ITEM 2 WOLLONGONG COASTAL MANAGEMENT PROGRAM - STAGE 2 COASTAL HAZARD RISK ASSESSMENT REPORT

Council is progressing through the process to prepare a Wollongong Coastal Management Program (CMP) for the open coast and estuaries of the Wollongong Local Government Area (excluding Lake Illawarra and the port of Port Kembla). A CMP sets the long-term strategy for the coordinated management of the coast, with a focus on achieving the objects and management objectives of the *Coastal Management Act 2016*.

Coastal hazards have been considered within development assessment in Wollongong LGA since hazards were first mapped in the Coastal Zone Study 2010. Technical coastal hazard studies have been prepared to update existing data and further identify the areas vulnerable to coastal hazards up to 2125, and the risks that these hazards pose. These technical studies have informed the development of the *Wollongong Coastal Management Program Stage 2 Coastal Hazard Risk Assessment Report* (CHRAR).

The CHRAR and associated mapping will inform the next stage of Council's CMP development and be used to update notations on planning certificates, guide development assessment, and inform policy.

RECOMMENDATION

Council endorse the *Wollongong Coastal Management Program – Stage 2 Coastal Hazard Risk Assessment Report* and Coastal Hazard Mapping for the purposes of informing:

a the development of the Wollongong Coastal Management Program (CMP)

b notations on planning certificates

c the assessment of development proposed on land within the coastal zone; and

d amendments to planning instruments and policies.

REPORT AUTHORISATIONS

Report of: Luke Musgrave, Manager City Strategy
Authorised by: Linda Davis, Director Planning + Environment - Future City + Neighbourhoods

ATTACHMENTS

1 Wollongong Coastal Management Program Stage 2 Coastal Hazard Risk Assessment Report
2 Port of Port Kembla Hazard Mapping

ACRONYMS USED IN REPORT

Abbreviation	Meaning
AR6	Assessment Report 6
CC&NH SEPP	*State Environmental Planning Policy* (Climate Change and Natural Hazards) (proposed)
CHRAR	Wollongong Coastal Management Program Stage 2 Coastal Hazard Risk Assessment Report
CM Act	*Coastal Management Act 2016*
CMP	Coastal Management Program
CZMP	Coastal Zone Management Plan
DPHI	Department of Planning, Housing and Infrastructure
DCCEEW	Department of Climate Change, Energy, the Environment and Water
EP&A	Environmental Planning and Assessment
LGA	Local Government Area

Abbreviation	Meaning
Manual	NSW Coastal Management Manual
R&H SEPP	*State Environmental Planning Policy (Resilience and Hazards) 2021*
Scoping Study	Wollongong Coastal Management Program Scoping Study
SSP	Shared Socioeconomic Pathway

BACKGROUND

Legislation Framework

The *Coastal Management Act 2016* (CM Act) provides the framework for councils to prepare and implement Coastal Management Programs (CMPs). CMPs set the long-term (10 year) strategy for the coordinated management of the coast. A CMP facilitates a strategic and collaborative approach 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 development in the coastal zone
- Maintain or improve recreational amenity and resilience
- Adapt to emerging issues such as population growth and climate change

The preparation of a CMP is prescribed by the NSW Coastal Management Framework, including the NSW Coastal Management Manual (Manual). Another relevant component of the Framework is the *State Environmental Planning Policy (Resilience and Hazards) 2021* (R&H SEPP), which: identifies and maps the coastal zone according to definitions in the CM Act; identifies development controls for consent authorities to apply to each coastal management area to achieve the objectives of the CM Act; and establishes the approval pathway for coastal protection works.

The CMP that is in preparation for the open coast and estuaries of the Wollongong LGA will supersede the existing Wollongong Coastal Zone Management Plan (CZMP 2017), which was prepared in accordance with now repealed legislation, and is likely to include actions relating to dune and estuary management which will replace the current Dune Management Strategy (2014) and Estuary Management Plans (various).

The Department of Planning, Housing and Infrastructure (DPHI) is currently seeking feedback on a new Climate Change and Natural Hazards SEPP (CC&NH SEPP) which is proposed to replace the R&H SEPP. The proposed changes and guidance have no immediate impact on the findings or coastal hazard mapping which forms the basis of this report. As the development of the CMP progresses, amendments to State Environmental Planning Policy will be appropriately considered.

Development of a CMP

There are five stages to develop a CMP, as prescribed in the Manual -

- Stage 1: Identify the scope of the CMP
- Stage 2: Determine risks, vulnerabilities, and opportunities
- Stage 3: Identify and evaluate options
- Stage 4: prepare, exhibit, certify and adopt the CMP
- Stage 5: Implement, monitor, evaluate and report

Work on Stage 1 of the CMP process was undertaken in 2022-23 and resulted in a Scoping Study. Wollongong Coastal Management Program Scoping Study (Scoping Study) defines the geographic extent of the proposed CMP, including the open coastline and the smaller estuaries of the LGA, and excluding the coastal zone around Lake Illawarra which is managed under the Lake Illawarra CMP and the Port of Port Kembla which is managed under a separate legislative framework (*SEPP Transport and*

Infrastructure 2021 – Chapter 5 Three Ports: Port Botany, Port Kembla and Port of Newcastle and *SEPP Precincts – Regional 2021 – Chapter 6 Port Kembla Land Transformation Precinct*).

The Scoping Study reviewed coastal management actions previously undertaken, identified knowledge gaps, developed a shared understanding of the values and issues along the coastal zone, conducted a ‘first-pass’ risk assessment, and provided a focus for development and subsequent stages of the final Wollongong CMP. At its meeting on 20 March 2023, the Council endorsed the *Wollongong Coastal Management Program Scoping Study* and endorsed progressing to Stage 2 of the CMP process, including undertaking recommended technical studies outlined in that study. These studies are listed in Table 1, along with progress update for each.

Table 1: Wollongong CMP Stage 2 Technical Studies

Stage 2 Study	Progress Update
Littoral Rainforest and Coastal wetlands mapping	*Project complete*. This project reviewed and updated coastal wetland and littoral rainforest mapping within the Wollongong CMP area, and largely focused on areas incorrectly mapped such as over roads, footpaths etc. This updated mapping will be the subject of a future planning proposal to update the RH SEPP (or alternate SEPP) mapping to improve planning controls and management of these vegetation communities.
Coastal Hazard Mapping and Risk Assessment	*Project complete*. This project is the subject of this report, and more detail is provided below.
Identification of Aboriginal Cultural Heritage values and assets, and vulnerability assessment (note this study spans Stages 2 and 3 of the CMP process)	*Project underway*. This project was co-designed with the Illawarra Local Aboriginal Land Council who have been engaged to undertake the assessment. To date the first phase has been competed – identification of cultural values and assets. The next phase is to utilise the coastal hazards mapping data to undertake a comprehensive risk assessment of these cultural values and assets. The final phase will develop management actions and strategies to address at-risk Aboriginal cultural heritage.
Port Kembla Beach – options assessment for management of windblown sand	*Project not started.* Vegetation management and removal of wind-blown sand from infrastructure has been ongoing. It is envisaged options to manage this issue long term will be determined through Stage 3.
Detailed Risk Assessment	*Project underway*. This project involves bringing all the information gained during Stage 2 of the CMP process and documenting the risks, priorities, and opportunities that will be addressed in Stage 3 of the CMP process, building on the first-pass risk assessment undertaken in Stage 1. This will include coastal hazard risks identified in the Coastal Hazard Mapping and Risk Assessment as well as other environmental, cultural and social issues that occur in the coastal zone.

Project Team

The Coastal Hazard Mapping and Risk Assessment project has been overseen with technical support by a project team including the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW), an independent scientific advisor from the University of Wollongong, and various Council subject matter experts. The team reviewed and contributed to both the project methodology and outputs to ensure they are consistent with relevant legislation and guidelines and are robust and fit-for-purpose.

The outputs of the project have been completed by a range of consultants who are specialists in specific types of coastal processes and hazards.

Coastal Hazard Mapping and Risk Assessment

The Wollongong Coastal Zone Study that informed the Wollongong CZMP 2017 was prepared in 2010 in accordance with the *Coastal Protection Act 1979*, which was in force at the time. That study investigated four (4) coastal hazards including beach erosion, shoreline recession, ocean inundation and cliff instability, and how the extent of these hazards may change up to 2100. This information was used to develop management actions for the subsequent CZMP and the hazard mapping has been considered within the development assessment process since 2010, including section 10.7 (formerly section 149) notations on properties potentially affected by the coastal hazards as identified in that study.

The *Coastal Protection Act 1979* was repealed and replaced with the CM Act, which came into force in 2018. The CM Act defines an additional three (3) coastal hazards, making seven (7) in total. These hazards, with their definitions, are:

a) 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. Beach erosion occurs due to one or more processes: wind, waves, tides, currents, elevated ocean water levels, and downslope movement of beach material due to gravity.

b) Shoreline recession: Refers to ongoing landward movement of the shoreline, that is, a net landward movement of the shoreline, generally assessed over a period of several years. As shoreline recession occurs, the “beach fluctuation zone” including the dunes, sandy beach, and underwater areas to depths of several tens of metres, is translated landwards.

c) Coastal lake or watercourse entrance instability: Refers to the variety of potential hazards and risks associated with the dynamic nature of both natural and trained entrances. Coastal lake and watercourse (e.g. creek) entrances are highly active environments with their shape constantly changing in response to processes such as alongshore sand movement, tidal flows, storms, and catchment flooding.

d) 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 shorelines (e.g. dunes or seawalls).

e) Coastal cliff or slope instability: This hazard occurs on the headlands and bluffs within and separating beaches and relates to the collapse, landslides, or toppling of rocks from these slopes. The nature of the instability often relates to the interaction of weathering and erosion processes on different geological formations and rock types.

f) Tidal inundation: The inundation of land by tidal action under average meteorological conditions including the incursion of sea water onto low lying land during high tides (e.g. king tides).

g) Erosion and inundation of foreshores: Caused by tides and the action of waves, including the interaction of those waters with catchment floodwaters. This refers to estuary foreshores where both coastal and catchment processes can impact.

The Manual guides how hazard studies should be prepared and requires hazards to be considered in the following timeframes: “Present Day” (2025), “20-year” (2045), “50-year” (2075) and “100-year” (2125), the final timeframe being 25 years further into the future than the 2100 date considered in the previous Coastal Zone Study.

A suite of coastal hazard studies has now been prepared to address the above seven (7) hazards and all relevant timeframes up to 100 years, to comply with the CM Act and Manual. In addition to compliance with the relevant legislation, the updated coastal hazard assessments benefit from contemporary data and practices including:

- The hazard modelling has considered a range of sea level rise values, informed by the latest Intergovernmental Panel on Climate Change information which updated sea level rise projections at a finer scale and further into the future. The coastal hazard studies used the high emission scenario, in accordance with the Council Resolution from March 2023: ‘Council endorse AR6 SSP5-8.5 Sea Level Rise Projection Values, for use in modelling of coastal hazards in Stage 2 of the CMP process (modelling a sea level rise range for each time horizon).’

- New data collected by both Council and the NSW Government since the previous study was prepared has been used to strengthen the hazard modelling, such as beach and dune volumes, sub-surface geology, offshore bathymetry and imagery collected via drone. This ensures the modelling reflects the information about local features captured in the new data.
- Where available, existing flood models developed for the Flood Program were able to be used to model inundation from ocean influences in the absence of rainfall (noting the Flood Program already considers coastal influences combined with rainfall).
- There have been considerable advances in beach erosion and recession hazard modelling methodology that enabled probabilities of a certain outcomes to be assessed, rather than a single deterministic line for each timeframe (which was how extents were represented in the 2010 study).
- Real data collected during and after the significant East Coast Low event that occurred in 2016, such as erosion volumes, wave runup distances and overtopping volumes, has been used to validate parts of the hazard models, providing further confidence in results.

Four (4) coastal hazard studies have been prepared by specialists in specific types of coastal processes and hazards:

- *Wollongong Coastal Management Program – Stage 2 Coastal and Estuary Processes Study,* prepared by Salients, outlining the physical environmental and human factors which influence coastal hazards along the Wollongong coastline.
- *Wollongong Coastal Management Program – Stage 2 Inundation, Beach Erosion and Recession Study,* prepared by sub-consultants Jeremy Benn Pacific, covering the Beach Erosion (a), Shoreline Recession (b), Coastal Inundation (d), and Tidal Inundation (f) hazards.
- *Wollongong Coastal Management Program Stage 2 Coastal Hazard Studies – Coastal Cliff Instability Study 2025,* prepared by sub-consultants Tetra Tech Coffey, covering the coastal cliff and slope instability hazard (e).
- *Wollongong Coastal Management Program – Stage 2 Coastal Entrance and Estuarine Foreshore Erosion Hazard Study,* prepared by Salients, covering the watercourse entrance instability (c) and erosion of foreshores inside creeks (g).

These individual informing studies will be available for viewing by the public on Council's website in the future. This report does not seek endorsement of the individual informing studies.

Wollongong Coastal Management Program Stage 2 Coastal Hazard Risk Assessment Report

Salients have prepared consolidated hazard mapping and the *Wollongong Coastal Management Program – Stage 2 Coastal Hazard Risk Assessment Report*, which collates findings from the above coastal hazard studies and presents a risk assessment relating to the potential threats to assets along the Wollongong coastline, arising from coastal hazards. In this context, assets refer not only to built assets such as roads, buildings, seawalls, and parks, but also natural resource assets such as areas of vegetation, coastal wetlands, or endangered ecological communities.

The *Wollongong Coastal Management Program – Stage 2 Coastal Hazard Risk Assessment Report* can be found at Attachment 1.

The main outputs of this project that will be used moving forward are:

- *Coastal Hazard Mapping*: A spatial data set showing the areas mapped as potentially vulnerable to coastal hazards up to 2125; and
- *Key Coastal Hazard Risks*: A consolidated list of risks that should be considered in Stage 3 of the CMP process which involves developing management actions.

These are discussed in more detail in the following sections.

Coastal Hazard Mapping

Coastal hazards have been considered within development assessment in Wollongong LGA since hazards were first mapped in the Coastal Zone Study 2010.

There is extensive new mapping associated with the suite of coastal hazard studies, including a range of likelihoods and timeframes. This has allowed detailed consideration of levels of risk to assets and will also assist in ongoing decisions within asset management and strategic planning.

If endorsed, a concise set of maps for each hazard at each timeframe ("Present Day" (2025), "20-year" (2045), "50-year" (2075) and "100-year" (2125)) will be made publicly available via Council's online mapping.

How the mapping will be used

Coastal hazards relating to specific property are disclosed on planning certificates issued under section 10.7 of the EP&A Act and in accordance with the Schedule 2 of the EP&A Regulation and the guidance provided in Planning Circular PS 21-033 *'Planning Certificates: coastal hazards'*.

The new coastal hazard information is sufficiently accurate, complete and reliable to enable the land likely to be impacted by coastal hazards across relevant timescales to be identified. If Council resolves to endorse the recommendation of this report, the updated coastal hazard information will be noted on planning certificates issued under section 10.7(2) of the EP&A Act and the new mapping will be used to consider coastal hazards within the assessment of development applications.

Because the new modelling looks further into the future, covers an increased number of coastal hazards and considers a wider range of sea level rise scenarios, more properties will now have coastal related notations. Of those properties not previously notated, the majority these will have new notations for coastal inundation. Most of these properties would already be notated for flooding, which results in similar development assessment requirements.

With regard to the port of Port Kembla, hazard extents for coastal and tidal inundation were mapped within the port area, due to its connectivity to the upstream area of South Wollongong. Even though the port area is not formally included in the scope of the coastal hazard risk assessment and future CMP, the hazard extent information has been made available as part of the associated hazard mapping outputs. As such it is proposed to include this area in planning certificate notation updates and public facing mapping. As this area is not specifically displayed in the CHRAR, Attachment 2 has been provided to show this hazard mapping.

Development Assessment

The mapping will identify where consideration of the coastal hazards is required when assessing the impact of development in accordance with:

- Section 2.12 of the R&H SEPP – which provides that: *Development consent must not be granted to development on land within the coastal zone unless the consent authority is satisfied that the proposed development is not likely to cause increased risk of coastal hazards on that land or other land.*
- Section 4.15(1)(b), (c) and (e) of the *Environmental Planning & Assessment Act 1979* (EP&A Act) – where consideration of coastal processes is required to be considered as part of assessing the impact of the development, the suitability of the site and the public interest.

Planning Policy

This new coastal hazard information will inform future policy-based actions, such as amendments to Wollongong Development Control Plan, to introduce development controls and guide how coastal hazards will be considered in development assessment.

Coastal Hazard Risks

A comprehensive risk assessment process, consistent with Council's Risk Management Framework, was undertaken following guidance from the international standard on risk management, Standards Australia's ISO 31000. Within that standard, risk is formally defined as the "effect of uncertainty on objectives". In practice, risks are analysed by determining the **likelihood** of a risk event occurring, alongside the **consequences** of that risk event occurring, and then combining the two to evaluate the risk. This project used the probabilistic outputs from the above suite of coastal hazard studies to determine the **likelihoods** of the hazard occurring, ranging from “rare” to “almost certain”. The **consequences** were determined with both qualitative (from stakeholder workshops) and quantitative guidance (mainly financial, with hectares/creek length used for natural assets) and ranged from “insignificant” to “catastrophic”.

Risks to a range of built, land natural assets were considered as shown in Table 2.

Table 2 – Assets considered in risk assessment

Built Asset	Land Asset	Natural Asset
Stormwater	Open space/recreational lands	Ecology
Transport	Private lands	Stormwater Creek length
Open space/recreation (Built)		
Private Buildings		
Water/sewer		

The evaluation of risks is presented in the CHRAR with a separate discussion provided for twenty-seven geographical ‘divisions’ of the Wollongong coastline, as well as commentary at the LGA scale. This LGA scale commentary ensures that cumulative risks are being clearly identified to assist with prioritisation. It is envisaged that this dual precinct based ‘divisions’ and LGA-wide approach will be carried through to the future CMP to enable planning for management actions at both scales.

Key risks identified

Section 5 of the CHRAR presents the results of the risk assessment up to the year 2125 and outlines the keys risks for each division that should be addressed in the future CMP. Section 6 then provides combined LGA scale risk assessment. It is important to note that these risks only identify threats to coastal assets from coastal hazards, and have not yet been considered in light of other social, cultural and environmental threats or values.

Considering the length of Wollongong Council’s coastline, the present exposure to coastal hazards is relatively benign when compared to other comparable local government areas. While Council will need to consider and act on the management of these risks, at this stage it appears to be manageable. This will be further considered in detail in Stage 3. A strategic approach is required, noting that the risks will become more severe over time, particularly considering ongoing sea level rise.

Table 3 provides a summary of the ‘headline’ or critical risks across all divisions.

Table 3 – Headline Risks

Headline Risk	Divisions Most Affected	Timeframe	Notes
Threats to roads (Lawrence Hargrave Drive, Cliff Road, Swan Street crossings)	Sharky Beach, Austinmer, Wollongong Central Wollongong City Beach (South Wollongong)	2025–2125	Extreme risks to road connectivity and public safety
Widespread inundation of low-lying urban land	Wollongong City Beach (including South Wollongong area and Golf Course), Corrimal, Thirroul	2045–2125	Residential occupation may become problematic in the medium term; adaptation planning required

Headline Risk	Divisions Most Affected	Timeframe	Notes
Loss of Endangered Ecological Communities	Mainly cliff top and slope communities (Themeda Grassland and Littoral Rainforest) in the Royal National Park, Clifton, Scarborough-Wombarra	2045–2125	Projected losses exceeding 60 ha by 2125
Failure of protective seawalls and structures	North Wollongong, Austinmer, Little Austinmer, Wollongong Central	2025–2125	Seawall audits are essential to confirm robustness. Unlikely to be an immediate concern for more recently built structures.
Exposure of wastewater and stormwater assets	City Beach, Little Austinmer, Wollongong Central	2025–2125	Sewer/water lines and outfalls (potentially) threatened by erosion and inundation. Investigation required.
Rock pool viability under sea level rise	Austinmer, Towradgi, Gentlemen's	Variable	Increasing overtopping and safety risks may render pools unusable in the long term. Consider development of adaptation plan which should involve broader considerations of filling with sand and usability.

The focus areas for coastal hazard risk management and planning are summarised in Table 4. These will be considered during Stage 3 of the CMP process.

Table 4 – Focus Areas for Coastal Hazard Risk Management along the Wollongong Coastline over time

Timeframe	Focus Areas (as indicated by Risk Assessment)
2025-2045	• Adopt hazard mapping information within Council's planning system. • Seawall, Rock Pool, and Coastal Structure Audit plus required maintenance/mitigation actions. • Stormwater and Sewer asset investigations to check for robustness. • Local Adaptation Planning at Selected Locations.
2045-2075	• More widespread adaptation planning. • Adaptation in some areas. • Manage losses of ecological communities (National Park in particular). • Reinforcement of key transport corridors against effects of sea level rise.
2075-2125	• Potential need to plan for strategic relocation of coastal assets and communities. • Re-purposing of impacted lands. • Set aside areas to enable the migration of key ecosystems to keep up with sea level rise.

Moving to the next stage of the CMP Process

The coastal hazard risk assessment report, and informing hazard studies, is one important element that will inform the development of management actions to be considered in the future Wollongong CMP. This is shown in Figure 1, with the coastal hazards components shaded.

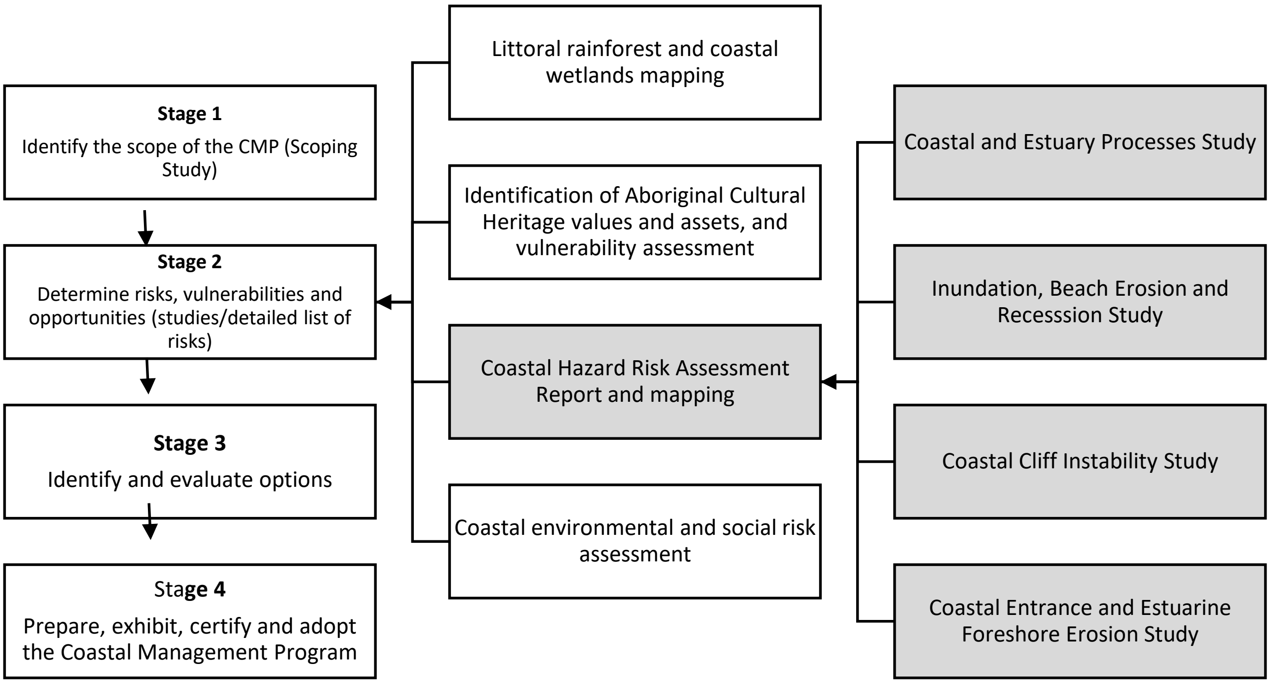


Figure 1 CMP Process Study Components

Work is being done to identify the other priority risks to environmental, social and cultural values that also need to be considered in the development of management actions in the CMP.

The consolidated set of risks will inform Stage 3, where management options will be identified and evaluated. This work will continue for the remainder of 2026 and will include both communication to the community about the key risks and engagement with stakeholders and community to evaluate the management options. The Wollongong CMP will then be drafted for Council’s consideration in 2027 (including public exhibition) and then submitted to the NSW Minister for the Environment for certification.

PROPOSAL

It is recommended that Council endorse the *Wollongong Coastal Management Program – Stage 2 Coastal Hazard Risk Assessment Report* so that it can be a key informing document for the future Wollongong CMP, as it relates to coastal hazards, and so the new coastal hazard mapping can to be used within the existing development assessment processes (including planning certificate notations) and form the basis of any future updates to planning instruments.

CONSULTATION AND COMMUNICATION

A Community and Stakeholder Engagement Plan has been prepared for the CMP process and is a living document to both plan for, and report on, engagement and communication activities. A community engagement webpage is used to share information and updates about this CMP process.

Stage 1 Scoping Study Engagement

A large range of community and stakeholder engagement activities were undertaken for the Scoping Study, which involved identifying what our community values about our coastline, how they use and enjoy it and what they identify as issues or challenges, now or in the future. This included First Nations engagement following the key principles of Council’s Aboriginal Engagement Framework and aimed to inform, engage, build trust, and connect with the local Aboriginal community. The engagement was designed to create the building block for deeper and focused engagement in future stages of the project.

Technical Support and Engagement

The CHRAR and informing technical studies were prepared in close consultation with DCCEEW who are providing council with technical and financial support to develop the CMP. Technical support has also been provided by an independent scientific advisor from the University of Wollongong, and various Council subject matter experts.

Staff and Agency Stakeholders

Key Council staff in City Strategy, Infrastructure Strategy and Planning, Project Delivery, Open Space and Environmental Services, Development Assessment and Certification, Property Services, Sport and Recreation and Legal Services have also been part of the risk assessment process.

In addition, a CMP must be prepared in collaboration with other relevant agencies and organisations, who must be engaged throughout the process and must commit to implementing any certified CMP actions within their remit. Representatives from relevant external agencies have been involved in the risk assessment process, such as Department of Planning, Housing and Infrastructure – Crown Lands, National Parks and Wildlife Service, Transport for NSW, Sydney Water, Endeavour Energy, Department of Primary Industries and Regional Development – Fisheries, State Emergency Service, and South East Local Land Services. In particular, mapped assets belonging to NPWS, Sydney Water and Transport for NSW have been included in the Coastal Hazard Risk Assessment.

Community Engagement and Communication

Communication to the broader community about the outputs of the CHRAR will occur once endorsed by Council, via a short video and project update on the Let's Talk Wollongong webpage, as well as distribution via social media, relevant newsletters and distribution lists. All documents from the suite of studies will be published on the Let's Talk Wollongong webpage.

Further communication summarising the all the consolidated priority risks within the coastal zone will occur once it is documented. The community will then be advised about the next stage of the CMP process and how to get involved as we move into Stage 3 and develop management options for the future CMP.

The Illawarra Local Aboriginal Land Council has been engaged by Council to undertake another CMP Stage 2 project – Identification of Aboriginal Cultural Heritage Values and Assets, and Vulnerability Assessment. There has been ongoing liaison between project teams as the projects have progressed, and the project manager has been provided a draft of the coastal hazard mapping to utilise in the assessment of the vulnerability of cultural values and assets.

PLANNING AND POLICY IMPACT

This report contributes to the delivery of Our Wollongong Our Future 2035 Goal 1 '*We are a sustainable and climate resilient city'*. It specifically delivers on the following:

Community Strategic Plan 2035		Delivery Program 2025-2029
Strategy		Service
1.2	Manage and improve the cleanliness, health, biodiversity of land and water including creeks, lakes, waterways and oceans	Environmental Services
1.3	Increase our resilience to natural disasters and ability to adapt to a changing climate, to protect life, property and the environment	
1.7	Manage our coastal environments, including Lake Illawarra, to protect and enhance environmental sustainability, social, cultural, and economic values.	

It also specifically delivers on the action "Prepare and deliver the Wollongong Coastal Management Program".

The future CMP will also support multiple other services of Council that provide services within the coastal zone. Ongoing collaboration with other relevant strategy areas is occurring as the project continues, including the current strategic recreation projects relating to beach services and surf sports and play spaces, to ensure a consistent strategic direction for our coastline.

SUSTAINABILITY IMPLICATIONS

The long-term management of the coastal zone is integral to maintaining the economic, cultural, environmental and social values of the area. Preparing for future implications of climate change was an important part of the CZMP and will continue to be throughout the development of the new CMP, as a long-term strategy for the coordinated management of land within the coastal zone.

The CHRAR will inform the development of the strategic approach to management of coastal hazards at both a precinct and LGA-wide scale.

The next stage of the CMP process (Stage 3) will identify management options, and evaluate these options with stakeholders and community to consider:

- Feasibility – are the options effective, ecologically sustainable and legal?
- Viability/financial – are the options affordable and consideration given to distribution of costs and benefits?
- Acceptability – are the options fair and equitable for community and stakeholders?

RISK MANAGEMENT

Risks associated with coastal hazards can be economic, social, operational, reputational and legal, arising in a variety of contexts including land use planning, development assessment, asset management, project delivery and public liability.

The CHRAR has considered how the magnitude and frequency of coastal hazards is expected to increase over time. It highlights the key risks to built and natural assets from coastal hazards and has identified key risks that should be considered for management action within the 10-year CMP. A CMP informed by contemporary and detailed hazard assessments will improve our knowledge and ability to respond to coastal hazards and help to mitigate associated risks.

This report seeks endorsement of the CHRAR to enable the defined coastal hazards to be made known through publicly available mapping and notations on Section 10.7 planning certificates, ensuring future risks to property and assets can be known and managed.

FINANCIAL IMPLICATIONS

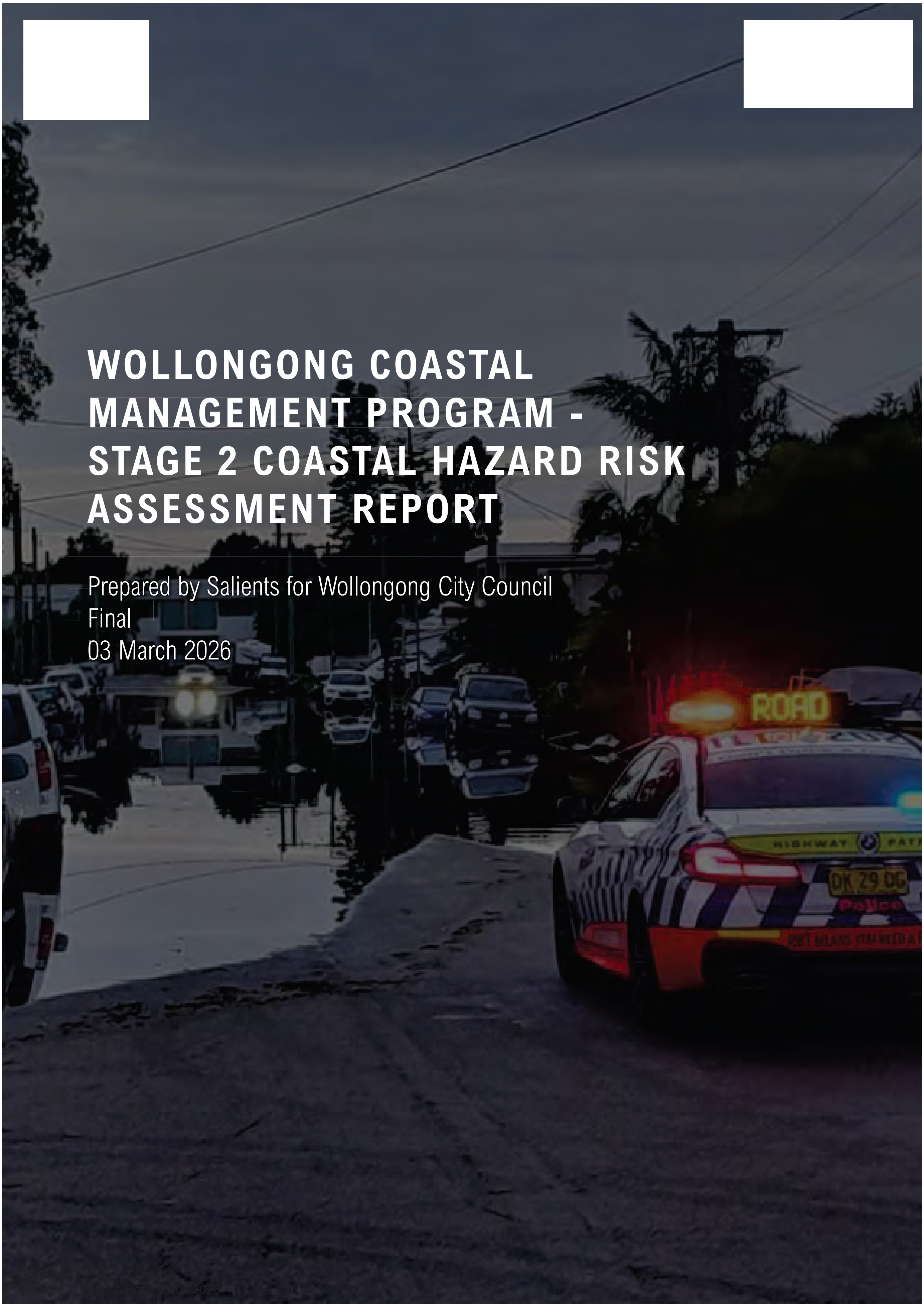
The development of a CMP for the Wollongong coast is an action within the Delivery Program 2025-2029. Council has been successful in receiving 2:1 funding from the NSW Government Coast and Estuary Grants Program for Stages 2 to 4 of the project and has allocated funding in its forward programs to meet the contribution commitments.

The development of Stage 3 and 4 will enable Council to plan future spending across coastal assets with a clear understanding of the likelihood and consequences of risks associated with coastal hazards.

Stage 5 is CMP implementation which currently has no allocated budget and will be subject to the business proposal process once the CMP is prepared.

CONCLUSION

The Wollongong Coastal Management Program – Stage 2 Coastal Hazard Mapping and Risk Assessment project has been undertaken as part of the process to prepare a CMP for the Wollongong coastal zone (excluding Lake Illawarra and the port of Port Kembla). It is recommended that Council endorse the CHRAR to inform the future Wollongong CMP, as it relates to coastal hazards, and use the new information within the existing development assessment processes and to form the basis of any future updates to planning instruments. This will help us to work towards a future with resilient coastal environments and communities.



WOLLONGONG COASTAL MANAGEMENT PROGRAM - STAGE 2 COASTAL HAZARD RISK ASSESSMENT REPORT

Prepared by Salients for Wollongong City Council
Final
03 March 2026

WOLLONGONG COASTAL MANAGEMENT PROGRAM - STAGE 2 COASTAL HAZARD RISK ASSESSMENT REPORT

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Executive Summary

E.1 Background

The Wollongong Coastal Management Program (CMP) will cover the open coastline within the Wollongong LGA, and all tidal lakes and lagoons, excluding the port of Port Kembla and Lake Illawarra. Lake Illawarra has its own CMP. The Wollongong CMP is being developed by Wollongong City Council (Council) under the *Coastal Management Act 2016 (CM Act)* and the NSW *Coastal Management Manual* (NSW Government, 2018). Under this management framework, coastal management is integrated with local planning under the *Environmental Planning and Assessment Act 1979*, via *State Environmental Planning Policy (Resilience and Hazards) 2021* (the RH SEPP). The *Coastal Management Manual* outlines a five-step process for the preparation of CMPs, as shown in Figure ES-1.

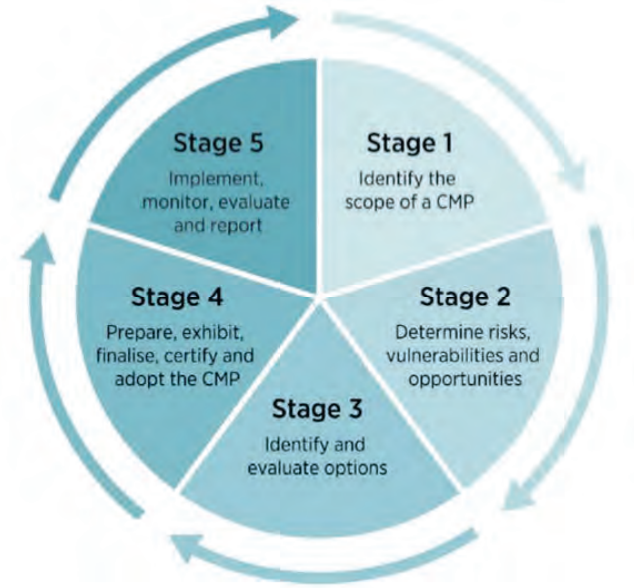

Figure ES-1 Stages in Preparing and Implementing a CMP

In 2023, Council completed Stage 1 of this process, when it finalised a Scoping Study to inform development of the CMP (Salients, 2023a). This Coastal Hazard Risk Assessment Report discusses a risk assessment completed as part of Stage 2 and relates only to risks arising from coastal hazards.

E.2 What are Coastal Hazards

There are seven coastal hazards, defined by the CM Act, which have been considered as part of this study.

a) 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. Beach erosion occurs due to one or more processes: wind, waves, tides, currents, elevated ocean water levels, and downslope movement of beach material due to gravity.

b) Shoreline recession: Refers to ongoing landward movement of the shoreline, that is, a net landward movement of the shoreline, generally assessed over a period of several years. As shoreline recession occurs, the "*beach fluctuation zone*" including the dunes, sandy beach, and underwater areas to depths of several tens of metres, is translated landwards.

c) Coastal lake or watercourse entrance instability: Refers to the variety of potential hazards and risks associated with the dynamic nature of both natural and trained entrances. Coastal lake and watercourse (e.g. creek) entrances are highly active environments with their shape constantly changing in response to processes such as alongshore sand movement, tidal flows, storms, and catchment flooding.

d) 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 shorelines (e.g. dunes or seawalls).

e) Coastal cliff or slope instability: This hazard occurs on the headlands and bluffs within and separating beaches and relates to the collapse, landslides, or toppling of rocks from these slopes. The nature of the instability often relates to the interaction of weathering and erosion processes on different geological formations and rock types.

f) Tidal inundation: The inundation of land by tidal action under average meteorological conditions including the incursion of sea water onto low lying land during high tides (e.g. king tides). In considering this, the effects of future sea level rise were considered.

g) Erosion and inundation of foreshores: Caused by tides and the action of waves, including the interaction of those waters with catchment floodwaters.

E.3 How were Coastal Hazards Assessed and Presented

A variety of modelling and analytical techniques were used to determine the extents of the different coastal hazards over time frames of "Present-Day" (2025), +20 year (2045), +50 year (2075) and +100 year (2125). While the analysis varied for the different coastal hazards, the probability of a coastal hazard affecting different areas was typically determined. The use of "probabilistic" coastal hazard assessment is one key difference between the coastal hazard zones derived as part of this study, and those developed in the past for Council. The use of probabilities allows for a more robust risk assessment. The risk assessment completed by this study is the focus of the present report. A detailed summary of the methods used to assess each of the coastal hazards is presented in Appendix A.

That summary is backed by several detailed technical studies which are supplementary to this report. The mapped hazard extents can now be used by Council to inform development control and assessment.

The port of Port Kembla was included in the hazard assessment for coastal and tidal inundation, as required to assess the hazard extents upstream of Port Kembla. As the port of Port Kembla is not within the scope of the future CMP, a risk assessment was not undertaken for this area. However, the hazard extent information is available in the associated project outputs.

E.4 Risk Model: How was the Risk Assessment Completed

The risk assessment undertaken follows the international standard for risk management (ISO-31000) with risk considered to be the product of likelihoods (or probabilities) and consequences (mostly expressed as $ values). Using likelihoods and consequences, the results were then assessed using Wollongong City Council's standard risk matrix (Wollongong City Council, 2025).

Risks were assessed on a coastal 'division' basis. The coastline was divided into 27 divisions to enable highlighting of areas where risks might be concentrated. The divisions are shown in Figure ES-2 (Northern) and Figure ES-3 (Southern).

