experienced.

The levee was also assessed for the 1% AEP local catchment event to determine its impacts and effectiveness on catchment flood events.

The levee was found to protect the region from local catchment floods. However, the levee reduced the overbank conveyance in Surfside Creek resulting in peak flood level increases in the adjacent creek by up to 0.12m. Increases of up to 0.02m occurred upstream to the highway. Impacts were typically fully contained within the creek and vegetated back areas, save for some increases of up to 0.03m which affected Batemans Bay public school. Given the relatively small size of these impacts, it is expected that they could be resolved during detailed design by minor adjustments to the levee alignment.

It is noted that the levee passes through private property and would need the approval of these properties to proceed. It is also noted that it would need all property owners to accept the works and easements gained to be feasible. If property owners object, it may be possible to instead raise Timbarra Crescent, which would still provide benefits for the wider residential region.

The construction of the levee would also necessitate upgrades to the existing drainage network. As part of this option, the outlets would require flood gates to prevent surcharge from the pits when sea levels are elevated.



Effectiveness:

- The Coastal Inundation Levee will protect the residential precinct (and the associated infrastructure and Council assets) in events up to and including the 100-year ARI ocean storm.
- Whilst the option has been developed in response to ocean flooding, it will also protect the region from catchment driven flood events.
- The effectiveness of the option will be dependent on the ongoing monitoring and maintenance of the levee and dune works to ensure they remain higher than projected storm levels.
- Climate change will reduce the effectiveness of a given levee level. To address this, the works are proposed to be staged, to lift the height of the levee in line with projected increases in ocean flood levels.

Timing:

- The Stage 1 levee is recommended for construction when funds are available. It will offer an immediate benefit to currently flood affected properties.
- The proposed extents and levels of future stages should be re-assessed when this CMP is revised in the future, in light of the most recent advice of projected sea level rise.

Cost Benefit Assessment

Costs: as above

Benefits:

This option derives benefits from avoided costs that arise from the flooding and damages to residential properties within Surfside that were forecasted in the coastal inundation modelling. As a result of the proposed works the following benefit is anticipated:

- **Avoided Property Damages** is a benefit that arises from protection of residential properties from coastal inundation events. The damages are calculated based on damage curves from the DPE and include maintenance, replacement and relocation costings. This is translated into an Average Annual Damage reading which summaries the potential damages in any given year, based on the severity and like hood of the damages occurring.

Results:

The tables below highlights that this option in both scenarios has a positive NPV and has a BCR above 1 indicating that the option economically feasible to implement at this point in time.

Option 1:

BCR		NPV	
1.41		$2,102,035	
Benefit		**Costs**	
AAD	$7,219,966	**Capital Costs**	$3,619,786
		Maintenance Costs	$1,498,145

CH4_G	Installation of flood gates on priority outlets
Location(s): Surfside	
Coastal threat(s) to be addressed: Beach Erosion and Coastal Inundation	
Outcome of CMP Assessment This option is recommended for inclusion in the CMP.	
Costs: Capital cost: $35,000 (average of $5,000 per gate) Maintenance cost: Up to $3000 / Year	
Option Description: Low-lying areas of land, while protected by adjacent coastal protection structures or dunes, can experience inundation as a result of surcharge from the local pit network when adjacent bay / ocean levels are high. The option would see the installation of flood flaps on selected pipes to prevent this surcharge. The locations, and their respective priority (high / medium / low) are: • Wharf Rd, Surfside West (high) • Korners Park (low) • Clyde St, CBD (high) • Beach Rd, CBD (low) • Beach Road at Club Catalina (high) • Batemans Bay Marina Resort, Catalina (two outlets) (high) Sites noted as high priority have the potential to impact a significant number of existing properties or to impact major access routes. Medium priority sites impact either some properties or interfere with minor access routes. Low priority sites largely affect open space.	
CMP Assessment: An analysis was undertaken to determine what regions of the study area were lower-lying than the adjacent level along the water front. Of these regions, those connected to the stormwater system were identified. The assessment indicated that there were seven outlets connected to low-lying with the potential to be affected by surcharge in Surfside, Batemans Bay, and Corrigans Beach. The locations of the outlets and the potential extent of inundation are shown in Attachment 1.	
Effectiveness: All of the identified surcharge locations affect existing development including private dwellings, commercial premises and roadways. The installation of flood flaps would increase the flood immunity of these locations, so that flooding would only commence when the adjacent waterfront structure (whether sand dune or sea wall) overtops. As smaller events are more comment, it would also serve to reduce the frequency of inundation for these locations. The works become increasingly beneficial under future sea level rise scenarios, as the trigger levels for surcharge would be reached with increasing frequency under a higher sea level condition.	

Timing: • The works could be implemented as soon as possible and would provide an immediate benefit.
Benefits The flood gates would reduce nuisance inundation of low lying locations where high tides are able to back up the stormwater system. This does not result in quantifiable economic benefits. As such, no cost benefit analysis has been provided.

Attachment 1

CH4_K	Seawall Raising and wave return barriers
Location(s): Batemans Bay to Batehaven	
Coastal threat(s) to be addressed: Coastal Inundation	
Outcome of CMP Assessment Recommended for inclusion in the CMP due to inundation risk reduction for the CBD, including assets and property protection, maintaining emergency access routes, safety and risk to life. The option also aligns with existing Masterplan for the CBD.	

Costs:

In total, 1200m of seawall raising is proposed along the length of the CBD foreshore and south to Herarde Street.

Two options:

1. Raise seawall and install crest wall to meet risk requirements out to 2100 and integrate with urban design of adjacent shared pathway.
2. Raise seawall with no crest wall to meet risk requirements out to 2065, and retrofit a vertical crest wall in future (for example, 2050). Integrate seawall structure with urban design of adjacent shared pathway.

Option 1: raise seawall and construct crest wall (to address future risk to 2100)

- Capital Cost: $15,500,000
- Maintenance Costs: 1% of capital costs over life of structure

Option 2: raise seawall without crest wall initially (to address future risk to 2050) and retrofit crest wall:

- Capital Cost: $10,500,000
- Future Capital Cost (~2050): $6,000,000
- Maintenance Costs: 1% of capital costs over life of structure

Option Description:

Raise the existing seawall protecting the Batemans Bay foreshore, to reduce impact of wave overtopping in the short to medium term. The seawall will incorporate urban design features to align with the guiding principles established in the Batemans Bay Waterfront Masterplan & Activation Strategy (the Masterplan) adopted by Council in 2020.

CMP Assessment:

An assessment of coastal inundation hazard has identified that significant portions of the CBD seawall are subject to existing risks of wave overtopping. Under future climate scenarios, as sea levels rise, storm tide (still water) inundation and increased wave overtopping will be experienced.

Adaption to future climate risks has been identified in the Batemans Bay Waterfront Masterplan and Activation strategy and should incorporated into the implementation of the masterplan.

Under current mean sea levels, the existing risk of inundation is predominantly limited to wave overtopping as shown in Figure 1 for the 20-year ARI (infrequent) and 100-year ARI (extreme) event. For the medium term up to 2065, under sea level rise scenarios, the likelihood and extent of inundation only increases, with up to 95% of the seawall length inundated under a 100-year ARI event (see Figure 2).

Based on an analysis of the existing crest levels, the priority areas for seawall raising would be the 400m length of seawall between North Street and Beach Road, followed by the 250m length of seawall along Beach Road further south to provide immediate protection against infrequent coastal storm events (up to the 20-year ARI). However, by 2065 the vast majority of the seawall length is inundated under both the 20-year and 100-year ARI events.

A proposed seawall raising option has been designed that would leverage off the existing seawall as a foundation but increase the crest level to +3.0mAHD, above the 100-year ARI Storm Tide level in 2100. A typical section for the seawall raising design is presented in Figure 3, and includes construction of a 1-2m wide crest and 1 in 2 seawall slope that keys into the existing seawall armour layer. At the back of the crest of the raised seawall a concrete cut-off wall would reduce the permeability of structure and neatly tie the seawall into the promenade behind.

Figure 1 CBD Seawall Inundation for the 100year ARI still water level under present day sea levels. Left: 20year ARI. Right: 100year ARI (red = existing seawall crest submerged)

Figure 2 CBD Seawall Inundation for the 100year ARI still water level at 2065 (red = existing seawall crest submerged)

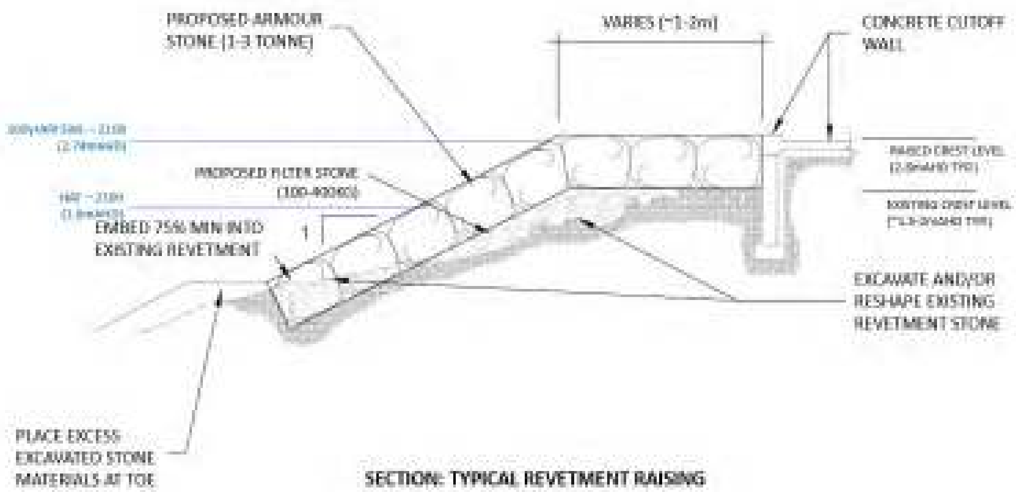


Figure 3 Typical cross section for raising of the CBD

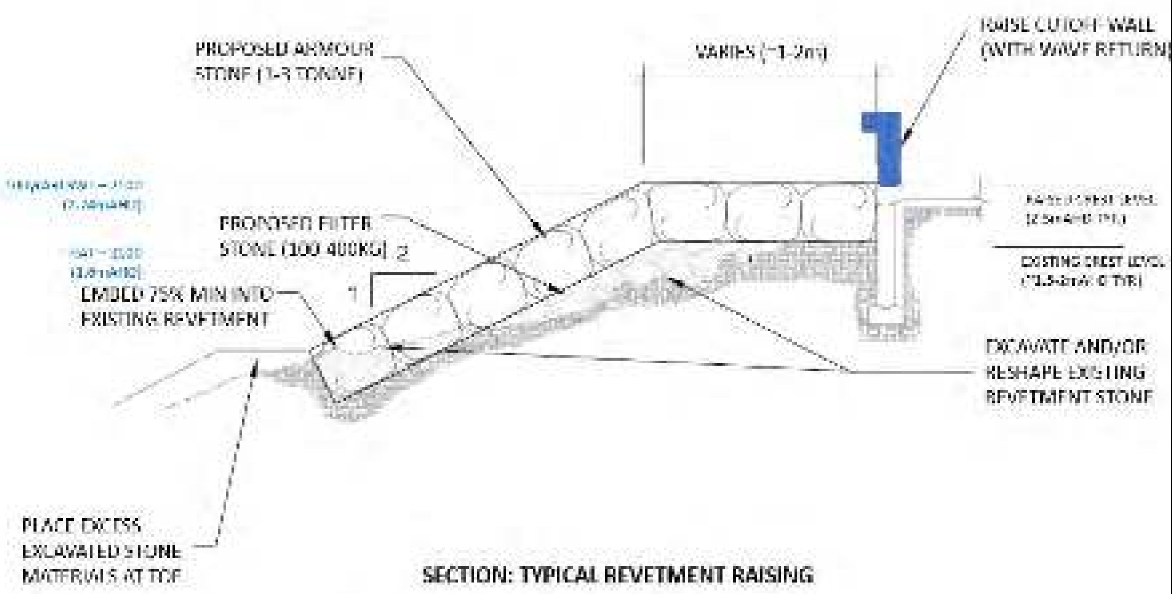
An assessment of wave runup and overtopping for the proposed raised seawall design along the CBD were performed using methods outlined in Eurotop (2018) to determine if the proposed seawall section (with crest at +3.0mAHD) would provide adequate protection against overtopping, both under present day and future sea level rise scenarios. The following table summarises the results, noting an average overtopping rate of less than 20 L/s/m is targeted to reduce the risk people at or near the seawall crest (based on a design wave height of 1m from Eurotop, 2018).

Mean Overtopping Rates (q) for the 100year ARI coastal storm under sea level rise scenarios

	Present	2050	2065	2100
q (L/s/m)	2	17	49	850

Initial analysis suggests that the proposed crest level and seawall design would be sufficient to ensure pedestrian safety up to the year 2050 (based on a 100-year ARI design storm). Beyond this, overtopping rates become hazardous for people near the crest and additional protection would be required to manage this future risk of wave overtopping.

A possible modification to the seawall design is presented in the Figure below and incorporates a vertical wall directly behind the structure crest (as an extension to the vertical cut-off wall). The vertical wall could include a wave return lip to further reduce an overtopping risk. Further overtopping calculations indicate a vertical wall of 0.5m in height (above the seawall crest) would reduce overtopping risk to within acceptable levels out to the year 2100.



Effectiveness:

- A correctly designed and constructed seawall will provide effective protection to both coastal flooding (from elevated storm tides) and foreshore hazard (from wave overtopping) along the length of the CBD and will ensure the safe use of Beach Road and foreshore promenade areas under a greater range of coastal conditions.
- A seawall designed for present day conditions will reduce in effectiveness as sea level rises under future scenarios, as the associated wave overtopping rate under extreme coastal storms will increase. As such the effective crest of the seawall will need to be raised into the future in line with this increasing risk. Should this be achieved then the seawall will be effective in protecting foreshore areas behind the crest.
- Seawall raising would not impact on the sediment dynamics of Batemans Bay, beyond the influence of the existing seawall, as all works would occur at elevations above the active channel bed and margins and would have negligible influence on tidal and flood hydrodynamics along the length of the seawall. As such, no detrimental impacts to shorelines on the northern side of the Bay area expected from raising of the seawall.

Benefits:

- Reduced inundation and flooding to the wider CBD area. The seawall raising would need to be considered along with Clyde River flood levels (to the west of the CBD) that were not considered as part of the CMP.
- Impacts to public and private infrastructure and amenity along the CBD foreshore and reduced hazard to people using these areas.
- Raising of the foreshore is already proposed as part of the Batemans Bay Waterfront Masterplan and Activation strategy. Raising of the seawall and protection of the CBD and foreshore areas must also incorporate place-making and urban design principles as identified in the Masterplan.

Timing:

- Option for staging of works to target areas at higher risk.
- Initial 400m length of seawall between North Street and Beach Road, followed by the 250m length of seawall along Beach Road further south would provide immediate protection against infrequent coastal storm events (up to the 20year ARI). Raising the remainder of seawall would provide coastal flood protection up to the 100year ARI event out to 2100.
- Without a crest wall, wave overtopping risk of the foreshore is minimised up to the year 2050 (for a 100-year ARI condition).
- Future retrofitting of a crest wall with wave return barrier would provide adequate protection from wave overtopping to the 2100 (for a 100-year ARI condition) and could be installed around the 2050.
- An initial design life of 50 years is considered reasonable for a coastal structure of this nature. With regular maintenance and future enhancement a 100-year design life could be achieved.

Cost Benefit Assessment

Costs: As above

Benefits:

This option derives benefits from avoided costs that arise from the flooding and damages to commercial and residential properties within the Batemans Bay CBD that was forecasted in the coastal inundation modelling. As a result of the proposed works the following benefit is anticipated:

- **Avoided Property Damages** is a benefit that arises from protection of residential and commercial properties from coastal inundation events. The damages are calculated based on damage curves from the DPE and include maintenance, replacement and relocation costings. This is translated into an Average Annual Damage reading which summaries the potential damages in any given year, based on the severity and like hood of the damages occurring.

Results:

The table below highlights that this option in both scenarios has a positive NPV and has a BCR well above 1 indicating that the option economically feasible to implement at this point in time.

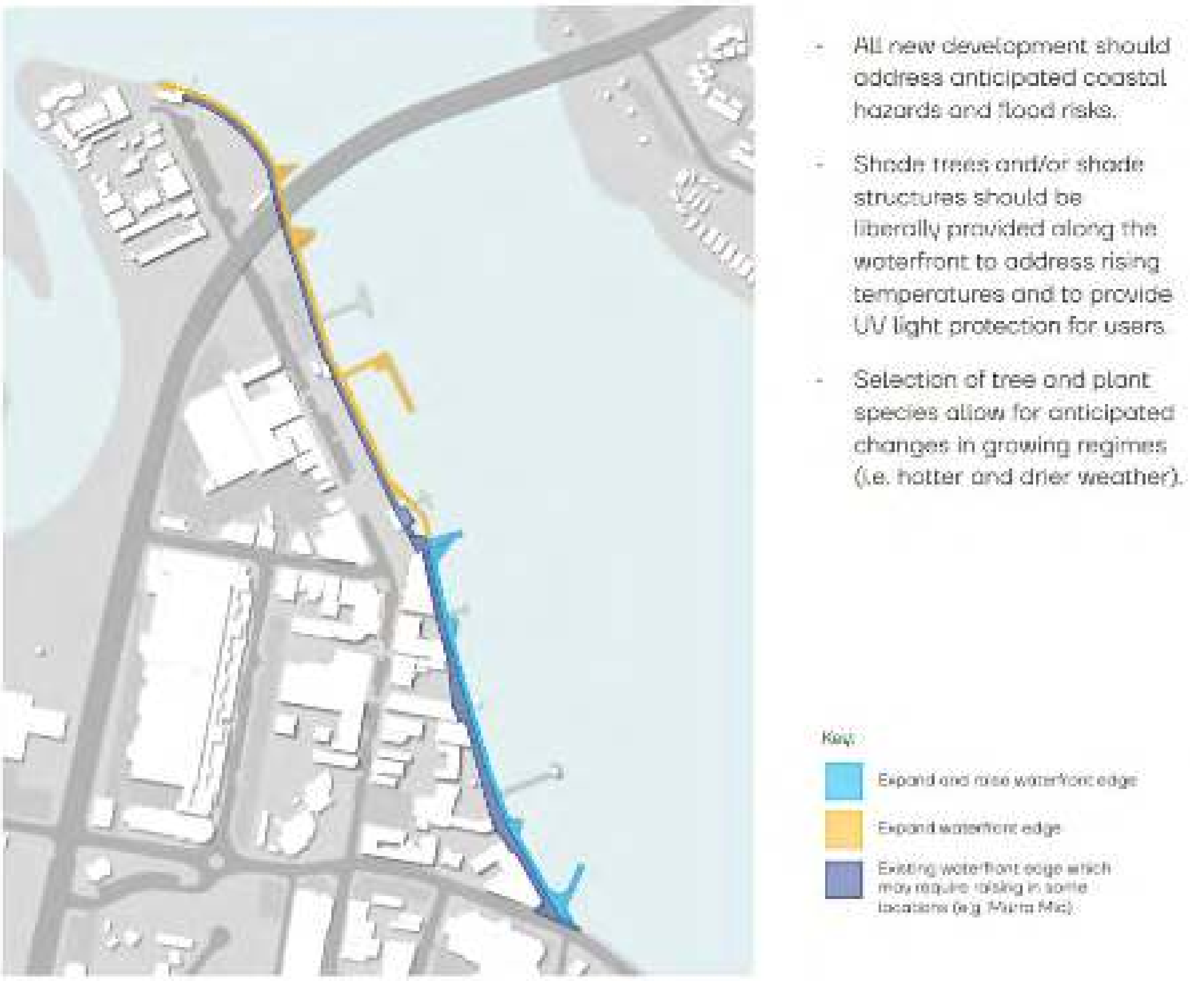
Option 1 (CH4_Ka)

BCR		NPV	
3.27		$32,935,194	
Benefit		**Costs**	
AAD	$47,460,493	**Capital Costs**	$12,652,617
		Maintenance Costs	$1,872,682

Option 2 (CH4_Kb)

BCR		NPV	
4.02		$35,666,376	
Benefit		**Costs**	
AAD	$47,460,493	**Capital Costs**	$9,800,617
		Maintenance Costs	$1,993,500

From Batemans Bay Waterfront Masterplan and Activation strategy



CH4_M	Adaptation plan for low lying areas to be impacted by tidal inundation
Location(s): Batemans Bay	
Coastal threat(s) to be addressed: • CH Threat 3 Coastal Inundation • CH Threat 4 Tidal Inundation	
Outcome of CMP Assessment Adaptation planning will be undertaken as part of the CMP for low lying areas in Batemans Bay that have existing exposure to large ocean storms and will increasingly be at risk under sea level rise. Adaptation planning will look to identify suitable approaches to continue to viability of this land. The planning will investigate a combination of rezoning land, landform adaptation through filling and raising of assets and roads, and property development controls.	
Costs The action for inclusion in the CMP is the preparation of an adaptation plan and associated flood modelling, civil design and community engagement. This has been estimated at a cost of $200,000.	
Option Description: There are low lying areas in Batemans Bay that have existing exposure to large ocean storms and will increasingly be at risk under sea level rise. The coastal vulnerability modelling undertaken in Stage 2 of the CMP identified locations in Batemans that will be inundated several times a year by 2100 (i.e. these areas are below the 2100 HHWS tidal level). Shown in blue hatching on the map below. The modelling also identified that even greater areas will be impacted on average annually by inundation from ocean storm events. Shown in pink hatching on the map below. This frequency of inundation is an unacceptable level of risk, and would likely result in these areas being uninhabitable not only due to regular inundation, but sub-ground level impacts on structural foundations, underground assets etc. Adaptation planning should commence immediately for these areas to identify suitable approaches to continue to viability of this land. This may involve a combination of rezoning land, landform adaptation through filling and raising of assets and roads, and property development controls. Detailed assessments are required to ensure the effectiveness of the strategy, including consideration of: • Access to imported fill, • Design to tie into existing surrounding levels, • Access to existing properties (e.g. driveways), • Land acquisition, • Management of inter-lot drainage, • Existing manhole levels/depths, • Electricity clearance heights, • Drainage improvements for local rainfall events, • Sequence of works and timeframe for overall scheme, • Determine acceptable cumulative impacts on flood behaviour as scheme is implemented, • Multi stakeholder involvement.	