Spatial data showing the location and characteristics of different categories of assets were provided by Council and other stakeholders, and, where possible, assets had values assigned to them. These data sets of different asset categories were then intersected with the coastal hazard extents at different time frames and probabilities, and total value losses calculated as an interim step to assessing risk levels. The categories of assets used in the assessment were:

1 Stormwater: including pits, pipes, outlets and connections.

2 Transport: including roads, car parks, pathways, boat ramps.

3 Open Space / Recreation (Built): including amenities, park shelters, playgrounds.

4 Private Dwellings.

5 Water / Sewerage.

6 Public Land.

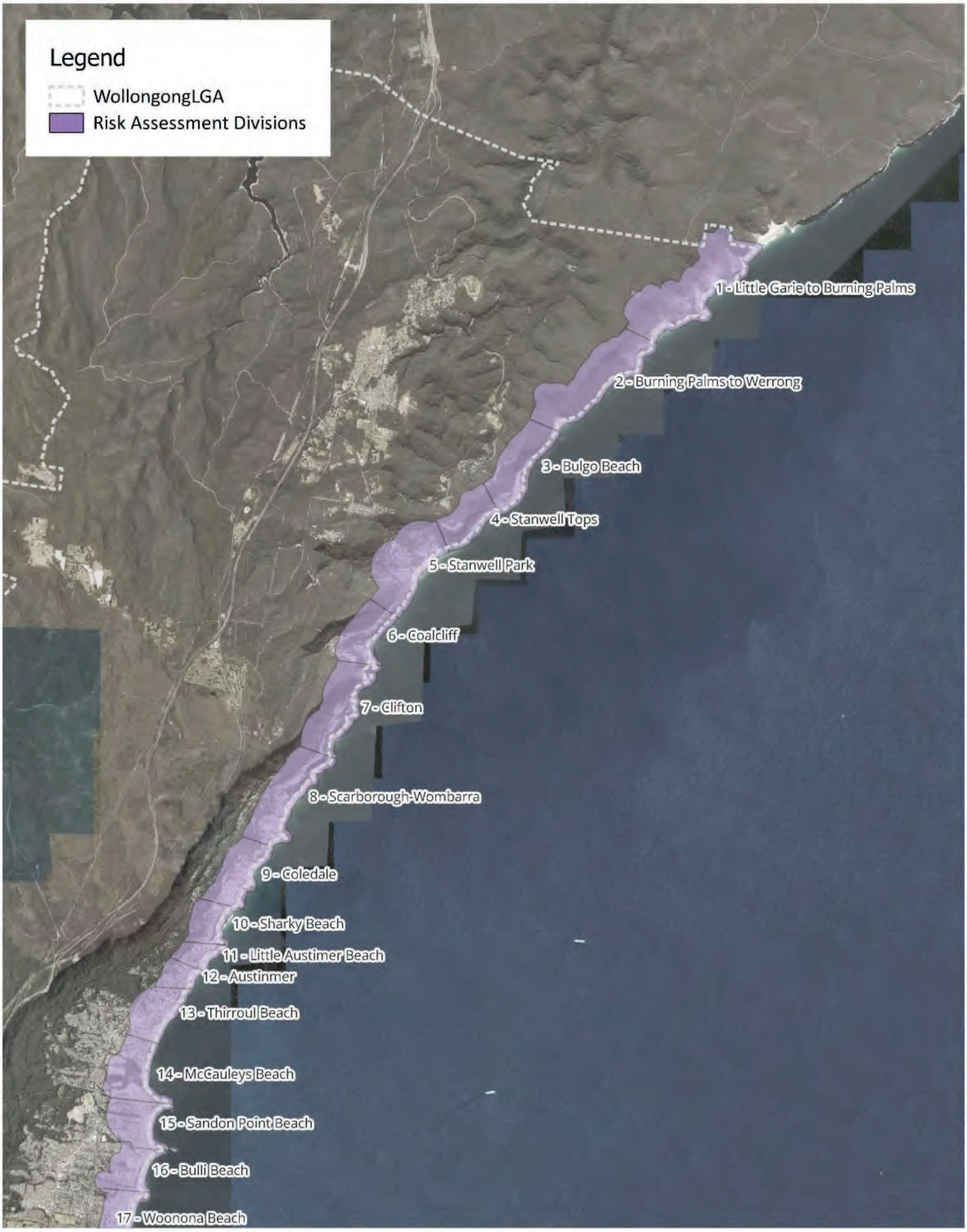

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Figure ES-2 Northern Risk Assessment Divisions

0 1,000 2,000 3,000 4,000 m

Wollongong CMP Stage 2 - Coastal Hazard Risk Assessment Report

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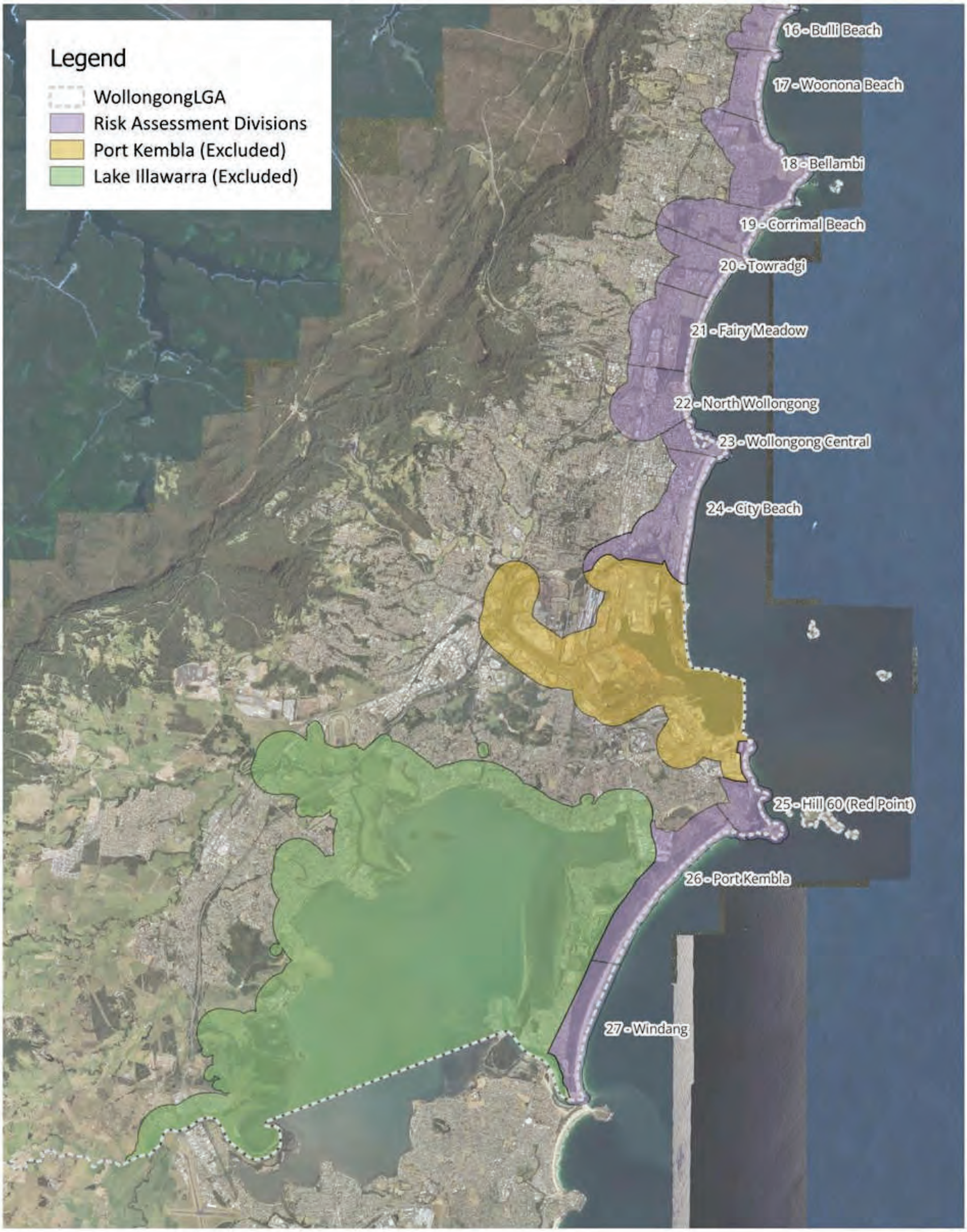

Figure ES-3 Southern Risk Assessment Divisions

Wollongong CMP Stage 2 - Coastal Hazard Risk Assessment Report

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7 Private Land.

8 Ecological Assets.

Of these, dollar values were typically assigned to the first seven categories, and the risks categorised accordingly, with the area lost calculated for ecological assets.

The risk model was thus applied to derive risk categories for different assets, relating to different coastal hazards over different timeframes. The outputs from the risk model were tabulated for each of the 27 divisions and then key risks of most relevance to the CMP ("High" or "Extreme" risks for Present-Day and 20-year time frames) were reviewed for consistency with known issues and on the ground observations.

As part of the review process some risks had their risk level adjusted. For example, there are sections of Lawrence Hargrave Drive in Wollongong's northern suburbs which could be destabilised by the collapse of a cliff. This may only affect a very short section of road (relatively low asset value lost) but could have a severe impact on traffic movement from affected suburbs. In this situation, the risk level would be elevated to account for those secondary impacts.

The remaining key risks are described and tabulated for each division in Section 5 of this report. Furthermore, efforts have been made to consider the accumulated risks at an LGA wide scale, to highlight key themes and patterns, and to enable consideration of the impact on the whole of Council's operations.

E.5 Results: Summary of Division Based Risk Assessment

In interpreting these results, it is important to note that the hazard assessment is based on adoption of a fossil fuel intensive scenario (SSP5-8.5) which results in the highest sea level rise projection of the standard scenarios presently reported by the IPCC. If follows that the future projected coastal hazards extend further inland for this scenario than it would for other scenarios which assume less future dependence on fossil fuels.

Considering the length of Wollongong Council's coastline, the present exposure to coastal hazards is relatively benign when compared to other comparable local government areas. The effort required to presently address coastal hazard related risks appear manageable, and Council is well placed to adopt a strategic approach to managing these in future. A strategic approach is required, noting that the risks will become more severe over time, particularly considering ongoing sea level rise.

Nevertheless, as these hazards become more intense, they may expose previously unrecognised issues in a sudden and unexpected manner. Being prepared with knowledge and a precautionary, adaptive mindset will help Council manage those emerging risks.

The division-based analysis presented in Chapter 5 demonstrates that coastal hazard risks vary across Wollongong's coastline, but several consistent themes emerge. Beach erosion and shoreline recession already present risks for transport assets, stormwater assets, and recreational reserves situated immediately behind some beaches. By 2045, these risks are projected to escalate to extreme levels in many divisions, particularly where dunes are narrow, such as Sharky Beach, and Austinmer. By 2075 and 2125, beach erosion and shoreline recession are projected to extend further inland and in some locations could threaten important infrastructure.

Coastal cliff and slope instability hazards tend to arise from more localised and acute failures (e.g. landslips, rock falls) but are still concerning. Divisions with steep bluffs, such as those in the National Park, and at Coalcliff, are notably exposed to these hazards. Natural assets are threatened in some locations, with endangered ecological communities (such as Themeda Grassland and littoral rainforest) noticeably exposed to cliff instability and erosion within the National Park. Littoral Rainforest and Themeda Grassland are projected to suffer substantial losses along the northern coastline extents, with a cumulative loss of more than 100 hectares projected by 2125.

Inundation risks arising both from coastal storm (event based) and tidal (more regular) processes, are generally low at present, but by 2045 they are projected to begin affecting significant areas of low-lying land (both public and private). By 2075 and 2125, the inundation risk is projected to become widespread, particularly in divisions with extensive low-lying land (mainly towards the southern parts of the LGA), which have more extensive coastal floodplains. Examples of this are the floodplains of Fairy/Cabbage Tree and Towradgi Creeks.

Rock pools, while intentionally exposed, face long-term viability challenges as overtopping and safety risks increase with sea level rise.

The projected loss of land to inundation and erosion hazards, enhanced by sea level rise, represents a widespread "Extreme" future risk using the methods applied in this assessment. This partly arises as the assessment has used published residential land sale values to also value public land. The resulting risks deserve to be considered and addressed separately as these represent concerningly widespread and pervasive risks which may leave no widely acceptable management solutions when considered over multi-generational time scales. In many locations, retreat from the rising water and receding coastlines may prove to be the only practicable option for management. A strategic, informed, and adaptive approach to managing this issue should soften the impact of these risks on the community.

Beyond noting that the risks relating to the loss of land are widespread and important, these are not focussed upon further within the present discussion. The risks associated with losing land to coastal hazards is highlighted in the discussion provided for individual assessment divisions within the main body of the report.

The remaining discussion highlights those risks that may well have workable and more acceptable solutions in the short to medium term. Regardless, management solutions will need to be considered in the context of underlying land potentially becoming unusable, in future, due to the impacts of climate change.

E.6 Results: Headline Risks

A summary table of "Headline" or critical risks across all divisions has been prepared and is presented in Table ES-1

Table ES-1 Headline Risks

Headline Risk	Divisions Most Affected	Timeframe	Notes
Threats to roads (Lawrence Hargrave Drive, Cliff Road, Swan Street crossings)	Sharky Beach, Austinmer, Wollongong Central, Wollongong City Beach (South Wollongong)	2025–2125	Extreme risks to road connectivity and public safety
Widespread inundation of low-lying urban land	Wollongong City Beach (including South Wollongong area and Golf Course), Corrimal, Thirroul	2045–2125	Residential occupation may become problematic; adaptation planning required
Loss of Endangered Ecological Communities	Mainly cliff top and slope communities (Themeda Grassland and Littoral Rainforest) in the Royal National Park, Clifton, Scarborough-Wombarra	2045–2125	Projected losses exceeding 60 ha by 2125
Failure of protective seawalls and structures	North Wollongong, Austinmer, Little Austinmer, Wollongong Central	2025–2125	Seawall audits essential to confirm robustness. Unlikely to be an immediate concern for more recently built structures.
Exposure of wastewater and stormwater assets	City Beach, Little Austinmer, Wollongong Central	2025–2125	Sewer/water lines and outfalls (potentially) threatened by erosion and inundation. Investigation required.
Rock pool viability under sea level rise	Austinmer, Towradgi, Gentlemen's	Variable	Increasing overtopping and safety risks may render pools unusable. Consider development of adaptation plan which should involve broader considerations of filling with sand and usability.

E.7 Results: Combined LGA Scale Risk Assessment

When considered at the scale of the entire Local Government Area, the cumulative effect of hazards becomes more apparent. Events that may be moderate at a single location, will combine to produce major or extreme impacts when viewed across the entire LGA. Several themes emerge from the overall assessment.

Transport corridors and stormwater infrastructure emerge as consistently high-value and high-risk asset classes across multiple divisions. In comparison, recreational reserves and open space lands, although less easily evaluated, have the added dimension of risks arising from the loss of social and environmental values.

By 2075 and 2125, built asset risks intensify, particularly for low-lying urban areas and critical facilities such as Wollongong's wastewater treatment plants. North Wollongong, Wollongong Central and City Beach divisions stand out as areas where inundation risks intersect with dense urban development, major recreational facilities, and critical infrastructure. This contrasts with the northern coastline and the Royal National Park, where ecological risks are more pronounced.

Current threats to private buildings (such as residences) are mostly related to potential instabilities of coastal cliffs and slope instability within the northern suburbs (broadly, between Stanwell Park and Thirroul). Further south, risks to private buildings arising from inundation during coastal storms emerge as a concern from 2045 onwards. Development within low-lying areas behind the coastline of Wollongong Harbour and City Beach, is presently exposed to overtopping and inundation through the stormwater network. Residential areas to the rear of Thirroul Beach also emerge as risks needing to be managed within a 20-year timeframe.

Unlike the risks associated with cliff and slope instability, the inundation type risks, intensified by sea level rise are projected to emerge in areas where they may well be unexpected, as there has been less historical experience. A summary of LGA-Scale themes to be considered over current and future timeframes is presented in ES-2.

In considering the risk levels outlined in ES-2, it is important to recognise that the results for different timeframes are considered cumulatively. For example, the risk level at 2125 represents the accumulation of all risks that have arisen from the present day up to and including 2125.

Table ES-2 Projected LGA-Scale Coastal Hazard Risk Themes

Hazard / Asset	2025 (Present Day)	2045	2075	2125
Beach Erosion and Shoreline Recession	Moderate–Extreme (localised)	Extreme (widespread)	Extreme (widespread)	Extreme (widespread)
Cliff and Slope Instability	Localised Moderate	High–Extreme	Extreme	Extreme
Coastal Inundation	Low	Moderate–High	High–Extreme	Extreme
Tidal Inundation	Low	Moderate–High	High–Extreme	Extreme
Natural Assets (EECs)	Minor losses (<1 ha)	Increasing (5–10 ha)	Noticeable (20–30 ha)	Significant (>60 ha)

E.8 Results: Implications for Management and Planning

The findings of the risk assessment are directly relevant for Wollongong's Coastal Management Program.

In the immediate term, as soon as practicable, Council should prioritise the audit and maintenance of seawalls and protective structures, particularly at North Wollongong, Austinmer, and Thirroul. Any remaining sewer and stormwater assets exposed to erosion following robust consideration of protective structures will need to be investigated and adapted accordingly. A robust consideration of protective structures was not possible as part of the present study, as the available details on existing structures was piecemeal and unreliable at many locations. This data gap needs to be addressed.

Similarly, the hazard mapping prepared as part of this study should be made available and used to set planning controls for development in coastal areas as soon as practicable.

Local adaptation planning is required promptly for divisions with emerging inundation risks, such as pockets of concern around the Wollongong CBD, and Thirroul.

In the medium term, between 2045 and 2075, adaptation strategies will become increasingly necessary. The implications for loss of important ecological communities will need to be managed by NPWS and, to a lesser extent by Wollongong Council. Beyond 2075, there will likely be issues within the more southerly parts of the Wollongong coastline, with coastal wetlands inside the coastal creeks being squeezed between rising sea levels and urban development.

Infrastructure realignment or reinforcement should be considered for transport corridors such as some sections of Lawrence Hargrave Drive, where collapse could significantly affect travel to and from the northern suburbs of Wollongong.

In the long term, between 2075 and 2125, strategic planning will be needed for widespread inundation of low-lying urban and recreational land, particularly in areas from Bellambi and further south. Planned relocation or re-purposing of land may be required where protective structures are no longer viable. Over time, beaches, including both the sandy berm and dune system, are expected to recede or migrate landward. This may not be possible where infrastructure or residential settlement is in the way. The land behind beaches needs to be proactively managed to allow for beach migration across the landscape in response to sea level rise. Without making 'accommodation space' for this movement of some beaches, they will be progressively squeezed out of existence.

In summary, the risk assessment indicates that future management is likely to focus on different matters over different timeframes. This variation is presented in Table ES-3.

Table ES-3 Focus Areas for Coastal Hazard Risk Management along the Wollongong Coastline over Time

Timeframe	Focus Areas (as indicated by Risk Assessment)
2025-2045	• Adopt hazard mapping information within Council's planning system. • Seawall, Rock Pool, and Coastal Structure Audit plus required maintenance/mitigation actions. • Stormwater and Sewer asset investigations to check for robustness. • Local sea level rise adaptation planning at selected locations.
2045-2075	• More widespread sea level rise adaptation planning. • Adaptation in some areas. • Manage losses of ecological communities (National Park in particular). • Reinforcement of key transport corridors against effects of sea level rise.
2075-2125	• Potential need to plan for strategic relocation of coastal assets and communities. • Re-purposing of impacted lands. • Set aside areas that allow key ecosystems to migrate in response to sea level rise.

Contents

Figures

Tables

1 Introduction

This report has been prepared during Stage 2 of developing the Wollongong Coastal Management Program (CMP). The CMP is being developed by Wollongong City Council under the requirements of the *Coastal Management Act 2016* (CM Act) and its associated Coastal Management Manual (NSW Government, 2018). That manual outlines the five stage process for preparing a CMP, as shown in Figure 1.

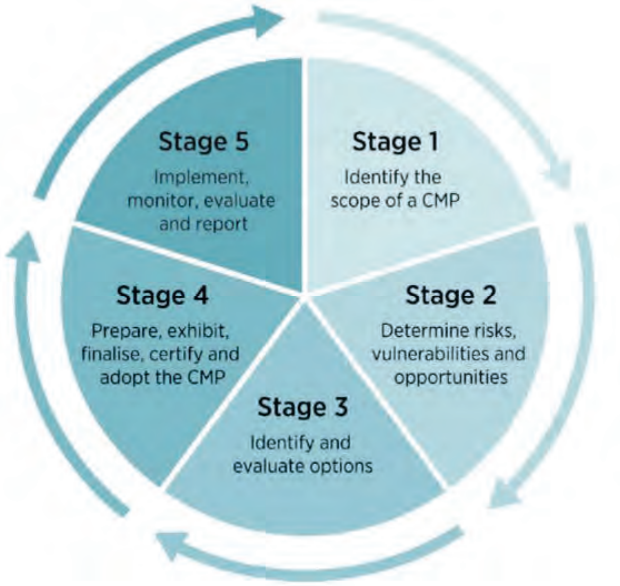

Figure 1 Stages in Preparing and Implementing a CMP (NSW Government, 2018)

A major component of Stage 2 was the completion of coastal hazard studies to assess the likelihoods relating to different hazard events, such as:

- The likelihood of combined storm erosion and shoreline recession eroding the beach to a certain location over a defined timeframe.
- The likelihood that areas could be regularly inundated by tides (in the absence of storm surge) because of future sea level rise.

This report collates findings from the coastal hazard studies and presents a risk assessment relating to the potential threats to assets along the Wollongong coastline, arising from coastal hazards. In this context, assets refer not only to built assets, such as roads, buildings, seawalls, and parks, but also natural resource assets such as areas of vegetation, coastal wetlands, or endangered ecological communities.

The risk assessment did not consider Aboriginal Coastal Cultural Values or objects. The Illawarra Local Aboriginal Land Council has used the outputs from the component studies to undertake a parallel assessment (Illawarra Local Aboriginal Land Council, 2024).

The methodology and outputs of all studies were reviewed and supported by a Technical Working Group comprising members from the Department of Climate Change, Energy, the Environment and Water, The University of Wollongong, and Council.

The report builds on coastal hazard related risks, as identified by the first pass risk assessment completed during the Scoping Study (Salients, 2023a).

The report is structured as follows:

- Section 2 outlines the approach taken to assessing coastal hazard risks.
- Section 3 provides a summary of the nature of coastal hazards and the consideration of their likelihoods. A more detailed summary of the component hazard studies is presented in Appendix A.
- Section 4 introduces the types of assets that have been considered in our risk assessment, discusses the available asset datasets and outlines how the consequences of coastal hazards interacting with those assets has been assessed. The reasoning behind those assessments has been substantially influenced by risk assessment workshops held with Council staff and other stakeholders during the first half of March 2025. Details of those workshops and the outcomes are presented in Appendix B.
- Section 5 contains a detailed summary of the risk assessment outcomes for twenty-seven separate 'divisions' of the Wollongong Coast. Those divisions represent alongshore segments of the Wollongong coastal zone within which risks are assessed and discussed as a group. The risk assessment for each division is prefaced by a discussion of notable features of that division.
- Section 6 contains an overarching discussion of coastal hazard related risk and key conclusions and implications for coastal management and planning, considering the entirety of Wollongong's coast.

The findings of this report are expected to support Council in fulfilling its planning obligations, such as the development of a new development control plan chapter relating to coastal hazards.

2 Adopted Approach to Coastal Hazard Risk Assessment

2.1 Risk Assessment Framework

The risk assessment was undertaken following guidance from the international standard on risk management, ISO 31000 (Standards Australia, 2018). Within that standard, risk is formally defined as the *"effect of uncertainty on objectives"*. In practice, risks are analysed by determining the likelihood of a risk event occurring, alongside the consequences of that risk event occurring, and then combining the two to evaluate the risk.

Risk assessment, as expressed by ISO 31000, sits within the bounds of a broader *Risk Management Process* as shown in Figure 2. The focus of this report is the three stages of the risk assessment, namely:

9 Risk Identification: The identification of risks is a natural product of the process outlined within this report but was also the key purpose of workshops held with staff from Council and representatives from other stakeholder organisations as part of this project. Those workshops and the identification of risks which arose from them is outlined in Section 4.2.

10 Risk Analysis: Which is split into the analysis of coastal hazards and their likelihoods (addressed in Section 3) and the consequences of coastal hazards interacting with assets (addressed in Section 4).

11 Risk Evaluation: The evaluation of risks is presented, with a separate discussion provided for twenty-seven geographical 'divisions' of the Wollongong coastline, as presented in Section 5. Risks are also aggregated to consider the entire coast, with a summary overview presented in Section 6.

Risk treatment is not addressed by this report. Within the five-stage process for CMP development established under the NSW coastal management framework (Figure 1), the "treatment" of risks relates to the development and assessment of management options within Stage 3. This report relates to Stage 2 of the CMP development process which focusses on the nature of the risks. Where relevant, "opportunities" in the form of potential management options are mentioned.

Finally, risk context, which is an important precursor to risk assessment is discussed within the remainder of Section 2, alongside other preliminary matters which set the stage for this assessment.

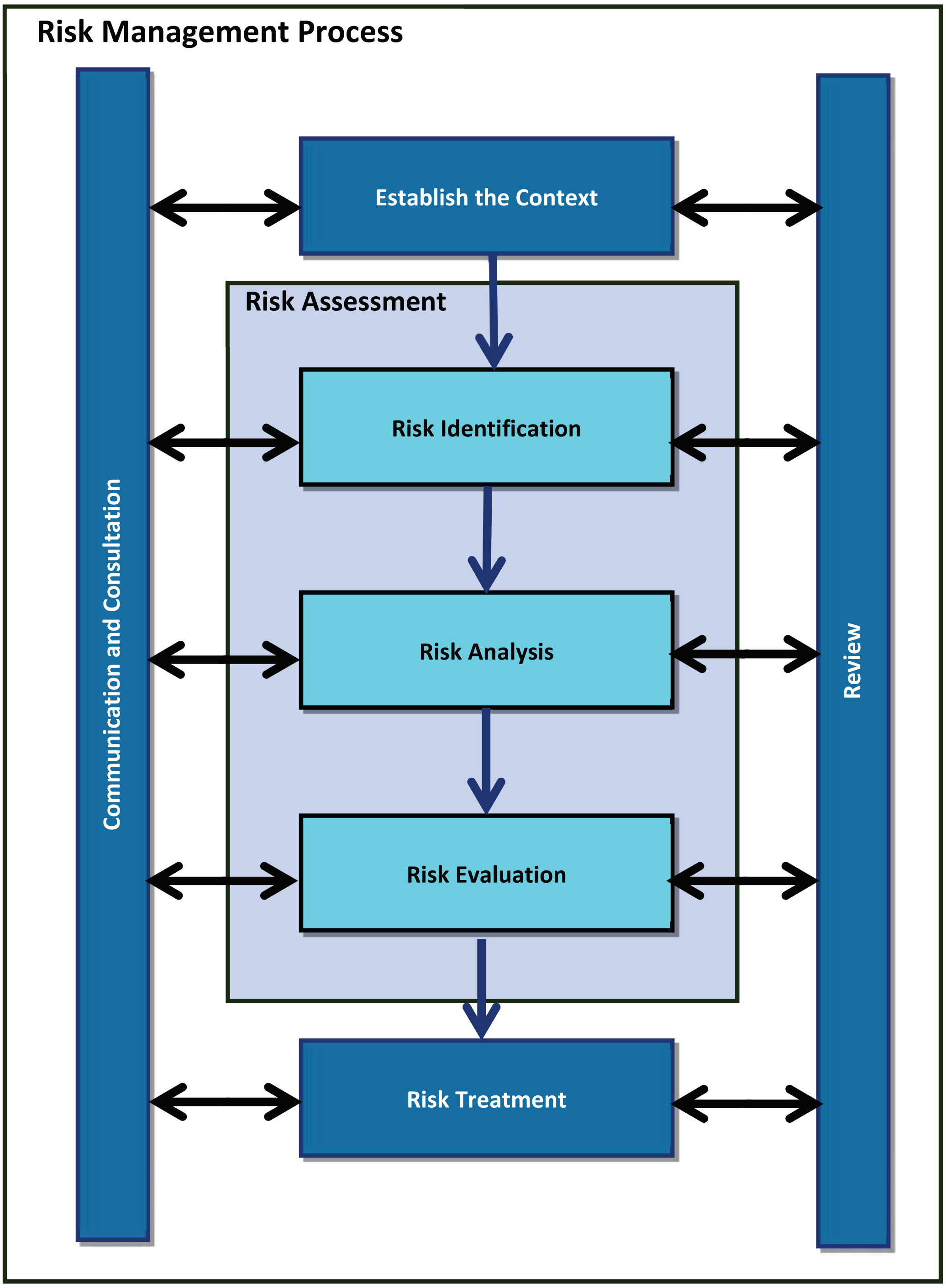

Figure 2 Risk Management Process from ISO 31000

2.2 Risk Context and Risk Assessment Divisions

2.2.1 Risk Management Implications of the Coastal Management Act 2016

The CM Act establishes the broad framework for coastal management by local councils in NSW, through the development of Coastal Management Programs. The CM Act also establishes the *Coastal Vulnerability Area* (CVA), which refers to the area identified as subject to coastal hazards. Once coastal hazard extents have been mapped, coastal councils may pursue formal mapping (and hence establishment) of the CVA within their local government area under *State Environmental Planning Policy (Resilience and Hazards) 2021 (the RH SEPP)*. Mapping outputs have been prepared as part of this study which could support formal establishment of the CVA within the Wollongong LGA.

The CM Act outlines *objectives* for the Coastal Vulnerability Area. Regardless of whether the CVA is formally mapped under the RH SEPP, we consider that these objectives remain relevant to the context of risk assessment associated with coastal hazards. The CVA objectives from the Act are:

> *(a) to ensure public safety and prevent risks to human life,*
>
> *(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,*
>
> *(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.

From these objectives, the following principles of relevance to the present risk assessment can be discerned:

1 The risk assessment should take account of public safety issues.

2 The risk assessment should consider the location of coastal developments, including infrastructure and settlements.

3 The risk assessment should provide information to inform future land use decisions, such that the decisions of today can avoid future legacy risks from coastal hazards.

4 Noting point (3) when projecting how the future may look, the impacts of climate change, most notably sea level rise, should be included.

5 Risks which involve the loss (or failure to *"maintain"*) beaches, dunes, and natural foreshores should be considered. Noting the wording of the CM Act, this is seemingly focussed on foreshores in the vicinity of beaches.

6 Risks to the public's ability to safely access and enjoy beaches and foreshore areas should be considered.

One notably absent feature from the list of CVA objectives is that there is no broad primary objective which relates to matters protecting ecological and biophysical processes from the impacts of coastal hazards. Instead, these matters are only raised in a subordinate manner, within the context of management actions that might be adopted (viz. objectives *f(i)* and *g(ii)*, listed above). These matters would normally be considered as part of strategic land use planning and as part of normal development assessment.

Broader issues of ecological integrity and biodiversity are covered by the objectives of the *Coastal Wetlands and Littoral Rainforest,* and *Coastal Environment* Areas, which are defined alongside the CVA in the CM Act.

Accordingly, impacts on coastal wetlands, littoral rainforests and other threatened ecological communities are not a focus of the risk assessment presented here. Even so, we have calculated areas of those ecosystems that might be impacted by coastal hazards in future. These are reported and discussed in the context of Wollongong's coast and may prove useful for subsequent studies.

Risks associated with the *Coastal Wetlands and Littoral Rainforest Area*, *Coastal Environment Area*, and *Coastal Use Area* will be considered, alongside the *Coastal Vulnerability* risks presented here, as part of a complete, detailed risk assessment as Stages 2 and 3 of CMP development progress.

2.2.2 Risk Management Implications of the Local Government Act 1993

Aside from the coastal management specific objectives outlined in the CM Act, there are also broader objectives of local government in NSW which contribute to the risk environment within which coastal management decisions need to be made.

Chapter 3 of the *Local Government Act 1993* (LG Act) outlines the guiding principles for the operation of local councils, with an overriding principle to:

> *"carry out their functions in a way that facilitates local communities that are strong, healthy and prosperous"*

Noting this, we have split the risk assessment into geographically "local" divisions so that risks to specific localities along the coast can be considered in isolation. However, there is a broader scope within which local councils need to behave prudently:

1. Section 8A of the LG Act outlines broad guiding principles including: strong and effective leadership, planning and decision-making; providing the best possible value for money for ratepayers, a need to plan strategically, cooperation with other arms of government, considering current and future needs of the community, the provision of appropriate services, a need to act fairly, ethically and without bias, acting as a responsible employer, and ensuring there is active engagement with their community.

2. Section 8A also notes that decisions should be made considering diverse needs within the community, social justice principles, long term impacts on the community, the principles of ecologically sustainable development; and that decisions should be transparent and decision makers accountable.

3. Section 8B outlines principles for sound financial management, noting the need for sustainable budgeting, sensible and sustainable investment in infrastructure, effective financial and asset management (including risk assessment practices), and a need to ensure that the cost of services provided today are not borne by future generations (i.e. intergenerational equity).

4 Section 8C outlines principles surrounding Integrated Planning and Reporting, focussing heavily on adopting, and pursuing goals to address key community needs and aspirations in a strategic manner, with actions taken based on evidence, and a risk management approach taken where appropriate.

Under this broad guidance, local government in NSW typically provides a range of functions, including:

- Local Planning and Development Regulation: particularly including land-use planning and development control. Councils need to balance development with environmental protection and community needs.
- Infrastructure and Asset Management: including local roads and bridges, public buildings, parks, street lighting, and stormwater. Council manages both the provision of new infrastructure and maintenance and repair functions. In the case of the Wollongong LGA, water and sewerage services are provided by Sydney Water.
- Waste Collection and Environmental Health: including household garbage collection and recycling, and waste management facilities. Broader environmental health involving the management of local waterways and bushland (including regeneration), keeping public areas clean, providing toilets and amenities, and providing a compliance role regarding food premises.
- Community Facilities: including libraries, community centres, recreational programs, arts, culture and sporting facilities, parks, playgrounds, and swimming pools.
- Economic Development: including supporting local businesses, encouraging investment and tourism. These functions are not specifically mandated under law but are becoming increasingly expected of local councils.

While local councils operate within the boundaries set by other Acts of parliament, the CM Act and LG Act are the two key acts of relevance to coastal management at the local scale in NSW.

The responsibilities and functions of local government are broad. Risks associated with coastal management need to be considered alongside risks to all these other functions. The way this is facilitated by the present study is discussed further in Section 2.2.6

2.2.3 Organisational Structure of Wollongong Council

The present organisational structure of Wollongong Council is shown in Figure 3. Considering the sections within each of Council's four directorates, the structure is clearly influenced by the legal requirements, objectives, and functions commonly served by local councils in NSW, as outlined above.

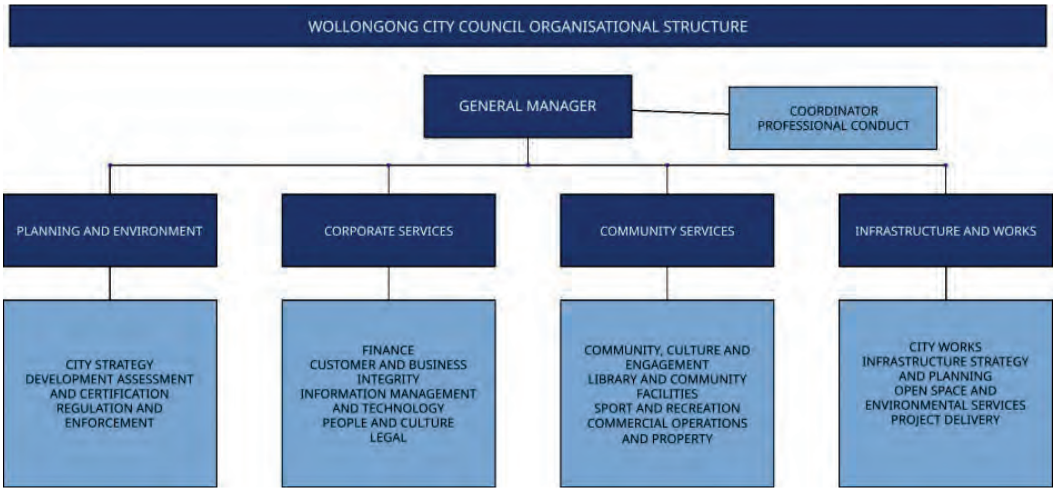

Figure 3 Organisational Structure of Wollongong Council

Under the CM Act, Councils are given a leading role in the development and delivery of CMPs including: a legal right (or in some cases an obligation) to prepare a CMP (s13), directions on how Councils should prepare a CMP (s14), an obligation to consult with the community and other stakeholders when preparing a CMP (s16), a right to submit a draft CMP for certification (s17), an obligation to review an adopted CMP and a subsequent right to amend, replace, or repeal a CMP (s18).

Importantly, Councils have the primary obligation to *"give effect"* to a coastal management program (s22).

Based on this context, the risk management environment within which coastal hazards are managed through delivery of a CMP is overwhelmingly influenced by the risk management environment within which local government works in NSW. It follows that the risk assessment methodology adopted by our analysis should align with the risk management processes formally adopted by Wollongong City Council (2025), allowing Council to balance coastal hazard risks against the myriad other risks it needs to manage.

2.2.4 Other Stakeholders

While Councils must *"give effect"* to a CMP, public authorities which have a responsibility that interacts with a CMP must *"have regard"* to that CMP where relevant. Furthermore, actions to be conducted by a public authority, or on any land owned or managed by a public authority, must not be included in the CMP without the agreement of that public authority (CM Act, s14(4)(b)).

While a local Council has a more proactive role than other authorities, they should still engage with relevant authorities throughout CMP development and delivery. In the case of the Wollongong coast a variety of authorities and stakeholders are relevant, and have been engaged as part of this risk assessment process:

- Department of Climate Change, Energy, the Environment and Water (DCCEEW) are Council's key State Government partner in CMP development, providing both funding and technical support. Representatives from DCCEEW have participated in project direction for the broader hazard and risk assessment, undertaken review and provided comment on all deliverables, and attended all risk workshops delivered as part of this risk assessment.

- Sydney Water own water supply and sewerage assets within Wollongong's coastal zone. Representatives of Sydney Water attended one of the risk workshops hosted as part of this project. Sydney Water datasets were available for consideration in this risk assessment.

- Endeavour Energy own electricity transmission and distribution assets throughout the coastal plain of the Wollongong LGA. The higher value distribution assets (11 KV high voltage distribution lines) still tend to be set back from the coastline. A representatives of Endeavour Energy attended one of the risk workshops hosted as part of this project. Endeavour Energy asset GIS datasets were not assessed within this risk assessment, however Endeavour Energy will utilise the hazard mapping for its own assessment and notify Council of any key risks that may need to be considered as part of the CMP.

- National Parks and Wildlife Service (NPWS) most notably manage the northernmost parts of the coastline within the Wollongong LGA, which are contained within the Royal National Park. NPWS also manages the Illawarra Escarpment State Conservation Area, which extends landwards from the cliff lines of the escarpment and is close to the coast in areas from Stanwell Park to Clifton. Furthermore, NPWS manage the Five Islands Nature Reserve, which includes the islands offshore of Port Kembla and Hill 60 (Red Point) and is contained within the Wollongong LGA and the presently mapped coastal zone. Hazards were not derived for the Five Islands, noting that these are composed of hard volcanic rocks which are resistant to erosion and don't contain significant built assets of concern. Accordingly, this risk assessment has not covered the Five Islands. Representatives of NPWS attended a workshop dealing specifically with their Royal National Park assets as part of this project. NPWS also provided datasets containing their assets for consideration.

- Department of Primary Industries and Regional Development (DPIRD - Fisheries) have an interest in a variety of matters relating to coastal management spanning the protection of aquatic ecosystems, biodiversity conservation, and the regulation of certain actions, such as entrance management, which may influence fish behaviour and therefore fish stock. While DPIRD–Fisheries do not own significant built assets or infrastructure within the coastal zone, a representative did attend a workshop as part of this project.

- Transport for NSW: Transport for NSW has direct responsibility for State Highways and Main Roads within the Wollongong coastal zone. These include parts of Memorial Drive and the Princes Highway to the south of Woonona, and sections of Corrimal St, Springhill Road, Primbee Bypass and Windang Road to the South of Wollongong. Of particular interest is Lawrence Hargrave Drive, to the north of Thirroul, including the Sea Cliff Bridge between Coalcliff and Clifton. This road is often constrained by the proximity of the Illawarra escarpment to the coast, meaning it is directly threatened by beach erosion and inundation, and geotechnical instabilities associated with coastal cliffs. In addition to roads, TfNSW also has some responsibility for boating infrastructure, although their role within the Wollongong LGA is typically limited to providing funding to Council, to support the development and management of that infrastructure. TfNSW is also commonly responsible for large breakwaters and harbour structures at Bellambi (TfNSW owns the breakwater) and Wollongong Harbour. At Wollongong Harbour, TfNSW is responsible for the breakwaters, wharves, seawalls, slipway, and roads, with the harbour fisherman's co-op building privately leased. A representative of TfNSW attended a risk workshop as part of this project.

- Local Land Services (LLS) have an interest in maintaining waterways, particularly through the restoration and maintenance of riparian zones and catchment management activities involving the maintenance of ground cover and erosion control. On the ground works are typically completed in partnership with private landowners, although LLS do partner with councils, community, and Aboriginal groups in developing strategies for improved land and waterway management. LLS are often involved in the development of CMPs in NSW and the delivery of actions within CMPs. A representative of LLS attended a risk workshop as part of this project.

- Department of Planning, Housing and Infrastructure (DPHI – Crown Lands) are responsible for the administration of Crown Land throughout New South Wales, including waterways, estuaries, beaches, and reserves. Crown Lands are often a key landholder in the NSW coastal zone, and their permission is often needed for management actions in a CMP under Section 15(4)(b) of the CM Act. A representative of Crown Lands attended a risk workshop as part of this project.

More detail on the risk assessment workshops facilitated by Council and study team members with participation from other stakeholders and Council staff, is presented in Section 4.2.

The traditional owners of Wollongong coast are important stakeholders in the CMP process. Parallel to the present study, the Illawarra Local Aboriginal Land Council

(ILALC) is undertaking a cultural values study. Using the hazard information being developed as part of our overall study, ILALC is also completing an assessment of risks to cultural values. Both the ILALC's assessment, and the assessment presented herein will be carried forwards to Stage 3 of the CMP process. Consultation between the ILALC, our study team and Council has continued through Stage 2, to achieve consistency between the two risk assessments where possible.

2.2.5 Geographical Extent and Divisions for Analysis

The risk assessment includes that part of the coastal zone within the Wollongong LGA, where coastal hazards could foreseeably have an impact over a time frame of around 100 years. This area is bound by the defined coastal zone. This zone is mapped under State Environmental Planning Policy (Resilience and Hazards) 2021 and this has been adopted as a preliminary boundary. However, we note that in some locations, assessed coastal hazards do extend beyond the presently mapped coastal zone. Also, the boundary between areas that are managed under the Lake Illawarra CMP (already completed and in force) and those to be managed under the Wollongong CMP (under development) may be unclear until further progress is made in the development of the latter.

The geographical extent of risk assessment is shown in Figure 4 (northern Wollongong coast) and Figure 5 (southern Wollongong coast). We highlight that an area around the port of Port Kembla is excluded from the CMP. However, hazard assessment for coastal and tidal inundation was undertaken here, as required to assess the hazard extents upstream of Port Kembla. This hazard extent information is available in the associated project outputs, but a risk assessment within that area is not included.

Noting that the overarching object of the LG Act is for Councils to facilitate:

*"…..**local** communities that are strong, healthy and prosperous"*

We have divided the coastal zone subject to the risk assessment into twenty-seven local divisions to better inform the risk assessment and later stages of the CMP process. However, we note that Wollongong Council has a broader responsibility to manage finances and fairness across the entire LGA and for this reason, risks have been aggregated across the entire coastal zone. This would enable, for example, informed budget planning for Council's overall coastal zone management.

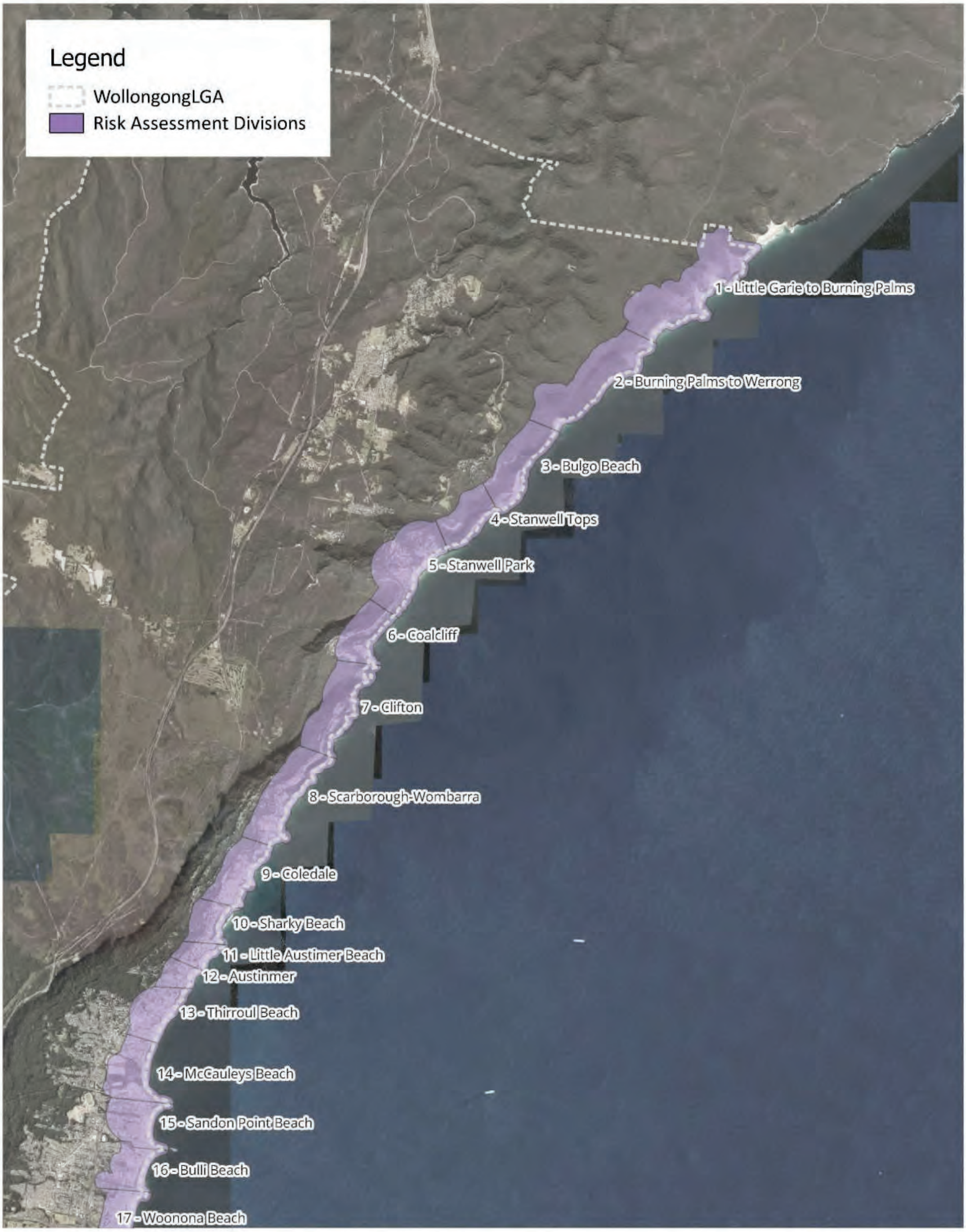

Figure 4 Geographical Context: Northern Risk Assessment Divisions

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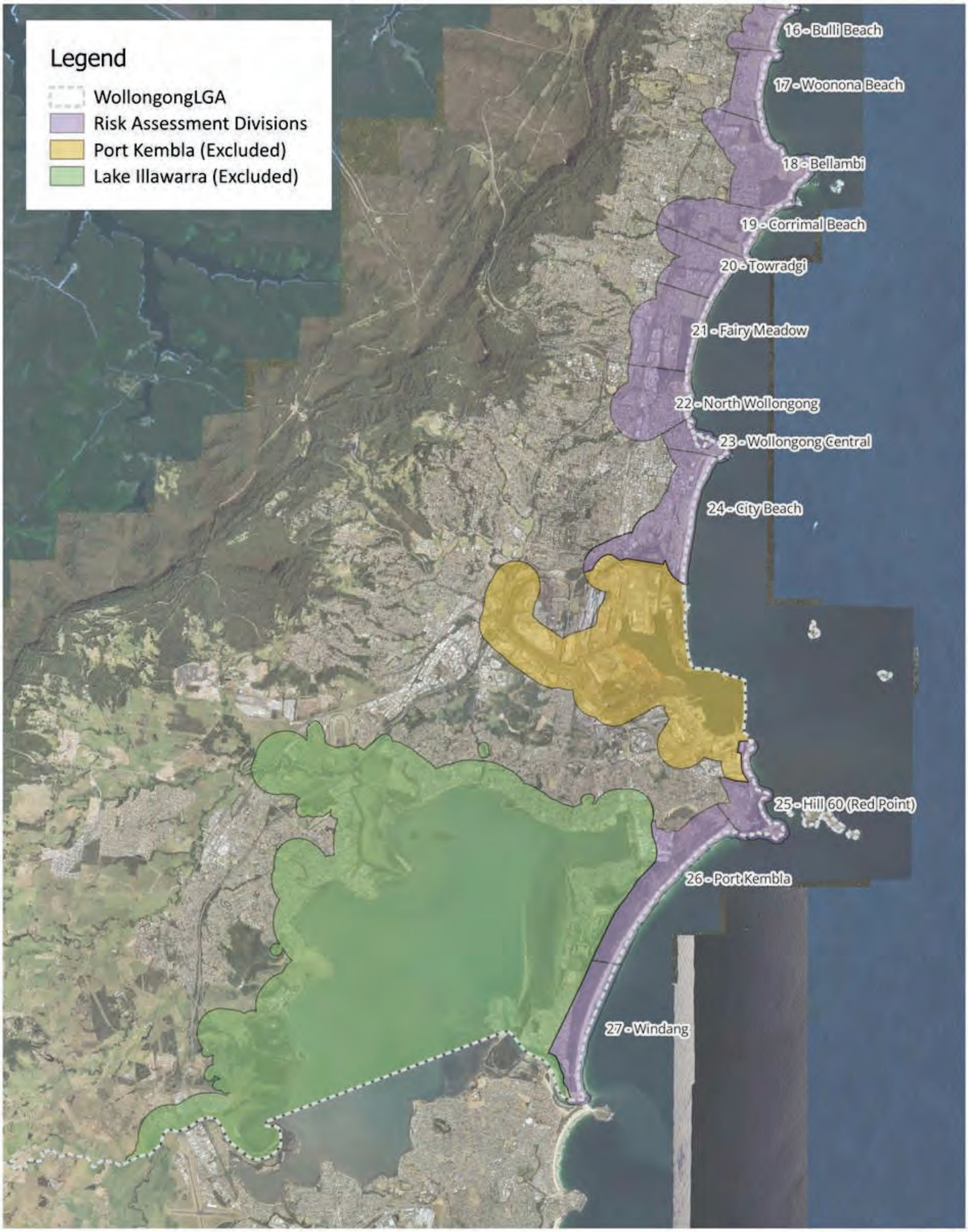

Figure 5 Geographical Context: Southern Risk Assessment Divisions

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2.2.6 Risk Assessment Criteria and Scales

To maintain broad consistency with Council's overarching risk management framework and policy (Wollongong City Council, 2023), the risk assessment tables used by Wollongong City Council (2025) have been adopted for this study. These tables are reproduced in Appendix D. As per normal risk assessment practice, risks are given scores for likelihood and consequences (referred to as "severity" in Appendix D).

The likelihood scale ranges from "Rare" to "Almost Certain" with guidance provided on probabilities or frequencies relating to a particular risk event to enable classification.

The severity scale ranges from "Insignificant" to "Catastrophic" with both qualitative and quantitative ($) guidance provided to enable classification. That guidance is presented in several themes ("People", "Reputation and Community Expectations", "Child Safety", "Financial Sustainability", "Environment" and "Service Delivery"). Coastal hazards have the potential to impact on many of these themes, potentially at the same time following a particularly severe event.

Sections 3 and 4 of this report present an assessment of the likelihoods associated with hazards and the consequences (severity) of impacts in more detail. Once these two dimensions of risk are categorised, the standard scoring table from Wollongong City Council, reproduced here as Table 1, has been used to score the risks.

Table 1 Standard Risk Scoring Matrix (Wollongong City Council, 2025)

Risk Score Matrix

Likelihood ▼ / Severity scale ▶	Catastrophic 5	Major 4	Moderate 3	Minor 2	Insignificant 1
A Almost Certain	E25	E20	E16	H10	M5
B Likely	E20	E16	H12	M8	L4
C Possible	H15	H12	M9	M6	L3
D Unlikely	H10	M8	M6	L4	L2
E Rare	M5	L4	L3	L3	L1

Note: Risk Level Classifications: 'E': Extreme, 'H': High, 'M': Medium, 'L': Low.

2.3 Hazard Types and Timeframes

The CM Act defines seven coastal hazards. These are defined as defined as follows:

h) 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. 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.

i) Shoreline recession: Refers to continuing landward movement of the shoreline, that is, a net landward movement of the shoreline, generally assessed over a period of several years. As shoreline recession occurs the "*beach fluctuation zone*", including the dunes and areas offshore to depths of several tens of metres, is translated landwards.

j) Coastal lake or watercourse entrance instability: Refers to the variety of potential hazards and risks associated with the dynamic nature of both natural and trained entrances. Coastal lake and watercourse entrances are highly active environments with their shape constantly changing in response to processes such as alongshore sediment transport, tidal flows, storms, and catchment flooding.

k) 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).

l) Coastal cliff or slope instability: This hazard occurs on the headlands and bluffs within and separating coastal sediment compartments and relates to the collapse, landslides, or toppling of rocks from these slopes. The differing degree of instability often relates to the interaction of weathering and erosion processes on different geological formations and rock types.

m) 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.

n) Erosion and inundation of foreshores: Caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters.

The hazard studies completed during Stage 2 investigated the above coastal hazards. The hazard datasets arising from those studies are discussed in Section 3, and a more detailed summary of the methods used to derive those datasets is provided in Appendix A.

The hazard datasets often include a range of different spatial polygons representing the extent of impact arising from a particular hazard, corresponding to a range of different likelihoods of occurrence over different timeframes. The likelihood values vary depending on the hazard being considered, but the timeframes normally considered are "Present Day", "20-year" (2045), "50-year" (2075) and "100-year" (2125).

Consideration of these timeframes meets Mandatory Requirement 13(i) of Part A of the Coastal Management Manual (NSW Government, 2018).

For this study, the key factor which changes the extent of coastal hazard impacts when comparing different timeframes is sea level rise. As noted in Appendix A of Salients (2025a), Wollongong City Council has adopted mean sea level rise values based on the SSP5-8.5 projection, adjusted to Australian Height Datum (AHD) as presented in Table 2. Wherever relevant, this risk assessment and its underpinning hazard studies have been based on these values.

Table 2 Recommended Sea Level Rise Projection for Wollongong Coastal Hazard Studies (m above AHD)

	Chance that Mean Sea Level will be Exceeded (assuming SSP5-8.5)				
Year	**95%**	**83%**	**50%**	**17%**	**5%**
2025	0.05	0.08	0.11	0.15	0.18
2045	0.15	0.18	0.23	0.29	0.35
2075	0.33	0.39	0.50	0.65	0.79
2125	0.65	0.78	1.1	1.54	1.89

To simplify the consideration of risks associated with different hazards, the seven hazards were classified into two groups representative of the way in which the hazards interact with assets. The hazards were broadly classified as "Erosion/Undermining" and "Inundation" type hazards as presented in Table 3. While there are nuances between the hazards in each classification, its adoption has helped to simplify the task of identifying and exploring risks, particularly during the risk workshops (Section 4.2).

Table 3 Classification of CM Act Hazards based on Damaging Action

Erosion/Undermining Hazards	Inundation Hazards
• Beach erosion / Shoreline Recession (considered together) • Coastal lake or watercourse entrance instability • Coastal cliff or slope instability • Erosion of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters.	• Coastal inundation • Tidal inundation • Inundation of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters. (note that assessment of this hazard has not been considered separately, but has been incorporated into the assessment of coastal and tidal inundation)

2.4 Nature of Asset GIS Datasets and Limitations of the Assessment

A dataset of assets within the Wollongong coastal zone was compiled with data sourced from multiple agencies. Geographical Information System (GIS) layers were provided for Council assets, road, and stormwater assets from TfNSW, built assets from NPWS, and sewer and water assets from Sydney Water. In addition, building footprints were sourced from the Microsoft Australia building footprint dataset[1].

GIS layers were clipped to only include those assets located within the coastal zone. The GIS layers for Council's assets were also linked with spreadsheet data provided from Council's asset database, with attributes such as asset type, dimensions, materials, and replacement costs available. However, not all assets could be matched with attributes and data were incomplete and contained errors.

Maps showing the spatial distribution of assets within each geographical division are provided in Appendix C2. While Sydney Water's water and sewer assets were used for the risk assessment, the location of those assets is not shown in the maps within Appendix C2.

Determining the intersection of the extents of coastal hazards and the location of any assets that could be impacted is a key step to understanding the physical risks arising from those hazards. Our risk assessment is fundamentally based on determining the quantities, areas, and lengths of different physical assets that might be impacted by hazards, at different probability levels and different timeframes and working out the representative cost arising from complete or partial loss of those assets.

By its nature, this spatial intersection does not consider compound or secondary risks. For example, we have assessed consequences in terms of the length of stormwater pipe that could be damaged by erosion (and associated replacement costs), but our assessment doesn't extend this to consider how delays in repairs may impact Council's reputation. The nature of many of these secondary risks is presented in Appendix B, but it was beyond the scope of the present assessment to attempt to quantify them.

The intersection of hazard extents and assets has been performed using the freely available open-source GIS platform QGIS.

The quantitative integrity of the assessment is dependent on the quality of datasets available. We have been able to control the quality of the hazard layers developed as part of this project but have relied on asset datasets "as-is", where they have been provided to us by a third party. Overall, datasets are reasonable in providing an indication of the horizontal location of different assets, but attributes attached to each item mapped in the datasets are often missing (such as elevations or even 'type' of

[1] https://github.com/microsoft/AustraliaBuildingFootprints.

asset). It was beyond the scope of the present project to complete quality assurance and to fill gaps within the data sets provided by third parties.

We have, however identified where information is missing and have corrected for these where feasible. The assumptions made, and corrections applied to the datasets are discussed in Section 4.

Based on the above, the risk assessment presented within this report is considered to provide a robust indication of the scale of coastal hazard related risks present within the geographical divisions presented in Section 2.2.5. The results from the different divisions can be reliably compared against each other and the types and relative scale of risks expected within each division are well represented.

However, noting that details are missing from the underlying datasets, the risk assessment would need to be revisited on a local basis, with data gaps filled, if more detailed consideration is required. This may be necessary, for example, if it were desired to prioritise and plan for asset replacement activities to address coastal hazard risks, or the development of local adaptation plans for different areas.

At both the scale of individual beaches, and the whole of LGA scale, the risk assessment is considered fit for purpose and will allow Council to set broad strategies and prioritise different areas for further investigation and action.

3 Coastal Hazards and their Likelihoods

3.1 Introduction

This section provides a brief introduction to the hazard assessments, their key outputs, and the way in which these have been used in the risk assessment. A more comprehensive summary is presented in Appendix A, and even further technical detail on the methods used in the underpinning hazard assessments can be found in the hazard studies, which are also listed in Appendix A. Generally, risk has been assessed by valuing the assets that could be "lost" because of coastal hazards across the various timeframes and probabilities. The approach varies for the different hazards but has been assessed based on Councils adopted risk tables (Appendix D).

Also included in Appendix A is a discussion of how the "Current" and "Future" vulnerability extents have been derived from available hazard layers.

3.2 Beach Erosion and Shoreline Recession Hazards

The assessment of beach erosion and shoreline recession applied a probabilistic (Monte Carlo modelling) approach to combine storm event-based beach erosion with longer-term recession trends. Longer term recession rates were influenced by both historically measured shoreline change and expected recession due to future sea-level rise.

Hazard zones were derived for four timeframes (Present day, +20, +50, and +100 years) and three exceedance probabilities (63%, 5%, 1%). For each combination of timeframe and probability, two key zones were derived:

1 Zone of slope adjustment (ZSA), which represents the extent of sand (or other soil) removed either during or soon after a storm.

2 Zone of reduced foundation capacity (ZRFC), which covers areas where the design of structural foundations needs special consideration. The ZRFC includes an appropriate engineering factor of safety.

In terms of the risk assessment presented herein, where the actual loss of assets is of interest, a scenario where assets are destabilised is more relevant (i.e. no factor of safety applied). Accordingly, the ZSA has been used in the risk assessment. The ZRFC is appropriate for siting development in an engineering and planning context.

Risks have been collated at each future timeframe and considering a 10 year window at that future timeframe. The 10 year window has been selected as a proxy for converting likelihoods to "encounter probabilities", corresponding to the 10 year timeframe over which CMPs are designed to act. The following likelihood rankings have been applied, consistent with Council's risk tables (see Appendix D):

- 63% ~ Almost Certain, has a greater than 99.99% of occurring over a 10 year period.

- 5% ~ Possible, has around a 40% chance of occurring over a 10 year period.
- 1% ~ Rare, has a slightly less than 10% chance of occurring over a 10 year period.

An example of the spatial outputs derived from the beach erosion and shoreline recession hazard assessment is shown in Figure 6.

3.3 Entrance Instability Hazard

The instability of creek and lagoon entrances, where they discharge across a beach, was analysed using a semi-automated image processing method to detect wetted entrance areas from historical aerial imagery (33–56 images per entrance). Present-day hazard lines were generated for 80%, 50%, 20%, 10%, 5%, and 1% probabilities of an area being "wetted" based on this imagery.

To project future entrance instability hazard zones, the study adopted a recession-aligned method, using the difference in location between present-day and future shoreline hazard zones (63% exceedance) to shift entrance hazard extents landward over 20-, 50-, and 100-year timeframes.

An example of the spatial outputs derived from the entrance instability hazard assessment is shown in Figure 7, which also illustrates the way in which hazard zones for future time frames have been established.

In defining the area affected by the entrance instability hazard, the envelope of area for all frequencies greater than "1% of the time" was considered, with that extent adopted as representing a "likely" condition. A "1% of the time" assessment means that it could be expected to occur more frequently than once a year, on average. However, the nature of this hazard is that the watercourse will tend to meander and stay in a particular location for months and possibly years. Key sites exhibiting entrance-related issues include Whartons Creek at Bulli, Bellambi Gully, and Fairy Creek at Stuart Park.

In defining the hazard area, a buffer was applied to the "1% of the time" extent to account for the possibility that conditions not evident from the aerial photographs used in the assessment might occur. The width of the 1% extent at the back of the beach was measured from GIS and a total buffer of 25% of that width (12.5% each side) was judged as reasonable to account for that possibility. The additional zone accommodated by that buffer was considered to represent an "unlikely" condition.

Following buffering and translation, the existing barriers to the entrance moving landward, such as known bedrock outcrops and headlands, were also considered. The extent of the translated envelope was clipped to account for those features which will act to constrain the movement of the entrance as it is forced to recede alongside the adjacent beach in future.

Figure 6 Example Beach Erosion and Shoreline Recession Hazard Zones (2075 ZRFC for City Beach North)

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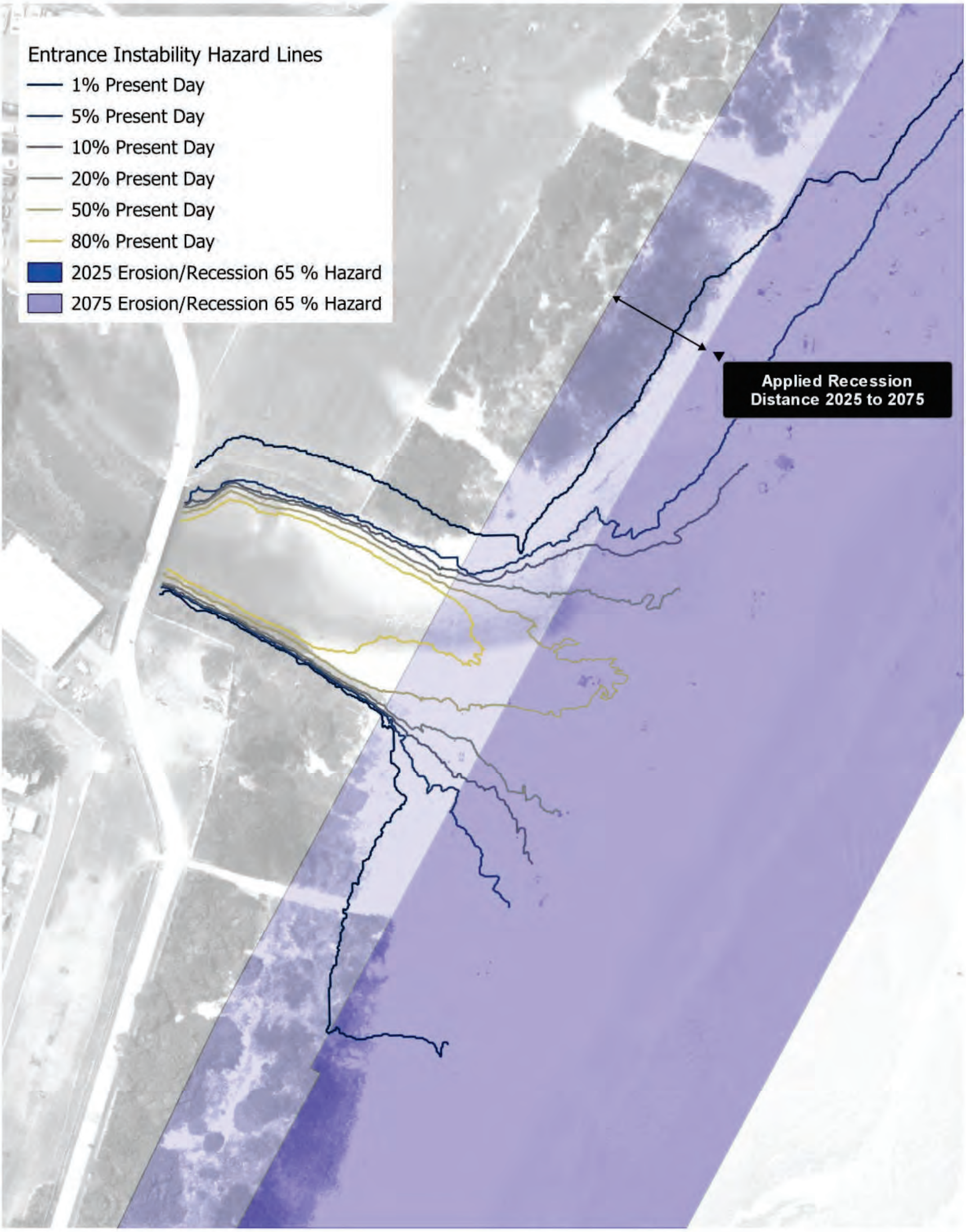

Figure 7 Whartons Creek Entrance Instability Hazard Lines and Future Recession Determination

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For the present risk assessment, this hazard was not considered. The reasoning here is that the area covered by this hazard is almost entirely contained within the erosion and shoreline recession hazard. The risks arising from the entrance instability hazard are thus captured through consideration of the beach erosion and shoreline recession hazard.

3.4 Coastal Inundation Hazard

Coastal inundation was assessed using pre-existing TUFLOW numerical flood models. Those flood models covered the coastline, creeks and lagoons between Thirroul and Port Kembla. The more sophisticated numerical modelling was supplemented by "bathtub" modelling elsewhere on the coast.

For the TUFLOW models, storm tide levels were derived from literature and modelled as time-varying boundary conditions. In addition, overtopping was applied dynamically as an inflow to the model, behind the crest of low points in dunes (or structures). Overtopping rates were modelled using methods from the Eurotop manual (Van der Meer et al., 2018), with wave run-up and overtopping discharges checked using hindcast wave data and observed video footage.

For areas covered by bathtub modelling, a static allowance for run-up was added to the peak storm tide levels and this was projected inland using GIS Software. This results in a conservative assessment of inundation for the creeks to the north of Thirroul.

An example of the spatial outputs derived from the coastal inundation hazard assessment is shown in Figure 8. The scenarios modelled are summarised in Table 4.

Table 4 Coastal Inundation Scenarios Considered

Year	SSP5-8.5 Sea Level Rise, chance of exceedance	Storm Likelihood (AEP[2])		
		63%	5%	1%
Present Day (2025)	n/a		X	
2045	5%	X	X	X
2075	5%	X	X	X
2125	5%	X	X	X
Present Day (2025)	n/a		X	
2045	50%	X	X	X
2075	50%	X	X	X
2125	50%			

[2] Annual Exceedance Probability: The probability (expressed as a percentage) of an exceedance (e.g. large wave height or high water level) in a given year.

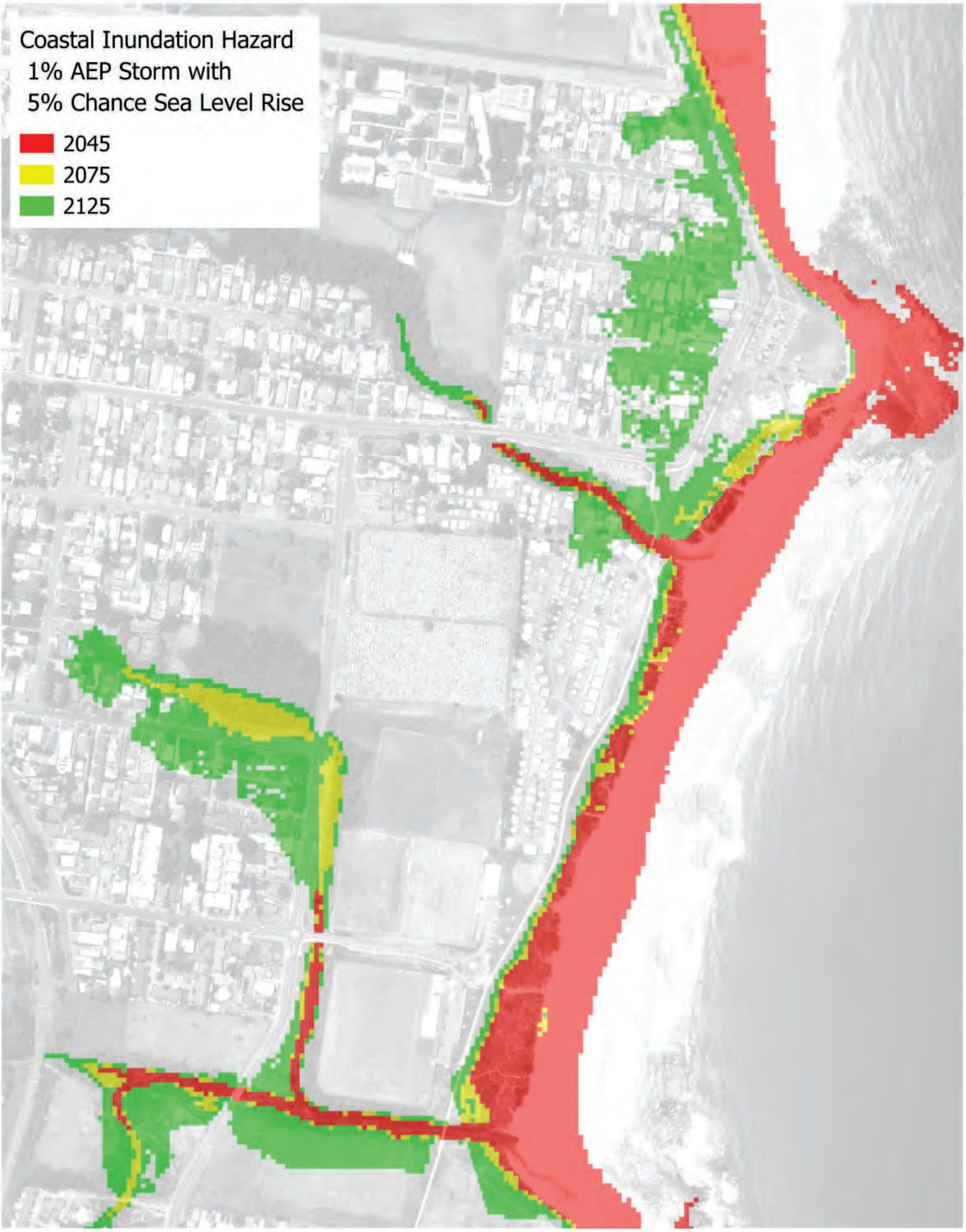

Figure 8 Example Coastal Inundation Hazard Mapping at Bulli

Wollongong CMP - Stage 2 Coastal Hazard Risk Assessment Report

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For a balanced risk assessment, we have calculated losses for both the 5% and 50% sea level rise scenarios, with a weighted average (5% sea level rise scenarios weighted at 0.3, 50% sea level rise scenarios weighted at 0.7) applied to estimate damages at 2045 and 2075. For the present day, the 5% AEP scenario was applied as representative (as it is the only available scenario).

Losses at a high sea level rise (5% chance of exceedance), long term (2125) timeframe were also calculated and reported, noting that only the 5% sea level rise scenario was considered at 2125.

To illustrate how different scenarios were weighted, Table 5 details the weightings applied to the scenarios available for 2075 in determining a representative value of risk at 2075.

Table 5 Example Weightings, as applied to 2075 Scenarios to Estimate Expected Annual Damages in 2075 for Coastal Inundation.

			AEP of Storm Event		
			63%	5%	1%
			0.66	0.31	0.03
Sea Level Rise Probability	5%	0.3	0.20	0.10	0.003
	50%	0.7	0.46	0.23	0.007

Note: Marginal Weightings are in light gray, applied scenario weightings in dark gray. Applied weighting are based on the product of the marginal weightings.

3.5 Coastal Cliff / Slope Instability Hazard

The assessment of instability around cliffs built upon previous work by GHD (2010), who completed their assessment during development of Council's previous coastal zone management plan. The updated assessment used LiDAR[3], drone imagery and a compilation of over six hundred site specific geotechnical records provided by Council. Two different models for recession were applied:

1 A "time-dependent" erosion model, incorporating historical retreat and a sea level rise acceleration factor.

2 An "immediate" hazard model, allowing for episodic failure (8m of sudden retreat) and an allowance for the collapse of soil at the top of cliffs.

[3] *"Light Detection and Ranging"* a method which applies pulsed laser light from an aircraft to measure ground elevations.

The "immediate" model consistently produced the more landward (and therefore more conservative) hazard zone, and that model was therefore adopted. The mapped hazard zones assume that cliffs fail by discrete failure events, with fallen debris temporarily protecting cliffs from further undercutting. While rare, these failure events could foreseeably occur at any location and at any time. The hazard lines are identical across all future timeframes (2025–2125) as, once collapse occurs at a location, a repeat of that event has only a very low probability of occurring over the 100-year period considered by the hazard studies.

There are broader landslide locations associated with the Illawarra Escarpment, but these mechanisms, which aren't initiated by coastal processes, are not included in the hazard zones mapped by our study.

An example of the spatial outputs derived from the cliff instability hazard assessment is shown in Figure 9. The hazard zones developed using this method are suitable for identifying areas requiring detailed site-specific geotechnical investigation as part of Council's development control plan but aren't particularly useful for assessing risk.

To assess risk, the hazard zones have been applied in the following manner:

- All assets that could be lost within the entire cliff instability hazard zone were determined with an assumption that all those assets would be lost over a 100 year timeframe.
- That amount was scaled down using the following formula:

$$L_s = L_T \times \frac{t}{100}$$

$where:$

$L_s = Scaled\ Loss\ Amount$

$L_T = Total\ Loss\ \ Amount$

$t = time\ frame\ being\ considered\ (years)$

Overall, this approach typically represents a slightly conservative expected loss amount and has been assigned a likelihood of "Possible". For the present day or "immediate" timeframe, we have considered potential losses over the next 5 years (t=5).

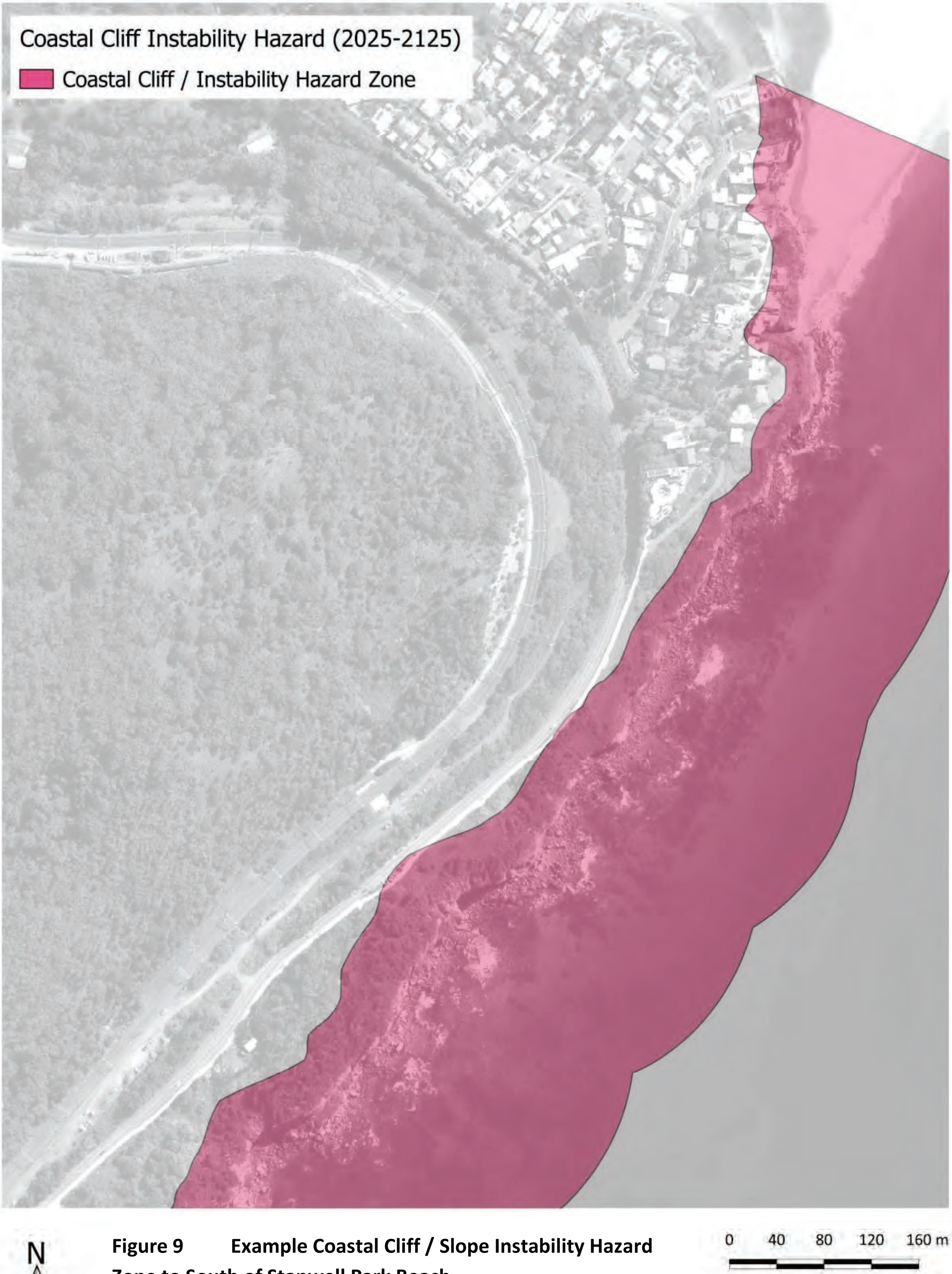

Figure 9 Example Coastal Cliff / Slope Instability Hazard Zone to South of Stanwell Park Beach

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3.6 Tidal Inundation Hazard

Tidal inundation (i.e., sunny-day flooding) was assessed via modelling of the High High Water Solstice Springs (HHWSS) tidal plane for scenarios representing a variety of sea level rise increments (typically 0.1m increments, but with values of mean sea level rise to 1.9m AHD). Simulations were completed using both dynamic (TUFLOW) and static (bathtub) models as outlined for the coastal inundation hazard.

Outputs included gridded flood depths and inundation extent polygons. An example of the spatial outputs derived from the tidal inundation hazard assessment is shown in Figure 10.

The mean sea level scenarios simulated were:

- Increments of 0.1m interval up to 0.80m AHD (approximately equal to the 95th percentile, or 5% chance of exceedance at 2075, assuming the SSP5-8.5 projection, as adopted by Council).
- One additional, upper limit sensitivity scenario executed for 1.90m AHD, which is close to the 2125 95th percentile (5% chance of exceedance) value under SSP5-8.5.

The "library of simulations" approach adopted supports flexible scenario selection and avoids the need to re-execute simulations if the adopted projection is updated or modified. Mapping typically shows modest impacts by 2075, but potentially significant inundation by 2125 in some locations (e.g. around Towragdi Creek, at Stuart Park, and along Squires Way).

In calculating likely damages over different timeframes, the scenarios outlined in Table 6 were applied. For this hazard, the full spectrum of probabilities is considered, where appropriate results were available from the simulation library. The simulations are selected to match (as closely as possible) the mean sea level values from the projection adopted by Council, as presented in Table 2. The loss resulting from the different scenarios were then weighted, using the loss weighting values listed in Table 6 to combine the impact of the full distribution of scenarios into a single representative loss value.

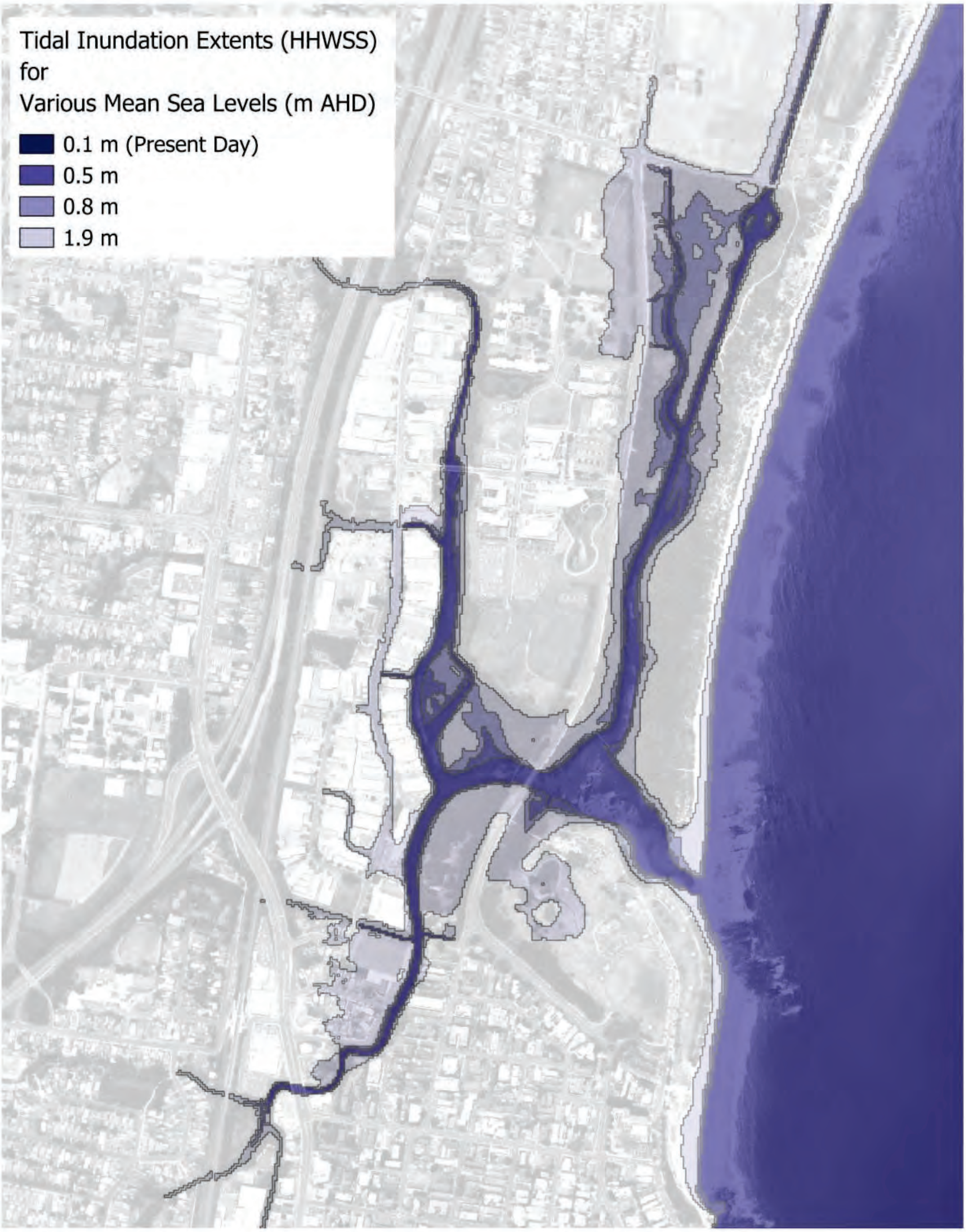

Figure 10 Tidal Inundation Hazard Mapping Around Fairy/Cabbage Tree Creeks

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Table 6 Application and Weighting of Losses for Various Future Timeframes

Chance of non-exceedance %	Loss Weighting	Sea Level Rise Scenario Applied (mean sea level, m AHD))		
		2045	2075	2125[4]
5	0.110	0.1	0.3	0.7
17	0.225	0.2	0.4	0.8
50	0.330	0.2	0.5	-
83	0.225	0.3	0.7	-
95	0.110	0.4	0.8	1.9

3.7 Estuary Foreshore Erosion Hazard

The assessment of foreshore erosion within creeks and estuaries was less comprehensive. Background information was reviewed and field inspection conducted across multiple sites to identify key sites for analysis. Seven key sites were selected for further consideration. Hazard lines were derived for these key sites, where sufficient information was available, incorporating evidence of historical bank retreat and active instability.