Timing

The timing for adaptation planning will be dependent on identifying the "Thresholds" and "Triggers" for continued liveability of the low lying areas of Batemans Bay. These would be established as part of the adaptation planning. However, for the purpose of CMP planning, it can be seen that frequent inundation of the low lying areas of Batemans Bay will likely occur by 2065. This may be considered the threshold where these locations begin to lose their liveability. The trigger point for this threshold requires analysis of the timeline between when the threshold is reached and when a response is required to avoid losing liveability of the area. This analysis would include consideration of a monitoring period, response time, and a safety buffer for uncertainty.

In order to adequately plan, prepare and implement adaptation, the planning should commence as soon as possible. The preparation of an adaptation plan at a concept stage has been included in this CMP and could be completed jointly as part of the floodplain risk management study and plan for this location depending on timing. If the concept stage plan identifies the need for more detailed planning, this would then proceed. This could also include implementing actions from the flood risk management study and plan ensuring joint outcomes for dealing with coastal inundation hazards identified through this CMP.

CH4_T	Offshore Reef
Location(s): Caseys Beach	
Coastal threat(s) to be addressed: Coastal Inundation	
Outcome of CMP Assessment This option is not recommended for inclusion in the CMP as the option: • Would not protect from north-easterly swells or wind-waves. • Would not effectively mitigate future coastal inundation under sea level rise. • High-cost relative to the degree of protection and mitigation of coastal inundation and wave runup. Overall, this option is not recommended to proceed, due to the high cost and degree of risk management it would provide	
Costs: Whilst not costed up in this stage of the Coastal Management Plan, this option is expected to be relatively expensive for the level of protection it would provide, based on other offshore breakwater costs of similar dimensions and the depths involved.	
Option Description: Artificial reef located offshore Caseys Beach (Figure 1) aimed at increasing wave dissipation, thereby decreasing wave runup and inundation of the road and bridge. This would allow increased access and reduced road damage during coastal storm events.	
CMP Assessment: • The Stage 2 Coastal Hazards Assessment, in conjunction with WRL (2017), identified that Caseys Beach had significant coastal inundation risk, in particular at Beach Road running the length of the beach and at the bridge towards the south of the beach. These areas are highly impacted from coastal inundation and wave runup, even at the 2017 100-year ARI level (**Figure 1**). • An offshore reef would dissipate wave energy coming from the south-east, which is the dominant wave direction at this site, and therefore reduce the wave runup level, resulting in reduced coastal hazard risk to the road and bridge. The approximate potential location of this reef is indicated in **Figure 1**, and designed to protect the beach from large south-easterly and southerly swells.	
Effectiveness: • Would minimise wave impacts on the existing seawall along Beach Road and reduce associated wave runup. • Would not protect from north-easterly swells or wind-waves. • Would not effectively mitigate future coastal inundation under sea level rise.	

Figure 1 Caseys Beach (as part of wider Sunshine Bay) coastal inundation and wave runup for 2017 to 2100 planning period at 100-year ARI. Red circle indicates approximate position of a proposed wave dissipation breakwater

Appendix F

Option Detailed Costs

Working Note

Baird.

Project Number :	13142.401	**Date :**	4-Sep-22
Staff Member :	SJG		
Title :	Eurobodalla CMP - Engineering Options Costings Development		
Summary / Description :	Summary of Costings for Engineering Concept Management Options		
File Reference :	C:\Rhelm Dropbox\J1400-J1499\J1412 - Eurobodalla CMP\4. Reports\Stages 3 and 4_CMP\CMP Appendices\Appendix F_Option Costs\[13142.401.W.SJG.Rev2_EngineeringOptions_Costings.xlsx]Baird-WorkingNotes		

Task

Develop concept level engineering design and cost estimates for proposed management options

Inputs / Methods

Costings are based on industry knowledge and reference cases from Caseys Beach seawall and IAG Actions of the Sea study.
See summary of Caseys Seawall on tab "Benchmark", which has been escalated based on recent market conditions including contractor availability, labour rates and material costs.
Input received from independent cost estimator.

Assumptions / Constraints / Clarifications

Conceptual level engineering detail only, focussed on dimension of structure required (length, crest height etc.). Cost estimates based on Order of Magintude unit rates (e.g. $/length of structure type) and considered +/-50% accurate (Class 5). Relativity of structure types/costs considered representative.

Calculations

Site / Structure	Unit Cost (Capital)	Length / Size	Captial Cost	Class 5 Capital Cost Range low	high	Notes
CH1_P Batehaven/Caseys Protection Works						
Rubble Mound	$12,500 /m length	525 m in length	$6,562,500	$3,281,250	$9,843,750	< from 2019 costing escalated to 2022
Rubble Mound w crest wall	$15,000 /m length	525 m in length	$7,875,000	$3,937,500	$11,812,500	< delta to seawall raising based on onsite casted concrete crest wall
Retrofit crest wall	$6,500 /m length	525 m in length	$3,412,500	$1,706,250	$5,118,750	< accounts for remobilisation
CH4_K CBD Inundation Protection						
Seawall Raising no crest wall	$8,500 /m length	1200 m in length	$10,200,000	$5,100,000	$15,300,000	< scaled from MTO relative to Caseys Seawall
Seawall Raising with crest wall	$12,500 /m length	1200 m in length	$15,000,000	$7,500,000	$22,500,000	< delta to seawall raising based on onsite casted concrete crest wall
Retrofit crest wall	$5,000 /m length	1200 m in length	$6,000,000	$3,000,000	$9,000,000	< accounts for remobilisation
CH1_D Long Beach Protection Works						
Rubble Mount Revetment - Stage 1	$12,500 /m length	200 m in length	$2,500,000	$1,250,000	$3,750,000	
Rubble Mount Revetment - Stage 2	$12,500 /m length	280 m in length	$3,500,000	$1,750,000	$5,250,000	
CH4_D Sursfide Flood Levee						
Sursfide Flood Berm	$7,500 /m length	320 m total	$2,400,000	$1,200,000	$3,600,000	< Stage 1 (2017) imunity. MTO of concept cross sections and unit rates for earthworks/landscaping
Surfside Flood Wall	$8,500 /m length	300 m total	$2,550,000	$1,275,000	$3,825,000	< benchmarked on NSW installs of vertical structures
CH1_ZA Surfside West Groyne						
Groyne / Culvert Extension	$40,000 /m length	90 m in length	$3,600,000	$1,800,000	$5,400,000	< scaled from MTO relative to Caseys Seawall, culvert units and marine construction
CH1_B Northcove Drive, Maloneys Protection						
Retaining structure and wave return wall	$10,500 /m length	250 m in length	$2,625,000	$1,312,500	$3,937,500	< benchmarked on NSW installs of vertical structures, plus wave crest wall
CH1_K Wharf Road Protection						
Wharf Road Stage 1	$21,000 /m length	100 m in length	$2,100,000	$1,050,000	$3,150,000	< scaled from MTO relative to Caseys Seawall plus inclusion of cutoff wall and road shoulder works
Wharf Road Stage 2	$8,500 /m length	440 m in length	$3,740,000	$1,870,000	$5,610,000	< benchmarked on NSW installs of vertical structures
Maintenance	**Maintenance Rate**					
Rubble Mound	1.0%					< assumes 2 x maintenance events (25% of capital cost) over 50year design life of

Working Note

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Innovation Engineered.

Project Number :	13142.401	**Date :**	4-Sep-22
Staff Member :	SJG		
Title :	Eurobodalla CMP - Engineering Options Costings Development		
Summary / Description :	Summary of Costings for Engineering Concept Management Options		
File Reference :	C:\Dropbox (Rhelm)\J1400-J1499\J1412 - Eurobodalla CMP\4. Reports\Stages 3 and 4_CMP\CMP Appendices\Appendix F_Option Costs\[13142.401.W.SJG.Rev2_EngineeringOptions_Costings.xlsx]Baird-WorkingNotes		

Task

Estimate escalation in capital cost estimate of the Caseys Seawall to 2022, based on inflation and current market conditions (contractor availability, labour rates and material costs).

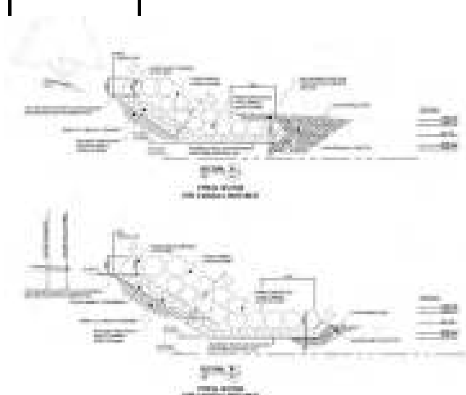
Inputs / Methods

Design for Caseys Seawall was developed by Aurecon in 2019.
Design sections and cost estimate breakdown below (from 505471-000-LET-LA-0001A.pdf, dated 24/09/2019).
525m of seawall for a total capital cost of $5.3M = ~$10k/metre of seawall

Calculations

Table 1 Estimated seawall construction costs

Description	Unit	Quantity	Rate (AUD)	Cost (AUD)	Escalation Est.	
Preliminaries				**$1,333,147.80**	$ 1,466,463	10% increase in preliminaries/mobilisation (CPI between 2019 and 2022)
Preliminaries	%	1	10%	$266,629.56		
Traffic management	%	1	15%	$399,944.34		
Erosion and sediment control	%	1	5%	$133,314.78		
Mobilisation and demobilisation	%	1	20%	$533,259.12		
Contractor overheads and indirects				**$746,562.77**	$ 1,045,188	40% increase in overheads/indirects (market conditions)
Contractor overheads and indirects	%	1	20%	$746,562.77		
Contractor risk pricing and margins				**$559,922.08**	$ 783,891	40% increase in risk pricing and margins (market conditions, inflation outlook)
Contractor risk pricing and margins	%	1	15%	$559,922.08		
Earthworks				**$2,660,795.61**	$ 3,192,955	
Removal of existing seawall and disposal off site of armour rock	tonnes	1179	35	$41,020.02		
Clearing and grubbing	m2	8645	1	$8,645.06		
Stripping of topsoil	m3	865	16	$13,832.09		
Excavation, all materials	m2	7440	20	$148,852.09		
Supply and placement of gravel/sand fill on upper slope	m3	120	17	$2,044.76		
Supply and installation of Geofabrics Texcel 600R nonwoven staple fibre geotextile OAE	m2	7702	20	$154,043.84		
Replaced beach sand	m3	692	17	$11,760.18		
Supply and installation of secondary armour rock, 170 kg	tonnes	2547	105	$278,605.34		
Supply and installation of primary armour rock, 1.7 tonne	tonnes	5220	105	$550,507.12		
Supply and installation of secondary armour rock, 250 kg	tonnes	4110	105	$433,460.36		
Supply and installation of primary armour rock, 2.5 tonne	tonnes	7578	105	$799,138.91		
Supply and installation of crest armour rock, 2.5 tonne	tonnes	420	105	$44,291.29		
Supply and installation of crest armour rock, 4.0 tonne	tonnes	1656	105	$174,594.57		
Road furniture				**$5,500.00**	$ 6,050	10% increase in road furniture (CPI between 2019 and 2022)
Supply and erection of regulatory, warning, hazard, direction and information signs	lump sum	10	550	$5,500.00		
TOTAL COST				**$5,305,928.28**	$ 6,494,546	22%
					$ 12,370.56	per m cost



Appendix G

Draft Coastal Hazard Code

DRAFT CODE

Code name	Coastal Hazard Code
Responsible manager(s)	Director, Planning and Sustainability Services
Contact officer(s)	Coastal and Flood Management Planner
Directorate	Planning and Sustainability Services
Approval date	*[To be Inserted]*
Amended	
Community Strategic Plan Objective	Objective 3: Our Community and Environment are in harmony
Delivery Program link	Natural Environment Planning
Operational Plan link	

Purpose

Eurobodalla Shire Council, as a coastal local government authority, needs to recognise and manage exposure of our Shire to coastal hazards and the potential impacts of climate change (including sea level rise). The challenge is to develop long term planning strategies that reduce our exposure to risk while recognising and maintaining the social, economic and environmental value of our builtand natural environments including our beaches.

Planning for coastal hazards requires long term management solutions. The current approach to managing the coastline in NSW is the development of comprehensive Coastal Management Programs that draw upon extensive consultation with the local community, Government agencies and experts in the field of identifying and managing coastal hazards. In this regard, Council, in partnership with the State Government, has prepared the Eurobodalla Open Coast Coastal Management Program (2022).

This Code has been prepared as an outcome of the Open Coast Coastal Management Program (2022). Reference is made herein to the hazard maps contained within the Open Coast Coastal Management Program (2022).

Council will also be preparing Coastal Management Programs for estuaries within the Local Government Area. This Code may need to be reviewed upon completion of these additional Coastal Management Programs.

This Code aims to:

- Facilitate economic and residential use of the coast and foreshore over the maximum period possible under conditions of sea level rise
- Provide a precautionary risk-based approach to managing the impacts of coastal hazards
- Provide strategic options for response to coastal hazards
- Promote appropriate development within Coastal Management Areas in accord with the *NSW Coastal Management Act 2016* and the State Environmental Planning Policy (Resilience and Hazards) 2021
- Apply coastal hazard planning guidelines for merit-based assessment of development applications.

Code criteria (relevant considerations for decision-making)

<table>
<tr><td>1</td><td>Application of this Code

This Code applies to the Eurobodalla Shire Council local government area, and all decisions by Eurobodalla Shire Council in relation to lands or relevant matters described in this Code.</td></tr>
<tr><td>2</td><td>Lands to which this Code applies

This Code will apply to lands within the coastal zone or areas identified by Council as potentially at risk from coastal hazards out to a maximum planning period ending at the 2100 coastal hazard projections identified in the Eurobodalla Open Coast Coastal Management Program (2022). The Coastal Vulnerability Area (CVA) is the relevant map in this regard.</td></tr>
<tr><td>3</td><td>Legislation

This Code will be applied with full consideration of the following New South WalesState legislation, Policies and Guidelines, including:

• Local Government Act 1993
• Environmental Planning & Assessment Act 1979
• Coastal Management Act 2016
• Marine Estate Management Act 2014
• Conveyancing Act 1919
• Crown Land Management Act 2016
• State Environmental Planning Policy (Resilience and Hazards) 2021
• NSW Flood Prone Land Policy 2022
• NSW Coastal Design Guidelines 2003 (or as updated)
• Coastal Management Manual 2018.</td></tr>
<tr><td>4</td><td>Coastal Vulnerability Area

Development proposed within the Coastal Vulnerability Area will be assessed against hazards associated with:

• Beach erosion
• Shoreline recession
• Coastal inundation
• Tidal inundation.

Note, the following hazards are not subject to this code:

• Coastal lake or watercourse entrance instability
• Erosion and inundation of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters
• Coastal cliff or slope instability.

Mapping of the coastal vulnerability area is available in the Eurobodalla Open Coast Coastal Management Program (Stage 2 Report 2021).</td></tr>
</table>

5 Procedures for development within coastal areas

It is recommended a proponent of development in the coastal vulnerability area identifies the relevant coastal hazards affecting the property prior to commencing the drafting of plans to accompany any development application.

Mapping identifying the extent of the immediate, 2050, 2065 and 2100 coastal hazards is available for most areas in the *Eurobodalla Open Coast Coastal Management Program (2022).*

Proponents of development within the coastal vulnerability area can take advantage of Council's pre-lodgement services to identify matters for consideration prior to preparing their application.

The basic steps for development procedures within the coastal area are:

- Identify relevant coastal hazard (i.e. erosion or inundation)
- If necessary, investigate appropriate solutions to manage potential risk from coastal hazards (see Section 9 below)
- Adopt preferred solution.

Note: After lodgement of a development application, some solutions may require consideration and general terms of approval by other authorities prior to proceeding tothe final stage of development assessment by Council.

6 Planning levels for coastal inundation

Coastal planning levels will vary throughout the Shire according to the location of a property in relation to the coast or tidal area. All properties will need to account for coastal inundation in the 100 Year ARI design event plus a freeboard (see below) and an allowance for sea level rise, when determining planning levels.

Council can assist by providing a planning level for areas where available information can inform the application of appropriate development controls (i.e. those locations within the CVA). These areas are identified under Schedule 1 attached to this Code. Indicative 2100 planning levels are provided for these locations, however, planning levels specific to the development location and type should be obtained from Council.

For areas not listed under Schedule 1, a proponent may be required to prepare a study that considers the impacts of inundation.

All coastal planning levels will include an additional freeboard above the projected inundation level. The following freeboard will apply:

- 500mm residential use
- 300mm other types of use.

Freeboard is an additional allowance above the projected coastal inundation level that adds a factor of safety to account for unknowns.

Wave run up affects some locations in excess of the coastal inundation level, this should either be accounted for within the planning level, or appropriate wave mitigation be

	implemented to protect the proposed development (e.g. wave return barriers). Notwithstanding the provision of a coastal planning level, it will be the responsibility of the proponent to demonstrate a suitable design response for those areas identified as at risk from coastal hazards.
7	**Application of this Code** Implementing this Code will ensure Council considers and incorporates coastal hazards and the projected effects of climate change (such as sea level rise) into: • assessment and management of coastal hazards • assessing and determining development applications • determining location and design life of essential assets and infrastructure • land use planning strategies to minimise the risk of coastal hazards on new and existing developments • planning and design of mitigation works to manage coastal hazards • management of natural assets such as coastal and estuarine habitats, lake entrances, beaches and dunes.
8	**Options for Development in Coastal Vulnerability Areas** There are a range of potential approaches to development that will reduce, manage or eliminate the risk from coastal hazards. Options can generally be summarised into three categories: 1. Avoidance 2. Mitigation. Avoidance is the preferred option, but it is limited to sites where hazard free areas are available on the subject lot. Application of this option would require placing development outside areas at risk (both existing and projected future risk) from coastal hazards. Mitigation includes a range of design, built or engineered responses such as resilient building design and/or engineered coastal protection works. Engineered works can also include other supplementary works such as sand nourishment. Mitigation can be used with partial avoidance where development is set as landward of the coast on the subject lot as possible.
90	**Mitigation - Engineered Coastal Protection Works** The owners of existing or proposed private developments identified as at risk fromcoastal hazards may seek to investigate engineered coastal protection works. Property owners investigating this option need to consider: • Any works on private lands will be subject to approval under the Environmental Planning & Assessment Act 1979

	• NSW Coastal Management Act 2016 • State Environmental Planning Policy (Resilience and Hazards) 2021 • Protection works must not be carried out or impact on public lands or public access without appropriate approval and permits • Engineered coastal protections works on private lands will be at the property owner's expense • Property owners must maintain the structure to an appropriate engineering standard for the life of the asset • Council will not accept any costs or responsibility for the construction, maintenance or renewal of private coastal protection works. Works to protect private property from coastal hazards and climate change will only be considered if the owner can demonstrate compliance with State policy and legislationand that the development will not adversely affect: • coastal processes and significant ecosystems • adjoining properties • the local built and natural environment • amenity and values of adjoining beaches and foreshores and • immediate and long-term public access to beaches and foreshores. If the works are found to adversely affect the adjoining beach or diminish public access to the beach, property owners must at their own expense maintain the beach through beach nourishment.
10	**Development Controls** i. General a. All building components set below the 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period) shall be constructed from inundation compatible materials b. All development must be designed and constructed so that it will have a low risk of damage and instability due to wave action (if applicable) and/or coastal inundation hazards. c. All development and/or activities must be designed and constructed so that they will not adversely impact on surrounding properties, coastal processes or the amenity of public foreshore lands. d. All uncontaminated dune sand excavated during construction operations shall be returned to the active beach zone as approved and as directed by Council. e. Wherever present, remnant foredune systems shall be appropriately rehabilitated and maintained for the life of the development to stabilise an adequate supply of sand (as determined by a coastal engineer) that is available to buffer erosion processes and/or minimise the likelihood of oceanic inundation.

	f. All vegetated dunes, whether existing or created as part of coastal protection measures shall be managed and maintained so as to protect the dune system from damage both during construction of the development and as a result of subsequent use during the life of the development. g. All electrical equipment, wiring, fuel lines or any other service pipes and connections must be waterproofed to the 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period). h. The storage of toxic or potentially polluting goods, materials or other products, which may be hazardous or pollute waters during property inundation, will not be permitted below the 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period). i. Where land is also subject to catchment flooding, the higher of the 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period) and Flood Planning Level shall apply. ii. Coastal Protection Works Hazard mitigation and coastal protection works that modify the coastal inundation within the development site, may be permitted subject to a Coastal Risk Management Report that demonstrates the following: a. The works do not have an adverse impact on any surrounding properties or coastal processes. b. A Section 88B notation under the Conveyancing Act 1919 is to be placed on the title describing the location and the type of mitigation works with a requirement for their retention and maintenance. c. Hazard mitigation works will result in the protection of the proposed development from coastal processes. d. Where coastal protection structures such as rock revetments or boulder seawalls already exist within the beach compartment, the position of such structures has been used to determine the location and alignment for any new terminal revetment or coastal protection works for the land on which development is proposed. e. In the case of an existing protection structure, a suitably qualified professional/s with appropriate expertise in the applicable areas of engineering has certified the structural integrity and competency of the works for their intended purpose and for the design storm event. iii. Coastal Erosion a. New development and major additions to existing development must be sited on the landward side of the 2100 100 Year ARI Coastal Erosion Line iv. All floor levels shall be at or above the 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period) v. Floor levels – additions a. The floor levels of the addition must be at or above the 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period). b. If the floor level of the existing dwelling is to be retained and is below the Coastline Planning Level, the existing dwelling must be satisfactorily inundation-proofed (either wet or dry) to the 100 Year ARI Coastal Inundation

Level (including sea level rise for appropriate planning period).
  c. The addition must be designed and constructed such that it does not preclude the raising of the existing structure to the 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period) at a future date or when further additions are proposed, e.g. through the provision of a construction joint.
  d. A second storey addition to the dwelling requires the floor level of the second storey to be at a height that allows for the internal ground floor of the existing dwelling to be either at or raised to the 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period) whilst maintaining minimum floor to ceiling height requirements.

vi. Floor levels – carparking facilities
  a. New enclosed garages: floor level shall be at or above the 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period) plus a freeboard.
  b. Covered basement (i.e. below natural ground level) or covered bunded carparking facilities must have all access, ventilation and any other potential water entry points above the 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period) and a clearly signposted inundation free pedestrian evacuation route from the basement or bunded area separate to the vehicular access ramps.
  c. Open carpark areas and carports (i.e. at least one side is open): permissible at the existing ground level.

vii. Land Subdivision
  a. Subdivision of land will not be permitted where new allotments that have a building entitlement will be created on the seaward side of the 2100 100 Year ARI Coastal Erosion Line.
  b. Subdivision of land will not be permitted where the building platforms of residential allotments will be created below the 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period).