In some cases, data limitations prevented the estimation of quantified hazard zones. However, based on a qualitative assessment of the risks, management actions were considered and prioritised. Sites exhibiting moderate to severe erosion were flagged for monitoring and potential engineering works, while others were considered suitable for low-regret or adaptive responses.

Noting that management actions have been identified for these “key” sites, and that the hazard lines were estimated based on limited information, a formal risk assessment relating to the foreshore erosion hazard was not completed.

[4] For 2125, in the absence all 5 representative scenarios, alternative weighting has been applied. 1.9m of sea level rise by 2125 is at the upper range of plausible estimates which the IPCC has most recently published.

4 Coastal Zone Assets and the Consequences of Coastal Hazards

4.1 Introduction

The risk assessment was based on the intersection of two groups of datasets using GIS[5]:

- The mapped extents of hazards for different probabilities and timeframes as presented in Chapter 3, and described in more detail in Appendix A.
- Asset datasets, which were introduced in Section 2.4, with more specific details presented in Section 4.3.

The assets indicated as being subject to coastal hazards have then been evaluated. Wherever possible, this has been converted to a dollar value. Of course, this does not include indirect effects of coastal hazards, which are difficult to quantify. Similarly, it is difficult to assign a value to natural assets (ecosystems, beaches). Where this is the case, the areas of different natural resource assets have been reported.

The extent to which we could complete the risk assessment was governed by the spatial data available. It is not possible to understand the coastal hazard risks associated with assets unless you know what assets exist, and where they are in relation to the coastal hazard extents.

In many cases, the data sets are incomplete. While this is acknowledged as a shortcoming, it is not reasonable to expect perfect data as part of a risk assessment. Where uncertainty exists this is explained, alongside any attempts to mitigate against that uncertainty in the assessment.

Section 4.2 discusses the risk workshops held as part of the project (detailed in Appendix B). Subsequently, Section 4.3 addresses different groupings of assets and describes the derivation of values and the methodologies used in assessing the risks associated with them.

It is not possible within the scale of this assessment to break down each individual asset for discussion (e.g. each stormwater pit or pipe). However, the present assessment has examined the impacts on a locality basis, within each of the geographical divisions presented in Section 2.2.5. The outcomes of the risk assessment for each geographical division are presented in Chapter 5.

[5] For the assessment, routines within the freely available QGIS Geographical Information Systems software platform were used.

4.2 Risk Identification Workshops

The assessment has aimed to provide Council with an appreciation of the scale of coastal hazard risks, and to identify those localities along the coast where efforts should first be concentrated, for example, in dealing with the need to adapt to the effects of future sea-level rise. To support the assessment, six structured risk assessment workshops were held in March 2025 to support the assessment. The focus was on risks from coastal hazards to both built and natural assets, aligning with the seven hazards defined under the CM Act, which were grouped for simplicity as follows:

- Erosion/Undermining Hazards: Beach erosion, shoreline recession, coastal lake entrance instability, cliff/slope instability, foreshore erosion.
- Inundation Hazards: Coastal inundation, tidal inundation, inundation of foreshores.

Each workshop focused on a specific asset group. Workshops were attended by stakeholder representatives as shown in Table 7. An online introductory session, covering common background information was held prior to the workshops.

Table 7 Risk Assessment Workshops

Asset Group	Date/Time	Stakeholder Organisations Attending[6]
Stormwater & Transport	12 March (AM)	TfNSW, DCCEEW, WCC (City Strategy, Infrastructure Strategy and Planning, Project Delivery).
Ecosystems	12 March (PM)	LLS, DPIRD - Fisheries, NPWS, DCCEEW, WCC (City Strategy, Open Space and Environmental Services).
Buildings & Residential	13 March (AM)	SES, DCCEEW, WCC (Infrastructure Strategy and Planning, Project Delivery, City Strategy, Development Assessment and Certification, Property and Recreation, Legal).
Water & Energy Services	13 March (PM)	Sydney Water, Endeavour Energy, DCCEEW, WCC (City Strategy).
Recreation & Open Space	14 March	DPHI – Crown Lands, DCCEEW, WCC (Property and Recreation, City Strategy, City Works, Open Space and Environment Services, Project Delivery).
Royal National Park	24 March (online)	NPWS, DCCEEW, WCC (City Strategy).

The workshops followed a two-stage process:

1 Risk Brainstorming: Identification of how erosion/inundation may impact specific assets. This was used to formally describe risks.

[6] **TfNSW**: Transport for NSW, **DCCEEW**: Department of Climate Change, Energy, The Environment and Water, **WCC**: Wollongong City Council, **NPWS**: National Parks and Wildlife Service, **DPIRD-Fisheries:** Department of Primary Industry and Regional Development, **LLS:** Local Land Services, **SES:** State Emergency Service, **DPHI-Crown Lands:** Department of Planning, Housing and Infrastructure.

2 Preliminary Consequence Rating: Risks were rated as Minor, Major, or Catastrophic. This helped to understand the risk severities and has influenced the way in which risks have been considered. The risk tables presented in Appendix B have informed the methodologies applied to assess risks for each asset group, as outlined in Section 4.3.

More details from the workshops and the processed outcomes (comprising formal risk descriptions and associated notes) are presented in Appendix B.

While not all details from the workshops were used in the current risk assessment, the process provided a comprehensive qualitative foundation for future stages of the CMP, particularly in planning risk treatments (management actions). The tables in Appendix B also provide information that would be useful if more detailed risk and adaptation assessments are proposed for any key localities that are identified by the present assessment as part of CMP delivery.

The most important finding from the workshops is that urbanised areas along the coast often function as a tightly integrated system, which means that impacts on one element of that system may trigger a set of cascading, secondary risks. A detailed risk assessment examining, for example, a particular locality, would need to drill down at a neighbourhood scale to see how all the different elements fit together, and the way interactions between those elements result in cascading risks.

As an example, while protective structures can be valued by considering the cost of construction (or asset value), they have a further intrinsic value relating to the assets which they protect – for example, a seawall may protect a Surf Lifesaving Club building. Even then, the SLSC building's value is not necessarily in the structure itself, but in the value of the service it supplies to the community (holding functions, revenue for owners, provision of employment, community cohesion, recreation etc.). Comprehensive coastal management would consider how these assets act together to provide a service to the community.

A full understanding of the risks would need to understand these varied aspects, and that degree of analysis and community consultation was beyond the scope of the present study.

4.3 Asset Classes and the Consideration of Consequences

4.3.1 Initial Processing of Datasets

Datasets provided to the study team were subject to initial processing to make them suitable for subsequent automated analysis. Data were provided in a range of formats but were converted to "assessment ready" datasets in ESRI shapefile format. In some instances, spatial data were updated via links to spreadsheets exported from Council's asset management database. The shapefiles were then processed to remove fields (GIS attributes) of limited interest to the risk assessment. Finally, all layers were clipped to include any assets within those parts of the coastal zone included within our study, and its component geographical divisions, as outlined in Section 2.2.5.

Finally, a broad check through the datasets was undertaken while documenting and agreeing upon the proposed methodology for assessment as the study progressed. The process is tabulated in Appendix C1, and the assessment ready datasets have been provided as a deliverable outcome from the project.

Through the risk analysis, the clipped datasets were intersected with hazard zones to develop GIS datasets containing the subset of assets impacted by the various hazards at different timeframes and probabilities. A value field was typically added to these "intersected" spatial datasets to indicate the value considered lost because of coastal hazard impacts. Those values were then aggregated across assets for a given timeframe. Importantly, the value adopted indicates a value for typical construction, or installation, of the asset. It doesn't include costs, for example, if the land supporting the asset is washed away. In some cases, this may need to be repaired.

4.3.2 Risk Analysis and Valuation of Different Asset Classes

A detailed discussion on the specifics of how risk assessment was completed for different asset class/hazard combinations is presented in Appendix E, with a summary provided below.

Stormwater Assets were valued using council data where available, with missing values substituted using averaged costs or inferred unit rates. Risk assessment assumed that most assets are resilient to inundation but are partly or wholly lost once intersected by erosion, with some point-features (e.g., water-quality devices) assumed to fail under frequent tidal inundation.

Transport Infrastructure including roads, footpaths, stairs, ramps, fencing, car parks, and bridges—were valued through a combination of GIS-derived geometry and benchmarked unit rates. Most assets are treated as resilient to rare inundation but lost or proportionally lost once intersected by tidal inundation thresholds, or by shoreline erosion.

Ecosystems (EECs and Coastal Wetlands) risks were evaluated on an area-lost basis, focusing on EECs and coastal wetlands mapped under the CM Act and BC Act. Ecosystems are assumed to be proportionally lost once erosion intersects them, while the effects of inundation are acknowledged but highly uncertain and dependent on the potential for upslope migration under sea-level rise.

Buildings and Private Land values were derived from recent property sales, adjusted to present-day values, and split into land versus building components. Land parcels and buildings lose value proportionally with inundation extent, while buildings are considered fully lost once 25% of their footprint is affected by erosion, assuming rapid loss of structural integrity once undermining begins.

Utilities (Water and Sewer) Sydney Water assets—including sewer mains, water mains, pumping stations and the wastewater treatment plant—were valued using Modern Engineering Equivalent Replacement Asset (MEERA) rates or independent cost benchmarks. Inundation generally does not cause direct failure (assuming electrical components remain above the inundation level), but any intersection with erosion triggers full replacement of mains or relocation of major facilities.

Recreation, Open Space and Public Buildings Public land (parks, reserves, sportsgrounds) was valued equivalently to private land on a per-suburb basis, while public buildings and park features used either supplied or averaged replacement costs. These assets are proportionally or wholly lost under both frequent inundation (63% AEP and HHWSS thresholds) and any intersection with erosion hazards.

Royal National Park Assets including visitor areas, walking tracks and heritage cabins—are valued either by unit rates (tracks) or simply reported as lost (visitor area and buildings) due to limited cost information. Tracks are impacted proportionally under inundation or erosion, while buildings and the campground are assumed fully lost once affected by either hazard.

5 The Wollongong Coast and Coastal Hazard Risks

5.1 Interpreting Risk Results for Coastal Divisions

The results of the risk assessment for each of the coastal divisions shown in Figure 4 and Figure 5 are presented in the subsections 5.2 through 5.28. There are several points which are worth highlighting before interpreting the tables presented therein.

An overarching matter is that the risk assessment is an approximation, albeit based on the best information available at the time. The assessment is based on a rigorous hazard assessment and dollar values as applied within Council's asset management system or from other sources. While the best available information may have some limitations, the assessment is considered fit for its intended purpose of informing and prioritising Council's actions relating to coastal management within its CMP. The focus was on determining those areas where risks are most pronounced and the broad nature of those risks. Care is advised when considering the outputs at finer scale (i.e. on an asset by asset basis) and more detailed investigation of the underpinning data is recommended if subsequent, more targeted assessment is required.

It is also important to recognise that all hazards were derived using the SSP5-8.5, climate change scenario as formally adopted by Council. SSP5-8.5 is a high emissions scenario, and future emissions may well be lower than assumed for that scenario. Conversely, there is a chance that emissions may exceed those assumed for SSP5-8.5. There is no way to reliably predict the emissions scenario that will eventually arise. However, the adoption of SSP5-8.5 can be seen as suitably cautious for the purposes of coastal management and planning.

5.1.1 Adoption of Values and Boundaries for Risk Consequence Categorisation

The risk assessment has mostly adopted monetary values as a proxy for the broader "total" value of assets, including intangible values and externalities. This is recognised as being an imperfect assumption but is considered sufficiently representative to enable the identification and prioritisation of where the key areas of risk are located across Council's coastal area and to highlight where management actions are needed.

While values have been calculated where possible, it is recognised that there is value in categorising risks using standard classifications ("Moderate", "Extreme" etc.). To achieve this, the threshold values adopted in Council's standard risk tables (Appendix D) for the "Financial Sustainability" risk category were used. This results in the ability to intersect risk probabilities (or qualitative 'likelihoods') and severities[7] to acquire a risk categorisation using Table 8. It is important to note that these risk categorisations

[7] Wollongong Council has adopted the term "Severity" in place of the more commonly applied "Consequences" within its risk management plan. Severity has been used in this assessment.

have been applied at a division by division basis, and it is worthwhile considering the spatially additive nature of events which give rise to coastal hazards.

Table 8 Adopted Risk Categorisation Table

Likelihood	Probability %	Severity Ranges for Loss of Value					
		C0 Negligible	C1 Insignificant	C2 Minor	C3 Moderate	C4 Major	C5 Catastrophic
		$0-$500	$500 – $50,000	$50,000 – $250,000	$250,000 - $750,000	$750,000 - $15,000,000	>$15,000,000
Rare	1	Low	Low	Low	Low	Low	Moderate
Possible	5	Low	Low	Moderate	Moderate	High	High
Likely	50	Low	Low	Moderate	High	Extreme	Extreme
Almost Certain	63	Low	Moderate	High	Extreme	Extreme	Extreme

Coastal hazard events (such as coastal storms and ongoing sea level rise) will have different spatial impact characteristics. Sea level rise and coastal/tidal inundation events are expected to be uniform along the Wollongong coastline, but the impact of different storms, in terms of erosion amounts, can differ markedly between beaches. Regardless, Council can expect that a coastal hazard event will impact multiple locations simultaneously. It follows that an event which results in a "Moderate" severity event at a local scale could be a "Major" event when considered at a whole of LGA scale.

One final matter regarding Table 8 is the addition of a severity category of "Negligible" which has a nominal upper threshold loss value of $500. This is not a category present in Council's standard tables but was introduced to eliminate the possibility that a "moderate" risk categorisation could result from a higher frequency event, even if the coastal hazard extent did not impact any assets.

5.1.2 Pricing and Inclusion of Land.

Of particular importance is the way that land has been treated in the risk assessment. Land has been separated out from the two asset classes where it was considered (*Buildings and Private Land*, and *Recreation, Open Space and Public Buildings*). If not separated out, the value of land lost tends to overshadow the impact on built assets. This arises from the adoption of an equivalent value (per square metre) between public and private (residential) lands. The equivalence seems reasonable, but there are factors which also mean that the assumption is not straightforward. For example:

- Public land provides social, cultural, and/or environmental values over and above those which would arise from selling the land for private use, and it is that additional value, in part, which results in the land being retained for public use.
- It could be argued that many areas of public land have other constraints which preclude sale for private use. For example, some areas within coastal floodplains

may have an otherwise unacceptable risk arising from catchment flooding or other natural hazards.

The high value of land adopted results in very frequent "Extreme" risk rankings relating to land, and these extreme rankings need to be considered in this context.

It was beyond the scope of the present study to provide a more detailed valuation of land. The actual value is likely to vary from location to location when considering these external factors. To address this limitation, a brief qualitative discussion of environmental and social factors that need to be considered is provided where useful. Where relevant, a localised discussion is provided for each division, within the tables outlining the key coastal hazard risks that need to be considered in developing the CMP.

The acceptability of present day behaviour of a beach also needs to be considered carefully. At many locations, there are public land parcels within the cadastral data set covering large areas of existing, highly dynamic parts of beaches which, by their nature, are subject to frequent fluctuations as they erode and recover from erosion. If those frequently reworked areas of the beach were included in the risk analysis for the present day, this results in extreme risks being evaluated, where none presently exist. Put simply, it is normal for beaches to erode and accrete, and this behaviour should not be interpreted as something from which risks arise.

To remove this undesired effect from the analysis, the value of land lost for the 63% (approximately once a year on average) present day beach erosion and shoreline recession loss value was discounted from all other erosion/recession scenarios (i.e. rarer events for the present day (2025) timeframe, and all scenarios for future timeframes). This results in a value of $0 of land lost (and subsequent “Low” risk categorisation) for the base, present day 63% scenario, with the value lost for other scenarios being ‘relative’ to that base value. In that way, a more appropriate representation of how the erosion/recession risk evolves over time is presented.

A similar approach was adopted for the other hazards, although their treatment has varied, depending on methods used in deriving the hazard, and the different scenario probabilities that were analysed during the definition of hazard zones.

5.1.3 Treatment of Seawalls

The risk analysis has assumed that seawalls and protective structures along the open coast are ineffective. This is clearly not the case in some locations, such as North Wollongong Beach and Wollongong Central, where it is reasonable to assume that recently constructed seawalls are robust and fit for purpose (at least at present). At other locations, the robustness of structures is less clear. This includes Coalcliff Beach, where a geotextile sand container wall is showing signs of degradation which mean that the wall may have a limited remaining life. Regardless, there is no clear and consistent information available to discriminate seawalls based on their existing condition and expected remaining life and there is some inconsistency in the way they were recorded and managed internally. Even so, no formal engineering assessment of protective structures was completed as part of this risk assessment.

This highlights a key risk which should be addressed by the CMP. There is uncertainty on the state of some of the structures. It is important that Council has a firm understanding of the state of these structures and continues to monitor and maintain them as part of their suite of assets. The first step, and a suggested management action for the CMP is to conduct an engineering audit of all coastal structures and ensure that these assets are mainstreamed consistently within Council's asset management system.

A qualitative assessment of existing seawall structures is provided for some divisions to highlight where the results of risk ranking may be unreasonably overstated, considering the expected protective function of any structures present.

5.1.4 Exclusion and Overlap of some Hazards

The watercourse entrance instability hazard has not been considered in the risk assessment. The reasoning here is that this hazard is normally limited to the landward extent of the adjacent beach erosion and shoreline recession hazard. The risks arising from the entrance instability hazard are thus captured through consideration of the beach erosion and shoreline recession hazard. Similarly, foreshore erosion risks have not been assessed as the assessment of that hazard was limited to key areas of known issues and was not spatially comprehensive.

It is also important to note that the hazard extents, and consequently some of the risks overlap. For example, there is some overlap at the interface between beach erosion/ shoreline recession hazard and areas affected by cliff and slope instability. In comparison, the tidal inundation hazard area is typically completely contained within the coastal inundation hazard area. Accordingly, it does not make much sense to add the risks from different hazards to get a "total" risk. Typically, coastal hazards should be considered separately, and this is important when the hazards have a notably different way in affecting assets.

5.1.5 Weighting of Scenarios and Adoption of a Composite Risk Category

Likelihood rankings have been applied, consistent with Council's risk tables (see Appendix D). As an example, for beach erosion and shoreline recession:

- 63% ~ This event is considered "Almost Certain" over a period of 10 years around the timeframe being considered.
- 5% ~ This event is considered "Possible" over a period of 10 years around the timeframe being considered.

- 1% ~ This event is considered "Rare", over a period of 10 years around the timeframe being considered.

Herein, the 10 year period was adopted as a reasonable measure noting the timeframe over which CMPs are intended to act under NSW's coastal management framework.

For other hazards, a single scenario representing a median or 50% likelihood has been derived, and this has been assigned a category of "Likely" as indicated in Table 8.

The actual risk level, which has been used to identify the "key" risks for treatment in the CMP, was determined using the risk table presented as Table 8, based on the dollar values. In the beach erosion / shoreline recession hazard case, risks levels were identified for the 63%, 5% and 1% scenarios. The highest risk category of these three was then used to set the composite risk category. This reflects that the dominant level of risk could arise from less frequent events which cause greater damage, or more frequent events which cause a lesser amount of damage.

5.1.6 Consideration of Future Risks

The damage values identified for future timeframes represent the full amount of damage expected to be realised over that timeframe. For example, the 2075 values represent expected losses over a 50 year period. The inclusion of 50 years' worth of losses is also reflected in the categories assigned to risks for that period.

Obviously, the gradual increase in risk over a 50 year period, mostly arising from anticipated future sea level rise, has a different character to risks that exist for the present day. In this assessment, we have presented the full impact or estimated value lost over the entirety of the future timeframe being considered. These long timeframe, but extreme, risks need to be considered carefully, and in context.

5.1.7 Consideration of Rock Pool Assets

The nine rock pools along the Wollongong Coast are assets of incredible value to residents and a drawcard for tourists to the area. A dollar value has not been assigned to these pools and risks cannot be defined in the same way as for other assets.

By their nature, these assets are intentionally exposed to coastal hazards, and the actions of overtopping waves and periodic inundation by high water levels is expected, and desirable, to allow for these pools to be flushed with ocean water. It does not make sense to consider that these assets are 'at risk' because of exposure to inundation or waves. We note that an ongoing issue, and cost borne by Council is the need to drain these pools, remove accumulated sand and clean them to keep them functional. For example, at Towradgi and Bulli, this is required regularly. The ongoing deposition of sand in these pools by the ocean is not captured as a coastal hazard under the CM Act, although we note that the required clearance and cleaning frequency is likely to increase with time due to sea level rise.

There will come a time when these pools are inundated too frequently as sea levels continue to rise, with larger waves able to break dangerously over and across the pool walls. In this way, they would become unsafe for use by the public for an unacceptable proportion of the time, rendering them unviable as a destination for recreation. This is a complex issue which involves the intersection of individual preferences, public safety, and Council's exposure to public liability.

Where relevant, the nature of the rock pool within a division is discussed, including approximate elevations of the walls of the pool, if these could be estimated from freely available digital elevation models derived from LiDAR.

5.1.8 Consideration of Natural Assets

Natural assets such as coastal wetlands, littoral rainforests, endangered ecological communities, dunes, beaches, and foreshores can also be affected by coastal hazards. Where GIS layers were available to delineate those features (for coastal wetlands, littoral rainforest, and endangered ecological communities) the areas intersected by erosion type hazards are reported. Similarly, where creek lines were included in Council's stormwater asset database and GIS layers, the length of creek line lost is reported, and this could be multiplied by two to approximate the length of creek foreshore lost.

Overall, it has normally been assumed that the beach and dune system will migrate landwards in response to sea level rise and in that sense, won't be 'lost'. In that case the loss experienced would be the loss of land which sits landward of the present day beach. In locations where there exist barriers to prevent that migration, meaning that the beach will narrow over time and eventually be 'squeezed' out of the landscape, this is also discussed.

5.2 Royal National Park – Little Garie to Burning Palms

5.2.1 Features

The northern 10km of the Wollongong LGA, lies within the Royal National Park. The northmost division of the National Park encompasses Little Garie Beach, North and South Era Beach, and Burning Palms Beach, the locality of which is shown in Figure 11. The beaches are shown in Figure 12 through Figure 14, respectively. These are small, embayed beaches bounded by rock platforms and headlands, with coastal cliffs between beaches and, typically, steep bluffs and/or cliffs to the rear of the beach.

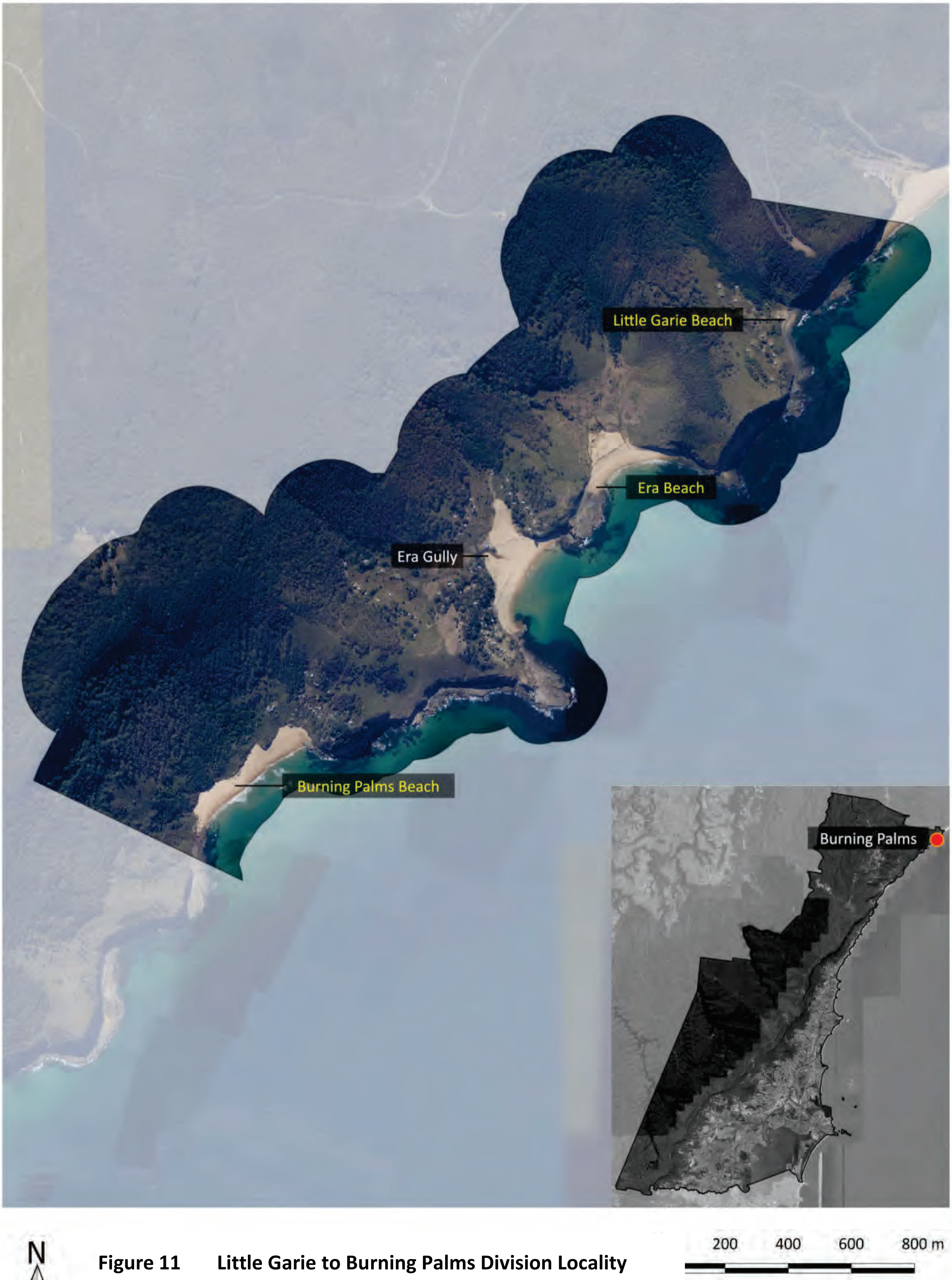

Figure 11 Little Garie to Burning Palms Division Locality

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Figure 12 Little Garie Beach, Royal National Park (May 2024).

Figure 13 South and North Era Beach, Royal National Park (May 2024).

Figure 14 Burning Palms Beach, Royal National Park. (May 2024).

There are shack communities located at Little Garie Beach, Era Beach, and Burning Palms Beach, with around two hundred cabins in total, mostly built around the 1930s to 1950s. These are heritage-protected, with licences up for renewal in 2027[8].Surf lifesaving clubs are located at Era Beach and Burning Palms Beach. Notably, the Era Surf Life Saving Club building is located adjacent to the entrance of Era Gully, a small creek line which discharges to the rear of the beach.

Built assets and ecological assets within this division of the Royal National Park are shown in Figure 1 and Figure 2 of Appendix C2. Extensive areas of EECs (Themeda Grassland in exposed areas and Littoral Rainforest in sheltered gullies) are present. Built assets along this section of the coast comprise NPWS assets including walking tracks, steps, bridges, visitor areas, sewage systems, and buildings. The Coast Track follows the coastline from the northern end of the LGA to Werrong Point.

5.2.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for the Little Garie to Burning Palms division is provided in Table 9. That table presents the outcomes from our spatial intersection and quantification model (Appendix E). We note the presence of shacks which are intermittently occupied and have poor road access. This differs from other divisions to the south, where road access would mean that evacuation is relatively easy with enough warning. For most of the coastline, we have not directly considered risks to life. However, within the shack communities of the Royal National Park, the

[8] https://www.abc.net.au/news/2025-02-26/the-hidden-history-of-australia-beach-shacks/104931076, Accessed 26/02/2025.

potential enhanced risk to life is a matter which needs to be considered and may be pursued as a study under the umbrella of the CMP.

Table 9 Consolidated Risk Profile for Little Garie to Burning Palms

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Royal National Park	Building Losses due to Erosion / Recession (No.)	2	2	3	8
Royal National Park	Building Losses due to Cliff and Slope Instability (No.)	0	2	5	9
Royal National Park	Building Losses due to Coastal Inundation (No.)	0	0	0	0
Royal National Park	Building Losses due to Tidal Inundation (No.)	0	0	0	0
Royal National Park	Track Losses due to Erosion / Recession	Moderate	Moderate	Moderate	High
Royal National Park	Track Losses due to Cliff and Slope Instability	Low	Moderate	Moderate	High
Royal National Park	Track Losses due to Coastal Inundation	Low	Low	Low	Moderate
Royal National Park	Track Losses due to Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Coastal Inundation	Low	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Tidal Inundation	Low	Extreme	Extreme	Extreme
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.084	0.089	0.119	0.210
Ecology	EEC Losses due to Cliff and Slope Instability (ha)	0.221	0.885	2.212	4.424
Ecology	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
Ecology	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		0	0	0	0

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

Where quantities are presented in Table 9, these are cumulative over time. For example, any building indicated as being at risk by 2125 include all buildings lost up until that point in time.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are considered herein.

Apart from the LGA wide issue of land being lost to the ocean, there are no high or extreme risks indicated by 2045. However, this is based on Wollongong Council's risk assessment matrix, and the NSW National Parks and Wildlife Service may reasonably apply a different assessment.

The loss of EECs due to cliff instability (primarily Themeda grassland) is notable and expected to increase to a total loss of around 4.5 hectares by 2125.

The most at risk buildings (shacks) from cliff and slope instability are located on the southern headland at Era, and the northern headland of Burning Palms. In comparison, the most at risk shacks from beach erosion and shoreline recession are located at the southern end of Era Beach.

5.3 Royal National Park –Burning Palms to Werrong

5.3.1 Features

The central division of the National Park includes Werrong Beach and the coastal cliffs to its north between Werrong and Burning Palms. The locality of this division is shown in Figure 16. Werrong (also known locally as “Hell Hole”) is a small, embayed beach bound by rock platforms and headlands with steep cliffs to the north and south. Werrong Beach is shown in Figure 15.

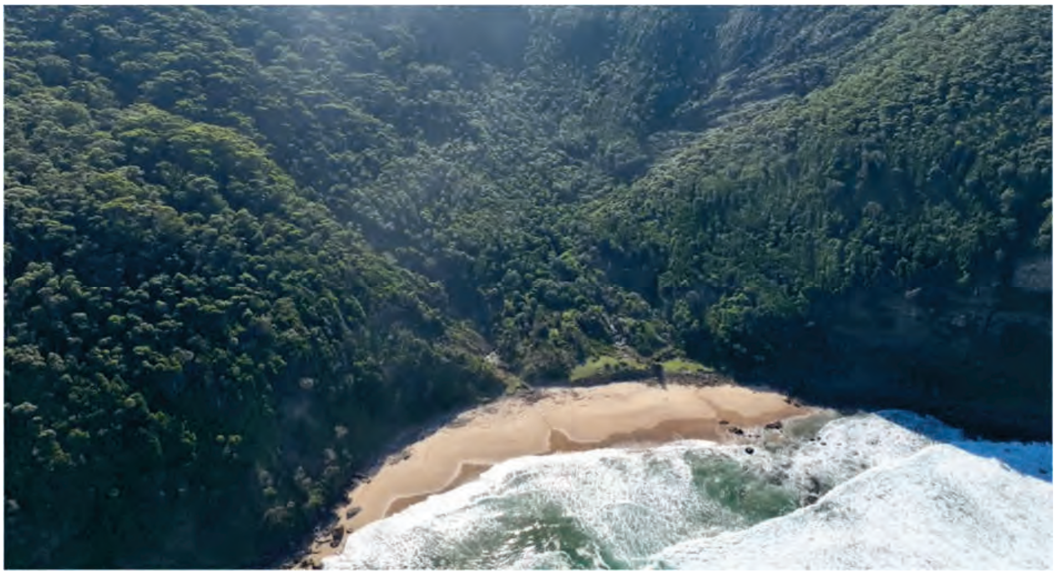

Figure 15 Werrong Beach (May 2024).

Built and ecological assets in this division of the Royal National Park are shown in Figure 3 and Figure 4 of Appendix C2, respectively. Extensive areas of littoral rainforest are present, with those areas behind the steep cliffs to the north of Werrong Beach contained within the coastal cliff and slope instability area. Built assets along this section of the coast comprise NPWS assets including walking tracks, steps, and bridges. The Coast Track runs landward of the crest of the cliff and sloped areas behind Werrong Beach, but access to Werrong Beach by foot is difficult, with a track leading from Lady Wakehurst Drive at Otford. The track is exposed to coastal cliff and slope instability risks to the north of Werrong Beach.

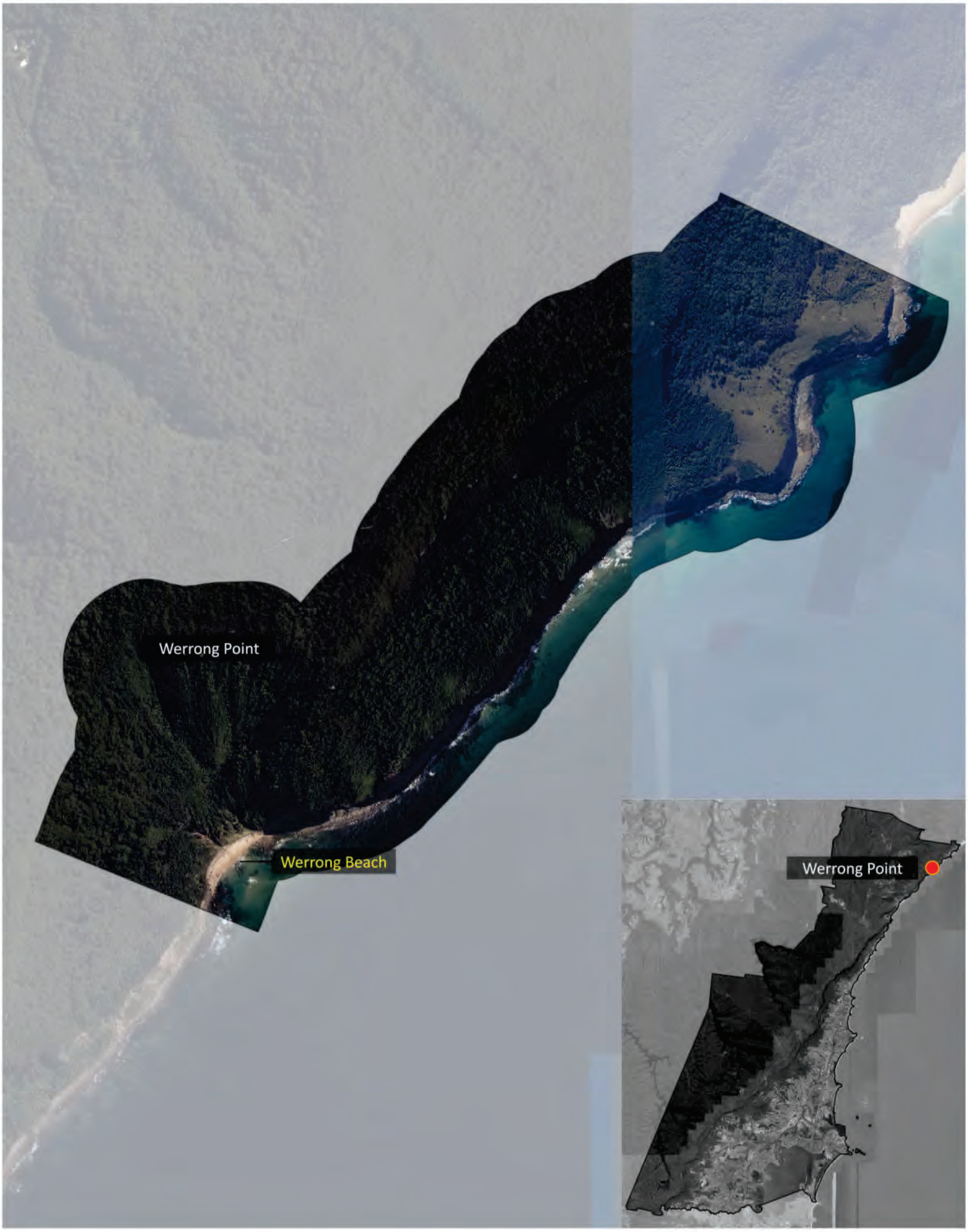

Figure 16 Burning Palms to Werrong Division Locality

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5.3.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for the Burning Palms to Werrong division is provided in Table 10. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E).

Table 10 Consolidated Risk Profile for Burning Palms to Werrong

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Royal National Park	Building Losses due to Erosion / Recession (No.)	0	0	0	0
Royal National Park	Building Losses due to Cliff and Slope Instability (No.)	0	0	0	0
Royal National Park	Building Losses due to Coastal Inundation (No.)	0	0	0	0
Royal National Park	Building Losses due to Tidal Inundation (No.)	0	0	0	0
Royal National Park	Track Losses due to Erosion / Recession	Moderate	Moderate	Moderate	Moderate
Royal National Park	Track Losses due to Cliff and Slope Instability	Moderate	High	High	Extreme
Royal National Park	Track Losses due to Coastal Inundation	Low	Low	Low	Low
Royal National Park	Track Losses due to Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Coastal Inundation	Low	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Tidal Inundation	Low	Extreme	Extreme	Extreme
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.521	0.547	0.547	0.547
Ecology	EEC Losses due to Cliff and Slope Instability (ha)	2.785	11.138	27.846	55.692
Ecology	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
Ecology	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		0	0	0	0

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

Where quantities are presented in Table 10, these are cumulative over time. For example, any projected EEC losses by 2125 include all projected losses up until that point in time.

We note the presence of shacks which are intermittently occupied and have poor road access. This differs from other divisions to the south, where road access would mean that evacuation is relatively easy with enough warning. For most of the coastline, we have not directly considered risks to life. However, within the shack communities of the Royal National Park, the potential enhanced risk to life is a matter which needs to be considered and may be pursued as a study under the umbrella of the CMP.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 11.

Apart from the LGA wide issue of land being lost to the ocean, there are no high or extreme risks indicated at present. However, this is based on Wollongong Council's risk assessment matrix, and the NSW National Parks and Wildlife Service could reasonably apply a different assessment.

The loss of EECs due to cliff instability (primarily Littoral Rainforest) is notable, potentially increasing to a total loss of some fifty-five hectares by 2125, although this would require substantial collapse of the coastal cliffs.

Table 11 Key Risks: Burning Palms to Werrong

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-02-01	High: 2045+	**Asset Group: Walking Tracks.** **Hazards of Concern: Coastal Cliff and Slope Instability.** Sections of the coast track to the north of Werrong Beach are indicated as being threatened by coastal cliff and slope instability hazards. It may be worthwhile for NPWS to have a site specific geotechnical assessment undertaken, and to relocate, where necessary, to enhance public safety in future. Noting that other sections of the track are threatened by coastal processes such as erosion (though not amounting to a 'high' risk ranking using the methods applied here) a more comprehensive assessment of the resilience of the track to climate change may be sensible.

5.4 Royal National Park – Bulgo Beach

5.4.1 Features

The southern 2 km of the National Park is contained within the division that encompasses Bulgo Beach. Walking tracks lead to Bulgo Beach from Lady Wakehurst Drive. Bulgo Beach hosts another shack community of fishing huts, mostly built in the 1930s, with fifty-three shacks in total. Some are occupied and others are used occasionally[9].

The locality of this division is shown in Figure 17, and Bulgo Beach with its shack community is shown in Figure 18. The shack community is highly exposed, between steep landward slopes and a narrow beach comprising a shallow accumulation of sand upon a rock platform.

[9] https://www.thewildlifediaries.com/bulgo-beach-a-unique-fishing-shack-village-in-royal-national-park/, Accessed 26/02/2025.

Figure 17 Bulgo Beach Division Locality

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Figure 18 Bulgo Beach, Royal National Park (May 2024).

Bulgo Beach Ocean Pool is situated at the southern end of Bulgo Beach, carved into the rocky intertidal platform. The 20mx7m pool was built in 1960 retaining the natural form of the rock albeit with the addition of a retaining wall that captures water at high tide (Larkin, 2020).

Built and Ecological assets in this division are shown in Figure 5 and Figure 6 of Appendix C2, respectively. Extensive areas of EECs, predominantly littoral rainforest, are present in sheltered areas landward of the top of cliff. Built assets threatened within this division almost exclusively comprise shacks which are exposed to a present day risk of the cliff to the rear collapsing in a landslide.

5.4.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for the Bulgo division is provided in Table 12. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion and table of key risks (Table 13).

Where quantities are presented in Table 12, these are <u>cumulative</u> over time. For example, any building indicated as being at risk by 2125 include all buildings lost up until that point in time.

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Table 12 Consolidated Risk Profile for Bulgo

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Royal National Park	Building Losses due to Erosion / Recession (No.)	5	6	7	9
Royal National Park	Building Losses due to Cliff and Slope Instability (No.)	4	17	42	84
Royal National Park	Building Losses due to Coastal Inundation (No.)	0	0	0	0
Royal National Park	Building Losses due to Tidal Inundation (No.)	0	0	0	0
Royal National Park	Track Losses due to Erosion / Recession	Low	Low	Low	Low
Royal National Park	Track Losses due to Cliff and Slope Instability	Low	Moderate	Moderate	High
Royal National Park	Track Losses due to Coastal Inundation	Low	Low	Low	Low
Royal National Park	Track Losses due to Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Coastal Inundation	Low	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Tidal Inundation	Low	Extreme	Extreme	Extreme
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.906	0.971	0.978	1.004
Ecology	EEC Losses due to Cliff and Slope Instability (ha)	3.258	13.032	32.579	65.159
Ecology	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
Ecology	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		0	0	0	0

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

We note the presence of shacks which are intermittently occupied and have poor road access. This differs from other divisions to the south, where road access would mean that evacuation is relatively easy with enough warning. For most of the coastline, we have not directly considered risks to life. However, within the shack communities of the Royal National Park, the potential enhanced risk to life is a matter which needs to be considered and may be pursued as a study under the umbrella of the CMP.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 13. In addition to those risks, substantial losses of littoral rainforest (up to ~65 ha) could occur over the next 100 years due to the collapse of coastal cliffs. However, this loss would largely be an ongoing, natural process, with minimal influence of sea level rise over that timeframe.