viii. Variations
  a. Minor Additions to Existing Development: Additions to existing dwellings may be permitted between the Existing and 2100 100 Year ARI Coastal Erosion Line provided that the addition is not located forward of the existing dwelling, and that the combined additional GFA (Gross Floor Area) to the dwelling forward of the 2100 100 Year ARI Coastal Erosion Line does not exceed a maximum total area of 30m^2 effective from the date of adoption of this Code.
  b. Floor Levels - Carparking Facilities: New enclosed garages: consideration may be given to a floor level for carparking facilities at a lower level where it can be demonstrated that providing the floor level at the 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period) is not practical and that the enclosed garage is not a part of, or is detached from, the dwelling and is used for car parking only.
  c. Ancillary Structures: Relocatable or sacrificial, ancillary, non-habitable, detached, light weight structures associated with landscaping, storage or

	outdoor living areas may be permitted seaward of the 2100 100 Year ARI Coastal Erosion Line where their destruction by coastal processes is unlikely to exacerbate property damage during a storm event. d. Business, Light Industrial and Other Development (not applicable to residential component): Where constructing the floor level at the 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period) or raising the floor level of the existing development to the 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period) may be difficult to achieve due to site and access constraints, consideration may be given to all floor levels for additions being at the existing floor level. This is subject to demonstration, through a Coastal Risk Management Report, that in respect of the development type proposed the assessed risk is acceptable. The whole of the development below the 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period) must be satisfactorily flood proofed (either wet or dry) to the 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period).
11	**Coastal Risk Management Report** A Coastal Risk Management Report is to be submitted for all development on land that is affected by coastal processes and has floor levels and/or carparking levels below the nominated development criteria. This report is to be prepared by suitably qualified coastal engineering and structural engineering consultants and must consider and address the following: a) 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period) and other relevant information. b) 2100 100 Year ARI Coastal Erosion Line. c) Proposed floor levels (and existing floor levels where these are proposed to be retained) of habitable and non-habitable structures, and where basement or enclosed parking is proposed, include levels of access, ventilation and any other potential water entry points. d) Constraints due to coastline impacts on the land, including an assessment of the degree of inundation, hazard level, impacts of waterborne debris, buoyancy effects, evacuation and other emergency issues during the design storm event (2100 100 ARI event). e) Compliance with the Controls. f) Recommendations for the structural design and construction of the total development, including foundation design, protection measures and any existing structures to be retained (where existing structures to be retained include coastline protection structures, these must be certified as fit for purpose for the design storm event). g) Recommendations on the monitoring and maintenance of all coastal protection and hazard mitigation measures proposed for the total development (including any existing structures to be retained) for the life of the development (taken to be 100 years unless

	specified otherwise and justified). h) Recommendations on all measures and precautions to minimise risk to personal safety of occupants and the risk of property damage for the total development (including any existing structures to be retained) to address the impacts on the site for the design storm event (100 ARI event) for the life of the development (taken to be 100 years unless specified otherwise and justified). These precautions shall include but are not limited to the following: a. Types of materials to be used, up to the 100 Year ARI Coastal Inundation Level (including sea level rise for appropriate planning period) to ensure the structural integrity for immersion and impact. b. Waterproofing methods, including but not limited to electrical equipment, wiring, fuel lines or any other service pipes and connections. c. Warning signs/depth indicators for areas that may be inundated, such as open carparking areas. d. An evacuation strategy to minimise harm; a point of assembly within a place of low risk; and a suitable method of transporting people to a place of low risk away from the effects of coastline hazards. i) Specify architectural/engineering plans on which the assessment is based j) Specify date/s of inspection. k) Specify professional qualifications and experience of the authors.
12	**Areas of Critical Utility** The following areas will be assessed on merit due to protection from coastal erosionby current mitigation measures: • The areas of Beach Road, Batemans Bay identified in Map (1) and Clause 11 will apply to any development proposals provided Exemption under this Clause. Alternatively, a proponent may choose to accept the Flood Planning levels provided by Council (Schedule 1).
13	**Special Circumstances** Special consideration will be extended to development of infrastructure associatedwith Surf Life Saving and other recognised emergency service providers. Clause 11 will apply to any development proposals granted Special Circumstances consideration under this Clause.

Map (1): Areas of Critical Community Utility – Batemans Bay

Table 3: Related external references

Department / Author	Publication
Office of Environment and Heritage (now Department of Planning and Environment), 2018	*Coastal Management Manual*
Department of Infrastructure, Planning & Natural Resources, 2005	*NSW Floodplain Development Manual – the management of flood liable land*. ISBN 0 7347 5476 0.
Rhelm, 2022 (on behalf of ESC)	*Eurobodalla Open Coast Coastal Management Program*
Rhelm, 2021 (on behalf of ESC)	*Eurobodalla Open Coast Coastal Management Program – Stage 2 Coastal Hazards Report*
Whitehead & Associates, 2014 (on behalf of ESC)	*South Coast Regional Sea Level Rise Policy and Planning Framework. Report prepared for Eurobodalla Shire and Shoalhaven City Councils, Final, October.*
ACT Geotechnical Engineers Pty Ltd, 2012 (on behalf of ESC)	*Geotechnical Slope Instability Risk Assessment.*

Table 4: Definitions

Word/Term	Definition
100 Year ARI Coastal Inundation Level	Water levels selected for planning purposes as determined for the coastline based on the 100 year ARI elevated water level due to astronomical tide, storm surge (barometric setup and open coast wind setup), local wind setup, sea level rise, wave setup, plus a freeboard, generally 500mm unless specified otherwise and justified.
100 Year ARI Coastal Erosion Line	The extent to which a beach may erode as a result of a design storm event, taking into consideration the following factors: • any shoreline recession due to sediment loss • shoreline recession due to sea level rise over the designated planning period • beach erosion due to design storm demand • slope adjustment.
Average Recurrence Interval (ARI)	The long-term average number of years between the occurrence of a storm event as big as, or larger than, the design storm event. For the purposes of this Code a 100 year ARI event has been adopted and 50 year and 100 year planning periods have been selected. In relation to risk during the life of a development, there is a 39% probability of experiencing a 100 year ARI storm event, or larger event, in a 50 year planning period and a 63% probability of occurrence in a 100 year planning period.
Coastal Hazard	Coastal hazards are defined in the CM Act 2018 as: • Beach erosion • Shoreline recession • Coastal lake or watercourse entrance instability • Coastal inundation • Coastal cliff or slope instability • Tidal inundation • Erosion and inundation or foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters.
Coastal Engineer	A specialist engineer who is a registered professional engineer with chartered professional status (CP Eng) and with coastal engineering as a core competency and has an appropriate level of professional indemnity insurance.
Coastal Processes	Coastal processes are the set of mechanisms that operate at the land-water interface. These processes incorporate sediment transport and are governed by factors such as tide, wave and wind energy.
Flood Proofing – DRY	Protecting a building by sealing its exterior walls to prevent inundation.
Flood Proofing – WET	A combination of measures incorporated in the design, construction and alteration of individual buildings, structures and surrounds, to mitigate potential damages due to inundation.

Freeboard	The factor of safety usually expressed as a height above the design water level. Freeboard tends to compensate for some uncertainty in estimating the components that make up the design water level.
Minor Development and/or Alterations	This includes minor internal alterations and may include minor additions, with a value of less than $20,000 or as determined by Council from time to time. There can only be one minor development and/or alteration to a property in any five year period for consideration under this category.
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.

Internal use

Responsible officer		Director, Planning & Sustainability Services		Approved by	Council
Min no		Report no		Effective date	
File No		Review date		Pages	

Schedule (1) –2100 100 Year ARI Coastal Inundation and Maximum Wave Run-up Levels

Area	2100 100 Year ARI Coastal Inundation Level (m AHD)	2100 100 Year ARI Maximum Wave Run-up Level (mAHD)
Durras Beach (south)	3.67	5.9
Cookies Beach	3.05	6
Maloneys Beach	2.84	7.4
Long Beach	2.85	5.6
Cullendulla Beach	2.86	4.7
Surfside	3.06	5.4
Wharf Road	2.61	5.9
Central Business District	2.85	5.7
Beach Road	2.93	7.4
Corrigans Beach	2.94	6.1
Joes Creek	2.94	6.1
Caseys Beach	2.47	7.0
Malua Bay	3.64	6.6
Guerilla Bay	3.24	6.7
Barlings Beach	2.83	5.7
Broulee	2.91	4.9

Notes:

- Coastal Planning Levels will be comprised of the inundation level at the subject property, consideration of wave run up (if in the wave affected zone), and a freeboard of 0.5m.
- Coastal Planning Levels will vary within each location and may need to also apply additional consideration for exposure to wave run-up
- Proponents will need to contact Council for the relevant coastal planning level

Rhelm
engineering | environmental | economics | engagement

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Innovation Engineered.

Appendix H

Coastal Zone Emergency Action Subplan

Eurobodalla Open Coast Coastal Zone Emergency Action Subplan

Final

Eurobodalla Shire Council | Final | December 2022

Contact Information

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Document Control

Rev	Effective Date	Description of Revision	Prepared by:	Reviewed by:
00	22 March 2022	Draft	Sarah Parton Sean Garber	Emma Maratea
01	June 2022	Revised draft incorporating ESC and DPE comments	Sarah Parton Sean Garber Courtney Smith	Emma Maratea
02	July 2022	Erosion trigger distances added and reissued to client	Sarah Parton	Emma Maratea
03	August 2022	Updated draft	Emma Maratea	Sean Garber
04	September 2022	Updated draft	Emma Maratea	
05	September 2022	Draft for Public Exhibition	Emma Maratea	
06	December 2022	Final for Council Adoption	Emma Maratea	
07	December 2022	Final for Certification by Minister (Adopted by Council 13 December 2022)	Emma Maratea	

Prepared For: Eurobodalla Shire Council

Project Name: Eurobodalla Open Coast Coastal Zone Emergency Action Subplan

Rhelm Reference: J1412

Document Location: C:\Dropbox (Rhelm)\J1400-J1499\J1412 - Eurobodalla CMP\4. Reports\Stages 3 and 4_CMP\RR_04_1412_07_CZEAS_Eurobodalla Open Coast.docx

Acknowledgements

Acknowledgement of Traditional Owners

Eurobodalla Shire Council recognises Aboriginal people as the original inhabitants and custodians of all land and water in the Eurobodalla and respects their enduring cultural and spiritual connection to it.

Acknowledgment of Financial Assistance

Eurobodalla Shire Council has prepared this document with financial assistance from the NSW Government through its Coastal and Estuary Grants Program. This document does not necessarily represent the opinions of the NSW Government or the NSW Department of Planning and Environment (DPE).

Table of Contents

Tables

Figures

Appendices

Acronyms and Abbreviations

AHD	Australian Height Datum
Bureau	Bureau of Meteorology
CM Act	NSW *Coastal Management Act 2016*
CMP	Coastal Management Program
CZEAS	Coastal Zone Emergency Action Subplan
CZMP	Coastal Zone Management Plan
DPE	NSW Department of Planning and Environment
DPIE	Former NSW Department of Planning, Industry and Environment
EMPLAN	Emergency Management Plan
ESC	Eurobodalla Shire Council
km^2	Square kilometres
LEOCON	Local Emergency Operations Controller
LEMC	Local Emergency Management Committee
LEMO	Local Emergency Management Officer
m^2	Square metres
m^3	Cubic metres
m/s	Metres per second
m^3/s	Cubic metres per second
MSL	Mean Sea Level
NSW	New South Wales
NSW SES	NSW State Emergency Service
OEH	Former NSW Office of Environment and Heritage
REOCON	Regional Emergency Operations Controller
SEOCON	State Emergency Operations Controller
SEPP	State Environmental Planning Policy
SERM Act	NSW *State Emergency and Rescue Management Act 1989*
WRL	Water Research Laboratory

Glossary*

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.
Asset	Something of value and may be environmental, economic, social, recreational or a piece of built infrastructure.
Australian Height Datum (AHD)	A common national surface level datum approximately corresponding to mean sea level.
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.
Beach erosion	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.
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
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. Signs of cliff instability include (DPIE, 2019): • Open cracks, or steps, along contours • Ground water seepage, or springs • Bulging in the lower part of the slope • Trees leaning down slope, or with exposed roots • Debris/fallen rocks at the foot of a cliff • Tilted power poles, or fences • Cracked or distorted structures.
Climate change	A process that 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.
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 hazard	Coastal hazards, as defined by the CM Act, include: • 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 processes	Coastal processes are the set of mechanisms that operate at the land-water interface. These processes incorporate sediment transport and are governed by factors such as tide, wave and wind energy.
Coastal protection works	In accordance with the CM Act and Resilience and Hazards SEPP: *(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.*
Coastal vulnerability area (CVA)	Defined in the CM Act as land subject to the seven coastal hazards included in the CM Act.
Coastal zone	The coastal zone, as defined by the CM Act, means the area of land comprised of the following coastal management areas: (a) the coastal wetlands and littoral rainforests area, (b) the coastal vulnerability area, (c) the coastal environment area, (d) the coastal use area.
Emergency coastal protection works	In accordance with the Resilience and Hazards SEPP: *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.*
Estuary	The CM Act defines an estuary 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.

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’.
Flood	A general and temporary condition of partial or complete inundation of normally dry land areas, including inundation as a result of sea/ocean storms and other coastal processes or catchment flows.
Geographical information system (GIS)	A system of software and procedures designed to support the management, manipulation, analysis and display of spatially referenced data.
High Tide	The maximum height reached by a rising tide. The high water is due to the periodic tidal forces and the effects of meteorological, hydrologic, and/or oceanographic conditions.
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.
Mean Sea Level (MSL)	MSL is a measure of the average height of the sea or ocean's surface such as the halfway point between the mean high tide and the mean low tide. At present, mean sea level is approximately equivalent to 0 mAHD (reported as 0.03 mAHD in MHL, 2019).
Probability	A statistical measure of the expected frequency or occurrence of flooding.
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.
Risk	The chance of something happening that will have an impact on objectives, usually measured in terms of a combination of the consequences of an event and likelihood of occurrence.

Sea level rise	A rise in the level of the sea surface that has occurred or is projected to occur in the future, as measured from a point in time. The rise can be reported as a global mean or as measured at a specific point or estimated for a specific part of the sea or ocean.
Severe Weather Warning	According to the NSW State Strom Plan (NSW SES, 2018a) the BoM specifies the following thresholds when issuing warnings of 'severe' storms: • Rainfall of sufficient intensity to cause flash flooding (generally 10% Annual Exceedance Probability or less) • Waves equal to or exceeding 5m height in the surf zone • Sea level higher than 50cm above the Highest Astronomical Tide (Abnormally High Tide and Storm Surge). According to the BoM website (BoM, 2022), Severe Weather Warnings are issued for: • *Sustained winds of gale force (63 km/h) or more* • *Wind gusts of 90 km/h or more (100 km/h or more in Tasmania)* • *Very heavy rain that may lead to flash flooding* • *Abnormally high tides (or storm tides) expected to exceed highest astronomical tide* • *Unusually large surf waves expected to cause dangerous conditions on the coast* • *Widespread blizzards in Alpine areas.*
Shoreline	The intersection between the sea and the land. The line delineating the shoreline is often approximated as the Mean High Water Mark, however, the definition can vary depending on the application.
Storm bite (escarpment)	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.
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.

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. For planning controls, it is defined as the land that is inundated up to the level of Highest Astronomical Tide (HAT).
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 especially important during storm events as it results in further increases in water level above the tide and surge levels.
Wind waves	Waves resulting from the action of the wind on the surface of the water.

*Many of the glossary terms here are derived or adapted from the *Coastal Management Glossary* within the Coastal Management Manual (OEH, 2018).

1 Introduction

This Coastal Zone Emergency Action Subplan (CZEAS) forms a part of the Eurobodalla Open Coast Coastal Management Program (CMP) (Rhelm, 2022b). This CZEAS applies to the open coast locations at risk within the Eurobodalla Shire Local Government Area (LGA), as listed in **Section 3**.

1.1 Purpose

As specified in the *Coastal Management Act 2016* (the CM Act), a CZEAS is a plan that outlines the roles and responsibilities of all public authorities (including the local council) in response to coastal emergency events 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.

Eurobodalla Shire Council (Council) with the assistance of NSW Department of Planning and Environment (DPE) have prepared this CZEAS to detail arrangements for the four emergency phases (prevention, preparation, response and recovery) to manage coastal emergency events relating to beach erosion, cliff instability and coastal inundation. Those roles and responsibilities include the carrying out of coastal protection works and emergency coastal protection works for the protection of property and assets affected or likely to be affected by coastal emergency events.

This CZEAS has been prepared in accordance with the mandatory requirements for CZEAS specified in the CM Act and accompanying NSW Coastal Management Manual (OEH, 2018), specifically the *Guideline for preparing a coastal zone emergency action subplan* (DPIE, 2019), referred to herein as the Guideline.

In accordance with the Guideline (DPIE, 2019), the purpose of this CZEAS is to identify and facilitate the implementation of appropriate emergency response actions in order to:

- Protect human life and public safety
- Minimise damage to property and assets
- Minimise impacts on social environmental and economic values
- Not create additional hazards or risk.

1.2 Scope

The CM Act requires that a CZEAS be included in the CMP if Council's LGA 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.

The extent of the CVA is shown in the *Eurobodalla LGA Open Coast CMP* (Rhelm, 2022b) and takes into account the full range of coastal hazards identified in the CM Act, as discussed in detail in the CMP.

The Eurobodalla Shire open coast is subject to the coastal hazards of beach erosion, coastal inundation and cliff instability, as well as shoreline recession and tidal inundation, which have all been addressed in the CMP (Rhelm, 2022b). At the time of preparing this document, the CVA for the Eurobodalla Shire LGA was yet to go through the planning proposal process to be included in the *State Environmental Planning Policy (Resilience and Hazards) 2021* (Resilience and Hazards SEPP). The planning proposal will be undertaken as an outcome of the CMP (Rhelm, 2022b).

Other coastal hazards identified in 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 this CZEAS (DPIE, 2019).

The NSW State Emergency Service (NSW SES) is the designated combat agency for management of floods, tsunami and storms, including severe storms which cause coastal erosion. The NSW SES prepares the State Storm Plan, State Flood Plan and State Tsunami Plan, which are subplans to the NSW State Emergency Management Plan (EMPLAN). The Emergency Operations Controller has responsibility for operations where no specific combat agency is nominated (DPIE, 2019).

A CZEAS within a CMP must not include matters dealt with in any plan made under the *State Emergency and Rescue Management Act 1989* (SERM Act) (DPIE, 2019). This CZEAS is consistent with plans prepared under the SERM Act including the state, regional and local EMPLANs and subplans, as shown in **Figure 1-1**.

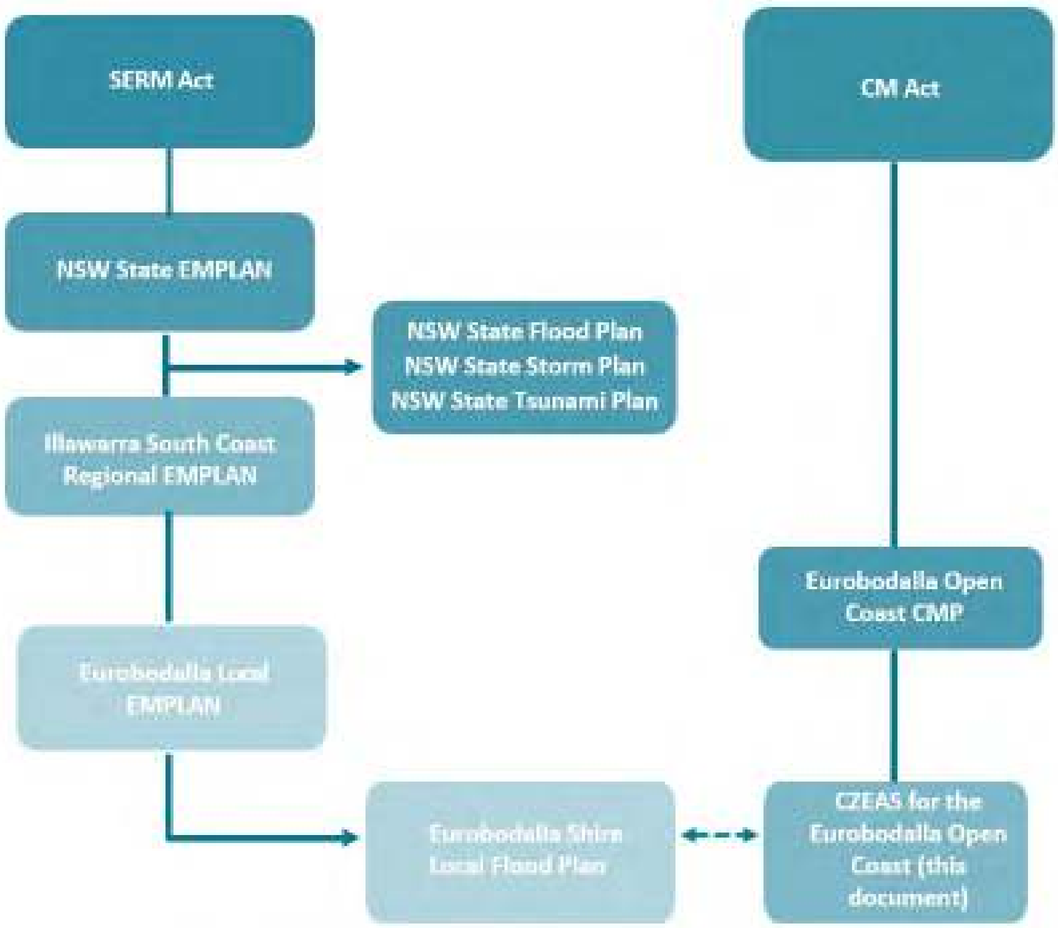

Figure 1-1 Legislative framework for emergency management in NSW and its relationship with coastal management legislation (adapted from DPIE, 2019)

Coastal erosion caused by storm activity is within the scope of the NSW State Storm Plan (NSW SES, 2018a). Emergency management of all forms of coastal erosion that is within the scope of this plan.

Flooding is within the scope of the NSW State Flood Plan (NSW SES, 2021) and the Eurobodalla Shire Local Flood Plan (NSW SES, 2013), which defines flood as a 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 (including tsunami) overtopping coastline defences.

1.3 Objectives

As required by the Guideline (DPIE, 2019) this CZEAS:

- Defines a coastal emergency and triggers for emergency response actions (**Section 2**)
- Identifies the locations that may be affected by beach erosion, coastal inundation or cliff instability that would constitute a coastal emergency (**Section 3**)
- Outlines the roles and responsibilities of all public authorities, including Council, and coordinates their response to emergencies immediately preceding or during periods of beach erosion, coastal inundation and cliff instability (**Section 4**)
- Outlines what actions are to be undertaken in the four phases of emergency management (**Section 5**)
- Identifies the locations and types of works that may be undertaken for the protection of property and assets (**Section 5**)
- Informs 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 (**Section 7**).

The four phases of emergency management are shown in **Figure 1-2.**

Figure 1-2 Emergency response in the coastal management context (from DPIE, 2019)

1.4 Consultation

Agencies other than Council involved in the implementation of this CZEAS, such as NSW DPE, NSW SES, and approval agencies were provided a copy of the draft CZEAS for review and comment. This CZEAS addresses feedback received.

2 Coastal Emergency Event Triggers

This section defines a coastal emergency and triggers for emergency response actions.

For the purposes of this CZEAS a coastal emergency event within the Eurobodalla Shire LGA is occurring when one or more of the below triggers occurs:

- When a public authority advises of a significant weather event that could impact any of the locations at risk identified in **Section 3**i.e the Bureau has issued a Severe Weather Warning (SWW) for potentially hazardous or dangerous weather that covers the Eurobodalla coastline (e.g. from Eden to Port Kembla).
- Storm bite is occurring or expected to occur at key locations at risk of beach erosion identified in **Section 3.1**, impacting or with potential to impact on public or private assets and/or affect safe access/egress
- Wave run-up is occurring or expected to occur at the key locations at risk of coastal inundation identified in **Section 3.2**, affecting/with potential to affect safe access/egress or impacting/with potential to impact on public or private assets
- Signs of cliff instability (refer below) are occurring or expected to occur at key locations at risk of cliff instability identified in **Section 3.3**.

In identifying triggers for erosion protection works (sand container placement and beach scraping), a balance needed to be found between predicted storm bite in large events, and avoiding the triggers being reached too often, resulting in “false alarms” and implementation of erosion protection works unnecessarily often.

All definitions relevant to the triggers are in the Glossary, however key definitions are repeated below for ease of reference:

- Severe Weather Warning: The BoM provides Severe Weather Warnings for potentially hazardous or dangerous weather, as follows (BoM, 2022):
    - Sustained winds of gale force (63 km/h) or more
    - Wind gusts of 90 km/h or more
    - Very heavy rain that may lead to flash flooding
    - Abnormally high tides (or storm tides) expected to exceed highest astronomical tide
    - Unusually large surf waves expected to cause dangerous conditions on the coast
- Storm bite: The landward limit of erosion in the dune system caused by storm waves. At the end of a storm the escarpment (storm bite) may be nearly vertical and as it dries out the sand slumps to a typical slope of one vertical to 1.5 horizontal
- 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
- 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. Signs of cliff instability include (DPIE, 2019):
    - Open cracks, or steps, along contours

- Ground water seepage, or springs
- Bulging in the lower part of the slope
- Trees leaning down slope, or with exposed roots
- Debris/fallen rocks at the foot of a cliff
- Tilted power poles, or fences
- Cracked or distorted structures.

Once a coastal emergency event is triggered, Council will activate this CZEAS and follow the actions detailed in the Response Phase of the Emergency Response Action Plan (**Section 5**).

3 Locations at Risk

This section identifies the locations that may be affected by beach erosion, coastal inundation or cliff instability that would constitute a coastal emergency event.

This Plan only applies to the known locations affected by beach erosion, coastal inundation or cliff instability as noted in this section. As per 5.15 this also includes high potential Aboriginal cultural heritage sites. It is possible that beach erosion, coastal inundation or cliff instability will affect additional locations not currently assessed or known to be risk locations anywhere along the Eurobodalla open coast. In this event Council should assess these locations and revise this Plan to include new locations at risk, as the need arises.

3.1 Beach Erosion

The *Eurobodalla Shire Coastal Hazards Scoping Study* (SMEC, 2010), *Eurobodalla Coastal Hazard Assessment* (WRL, 2017) as well as the revised deterministic beach erosion mapping undertaken for the CMP Stage 2 Vulnerability Assessments (Rhelm, 2022a) have informed the locations discussed below.

The CMP identifies 11 open coast locations within the Eurobodalla LGA at risk of beach erosion, which are listed in Table 3-1. Maps showing these locations are contained in the CMP Stage 2 Vulnerability Assessments (Rhelm, 2022a).

Table 3-1 Locations at Risk of Beach Erosion

Location	Description
Maloneys Beach	Erosion at current sea levels could significantly impact the beach and dunes and may impact the foundational stability of Northcove Road and associated culverts. Under future seal level rise, the erosion risk to Northcove Road is increased.
Long Beach	Erosion risk under existing and future conditions threatens beach amenity, public land, roadways (i.e. Bay Road), stormwater outlets, reticulation assets, private property and a car park at the eastern end of Long Beach and also stormwater outlets at the western end of Long Beach.
Surfside	Erosion risk at current sea levels is mostly limited to beach front and public land. However, existing risk to Wharf Road at the Surfside Creek outlet. Future (2100) erosion risk will exacerbate the risk to Wharf Road, threaten private properties and a number of stormwater outlets. CMP includes an action to provide protection to Wharf Road. This CZEAS would be used as an interim measure to respond to erosion risk at this location until these works are complete.

Location	Description
Wharf Road	There is erosion risk under existing and future conditions to private properties seaward of Wharf Road. It is noted that the CMP includes action to voluntarily acquire these properties and return to public ownership. There is erosion risk to Wharf Road and adjacent infrastructure (e.g. sewer and water infrastructure) under existing and future (2100) conditions. The CMP includes an action to provide protection to Wharf Road. This CZEAS would be used as an interim measure to respond to erosion risk at this location until these works are complete. There is erosion risk to informal beach accessways across the low frontal dune, a small area of vegetation and an existing low rock revetment fronting the bend in Wharf Road and the holiday park.
Caseys Beach	Not assessed in the CMP Stage 2 assessment, however, previous studies indicate a high erosion risk to foreshore assets (including roads) and potentially adjoining private properties. The CMP includes an action to upgrade the existing seawall at Caseys Beach. This would address the erosion and inundation risk to the roadway, assets and private properties. This CZEAS would be used as an interim measure to respond to erosion risk until these works are complete.
Sunshine Bay	Existing erosion risk to beach amenity, dunes and the foreshore section of the public carpark. Future (2100) erosion risk extends to the entire public carpark and adjoining private property.
Malua Bay	Existing erosion risk to beach, public recreational land, dune system Kuppa Avenue. Future (2100) erosion risk extends to Malua Bay Surf Lifesaving Club, carpark, public toilets, private properties at Kuppa Avenue, stormwater outlets and reticulation assets at northern end of beach.
Guerilla Bay (south)	Existing erosion risk is limited to the beach and the coastal boundary of several private properties. Future erosion risk extends marginally further into private properties.
Barlings Beach	Existing erosion risk to the beach and dunes. Future erosion risk extends to Barlings Beach Holiday Park frontage.
Tomakin Cove	Existing erosion risk to the beach and dunes. Future erosion risk extends to private property along Sunpatch Parade and stormwater outlets.
Broulee	Existing erosion risk to the beach and dunes. Future erosion risk extends to roadway, reticulation assets and private properties at northern end of beach.
Aboriginal Cultural Heritage Sites	Existing and future (2100) erosion risk to known and high potential Aboriginal cultural sites along the Eurobodalla coastline. This includes risks to extensive coastal middens, burial sites and artefacts.

A former site-specific Emergency Action Sub-plan was prepared for the Wharf Road locality (Umwelt, 2016) as part of the former Wharf Road Coastal Zone Management Plan (ESC, 2017). This document replaces this former site-specific Emergency Action Sub-plan.

3.2 Coastal Inundation

The *Eurobodalla Shire Coastal Hazards Scoping Study* (SMEC, 2010), *Eurobodalla Coastal Hazard Assessment* (WRL, 2017) as well as the refined coastal inundation assessment undertaken for the CMP Stage 2 Vulnerability Assessments (Rhelm, 2022a) have informed the locations discussed below.

The CMP identifies 14 open coast locations within the Eurobodalla LGA at risk of coastal inundation, which are listed in **Table 3-2**, with the exception of Batemans Bay CBD. Maps showing these locations are contained in the CMP Stage 2 Vulnerability Assessments (Rhelm, 2022a).

Table 3-2 Locations at Risk of Coastal Inundation

Location	Description
Durras Beach (south)	Existing inundation risk to private properties and roads under existing conditions.
Maloneys Beach	Existing inundation risk to Northcove Road in 100 Year ARI existing event. Private property becomes at risk of inundation in a 20 Year ARI event in 2100.
Long Beach	Wave overtopping poses a threat to Bay Road under existing conditions and minor impacts to private properties in a 100 Year ARI storm event. In 2100, a 20 Year ARI event inundation impacts several private properties and Bay Road.
Surfside	Future (2100) 1 Year ARI inundation risk threatens a small number of low lying properties and several roads.
	Existing 20 Year ARI inundation threatens considerable number of private properties and roads within Surfside. This risk will increase under sea level rise, both in terms of the depth of inundation and the number of properties and roads impacted.
Wharf Road	Existing 20 Year ARI inundation threatens considerable number of private properties and Wharf Road. The depth of inundation rather than the extent will increase under sea level rise.
Batemans Bay CBD	Future (2100) 1 Year ARI inundation risk to Clyde Street and a section of North Street.
	Existing 20 Year ARI inundation risk threatens portions of the CBD including properties and roads. Future (2100) inundation risk significantly increases in depth and extent, with a larger number of properties and roads impacted.
Boat Harbour	Inundation risk to properties, roads and assets is significant under existing 20 Year ARI storm conditions. This risk increases under sea level rise, with large areas impacted by inundation by a 1 Year ARI event by 2100.
Corrigans Beach	The dunes at Corrigans Beach are overtopped in a 20 Year ARI event under existing conditions impacting the caravan park, private and public land include roads and other assets.
Caseys Beach	Existing and Future (2100) 100 Year ARI inundation risk poses risk to private properties adjoining the lower reaches of Short Beach Creek, Sunshine Bay Public School and Pleasurelea Tourist Park. Wave overtopping poses a risk to Beach Road.
Malua Bay	Future (2100) 100 Year ARI inundation risk to private properties.

Location	Description
Guerilla Bay	Minor inundation risk occurs along the creek due to coastal inundation in a 100 Year ARI event under existing and future sea level rise conditions.
Barlings Beach	Minor inundation risk occurs along the creek through the tourist park in a 20 Year ARI event under existing and future sea level rise conditions.
Broulee	Existing and future (2100) 100 Year ARI inundation risk (shallow) to a small number of properties on Candlagan Drive.

3.3 Cliff Instability

The CMP identifies three open coast locations within the Eurobodalla LGA at risk of cliff instability. Coastal cliff and slope instability information has been derived from the *Geotechnical Slope Instability Risk Assessment* undertaken for Batemans Bay (ACT Geotechnical Engineers Pty Ltd, 2012). These locations are:

- Long Beach – Headland at the eastern end of Long Beach
- Corrigans Beach – Headland at the southern end of Corrigans Beach
- Caseys Beach – Headland at the southern end of Caseys Beach.

Maps showing these locations, including key risk features of the headlands, are contained in **Appendix A**, adapted from ACT Geotechnical Engineers Pty Ltd (2012).

4 Roles and Responsibilities

This section outlines the roles and responsibilities of all public authorities, including Council, and coordinates their response to coastal emergency events immediately preceding or during periods of beach erosion, coastal inundation and cliff instability.

Table 4-1 lists personnel and agencies with roles and responsibilities under this CZEAS, along with a description of their roles and responsibilities. The general responsibilities of emergency services organisations and support agencies are listed in the Local and State EMPLANs. Some specific responsibilities are expanded upon in **Table 4-1**.

Table 4-1 Roles and responsibilites

Agency	Responsibilities
Eurobodalla Shire Council	• Prepare, maintain and update this CZEAS as necessary and provide the NSW SES with a copy • Implement the Prevention and Preparation Phase emergency actions prior to a coastal emergency event occurring (**Section 5**) • In the event of a coastal emergency at a location at risk, activate this CZEAS and implement the Response Phase emergency actions for the duration of the coastal emergency event (**Section 5**) • Implement the Recovery Phase emergency actions following a coastal emergency event (**Section 5**) • As identified in **Section 5**, implement (or authorise and coordinate) emergency coastal protection works, including construction of physical works where appropriate, to protect property and public assets from beach erosion, coastal inundation and cliff instability • Assist the NSW SES with reconnaissance of areas susceptible to coastal erosion and/or inundation • Liaise with the NSW SES Local Controller to provide advice regarding the need for response actions by the NSW SES such as evacuations • Assist, at their request, the Police, NSW SES, and Local Emergency Operations Controller (LEOCON) in dealing with a coastal emergency • Provide engineering resources required for response and recovery phases • Provide a range of support to the LEOCON • Provide back-up radio communications.
Local Emergency Operations Controller (LEOCON)	• Monitor coastal emergency event operations • Act as the combat/responsible agency in the event of coastal erosion that is not caused by storm activity by controlling and coordinating emergency management of the coastal emergency event • Act as the combat/responsible agency in the event of a landslip (Illawarra South Coast Regional Emergency Management Committee, 2019) • Coordinate support to the NSW SES Eurobodalla Shire Local Controller, if requested to do so.

Agency	Responsibilities
Eurobodalla Shire Council Local Emergency Management Officer (LEMO)	• Provide executive support to the Local Emergency Management Committee (LEMC) and LEOCON in accordance with the Eurobodalla Local EMPLAN (ESC, 2019).
Eurobodalla Shire Council Local Emergency Management Committee (LEMC)	• The LEMC is a Council advisory committee, including representatives from the below-listed agencies: • NSW Police • NSW SES • Kantungal • Aboriginal Affairs • NSW Health

NSW State Emergency Service (NSW SES) Eurobodalla Shire Unit Members	• Act as the combat/responsible agency for damage control and the coordination of community evacuation during the following coastal zone hazards as per the Eurobodalla Local EMPLAN (ESC, 2019):
	  • Flooding
	  • Storms
	  • Tsunamis
	• Act as the combat/responsible agency in the event of coastal erosion that is caused by storm activity (emergency management of coastal erosion that is caused by storm activity is within the scope of the NSW State Storm Plan)
	• Carry out required response tasks. These may include:
	  • Assist in the collection of flood and coastal erosion/inundation information for the development of intelligence
	  • Evacuation
	  • Delivery of warnings
	  • Assisting with road closures and traffic control operations
	• The NSW SES is not responsible for planning or conduct of emergency beach protection works or other physical mitigation works (NSW SES, 2013) and as such is not authorised to undertake emergency coastal protection works.

NSW SES Eurobodalla Shire Local Controller	• Deal with floods as per the Eurobodalla Shire Local Flood Plan (NSW SES, 2013)
	• Identify and monitor people and/or communities at risk of flooding and coastal erosion
	• Provide an information service in relation to:
	  • Coastal erosion
	  • Coastal inundation
	  • Road conditions and closures (general information only)
	  • Confirmation of evacuation warnings
	• Direct the evacuation of people and/or communities
	• Ensure caravan parks are advised of flood/coastal inundation warnings
	• Coordinate the collection of flood and coastal erosion/inundation information for development of intelligence.

Agency	Responsibilities
The Ambulance Service of NSW	• Assist with the evacuation of at-risk communities (in particular elderly and/or infirm people) (NSW SES, 2013).
NSW Police Force	• Assist the NSW SES with delivery of evacuation warnings and the conduct of evacuations • Conduct road and traffic control operations in conjunction with Council and/or Transport for NSW • Coordinate the registration of evacuees • Secure evacuated areas (NSW SES, 2013).
Fire and Rescue NSW	• Assist the NSW SES with delivery of evacuation warnings and the conduct of evacuations • Provide equipment for pumping flood water out of buildings and from low-lying areas • Provide back-up radio communications • Assist with clean-up operations, including the hosing of flood affected properties (NSW SES, 2013).
Australian Government Bureau of Meteorology (Bureau)	• Issue public weather warning products before and during an event for the Eurobodalla Shire i.e. Severe Thunderstorm Warnings, Severe Weather Warnings, Tropical Cyclone Watches and Tropical Cyclone Warnings (NSW SES, 2018a) as well as Flood Watches and Flood Warnings (NSW SES, 2021).
Marine Rescue NSW (Batemans Bay, Tuross and Narooma)	• Assist the NSW SES with delivery of evacuation warnings and ethe conduct of evacuations (NSW SES, 2013).
Surf Life Saving NSW	• Assist the NSW SES with the warning and/or evacuation of at-risk communities and flood rescue operations (NSW SES, 2013).
Narooma Volunteer Rescue Association Rescue Squad	• Assist the NSW SES Eurobodalla Shire Local Controller with flood operations with equipment, resources and appropriately trained members within their capabilities (NSW SES, 2013).

5 Emergency Response Action Plans for Locations at Risk

This section outlines what actions are to be undertaken in the four phases of emergency management at each of the locations at risk that this Plan applies to. It also identifies the locations and types of works that may be undertaken for the protection of property and assets.

Council's ability to undertake the actions identified in this CZEAS will be dependent on the availability of resources during emergency events. Actions must not conflict with or impede NSW SES or NSW Department of Planning and Environment (DPE) actions. Emergency coastal protection works must not be undertaken during extreme weather unless safe to do so, as emergency actions must not put Council or other agency staff or volunteers at risk.

Each table in the following sub-sections details the coastal emergency actions through the four phases of emergency response, which apply to the locations at risk along the Eurobodalla Shire open coast (**Section 3**). Any implementation options indicated in the sub-sections below with an Option ID are discussed in detail in the CMP (Rhelm, 2022b).

Actions in this CZEAS aim to reduce risk:

- In areas where Council has chosen not to implement other 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 a CMP has not yet been implemented
- Where coastal hazard risks remain after other actions have been implemented (residual risk)
- When rare and large or unexpected events occur, outside the design criteria or capacity of agreed management actions in the CMP.

5.1 Durras Beach

Durras Beach is subject to coastal inundation.

Table 5-1 lists the response action plan for Durras Beach.

Table 5-1 Coastal Emergency Actions for Durras Beach

Action	Responsibility
Phase 1 – Prevention	
Provide advice to the community, landholders and the NSW SES about the potential for a coastal emergency event and the types of responses that are permitted and not permitted.	Council
Assess threats to life and property arising from a coastal emergency through the CMP process. Make the public aware of the hazards and risks through publication of the Eurobodalla Open Coast CMP and this CZEAS, and education campaigns.	NSW SES and Council
Council to monitor beach/dune condition and weather events such as warnings issued by the Bureau (i.e. Severe Weather Warnings from Port Kembla to Eden).and/or advice provided by Agencies which may impact the area.	Council
Phase 2 – Preparation	
Identify the most appropriate emergency coastal protection works including access and location. For Durras Beach this is considered to be road closure, and evacuation of residents, as required.	Council
Develop an operations procedure to guide Council's response to coastal emergency events (including resourcing, internal training, testing and periodic review).	Council
Maintain up-to-date personal contact details for key Council staff involved in coordinating actions under this CZEAS and individuals Council may need advice from, such as DPE staff, or to integrate with personnel from other emergency sectors.	Council
Phase 3 – Response	
Implement the communication protocol in conjunction with the combat agency (NSW SES) to advise landholders, residents, public authorities and other organisations that a coastal emergency is likely or is occurring and that actions in this CZEAS are to be implemented.	Council and NSW SES
Alert residents if risk level is high and if any emergency management actions are being implemented.	NSW SES
Erect temporary signage of dangers or closure to the beach.	Council
Evacuate residents if necessary.	NSW SES
Increase surveillance of coastal hazards at this location.	Council
Close affected Council managed roads or liaise with road owners to enable closure.	Council
Phase 4 – Recovery	
Inspect the beach, public assets and properties after damaging storm events and carry out works to ensure the area is safe, including general clean up and clearing of any exposed debris, before taking down signage or reopening the area.	Council

Action	Responsibility
Erect permanent warning signs if necessary.	Council
Restore access to beaches and headlands.	Council
Maintain temporary safety fencing and associated warning signage, as necessary.	Council
Issue clean-up orders under the *Local Government Act 1993*.	Council
Assess the structural integrity of unprotected assets affected by or damaged during the coastal emergency event. Geotechnical, structural and/or coastal engineering investigations may be required to understand residual risk following a coastal emergency event.	Council
Liaise with property owners to ensure any private and/or public structures do not pose a risk to the public.	Council
Undertake works to re-establish or enhance the natural protective features of the coast, such as dune shaping and revegetation.	Council
Issue orders under the *Local Government Act 1993* and/or the *Environmental Planning and Assessment Act 1979* when properties are deemed structurally unsafe or pose a risk to the public.	Council
Critically review this CZEAS, communications protocol/plan and operational procedures to ensure they achieved their performance objectives. Amend if shortcomings or improvements are identified.	Council

5.2 Maloneys Beach

Maloney Beach is subject to beach erosion and coastal inundation.

The CMP recommends upgrading Northcove Road to reduce the impacts of coastal inundation and beach erosion at this location (Option CH1_B). In total, 250m of retaining structure and wave return wall is recommended along the eastern section of Northcove Road and the western section of Maloneys Drive. The option also includes raising a 100-120m section Northcove Road.

Table 5-2 lists the response action plan for Maloneys Beach, including fast-tracking of the abovementioned CMP option as a high priority recovery action, if necessary.