The risk model indicates a low risk for coastal inundation at the Bulgo Shack Community. This has arisen as the more complicated nature of the beach (perched beach, with extensive protective rock platform) means that the standard wave runup formulae applied at most of the sandy beaches, when deriving runup and overtoppping levels, was not applied here during the hazard assessment. There is no simplistic method that can be applied here to calculate the level of runup and inundation. While detailed modelling, which was beyond the scope of our overall project, could help to quantify these processes more reliably at this location, we consider that the elevation at the back of the beach (~4.5m AHD) is sufficiently low to conclude that the shacks at Bulgo are exposed to a present day risk level which needs to be managed.

Table 13 Key Risks: Bulgo

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-03-01	High: 2025, Extreme: 2045+	**Asset Group: Shacks** **Hazards of Concern: Coastal Cliff and Slope Instability, Beach Erosion and Shoreline Recession** The existing shacks, particularly those located to the rear of the narrow beach, are exposed to potential collapse of the landward cliff, and future beach erosion and shoreline recession. If occupation is to continue, a detailed geotechnical assessment is recommended so that the risk can be comprehensively understood.
CH-03-02	High: 2025, Extreme, 2045+	**Asset Group: Shacks** **Hazards of Concern: Coastal Inundation** The existing shacks, particularly those located to the rear of the narrow beach, are exposed to present day runup and overtopping processes. This will increase in severity with sea level rise and, given the isolation and limited access to this location, this risk needs to be managed.

5.5 Stanwell Tops

5.5.1 Features

The Stanwell Tops division features the 1.5 km length of coastline to the north of Stanwell Park Beach, with its locality shown in Figure 19. The division is dominated by sandstone cliffs along the coastline at the southern end of the Royal National Park. Only the southernmost coastline of this division, to the south of the Bald Hill car park, is outside the boundary of the Royal National Park. The built, open space and recreation and ecological assets are shown in Figures 7, 8 and 9 of Appendix C2, respectively. The only assets threatened by coastal hazards in this division arise from ecological assets intersecting with the coastal cliff and slope instability hazard.

5.5.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for the Stanwell Tops division is provided in Table 14. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and, in some cases, further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion which follows.

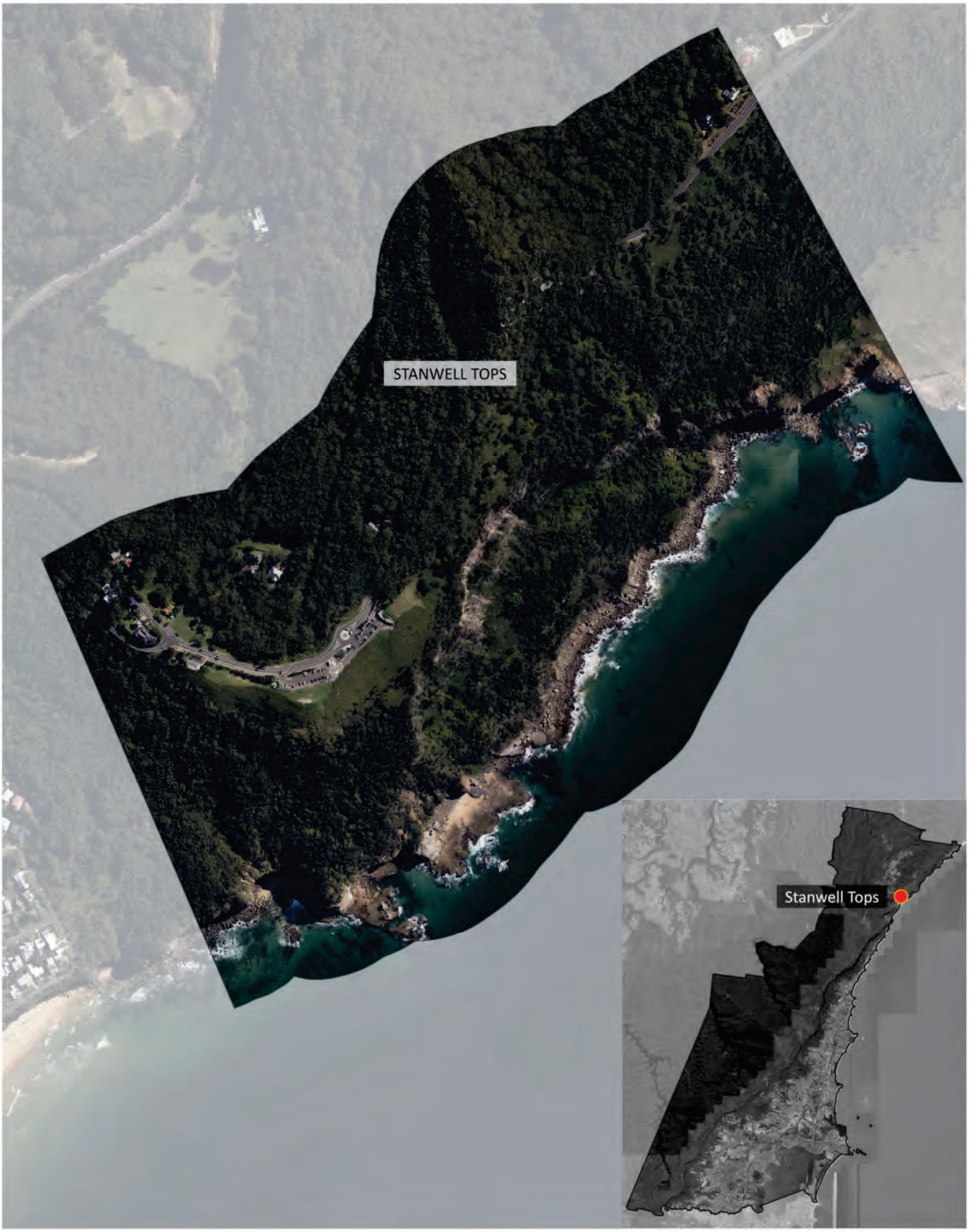

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Figure 19 Stanwell Tops Division Locality

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Table 14 Consolidated Risk Profile for Stanwell Tops

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Low	Low	Low	Low
	Cliff and Slope Instability (Threatened)	Low	Low	Low	Low
	Coastal Inundation (Losses)	Low	Low	Low	Low
	Tidal Inundation (Losses)	Low	Low	Low	Low
Transport	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (ha)	1.241	4.966	12.414	24.829
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		0	0	0	0

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

The risks associated with open space and recreational assets (Inundation hazards and Cliff and Slope Instability) are limited to the rock platforms at the base of the cliff which will be increasingly inundated in future.

It follows that the primary risk is associated with the loss of EEC's, primarily littoral rainforest, due to the coastal cliff and slope instability hazard.

5.6 Stanwell Park

5.6.1 Features

Stanwell Park Beach is 850m long and located in a small valley with steep, forested slopes rising to 300m, creating an amphitheatre like setting. The suburb of Stanwell Park, located behind Stanwell Park Beach, occupies two smaller sub-valleys drained by Hargraves Creek and Stanwell Creek (Short, 2007). Entrances to those creeks are located towards the northern and southern ends of Stanwell Park Beach, respectively. These features are shown in Figure 20.

Stanwell Park Beach faces southeast and is exposed to waves averaging 1.6m in height. This wave action typically generates four strong rips: two against each headland and two to three shifting beach rips. The bar separating these rips is often divided from the beach by a wide, deep trough, with waves reforming to surge up the steep beach face (Short, 2007).

The beach is bordered by 100m sandstone cliffs at its northern and southern ends, as shown in Figure 21 and Figure 22, respectively. Dunes are located along the middle section of the beach, which can also be seen in Figure 21. The beach's dune system experiences periodic scarping, but it tends to recover quickly. The dune height has reportedly increased over time (GHD, 2014).

The Helensburgh-Stanwell Park Surf Life Saving Club (SLSC) building is situated in the southern half of the beach, behind dunes on the northern side of Stanwell Creek. Those dunes reach an elevation of about 6m AHD in front of the SLSC building but decrease to 3-5m AHD in front of the adjacent car park and amenities building.

Assets within Stanwell Park are presented in Figures 10, 11 and 12 of Appendix C2 for Built Assets (buildings, stormwater, and transport), Open Space and Recreation, and Ecological Assets, respectively. Some low-lying parks and associated car parks are currently exposed to coastal inundation, and some private dwellings are contained within cliff and slope instability areas to the south of the beach.

5.6.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for the Stanwell Park division is provided in Table 15. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion and table of key risks which follows.

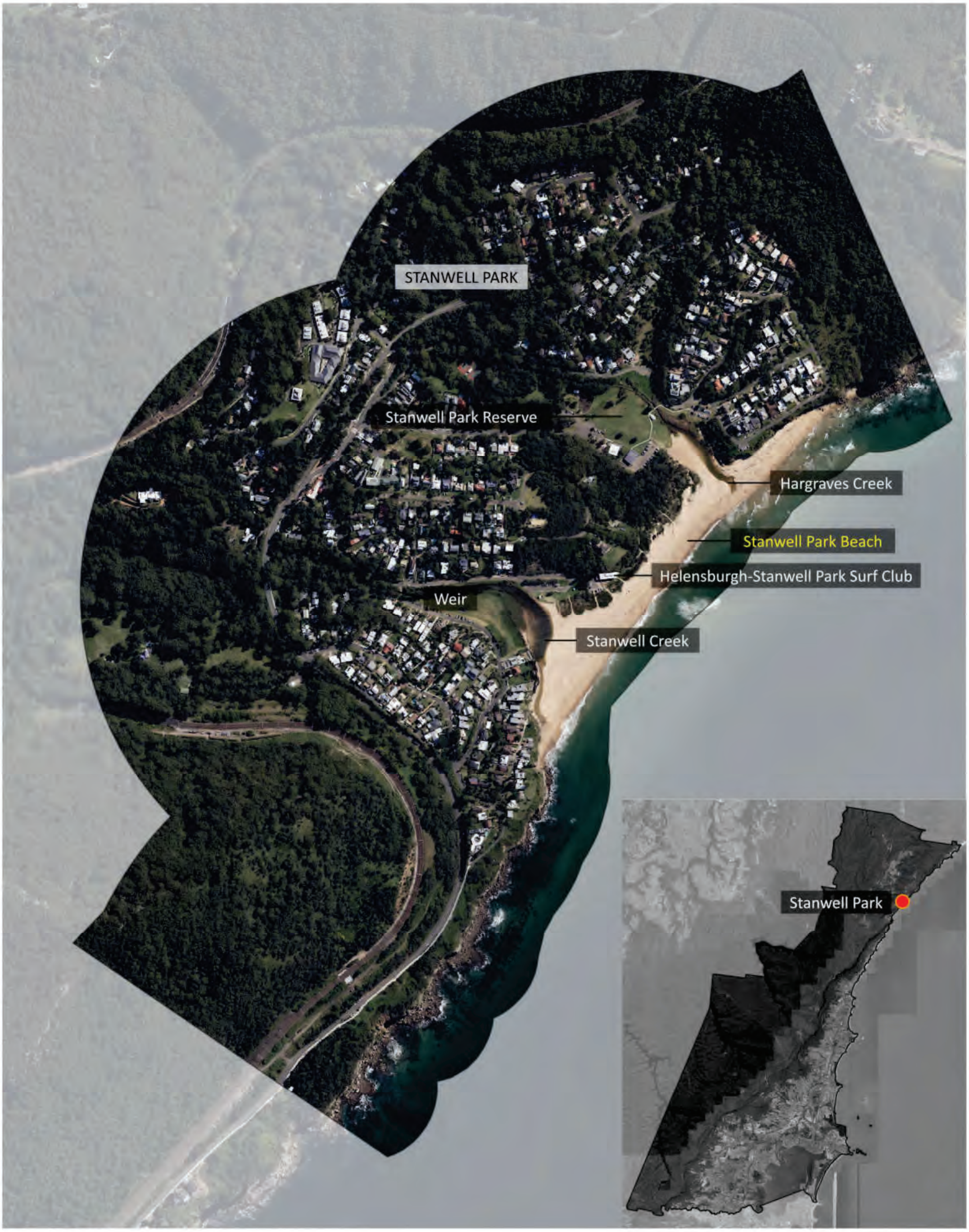

Figure 20 Stanwell Park Division Locality

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Figure 21 Northern section of Stanwell Park Beach (May 2024).

Figure 22 Northern section of Stanwell Park Beach (May 2024).

Table 15 Consolidated Risk Profile for Stanwell Park

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Low	Low	Low	Low
	Cliff and Slope Instability (Threatened)	Low	Low	Low	Moderate
	Coastal Inundation (Losses)	Low	Low	Low	Low
	Tidal Inundation (Losses)	Low	Low	Low	Low
Transport	Losses due to Erosion / Recession	Moderate	Moderate	Moderate	High
	Cliff and Slope Instability	Moderate	High	Extreme	Extreme
	Coastal Inundation	Low	High	High	Extreme
	Tidal Inundation	Low	Low	Low	Moderate
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Moderate	Moderate	Moderate	Moderate
	Cliff and Slope Instability	High	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Low	Low	Low
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	High
	Cliff and Slope Instability	High	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Low	Low	Extreme
	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Moderate	High	High
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	High	High	Extreme	Extreme
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (ha)	0.039	0.158	0.394	0.788
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.134	0.148	0.188	0.306
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.015	0.060	0.150	0.300
Stormwater Creek Length Loss (in m), Erosion/Recession		9	10	12	32

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 16. In addition to those risks, the area of mapped coastal wetland presently exposed to beach erosion and shoreline recession is expected to approximately double by 2125. Areas of themeda grassland and littoral rainforest are expected to become increasingly exposed to ongoing cliff instability issues at the northern end of the beach, with the area lost expected to reach around 0.8 hectares by 2125.

The indicated "High" present day risk for "Open Space" is related to the surf lifesaving club, which is captured in the coastal cliff and slope instability hazard zone. However, this sits seaward of the cliffs and will be affected by beach erosion before coastal processes can destabilise the cliff, this is therefore not included in Table 16.

Table 16 Key Risks: Stanwell Park

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-05-01	High: 2025 – Extreme 2045+	**Asset Group: Private Buildings** **Hazards of Concern: Coastal Cliff and Slope Instability** Residences along the southern cliff line, to the south of Stanwell Park Creek are expected to eventually be threatened by cliff and slope instability. Suitable development controls for future development should be applied / maintained to cover this location.
CH-05-02	Extreme 2045+	**Asset Group: Open Space / Recreation (Built)** **Hazards of Concern: Coastal Inundation** Risk arises from coastal inundation around the amenities and restaurant buildings within Stanwell Park Beach Reserve, and the toilet block in the car park adjacent to the entrance of Stanwell Creek. The floor level of these buildings should be checked to confirm at what stage above floor flooding could occur.
CH-05-03	High: 2045 – Extreme 2075+	**Asset Group: Transport** **Hazards of Concern: Coastal Cliff and Slope Instability** The cliff instability risks are mostly related to the potential collapse of the cliff below "The Drive" above the northern end of the beach, which would involve loss of the road and car park. This may warrant additional site specific investigation to ensure the cliff is reasonably stable.
CH-05-04	High: 2045+	**Asset Group: Transport** **Hazards of Concern: Coastal Inundation** Over time, Beach Road between the causeway and the south end car park will be increasingly inundated by the ocean. Raising and/or reconstructing this road with different materials may be considered.

5.7 Coalcliff

5.7.1 Features

Coalcliff Beach is a small, embayed beach around 500m long, fronting the suburb of Coalcliff which occupies a steep, narrow valley. The locality of this division is shown in Figure 23. The beach faces east-southeast and is bounded by cliffs at its northern end, shown in Figure 24, with a rock platform at its southern end (Figure 25). The entrance to Stony Creek is located just north of the rock platform at the southern end of the beach, which can also be seen in Figure 25.

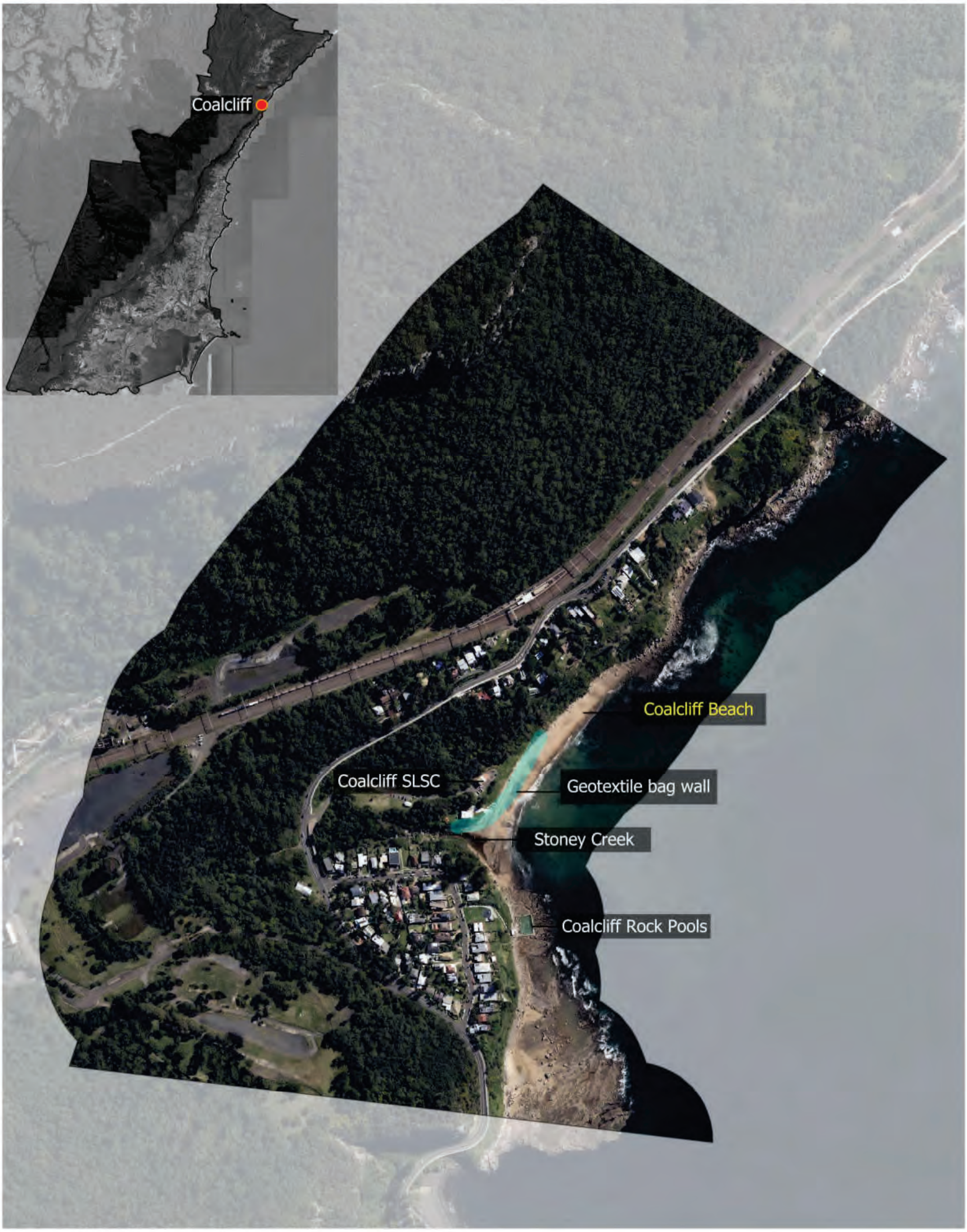

Figure 23 Coalcliff Division Locality

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Figure 24 Northern end of Coalcliff Beach (May 2022).

Figure 25 Southern end of Coalcliff Beach (May 2024).

Coalcliff Beach is reportedly experiencing a long-term loss of sand (Cardno, 2017). In 2016, a sand-filled geotextile bag wall was constructed in front of the reserve to protect it and other infrastructure from beach erosion. This wall was extended in 2017 towards the north and south, reaching the entrance of Stony Creek. The full extent of the wall after its extension is shown in Figure 26. The sea floor offshore of the beach features a mix of coarse sand and rock, and wave heights average 1-1.5m. The beach has three dominant rips: a strong rip against the southern rocks, a shifting central rip, and one flowing north past the northern rocks. Waves reform and surge heavily up the steep beach face during conditions where the bars are separated from the beach (Short, 2007).

Figure 26 Geotextile bag wall and Stony Creek entrance, Coalcliff Beach (May 2024).

Coalcliff Surf Life Saving Club (SLSC) and Coalcliff Beach Reserve are located towards the southern end of the beach, on the northern side of Stony Creek. Asset maps detailing built infrastructure, ecology, and open space and recreation are provided in Figures 13, 14 and 15 of Appendix C2, respectively.

The rock platform to the south of Stony Creek is around 400m long. Coalcliff Rockpool, constructed in 1923, sits on the exposed rock platform at the southern end of Coalcliff Beach and is shown in Figure 23. Its rectangular concrete structure, measuring around 20m by 7m, provides a space for lap swimming (Larkin, 2020). The concrete walls of the rockpool have an elevation around 1.25m AHD (north and south) and 1.1m AHD (offshore, estimated from LiDAR captured in 2021). The surrounding rock platform typically has an elevation of around 0.0m AHD to the east of the pool, sloping upwards to the west and north. The pool is most exposed to waves approaching from the east with the southeastern corner less than 20m from the offshore edge of the rock platform.

5.7.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for the Coalcliff division is provided in Table 17. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion and table of key risks which follows.

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Table 17 Consolidated Risk Profile for Coalcliff

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Low	Low	Low	Low
Stormwater	Cliff and Slope Instability (Threatened)	Low	Moderate	High	High
Stormwater	Coastal Inundation (Losses)	Low	Low	Low	Low
Stormwater	Tidal Inundation (Losses)	Low	Low	Low	Low
Transport	Losses due to Erosion / Recession	Extreme	Extreme	Extreme	Extreme
Transport	Cliff and Slope Instability	High	Extreme	Extreme	Extreme
Transport	Coastal Inundation	Low	Low	Low	Low
Transport	Tidal Inundation	Low	Low	Moderate	High
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Moderate	Moderate	Moderate	Moderate
Open Space / Recreation (Built)	Cliff and Slope Instability	Moderate	High	Extreme	Extreme
Open Space / Recreation (Built)	Coastal Inundation	Low	Moderate	Moderate	Moderate
Open Space / Recreation (Built)	Tidal Inundation	Low	Low	Low	Low
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
Private Buildings	Cliff and Slope Instability	Extreme	Extreme	Extreme	Extreme
Private Buildings	Coastal Inundation	Low	Low	Low	Low
Private Buildings	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	Low	Low	Low	Low
Water / Sewerage	Cliff and Slope Instability	Moderate	High	High	Extreme
Water / Sewerage	Coastal Inundation	Low	Low	Low	Low
Water / Sewerage	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Coastal Inundation	Low	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	Low	Low	Low	Low
Private Lands	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
Private Lands	Coastal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Tidal Inundation	Low	Extreme	Extreme	Extreme
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
Ecology	EEC Losses due to Cliff and Slope Instability (ha)	0.001	0.002	0.006	0.011
Ecology	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
Ecology	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		29	35	41	41

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 18. In addition to those risks, a minimal amount of littoral rainforest related EECs could be lost from the gully containing Stony Creek to the west of Lawrence Hargrave Drive due to collapse of the coastal slopes.

Table 18 Key Risks: Coalcliff

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-06-01	Extreme: 2025+	**Asset Group: Transport** **Hazards of Concern: Beach Erosion and Shoreline Recession** Protective structures are present: • From the northern foreshore of Stony Creek, around the front of the reserve at the back of the beach (a geotextile sand container wall). • Landward of the Coalcliff rock pool (a vertical concrete seawall). Risks related to beach erosion and shoreline recession landward of these structures would only arise if those structures failed. While not rigorously assessed, the sand container wall is showing signs of deterioration, while the concrete seawall seems robust. An audit and collation of details of the structures should be undertaken to determine whether associated risks are worth considering further, and maintenance of the structures completed promptly following any damage.
CH-06-02	Extreme: 2025+	**Asset Group: Private Buildings** **Hazards of Concern: Coastal Cliff and Slope Instability** Private buildings on top of the cliff line to the north of the SLSC, and around the bend of Patterson Road (south of the entrance to Stony Creek) are indicated as presently at risk from cliff and slope instability. Robust planning controls are required here for any future development.
CH-06-03	High: 2025 Extreme: 2045+	**Asset Group: Transport** **Hazards of Concern: Cliff and Slope Instability** Several transport assets are threatened by the cliff and slope instability hazard. Most notably, these are: • Sections of Lawrence Hargrave Drive to the north of the northern intersection with Patterson Road for around 375m, and, to the south of the southern intersection of Patterson Road, for around 100m to the boundary of the Coalcliff division. • The SLSC access road and associated car parks. Council and TfNSW should examine data they have on these sites and confirm that the hazard does not result in risks of concern. If concerning risks are indicated, mitigative actions should be considered.
CH-06-04	High: 2025+	**Asset Group: Open Space** **Hazards of Concern: Coastal Cliff and Slope Instability** The SLSC building may be at risk if the slope landward of the building collapses. Concerns here could be alleviated as part of the analysis/review proposed for risk CH-06-03. This risk was adjusted from that indicated in Table 17, considering the location of the building and potential for waves to attack the base of the cliff adjacent to the building.

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-06-05	High: 2025+	**Asset Group: Water/Sewerage** **Hazards of Concern: Coastal Cliff and Slope Instability** Water and sewerage infrastructure, including lines along Lawrence Hargrave Drive, the low pressure sewer system and water lines servicing the SLSC and buildings along Patterson Road (and pumping station along the access road) are all threatened by the coastal cliff and slope instability hazard. Concerns here could be alleviated as part of the analysis/review proposed for risk CH-06-03. This risk was adjusted from that indicated in Table 17 as loss of the sewerage system may have cascading effects on the health and safety of residents away from the direct impacts of the hazard.

5.8 Clifton

5.8.1 Features

The Clifton division covers around 2 km of the coastline between Coalcliff and Clifton. The Illawarra escarpment is especially close to the coast here and Lawrence Hargrave Drive hugs the coastline. The South Coast railway line is present further up the slope. The locality of the Clifton Division is shown in Figure 28.

At the northern end of the division, the Sea Cliff Bridge carries Lawrence Hargrave Drive over the water, in front of the escarpment (Figure 27).

Figure 27 View North along Clifton Coastline to Sea Cliff Bridge (May 2024).

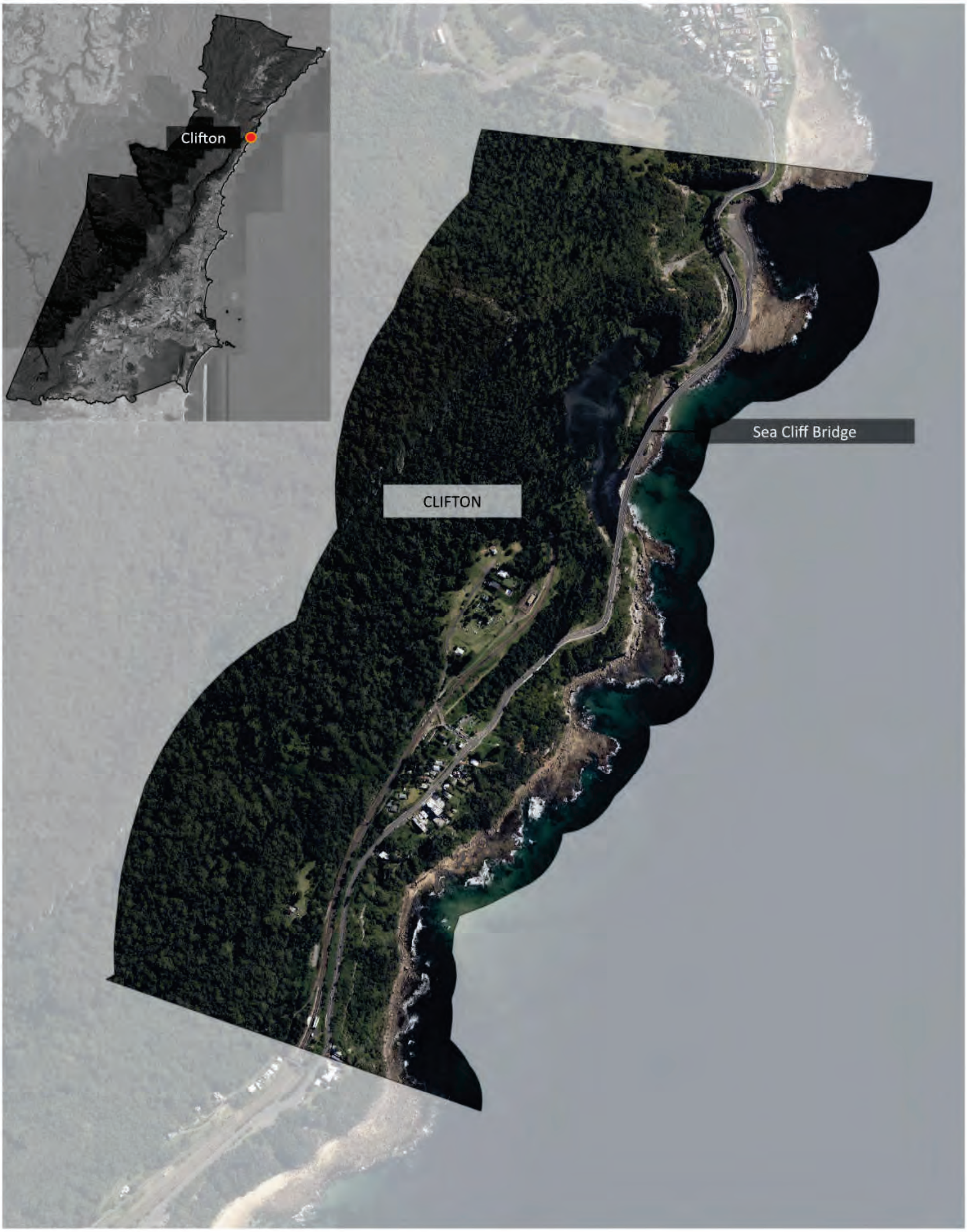

Figure 28 Clifton Division Locality

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Further south, the suburb of Clifton is situated above steep coastal cliffs (Figure 29). There is no substantial sandy beach along this section of the coast.

Assets within the Clifton division are presented in Figures 16, 17 and 18 of Appendix C2 for Built Assets (buildings, stormwater, and transport), Open Space and Recreation, and Ecological Assets, respectively. Those maps show exposure to hazards primarily associated with property within Clifton, and with the road and infrastructure associated with Lawrence Hargrave Drive.

Figure 29 Clifton Township with narrow beach at cliff base (May 2024).

5.8.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for the Clifton division is provided in Table 19. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion and table of key risks which follows.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 20. In addition to those risks, areas landward of the cliff face tend to include areas of littoral rainforest, with up to twenty hectares of this EEC considered to be potentially lost by 2125 due to collapse of the coastal cliffs.

Table 19 Consolidated Risk Profile for Clifton

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Low	Low	Low	Low
	Cliff and Slope Instability (Threatened)	Moderate	High	Extreme	Extreme
	Coastal Inundation (Losses)	Low	Low	Low	Low
	Tidal Inundation (Losses)	Low	Low	Low	Low
Transport	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	High	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	High	High	Extreme
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Moderate	Moderate
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	High	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Moderate	Moderate
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (ha)	1.038	4.153	10.382	20.764
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		0	0	0	0

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

The coastal inundation risk for transport assets has captured the sea cliff bridge as an asset at extreme risk by 2045. Noting its elevation above sea level, this is clearly not the case. Similarly, the high tidal inundation risk has picked up the sea cliff bridge and is considered overstated for these reasons.

Table 20 Key Risks: Clifton

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-07-01	High: 2025 – Extreme 2045+	**Asset Group: Transport** **Hazards of Concern: Coastal Cliff and Slope Instability** The risk indicated for transport assets relates to the coastal cliff and slope instability hazard interacting with Lawrence Hargrave Drive. While this risk has been flagged, this has been addressed in recent decades by the Sea Cliff bridge. Continued ongoing monitoring and maintenance of this stretch of the road and associated structures by TfNSW is recommended.
CH-07-02	High: 2025 – Extreme 2045+	**Asset Group: Private Buildings** **Hazards of Concern: Coastal Cliff and Slope Instability** A few private buildings at Clifton are indicated as being at risk from the coastal cliff and slope instability hazard. Robust planning controls are required here for any future development.
CH-07-03	High: 2025, Extreme 2045+	**Asset Group: Stormwater** **Hazards of Concern: Coastal Cliff and Slope Instability** This is the risk level resulting from the impact of cross drainage to Lawrence Hargrave Drive and the Sea Cliff Bridge, due to coastal cliff and slope instability. This risk was adjusted from that indicated in the consolidated risk table on account of landslip potentially interacting with and blocking stormwater drainage, which could lead to a more catastrophic failure. As for CH-07-01, continued ongoing monitoring and maintenance by TfNSW is recommended.

5.9 Scarborough – Wombarra

5.9.1 Features

The coastline from Scarborough North Beach to Wombarra Beach is shown in Figure 30. Scarborough-Wombarra Beach (Figure 31) is approximately 1km long and faces southeast. Around 100m of rocky bluff separates the northern section, known as Scarborough Beach, from the southern section, Wombarra Beach. North of Scarborough Beach is a small, 250m long beach known as Scarborough North Beach.

Scarborough North Beach is separated from the main beach by a rock platform and is positioned at the base of 60m high cliffs. Rock platforms mark its northern and southern ends. Waves here average 1.5m, breaking over a mixture of sand and rocks, with a strong permanent rip typically located against the northern rock platform. This isolated section is prone to rock falls (Short, 2007). From the rock platform, Scarborough Beach extends south-southwest for approximately 750m. This beach is subject to average wave heights of 1.4m and typically has 3-4 rips: one at each end near the rocks and one to two shifting beach rips. Waves often surge up the steep beach face (Short, 2007).

Figure 30 Scarborough-Wombarra Division Locality

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Figure 31 Scarborough Beach, view southwards from the northern end of the beach. (Wombarra Beach in background, May 2024).

Scarborough Beach is backed by steep vegetated slopes, rising to an oval behind the northern section and houses to the south. The Scarborough-Wombarra SLSC is located towards the middle of the beach, with an elevation around 11m AHD. Two creeks drain across the beach: an unnamed creek, which discharges to the north of the SLSC, and Horse Creek, which drains a catchment of approximately 90 ha, and discharges towards the southern end of the beach. The oval, SLSC, and two creeks can be seen in Figure 32.

Wombarra Beach is a narrow 250m stretch fronting the town of Wombarra and is shown in Figure 33. The sand and cobble beach is backed by rocks and boulders and is fronted by rock platforms, leaving only a narrow break for direct access to the sea (Short, 2007). Reeces Creek, which runs through the suburb of Wombarra for 1.2km, discharges across Wombarra Beach and can be seen on the right-hand side of Figure 33.

A seawall is located along the southern end of Wombarra Beach, in front of the beach amenities block, with a crest elevation of around 4m AHD. Wombarra Rockpool sits on the exposed rock platform in front of the seawall and is also shown in Figure 33. Constructed in 1937, the concrete pool has an irregular shape.

The concrete walls of the rockpool have an elevation around 1.3m AHD (estimated from LiDAR captured in 2021). The surrounding rock platform slopes downwards towards the sea from elevations of around 1.0m at the landward edge, to around 0.4m at the offshore edge. The pool is most exposed to waves approaching from the east.

Figure 32 Scarborough Beach and Scarborough Wombarra SLSC (May 2024).

Figure 33 Wombarra Beach (May 2024).

Assets within the Scarborough-Wombarra division are presented in Figures 19, 20 and 21 of Appendix C2 for Built Assets (buildings, stormwater, and transport), Open Space and Recreation, and Ecological Assets, respectively. Assets exposed to hazards are primarily associated with residential property immediately to the rear of the beach and associated utilities such as roads, water, sewer, and stormwater.

5.9.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for the Scarborough-Wombarra division is provided in Table 21. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion and table of key risks which follows.

Table 21 Consolidated Risk Profile for Scarborough-Wombarra

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Moderate	Moderate	Moderate	High
	Cliff and Slope Instability (Threatened)	Moderate	High	Extreme	Extreme
	Coastal Inundation (Losses)	Low	Low	Low	Low
	Tidal Inundation (Losses)	Low	Low	Low	Low
Transport	Losses due to Erosion / Recession	High	High	Extreme	Extreme
	Cliff and Slope Instability	Moderate (hatched)	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Moderate	Moderate	Moderate
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Moderate	Moderate	Moderate	High
	Cliff and Slope Instability	Moderate	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Moderate	Moderate	Moderate
	Tidal Inundation	Low	Low	Low	Low
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Extreme	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	High	High	High	Extreme
	Cliff and Slope Instability	Moderate	High	High	Extreme
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	High	High	Extreme	Extreme
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.457	0.468	0.507	0.593
	EEC Losses due to Cliff and Slope Instability (ha)	0.733	2.932	7.330	14.660
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		12	13	17	29

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 22.

In addition to those risks, areas landward of the beach include patches of littoral rainforest, particularly behind Scarborough and North Scarborough Beach, with up to fifteen hectares of this EEC considered to be potentially lost by 2125 due to collapse of the coastal bluffs.

Table 22 Key Risks: Scarborough - Wombarra

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-08-01	Extreme: 2025+	**Asset Group: Private Buildings** **Hazards of Concern: Coastal Cliff and Slope Instability** This risk relates to private buildings affected by the coastal cliff and slope instability hazard, with several affected buildings present to the north of Jim Allen Oval, on top of the headland separating Scarborough and Wombarra Beaches, and behind the beach to the south. Robust planning controls are required here for any future development.
CH-08-02	Extreme: 2025+	**Asset Group: Transport** **Hazards of Concern: Coastal Cliff and Slope Instability** This risk captures the threat to roadways, stairs and paths including Haig Street, Reef Avenue, Monash Street, and the roadway leading to the SLSC building. All sit within the coastal cliff and slope instability area and are close to the back of the beach. In addition, a length of Lawrence Hargrave Drive above North Scarborough Beach is at risk. The risk level here has been adjusted from that presented in the consolidated risk summary table on account of the secondary risks associated with access within and around this locality, and along the coastline to the north. Council and TfNSW should confirm the present safety of these roadways relating to instability of the coastal slopes to the rear of these beaches.
CH-08-03	Extreme:2045+	**Asset Group: Open Space / Recreation (Built)** **Hazards of Concern: Coastal Cliff and Slope Instability** This risk captures the threat to buildings such as the Scarborough-Wombarra SLSC building and the Kiosk and Amenities/Change Room at Jim Allan Oval. These assets are indicated as presently threatened by coastal cliff and slope instability, and Council should confirm their present safety.
CH-08-04	High: 2025+	**Asset Group: Transport (and associated Stormwater)** **Hazards of Concern: Beach Erosion and Shoreline Recession** Beach erosion and shoreline recession threaten several assets including the roadway at the end of Haig Street, the roadway at the end of Reef Avenue, and the ramp and stairway fronting the SLSC. Some consideration should be given to how these assets may be adapted to manage future erosion. Associated stormwater assets are also threatened and contribute to the risk.

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-08-05	High: 2025+	**Asset Group: Water and Sewer** **Hazards of Concern: Coastal Cliff and Slope Instability, and Beach Erosion and Shoreline Recession** Assets including sewer and water mains and a sewer pumping station (near end of Haig Street) are threatened by beach erosion and shoreline recession, and coastal cliff and slope instability hazards. The actual level of the threat will depend on the depth of the asset, and a more detailed assessment should be undertaken. The assets threatened are associated with the locations threatened by risks CH-08-02 and CH-08-04.

5.10 Coledale

5.10.1 Features

Coledale Beach, shown in Figure 34, is a small, embayed beach approximately 300m in length. The beach faces east-southeast and its northern and southern extents are marked by headlands and extensive rock platforms. Coledale Beach experiences average wave heights of 1.5m, which create permanent rips near the rocks at both ends and a shifting central beach rip (Short, 2007).

Stormwater drains discharge across the beach in three locations: Stockyard Creek at the northern end, Dalys Creek around 50m south of Stockyard (Figure 35), and Carricks Creek, near Coledale SLSC (Wollongong City Council, 2012). At Stockyard Creek, following heavy rain and large storms, sand is often stripped from the beach revealing a cobble and boulder beach below (Short, 2007).

The Coledale Camping Reserve, with an elevation of around 4-5 meters AHD, spans the entire length of the beach behind the dune. The original dune system has been modified and capped with various fill materials to establish the recreational areas that now form the reserve. A small, degraded remnant of the dune system remains at the northern end of the beach, in front of the camping reserve (Wollongong City Council, 2012).

The southern section of the camping reserve (Figure 36) is fronted by a 200m long concrete crib lock seawall, also with elevation around 4-5m AHD. Parts of the seawall are deteriorating. Behind the seawall are 11 heritage listed Norfolk Island pines (Wollongong City Council, 2012). Coledale SLSC is located south of the seawall on similarly low-lying land (~5m AHD).

Figure 34 Coledale Division Locality

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Figure 35 Northern end of Coledale Beach (May 2024).

Figure 36 Coledale Beach and Coledale SLSC. (May 2024).

At the southern end of the beach lies a 700m long rock platform (Figure 37) containing Coledale Rockpool which was constructed in 1921. The rockpool measures 12m wide and 50m long, with its long rectangular shape providing a safe place for lap swimming (Larkin, 2020). The concrete walls of the rockpool have an elevation around 1.0m AHD (estimated from LiDAR captured in 2013), approximately flush with the surrounding rock platform. The pool is most exposed to waves approaching from the southeast with the southeastern corner less than 10m from the outer edge of the platform. South of the rock pool, there is ongoing, intermittent erosion of the foreshore fronting several properties along Coledale Avenue, as shown in Figure 38.