Table 5-2 Coastal Emergency Actions for Maloneys Beach

Action	Responsibility
Phase 1 – Prevention	
Provide advice to the community, landholders and the NSW SES about the potential for a coastal emergency event and the types of responses that are permitted and not permitted.	Council
Assess threats to life and property arising from a coastal emergency through the CMP process. Make the public aware of the hazards and risks through publication of the Eurobodalla Open Coast CMP and this CZEAS, and education campaigns.	NSW SES and Council
Council to monitor beach/dune condition and weather events such as warnings issued by the Bureau (i.e. Severe Weather Warnings from Port Kembla to Eden) and/or advice provided by Agencies which may impact the area.	Council
Phase 2 – Preparation	
Identify the most appropriate emergency coastal protection works including access and location. For Maloneys Beach this is considered to be toe protection using sand containers or sand nourishment via beach scraping if conditions/resources permit. Access is via Northcove Road.	Council
Prepare an environment impact assessment for emergency coastal protection works and gain necessary approvals from state agencies.	Council
Maintain a stockpile of sand containers for the purpose of erosion protection works. These will be stored at the nearest Council Depot. Sand containers made of geotextile fabric or woven polypropylene fabric (not hessian) with maximum volume of 0.75m^3 should be used (DECCW, 2011). It is recommended that a container volume of not less than 0.3m^3 be used. Sand can be imported to the site from a lawfully approved source. Imported sand should have a grain size (D50) of at least 0.2mm and no greater than 0.25mm.	
Maintain the ability to mobilise required plant and equipment at short notice.	Council
Develop an operations procedure to guide Council's response to coastal emergency events (including resourcing, internal training, testing and periodic review).	Council

<table>
<tr><th>Action</th><th>Responsibility</th></tr>
<tr><td>Maintain up-to-date personal contact details for key Council staff involved in coordinating actions under this CZEAS and individuals Council may need advice from, such as DPE staff, or to integrate with personnel from other emergency sectors.</td><td>Council</td></tr>
<tr><td colspan="2">Phase 3 – Response</td></tr>
<tr><td>Implement the communication protocol in conjunction with the combat agency (NSW SES) to advise landholders, residents, public authorities and other organisations that a coastal emergency is likely or is occurring and that actions in this CZEAS are to be implemented.</td><td>Council and NSW SES</td></tr>
<tr><td>Alert residents if risk level is high and if any emergency management actions are being implemented.</td><td>NSW SES</td></tr>
<tr><td>Erect temporary signage of dangers or closure to the beach.</td><td>Council</td></tr>
<tr><td>Evacuate residents if necessary.</td><td>NSW SES</td></tr>
<tr><td>Alert land managers about access requirements.</td><td>Council</td></tr>
<tr><td>Increase surveillance of coastal hazards at this location.</td><td>Council</td></tr>
<tr><td>Place appropriate equipment on stand-by.</td><td>Council</td></tr>
<tr><td>Dune toe protection works may be undertaken prior to dangerous ocean conditions developing, if the following triggers are reached:
East Coast Low predicted and;
Erosion scarp is at trigger line (Figure 5-2), located approximately 10m from Northcove Drive.
The protection structure will be temporary and constructed as a single stack of containers along the erosion scarp to a maximum height of 1.5m from the toe of the escarpment (DECCW, 2011), as shown in Figure 5-1. Approximately 25 containers are required for every 10m of structure length, with the total number required dependant on the length of shoreline requiring immediate protection and the number of containers that can be installed in the time available. Emergency protection would prioritise sections of the shoreline most exposed at the time and remain within the area specified on Figure 5-2.

Beach scraping as a form of beach nourishment, could also be undertaken if time, resource and event magnitude permit. Determination of beach scraping location will involve consultation with relevant NSW government agencies as per the communication protocol.

Beach scraping involves the relocation (by mechanical means) of sand from the intertidal zone to the upper beach or dune. The volumes practically able to be moved will not be generally sufficient to renourish the beach profile, however, can be used to enhance the remaining dune, provide buffer to the asset and accelerate the natural process of dune re-building.

The ‘borrow’ area should be restricted to within the intertidal zone with no greater than 0.3m depth removed from the beach profile between elevations of -0.5mAHD and +1mAHD.</td><td>Council</td></tr>
</table>

Action	Responsibility
The 'placement' area should be placed at the base of the asset at a slope of approximately 1 in 7. Placement volumes are likely to be approximately 15-20m3/m width of beach. Ideally a small lip can be left to minimise sand blowing over the top of foreshore, and/or other considerations such as use of jute mesh and plantings on the landward margin of the nourishment if appropriate can increase stability. The sand scraping area is shown on **Figure 5-2**. Plant and equipment should access the area for the works via **Northcove Road**, avoiding disturbance to surrounding areas, in particular to any dune vegetation.	
Close Northcove Road if affected by inundation (including wave overtopping) or instability due to beach erosion.	Council
Phase 4 – Recovery	
Inspect the beach, public assets and properties after damaging storm events and carry out works to ensure the area is safe, including general clean up and clearing of any exposed debris, before taking down signage or reopening the area.	Council
Beach scraping may be undertaken if required Beach scraping may be undertaken if required to restore public beach access following storm erosion and to assist beach recovery. The location and scale of beach scraping activities will depend on the damage caused by the event and will need to be determined at the time of the event. Beach scraping involves the relocation (by mechanical means) of sand from the intertidal zone to the upper beach or dune. The volumes practically able to be moved will not be sufficient to renourish the beach profile following a large erosion event, however, can be used to enhance the remaining dune and accelerate the natural process of dune re-building. The 'borrow' area should be restricted to within the intertidal zone with no greater than 0.5m depth removed from the beach profile between elevations of -0.5mAHD and +1mAHD. The 'placement' area should be placed at the base of the erosion scarp at a slope of approximately 1 in 7. Placement volumes are likely to be approximately 10-15m^3/m width of beach.	Council
If beach erosion is within 6m of Northcove Road, recovery works should include the implementation of CMP Option CH1_B if funding is available.	Council
Erect permanent warning signs if necessary.	Council
Remove any sand containers within 90 days.	Council
Monitor the condition, performance and impact of any coastal protection works or emergency coastal protection works.	Council
Restore access to beaches and headlands.	Council
Maintain temporary safety fencing and associated warning signage, as necessary.	Council
Issue clean-up orders under the *Local Government Act 1993*.	Council
Assess the structural integrity of unprotected assets affected by or damaged during the coastal emergency event. Geotechnical, structural and/or coastal engineering investigations may be required to understand residual risk following a coastal emergency event.	Council

Action	Responsibility
Liaise with property owners to ensure any private and/or public structures do not pose a risk to the public.	Council
Undertake works to re-establish or enhance the natural protective features of the coast, such as dune shaping and revegetation.	Council
Issue orders under the *Local Government Act 1993* and/or the *Environmental Planning and Assessment Act 1979* when properties are deemed structurally unsafe or pose a risk to the public.	Council
Replenish any emergency materials and supplies for future emergency events.	Council
Critically review this CZEAS, communications protocol/plan and operational procedures to ensure they achieved their performance objectives. Amend if shortcomings or improvements are identified.	Council

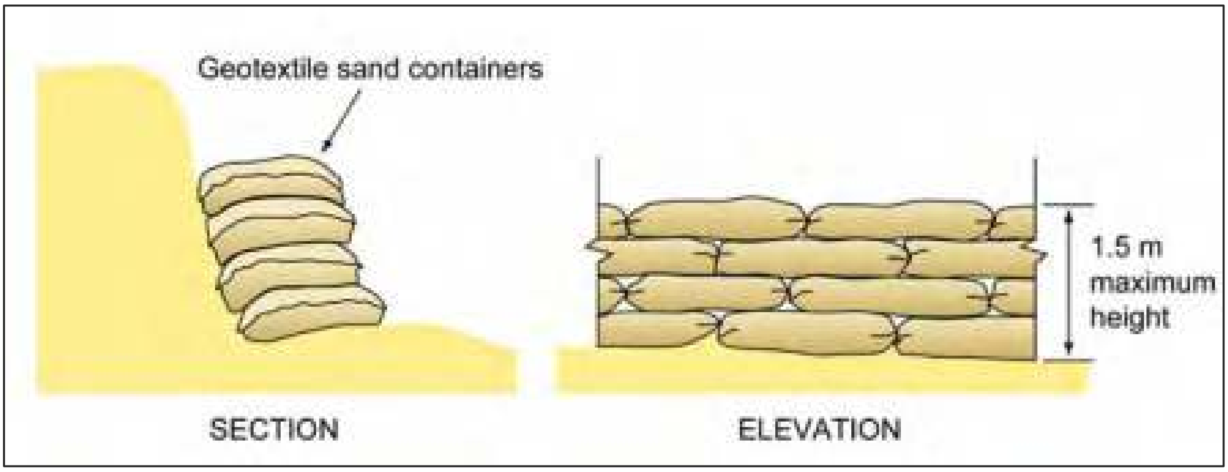

Figure 5-1 Concept Sand Container Placement Method (DECCW, 2011)

Figure 5-2 Maloneys Beach Erosion Protection Works

5.3 Long Beach

Long Beach has coastal risks associated with beach erosion, coastal inundation and cliff instability.

The CMP recommends the construction of a revetment wall at Long Beach, to protect Bay Road and the carpark from beach erosion (Option CH1_D). These works are identified for immediate action (commencing with investigation and design, followed by construction). In the interim, the existing erosion risks remain. The action plan below considers this interim risk.

Table 5-3 lists the response action plan for Long Beach.

Table 5-3 Coastal Emergency Actions for Long Beach

Action	Responsibility
Phase 1 – Prevention	
Provide advice to the community, landholders and the NSW SES about the potential for a coastal emergency event and the types of responses that are permitted and not permitted.	Council
Assess threats to life and property arising from a coastal emergency through the CMP process. Make the public aware of the hazards and risks through publication of the Eurobodalla Open Coast CMP and this CZEAS, and education campaigns.	NSW SES and Council
Council to monitor beach/dune condition and weather events such as warnings issued by the Bureau (i.e. Severe Weather Warnings from Port Kembla to Eden) and/or advice provided by Agencies which may impact the area.	Council
Phase 2 – Preparation	
Identify the most appropriate emergency coastal protection works including access and location. For Long Beach this is considered to be toe protection using sand containers or beach nourishment through sand scraping if conditions and resourcing permit. Access to undertake these works is via Bay Road, which has a number of low access points that can be utilised depending on conditions.	Council
Prepare an environment impact assessment for emergency coastal protection works and gain necessary approvals from state agencies.	Council
To prepare for cliff instability, maintain an adequate supply of fencing, hazard tape and hazard signage at the Council depot.	Council
Maintain a stockpile of sand containers for the purpose of erosion protection works. These will be stored at the nearest Council Depot. Sand containers made of geotextile fabric or woven polypropylene fabric (not hessian) with maximum volume of 0.75m^3 should be used (DECCW, 2011). It is recommended that a container volume of not less than 0.3m^3 be used. Sand can be imported to the site from a lawfully approved source. Imported sand should have a grain size (D50) of at least 0.2mm and no greater than 0.25mm.	Council
Maintain the ability to mobilise required plant and equipment at short notice.	Council
Develop an operations procedure to guide Council's response to coastal emergency events (including resourcing, internal training, testing and periodic review).	Council

Action	Responsibility
Maintain up-to-date personal contact details for key Council staff involved in coordinating actions under this CZEAS and individuals Council may need advice from, such as DPE staff, or to integrate with personnel from other emergency sectors.	Council
Private property owners at risk from coastal erosion can submit a Development Application to Council for the implementation of emergency coastal protection works on their land and ensuring Part 5 Section 27 is satisfied. The works on private property cannot be undertaken until the erosion scarp has reached the trigger line shown on **Figure 5-3.**	Private property owners
Phase 3 – Response	
Implement the communication protocol in conjunction with the combat agency (NSW SES) to advise landholders, residents, public authorities and other organisations that a coastal emergency is likely or is occurring and that actions in this CZEAS are to be implemented.	Council and NSW SES
Alert residents if risk level is high and if any emergency management actions are being implemented.	NSW SES
Erect temporary signage of dangers or closure to the beach.	Council
Evacuate residents if necessary.	NSW SES
Alert land managers about access requirements.	Council
Erect temporary signage of dangers or closure to the cliff area, etc and fencing to barricade access to the unstable cliff area (above and below area of instability).	Council
Increase surveillance of coastal hazards at this location.	Council
Place appropriate equipment on stand-by.	Council
Dune toe protection works may be undertaken prior to dangerous ocean conditions developing, if the following triggers are reached: • East Coast Low predicted and; • Erosion scarp is at trigger line (**Figure 5-3**), located approximately 7m from Bay Road. Prior to the implementation of the formal coastal protection works as part of the CMP, a temporary protection structure will be constructed as a single stack of containers along the erosion scarp to a maximum height of 1.5m from the toe of the escarpment (DECCW, 2011), as shown in **Figure 5-3**. Approximately 25 containers are required for every 10m of structure length, with the total number required dependant on the length of shoreline requiring immediate protection and the number of containers that can be installed in the time available. Emergency protection would prioritise sections of the shoreline most exposed at the time and remain within the area specified on **Figure 5-3**. Plant and equipment should access the area to be sandbagged via Bay Road, avoiding disturbance to surrounding areas, in particular to any dune vegetation. Beach scraping as a form of beach nourishment, could also be undertaken if time, resource and event magnitude permit. Determination of beach scraping location will involve consultation with relevant NSW government agencies as per the communication protocol.	Council

Action	Responsibility
Beach scraping involves the relocation (by mechanical means) of sand from the intertidal zone to the upper beach or dune. The volumes practically able to be moved will not be generally sufficient to renourish the beach profile**,** however, can be used to enhance the remaining dune, provide buffer to the asset and accelerate the natural process of dune re-building. The 'borrow' area should be restricted to within the intertidal zone with no greater than 0.3m depth removed from the beach profile between elevations of -0.5mAHD and +1mAHD. The 'placement' area should be placed at the base of the asset at a slope of approximately 1 in 7. Placement volumes are likely to be approximately 15-20m3/m width of beach. Ideally a small lip can be left to minimise sand blowing over the top of foreshore, and/or other considerations such as use of jute mesh and plantings on the landward margin of the nourishment if appropriate can increase stability. The sand scraping area is shown on **Figure 5-3**.	
Where an approved Development Application exists, dune toe protection works on private property may be undertaken to protect private property prior to dangerous ocean conditions developing, if the following triggers are reached: • East Coast Low predicted and; • Erosion scarp is at trigger line (**Figure 5-3**), located approximately 7m from Bay Road.	Private property owners
Close Bay Road if affected by inundation (including wave overtopping) or instability due to beach erosion.	Council
Phase 4 – Recovery	
Inspect the beach, public assets and properties after damaging storm events and carry out works to ensure the area is safe, including general clean up and clearing of any exposed debris, before taking down signage or reopening the area.	Council
Beach scraping may be undertaken if required to restore public beach access following storm erosion and to assist beach recovery. The location and scale of beach scraping activities will depend on the damage caused by the event and will need to be determined at the time of the event. Beach scraping involves the relocation (by mechanical means) of sand from the intertidal zone to the upper beach or dune. The volumes practically able to be moved will not be sufficient to renourish the beach profile following a large erosion event, however, can be used to enhance the remaining dune and accelerate the natural process of dune re-building. The 'borrow' area should be restricted to within the intertidal zone with no greater than 0.5m depth removed from the beach profile between elevations of -0.5mAHD and +1mAHD. The 'placement' area should be placed at the base of the erosion scarp at a slope of approximately 1 in 7. Placement volumes are likely to be approximately 15-20m3/m width of beach.	Council

Action	Responsibility
Undertake cliff stabilisation works, if necessary. This may be done by anchoring (the use of terracing, planting, wiring or concrete supports to hold cliffs in place), smoothing the slope, or dewatering (drainage of excess rainwater to reduce waterlogging).	Council
If the Long Beach revetment construction works (Option CH1_D) are yet to be commenced, fast track these works as a high priority recovery action.	Council
Erect permanent warning signs if necessary.	Council
Remove any sand containers within 90 days.	Council Private property owners
Monitor the condition, performance and impact of any coastal protection works or emergency coastal protection works.	Council
Restore access to beaches and headlands.	Council
Maintain temporary safety fencing and associated warning signage, as necessary.	Council
Issue clean-up orders under the *Local Government Act 1993*.	Council
Assess the structural integrity of unprotected assets affected by or damaged during the coastal emergency event. Geotechnical, structural and/or coastal engineering investigations may be required to understand residual risk following a coastal emergency event.	Council
Liaise with property owners to ensure any private and/or public structures do not pose a risk to the public.	Council
Undertake works to re-establish or enhance the natural protective features of the coast, such as dune shaping and revegetation.	Council
Issue orders under the *Local Government Act 1993* and/or the *Environmental Planning and Assessment Act 1979* when properties are deemed structurally unsafe or pose a risk to the public.	Council
Replenish any emergency materials and supplies for future emergency events.	Council
Critically review this CZEAS, communications protocol/plan and operational procedures to ensure they achieved their performance objectives. Amend if shortcomings or improvements are identified.	Council

Figure 5-3 Long Beach Erosion Protection Works

5.4 Surfside

Surfside is subject to beach erosion and coastal inundation.

The CMP recommends a number of permanent options to address these coastal hazards, including:

- Construction of a culvert extension that would also act as a groyne at Surfside West (Macleods) in order to stabilise the beach compartment and address beach erosion and shoreline recession at this location (Option CH1_ZA)
- A periodic sand nourishment program at Surfside Beach for the sub-aerial beach to maintain the beach width and afford a buffer against beach erosion (Option CH1_L).
- Construction of a flood berm at Surfside to protect low lying urban areas from coastal inundation during storm events at this location (Option CH4_D). The option would see the staged construction of a flood berm to protect the low-lying residential precinct adjacent to the bay. This would reduce the impact of coastal inundation to properties, assets and roads.

Table 5-4 lists the response actions specific to Surfside, including fast-tracking of the abovementioned CMP options as high priority recovery actions, if necessary.

Table 5-4 Coastal Emergency Actions for Surfside

Action	Responsibility
Phase 1 – Prevention	
Provide advice to the community, landholders and the NSW SES about the potential for a coastal emergency event and the types of responses that are permitted and not permitted.	Council
Assess threats to life and property arising from a coastal emergency through the CMP process. Make the public aware of the hazards and risks through publication of the Eurobodalla Open Coast CMP and this CZEAS, and education campaigns.	NSW SES and Council
Council to monitor beach/dune condition and weather events such as warnings issued by the Bureau (i.e. Severe Weather Warnings from Port Kembla to Eden) and/or advice provided by Agencies which may impact the area.	Council
Phase 2 – Preparation	
Identify the most appropriate emergency coastal protection works including access and location. For Surfside this is considered to be toe protection using sand containers or sand nourishment via beach scraping if conditions/resources permit. Access is via Wharf Road (Macleods) or Myamba Parade (Surfside Beach).	Council
Prepare an environment impact assessment for emergency coastal protection works and gain necessary approvals from state agencies.	Council
Maintain a stockpile of sand containers for the purpose of erosion protection works. These will be stored at the nearest Council Depot. Sand containers made of geotextile fabric or woven polypropylene fabric (not hessian) with maximum volume of $0.75m^3$ should be used (DECCW, 2011). It is recommended that a container volume of not less than $0.3m^3$ be used.	Council

Action	Responsibility
Sand can be imported to the site from a lawfully approved source. Imported sand should have a grain size (D50) of at least 0.2mm and no greater than 0.25mm.	
Maintain the ability to mobilise required plant and equipment at short notice.	Council
Develop an operations procedure to guide Council's response to coastal emergency events (including resourcing, internal training, testing and periodic review).	Council
Maintain up-to-date personal contact details for key Council staff involved in coordinating actions under this CZEAS and individuals Council may need advice from, such as DPE staff, or to integrate with personnel from other emergency sectors.	Council
Phase 3 – Response	
Implement the communication protocol in conjunction with the combat agency (NSW SES) to advise landholders, residents, public authorities and other organisations that a coastal emergency is likely or is occurring and that actions in this CZEAS are to be implemented.	Council and NSW SES
Alert residents if risk level is high and if any emergency management actions are being implemented.	NSW SES
Erect temporary signage of dangers or closure to the beach.	Council
Evacuate residents if necessary.	NSW SES
Alert land managers about access requirements.	Council
Increase surveillance of coastal hazards at this location.	Council
Place appropriate equipment on stand-by.	Council
Dune toe protection works may be undertaken prior to dangerous ocean conditions developing, if the following triggers are reached: • East Coast Low predicted and; • Erosion scarp is at trigger line (**Figure 5-4**), located approximately 8m from Wharf Road. The protection structure will be temporary and constructed as a single stack of containers along the erosion scarp to a maximum height of 1.5m from the toe of the escarpment (DECCW, 2011). Approximately 25 containers are required for every 10m of structure length, with the total number required dependant on the length of shoreline requiring immediate protection and the number of containers that can be installed in the time available. Emergency protection would prioritise sections of the shoreline most exposed at the time and remain within the area specified on **Figure 5-4**. Beach scraping as a form of beach nourishment, could also be undertaken if time, resource and event magnitude permit. Determination of beach scraping location will involve consultation with relevant NSW government agencies as per the communication protocol. Beach scraping involves the relocation (by mechanical means) of sand from the intertidal zone to the upper beach or dune. The volumes practically able to be	Council

Action	Responsibility
moved will not be generally sufficient to renourish the beach profile**,** however, can be used to enhance the remaining dune, provide buffer to the asset and accelerate the natural process of dune re-building. The 'borrow' area should be restricted to within the intertidal zone with no greater than 0.3m depth removed from the beach profile between elevations of -0.5mAHD and +1mAHD. The 'placement' area should be placed at the base of the asset at a slope of approximately 1 in 7. Placement volumes are likely to be approximately 15-20m3/m width of beach. Ideally a small lip can be left to minimise sand blowing over the top of foreshore, and/or other considerations such as use of jute mesh and plantings on the landward margin of the nourishment if appropriate can increase stability. The sand scraping area is shown on **Figure 5-4**. Plant and equipment should access the area for the works via Wharf Road, avoiding disturbance to surrounding areas, in particular to any dune vegetation.	
Close affected Council managed roads or liaise with road owners to enable closure.	Council
Phase 4 – Recovery	
Inspect the beach, public assets and properties after damaging storm events and carry out works to ensure the area is safe, including general clean up and clearing of any exposed debris, before taking down signage or reopening the area.	Council
Beach scraping may be undertaken if required to restore public beach access following significant storm erosion and to assist beach recovery. The location and scale of beach scraping activities will depend on the damage caused by the event and will need to be determined at the time of the event. Beach scraping involves the relocation (by mechanical means) of sand from the intertidal zone to the upper beach or dune. The volumes practically able to be moved will not be sufficient to renourish the beach profile following a large erosion event, however, can be used to enhance the remaining dune and accelerate the natural process of dune re-building. The 'borrow' area should be restricted to within the intertidal zone with no greater than 0.5m depth removed from the beach profile between elevations of -0.5mAHD and +1mAHD. The 'placement' area should be placed at the base of the erosion scarp at a slope of approximately 1 in 2. Placement volumes are likely to be approximately 10-15m3/m width of beach.	Council
If the groyne construction works (Option CH1_ZA) at Surfside West (Macleods Beach) are yet to be commenced, implement these works as a high priority recovery action.	Council
If the flood berm construction works at Surfside to protect low lying urban areas from coastal inundation (Option CH4_D) are yet to be commenced, implement these works as a high priority recovery action.	Council
Erect permanent warning signs if necessary.	Council

Action	Responsibility
Remove any sand containers within 90 days.	Council
Monitor the condition, performance and impact of any coastal protection works or emergency coastal protection works.	Council
Restore access to beaches and headlands.	Council
Maintain temporary safety fencing and associated warning signage, as necessary.	Council
Issue clean-up orders under the *Local Government Act 1993*.	Council
Assess the structural integrity of unprotected assets affected by or damaged during the coastal emergency event. Geotechnical, structural and/or coastal engineering investigations may be required to understand residual risk following a coastal emergency event.	Council
Liaise with property owners to ensure any private and/or public structures do not pose a risk to the public.	Council
Undertake works to re-establish or enhance the natural protective features of the coast, such as dune shaping and revegetation.	Council
Issue orders under the *Local Government Act 1993* and/or the *Environmental Planning and Assessment Act 1979* when properties are deemed structurally unsafe or pose a risk to the public.	Council
Replenish any emergency materials and supplies for future emergency events.	Council
Critically review this CZEAS, communications protocol/plan and operational procedures to ensure they achieved their performance objectives. Amend if shortcomings or improvements are identified.	Council

Figure 5-4 Surfside Beach Erosion Protection Works

5.5 Wharf Road

Wharf Road is subject to beach erosion and coastal inundation.