Figure 37 Rock platform at the southern end of Coledale Beach. View southwards from Coledale SLSC (May 2024).

Figure 38 Erosion to the south of Coledale Rock Pool (May 2024).

Assets within the Coledale division are presented in Figures 22, 23 and 24 of Appendix C2.

Key threatened assets include the camping reserve, which may well be exposed during a severe storm at present, if the seawall at the beach fails. Constructed assets to the rear of the seawall may well be exposed in future, including public buildings, water and sewer mains and access roads. At the northern end of beach, parts of Lawrence Hargrave Drive are threatened by coastal cliff instability, with that threat expected to intensify as time passes. Some property along Lawrence Hargrave Drive to the north of the beach, including buildings atop the cliff may similarly become threatened over time. Nearby areas of endangered ecological communities may also eventually collapse into the ocean because of cliff instability.

There also exist, to the south of Coledale SLSC, and to the rear of the rock platform, properties along Hyde Lane and associated stormwater and sewer infrastructure, which are notably threatened at present by both beach erosion and cliff instability.

5.10.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for Coledale is provided in Table 23. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion and table of key risks which follows.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 24. In addition to those risks, it is expected that some Themeda grassland EEC along the cliff lines to the north of Coledale Beach could be lost through collapse of the cliffs.

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Table 23 Consolidated Risk Profile for Coledale

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Moderate	Moderate	Moderate	High
Stormwater	Cliff and Slope Instability (Threatened)	Low	Moderate	High	High
Stormwater	Coastal Inundation (Losses)	Low	Low	Low	Low
Stormwater	Tidal Inundation (Losses)	Low	Low	Low	Low
Transport	Losses due to Erosion / Recession	Moderate	Moderate	Moderate	Moderate
Transport	Cliff and Slope Instability	Moderate	High	Extreme	Extreme
Transport	Coastal Inundation	Low	Low	Moderate	Extreme
Transport	Tidal Inundation	Low	Low	Low	Low
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Moderate	Moderate	Moderate	Moderate
Open Space / Recreation (Built)	Cliff and Slope Instability	Low	Moderate	High	High
Open Space / Recreation (Built)	Coastal Inundation	Low	Low	Low	Extreme
Open Space / Recreation (Built)	Tidal Inundation	Low	Low	Low	Low
Private Buildings	Losses due to Erosion / Recession	High	High	High	Extreme
Private Buildings	Cliff and Slope Instability	Extreme	Extreme	Extreme	Extreme
Private Buildings	Coastal Inundation	Low	Low	Low	Low
Private Buildings	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	High	High	High	High
Water / Sewerage	Cliff and Slope Instability	Low	Moderate	High	Extreme
Water / Sewerage	Coastal Inundation	Low	Low	Low	Low
Water / Sewerage	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Coastal Inundation	Low	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
Private Lands	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
Private Lands	Coastal Inundation	Low	Moderate	High	Extreme
Private Lands	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
Ecology	EEC Losses due to Cliff and Slope Instability (ha)	0.034	0.135	0.339	0.677
Ecology	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
Ecology	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		55	57	61	75

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

Table 24 Key Risks: Coledale

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-09-01	High: 2025+	**Asset Group: Transport** **Hazards of Concern: Coastal Cliff and Slope Instability** Over a 100 year time frame, up to 220m of Lawrence Hargrave Drive to the north of Coledale Beach is exposed to potential collapse of the cliffs. The risk level from 2025 has been increased from that in the consolidated profile. Collapse of the cliff here would cut travel along the coast, isolating areas further north from the rest of Wollongong.
CH-09-02	High-Extreme: 2025+	**Asset Group: Private Buildings** **Hazards of Concern: Beach Erosion and Shoreline Recession, Coastal Cliff and Slope Instability** Portions of buildings at the northern end of Hyde Lane are indicated as being presently threatened by infrequent erosion events. Similarly, properties landward of the rock pool, at the very end of Coledale Avenue and some buildings at Coledale Public School may eventually be threatened by cliff instability. Robust planning controls are required here for any future development.
CH-09-03	High: 2025+	**Asset Group: Water / Sewerage** **Hazards of Concern: Beach Erosion and Shoreline Recession** A sewer main which runs along the cliff line between Coledale and Sharky Beach could be damaged through beach erosion and shoreline recession and/or cliff and slope instability here.

5.11 Sharky Beach

5.11.1 Features

A locality plan for the Sharky Beach division is shown in Figure 39. Sharky Beach (Figure 40) is around 600m long, bounded by rock platforms at the northern and southern ends, with a reef offshore of its northern half. Large waves break on the reef, reform, and surge up the steep beach face, generating a strong permanent rip in the centre of the beach. A second rip is typically located along the southern half of the beach (Short, 2007).

Figure 39 Sharky Beach Division Locality

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Figure 40 Sharky Beach (May 2024).

Lawrence Hargrave Drive runs parallel to the beach along its entire length, with a car park situated along the northern half between the road and the beach. Stormwater drains discharge across the beach at three locations: Wards Gully at the northern end of the beach, an unnamed creek 80m to the south (both visible in Figure 41), and a third outlet known as Jacky Jones Gully.

Brickyard Point Beach, also known as Austinmer Boat Harbour, is located to the south of Sharky Beach and is around 160m long. The beach can be seen in the background of Figure 40 and from the south in Figure 42. The northern end of Brickyard Point Beach features a rock platform that separates it from Sharky Beach. The southern end of the beach is marked by Brickyard Point, also known as Long Point. The beach faces northeast and typically receives waves averaging 0.5 meters. It is a narrow, steep, and reflective beach with an offshore reef.

A car park is located along the back of Brickyard Point Beach with a boat ramp at the northern end for launching small boats. The boat ramp can be seen in Figure 42.

Assets within the Sharky Beach division are presented in Figures 25, 26 and 27 of Appendix C2 for Built Assets (buildings, stormwater, and transport), Open Space and Recreation, and Ecological Assets, respectively. Those maps show that the key assets exposed are transport assets to the immediate rear of the beach.

Figure 41 Northern end of Sharky Beach (May 2024).

Figure 42 Brickyard Point (also known as Long Point), view looking north at Brickyard Point Beach (also known as Austinmer Boat Harbour, May 2024).

5.11.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for the Sharky Beach division is provided in Table 25. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion and table of key risks which follows.

Table 25 Consolidated Risk Profile for Sharky Beach

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Moderate	Moderate	High	High
	Cliff and Slope Instability (Threatened)	Low	Moderate	Moderate	High
	Coastal Inundation (Losses)	Low	Low	Low	Low
	Tidal Inundation (Losses)	Low	Low	Low	Low
Transport	Losses due to Erosion / Recession	Extreme	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Moderate (hatched)	High (hatched)	Extreme	Extreme
	Coastal Inundation	Low	High	High	High
	Tidal Inundation	Low	High	High	High
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Moderate	Moderate	High	High
	Cliff and Slope Instability	Low	Moderate	Moderate	High
	Coastal Inundation	Low	Low	Low	Moderate
	Tidal Inundation	Low	Low	Low	Low
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	Low	Low	Moderate	Moderate
	Cliff and Slope Instability	Low	Moderate	High	Extreme
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	High	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	High	High	High	Extreme
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Moderate
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (ha)	0.011	0.045	0.112	0.225
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		71	71	87	122

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 25. In addition to those risks, a small amount of EEC is mapped as threatened, comprising Themeda Grassland to the rear of Brickyard Point Beach.

Table 26 Key Risks: Sharky Beach

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-10-01	Extreme: 2025+	**Asset Group: Transport** **Hazards of Concern: Beach Erosion and Shoreline Recession** The car parks to the rear of both beaches are threatened by present day beach erosion and these assets should be checked and adapted to manage a future with more sea level rise. Similarly, the boat ramp and small amenities block at the northern end of Brickyard Point Beach are threatened.
CH-10-02	Extreme: 2025+	**Asset Group: Transport** **Hazards of Concern: Cliff and Slope Instability** A section of Lawrence Hargrave Drive to the south of the car park on Sharky Beach, where it rises onto the bluff to the rear of this part of the beach is indicated as being threatened by the coastal cliff and slope instability hazard. The risk has been elevated from that presented in Table 25, due to the role that Lawrence Hargrave Drive has in connecting communities along the coast. This should be investigated with a mitigative action adopted if required.
CH-10-03	High: 2045+	**Asset Group: Transport** **Hazards of Concern: Coastal Inundation and Tidal Inundation** The boat ramp at Brickyard Point Beach will become increasingly less usable over time as water levels rise. However, this boat ramp is relatively informal and may prove reasonably robust.

5.12 Little Austinmer

5.12.1 Features

Little Austinmer Beach is 400m long, situated between Brickyard Point at its northern end and Bells Point to the south. The beach is shown in Figure 43.

Little Austinmer Beach is backed by grassy slopes that rise to the road, dotted with tall pine trees, shown in Figure 40. Rock outcrops and reefs are present along most of the beach. Towards the southern end of the beach a gap between these rock features leads directly to a rip (Short, 2007).

Behind the northern end of Little Austinmer Beach lies Tuckerman Park, which includes an adjoining car park with elevations between 4-5.5m AHD. There is a retaining wall along the rear of the beach in front of the park and carpark. The park and carpark can be seen in Figure 44. South of the park, Lawrence Hargrave Drive runs parallel to the back of the beach. Seaward of Lawrence Hargrave Drive, a sewer main is located along the back of the beach.

Figure 43 Little Austinmer Division Locality

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Figure 44 Northern section of Little Austinmer Beach (May 2024).

A stormwater outlet discharges near the middle of the beach via a culvert under Lawrence Hargrave Drive. Additionally, a smaller stormwater outlet discharges onto the beach approximately 70m south of the culvert. Both are shown in Figure 45. A view looking northward over Bells Point along Little Austinmer Beach is shown in Figure 46.

Figure 45 Stormwater outlets along Little Austinmer Beach (May 2024).

Figure 46 View northwards looking at Bells Point and Little Austinmer Beach (May 2024).

Assets within the Little Austinmer division are presented in Figures 28, and 29 of Appendix C2 for Built Assets (buildings, stormwater, and transport), and Open Space and Recreation, respectively.

No key ecological assets are mapped in the vicinity of Little Austinmer Beach.

5.12.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for the Little Austinmer division is provided in Table 27. With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 28. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E). Further information can be found in the discussion and table of key risks which follows.

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Table 27 Consolidated Risk Profile for Little Austinmer

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Moderate	Moderate	Moderate	High
	Cliff and Slope Instability (Threatened)	Low	Low	Moderate	Moderate
	Coastal Inundation (Losses)	Low	Low	Low	Low
	Tidal Inundation (Losses)	Low	Low	Low	Low
Transport	Losses due to Erosion / Recession	Extreme	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Moderate	Moderate	High	Extreme
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Moderate	Moderate	Moderate	Moderate
	Cliff and Slope Instability	Low	Low	Moderate	Moderate
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Moderate	Moderate	High
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	High	High	High	Extreme
	Cliff and Slope Instability	Low	Moderate	High	Extreme
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	Moderate	Moderate	Moderate	Moderate
	Cliff and Slope Instability	Low	Moderate	High	Extreme
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		9	9	10	20

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

Table 28 Key Risks: Little Austinmer

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-11-01	Extreme: 2025+	**Asset Group: Transport** **Hazards of Concern: Beach Erosion and Shoreline Recession** The car park and protective structure at the northern end of the beach is indicated as being at extreme present day risk. This may be invalid as the effect of seawalls was excluded from the assessment. While the existing seawall is robust, this should be confirmed by Council as part of a broader audit of coastal structures.
CH-11-02	High: 2025+	**Asset Group: Water and Sewerage** **Hazards of Concern: Beach Erosion and Shoreline Recession** Sewer and water lines run to the rear of the beach and are indicated as threatened by beach erosion and shoreline recession. This should be investigated, considering the depth of burial of these assets.

5.13 Austinmer

5.13.1 Features

Austinmer Beach is shown in Figure 47. It lies between low headlands with rock platforms at both ends and extends approximately 350m south from Bells Point (Figure 48). Austinmer Beach faces southeast and receives average waves of 1.4m. There are two strong permanent rips against the platforms at each end of the beach. Typically, an attached bar occupies the centre of the surf zone; however, high waves can cut through this bar and generate a trough along the sloping beach face (Short, 2007).

Figure 47 Austinmer Division Locality

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Figure 48 Bells Point, between Austinmer (left) and Little Austinmer Beach (right, May 2024).

The northern end of Austinmer Beach is shown in Figure 49. A car park is located behind the northern half of the beach, with Knox Park Playground situated on its landward side (Figure 50). Both the carpark and playground are low-lying, with this area mostly situated below 4m AHD.

Lawrence Hargrave Drive runs parallel to the beach, located 20-30m from the back of the beach, with elevation around 5m AHD. Along the southern end of the beach, the beach reserve, Austinmer SLSC, Austinmer War Memorial, and the Pavilion, are also low-lying, predominantly below 4m AHD. The SLSC, Pavilion, and Austinmer Rock Pools are shown in Figure 51.

The Austinmer Rock Pools are located on the southern rock platform. The two pool sections were constructed in 1921 and are separated by a covered concrete stormwater culvert. The larger northern portion of the pool measures 20m wide and 40m in length, with the narrower southern 'lap' pool being 12m wide and 50m long (Larkin, 2020). The surrounding rock platform slopes downwards towards the sea from elevations of around 0.5m at the landward edge, to below mean sea level at the offshore edge. The pool is most exposed to waves approaching from the southeast through east.

The pools are partly located within the active, sub aerial beach with the north and south walls at approximately 0.7m AHD (estimated from LiDAR captured in 2013). The low walls and active sand movement mean that this pool is exposed to waves and prone to infilling with sand. In terms of exposure, this rock pool is among the more exposed along the Wollongong coastline. Active wave overtopping is frequent.

Figure 49 Northern section of Austinmer Beach (May 2024).

Figure 50 Carpark, Knox Park Playground, carpark, and reserve along Austinmer Beach (May 2024).

Figure 51 Southern end of Austinmer Beach, with Austinmer Ocean Pools, Austinmer SLSC and Pavilion (May 2024).

Assets within the Austinmer division are presented in Figures 30, and 31 of Appendix C2 for Built Assets (buildings, stormwater, and transport), and Open Space and Recreation, respectively. No key ecological assets are mapped in the vicinity of Austinmer Beach.

5.13.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for the Austinmer division is provided in Table 29. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion and table of key risks which follows.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 30.

The “High” present day risk associated with slope instability and private buildings relates to the residential buildings on top of the cliffs to the south of Austinmer Beach.

Table 29 Consolidated Risk Profile for Austinmer

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	High	High	High	Extreme
	Cliff and Slope Instability (Threatened)	Low	Moderate	High	Extreme
	Coastal Inundation (Losses)	Low	Low	Low	Low
	Tidal Inundation (Losses)	Low	Low	Low	Low
Transport	Losses due to Erosion / Recession	High	High	High	Extreme
	Cliff and Slope Instability	Moderate	Moderate	High	Extreme
	Coastal Inundation	Low	Low	High	Extreme
	Tidal Inundation	Low	Moderate	High	High
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Moderate	Moderate	Moderate	High
	Cliff and Slope Instability	Moderate	High	Extreme	Extreme
	Coastal Inundation	Low	Moderate	Moderate	Extreme
	Tidal Inundation	Low	Low	Low	Low
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	High
	Cliff and Slope Instability	High	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Low	High	Extreme
	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	Moderate	Moderate	Moderate	High
	Cliff and Slope Instability	Low	Moderate	High	High
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Low	Extreme	Extreme
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		0	0	0	0

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

The "High" risk indicated for Open Space/Recreation Assets impacted by Cliff and Slope Instability Hazards by 2045 relates to buildings in behind the seawall, most notably the SLSC building and pavilion landward of the rock pool. There are two matters here which have led us to reclassify the risk:

- Both buildings would need to be affected by erosion and recession before the base of the cliff could be destabilised by wave impacts.
- The SLSC building is only marginally impacted and is protected from slope collapse by a retaining wall along its southern side.

Table 30 Key Risks: Austinmer

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-12-01	High: 2025+	**Asset Group: Transport** **Hazards of Concern: Coastal Cliff and Slope Instability** A short section of Lawrence Hargrave Drive at the northern end of the division is indicated as being at risk from the slope instability hazard. This may or not be the case, and Council/TfNSW should work to confirm whether this is of concern. Loss of this section of road would require the diversion of traffic through residential streets and the preliminary risk level has been elevated due to these secondary impacts.
CH-12-02	High: 2025+	**Asset Group: Transport and Stormwater** **Hazards of Concern: Beach Erosion and Shoreline Recession** Protective structures extending from north of the rock pool for the full length of the beach are indicated as potentially lost due to beach erosion and/or shoreline recession. This risk would only arise if those structures failed. These assets are duplicated in both the stormwater and transport asset datasets in Council's system. Failure would expose assets behind the seawall, including: • Stormwater lines running to the rear of, and just landward of the seawall, to the south of the car park. • The car park and buildings within the reserve. An audit and collation of details of the structures should be undertaken to determine whether this risk is worth considering further, and maintenance of the seawall structure completed promptly following any damage.
CH-12-03	High 2025 Extreme 2045+	**Asset Group: Private Buildings** **Hazards of Concern: Coastal Cliff and Slope Instability** Around 20 residential buildings sit above the cliffs to the south of Austinmer Beach and are mapped within the coastal cliff and slope instability hazard area. Robust planning controls are required here for any future development.

5.14 Thirroul

5.14.1 Features

Thirroul Beach is 1km long and faces southeast. Its northern end is backed by a low headland fronted by wide rock platforms that separate Thirroul Beach from Austinmer Beach. The southern end of the beach is marked by a 500m strip of a narrow but variable sandy beach, backed by a coastal bluff that separates it from McCauley's Beach. Thirroul Beach is shown in Figure 52. Thirroul Beach experiences average wave heights of 1-1.5m, which usually maintain a single bar cut by six rips, including permanent rips against the boundary rock platforms. During and after large wave events, the bar typically detaches to form a continuous trough (Short, 2007).

Figure 52 Thirroul Division Locality

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A grassed reserve lies behind the beach for its entire length. Towards the northern end of the beach, the dune is low, with a maximum elevation of around 4m AHD. A stormwater outlet discharges at this northern end. Several low-lying residences are situated behind the reserve in this area, with elevations around 3-4m AHD at the very northern end, behind the outlet (near Jones St.), and below 5m AHD near the carpark located within the reserve. The northern end of the beach, including the reserve, carpark, residential area and stormwater outlet, can be seen in Figure 53.

Figure 53 Dunes and stormwater outlet at the northern end of Thirroul Beach (May 2024).

The entrance to Flanagans Creek is located around 180m south of the stormwater outlet and is shown in Figure 54. The residential area behind Thirroul Beach to the south of Flanagans Creek is also very low-lying and the vegetated dune through this area, also shown in Figure 54, has crest elevations at around 4-5m AHD.

The Thirroul SLSC and adjacent carpark, the Beach Pavilion and the Thirroul Ocean Pool are all located at the back of the beach around 130m south of the Flanagans Creek entrance, with adjacent ground elevations a 3.5-4m AHD. A low, concrete seawall extends along the beach through this section. The seawall, SLSC, Beach Pavilion and the Thirroul Pool are shown in Figure 55.

A stormwater outlet is located at the end of the seawall, at the southern end of the beach, including rock scour protection at the back of the beach. Further south, the pumphouse for the intake to Thirroul Ocean Pool connects to intake lines which run across the beach here. These features are shown in Figure 56.

Figure 54 Entrance to Flanagans Creek, Thirroul Beach (May 2024).

Figure 55 Thirroul Pool, Thirroul Beach Pavilion, and Thirroul SLSC (May 2024).

Figure 56 Southern end of Thirroul Beach (May 2024).

Assets within the Thirroul division are presented in Figures 32 and 33 of Appendix C2, for Built Assets (buildings, stormwater, and transport) and Open Space and Recreation, respectively.

Importantly, the seawall along the southern end of the division performs an important role in protecting valuable assets such as the Pool and SLSC Building. Monitoring and maintenance of that asset are important. Otherwise, the main concerns relating to coastal hazards along Thirroul Beach arise from coastal inundation, particularly inland from the entrances to Flanagan Creek and in the areas landward of Mary and Jones Streets. Residential property, buildings, and roads are threatened through this area. These threats are expected to expand further inland over time. Residences sitting on top of the cliff to the north of the beach are presently located within the zone threatened by slope and cliff instability hazards.

5.14.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for Thirroul is provided in Table 31. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion and table of key risks which follows.

Much of the stormwater infrastructure threatened at the back of the beach sits landward of the southern stormwater discharge location, which is protected by a rock revetment. This is not expected to comprise an "Extreme" risk, although the protective structure will need to be monitored and maintained. Similarly, the threatened

"Transport" assets at Thirroul comprise the seawall itself and the cycle path to the rear of the seawall. The integrity of the seawall is important and should be checked.

Table 31 Consolidated Risk Profile for Thirroul

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Extreme	Extreme	Extreme	Extreme
	Cliff and Slope Instability (Threatened)	Low	Low	Low	Moderate
	Coastal Inundation (Losses)	Low	Low	Low	Low
	Tidal Inundation (Losses)	Low	Low	Low	Moderate
Transport	Losses due to Erosion / Recession	Extreme	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Moderate	High	High
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Low	High	Extreme
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Extreme	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Moderate	Moderate	High
	Coastal Inundation	Low	High	Extreme	Extreme
	Tidal Inundation	Low	Low	Low	Low
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	High
	Cliff and Slope Instability	Extreme	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	Moderate	Moderate	Moderate	High
	Cliff and Slope Instability	Low	Moderate	High	Extreme
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	Moderate	Moderate	Extreme	Extreme
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		12	16	22	44

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

Table 32 Key Risks: Thirroul

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-13-01	Extreme: 2025+	**Asset Group: Open Space/Recreation (Built), Stormwater, Transport** **Hazards of Concern: Beach Erosion / Recession and Coastal Inundation** The application of an "Extreme" risk to these assets, is dependent on whether the seawall lacks the integrity required to withstand a suitable design storm, as discussed in the text. That would expose all assets landward to damage. Open Space/Recreation assets behind the seawall include buildings associated with the ocean pool, the ocean pool itself, the pavilion, and surf lifesaving club. These assets also become increasingly exposed to coastal inundation with a high risk level indicated by 2045. The seawall may need to be adapted to wave overtopping during higher sea levels in future. The structure should be audited to confirm its integrity, particularly in the face of future sea level rise which will result in more severe design waves potentially impacting the structure. The seawall may need to be adapted to manage higher sea levels in future.
CH-13-02	Extreme: 2045+	**Asset Group: Transport** **Hazards of Concern: Coastal Inundation** Roads to the rear of Thirroul Beach, notably around Mary Street and Jones Street, and the area around Cliff Parade are expected to become increasingly inundated over time, through coastal inundation. An adaptation plan for roads through these low-lying areas may be considered.
CH-13-03	Extreme: 2045+	**Asset Group: Private Buildings** **Hazards of Concern: Coastal Inundation** Private residences in the vicinity of Henley Rd, Mary St and Jones St are expected to interact with coastal inundation to create an extreme risk by 2045. Planning controls and adaptation are possible solutions.
CH-13-04	Extreme: 2025+	**Asset Group: Private Buildings** **Hazards of Concern: Coastal Cliff and Slope Instability** Properties along the cliffs to the north of the Thirroul division are presently within the coastal cliff and slope instability hazard area. Appropriate planning controls for future development and monitoring may be considered.

5.15 McCauleys Beach

5.15.1 Features

McCauleys Beach is around 750m long, situated between a coastal bluff that separates it from Thirroul Beach to the north, and Sandon Point at its southern end. McCauleys Beach is shown in Figure 57.

Figure 57 McCauleys Beach Division Locality

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The northern section of the beach experiences average waves heights of 1.5m, with 0.5m waves typically at the southern end of the beach. Rips tend to be spaced every 200m across the northern – central section of the beach, with fewer and weaker rips occurring towards the southern end (Short, 2007).

To the north of the beach (and south of Thirroul Beach) residential development atop coastal cliffs is present. Buildings to the rear of the beach are threatened by instability of the cliffs in this area (Figure 58). Two creeks cross the beach, with the entrance of Hewitts Creek located towards the northern end of the beach and the entrance to Tramway Creek in the centre of the beach. The beach is narrow, with its widest section between the two creek entrances (Figure 59).

The Sandon Point Aboriginal Place spans McCauleys Beach and adjacent land from Hewitts Creek to Sandon Point. The back of the beach in this area is at the toe of an eroding, near vertical slope (Figure 60) which has been the fastest receding length of beach along the entire Wollongong coastline over the past few decades. There has been an ongoing pattern of recession at McCauleys Beach since at least the 1960s (Salients, 2023b).

The southern section of the beach comprises a rocky foreshore along the northern side of Sandon Point. This section of beach is shown in Figure 61. This southern end receives some protection from Sandon Point and is also known as Bulli Harbour (Short, 2007). The area once had a jetty which was used for loading coal from the Bulli Colliery and several boat sheds are nestled at the base of the cliff, below the Sandon Point car park.

Figure 58 Northern end of McCauleys Beach (May 2024).

Figure 59 Hewitts Creek (right) and Tramway Creek entrance (left), McCauleys Beach (May 2024).

Figure 60 Eroding slope along McCauleys Beach, south of Tramway Creek (August 2020).

Figure 61 Southern end of McCauleys Beach (May 2024).

Assets within McCauleys Beach division are presented in Figures 34, 35 and 36 of Appendix C2 for Built Assets (buildings, stormwater, and transport), Open Space and Recreation, and Ecological Assets, respectively. Presently threatened assets include residential land, buildings and associated services along the cliff line to the north of the Hewitts Creek (and south of Thirroul Beach), sewerage assets to the rear of the beach between the two creeks, a rising sewer main to the south of Tramway Creek and sections of the shared pathway to the south of Hewitts Creek, and at the southernmost extent of the Beach.

5.15.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for McCauleys Beach is provided in Table 33.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 34. The risk assessment has not identified any threatened coastal ecosystems at risk from beach erosion/shoreline recession or cliff instability.

One open space asset, incorporating the Sandon Point Aboriginal Place, is threatened, but is not mapped as an open space asset within Council's data. The risks associated with this are being assessed as part of a separate study (Illawarra Local Aboriginal Land Council, 2024).

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Table 33 Consolidated Risk Profile for McCauleys Beach

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Moderate	Moderate	Moderate	Moderate
	Cliff and Slope Instability (Threatened)	Low	Low	Low	Moderate
	Coastal Inundation (Losses)	Low	Low	Low	Low
	Tidal Inundation (Losses)	Low	Low	Low	Low
Transport	Losses due to Erosion / Recession	High	High	High	High
	Cliff and Slope Instability	Low	Moderate	High	High
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Extreme	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Moderate	High	High
	Coastal Inundation	Low	Low	Low	Moderate
	Tidal Inundation	Low	Low	Low	Low
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Extreme	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	Low	Moderate	Moderate	High
	Cliff and Slope Instability	Low	Moderate	High	High
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	High	High	Extreme	Extreme
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.150	0.187	0.314	0.660
	EEC Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.054	0.066	0.098	0.268
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		31	45	64	155

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

Table 34 Key Risks: McCauleys Beach

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-14-01	High: 2025+	**Asset Group: Transport** **Hazards of Concern: Beach Erosion and Shoreline Recession.** There is reportedly a "retaining wall" along the back of the beach stretching northwards from the entrance to Hewitts Creek This structure (partly rock revetment, partly concrete seawall) is partially mapped in the data set used for the assessment. However, alongside clear identification as a seawall in Council's asset management system, it should be assessed to determine whether it is fit for purpose. The southern approach of the shared pathway over Hewitts Creek is also indicated as threatened by beach erosion and shoreline recession.
CH-14-02	Extreme: 2025+	**Asset Group: Private Buildings** **Hazards of Concern: Coastal Cliff and Slope Instability** Clifftop residences between McCauleys and Thirroul Beaches are already extensively exposed to coastal cliff and slope instability hazards. Robust planning controls are required here for any future development.
CH-14-03	Extreme: 2025+	**Asset Group: Open Space / Recreation** **Hazards of Concern: Coastal Cliff and Slope Instability, Beach Erosion and Shoreline Recession, and Coastal Inundation** The risk model identifies the boat sheds to the north of Sandon Point (listed as a heritage item in Wollongong's LEP) as threatened by cliff and slope instability hazards and erosion/recession hazards. However, the beach here is shallow, overlying a rock platform and the indicated hazard is likely somewhat overstated. The boat sheds are also likely threatened by present day inundation but weren't captured as affected by that process as they were represented by a single point in the data set. A more detailed investigation and management plan for these sheds could be considered.

5.16 Sandon Point

5.16.1 Features

Sandon Point Beach extends southward from Sandon Point for approximately 1km to its southern end at Waniora Point. Waniora Point extends offshore as a reef, for some 500m. The beach is crossed by Slacky Creek approximately midway along its length. The Sandon Point Division is shown in Figure 62.

The northern section of the beach faces southeast, with the remainder of the beach facing east. Wave conditions vary along the beach, with the northern end experiencing average wave heights of 1m, decreasing to 0.5m towards southern end, which is more sheltered by the reefs offshore of Waniora Point. These wave patterns typically maintain a continuous sandbar along the beach, with 2-3 rips forming in the northern half. These rips tend to fill in during periods of lower wave activity (Short, 2007).

Figure 62 Sandon Point Division Locality

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Sandon Point SLSC is located at the northern end of the Beach and is shown in Figure 63. The beach is backed by a well vegetated dune to the south of the SLSC, with a grass reserve located behind the beach between the SLSC and Slacky Creek. The southern end of the reserve can be seen on the right side of Figure 64, which shows the middle section of the beach containing the Slacky Creek entrance.

The coastline cycleway runs behind the beach for most of its length, with a road parallel to the path on the landward side. The height of the dune behind the beach and the width of grass reserve between the beach and the cycle path decreases with distance southwards. Several low-lying residential properties are present on the landward side of the southern end of the beach as well as a sports ground.

South of Slacky Creek, the back of the beach steepens once more, as shown in Figure 65. Close to Waniora Point, a stepped rock wall has been constructed (Figure 66). This section of beach was previously subject to erosion in 2007 (Figure 67).

Assets within the Sandon Point division are presented in Figures 37 and 38 of Appendix C2 for Built Assets (buildings, stormwater, and transport), and Open Space and Recreation, respectively. Presently threatened assets are mostly confined to the dune system along the beach, although areas to the rear of protective structures fronting the SLSC building and the southern end of the beach are indicated as threatened as well, noting that the robustness of those structures has not been included in our assessment, and it was assumed that they would fail. This will not necessarily be the case.

No key ecological assets are mapped in the vicinity of Sandon Point Beach.

Figure 63 Sandon Point SLSC, Sandon Point Beach (May 2024).

Figure 64 Slacky Creek entrance, Sandon Point Beach (May 2024).

Figure 65 Sandon Point Beach, south of Slacky Creek (May 2024).

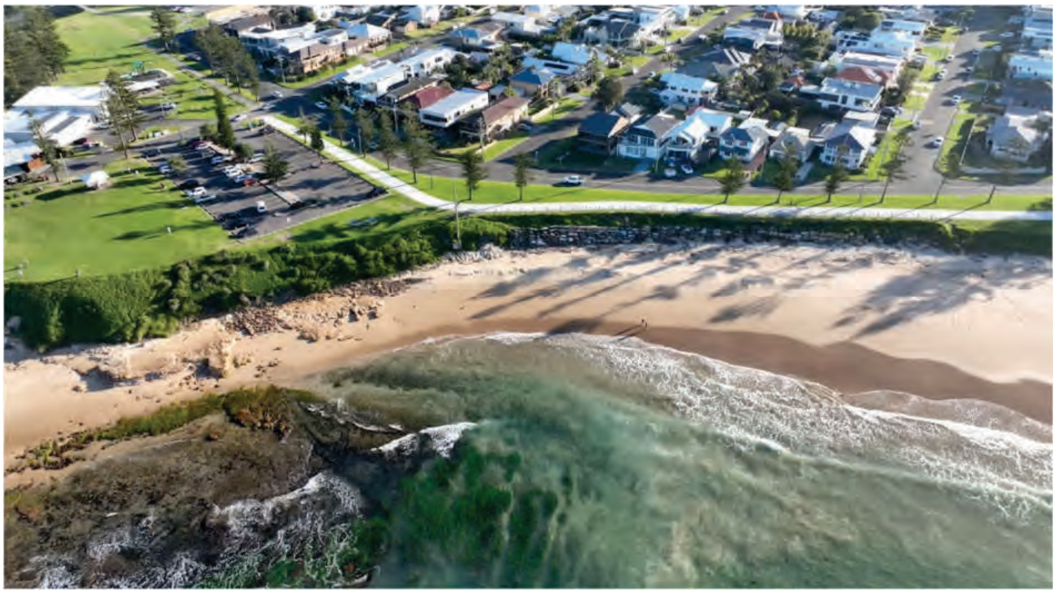

Figure 66 Southern section of Sandon Point Beach (May 2024).

Figure 67 Erosion at the southern end of Sandon Point Beach (August 2007, courtesy Wollongong City Council).

5.16.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for the Sandon Point division is provided in Table 35. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E). Further information can be found in the discussion and table of key risks which follows.

Table 35 Consolidated Risk Profile for Sandon Point

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Low	Low	Low	Moderate
	Cliff and Slope Instability (Threatened)	Low	Low	Low	Low
	Coastal Inundation (Losses)	Low	Low	Low	Low
	Tidal Inundation (Losses)	Low	Low	Low	Moderate
Transport	Losses due to Erosion / Recession	Extreme	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Moderate	High	Extreme	Extreme
	Coastal Inundation	Low	Low	Low	Extreme
	Tidal Inundation	Low	Moderate	Extreme	Extreme
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Moderate	Moderate	Moderate	High
	Cliff and Slope Instability	Moderate	High	Extreme	Extreme
	Coastal Inundation	Low	Moderate	Moderate	Extreme
	Tidal Inundation	Low	Low	Low	Low
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Extreme
	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	High	High	High	High
	Cliff and Slope Instability	Low	Low	Moderate	Moderate
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	Low	Low	Low	Moderate
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Extreme
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (Ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (Ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Erosion / Recession (Ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Cliff and Slope Instability (Ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		0	0	3	9

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 36.

Table 36 Key Risks: Sandon Point

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-15-01	Extreme: 2025+	**Asset Group: Transport** **Hazards of Concern: Beach Erosion and Shoreline Recession, Coastal Cliff and Slope Instability** The stepped rock structure extending for around 100m immediately north of Waniora Point has an important role in protecting the coastal cycleway and the road pavement of Trinity Row to the north of Jardine St. The risks would only arise if the seawall failed and exposed the assets landward of the structure, which it is intended to protect. An audit and collation of details of the structures should be undertaken to determine whether this risk is worth considering further, and maintenance of the seawall structure completed promptly following any damage. In addition, areas of the car park at Waniora Point and additional lengths of the coastal cycleway are within the area affected by the coastal cliff and slope instability hazard.
CH-15-02	High: 2025+	**Asset Group: Water/Sewer** **Hazards of Concern: Beach Erosion and Shoreline Recession** Approximately 150m of sewer main, in the vicinity of the stepped rock structure (CH-15-01) is threatened by erosion. Sydney Water should consider confirming the depth of burial and precise location of this sewer main to determine whether the risk is genuinely of concern.
CH-15-03	High: 2045, Extreme 2075+	**Asset Group: Open Space / Recreation (Buildings)** **Hazards of Concern: Coastal Cliff and Slope Instability** The SLSC and associated stairways at Sandon Point are potentially affected by the coastal cliff and slope instability hazard. Council should check and confirm whether this is a present concern using more location specific data or additional investigation (if required).

5.17 Bulli Beach

5.17.1 Features

Bulli Beach, shown in Figure 68, is approximately 900m long and situated between rock outcrops at Waniora Point in the north and Collins Point in the south. Bulli Rockpool is located within the rock platform at Waniora Point (Figure 69).

Bulli Rockpool is exposed and experiences wave overtopping at high tides. It was constructed in 1903 and measures 25m wide and 50m long (Larkin, 2020). The concrete walls of the rockpool have an elevation between 1.3-1.5m AHD (estimated from LiDAR captured in 2013), notably higher than the adjacent rock platform which is seemingly around 0m AHD.

Figure 68 Bulli Beach Division Locality

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Figure 69 Bulli Rockpool and SLSC at the northern end of Bulli Beach (left, May 2024).

The pool is most exposed to waves approaching from the southeast with the southern corner immediately adjacent to the edge of the rock platform. Remnants of previous pool configurations, retaining structures and small seawalls are intermittently exposed to the south and landward of the rockpool.

Bulli Beach is straight and faces southeast. The beach is exposed to waves averaging 1.5m, and there are typically 4-6 rips along the beach, including permanent rips near the rocks at each end and 2-4 shifting beach rips. During and following large wave events, the sandbars can become separated from the beach by a trough (Short, 2007). The characteristics of the dunes vary along the beach, with the northern dunes being high and narrow, while the southern dunes are wide and flat. Vegetation on these dunes, established in the mid-1980s, has gradually spread seaward over time.

Bulli SLSC and a café are located at the northern end of the beach, upon / flanking the headland at Waniora Point (Figure 69). Vegetated dunes are present along the entire beach. The Wollongong to Thirroul coastline cycleway is located behind the dunes for the full length of the beach. The dunes and cycleway behind Bulli Beach are shown in Figure 70.

The entrance to Whartons Creek (Figure 71) typically discharges across the beach around 200m south of the rockpool, although this entrance is prone to significant meandering towards the north. Recent management activities have included beach scraping and re-profiling around Whartons Creek to realign the entrance channel and rebuild the beach after periods of intense scouring from creek discharge (Wollongong City Council, 2021). The land to the rear of the beach dunes and coastal cycleway, to the south of Whartons Creek, is occupied by the Bulli Beach Tourist Park. The Park occupies this space for around half the length of Bulli Beach.

Further south, The entrance to Collins Creek discharges across the beach to the north of Collins Point (Figure 72).

Figure 70 View southwards along Bulli Beach from Whartons Creek (November 2020, image courtesy of Wollongong City Council).

Figure 71 Whartons Creek entrance, Bulli Beach (May 2024).

Figure 72 Collins Creek entrance (May 2024).

Assets within the Bulli division are presented in Figures 39, 40 and 41 of Appendix C2, for Built Assets (buildings, stormwater, and transport), Open Space and Recreation, and Ecological Assets, respectively.

Presently threatened assets include the SLSC and Café buildings at Waniora Point and parts of the seaward edge of the Tourist Park, with a handful of cabins presently threatened (by an extreme event) and more expected to become threatened in future. Similarly, lengths of the coastal cycleway are already threatened. While not threatened at present, it is expected that lower lying properties along Carrington Street and Lawrence St will become threatened in future via inundation from Collins Creek.

5.17.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for Bulli is provided in Table 37. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion and table of key risks which follows.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 38.

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Table 37 Consolidated Risk Profile for Bulli

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Moderate	Moderate	Moderate	Extreme
	Cliff and Slope Instability (Threatened)	Low	Low	Low	Low
	Coastal Inundation (Losses)	Low	Low	Low	Low
	Tidal Inundation (Losses)	Low	Moderate	Extreme	Extreme
Transport	Losses due to Erosion / Recession	Moderate	High	High	High
	Cliff and Slope Instability	Low	Low	Moderate	Moderate
	Coastal Inundation	Low	Low	Low	Extreme
	Tidal Inundation	Low	Low	High	Extreme
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Moderate	Moderate	Moderate	High
	Cliff and Slope Instability	Moderate	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Moderate	Moderate	Moderate
	Tidal Inundation	Low	Low	Low	Low
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Extreme
	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	Moderate	High	High	Extreme
	Cliff and Slope Instability	Low	Low	Moderate	Moderate
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	High	Extreme
	Tidal Inundation	Low	Low	Moderate	Extreme
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (Ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (Ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Erosion / Recession (Ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Cliff and Slope Instability (Ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		97	104	124	161

Table 38 Key Risks: Bulli

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-16-01	Extreme: 2045+	**Asset Group: Open Space and Recreation** **Hazards of Concern: Coastal Cliff and Slope Instability** The building at Waniora Point containing the café is expected to be unacceptably exposed to cliff and slope instability hazards by 2045. A plan for reconfiguring, relocating this building may be considered.
CH-16-02	High: 2045+	**Asset Group: Water/Sewerage** **Hazards of Concern: Coastal Cliff and Slope Instability** A sewer main is mapped (in Sydney Water data) as running along the back of Bulli Beach, in front of the Tourist Park and is expected to become exposed to beach erosion/shoreline recession, although the elevation at which it is buried will be important. Whether or not this infrastructure has been appropriately designed to withstand coastal processes is unclear. Sydney Water should consider investigating this.
CH-16-03	High: 2045+	**Asset Group: Transport** **Hazards of Concern: Beach Erosion and Shoreline Recession** The risk related to transport related assets exposed to beach erosion and shoreline recession refers to the potential loss of around 100m of the cycleway in front of the Bulli Beach Tourist Park. There may be an opportunity for landward relocation in future.

5.18 Woonona Beach

5.18.1 Features

The beach compartment spanning between Woonona and Bellambi is shown in Figure 73. For the purposes of risk assessment, the Woonona Beach division extends from the northern headland (Collins Point) for around 1.3km.

This section of the beach typically experiences waves averaging 1-1.5m, with an attached bar that is interrupted by rips every 200m. During large seas, a secondary bar can form further offshore. A permanent rip is located against the northern rocks (Short, 2007).

Woonona Rockpool is situated on the rock platform at Collins Point, shown in Figure 74 and Figure 75. Like the Bulli Rockpool, it experiences wave overtopping during high tides or times of high swell. It was constructed in 1925 and is 20m wide and 50m long (Larkin, 2020). The concrete walls are notably higher than the adjacent rock platform. The pool is most exposed to waves approaching from the south. Remnants of previous pool configurations are present across the rock platform, and a historic changing pavilion is located landward of the pool.