The CMP recommends the acquisition of the private properties seaward of Wharf Road and conversion of this area to a public reserve, to restore the area for safe public use (Option CH1_M).

Natural coastal processes will be allowed to occur, including beach erosion and shoreline recession, until they begin to threaten the existing sewer main through the area. Council will then construct a revetment wall aligned with the sewer to provide protection to the sewer and the road behind it (Option C1_Kd). The CMP includes the Wharf Road Protection Stage 1 as priority works at the exposed corner of Wharf Road (Option C1_Ka).

Table 5-5 lists the response actions specific to Wharf Road, including fast-tracking of the abovementioned CMP options as high priority recovery actions, if necessary.

Table 5-5 Coastal Emergency Actions for Wharf Road

Action	Responsibility
Phase 1 – Prevention	
Provide advice to the community, landholders and the NSW SES about the potential for a coastal emergency event and the types of responses that are permitted and not permitted.	Council
Assess threats to life and property arising from a coastal emergency through the CMP process. Make the public aware of the hazards and risks through publication of the Eurobodalla Open Coast CMP and this CZEAS, and education campaigns.	NSW SES and Council
Council to monitor beach/dune condition and weather events such as warnings issued by the Bureau (i.e. Severe Weather Warnings from Port Kembla to Eden) and/or advice provided by Agencies which may impact the area.	Council
Phase 2 – Preparation	
Identify the most appropriate emergency coastal protection works including access and location. For Wharf Road this is considered to be toe protection using sand containers or sand nourishment via beach scraping if conditions/resources permit. Access is via **Wharf Road**.	Council
Prepare an environment impact assessment for emergency coastal protection works and gain necessary approvals from state agencies.	Council
Maintain a stockpile of sand containers for the purpose of erosion protection works. These will be stored at the nearest Council Depot. Sand containers made of geotextile fabric or woven polypropylene fabric (not hessian) with maximum volume of $0.75m^3$ should be used (DECCW, 2011). It is recommended that a container volume of not less than $0.3m^3$ be used. Sand can be imported to the site from a lawfully approved source. Imported sand should have a grain size (D50) of at least 0.2mm and no greater than 0.25mm.	Council

Action	Responsibility
Maintain the ability to mobilise required plant and equipment at short notice.	Council
Develop an operations procedure to guide Council's response to coastal emergency events (including resourcing, internal training, testing and periodic review).	Council
Maintain up-to-date personal contact details for key Council staff involved in coordinating actions under this CZEAS and individuals Council may need advice from, such as DPE staff, or to integrate with personnel from other emergency sectors.	Council
Phase 3 – Response	
Implement the communication protocol in conjunction with the combat agency (NSW SES) to advise landholders, residents, public authorities and other organisations that a coastal emergency is likely or is occurring and that actions in this CZEAS are to be implemented.	Council and NSW SES
Alert residents if risk level is high and if any emergency management actions are being implemented.	NSW SES
Erect temporary signage of dangers or closure to the beach.	Council
Evacuate residents if necessary.	NSW SES
Alert land managers about access requirements.	Council
Increase surveillance of coastal hazards at this location.	Council
Place appropriate equipment on stand-by.	Council
Dune toe protection works should be undertaken prior to dangerous ocean conditions developing, if the following triggers are reached: • East Coast Low predicted • Erosion scarp is at trigger line (**Figure 5-5**), located approximately 6m from Wharf Road, The protection structure will be temporary and constructed as a single stack of containers along the erosion scarp to a maximum height of 1.5m from the toe of the escarpment (DECCW, 2011). Approximately 25 containers are required for every 10m of structure length, with the total number required dependant on the length of shoreline requiring immediate protection and the number of containers that can be installed in the time available. Emergency protection would prioritise sections of the shoreline most exposed at the time and remain within the area specified on **Figure 5-5**. Beach scraping as a form of beach nourishment, could also be undertaken if time, resource and event magnitude permit. Determination of beach scraping location will involve consultation with relevant NSW government agencies as per the communication protocol. Beach scraping involves the relocation (by mechanical means) of sand from the intertidal zone to the upper beach or dune. The volumes practically able to be moved will not be generally sufficient to renourish the beach profile**,** however, can be used to enhance the remaining dune, provide buffer to the asset and accelerate the natural process of dune re-building.	Council

Action	Responsibility
The 'borrow' area should be restricted to within the intertidal zone with no greater than 0.3m depth removed from the beach profile between elevations of -0.5mAHD and +1mAHD. The 'placement' area should be placed at the base of the asset at a slope of approximately 1 in 7. Placement volumes are likely to be approximately 15-20m3/m width of beach. Ideally a small lip can be left to minimise sand blowing over the top of foreshore, and/or other considerations such as use of jute mesh and plantings on the landward margin of the nourishment if appropriate can increase stability. The sand scraping area is shown on **Figure 5-5**. Plant and equipment should access the area works area via **Myamba Parade**, avoiding disturbance to surrounding areas, in particular to any dune vegetation.	
Close affected Council managed roads, such as Wharf Road, or liaise with road owners to enable closure. Liaise with other agencies, including Transport for NSW, Crown Land and National Parks and Wildlife Service if debris from coastal hazards creates a safety hazard in adjoining areas.	Council
Phase 4 – Recovery	
If the coastal emergency event threatens to cause damage or has caused damage to the sewer infrastructure in this area (150mm pipe shown on **Figure 5-6**), the sewer line should be relocated to align with Wharf Road.	Council
If the coastal emergency event threatens to or has caused damage to Wharf Road, then the Wharf Road Protection Stage 1 priority works (Option C1_Ka) should be implemented as a high priority recovery action, if the protection works are yet to be commenced.	Council
Inspect the beach, public assets and properties after damaging storm events and carry out works to ensure the area is safe, including general clean up and clearing of any exposed debris, before taking down signage or reopening the area.	Council
The location east of the rock revetment (where the unauthorised rock structure is located) has a lot of debris on the foreshore (tyres, car bodies), that may be moved or exposed following a storm event. If this is the case, erect signage warning of the hazard, or if the public safety risks are considered to be extreme, temporarily close access to this beach area, until said risks are mitigated.	Council
Repair Wharf Road if necessary.	Council
Repair the seawall if necessary.	Council
Beach scraping may be undertaken if required to restore public beach access following significant storm erosion and to assist beach recovery. The location and scale of beach scraping activities will depend on the damage caused by the event and will need to be determined at the time of the event. Beach scraping involves the relocation (by mechanical means) of sand from the intertidal zone to the upper beach or dune. The volumes practically able to be moved will not be sufficient to renourish the beach profile following a large	Council

Action	Responsibility
erosion event, however, can be used to enhance the remaining dune and accelerate the natural process of dune re-building. The 'borrow' area should be restricted to within the intertidal zone with no greater than 0.5m depth removed from the beach profile between elevations of -0.5mAHD and +1mAHD. The 'placement' area should be placed at the base of the erosion scarp at a slope of approximately 1 in 2. Placement volumes are likely to be approximately 10-15m3/m width of beach.	
Erect permanent warning signs if necessary.	Council
Remove any sand containers within 90 days.	Council
Monitor the condition, performance and impact of any coastal protection works or emergency coastal protection works.	Council
Restore access to beaches and headlands.	Council
Maintain temporary safety fencing and associated warning signage, as necessary.	Council
Issue clean-up orders under the *Local Government Act 1993*.	Council
Assess the structural integrity of unprotected assets affected by or damaged during the coastal emergency event. Geotechnical, structural and/or coastal engineering investigations may be required to understand residual risk following a coastal emergency event.	Council
Liaise with property owners to ensure any private and/or public structures do not pose a risk to the public.	Council
Undertake works to re-establish or enhance the natural protective features of the coast, such as dune shaping and revegetation.	Council
Issue orders under the *Local Government Act 1993* and/or the *Environmental Planning and Assessment Act 1979* when properties are deemed structurally unsafe or pose a risk to the public.	Council
Replenish any emergency materials and supplies for future emergency events.	Council
Critically review this CZEAS, communications protocol/plan and operational procedures to ensure they achieved their performance objectives. Amend if shortcomings or improvements are identified.	Council

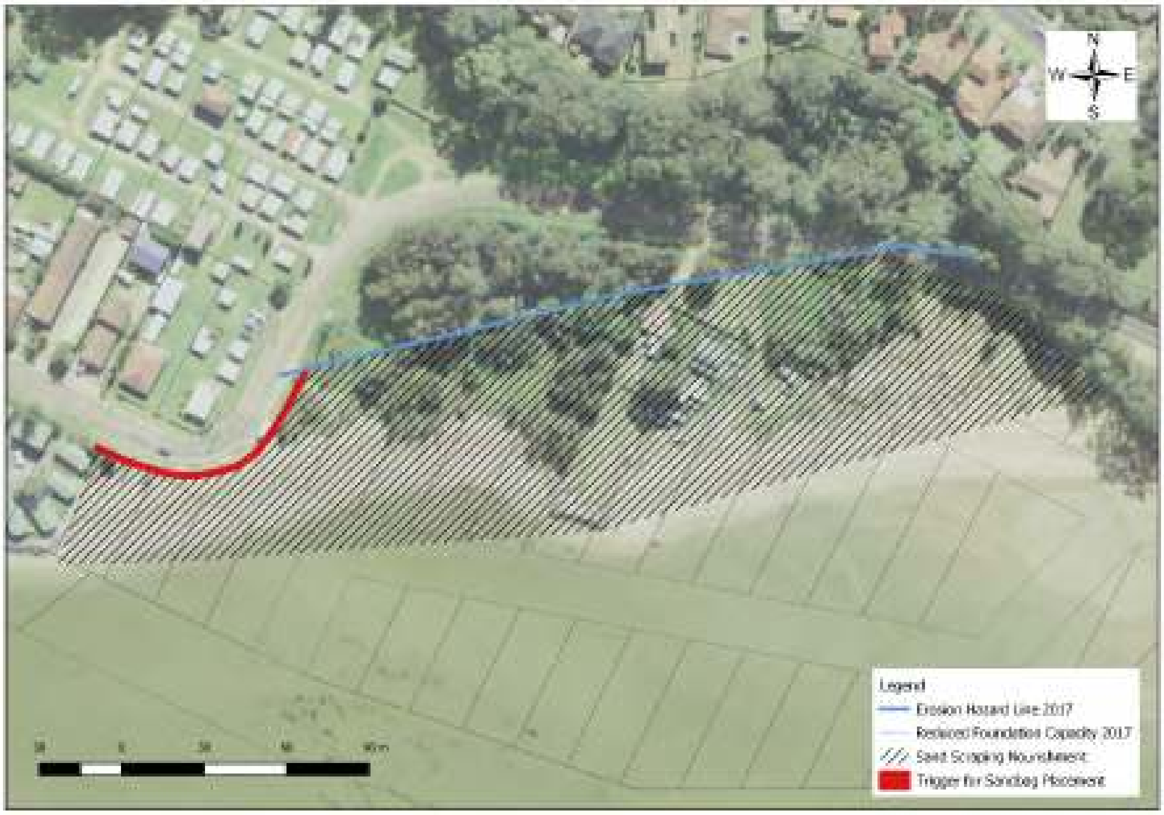

Figure 5-5 Wharf Road Erosion Protection Works

Figure 5-6 Sewer Infrastructure at Wharf Road

5.6 Batemans Bay CBD and Boat Harbour

Batemans Bay CBD and Boat Harbour are subject to coastal inundation.

Table 5-6 lists the response action plan for Batemans Bay CBD and Boat Harbour.

Table 5-6 Coastal Emergency Actions for Batemans Bay CBD and Boat Harbour

Action	Responsibility
Phase 1 – Prevention	
Provide advice to the community, landholders and the NSW SES about the potential for a coastal emergency event and the types of responses that are permitted and not permitted.	Council
Assess threats to life and property arising from a coastal emergency through the CMP process. Make the public aware of the hazards and risks through publication of the Eurobodalla Open Coast CMP and this CZEAS, and education campaigns.	NSW SES and Council
Council to monitor beach/dune condition and weather events such as warnings issued by the Bureau (i.e. Severe Weather Warnings from Port Kembla to Eden) and/or advice provided by Agencies which may impact the area.	Council
Phase 2 – Preparation	
Identify the most appropriate emergency coastal protection works including access and location. For Boat Harbour this is considered to be road closures and evacuation warnings.	Council
Develop an operations procedure to guide Council's response to coastal emergency events (including resourcing, internal training, testing and periodic review).	Council
Maintain up-to-date personal contact details for key Council staff involved in coordinating actions under this CZEAS and individuals Council may need advice from, such as DPE staff, or to integrate with personnel from other emergency sectors.	Council
Phase 3 – Response	
Implement the communication protocol in conjunction with the combat agency (NSW SES) to advise landholders, residents, public authorities and other organisations that a coastal emergency is likely or is occurring and that actions in this CZEAS are to be implemented.	Council and NSW SES
Alert residents if risk level is high and if any emergency management actions are being implemented.	NSW SES and Council
Issue evacuation warnings, if necessary.	NSW SES
Increase surveillance of coastal hazards at this location.	Council
Close affected Council managed roads or liaise with road owners to enable closure.	Council
Phase 4 – Recovery	
Inspect the beach, public assets and properties after damaging storm events and carry out works to ensure the area is safe, including general clean up and clearing of any exposed debris, before taking down signage or reopening the area.	Council
Erect permanent warning signs if necessary.	Council

Action	Responsibility
Monitor the condition, performance and impact of any coastal protection works, following a structural inspection and assessment by a qualified engineer.	Council
Maintain temporary safety fencing and associated warning signage, as necessary.	Council
Issue clean-up orders under the *Local Government Act 1993*.	Council
Assess the structural integrity of unprotected assets affected by or damaged during the coastal emergency event. Geotechnical, structural and/or coastal engineering investigations may be required to understand residual risk following a coastal emergency event.	Council
Liaise with property owners to ensure any private and/or public structures do not pose a risk to the public.	Council
Issue orders under the *Local Government Act 1993* and/or the *Environmental Planning and Assessment Act 1979* when properties are deemed structurally unsafe or pose a risk to the public.	Council
Critically review this CZEAS, communications protocol/plan and operational procedures to ensure they achieved their performance objectives. Amend if shortcomings or improvements are identified.	Council

5.7 Corrigans Beach

Corrigans Beach is subject to coastal inundation and cliff instability.

Table 5-7 lists the response action plan for Corrigans Beach.

Table 5-7 Coastal Emergency Actions for Corrigans Beach

Action	Responsibility
Phase 1 – Prevention	
Provide advice to the community, landholders and the NSW SES about the potential for a coastal emergency event and the types of responses that are permitted and not permitted.	Council
Assess threats to life and property arising from a coastal emergency through the CMP process. Make the public aware of the hazards and risks through publication of the Eurobodalla Open Coast CMP and this CZEAS, and education campaigns.	NSW SES and Council
Council to monitor beach/dune condition and weather events such as warnings issued by the Bureau (i.e. Severe Weather Warnings from Port Kembla to Eden) and/or advice provided by Agencies which may impact the area.	Council
Phase 2 – Preparation	
Identify the most appropriate emergency coastal protection works including access and location. For Corrigans Beach this is considered to be road closures and evacuation warnings.	Council
To prepare for cliff instability, maintain an adequate supply of fencing, hazard tape and hazard signage at the Council depot.	Council
Develop an operations procedure to guide Council's response to coastal emergency events (including resourcing, internal training, testing and periodic review).	Council
Maintain up-to-date personal contact details for key Council staff involved in coordinating actions under this CZEAS and individuals Council may need advice from, such as DPE staff, or to integrate with personnel from other emergency sectors.	Council
Phase 3 – Response	
Implement the communication protocol in conjunction with the combat agency (NSW SES) to advise landholders, residents, public authorities and other organisations that a coastal emergency is likely or is occurring and that actions in this CZEAS are to be implemented.	Council and NSW SES
Alert residents if risk level is high and if any emergency management actions are being implemented.	NSW SES
Erect temporary signage of dangers or closure to the beach.	Council
Issue evacuation warnings, if necessary.	NSW SES
Alert land managers about access requirements.	Council
Erect temporary signage of dangers or closure to the cliff area, etc and fencing to barricade access to the unstable cliff area (above and below area of instability).	Council
Increase surveillance of coastal hazards at this location.	Council

Action	Responsibility
Close affected Council managed roads or liaise with road owners to enable closure.	Council
Phase 4 – Recovery	
Inspect the beach, public assets and properties after damaging storm events and carry out works to ensure the area is safe, including general clean up and clearing of any exposed debris, before taking down signage or reopening the area.	Council
Undertake cliff stabilisation works, if necessary. This may be done by anchoring (the use of terracing, planting, wiring or concrete supports to hold cliffs in place), smoothing the slope, or dewatering (drainage of excess rainwater to reduce waterlogging).	Council
Erect permanent warning signs if necessary.	Council
Restore access to beaches and headlands.	Council
Maintain temporary safety fencing and associated warning signage, as necessary.	Council
Issue clean-up orders under the *Local Government Act 1993*.	Council
Assess the structural integrity of unprotected assets affected by or damaged during the coastal emergency event. Geotechnical, structural and/or coastal engineering investigations may be required to understand residual risk following a coastal emergency event.	Council
Liaise with property owners to ensure any private and/or public structures do not pose a risk to the public.	Council
Undertake works to re-establish or enhance the natural protective features of the coast, such as dune shaping and revegetation.	Council
Issue orders under the *Local Government Act 1993* and/or the *Environmental Planning and Assessment Act 1979* when properties are deemed structurally unsafe or pose a risk to the public.	Council
Critically review this CZEAS, communications protocol/plan and operational procedures to ensure they achieved their performance objectives. Amend if shortcomings or improvements are identified.	Council

5.8 Caseys Beach

Caseys Beach is subject to beach erosion, coastal inundation and cliff instability.

The CMP recommends the immediate replacement of the existing coastal protection works at Caseys Beach with a seawall to protect Beach Road and reduce the likelihood of damage from wave overtopping during storm events (Option CH1_P).

Table 5-3 lists the response action plan for Caseys Beach, including fast-tracking of the abovementioned CMP option as a high priority recovery action, if necessary.

Table 5-8 Coastal Emergency Actions for Caseys Beach

Action	Responsibility
Phase 1 – Prevention	
Provide advice to the community, landholders and the NSW SES about the potential for a coastal emergency event and the types of responses that are permitted and not permitted.	Council
Assess threats to life and property arising from a coastal emergency through the CMP process. Make the public aware of the hazards and risks through publication of the Eurobodalla Open Coast CMP and this CZEAS, and education campaigns.	NSW SES and Council
Council to monitor beach/dune condition and weather events such as warnings issued by the Bureau (i.e. Severe Weather Warnings from Port Kembla to Eden) and/or advice provided by Agencies which may impact the area.	Council
Phase 2 – Preparation	
Identify the most appropriate emergency coastal protection works including access and location. For Caseys Beach this is considered to be road closure. Once the proposed seawall upgrade (Option CH1_P) is complete wave overtopping should no longer occur and road closures will not likely be required.	Council
To prepare for cliff instability, maintain an adequate supply of fencing, hazard tape and hazard signage at the Council depot.	Council
Maintain the ability to mobilise required plant and equipment at short notice. This includes a bobcat in the event large rocks and debris need to be moved following a landslip.	Council
Develop an operations procedure to guide Council's response to coastal emergency events (including resourcing, internal training, testing and periodic review).	Council
Maintain up-to-date personal contact details for key Council staff involved in coordinating actions under this CZEAS and individuals Council may need advice from, such as DPE staff, or to integrate with personnel from other emergency sectors.	Council
Phase 3 – Response	
Implement the communication protocol in conjunction with the combat agency (NSW SES) to advise landholders, residents, public authorities and other organisations that a coastal emergency is likely or is occurring and that actions in this CZEAS are to be implemented.	Council and NSW SES

Action	Responsibility
Alert residents if risk level is high and if any emergency management actions are being implemented.	NSW SES
Erect temporary signage of dangers or closure to the beach.	Council
Evacuate residents if necessary.	NSW SES
Alert land managers about access requirements.	Council
Erect temporary signage of dangers or closure to the cliff area, etc and fencing to barricade access to the unstable cliff area (above and below area of instability).	Council
Increase surveillance of coastal hazards at this location.	Council
Place appropriate equipment on stand-by.	Council
Close affected Council managed roads, such as Beach Road, or liaise with road owners to enable closure.	Council
Phase 4 – Recovery	
Inspect the beach, public assets and properties after damaging storm events and carry out works to ensure the area is safe, including general clean up and clearing of any exposed debris, before taking down signage or reopening the area.	Council
Undertake cliff stabilisation works, if necessary. This may be done by anchoring (the use of terracing, planting, wiring or concrete supports to hold cliffs in place), smoothing the slope, or dewatering (drainage of excess rainwater to reduce waterlogging).	Council
If the Beach Road seawall construction works (Option CH1_P) are yet to be commenced, implement these works as a high priority recovery action.	Council
Erect permanent warning signs if necessary.	Council
Monitor the condition, performance and impact of any coastal protection works or emergency coastal protection works, following a structural inspection by a qualified engineer.	Council
Restore access to beaches and headlands.	Council
Maintain temporary safety fencing and associated warning signage, as necessary.	Council
Issue clean-up orders under the *Local Government Act 1993*.	Council
Assess the structural integrity of unprotected assets affected by or damaged during the coastal emergency event. Geotechnical, structural and/or coastal engineering investigations may be required to understand residual risk following a coastal emergency event.	Council
Liaise with property owners to ensure any private and/or public structures do not pose a risk to the public.	Council
Undertake works to re-establish or enhance the natural protective features of the coast, such as dune shaping and revegetation.	Council
Issue orders under the *Local Government Act 1993* and/or the *Environmental Planning and Assessment Act 1979* when properties are deemed structurally unsafe or pose a risk to the public.	Council
Replenish any emergency materials and supplies for future emergency events.	Council

Action	Responsibility
Critically review this CZEAS, communications protocol/plan and operational procedures to ensure they achieved their performance objectives. Amend if shortcomings or improvements are identified.	Council

5.9 Sunshine Bay

Sunshine Bay is subject to beach erosion.

Table 5-9 lists the response action plan for Sunshine Bay.

Table 5-9 Coastal Emergency Actions for Sunshine Bay

Action	Responsibility
Phase 1 – Prevention	
Provide advice to the community, landholders and the NSW SES about the potential for a coastal emergency event and the types of responses that are permitted and not permitted.	Council
Assess threats to life and property arising from a coastal emergency through the CMP process. Make the public aware of the hazards and risks through publication of the Eurobodalla Open Coast CMP and this CZEAS, and education campaigns.	NSW SES and Council
Council to monitor beach/dune condition and weather events such as warnings issued by the Bureau (i.e. Severe Weather Warnings from Port Kembla to Eden) and/or advice provided by Agencies which may impact the area.	Council
Phase 2 – Preparation	
Identify the most appropriate emergency coastal protection works including access and location. For Sunshine Bay this is considered to be toe protection using sand containers.	Council
Prepare an environment impact assessment for emergency coastal protection works and gain necessary approvals from state agencies.	Council
Maintain a stockpile of sand containers for the purpose of erosion protection works. These will be stored at the nearest Council Depot. Sand containers made of geotextile fabric or woven polypropylene fabric (not hessian) with maximum volume of $0.75m^3$ should be used (DECCW, 2011). It is recommended that a container volume of not less than $0.3m^3$ be used. Sand can be imported to the site from a lawfully approved source. Imported sand should have a grain size (D50) of at least 0.2mm and no greater than 0.25mm.	Council
Maintain the ability to mobilise required plant and equipment at short notice.	Council
Develop an operations procedure to guide Council's response to coastal emergency events (including resourcing, internal training, testing and periodic review).	Council
Maintain up-to-date personal contact details for key Council staff involved in coordinating actions under this CZEAS and individuals Council may need advice from, such as DPE staff, or to integrate with personnel from other emergency sectors.	Council
Private property owners at risk from coastal erosion can submit a Development Application to Council for the implementation of emergency coastal protection works on their land and ensuring Part 5 Section 27 is satisfied. The works on private property cannot be undertaken until the erosion scarp has reached the trigger line shown on **Figure 5-7** (approximately 8m from property boundaries).	Private property owners
Phase 3 – Response	

Action	Responsibility
Implement the communication protocol in conjunction with the combat agency (NSW SES) to advise landholders, residents, public authorities and other organisations that a coastal emergency is likely or is occurring and that actions in this CZEAS are to be implemented.	Council and NSW SES
Alert residents if risk level is high and if any emergency management actions are being implemented.	NSW SES
Evacuate residents if necessary.	NSW SES
Alert land managers about access requirements.	Council
Erect temporary signage of dangers or closure to the beach.	Council
Increase surveillance of coastal hazards at this location.	Council
Place appropriate equipment on stand-by.	Council
Dune toe protection works should be undertaken prior to dangerous ocean conditions developing, if the following triggers are reached: • East Coast Low predicted • Erosion scarp is at trigger line (**Figure 5-7**) The protection structure will be temporary and constructed as a single stack of containers along the erosion scarp to a maximum height of 1.5m from the toe of the escarpment (DECCW, 2011). Approximately 25 containers are required for every 10m of structure length, with the total number required dependant on the length of shoreline requiring immediate protection and the number of containers that can be installed in the time available. Emergency protection would prioritise sections of the shoreline most exposed at the time and remain within the area specified on **Figure 5-7**. Plant and equipment should access the works area via **Beach Road** avoiding disturbance to surrounding areas, in particular to any dune vegetation.	Council
Where an approved Development Application exists, dune toe protection works on private property may be undertaken to protect private property prior to dangerous ocean conditions developing, if the following triggers are reached: • East Coast Low predicted and; Erosion scarp is at trigger line (**Figure 5-7**), located approximately 8m from property boundaries.	Private property owners
Phase 4 – Recovery	
Inspect the beach, public assets and properties after damaging storm events and carry out works to ensure the area is safe, including general clean up and clearing of any exposed debris, before taking down signage or reopening the area.	Council
Beach scraping may be undertaken to restore public beach access following storm erosion and to assist beach recovery. The location and scale of beach scraping activities will depend on the damage caused by the event and will need to be determined at the time of the event. Beach scraping involves the relocation (by mechanical means) of sand from the intertidal zone to the upper beach or dune. The volumes practically able to be moved will not be sufficient to renourish the beach profile following a large erosion event, however, can be used to	Council

Action	Responsibility
enhance the remaining dune and accelerate the natural process of dune re-building. The ‘borrow’ area should be restricted to within the intertidal zone with no greater than 0.5m depth removed from the beach profile between elevations of -0.5mAHD and +1mAHD. The ‘placement’ area should be placed at the base of the erosion scarp at a slope of approximately 1 in 2. Placement volumes are likely to be approximately 10-15m3/m width of beach.	
Erect permanent warning signs if necessary.	Council
Remove any sand containers within 90 days.	Council Private property owners
Monitor the condition, performance and impact of any coastal protection works or emergency coastal protection works.	Council
Restore access to beaches and headlands.	Council
Maintain temporary safety fencing and associated warning signage, as necessary.	Council
Issue clean-up orders under the *Local Government Act 1993*.	Council
Assess the structural integrity of unprotected assets affected by or damaged during the coastal emergency event. Geotechnical, structural and/or coastal engineering investigations may be required to understand residual risk following a coastal emergency event.	Council
Liaise with property owners to ensure any private and/or public structures do not pose a risk to the public.	Council
Undertake works to re-establish or enhance the natural protective features of the coast, such as dune shaping and revegetation.	Council
Issue orders under the *Local Government Act 1993* and/or the *Environmental Planning and Assessment Act 1979* when properties are deemed structurally unsafe or pose a risk to the public.	Council
Replenish any emergency materials and supplies for future emergency events.	Council
Critically review this CZEAS, communications protocol/plan and operational procedures to ensure they achieved their performance objectives. Amend if shortcomings or improvements are identified.	Council

Figure 5-7 Sunshine Bay Erosion Protection Works

5.10 Malua Bay

Malua Bay is subject to beach erosion and coastal inundation.

Table 5-10 lists the response action plan for Malua Bay.

Table 5-10 Coastal Emergency Actions for Malua Bay

Action	Responsibility
Phase 1 – Prevention	
Provide advice to the community, landholders and the NSW SES about the potential for a coastal emergency event and the types of responses that are permitted and not permitted.	Council
Assess threats to life and property arising from a coastal emergency through the CMP process. Make the public aware of the hazards and risks through publication of the Eurobodalla Open Coast CMP and this CZEAS, and education campaigns.	NSW SES and Council
Council to monitor beach/dune condition and weather events such as warnings issued by the Bureau (i.e. Severe Weather Warnings from Port Kembla to Eden) and/or advice provided by Agencies which may impact the area.	Council
Phase 2 – Preparation	
Identify the most appropriate emergency coastal protection works including access and location. For Malua Bay this is considered to be toe protection using sand containers or sand nourishment via beach scraping if conditions/resources permit.	Council
Prepare an environment impact assessment for emergency coastal protection works and gain necessary approvals from state agencies.	Council
Maintain a stockpile of sand containers for the purpose of erosion protection works. These will be stored at the nearest Council Depot. Sand containers made of geotextile fabric or woven polypropylene fabric (not hessian) with maximum volume of 0.75m^3 should be used (DECCW, 2011). It is recommended that a container volume of not less than 0.3m^3 be used. Sand can be imported to the site from a lawfully approved source. Imported sand should have a grain size (D50) of at least 0.2mm and no greater than 0.25mm.	Council
Maintain the ability to mobilise required plant and equipment at short notice.	Council
Maintain the ability to mobilise required plant and equipment at short notice. This includes a bobcat, filling frame and sewing machine.	Council
Develop an operations procedure to guide Council's response to coastal emergency events (including resourcing, internal training, testing and periodic review).	Council

Action	Responsibility
Maintain up-to-date personal contact details for key Council staff involved in coordinating actions under this CZEAS and individuals Council may need advice from, such as DPE staff, or to integrate with personnel from other emergency sectors.	Council
Phase 3 – Response	
Implement the communication protocol in conjunction with the combat agency (NSW SES) to advise landholders, residents, public authorities and other organisations that a coastal emergency is likely or is occurring and that actions in this CZEAS are to be implemented.	Council and NSW SES
Alert residents if risk level is high and if any emergency management actions are being implemented.	NSW SES
Erect temporary signage of dangers or closure to the beach.	Council
Evacuate residents if necessary.	NSW SES
Alert land managers about access requirements.	Council
Increase surveillance of coastal hazards at this location.	Council
Place appropriate equipment on stand-by.	Council
Dune toe protection works should be undertaken prior to dangerous ocean conditions developing, if the following triggers are reached: • East Coast Low predicted • Erosion scarp is at trigger line (**Figure 5-8**) The protection structure will be temporary and constructed as a single stack of containers along the erosion scarp to a maximum height of 1.5m from the toe of the escarpment (DECCW, 2011). Approximately 25 containers are required for every 10m of structure length, with the total number required dependant on the length of shoreline requiring immediate protection and the number of containers that can be installed in the time available. Emergency protection would prioritise sections of the shoreline most exposed at the time and remain within the area specified on **Figure 5-8**. Beach scraping as a form of beach nourishment, could also be undertaken if time, resource and event magnitude permit. Determination of beach scraping location will involve consultation with relevant NSW government agencies as per the communication protocol. Beach scraping involves the relocation (by mechanical means) of sand from the intertidal zone to the upper beach or dune. The volumes practically able to be moved will not be generally sufficient to renourish the beach profile**,** however, can be used to enhance the remaining dune, provide buffer to the asset and accelerate the natural process of dune re-building. The ‘borrow’ area should be restricted to within the intertidal zone with no greater than 0.3m depth removed from the beach profile between elevations of -0.5mAHD and +1mAHD.	Council

Action	Responsibility
The 'placement' area should be placed at the base of the asset at a slope of approximately 1 in 7. Placement volumes are likely to be approximately 15-20m3/m width of beach. Ideally a small lip can be left to minimise sand blowing over the top of foreshore, and/or other considerations such as use of jute mesh and plantings on the landward margin of the nourishment if appropriate can increase stability. The sand scraping area is shown on **Figure 5-8**. Plant and equipment should access the area to be sandbagged via **George Bass Drive or Kuppa Avenue**, avoiding disturbance to surrounding areas, in particular to any dune vegetation.	
Close affected Council managed roads, such as Kuppa Avenue, or liaise with road owners to enable closure.	Council
Phase 4 – Recovery	
Inspect the beach, public assets and properties after damaging storm events and carry out works to ensure the area is safe, including general clean up and clearing of any exposed debris, before taking down signage or reopening the area.	Council
Beach scraping may be undertaken if required to restore public beach access following storm erosion and to assist beach recovery. The location and scale of beach scraping activities will depend on the damage caused by the event and will need to be determined at the time of the event. Beach scraping involves the relocation (by mechanical means) of sand from the intertidal zone to the upper beach or dune. The volumes practically able to be moved will not be sufficient to renourish the beach profile following a large erosion event, however, can be used to enhance the remaining dune and accelerate the natural process of dune re-building. The 'borrow' area should be restricted to within the intertidal zone with no greater than 0.5m depth removed from the beach profile between elevations of -0.5mAHD and +1mAHD. The 'placement' area should be placed at the base of the erosion scarp at a slope of approximately 1 in 7. Placement volumes are likely to be approximately 10-15m3/m width of beach.	Council
Erect permanent warning signs if necessary.	Council
Remove any sand containers within 90 days.	Council
Monitor the condition, performance and impact of any coastal protection works or emergency coastal protection works.	Council
Restore access to beaches and headlands.	Council
Maintain temporary safety fencing and associated warning signage, as necessary.	Council
Issue clean-up orders under the *Local Government Act 1993*.	Council
Assess the structural integrity of unprotected assets affected by or damaged during the coastal emergency event. Geotechnical, structural and/or coastal engineering investigations may be required to understand residual risk following a coastal emergency event.	Council

Action	Responsibility
Liaise with property owners to ensure any private and/or public structures do not pose a risk to the public.	Council
Undertake works to re-establish or enhance the natural protective features of the coast, such as dune shaping and revegetation.	Council
Issue orders under the *Local Government Act 1993* and/or the *Environmental Planning and Assessment Act 1979* when properties are deemed structurally unsafe or pose a risk to the public.	Council
Replenish any emergency materials and supplies for future emergency events.	Council
Critically review this CZEAS, communications protocol/plan and operational procedures to ensure they achieved their performance objectives. Amend if shortcomings or improvements are identified.	Council

Figure 5-8 Malua Bay Erosion Protection Works

5.11 Guerilla Bay

Guerilla Bay is subject to beach erosion and coastal inundation.

Table 5-11 lists the response action plan for Guerilla Bay.

Table 5-11 Coastal Emergency Actions for Guerilla Bay

Action	Responsibility
Phase 1 – Prevention	
Provide advice to the community, landholders and the NSW SES about the potential for a coastal emergency event and the types of responses that are permitted and not permitted.	Council
Assess threats to life and property arising from a coastal emergency through the CMP process. Make the public aware of the hazards and risks through publication of the Eurobodalla Open Coast CMP and this CZEAS, and education campaigns.	NSW SES and Council
Council to monitor beach/dune condition and weather events such as warnings issued by the Bureau (i.e. Severe Weather Warnings from Port Kembla to Eden) and/or advice provided by Agencies which may impact the area.	Council
Phase 2 – Preparation	
Identify the most appropriate emergency coastal protection works including access and location. For Guerilla Bay this is considered to be severe storm warnings.	Council
Maintain up-to-date personal contact details for key Council staff involved in coordinating actions under this CZEAS and individuals Council may need advice from, such as DPE staff, or to integrate with personnel from other emergency sectors.	Council
Phase 3 – Response	
Implement the communication protocol in conjunction with the combat agency (NSW SES) to advise landholders, residents, public authorities and other organisations that a coastal emergency is likely or is occurring and that actions in this CZEAS are to be implemented.	Council and NSW SES
Alert residents if risk level is high and if any emergency management actions are being implemented.	NSW SES
Erect temporary signage of dangers or closure to the beach.	Council
Increase surveillance of coastal hazards at this location.	Council
Phase 4 – Recovery	
Inspect the beach, public assets and properties after damaging storm events and carry out works to ensure the area is safe, including general clean up and clearing of any exposed debris, before taking down signage or reopening the area.	Council
Beach scraping may be undertaken to restore public beach access following storm erosion and to assist beach recovery. The location and scale of beach scraping activities will depend on the damage caused by the event and will need to be determined at the time of the event. Beach scraping involves the relocation (by mechanical means) of sand from the intertidal zone to the upper beach or dune. The volumes practically able to be moved will not be sufficient to	Council

Action	Responsibility
renourish the beach profile following a large erosion event, however, can be used to enhance the remaining dune and accelerate the natural process of dune re-building. The 'borrow' area should be restricted to within the intertidal zone with no greater than 0.5m depth removed from the beach profile between elevations of -0.5mAHD and +1mAHD. The 'placement' area should be placed at the base of the erosion scarp at a slope of approximately 1 in 2. Placement volumes are likely to be approximately 10-15m3/m width of beach.	
Erect permanent warning signs if necessary.	Council
Restore access to beaches and headlands.	Council
Maintain temporary safety fencing and associated warning signage, as necessary.	Council
Issue clean-up orders under the *Local Government Act 1993*.	Council
Assess the structural integrity of unprotected assets affected by or damaged during the coastal emergency event. Geotechnical, structural and/or coastal engineering investigations may be required to understand residual risk following a coastal emergency event.	Council
Liaise with property owners to ensure any private and/or public structures do not pose a risk to the public.	Council
Undertake works to re-establish or enhance the natural protective features of the coast, such as dune shaping and revegetation.	Council
Issue orders under the *Local Government Act 1993* and/or the *Environmental Planning and Assessment Act 1979* when properties are deemed structurally unsafe or pose a risk to the public.	Council
Critically review this CZEAS, communications protocol/plan and operational procedures to ensure they achieved their performance objectives. Amend if shortcomings or improvements are identified.	Council

5.12 Barlings Beach

Barlings Beach is subject to beach erosion and coastal inundation.

Table 5-12 lists the response action plan for Barlings Beach.

Table 5-12 Coastal Emergency Actions for Barlings Beach

Action	Responsibility
Phase 1 – Prevention	
Provide advice to the community, landholders and the NSW SES about the potential for a coastal emergency event and the types of responses that are permitted and not permitted.	Council
Assess threats to life and property arising from a coastal emergency through the CMP process. Make the public aware of the hazards and risks through publication of the Eurobodalla Open Coast CMP and this CZEAS, and education campaigns.	NSW SES and Council
Council to monitor beach/dune condition and weather events such as warnings issued by the Bureau (i.e. Severe Weather Warnings from Port Kembla to Eden) and/or advice provided by Agencies which may impact the area.	Council
Phase 2 – Preparation	
Identify the most appropriate emergency coastal protection works including access and location. For Barlings Beach this is considered to be severe storm warnings.	Council
Maintain up-to-date personal contact details for key Council staff involved in coordinating actions under this CZEAS and individuals Council may need advice from, such as DPE staff, or to integrate with personnel from other emergency sectors.	Council
Phase 3 – Response	
Implement the communication protocol in conjunction with the combat agency (NSW SES) to advise landholders, residents, public authorities and other organisations that a coastal emergency is likely or is occurring and that actions in this CZEAS are to be implemented.	Council and NSW SES
Alert residents if risk level is high and if any emergency management actions are being implemented.	NSW SES
Erect temporary signage of dangers or closure to the beach.	Council
Increase surveillance of coastal hazards at this location.	Council
Phase 4 – Recovery	
Inspect the beach, public assets and properties after damaging storm events and carry out works to ensure the area is safe, including general clean up and clearing of any exposed debris, before taking down signage or reopening the area.	Council
Erect permanent warning signs if necessary.	Council
Beach scraping may be undertaken to restore public beach access following storm erosion and to assist beach recovery. The location and scale of beach scraping activities will depend on the damage caused by the event and will need to be determined at the time of the event. Beach scraping involves the relocation (by mechanical means) of sand from the intertidal zone to the upper	Council

Action	Responsibility
beach or dune. The volumes practically able to be moved will not be sufficient to renourish the beach profile following a large erosion event, however, can be used to enhance the remaining dune and accelerate the natural process of dune re-building. The 'borrow' area should be restricted to within the intertidal zone with no greater than 0.5m depth removed from the beach profile between elevations of -0.5mAHD and +1mAHD. The 'placement' area should be placed at the base of the erosion scarp at a slope of approximately 1 in 2. Placement volumes are likely to be approximately 10-15m3/m width of beach.	
Restore access to beaches and headlands.	Council
Maintain temporary safety fencing and associated warning signage, as necessary.	Council
Issue clean-up orders under the *Local Government Act 1993*.	Council
Liaise with property owners to ensure any private and/or public structures do not pose a risk to the public.	Council
Undertake works to re-establish or enhance the natural protective features of the coast, such as dune shaping and revegetation.	Council
Issue orders under the *Local Government Act 1993* and/or the *Environmental Planning and Assessment Act 1979* when properties are deemed structurally unsafe or pose a risk to the public.	Council
Critically review this CZEAS, communications protocol/plan and operational procedures to ensure they achieved their performance objectives. Amend if shortcomings or improvements are identified.	Council

5.13 Tomakin Cove

Tomakin Cove is subject to beach erosion.

Table 5-13 lists the response actions specific to Tomakin Cove, including the abovementioned CMP option, if triggered by the event.

Table 5-13 Coastal Emergency Actions for Tomakin Cove

Action	Responsibility
Phase 1 – Prevention	
Provide advice to the community, landholders and the NSW SES about the potential for a coastal emergency event and the types of responses that are permitted and not permitted.	Council
Assess threats to life and property arising from a coastal emergency through the CMP process. Make the public aware of the hazards and risks through publication of the Eurobodalla Open Coast CMP and this CZEAS, and education campaigns.	NSW SES and Council
Council to monitor beach/dune condition and weather events such as warnings issued by the Bureau (i.e. Severe Weather Warnings from Port Kembla to Eden) and/or advice provided by Agencies which may impact the area.	Council
Phase 2 – Preparation	
Identify the most appropriate emergency coastal protection works including access and location. For Tomakin Cove this is considered to be severe storm warnings.	Council
Maintain up-to-date personal contact details for key Council staff involved in coordinating actions under this CZEAS and individuals Council may need advice from, such as DPE staff, or to integrate with personnel from other emergency sectors.	Council
Phase 3 – Response	
Implement the communication protocol in conjunction with the combat agency (NSW SES) to advise landholders, residents, public authorities and other organisations that a coastal emergency is likely or is occurring and that actions in this CZEAS are to be implemented.	Council and NSW SES
Alert residents if risk level is high and if any emergency management actions are being implemented.	NSW SES
Erect temporary signage of dangers or closure to the beach.	Council
Evacuate residents if necessary.	NSW SES
Alert land managers about access requirements.	Council
Increase surveillance of coastal hazards at this location.	Council
Phase 4 – Recovery	
Inspect the beach, public assets and properties after damaging storm events and carry out works to ensure the area is safe, including general clean up and clearing of any exposed debris, before taking down signage or reopening the area.	Council
Beach scraping may be undertaken if required to restore public beach access following storm erosion and to assist beach recovery. The location and scale of beach scraping activities will depend on the damage caused by the event and will	Council

Action	Responsibility
need to be determined at the time of the event. Beach scraping involves the relocation (by mechanical means) of sand from the intertidal zone to the upper beach or dune. The volumes practically able to be moved will not be sufficient to renourish the beach profile following a large erosion event, however, can be used to enhance the remaining dune and accelerate the natural process of dune re-building. The 'borrow' area should be restricted to within the intertidal zone with no greater than 0.5m depth removed from the beach profile between elevations of -0.5mAHD and +1mAHD. The 'placement' area should be placed at the base of the erosion scarp at a slope of approximately 1 in 5. Placement volumes are likely to be approximately 10-15m3/m width of beach.	
Restore access to beaches and headlands.	Council
Maintain temporary safety fencing and associated warning signage, as necessary.	Council
Issue clean-up orders under the *Local Government Act 1993*.	Council
Assess the structural integrity of unprotected assets affected by or damaged during the coastal emergency event. Geotechnical, structural and/or coastal engineering investigations may be required to understand residual risk following a coastal emergency event.	Council
Liaise with property owners to ensure any private and/or public structures do not pose a risk to the public.	Council
Undertake works to re-establish or enhance the natural protective features of the coast, such as dune shaping and revegetation.	Council
Issue orders under the *Local Government Act 1993* and/or the *Environmental Planning and Assessment Act 1979* when properties are deemed structurally unsafe or pose a risk to the public.	Council
Replenish any emergency materials and supplies for future emergency events.	Council
Critically review this CZEAS, communications protocol/plan and operational procedures to ensure they achieved their performance objectives. Amend if shortcomings or improvements are identified.	Council

5.14 Broulee

Broulee is subject to beach erosion and coastal inundation.