Figure 73 Woonona Beach Division Locality

Wollongong CMP Stage 2 - Coastal Hazard Risk Assessment Report

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Figure 74 Woonona Rockpool, Collins Point, southern end of Bulli Beach (May 2024).

Woonona SLSC is also located towards the northern end of the beach and can be seen in Figure 75 and Figure 76.

A small stormwater line exits the compartment across the beach near the southern end of Woonona Beach (Figure 77) and can scour that part of the beach during heavy rainfall.

Figure 75 Collins Point, between Bulli Beach (right) and Woonona Beach (left, May 2024).

Figure 76 View southwards along Woonona Beach (April 2024, image courtesy of Wollongong City Council).

Figure 77 Stormwater outlet midway along Woonona – Bellambi Beach (May 2024).

The entire length of Woonona-Bellambi Beach is backed by vegetated dunes, with high narrow dunes in the north and wider flatter dunes in the south. The coastal cycleway runs behind these dunes for the full length of the beach.

Dune vegetation, established in the mid-1980s, has progressively spread seaward over time. Recent management interventions include re-profiling the northern section in front of the Woonona SLSC in June 2014 to strip back foredune vegetation and lower the dune height. There have, subsequently, been ongoing vegetation management efforts to establish lower-growing species.

Assets within the Woonona division are presented in Figures 42, 43 and 44 of Appendix C2, for Built Assets (buildings, stormwater, and transport), Open Space and Recreation, and Ecological Assets, respectively. Towards the southern end of Beach Drive, some transport assets are threatened by low frequency (present day 1% chance) events but are indicated as becoming more threatened after 2045 due to beach erosion and shoreline recession. Those assets include part of the roadway and the coastal cycleway. Utilities such as stormwater and sewer mains associated with the roadway have a similar risk profile. The residential development landward of these dunes is expected to become increasingly exposed over time to inundation via the drainage outlet which crosses the beach to the south.

5.18.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for Woonona Beach is provided in Table 39. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion and table of key risks which follows.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 40. There are no identified, coastal hazard related risks to EEC's, coastal wetlands, or littoral rainforest within the Woonona Beach division.

Table 39 indicates a high level present day risk relating to transport infrastructure, however interrogation of the results indicates that this is mostly due to identification of fencing of dune vegetation, which has been inconsistently recorded in Wollongong Council's GIS and asset data systems. The key asset affected from the "Transport" category is the ramp leading from the carpark landward of the Woonona rock pool down to the beach. The categorisation for that item has been considered under Risk CH-14-01. Similarly, the open space assets indicated to be at high risk from coastal inundation by 2045 corresponds to a relocatable lifeguard tower within the dunes. Noting the nature of that asset, this is not considered to be a key risk needing treatment by the CMP.

Salients

Table 39 Consolidated Risk Profile for Woonona Beach

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Low	Low	Low	Moderate
	Cliff and Slope Instability (Threatened)	Low	Low	Low	Low
	Coastal Inundation (Losses)	Low	Low	Low	Low
	Tidal Inundation (Losses)	Low	Low	Low	Low
Transport	Losses due to Erosion / Recession	High	High	High	Extreme
	Cliff and Slope Instability	Moderate	Moderate	High	Extreme
	Coastal Inundation	Low	Moderate	High	Extreme
	Tidal Inundation	Low	Low	Low	Moderate
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Moderate	Moderate	High	High
	Cliff and Slope Instability	Moderate	Moderate	High	Extreme
	Coastal Inundation	Low	High	High	High
	Tidal Inundation	Low	Low	Low	Low
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Moderate	Extreme	Extreme
	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	Moderate	Moderate	Moderate	High
	Cliff and Slope Instability	Low	Low	Low	Moderate
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	High	High	High	Extreme
	Cliff and Slope Instability	Low	High	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Low	Low	Moderate
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		29	32	43	70

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

Table 40 Key Risks: Woonona Beach

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-17-01	High: 2045+	**Asset Group: Transport** **Hazards of Concern: Coastal Inundation** Impacts to the ramp leading to the beach north of the Woonona rock pool are expected to be amplified with sea level rise. The integrity of this structure against more frequent inundation and waves should be checked.

5.19 Bellambi

5.19.1 Features

Bellambi Beach extends south from Woonona Beach, comprising the southern end of the Woonona – Bellambi embayment (Figure 78). At its southern end, Bellambi Point shelters the beach. The entrance to Bellambi Gully is located towards the southern end of Bellambi Beach and is shown in Figure 79. The Bellambi SLSC building, also shown, is located behind the western foreshore of Bellambi Gully. To the north of Bellambi Gully, the back of the beach contains vegetated dunes, with these dunes narrowing and increasing in height with distance north. The coastal cycleway extends behind these dunes, northward to Woonona. In December 2019, minor re-profiling and vegetation removal were conducted near the entrance to Bellambi Gully on the northern side (Wollongong City Council, 2021).

Bellambi Rock Pool, which is immediately to the south of the entrance to Bellambi Gully, is shown in Figure 80 and has been constructed on a platform fronting a low rocky headland. A rock revetment is located along the back of the beach between the creek entrance and the rock pool, as shown in Figure 81. The exposed northern and eastern walls of the rock pool have elevations between 0.7-0.8m (estimated from LiDAR captured in 2013), with the promenades around the southern and eastern edges some 0.2m higher. The pool is set back some 35m from the eastern edge of the rock platform, which slopes downwards with distance offshore. Low concrete walls constructed upon the rock platform, parallel to three sides of the rock pool may provide some protection from wave energy but it is unclear whether these were built for that purpose or remain from a prior pool configuration.

Bellambi Point, shown in Figure 82, is a low dune-capped shale headland that extends around 1km out from the coast, and a further 600m offshore as a reef. Two reef-dominated beaches are located on either side of the point: Bellambi Harbour Beach on the northern side, and Bellambi Point Beach on the southern side (Short, 2007).

Bellambi Harbour Beach, on the northern side of Bellambi Point, is a narrow 400m long strip of sand interspersed with nearshore rocky reef between the low headland at Bellambi Rockpool and Bellambi Point. The beach faces northeast and is partly sheltered by the boat harbour breakwater to the east, which also shelters a boat ramp, jetty, and carpark at the eastern end of the beach. The offshore edge of the carpark is also protected by a rock revetment to the west of the boat ramp. The entire carpark is below 3.5m AHD. The beach, carpark, boat ramp, and breakwater are shown in Figure 82. The boat ramp is accessible via Robert Cram Drive a low-lying road, which is located at the back of Bellambi Harbour Beach. Sections of the beach are eroding, most notably at the location shown in Figure 83. While influenced by coastal processes, this erosion is related to runoff from the sealed carpark midway along Robert Cram Drive.

Figure 78 Bellambi Division Locality

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Figure 79 Entrance to Bellambi Gully, showing the Bellambi SLSC Building

Figure 80 View over Bellambi Rock Pool, looking south.

Figure 81 Rock Revetment to north of Bellambi Rock Pool

Figure 82 Bellambi Point, Boat Ramp Facility and Bellambi Harbour Beach

Figure 83 Erosion along Robert Cram Drive, Bellambi Harbour Beach (May 2024).

Bellambi Wastewater Treatment Plant is located at Bellambi Point, just south of the carpark, with an elevation between 6-7m AHD. The wastewater treatment plant can be seen in Figure 82. This area is managed in part by the NSW Government and in part by Council.

The Bellambi division also extends to the south of Bellambi Point, including Bellambi Lagoon and the beach north of its entrance.

Bellambi Point Beach occupies the southern side of Bellambi Point, extending along the southern side of the point and running southwest for 900m to Sandspit Point. Bellambi Point Beach and Sandspit Point are shown in Figure 85. Historical sand mining has occurred within the Bellambi dunes. The beach is backed by vegetated dunes and typically experiences waves less than 1m high due to the rocks and offshore reefs.

Assets within the Bellambi division are presented in Figures 45, 46 and 47 of Appendix C2. Key threatened assets include the freshwater lagoon/lake near the entrance to Bellambi Gully, which will become prone to tidal and coastal inundation as sea levels rise. Similarly, fringing residential areas to the north of Bellambi Lagoon will likely become threatened in future. Some properties fringing Bellambi Lagoon, particularly south of the entrance, and adjacent to the western foreshore are projected to become exposed to coastal inundation hazards, albeit at a low probability level, by 2075.

Figure 84 Northern end of Bellambi Point Beach (May 2024).

Figure 85 View northeast along Bellambi Point Beach, from Sandspit Point to Bellambi Point (May 2024).

The car park for the boat ramp facility and Robert Cram Drive are also threatened by a combination of erosion and inundation hazards.

5.19.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for Bellambi is provided in Table 41. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion and table of key risks which follows.

Table 41 Consolidated Risk Profile for Bellambi

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Extreme	Extreme	Extreme	Extreme
	Cliff and Slope Instability (Threatened)	Low	Low	Low	Low
	Coastal Inundation (Losses)	Low	Extreme	Extreme	Extreme
	Tidal Inundation (Losses)	Low	Extreme	Extreme	Extreme
Transport	Losses due to Erosion / Recession	Extreme	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Open Space / Recreation (Built)	Losses due to Erosion / Recession	High	High	Extreme	Extreme
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Moderate	Moderate	Extreme
	Tidal Inundation	Low	Moderate	Moderate	Moderate
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	High	High	High	High
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Low	Extreme	Extreme
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.156	0.165	0.226	0.405
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		7	7	11	22

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

The indicated risk to "stormwater" assets by inundation hazards are related to impacts on the lagoon to the north and west of the bridge over Bellambi Gully, which is recorded as a stormwater asset. By 2045, inundation would only occur infrequently, it seems unlikely that this would result in an "extreme" risk for that particular asset.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 42. In addition to those risks, it is expected that some coastal wetlands, associated with Bellambi Gully, will be lost through beach erosion and/or watercourse entrance instability.

Table 42 Key Risks: Bellambi

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-18-01	Extreme: 2025+	**Asset Group: Transport (and Stormwater)** **Hazards of Concern: Beach Erosion and Shoreline Recession** Protective structures extending from north of the rock pool are indicated as potentially lost due to beach erosion and/or shoreline recession. This risk would only arise if those structures failed. These assets are duplicated in both the Stormwater and Transport asset categories in Council's system. Failure would also expose the coastal cycleway between the rock pool and the cycleway bridge over Bellambi Gully. An audit and collation of details of the structures should be undertaken to determine whether this risk is worth considering further, and maintenance of the seawall revetment structure completed promptly following any damage.
CH-18-02	Extreme: 2045+	**Asset Group: Transport** **Hazards of Concern: Coastal Inundation and Tidal Inundation** The boat ramp and adjacent jetty may be affected by coastal and tidal inundation. If replaced, it will be important to consider sea level rise in the design.
CH-18-03	Extreme: 2025+	**Asset Group: Transport (Road which is actually public land)** **Hazards of Concern: Beach Erosion and Shoreline Recession** Robert Cram Drive is exposed to beach erosion and shoreline recession hazards which could potentially prevent access to the boat ramp facility. A protective structure (or improvements to the existing one) may be required here. We note that Robert Cram Drive is not strictly classified as a "road."
CH-18-04	High: 2025+	**Asset Group: Open Space / Recreation** **Hazards of Concern: Beach Erosion and Shoreline Recession** Lifeguard tower north of bridge at Bellambi Gully could be threatened by a severe storm. Consider lightweight / relocatable structure upon its replacement or relocate, depending on practicality.

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-18-05	High: 2025+	**Asset Group: Sewer / Water** **Hazards of Concern: Beach Erosion and Shoreline Recession** Beach erosion / shoreline recession threatens Sydney Water Infrastructure including an overflow to Bellambi Boat Harbour and an outfall to Bellambi Point Beach

5.20 Corrimal

5.20.1 Features

Corrimal Beach is located between two rocky outcrops, Sandspit Point to the north and Towradgi Point to the south. It is approximately 1.5km long, backed by wide, vegetated dunes and shown here in Figure 86. There are ICOLLs at the north and south ends of the beach, Bellambi Lagoon and Towradgi Creek respectively, with Towradgi Creek included in the Corrimal division (Bellambi Lagoon is considered in the Bellambi division).

Corrimal Beach faces southeast and receives average waves of 1.5m. The beach usually features a single bar cut by 5-6 rips, with permanent rips against the rocks at each end. During and following large wave events, a trough often forms, separating the bar from the beach, particularly towards the northern end of the beach. Occasionally a second bar forms further seaward with more widely spaced rips (Short, 2007).

Corrimal Beach Tourist Park occupies most of the area behind the dunes along the central section of the beach, between Bellambi Lagoon and Towradgi Creek. This section of the beach, shown in Figure 88, features wide dunes of moderate height. Dune vegetation was established in the mid-1980s and has spread seawards over time.

Corrimal SLSC is located behind the dune on the north side of Towradgi Creek. Ground surrounding the SLSC building is around 3.3m AHD, and the seaward dune crest is around 4m AHD.

In November 2016, the dunes in front of the southern end of the tourist park, just north of the SLSC, were re-profiled. This process included removal of vegetation and flattening the steep slope, with re-planting on the seaward edge.

On the southern side of the Towradgi Creek entrance, the vegetated foredune extends for another 250m, fronting a sports field, picnic area, and playground. There is a layer of rocks placed against the dunes at the southern end of the beach, immediately to the north of the Towradgi rockpool. This section of the beach is shown in Figure 89.

Figure 86 Corrimal Beach Division Locality

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Assets within the Corrimal division are presented in Figures 48, 49 and 50 of Appendix C2. Some inundation is expected to eventually impact residential areas to the south of the entrance to Bellambi Lagoon, and low-lying areas to the north of Towradgi Creek (west of the tourist park) are exposed to present day coastal inundation risks.

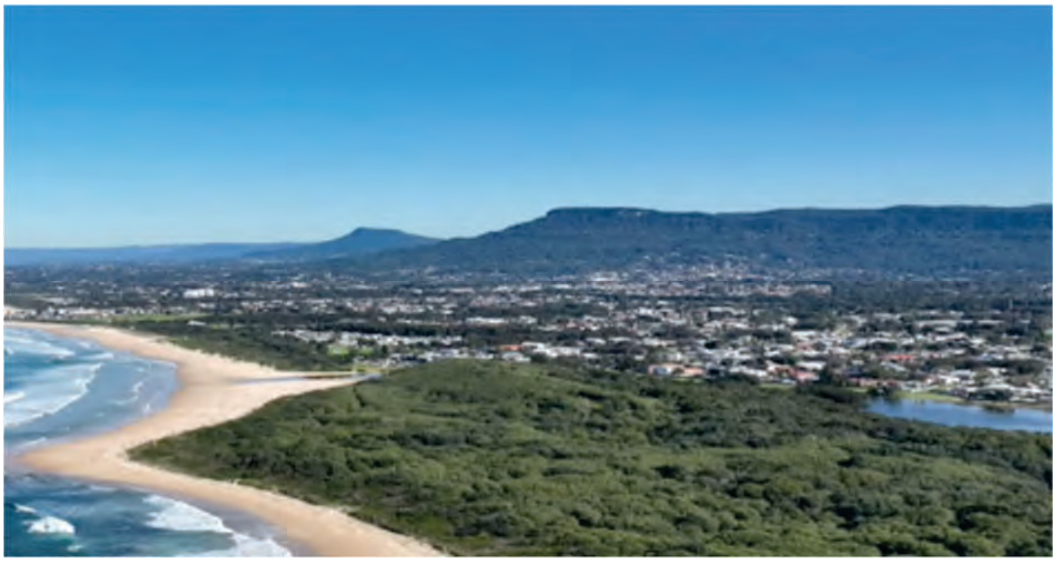

Figure 87 View southeast from Sandspit Point along Corrimal Beach (May 2024).

Figure 88 Corrimal Beach Tourist Park (May 2024).

Figure 89 Southern end of Corrimal Beach (May 2024).

5.20.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for Corrimal is provided in Table 43. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion and table of key risks which follows.

The "High" risk indicated for Stormwater assets on account of Beach Erosion and Shoreline Recession is related to the training structures of Towradgi Creek. Similarly, the tidal inundation assessment captures those structures and additional protective structures further upstream in the estuary. While this is not considered a key risk of concern, <u>these should be audited, mainstreamed into Councils asset system, monitored, and maintained</u>.

The "High Risk" indicated for beach erosion/shoreline recession and transport assets relates to the mapping of beach accessway fences (Council's mapping overall is incomplete in this regard, although this is currently being addressed by Council staff). The methods used, as outlined in Appendix E, tend to overstate the cost to replace such assets and the risk is therefore considered low in this instance.

Finally, the "Extreme" risk for 2045 indicated for transport assets from tidal inundation is due to the initial risk analysis capturing the bridge at Pioneer Road, and the Coastal Cycleway bridge near the entrance. However, these risks are considered unlikely to be problematic in the medium term, as the bridge decks are sufficiently elevated above existing water levels, and not worth further consideration in the CMP. Accordingly, there remain no key risks considered important for the short – medium term timeframe of the CMP, within the Corrimal division.

However, there are substantial risks which arise from an increasing frequency of inundation of land, over time, although these are expected to emerge as being notably problematic only after around 20 years. As for almost all other divisions, risks relating to the loss of land are likely to be high to extreme within 20 years. Around 0.06 hectares of coastal wetland is expected to be lost from beach erosion, via recession of the entrances to Towradgi Creek, by 2125.

Table 43 Consolidated Risk Profile for Corrimal

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	High	High	High	Extreme
	Cliff and Slope Instability (Threatened)	Low	Low	Low	Low
	Coastal Inundation (Losses)	Low	Low	Low	Low
	Tidal Inundation (Losses)	Low	Extreme	Extreme	Extreme
Transport	Losses due to Erosion / Recession	High	High	Extreme	Extreme
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Moderate	Moderate	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Moderate	Moderate	High	Extreme
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Moderate	Moderate	Extreme
	Tidal Inundation	Low	Low	Low	Moderate
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Extreme
	Tidal Inundation	Low	Low	Low	Extreme
Water / Sewerage	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	Low	Low	Low	Moderate
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	High	Extreme	Extreme
	Tidal Inundation	Low	High	Extreme	Extreme
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.001	0.003	0.011	0.060
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		15	21	34	59

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

5.21 Towradgi

5.21.1 Features

The Towradgi Division (Figure 90) extends around 1.2km from the rocky outcrops at Towradgi Point at its northern end to south of the Wollongong Surf Leisure Resort. Towradgi Beach faces towards the southeast and is backed by vegetated dunes along its entire length. In turn, those dunes are backed by a drained back barrier swamp (Short, 2007). Towradgi Arm, which connects to Fairy Creek at the southern end of the beach, also runs parallel to the beach for its entire length.

Along this section of the beach, waves average 1.5m. There is usually a single bar with up to 6-7 rips spaced 200m apart, with the rips increasing in size and intensity with distance south along the beach. The bar is typically attached during periods of smaller waves, with larger waves producing a continuous trough and rip feeder currents. A second outer bar sometimes forms along Towradgi Beach.

The beach is characterised by large dunes with steep scarps. Towradgi SLSC is located around 350m south of Towradgi Point. Between the SLSC and Towradgi Point, the coastline cycleway is located behind the dunes, parallel to the beach. This northern end of the beach, captured from in front of Towradgi SLSC, is shown in Figure 91.

Recent works at Towradgi – Fairy Meadow Beach have been undertaken to address community concerns of dune scarping following storms, as well as decreased beach amenity and sight lines from lifeguard towers from dune vegetation. Interventions have included reprofiling the northern end of the beach in June 2015 with sand fencing in place from February 2016 to March 2018 to manage sand accretion.

Towradgi rockpool, constructed in 1964, is located at Towradgi Point, at the southern end of Corrimal Beach. It is rectangular in shape and 50m long. Its location and positioning have led to regular sediment build up in the southern corner. The concrete walls of the pool are notably higher than the adjacent rock platform (0.9-1.0m AHD, compared to around 0.0m on the surrounding platform). The pool is most exposed to waves approaching from the southeast.

A rock gabion / reno mattress protective structure, which remains buried most of the time, is present along the back of the beach, to the south of the rock pool.

Assets within the Towradgi division are presented in Figures 51, 52 and 53 of Appendix C2. The beach erosion and shoreline recession hazard is of most concern in this division, and the assets exposed to that hazard are mostly contained at the northern end of the beach. There are inundation threats expected to arise in future at the northern end of the Towradgi arm, affecting significant areas of residential settlement.

Figure 90 Towradgi Division Locality

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Figure 91 Northern end of Towradgi Beach (May 2024).

Figure 92 View southward along Towradgi Beach (May 2023, image courtesy of Wollongong City Council).

5.21.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for Towradgi is provided in Table 44. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E).

Table 44 Consolidated Risk Profile for Towradgi

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Low	Low	Low	Low
	Cliff and Slope Instability (Threatened)	Low	Low	Low	Low
	Coastal Inundation (Losses)	Low	Low	High	High
	Tidal Inundation (Losses)	Low	Low	Low	Moderate
Transport	Losses due to Erosion / Recession	High	High	High	Extreme
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Moderate
	Tidal Inundation	Low	Moderate	High	Extreme
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Moderate	Moderate	Moderate	High
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Moderate
	Tidal Inundation	Low	Low	Low	Low
Private Buildings	Losses due to Erosion / Recession	Low	Moderate	Moderate	Extreme
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	High
	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	Low	Low	Low	Moderate
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Moderate	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	Low	Low	Low	High
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Extreme
	Tidal Inundation	Low	Low	Low	Moderate
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		0	0	0	0

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 45.

In addition to those risks, ecological assets are not expected to be significantly threatened by coastal hazards over a one hundred year timeframe.

Table 45 Key Risks: Towradgi

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-20-01	High: 2025+	**Asset Group: Transport** **Hazards of Concern: Beach Erosion and Shoreline Recession** The state of the protective structure to the south of the rock pool remains unknown and the capability of that structure to protect the coastal cycleway and associated infrastructure remains uncertain. An audit and collation of details of the structures should be undertaken to determine whether this risk is worth considering further, and maintenance of the seawall revetment structure completed promptly following any damage.

5.22 Fairy Meadow

5.22.1 Features

The Fairy Meadow division extends 1.6 km from the south end of the Towradgi division to just north of the Fairy Creek entrance at its southern end. Fairy Meadow Beach faces east, and the division is shown in Figure 93.

Waves decrease to 1m toward the southern end of the beach compartment. There is usually a single bar with up to seven rips spaced 200m apart, with the rips increasing in size and intensity with distance south along the beach. The bar is typically attached during periods of smaller waves, particularly at the southern end, with larger waves producing a continuous trough and rip feeder currents. At the southern end of the beach there is a strong, permanent rip against the rocks near the entrance to Fairy Creek (Short, 2007).

The entire beach is backed by vegetated dunes that are backed by a now drained back barrier swamp (Short, 2007). Towradgi Arm, which connects to Fairy Creek at the southern end of the beach, also runs parallel to the coastline within this division for its entire length.

The beach is characterised by wide, low dunes. Fairy Meadow SLSC is located approximately 1.2km south of Towradgi SLSC. The Fairy Meadow SLSC can be seen in the foreground of Figure 94, which shows a view southwards along this division. Puckey's Estate Reserve and the Towradgi Arm can also be seen. A view from the opposite direction, looking across the entrance to Fairy Creek and along Towradgi Arm is shown in Figure 95.

Figure 93 Fairy Meadow Division Locality

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Figure 94 View southwards along Fairy Meadow Beach and Fairy Meadow SLSC (August 2021, image courtesy of Wollongong City Council.

Figure 95 Fairy Creek and Towradgi – Fairy Meadow Beach (August 2021, image courtesy of Wollongong City Council).

Recent works have been undertaken in front of the Fairy Meadow SLSC to address community concerns of dune scarping, beach amenity, and sight lines. (Wollongong City Council, 2021).

Assets within the Fairy Meadow division are presented in Figures 54, 55 and 56 of Appendix C2. The beach erosion and shoreline recession hazard is of limited concern in this division. There are inundation threats indicated along the Towradgi arm, affecting Squires Way and drainage infrastructure. The resulting impacts become more widespread in future, impacting large parts of the University of Wollongong Innovation Campus and residential areas to the north, including areas west of Thomas Dalton Park. The Montague St industrial area will also be affected by inundation via Cabbage Tree Creek in time.

5.22.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for Fairy Meadow is provided in Table 46. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion and table of key risks which follows.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 47. Ecological assets are not expected to be significantly threatened by erosion type hazards over a 100 year timeframe, but those associated with Puckey's Estate are likely to be exposed to coastal squeeze. This means that more frequent inundation will reduce the suitable area for some ecosystems between open water and areas which have been developed.

The extreme risk at 2045 due to tidal inundation indicated for transport assets was found to relate to a footbridge across a small side channel of the upper reaches of the Towradgi Arm. In the absence of specific price information, this bridge had been overpriced, and this risk is most likely overstated.

5.23 North Wollongong

5.23.1 Features

North Wollongong Beach, commonly referred to as North Beach, is to the southern side of Fairy Creek. It is around 600m long with a rock platform and Wollongong Harbour at its southern end. The North Wollongong division is shown in Figure 96. The entrance to Fairy Creek is located at the northern end of North Wollongong Beach, and the floodplain of Fairy Creek is included within the North Wollongong Beach risk assessment division.

North Wollongong Beach faces east and is protected by Flagstaff Point to the south. The beach receives waves averaging 1.2m, typically maintaining a single bar that is cut by 3-4 rips. Under normal conditions the rips are small but intensify when waves exceed 1m or during northeast swells (Short, 2007).

Table 46 Consolidated Risk Profile for Fairy Meadow

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Low	Low	Low	Low
	Cliff and Slope Instability (Threatened)	Low	Low	Low	Low
	Coastal Inundation (Losses)	Low	Low	High	High
	Tidal Inundation (Losses)	Low	Extreme	Extreme	Extreme
Transport	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	High	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Moderate	Moderate	High	High
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Moderate	Moderate	Extreme
	Tidal Inundation	Low	Moderate	Moderate	Moderate
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Moderate	Extreme
	Tidal Inundation	Low	Low	Low	High
Water / Sewerage	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		0	0	0	0

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

Table 47 Key Risks: Fairy Meadow

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-21-01	Extreme: 2045+	**Asset Group: Stormwater (Bank Protection Structures)** **Hazards of Concern: Tidal Inundation** The relates to the frequent tidal inundation and tidal currents impacting on bank protection structures along Cabbage Tree Creek. The structures are along the left bank downstream of Montague Street, and adjacent to the bridge abutments at Puckey Avenue. Inspections undertaken during this study indicate that both locations have suffered recent damage and remedial works should be considered as part of the CMP.

Figure 96 **North Wollongong Division Locality**

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Stuart Park is located behind the beach at its northern end, on the southern side of Fairy Creek, and is situated mostly below 5m AHD. This section of the beach is backed by dunes ranging from 5-7m AHD, with gabions (partly exposed by storms in 2025) under the dune. The northern section of the beach is shown in Figure 97.

Figure 97 Stuart Park, North Wollongong Beach (October 2021, image courtesy of Wollongong City Council.

South of Stuart Park, to the rear of the beach, is the North Wollongong SLSC and a café, with ground elevations around 5.5m AHD. The SLSC building can be seen in the midground of Figure 99, a stepped concrete seawall was recently (2023) constructed seaward of the SLSC. The southern section of the beach is backed by an older crib-lock seawall, shown in Figure 98, stretching from the SLSC to the southern end of the beach. This section of seawall is due for replacement in 2026.

North Wollongong Beach Pavilion is located towards the southern end of the beach, also behind the seawall, and can be seen in Figure 98, Figure 99, and Figure 100. The floor elevation of the pavilion is around 4.5-5m AHD.

A wide rock platform is located at the southern end of the beach which extends into the risk division to the south.

This area forms a focal point for recreational activities and access from the Wollongong CBD to the coast. The Blue Mile shared pathway links Stuart Park to areas south of the Wollongong CBD and facilitates access of the public to the foreshore in this area.

Figure 98 Seawall along North Wollongong Beach (May 2024).

Figure 99 North Wollongong Beach (June 2020, image courtesy of Wollongong City Council).

Figure 100 North Beach Pavilion, North Wollongong Beach (June 2020, image courtesy of Wollongong City Council).

Assets within the North Wollongong Beach division are presented in Figures 57, 58 and 59 of Appendix C2, for Built Assets (buildings, stormwater, and transport), Open Space and Recreation, and Ecological Assets, respectively. Presently threatened assets are mostly confined to the area between the beach and the cliffs/dunes backing the coastline to the south of Fairy Creek. Our assessment assumes that the seawalls to the rear of the beach could fail although this may be unlikely. We have not verified the state of the seawalls as part of our assessment.

Some assets at the upper tidal reaches of Fairy Creek are also presently threatened by coastal inundation. In future, the risks from coastal inundation become more concerning, across much of the low-lying floodplain area of Fairy Creek, including all of Stuart Park, residential properties adjacent to the creek and light industrial development along Montague Street and Ralph Black Drive.

5.23.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for North Wollongong Beach is provided in Table 48. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion and table of key risks which follows.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 49.

In addition to those risks, it is expected that some of the RH SEPP mapped coastal wetland, associated with Fairy Creek, will be lost through beach erosion and/or watercourse entrance instability.

There are no identified, coastal hazard related risks to EEC's or littoral rainforest within the North Wollongong division. An extreme risk level, arising from coastal cliff and slope instability, is indicated by 2045, for open space/recreation assets, including the Pavilion and SLSC building. However, they are located seaward of the cliff, and considering the height and available space to the rear of these buildings, this risk is not considered to be a key concern.

The heavily utilised length of North Wollongong Beach, to the south of the SLSC building, has the potential to increasingly narrow with time, as sea levels rise. As it sits below the cliff along Cliff Road (or bound by the seawall if it remains in future), there is potential for the beach to be squeezed out of existence over time due to sea level rise.

Table 48 Consolidated Risk Profile for North Wollongong Beach

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	High	High	High	High
	Cliff and Slope Instability (Threatened)	Low	Moderate	High	High
	Coastal Inundation (Losses)	Low	Low	Low	Extreme
	Tidal Inundation (Losses)	Low	Extreme	Extreme	Extreme
Transport	Losses due to Erosion / Recession	Extreme	Extreme	Extreme	Extreme
	Cliff and Slope Instability	High	Extreme	Extreme	Extreme
	Coastal Inundation	Low	High	High	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Open Space / Recreation (Built)	Losses due to Erosion / Recession	High	High	High	High
	Cliff and Slope Instability	High	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Moderate	Moderate	Extreme
	Tidal Inundation	Low	Low	Low	High
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Extreme
	Tidal Inundation	Low	Low	Low	Extreme
Water / Sewerage	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Moderate
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.137	0.142	0.154	0.177
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		27	29	34	43

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

Table 49 Key Risks: North Wollongong

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-22-01	Extreme or High: 2025+	**Asset Group: Transport (Seawall), Stormwater and Open Space/Recreation** **Hazards of Concern: Beach Erosion and Shoreline Recession** Protective structures throughout this section, including those protecting the pavilion and SLSC building, and the (mostly buried) gabion/reno mattress structure at the back of the beach fronting Stuart Park, are indicated as potentially lost due to beach erosion and/or shoreline recession. This risk would only arise if those structures failed. Should the southernmost, more formal structures fail, this could well result in the loss of: • Stormwater pipes and pits. • The Pavilion and SLSC buildings. An audit and collation of details and structural audit where necessary (noting that some of the structures are relatively new and more likely to be robust), should be undertaken to determine whether this risk is worth considering further, and maintenance of the seawall structures completed promptly following any damage.
CH-22-02	Extreme: 2045+	**Asset Group: Stormwater (Bank Protection)** **Hazards of Concern: Tidal Inundation** Within the upper reaches of Fairy Creek, there are several locations of bank support structures which will become increasingly impacted by tidal inundation. These will need to be audited to confirm that they are designed to withstand the additional tidal inundation. If so, this risk is not an issue.
CH-22-03	High: 2025, Extreme: 2045+	**Asset Group: Transport** **Hazards of Concern: Coastal Cliff and Slope Instability** Parts of the roadway of Cliff Rd and associated car parking are presently within the cliff and slope instability hazard zone. Based on information provided during the present study, it is expected that the stability of this slope has been assessed thoroughly. This should be confirmed with Council's geotechnical engineers.
CH-22-04	Extreme: 2045+	**Asset Group: Transport** **Hazards of Concern: Coastal Inundation and Tidal Inundation** This covers bridges along Fairy Creek and Towradgi Arm (including boardwalk bridges) which may be increasingly inundated by high tides and coastal storm inundation in future. The elevations of these bridges should be checked.

5.24 Wollongong Central

5.24.1 Features

The Wollongong Central Division extends south from North Wollongong Beach, along the Blue Mile to Belmore Basin (Wollongong Harbour) and includes Flagstaff Point, with its southern extent located at the northern end of Wollongong City Beach. The locality of this division is shown in Figure 101.

Between North Wollongong Beach and the southern breakwater of the harbour, the seawall protected Blue Mile pathway is elevated, to the rear of a rock platform, and in front of a coastal bluff which carries Cliff Road at its crest (Figure 102).

Along this length of the shoreline, there are two pools – the formal, Continental Ocean Pool, immediately north of the breakwater and protected on its ocean side by a raised seawall, and the less formal Gentlemen's Pool a little further north (Figure 103). The Gentlemen's Pool is hewn directly into the rock platform here, with an aging concrete wall marking its landward edge. With the platform having typical elevations between 0.1-0.3 m AHD, this pool could expect to be particularly exposed for much of the time. The Gentlemen's Pool is around 35m long, and 20m wide and was one of the earliest constructed pools in the Wollongong region.

Wollongong Harbour, also known as Belmore Basin, is situated on the western side of Flagstaff Hill and is enclosed by breakwalls on its northern and northeastern sides, as shown in Figure 101. Within the harbour lies Belmore Beach, also referred to as Cove Beach, which stretches for 380m along the southwestern side of the harbour. The beach faces east at its northern end and curves to face north at its southern end. Wave exposure is reduced on account of the narrow 50m wide gap between the breakwaters.

The northern half of Belmore Beach features a rock outcrop and grassed area at the back of the beach which is backed by a seawall. The Blue Mile pathway continues along the entire length of the beach, with Cliff Road located landward. This northern section of the beach is shown in Figure 105. That figure also shows a large stormwater outlet which is located towards the middle of the beach, draining low-lying areas to the west of Cliff Road.

Along the southeastern half of the beach, the back of the beach along the Blue Mile Pathway has been stabilised using reno mattresses and vegetation. Behind the pathway in this section is a grassed area known as Brighton Lawn Reserve, along with a playground and a café. The full length of the beach, captured from its southern end, is shown in Figure 106. A car park is situated at the southeastern end of the beach, with a jetty extending northwest from the end of the car park, running parallel to the beach.

Figure 101 Wollongong Central Division Locality

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Figure 102 Seawall Fronting Blue Mile Shared Pathway, Looking South Towards North Wollongong Beach

Figure 103 Rock platform at the southern end of North Wollongong Beach. Gentlemen's Pool to left, Continental Pool to Right (May 2024).

Figure 104 Wollongong Harbour (June 2020, image courtesy of Wollongong City Council).

Figure 105 Northern section of Belmore Beach, Wollongong Harbour (May 2024).

Figure 106 View northwards along Belmore Beach, Wollongong Harbour (May 2024).

The rock platform at the base of Flagstaff Hill is home to two of the oldest ocean pools in the Wollongong LGA. Accessible from Flagstaff Hill, the Nuns Baths, known originally as 'Ladies Chain Baths' or 'Lovers Cove', is a secluded ocean pool accessible only down a steep rocky path. It is one of the oldest ocean pools in Australia, with usage dating from 1829. The pool is 20m long and 10m wide and features a simple retaining wall to capture water at low tide. Wollongong Ladies Baths, now referred to as Wollongong Head Lighthouse Rockpool was excavated and enclosed on the rock platform around the corner from the Nuns Baths in 1887. The pool is 20 m long and 8 m wide and is accessible from a steep staircase on the headland or by walking across the rocky platform from the northern end of City Beach.

Within Wollongong Harbour, the northern and southern breakwalls and marine assets within the harbour southeast of the southern breakwater (wharves, seawalls, slipways, roads) are owned by Transport for NSW. Commercial premises at the Fishermans Coop, including restaurants and cafés, are leased to private concerns. The Brighton Lawn Reserve, the beach, Blue Mile pathway, and associated playground and commercial premises are the responsibility of Wollongong Council.

Assets within the Wollongong Central division are presented in Figures 60, and 61 of Appendix C2 for Built Assets (buildings, stormwater, and transport), and Open Space and Recreation, respectively. No key ecological assets are mapped in the vicinity of this Division. Importantly this assessment does not include the harbour based assets managed by TfNSW.

Most of the shoreline is either rocky or protected by extensive seawall structures and breakwaters. Of note is that there is an indicated threat from inundation which extends south and east from Belmore Beach, into the low-lying area drained by a large rectangular stormwater culvert. Risks arising from this are partly captured within the discussion on the City Beach Division provided in the next section.

5.24.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for the Wollongong Central division is provided in Table 50. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the following discussion and tables.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 51.

5.25 Wollongong City Beach

5.25.1 Features

Wollongong City Beach, shown in Figure 107, spans approximately 2.8km from Flagstaff Hill in the north to the revetment and groyne fronting NSW Ports land at Port Kembla to the south. The southern end of the beach is also known as Coniston Beach.

Wollongong City Beach experiences average wave heights of 1.5m, which generate up to twenty rips. Typically, this includes three rips between Flagstaff Point and the SLSC at the northern end of the beach, and rips spaced every 200m for the remainder of the beach. Under normal conditions there is a single bar between rips (Short, 2007).

The beach is backed by vegetated dunes that are wider and taller at the northern end of the beach and are lower towards the south. Dune vegetation was established in the mid-1980s and has spread seawards over time. There are no creeks present along the beach. Management interventions have included clearing and re-vegetating the three bays of vegetation in front of the SLSC, at the northern end of the beach, in the early 2000s. Additionally, following storm events, steep scarps can form in the north which have occasionally been manually slumped using machinery. Ongoing dune management efforts focus on establishing low-growing species (Wollongong City Council, 2021).

Table 50 Consolidated Risk Profile for Wollongong Central

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Moderate	Moderate	Moderate	High
	Cliff and Slope Instability (Threatened)	Low	Moderate	High	High
	Coastal Inundation (Losses)	Low	Low	Low	Low
	Tidal Inundation (Losses)	Low	Low	Low	Moderate
Transport	Losses due to Erosion / Recession	Extreme	Extreme	Extreme	Extreme
	Cliff and Slope Instability	High	Extreme	Extreme	Extreme
	Coastal Inundation	Low	High	Extreme	Extreme
	Tidal Inundation	Low	Low	Extreme	Extreme
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Extreme	Extreme	Extreme	Extreme
	Cliff and Slope Instability	High	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Low	Low	Extreme
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	Extreme	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Moderate	Moderate	High	Extreme
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		0	0	0	0

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

Table 51 Key Risks: Wollongong Central

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-23-01	Extreme: 2025+	**Asset Group: Transport, Open Space/Recreation, Water/Sewerage** **Hazards of Concern: Beach Erosion and Shoreline Recession** Qualitatively, protective structures throughout the division seem robust. However, it is essential that these are monitored and maintained so that they continue providing protection to assets such as the sewer pressure main through this area, pathways, park furniture, buildings, and reserves. An audit and collation of details of the structures should be undertaken to determine whether this risk is worth considering further, and maintenance of the seawall revetment structure completed promptly following any damage.
CH-23-02	High: 2025, Extreme: 2045+	**Asset Group: Transport, Open Space/Recreation** **Hazards of Concern: Coastal Cliff and Slope Instability** Significant assets are indicated as being threatened by coastal cliff and slope instability. Areas of roadway, including Cliff Road above the Blue Mile at the northern end of the division, Endeavour Drive above Wollongong Harbour, and the Car Park at the northern end of City Beach are all indicated as threatened. Similarly, pathways, retaining structures, seawalls, and the buildings at Continental Pool could be threatened if the cliff above them collapses onto those assets. The density of assets and high usage of this area make this a key risk through the area. Noting the level of site specific geotechnical investigation provided to us for the purpose of coastal hazard definition, we expect that Council understands these risks well. This should, however, be confirmed.
CH-23-03	Extreme: 2045+	**Asset Group: Private Buildings and Open Space/Recreation (Public Buildings)** **Hazards of Concern: Coastal Inundation** Coastal inundation results in low risk levels to buildings at present but is projected to result in high to extreme risks by 2045, so some action is required. Assets expected to be impacted include: • Buildings associated with the continental pool and the kiosk in Brighton Lawn Reserve. • The Osborne Park Amenities/Storage Building. • Park shelters in Brighton Lawn Reserve and in Osborne Park. • Residences adjacent to the low (sag) points along Cliff Road and Wilson St. • Low lying development either side of the low point along Wilson St, Between Smith St and Campbell St. The central location and relatively imminent threat posed by coastal inundation through this area, particularly noting that it is not presently considered a high risk, indicates that this area should be a candidate for local adaptation planning as an action within the CMP.

Figure 107 Wollongong City Beach

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The Wollongong City Beach SLSC (City Beach Function Centre) and a lifeguard tower are located at the northern end of the beach and can be seen in Figure 108. Lang Park, a large, grassed area with playground and a carpark, are located behind the dune at the north end of the beach. To the south of the park is WIN Stadium, with ground elevation around 6.3m AHD. The dune in front of the stadium has elevations between 7-8.5m AHD and is notably narrower in this location compared to the northern section of the beach. This beach section in front of the stadium is shown in Figure 109.

Most of the land behind the beach from WIN Stadium to the southern end of the division is occupied by Wollongong Golf Course. The golf club and nearby commercial and residential streets are almost entirely below 3m AHD. The dune in front of this area ranges from around 4-7m AHD and appears to be particularly degraded in front of the golf course. The Wollongong wastewater treatment/recycling plant is located to the south of the golf course, with ground elevations between 3.2-5.2m AHD.

Assets within the Wollongong City Beach division are presented in Figures 62, 63 and 64 of Appendix C2. Notably, parts of the eastern edges of WIN Stadium are threatened by beach erosion at present, and the extent of this threat is expected to move inland over time.

Figure 108 Northern end of Wollongong City Beach (June 2024, image courtesy of Wollongong City Council).