Table 5-14 lists the response action plan for Broulee.

Table 5-14 Coastal Emergency Actions for Broulee

Action	Responsibility
Phase 1 – Prevention	
Provide advice to the community, landholders and the NSW SES about the potential for a coastal emergency event and the types of responses that are permitted and not permitted.	Council
Assess threats to life and property arising from a coastal emergency through the CMP process. Make the public aware of the hazards and risks through publication of the Eurobodalla Open Coast CMP and this CZEAS, and education campaigns.	NSW SES and Council
Council to monitor beach/dune condition and weather events such as warnings issued by the Bureau (i.e. Severe Weather Warnings from Port Kembla to Eden) and/or advice provided by Agencies which may impact the area.	Council
Phase 2 – Preparation	
Identify the most appropriate emergency coastal protection works including access and location. For Broulee this is considered to be road closure, and evacuation of residents, as required.	Council
Maintain up-to-date personal contact details for key Council staff involved in coordinating actions under this CZEAS and individuals Council may need advice from, such as DPE staff, or to integrate with personnel from other emergency sectors.	Council
Private property owners at risk from coastal erosion can submit a Development Application to Council for the implementation of emergency coastal protection works on their land and ensuring Part 5 Section 27 is satisfied. The works on private property cannot be undertaken until the erosion scarp has reached the trigger line shown on **Figure 5-9** (approximately 12m from property boundaries).	Private property owners
Phase 3 – Response	
Implement the communication protocol in conjunction with the combat agency (NSW SES) to advise landholders, residents, public authorities and other organisations that a coastal emergency is likely or is occurring and that actions in this CZEAS are to be implemented.	Council and NSW SES
Alert residents if risk level is high and if any emergency management actions are being implemented.	NSW SES
Erect temporary signage of dangers or closure to the beach.	Council
Evacuate residents if necessary.	NSW SES
Increase surveillance of coastal hazards at this location.	Council
Close affected Council managed roads, such as Candlagan Drive, or liaise with road owners to enable closure.	Council

Action	Responsibility
Where an approved Development Application exists, dune toe protection works on private property may be undertaken to protect private property prior to dangerous ocean conditions developing, if the following triggers are reached: • East Coast Low predicted and; Erosion scarp is at trigger line (**Figure 5-9**), located approximately 12m from property boundaries.	Private property owners
Phase 4 – Recovery	
Inspect the beach, public assets and properties after damaging storm events and carry out works to ensure the area is safe, including general clean up and clearing of any exposed debris, before taking down signage or reopening the area.	Council
Erect permanent warning signs if necessary.	Council
Remove any sand containers within 90 days.	Private property owners
Monitor the condition, performance and impact of any coastal protection works or emergency coastal protection works.	Council
Restore access to beaches and headlands.	Council
Maintain temporary safety fencing and associated warning signage, as necessary.	Council
Issue clean-up orders under the *Local Government Act 1993*.	Council
Assess the structural integrity of unprotected assets affected by or damaged during the coastal emergency event. Geotechnical, structural and/or coastal engineering investigations may be required to understand residual risk following a coastal emergency event.	Council
Liaise with property owners to ensure any private and/or public structures do not pose a risk to the public.	Council
Undertake works to re-establish or enhance the natural protective features of the coast, such as dune shaping and revegetation.	Council
Issue orders under the *Local Government Act 1993* and/or the *Environmental Planning and Assessment Act 1979* when properties are deemed structurally unsafe or pose a risk to the public.	Council
Replenish any emergency materials and supplies for future emergency events.	Council
Critically review this CZEAS, communications protocol/plan and operational procedures to ensure they achieved their performance objectives. Amend if shortcomings or improvements are identified.	Council

Figure 5-9 Broulee Erosion Protection Works

5.15 Aboriginal Cultural Sites

The Eurobodalla Coastline has significant Aboriginal cultural heritage sites. This includes extensive coastal middens, burial sites and artefacts and other cultural aspects and values that are of importance to the First Nations community. The coastal risks associated with beach erosion and cliff instability can impact these sites.

Table 5-15 lists the response action plan for these locations.

Table 5-15 Coastal Emergency Actions for Aboriginal Cultural Heritage Sites

Action	Responsibility
Phase 1 – Prevention	
Work in partnership with the Aboriginal community, LALCS, DPE, NPWS and Heritage NSW to understand and provide advice to the community, landholders and the NSW SES about the potential for a coastal emergency event and the types of responses that are permitted and not permitted.	Council
Assess threats to cultural assets arising from a coastal emergency through the CMP process for both known and high potential locations.	Council
Council to monitor beach/dune condition and weather events such as warnings issued by the Bureau (i.e. Severe Weather Warnings from Port Kembla to Eden) and/or advice provided by Agencies which may impact the area.	Council
Phase 2 – Preparation	
Identify the most appropriate emergency coastal protection works including access and location. For known locations this is documented in the 'EASP Aboriginal Cultural Heritage Sites Confidential Report'. This report documents the location, appropriate emergency coastal works and trigger that has been developed in consultation with the Aboriginal community, LALCS, DPE, NPWS and Heritage NSW. For all high potential locations contained in **Figure 5-10**. the appropriate emergency coastal protection work is considered to be site protection using sand containers or beach nourishment.	Council
Prepare an environment impact assessment for emergency coastal protection works and gain necessary approvals from state agencies.	Council
Maintain a stockpile of sand containers for the purpose of erosion protection works. These will be stored at the nearest Council Depot. Sand containers made of geotextile fabric or woven polypropylene fabric (not hessian) with maximum volume of 0.75m^3 should be used (DECCW, 2011). It is recommended that a container volume of not less than 0.3m^3 be used. Sand can be imported to the site from a lawfully approved source. Imported sand should have a grain size (D50) of at least 0.2mm and no greater than 0.25mm. This applies for both sand containers and beach nourishment. For beach scraping as a form of beach nourishment, the location and scale of beach scraping activities will depend on the determined buffer required in anticipation of the event and asset at risk. This will involve the Aboriginal community and relevant NSW government agencies as per the communication protocol.	Council
Maintain the ability to mobilise required plant and equipment at short notice.	Council

Action	Responsibility
Develop an operations procedure to guide Council's response to coastal emergency events (including resourcing, internal training, testing and periodic review).	Council
Maintain up-to-date personal contact details for key Council staff involved in coordinating actions under this CZEAS and individuals Council may need advice from, such as LALCs, Heritage NSW, DPE, NPWS staff, or to integrate with personnel from other emergency sectors.	Council
Phase 3 – Response	
Implement the communication protocol in conjunction with the combat agency (NSW SES) to discuss actions with the Aboriginal Community, LALCs, Heritage NSW, DPE, NPWS, landholders, residents, public authorities and other organisations that a coastal emergency is likely or is occurring and that actions in this CZEAS are to be implemented.	Council and NSW SES
If any emergency management actions are being implemented, alert Aboriginal community, LALCs, Heritage NSW, DPE, NPWS, landholders, residents, public authorities	Council
Erect temporary signage of dangers or closure to the beach.	Council
Alert land managers about access requirements.	Council
Increase surveillance of coastal hazards at this location.	Council
Place appropriate equipment on stand-by.	Council
Protection works should be undertaken prior to dangerous ocean conditions developing, if the following triggers are reached: • East Coast Low predicted and • Existing erosion scarp within nominated distance identified 'EASP Aboriginal Cultural Heritage Sites Confidential Report' • Or for high potential locations, exposure of Aboriginal cultural site occurs and Aboriginal community and/or NSW Government Agencies have discussed, and emergency protection works are required. The emergency protection structure will be temporary and constructed as a stack of containers to a maximum height of 1.5m from the toe of the escarpment (DECCW, 2011). Approximately 25 containers are required for every 10m of structure length, with the total number required dependant on the length of shoreline requiring immediate protection and the number of containers that can be installed in the time available. Emergency protection would prioritise sections of the shoreline and assets most exposed at the time. For beach scraping as a form of beach nourishment, the location and scale of beach scraping activities will depend on the determined buffer required in anticipation of the event and asset at risk. This will involve the Aboriginal community and relevant NSW government agencies as per the communication protocol. Beach scraping involves the relocation (by mechanical means) of sand from the intertidal zone to the upper beach or dune. The volumes practically able to be	Council

Action	Responsibility
moved will not be generally sufficient to renourish the beach profile, however, can be used to enhance the remaining dune, provide buffer to the asset and accelerate the natural process of dune re-building. The ‘borrow’ area should be restricted to within the intertidal zone with no greater than 0.5m depth removed from the beach profile between elevations of -0.5mAHD and +1mAHD. The ‘placement’ area should be placed at the base of the asset at a slope of approximately 1 in 7. Placement volumes are likely to be approximately 10-20m3/m width of beach. Ideally a small lip can be left to minimise sand blowing over the top of foreshore, and/or other considerations such as use of jute mesh and plantings on the landward margin of the nourishment if appropriate can increase stability. Plant and equipment for undertaking the works should avoid disturbance to surrounding areas, in particular damage to aboriginal cultural assets and existing dune and cliff vegetation.	
Phase 4 – Recovery	
Inspect the beach and cultural sites after damaging storm events and carry out works to ensure the area is safe, including general clean up and clearing of any exposed debris, before taking down signage or reopening the area.	Council
Beach scraping may be undertaken if required to restore public beach access following storm erosion and to assist beach recovery.	Council
Erect permanent warning signs if necessary.	Council
Remove any sand containers within 90 days.	Council
Monitor the condition, performance and impact of any coastal protection works or emergency coastal protection works.	Council
Restore access to beaches and headlands.	Council
Maintain temporary safety fencing and associated warning signage, as necessary.	Council
Replenish any emergency materials and supplies for future emergency events.	Council
Critically review this CZEAS, communications protocol/plan and operational procedures to ensure they achieved their performance objectives. Amend if shortcomings or improvements are identified.	Council

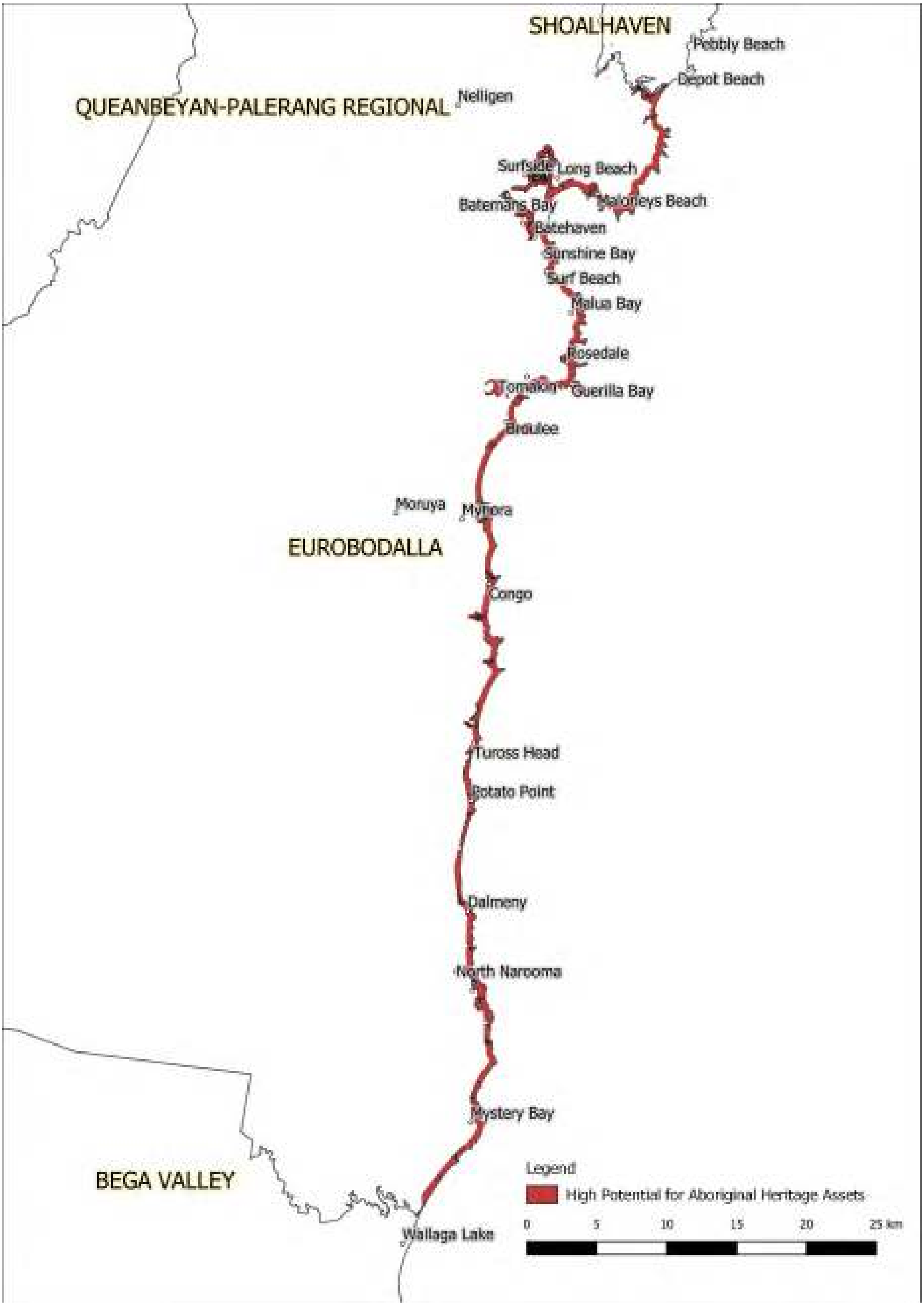

Figure 5-10 High Potential Locations for Aboriginal Heritage Assets

6 Other Emergency Response Details

6.1 Emergency Coordination Centres

The key coordination centre will be the Eurobodalla Shire Council Administration Centre. Alternative centres may include the central hubs for emergency response services, such as NSW SES or RFS hubs in Moruya.

6.2 Approval Pathways

Information on approval pathways for coastal protection works and emergency coastal protection works are set out in the Coastal protection works fact sheet (DPE, 2018).

A public authority, such as Council, cay carry out coastal protection works without development consent if the works are (DPE, 2018):

- Identified in the relevant certified CMP
- Beach nourishment
- Placing sandbags for not more than 90 days
- Routine maintenance works or repairs to existing coastal protection works.

A public authority, such as Council, can conduct emergency coastal protection works, as exempt development, where these works are in accordance with a CZEAS (this document) prepared by Council and included in the relevant certified CMP (DPE, 2018).

The fact sheet (DPE, 2018) notes that other approvals may still be required under different legislation.

6.3 Recording Coastal Emergency Impacts and Emergency Response Actions

After a coastal emergency event, Council will record the following details in a database in order to maintain effective emergency actions and understand any changes in coastal conditions over time:

- Details of any beach erosion, coastal inundation, landslips or cliff instability and the weather conditions under which they were caused, including photographs, locations of assets and infrastructure that were damaged by the storm and details of the extent of damage
- Details of any emergency coastal protection works undertaken, including the cost and the installation date
- Details of any survey of the beach levels and other features that may be considered required to provide a greater understanding of the hazard or the event
- Review and update (if required) this CZEAS, in particular the Emergency Action Plan, in consultation with the NSW SES and any other relevant agencies.

The records of storm events, extent of damage and coastal protection works will assist Council to understand how climate change and/or extreme events are affecting its coastline and to better plan for retreat of some assets over time, to adapt to the effects of sea level rise and other factors such as increasing storm frequency and intensity.

7 Communication Protocol for Coastal Emergency Events

This section outlines the communications required before, during and after a coastal emergency event to inform 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.

Eurobodalla Shire Council will provide information about anticipated coastal emergency events to residents near the hazard zones and community representatives from the Surf Life Saving Clubs, holiday park and nearby businesses through the following mechanisms:

- Provide routine emergency management briefings to Council staff to communicate the strategy outlined in this CZEAS, including coastal emergency event triggers, locations at risk, roles and responsibilities and the emergency response actions, including ensuring they have the capacity to respond
- Provide emergency management briefings to the public as needed, in particular affected landholders, to communicate the strategy outlined in this CZEAS, including coastal emergency event triggers, locations at risk, roles and responsibilities and the emergency response actions, including what actions a landholder may need to take and any assistance that may be available to them
- Provide emergency management information (in the form of signage and brochures) at local community centres and at Council offices
- Coordinate with the NSW SES to issue safety advice to landowners and the community of the likelihood of an impending emergency that would initiate actions under this CZEAS and ensure residents are aware of urgent hazards during emergency events, and provide assistance with door-to-door communication as necessary
- Communicate with relevant NSW Stage Government agencies if sand nourishment is being pursued.
- For Aboriginal cultural sites identified in 5.15 above, consult with the Aboriginal community, LALCS, DPE, NPWS and Heritage NSW prior to any works being undertaken.
- Place barriers and signage at beach accessways and roads that are closed due to coastal erosion and/or coastal inundation impacts
- Provide up to date information on Council's website regarding beach accessway/area closures and road closures and re-openings.

8 References

ACT Geotechnical Engineers Pty Ltd (2012). *Geotechnical Slope Instability Risk Assessment*. Prepared on behalf of Umwelt Australia Pty Ltd as an input to the Coastal Zone Management Plan.

BoM (2022) Severe Weather Warning Services. Australian Government Bureau of Meteorology. Available online: http://www.bom.gov.au/weather-services/severe-weather-knowledge-centre/WarningsInformation_SW_SWW.shtml.

DECCW (2011) *Guide to the Statutory Requirements for Emergency Coastal Protection Works*. March 2011. Repealed.

DPE (2018) *Coastal Management State Environmental Planning Policy – Fact Sheet 3: Coastal Protection Works*. April 2018.

DPIE (2019). *Guideline for preparing a coastal zone emergency action subplan*.

ESC (2017). *Coastal Zone Management Plan Wharf Road North Batemans Bay*.

ESC (2019). *Eurobodalla Local Emergency Management Plan 2019*.

Australian Geomechanics Society (2007). *Australian GeoGuide LR2 (Landslides)*. Australian Geomechanics, Vol 42 No 1 Page 162.

Illawarra South Coast Regional Emergency Management Committee (2019). *Illawarra South Coast Regional Emergency Management Plan*. February 2019.

NSW SES (2013) *Eurobodalla Shire Local Flood Plan*. A Sub-Plan of the Eurobodalla Shire Local Emergency Management Plan.

NSW SES (2018a). *New South Wales State Storm Plan*. A Sub Plan of the State Emergency Management Plan. Endorsed by the State Emergency Management Committee, 7 June 2018.

NSW SES (2018b). *New South Wales State Tsunami Plan*. A Sub Plan of the State Emergency Management Plan. Endorsed by the State Emergency Management Committee, 13 September 2018.

NSW SES (2021). *New South Wales State Flood Plan*. A Sub Plan of the State Emergency Management Plan. Endorsed by the State Emergency Management Committee, 2 December 2021.

OEH (2018). Coastal Management Manual.

Rhelm (2021). *Eurobodalla Open Coast Coastal Management Program Stage 1 – Scoping Study.* Prepared for Eurobodalla Shire Council. Final report, 27 July 2021.

Rhelm (2022a). *Eurobodalla Open Coast Coastal Management Program Stage 2 – Vulnerability Assessments.* Prepared for Eurobodalla Shire Council. Final report, 21 January 2022.

Rhelm (2022b). *Eurobodalla Open Coast Coastal Management Program.* Prepared for Eurobodalla Shire Council. Draft report for Public Exhibition, May 2022.

SMEC (2010). *Eurobodalla Shire Coastal Hazards Scoping Study*. Report prepared for Eurobodalla Shire Council.

Umwelt (2016) *Emergency Action Subplan for the Wharf Road Coastal Erosion 'Hot Spot' Batemans Bay, NSW*. Prepared for Eurobodalla Shire Council. Amended November 2016.

WRL (2017). *Eurobodalla Coastal Hazard Assessment*. WRL Technical Report 2017/09. Report prepared for Eurobodalla Shire Council. October.

Appendix A

Cliff Instability Maps

LEGEND

F1: Feature 1 - Differential Erosion of Phyllite Beds
F2: Feature 2 - Undercut Slope Top
F3: Feature 3 - Dwellings near Slope Top
F4: Feature 4 - Slope at Rear of Dwellings in Bay Road

AERIAL PHOTOGRAPH & LOCATION OF CLIFF INSTABILITY FEATURES – LONG BEACH

Adapted from ACT Geotechnical Engineers Pty Ltd **Appendix D - Map D1**

LEGEND

F1: Feature 1 - Dwellings facing Beach Road at SW Headland End
F2: Feature 2 - Soil Erosion near Slope Base
F3: Feature 3 - Soil & Weathered Rock Erosion of Steep Slope
F4: Feature 4 - Erosion of Slope with Vertical Base
F5: Feature 5 - Erosion of Headland Slope
F6: Feature 6 - Cave at Cliff Base
F7: Feature 7 - Fretting Boulders from Cliff Face
F8: Feature 8 - Erosion of Headland Below Proposed Viewing Platform
F9: Feature 9 - Cave at Cliff Base of Headland Slope
F10: Feature 10 - Boulders at Cliff Base
F11: Feature 11 - Failure on Clay Infilled Joint
F12: Feature 12 - Rock Falls from Cliff Face

AERIAL PHOTOGRAPH & LOCATION OF CLIFF INSTABILITY FEATURES – CORRIGANS BEACH

Adapated from ACT Geotechnical Engineers Pty Ltd **Appendix D - Map D2**

LEGEND

F1: Feature 1 - Cave at Cliff Base
F2: Feature 2 - Erosion of Headland Slope
F3: Feature 3 - Erosion near Slope Top
F4: Feature 4 - Eroded & Undercut Area Mid Slope
F5: Feature 5 - Dislodged Boulders
F6: Feature 6 - Rockfall
F7: Feature 7 - Undercut Upper Cliff

AERIAL PHOTOGRAPH & LOCATION OF CLIFF INSTABILITY FEATURES – CASEYS BEACH

Adapted from ACT Geotechnical Engineers Pty Ltd **Appendix D - Map D3**

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