Figure 109 View southwards along Wollongong City Beach, in front of WIN Stadium (May 2024).

Coastal inundation threats are expected to increase markedly over time. With high amounts of sea level rise, which could occur by 2125, the extent of inundation threat extends across almost the entire golf course, with that threat emerging from both the open coast and through connectivity along the Gurungaty Waterway via Port Kembla. Tidal inundation also extends west of Corrimal St/Springhill Road, causing inundation of property along Tate and Bridge Streets, and developed areas to the west of the golf course (between Corrimal St and Church Street).

5.25.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for Wollongong City Beach is provided in Table 52. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E. The key risks for Wollongong City Beach are summarised in Table 53.

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Table 52 Consolidated Risk Profile for Wollongong City Beach

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Low	Low	Low	Low
	Cliff and Slope Instability (Threatened)	Low	Low	Low	Low
	Coastal Inundation (Losses)	Low	Moderate	Moderate	Moderate
	Tidal Inundation (Losses)	Low	High	High	High
Transport	Losses due to Erosion / Recession	Low	Low	Moderate	High
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	High	High	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Open Space / Recreation (Built)	Losses due to Erosion / Recession	Moderate	Moderate	High	High
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Moderate	Moderate	High
	Tidal Inundation	Low	Low	Low	Moderate
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Low	Low	Extreme
Water / Sewerage	Losses due to Erosion / Recession	High	High	High	Extreme
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Extreme
	Tidal Inundation	Low	Low	Low	Extreme
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Low	Moderate	High
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		0	0	0	0

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

Table 53 Key Risks: Wollongong City Beach

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-24-01	High: 2045+	**Asset Group: Stormwater** **Hazards of Concern: Tidal Inundation** Tidal inundation impacts on stormwater assets are expected to become more intense and frequent over time. Most stormwater assets are resilient to inundation. The assets identified are located upstream on Gurungaty Waterway, adjacent to Swan Street and comprise channel linings and a flood diversion mound. These should be assessed to confirm the suitability of their design considering tidal inundation.
CH-24-02	Extreme: 2045+	**Asset Group: Transport** **Hazards of Concern: Coastal Inundation and Tidal Inundation** The road crossings (Bridges/Culverts) of the Gurungaty Waterway at Swan Street and Springhill Road will increasingly experience coastal and tidal inundation, originating from Port Kembla. These road crossings should be checked to ensure they retain their required hydraulic capacity and clearance given future conditions.
CH-24-03	Extreme: 2045+	**Asset Group: Private Buildings** **Hazards of Concern: Coastal Inundation** By 2045, there are two residential areas in the Wollongong City Beach division which are expected to see increased inundation to an extent where continued occupation may become problematic. These are: • The area north of Swan Street, west of Corrimal Street, then roughly diagonal between Corrimal Street/Bank Street and Swan Street/Evans Street (coastal inundation via Port Kembla). • The area north of Smith Street, Between Wilson Street and Corrimal Street. Beyond 2045, the extent of problems will increase further. More detailed assessment and adaptation planning may be a suitable management action for these localities.
CH-24-04	High: 2025 +	**Asset Group: Water/Sewerage** **Hazards of Concern: Beach Erosion and Shoreline Recession** The outfall pipelines for the wastewater treatment plant at Wollongong are indicated as being exposed to beach erosion. However, it seems likely that these have been designed to withstand the effects of erosion, considering their locality. Sydney Water should confirm that this is the case.

5.26 Hill 60– Red Point

5.26.1 Features

This division is the first south of Port Kembla. Land within the port of Port Kembla is not included in the CMP and risks have not been assessed there. A locality plan for the division is shown in Figure 110.

At the most northern extent of the division is MM Beach, named for the company which still manufactures pipes at the southern end of the beach. Landward of MM Beach, the roadway (Gloucester Boulevarde) is captured within the risk assessment, although most development on the western side of the road is within Port lands and excluded from the risk assessment. Notably, one property at the most northern extent (north of Darcy Road) is included. That property is presently used to manufacture green hydrogen.

MM Beach, also known as North Beach, is a 1km long pocket beach situated immediately south of Port Kembla. MM Beach faces east and is sheltered, receiving protection from Red Point, Big Island and Martin Islet located to the southeast. The beach receives average waves of less than 1m, resulting in a reflective beach that is typically free from rips (Short, 2007). The northern end of the beach is marked by a rocky point approximately 350m south of the Port's southern breakwall (Figure 111). The beach terminates at Boilers Point (Figure 112) at its southern end, which separates MM Beach from Fishermans Beach.

Rock platforms are located at the northern and southern ends of the beach. The beach is backed by narrow vegetated dunes. The southern end of the beach, shown in the right-hand side of Figure 112, is a narrow strip of sand fronted by a 50m wide rock platform.

Fishermans Beach, shown in Figure 113, is a 600m long pocket beach situated between Boilers Point and Red Point, at the base of a steep hill known as Hill 60. The beach faces northeast and receives average waves of 0.5m. The beach is usually steep and reflective, with a rock platform present offshore towards the southern end (Short, 2007).

The Red Point headland, at the southern end of Fishermans Beach, is occupied by the Port Kembla Wastewater Treatment Plant, shown in Figure 113. At the southernmost extent of this division, residential property along Dovers Drive faces south over the cliffs of Red Point (Figure 114).

Figure 110 Hill 60 – Red Point Division Locality

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Figure 111 MM Beach (May 2024).

Figure 112 Boilers Point, between Fishermans Beach (left) and MM Beach (right, May 2024).

Figure 113 Red Point and Fishermans Beach (May 2024).

Figure 114 Cliff Top Residences, Southern Red Point (May 2024)

Assets within the Hill 60 - Red Point division are presented in Figures 65 and 66 of Appendix C2, for Built Assets (buildings, stormwater, and transport) and Open Space and Recreation Assets, respectively. Threats from coastal hazards are primarily related to the Wastewater Treatment Plant at Red Point and assets behind MM Beach, which are threatened by beach erosion.

5.26.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for Hill 60 – Red Point is provided in Table 54. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion and table of key risks which follows.

Table 54 Consolidated Risk Profile for Hill 60 – Red Point

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Moderate	Moderate	Moderate	High
Stormwater	Cliff and Slope Instability (Threatened)	Low	Moderate	Moderate	High
Stormwater	Coastal Inundation (Losses)	Low	Low	Low	Low
Stormwater	Tidal Inundation (Losses)	Low	Low	Low	Low
Transport	Losses due to Erosion / Recession	Extreme	Extreme	Extreme	Extreme
Transport	Cliff and Slope Instability	High	Extreme	Extreme	Extreme
Transport	Coastal Inundation	Low	Low	Low	High
Transport	Tidal Inundation	Low	Low	Low	Moderate
Open Space / Recreation (Built)	Losses due to Erosion / Recession	High	High	High	High
Open Space / Recreation (Built)	Cliff and Slope Instability	Moderate	High	Extreme	Extreme
Open Space / Recreation (Built)	Coastal Inundation	Low	Moderate	Moderate	Moderate
Open Space / Recreation (Built)	Tidal Inundation	Low	Low	Low	Low
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
Private Buildings	Cliff and Slope Instability	Moderate	Extreme	Extreme	Extreme
Private Buildings	Coastal Inundation	Low	Low	Low	Low
Private Buildings	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	Low	Moderate	Moderate	High
Water / Sewerage	Cliff and Slope Instability	Moderate	High	Extreme	Extreme
Water / Sewerage	Coastal Inundation	Low	Low	Low	Low
Water / Sewerage	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Coastal Inundation	Low	Extreme	Extreme	Extreme
Open Space /Recreational Lands	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	Moderate	High	Extreme	Extreme
Private Lands	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
Private Lands	Coastal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Tidal Inundation	Low	Extreme	Extreme	Extreme
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
Ecology	EEC Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Ecology	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
Ecology	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		6	7	13	26

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 55. There are no mapped, key ecological assets within the Hill 60 – Red Point Division. The "High" risk indicated for all time frames, related to open space / recreation losses from beach erosion and shoreline recession is related to a single asset within the database used for analysis, which had no information attached. Considering the location of that particular asset, it seems unlikely that it is associated with any significant risk.

Table 55 Key Risks: Hill 60 – Red Point

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-25-01	Extreme: 2025+	**Asset Group: Transport** **Hazards of Concern: Beach Erosion and Shoreline Recession** Erosion is indicated as presenting an extreme risk to transport assets at present. This relates to the undermining of assets associated with Gloucester Boulevarde with part of the road towards the north of MM Beach indicated as being exposed. Behind the southern end of MM Beach, the footpath on the Eastern side of Gloucester Boulevarde is threatened. A plan to protect Gloucester Boulevarde could be considered, involving the installation of a terminal seawall. However, responsibility may well need to be discussed with NSW Ports. As part of this, the potential loss of MM Beach through coastal squeeze needs to be considered.
CH-25-02	High:2025, Extreme: 2045+	**Asset Group: Transport** **Hazards of Concern: Coastal Cliff and Slope Instability** Assets around Hill 60 are potentially affected by coastal cliff and slope instability hazards. These include the roadway leading to the wastewater treatment plant and the car park at Hill 60. The threat to these assets should be considered by Council to determine whether mitigative action is required.
CH-25-03	Extreme: 2045+	**Asset Group: Private Buildings** **Hazards of Concern: Coastal Cliff and Slope Instability** The landward extent of some clifftop residences along the southern edge of Red Point sits within the coastal cliff and slope instability hazard area. It seems likely that these residences are risk free, but robust planning controls for future development should be maintained.

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-25-04	High: 2025+	**Asset Group: Water / Sewerage** **Hazards of Concern: Coastal Inundation and Tidal Inundation** The Port Kembla Wastewater Treatment Plant sits in a highly exposed location. While it is indicated as threatened by coastal cliff and slope instability hazards, this is likely less of a concern than inundation of the facility which was not captured by our risk assessment as the assets owned by Sydney Water in this facility were not included in the dataset supplied to us. Accordingly, this risk has been adjusted. Noting the importance of this infrastructure, Sydney Water should undertake a detailed assessment of risks arising from overtopping and the robustness of protective structures.
CH-25-05	High: 2045+	**Asset Group: Open Space / Recreation** **Hazards of Concern: Coastal Cliff and Slope Instability** The marine rescue facility at Hill 60 is indicated as being potentially at risk from coastal cliff and slope instability hazards. Whether or not this is a real concern should be investigated, using site specific geotechnical data.

5.27 Port Kembla Beach

5.27.1 Features

The beach embayment extending from Red Point to entrance of Lake Illawarra spans 6.5km, comprising Port Kembla beach at the northern end, Perkins Beach in the middle, and Windang Beach at the southern end. The Port Kembla Beach division covers the northern 3.8 km of this embayment. A locality plan is shown in Figure 115. While some of the area around the foreshores of Lake Illawarra is shown, risks emanating from the lake side are not considered here and are managed under a separate CMP.

At Port Kembla, the beach faces southeast curving gradually around to more easterly with distance south. The beach is dominated by persistent and often strong rips every 200-300m. A permanent rip exists against the northern headland, and there are up to 3-4 rips present within the patrolled area at Port Kembla Beach. Sandbars between rips alternate between being attached to the shore following periods of lower wave activity and detached during higher wave events.

The entire beach is backed by vegetated dunes that are highest at the northern end, with very wide, flatter dunes towards the south. In the 1930s-1940s, the dunes actively extended hundreds of metres inland (Short, 2007). Presently, the dunes are backed by Port Kembla SLSC and car park, Coomaditchy Lagoon Reserve, and an industrial area behind Port Kembla Beach, and Port Kembla Golf Course behind Perkins Beach. Dune vegetation was established in the mid-1980s and has spread seawards over time (Wollongong City Council, 2021).

Figure 115 Port Kembla Beach Division Locality

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The northern end of Port Kembla Beach is shown in Figure 116. Port Kembla Pool is situated on the rocks at the northern end of the beach. The Port Kembla SLSC and a viewing platform are present above the dunes towards the northern end of the beach, shown in Figure 117. Port Kembla Beach has always been subject to substantial sand drift, primarily because of windblown transport, particularly when winds approach from the south and are funnelled landwards of Hill 60. This can result in significant maintenance issues with sand migrating onto paths, roads and pool infrastructure at the northern end of the beach, and preventing access to ground-level buildings. Examples are shown in Figure 118 and Figure 119. Recent management interventions in this area include beach scraping and reprofiling to clear access for deployment of lifesaving equipment, with ongoing maintenance scraping of accessways (Wollongong City Council, 2021). While notable at this location the sand drift issue is not one of the coastal hazards identified in the *Coastal Management Act 2016*, and for that reason, associated risks are not discussed here.

Assets within the Port Kembla Beach division are presented in Figures 67, 68 and 69 of Appendix C2, for Built Assets (buildings, stormwater, and transport), Open Space and Recreation Assets, and Ecological Assets respectively. Threats from coastal hazards are relatively benign, except perhaps for some concentration near the northern (Port Kembla) end. While ecological assets are presented on Figure 69 of Appendix C2, these are mostly well clear of the future vulnerability area associated with open coast hazards and therefore are not considered here. The one exception is a small area of coastal wetland, apparently associated with a perched dune swamp, near the southeastern corner of the light industrial development at Kemblawarra.

Figure 116 Northern end of Port Kembla Beach (May 2024).

Figure 117 View towards the south along Port Kembla – Perkins Beach (2021, image courtesy of Wollongong City Council).

Figure 118 Wind-blown sand blocking a building at Port Kembla Beach (February 2022).

Figure 119 Wind-blown sand across path behind Port Kembla Beach (July 2022).

5.27.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for Port Kembla Beach is provided in Table 56. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E).

With a focus on risks which have a high or extreme rating, either at present (2025) or by 2045, key risks which should be addressed by the CMP are summarised in Table 57. The loss of land containing dunes, due to beach erosion and shoreline recession is captured as an issue (for open space/recreation). However, given the space available landward for migration, it is expected that the dunes will continue to exist, albeit in a further landward location and this risk level has been reduced.

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Table 56 Consolidated Risk Profile for Port Kembla Beach

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Moderate	Moderate	Moderate	High
	Cliff and Slope Instability (Threatened)	Low	Low	Low	Low
	Coastal Inundation (Losses)	Low	Low	Low	Low
	Tidal Inundation (Losses)	Low	Low	Low	Low
Transport	Losses due to Erosion / Recession	High	High	High	High
	Cliff and Slope Instability	Low	Low	Low	Moderate
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Open Space / Recreation (Built)	Losses due to Erosion / Recession	High	High	High	Extreme
	Cliff and Slope Instability	Low	Low	Moderate	Moderate
	Coastal Inundation	Low	High	High	Extreme
	Tidal Inundation	Low	Moderate	Moderate	Moderate
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Moderate
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Extreme	Extreme	Extreme
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Low	Low	High
Private Lands	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Extreme
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		1	1	3	11

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

Table 57 Key Risks: Port Kembla Beach

Risk Number	Risk Level / Timeframe	Description / Discussion
CH-26-01	High: 2025+	**Asset Group: Transport, Open Space/ Recreation** **Hazards of Concern: Beach Erosion and Shoreline Recession, and Coastal Inundation** A protective structure (seawall and promenade) is present around the paved area to the south and west of the Ocean Pool at Port Kembla. This is indicated as potentially lost due to beach erosion and/or shoreline recession, but this seems unlikely in the near timeframe. This structure protects several open space assets including buildings associated with the pool. These are indicated as threatened by coastal inundation by 2045. Noting the importance of this structure, an audit and collation of details of the structure should be undertaken to determine whether this risk is worth considering further. Maintenance of the seawall structure should be completed promptly following any damage.

5.28 Windang Beach

5.28.1 Features

The Windang Beach division covers the southern 3.0km of the broader Port Kembla-Windang embayment, terminating at the northern breakwater at the entrance to Lake Illawarra. A locality plan is shown in Figure 120. While some of the areas around the foreshores of Lake Illawarra are shown, including areas within the entrance channel, risks emanating from the lake side are not considered here and are managed under a separate CMP.

With distance south, the beach within the embayment continues to curve from facing south of east at the northern end of this division, to facing east, adjacent to the breakwater. This southern section receives smaller waves than the northern section, however, is still dominated by rips with attached bars typically present between rips. The lake entrance was trained in the 2000's with twin breakwalls on either side of the entrance.

Towards the southern end of the beach, Windang SLSC (Figure 121) is located behind the dune on land with elevation around 5m AHD. The breakwater and the southern section of Windang Beach are shown in Figure 122. Within that figure, the suburb of Windang, which is located some 250m landward of the back of the beach, can be seen in the background.

Figure 120 Windang Beach Division Locality

Wollongong CMP Stage 2 - Coastal Hazard Risk Assessment Report

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Figure 121 Windang SLSC, Windang Beach (May 2024).

Figure 122 Northern breakwall at the Lake Illawarra entrance, at the southern end of Windang Beach (May 2024).

Assets within the Windang Beach division are presented in Figures 70, 71 and 72 of Appendix C2, for Built Assets (buildings, stormwater, and transport), Open Space and Recreation Assets, and Ecological Assets, respectively. Threats from coastal hazards are benign, except perhaps for some concentration at the southern end, near the Surf Club and Windang Beach Tourist Park. While ecological assets are presented on Figure 72 of Appendix C2, these are mostly well clear of the future vulnerability area associated with open coast hazards and therefore are not considered here.

5.28.2 Summary of Risk Assessment

The consolidated coastal hazard risk profile for Windang Beach is provided in Table 58. That table presents the initial outcomes from our spatial intersection and quantification model (Appendix E) and in some cases further consideration has resulted in us reclassifying the risk. Reclassified risks are shown as hatched and further information can be found in the discussion which follows.

The risks which have a high or extreme rating, either at present (2025) or by 2045, have been considered.

The loss of land containing dunes, due to beach erosion and shoreline recession is captured as an issue (for open space/recreation). In this instance, the presence of landward development, including the Windang Beach Tourist Park and Windang itself, may hinder the evolution of the dunes in response to sea level rise. One consequence of this could be the loss of areas of EEC (Bangalay Sand Forest) to the rear of the dune, as they are squeezed out of existence between the fringe of urban development and the dune as (or if) it migrates across the landscape while adjusting to future sea level rise.

Of interest is that the low point in the dune fronting the SLSC is expected to increasingly allow overtopping waves through, potentially threatening the SLSC and landward development at the Tourist Park. However, this is not a particularly concerning risk by 2045, with the only built asset captured being the lifeguard tower (visible in both Figure 121 and Figure 122). It is expected that the resulting risks could be addressed by raising and fortifying the SLSC accessway and relocating the lifeguard tower, as required.

Table 58 Consolidated Risk Profile for Windang Beach

	Hazard	2025 Risk Level	2045 Risk Level	2075 Risk Level	2125 Risk Level
Risk Levels for Built Assets					
Stormwater	Erosion / Recession (Losses)	Low	Low	Low	Low
	Cliff and Slope Instability (Threatened)	Low	Low	Low	Low
	Coastal Inundation (Losses)	Low	Low	Low	Low
	Tidal Inundation (Losses)	Low	Low	Low	Low
Transport	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Open Space / Recreation (Built)	Losses due to Erosion / Recession	High	High	High	High
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	High	High	Extreme
	Tidal Inundation	Low	Low	Low	Low
Private Buildings	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Water / Sewerage	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Land					
Open Space /Recreational Lands	Losses due to Erosion / Recession	High	Extreme	Extreme	Extreme
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Extreme	Extreme	Extreme
	Tidal Inundation	Low	Extreme	Extreme	Extreme
Private Lands	Losses due to Erosion / Recession	Low	Low	Low	Low
	Cliff and Slope Instability	Low	Low	Low	Low
	Coastal Inundation	Low	Low	Low	Low
	Tidal Inundation	Low	Low	Low	Low
Risk Levels for Natural Assets					
Ecology	EEC Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	EEC Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Erosion / Recession (ha)	0.000	0.000	0.000	0.000
	Coastal Wetland Losses due to Cliff and Slope Instability (ha)	0.000	0.000	0.000	0.000
Stormwater Creek Length Loss (in m), Erosion/Recession		0	0	0	0

Hatching indicates that the risk calculated by the spatial intersection model is considered unreliable. Refer to text for discussion.

6 Discussion and Conclusions

6.1 Summary of Division Based Risk Assessment

In interpreting these results, it is important to note that the hazard assessment is based on adoption of a fossil fuel intensive scenario (SSP5-8.5) which results in the highest sea level rise projection of the standard scenarios presently reported by the IPCC. If follows that the future projected coastal hazards extend further inland for this scenario than it would for other scenarios which assume less future dependence on fossil fuels.

Considering the length of Wollongong Council's coastline, the present exposure to coastal hazards is relatively benign when compared to other comparable local government areas. The effort required to presently address coastal hazard related risks appears manageable, and Council is well placed to adopt a strategic approach to managing these risks in future. A strategic approach is required, noting that the risks will become more severe over time, particularly considering ongoing sea level rise.

Nevertheless, as these hazards become more intense, they may expose previously unrecognised issues in a sudden and unexpected manner. Being prepared with knowledge and a precautionary, adaptive mindset will help Council manage those emerging risks.

The division-based analysis presented in Chapter 5 demonstrates that coastal hazard risks vary across Wollongong's coastline, but several consistent themes emerge. Beach erosion and shoreline recession already present risks for transport assets, stormwater assets, and recreational reserves situated immediately behind some beaches. By 2045, these risks are projected to escalate to extreme levels in many divisions, particularly where dunes are narrow, such as Sharky Beach, and Austinmer. By 2075 and 2125, beach erosion and shoreline recession are projected to extend further inland and in some locations could threaten important infrastructure.

Coastal cliff and slope instability hazards tend to arise from more localised and acute failures (e.g. landslips, rock falls), but are still concerning. Divisions with steep bluffs, such as those in the National Park, and at Coalcliff, are notably exposed to these hazards. Natural assets are threatened in some locations, with endangered ecological communities (such as Themeda Grassland and littoral rainforest) noticeably exposed to cliff instability and erosion within the National Park. Littoral Rainforest and Themeda Grassland are projected to suffer substantial losses along the northern coastline extents, with a cumulative loss of more than 100 hectares projected by 2125.

Inundation risks arising both from coastal storm (event based) and tidal (more regular) processes, are generally low at present, but by 2045 they are projected to begin affecting significant areas of low-lying land (both public and private). By 2075 and 2125, the inundation risk is projected to become widespread, particularly in divisions with extensive low-lying land (mainly towards the southern parts of the LGA), which have more extensive coastal floodplains. Examples of this are the floodplains of Fairy/Cabbage Tree and Towradgi Creeks.

Rock pools, while intentionally exposed, face long-term viability challenges as overtopping and safety risks increase with sea level rise.

The projected loss of land to inundation and erosion hazards, enhanced by sea-level rise, represents a widespread "Extreme" future risk using the methods applied in this assessment. This partly arises as the assessment has used published residential land sale values to also value public land. The resulting risks deserve to be considered and addressed separately as these represent concerningly widespread and pervasive risks which may leave no widely acceptable management solutions when considered over multi-generational time scales. In many locations, retreat from the rising water and receding coastlines may prove to be the only practicable option for management. A strategic, informed, and adaptive approach to managing this issue should soften the impact of these risks on the community.

Beyond noting that the risks relating to the loss of land are widespread and important, these are not focussed upon further within the present discussion. The risks associated with losing land to coastal hazards is highlighted in the discussion provided for individual assessment divisions within the main body of the report.

The remaining discussion highlights those risks that may well have workable and more acceptable solutions in the short to medium term. Regardless, management solutions will need to be considered in the context of underlying land potentially becoming unusable, in future, due to the impacts of climate change.

6.2 Headline Risks

A summary table of "Headline" or critical risks across all divisions has been prepared and is presented in Table 59.

Table 59 Headline Risks

Headline Risk	Divisions Most Affected	Timeframe	Notes
Threats to roads (Lawrence Hargrave Drive, Cliff Road, Swan Street crossings)	Sharky Beach, Austinmer, Wollongong Central, Wollongong City Beach (South Wollongong)	2025–2125	Extreme risks to road connectivity and public safety
Widespread inundation of low-lying urban land	Wollongong City Beach (including South Wollongong area and Golf Course), Corrimal, Thirroul.	2045–2125	Residential occupation may become problematic; adaptation planning required

Headline Risk	Divisions Most Affected	Timeframe	Notes
Loss of Endangered Ecological Communities	Mainly cliff top and slope communities (Themeda Grassland and Littoral Rainforest) in the Royal National Park, Clifton, Scarborough-Wombarra	2045–2125	Projected losses exceeding 60 ha by 2125
Failure of protective seawalls and structures	North Wollongong, Austinmer, Little Austinmer, Wollongong Central	2025–2125	Seawall audits essential to confirm robustness. Unlikely to be an immediate concern for more recently built structures.
Exposure of wastewater and stormwater assets	City Beach, Little Austinmer, Wollongong Central	2025–2125	Sewer/water lines and outfalls (potentially) threatened by erosion and inundation. Investigation required.
Rock pool viability under sea level rise	Austinmer, Towradgi, Gentlemen's	Variable	Increasing overtopping and safety risks may render pools unusable. Consider development of adaptation plan which should involve broader considerations of filling with sand and usability.

6.3 Combined LGA Scale Risk Assessment

When considered at the scale of the entire Local Government Area, the cumulative effect of hazards becomes more apparent. Events that may be moderate at a single location, will combine to produce major or extreme impacts when viewed across the entire LGA. Several themes emerge from the overall assessment.

Transport corridors and stormwater infrastructure emerge as consistently high-value and high-risk asset classes across multiple divisions. In comparison, recreational reserves and open space lands, although less easily evaluated, have the added dimension of risks arising from the loss of social and environmental values.

By 2075 and 2125, built asset risks intensify, particularly for low-lying urban areas and critical facilities such as Wollongong's wastewater treatment plants. North Wollongong, Wollongong Central and City Beach divisions stand out as areas where inundation risks intersect with dense urban development, major recreational facilities, and critical infrastructure. This contrasts with the northern coastline and the Royal National Park, where ecological risks are more pronounced.

Current threats to private buildings (such as residences) are mostly related to potential instabilities of coastal cliffs and slope instability within the northern suburbs (broadly, between Stanwell Park and Thirroul). Further south, risks to private buildings arising from inundation during coastal storms emerge as a concern from 2045 onwards. Development within low-lying areas behind the coastline of Wollongong Harbour and City Beach, is presently exposed to overtopping and inundation through the stormwater network. Residential areas to the rear of Thirroul Beach also emerge as risks needing to be managed within a 20-year timeframe.

Unlike the risks associated with cliff and slope instability, the inundation type risks, intensified by sea level rise are projected to emerge in areas where they may well be unexpected, as there has been less historical experience. A summary of LGA-Scale themes to be considered over current and future timeframes is presented in Table 60.

In considering the risk levels outlined in Table 60, it is important to recognise that the results for different timeframes are considered cumulatively. For example, the risk level at 2125 represents the accumulation of all risks that have arisen from the present day up to and including 2125.

Table 60 Projected LGA-Scale Coastal Hazard Risk Themes

Hazard / Asset	2025 (Present Day)	2045	2075	2125
Beach Erosion and Shoreline Recession	Moderate–Extreme (localised)	Extreme (widespread)	Extreme (widespread)	Extreme (widespread)
Cliff and Slope Instability	Localised Moderate	High–Extreme	Extreme	Extreme
Coastal Inundation	Low	Moderate–High	High–Extreme	Extreme
Tidal Inundation	Low	Moderate–High	High–Extreme	Extreme
Natural Assets (EECs)	Minor losses (<1 ha)	Increasing (5–10 ha)	Noticeable (20–30 ha)	Significant (>60 ha)

6.4 Implications for Management and Planning

The findings of the risk assessment are directly relevant for Wollongong's Coastal Management Program.

In the immediate term, as soon as practicable, Council should prioritise the audit and maintenance of seawalls and protective structures, particularly at North Wollongong, Austinmer, and Thirroul. Any remaining sewer and stormwater assets exposed to erosion following robust consideration of protective structures will need to be investigated and adapted accordingly. A robust consideration of protective structures was not possible as part of the present study, as the available details on existing structures was piecemeal and unreliable at many locations. This data gap needs to be addressed.

Similarly, the hazard mapping prepared as part of this study should be made available and used to set planning controls for development in coastal areas as soon as practicable.

Local adaptation planning is required promptly for divisions with emerging inundation risks, such as pockets of concern around the Wollongong CBD, and Thirroul.

In the medium term, between 2045 and 2075, adaptation strategies will become increasingly necessary. The implications for loss of important ecological communities will need to be managed by NPWS and, to a lesser extent by Wollongong Council. Beyond 2075, there will likely be issues within the more southerly parts of the Wollongong coastline, with coastal wetlands inside the coastal creeks being squeezed between rising sea levels and urban development.

Infrastructure realignment or reinforcement should be considered for transport corridors such as some sections of Lawrence Hargrave Drive, where collapse could significantly affect travel to and from the northern suburbs of Wollongong.

In the long term, between 2075 and 2125, strategic planning will be needed for widespread inundation of low-lying urban and recreational land, particularly in areas from Bellambi and further south. Planned relocation or re-purposing of land may be required where protective structures are no longer viable. Over time, beaches, including both the sandy berm and dune system, are expected to recede or migrate landward. This may not be possible where infrastructure or residential settlement is in the way. Without making 'accommodation space' for this movement of some beaches, they will be progressively squeezed out of existence.

In summary, the risk assessment indicates that future management is likely to focus on different matters over different timeframes. This variation is presented in Table 61.

Table 61 Focus Areas for Coastal Hazard Risk Management along the Wollongong Coastline over Time

Timeframe	Focus Areas (as indicated by Risk Assessment)
2025-2045	• Adopt hazard mapping information within Council's planning system. • Seawall, rock pool, and coastal structure audit plus required maintenance/mitigation actions. • Stormwater and sewer asset investigations to check for robustness. • Local sea level rise adaptation planning at Selected Locations.
2045-2075	• More widespread sea level rise adaptation planning. • Adaptation in some areas. • Manage losses of ecological communities (National Park in particular). • Reinforcement of key transport corridors against effects of sea level rise.

Timeframe	Focus Areas (as indicated by Risk Assessment)
2075-2125	• Potential need to plan for strategic relocation of coastal assets and communities. • Re-purposing of impacted lands. • Set aside areas that allow key ecosystems to migrate in response to sea level rise.

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Appendix A Summary of Coastal Hazard Assessments

A.1 Introduction

There are seven hazards defined by the *Coastal Management Act 2016*:

a) *Beach erosion*

b) *Shoreline recession*

c) *Coastal lake or watercourse entrance instability*

d) *Coastal inundation*

e) *Coastal cliff or slope instability*

f) *Tidal inundation*

g) *Erosion and inundation of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters.*

Assessments of these hazards were completed and reported in the following studies as part of our project:

- *Wollongong Coastal Management Program Stage 2 – Inundation, Beach Erosion and Recession Study* (Jeremy Benn Pacific, 2025), covering the Beach Erosion (a), Shoreline Recession (b), Coastal Inundation (d), and Tidal Inundation (f) hazards.
- *Wollongong Coastal Management Program Stage 2 Coastal Hazard Studies – Coastal Cliff Instability Study 2025* (Tetra Tech Coffey, 2025), covering the coastal cliff and slope instability hazard (e).
- *Wollongong Coastal Management Program – Stage 2 Coastal Entrance and Estuarine Foreshore Erosion Hazard Study* (Salients, 2025a), covering the watercourse entrance instability (d) and erosion of foreshores inside creeks (g).

The methods used and outputs from these studies are summarised below. For more detail, the original studies should be consulted. This appendix presents examples of the outputs available from the component studies. Importantly, some manipulation of these outputs was undertaken to clean, combine, merge, and convert polylines to representative polygons. Those processes are outlined in the main Coastal Hazard and Risk Assessment report and were completed to facilitate the risk assessment process and to provide outputs suitable for use in Council's planning system.

The port of Port Kembla was included in the hazard assessment for coastal and tidal inundation, as required to assess the hazard extents upstream of Port Kembla. As the port of Port Kembla is not within the scope of the future CMP, a risk assessment was not undertaken for this area. However, the hazard extent information is available in the associated project outputs.

A.2 Derivation of Hazards relating to Beach Erosion and Shoreline Recession

A.2.1 Beach Erosion Methodology

Beach Erosion and Shoreline Recession hazards are most often analysed together. For present day conditions, the typical existing state of the beach is considered and the effects that storms of different sizes would have on the beach is assessed. The effect of a single storm or closely spaced set of storms is referred to as beach erosion.

The commonly adopted approach in NSW is for a "Design Storm Cut", or "Storm Demand" to be applied to a suitably representative shore normal beach profile, above mean sea level (around 0.1 m AHD at present). The assumed geometry of the beach profile following passage of a storm is illustrated in Figure A-1. A vertical erosion 'scarp' is present at the back of the beach, with a short, truncated beach slope reaching up to 2.0m above mean sea level, and an almost flat beach slope offshore, at around mean sea level. It is also assumed that passage of the storm disturbs sand at the toe of the scarp down to a depth of around 1.0m below mean sea level. This reasoning is outlined based on measurements at several NSW beaches as reported in Nielsen et al. (1992). The area seaward of the vertical scarp, is designated the *"Zone of Wave Impact"* (see Figure A-1).

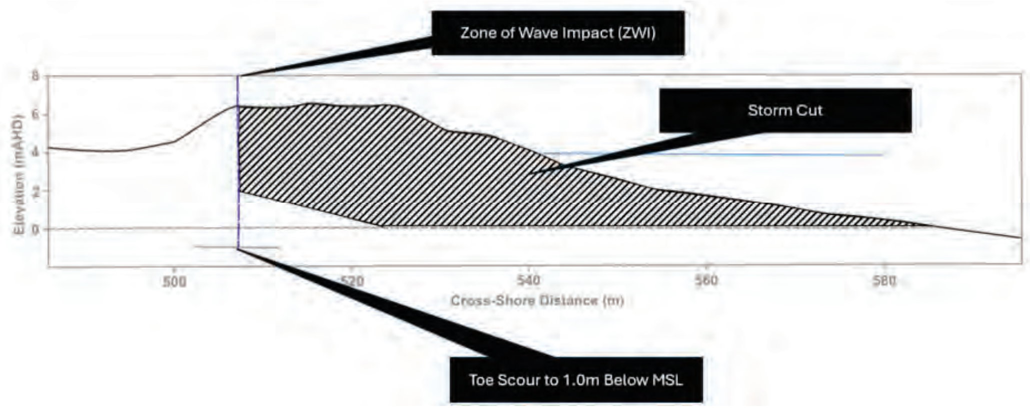

Figure A-1 Initial Removal of Sand by a Storm

Nielsen et al. (1992) also designated other "zones" that are of interest to the siting of infrastructure and the founding of buildings: The *"Zone of Slope Adjustment"* (ZSA, Figure A.2) and the *"Zone of Reduced Foundation Capacity"*(ZRFC, Figure A.3). The Zone of slope adjustment represents the location at the top of the erosion scarp once it has collapsed onto to a stable slope after drying out. That slope is typically assumed to be the angle of repose of sand (around 30 degrees for loose sand).

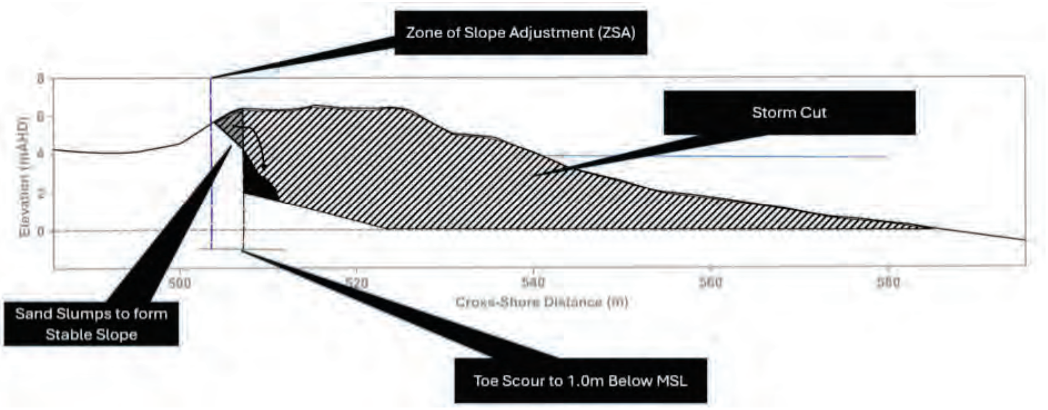

Figure A-2 Post Storm Collapse

The ZRFC represents the landward limit of the effects of beach erosion. Seaward of this location, it is assumed that development will need to take special precautions with foundations. It is customary that any buildings in this zone have foundations that extend into, and are supported by, soils within the "Stable Foundation Zone". By founding buildings in the stable foundation zone, the normal geotechnical engineering factor of safety of 1.5 is assumed to have been applied with regards to the loss of lateral support caused by erosion of the beach.

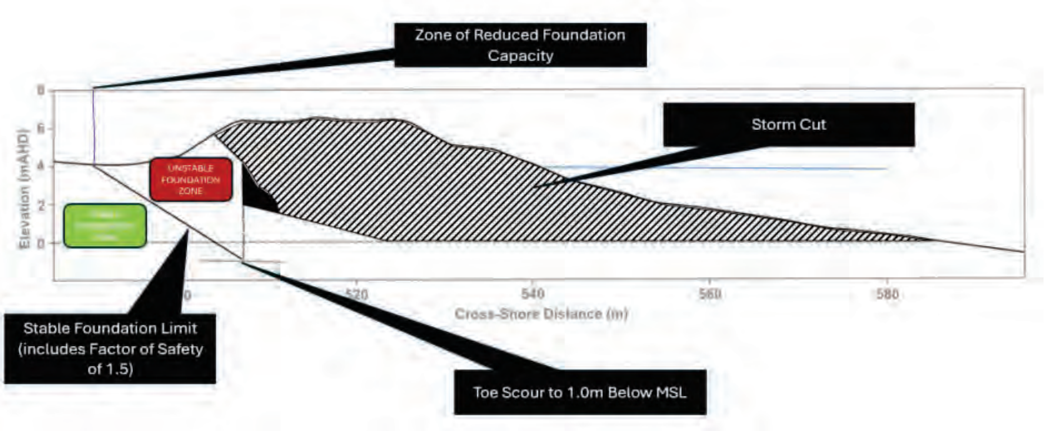

Figure A-3 Beach Erosion Effects on Landward Stability

Noting that the ZRFC includes an engineering factor of safety and is suitable for adoption in terms of planning controls, adoption of this line as representative of infrastructure or buildings that could collapse, or the loss of land that could result from beach erosion is unnecessarily conservative. In comparison, the ZSA is likely to be moderately non-conservative, given that it does not consider the most extreme condition, where collapse of the eroding beach face extends down to the full depth of toe scour. However, given mitigating factors, such as potential protection by vegetation and likelihood that building foundations extend down to some depth below the surface or that infrastructure is buried, adoption of the ZSA as a boundary where infrastructure would be lost or damaged is reasonable for the present risk assessment, where impacts are being collated and considered by localities typically covering an entire beach. If the risk to discrete pieces of infrastructure is required, more detailed examination may be considered, but this is beyond the scope of the present assessment.

One final thing to understand is that the probabilistic "Monte Carlo" modelling includes an allowance for the maximum annual beach erosion amount. The maximum beach erosion (storm cut) that will occur varies from year to year, with recovery of the beach expected between storms if the beach and/or dune being eroded is sandy. Beaches backed by rock, colluvium, a silty/clay scarp, or a combination of these require special treatment as summarised in Section A.2.3. An example *probability density function* for beach erosion is shown in Figure A-4. The erosion volumes represent (annual maximum) volume losses, compared to a "normal" accreted beach state.

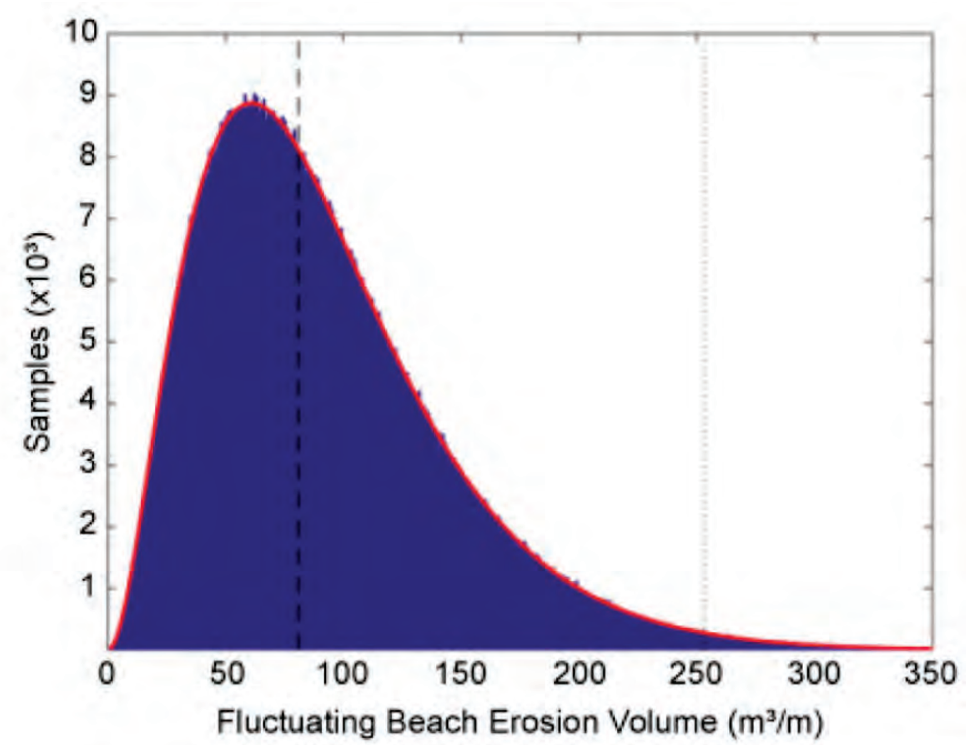

Figure A-4 Distribution of Potential Short-term erosion showing 50th (dashed line) and 99th (dotted line) percentiles (right). From Kinsela et al. (2017).

The probability density function has been scaled at different locations along the coast as part of the assessment to account for reduced wave energy at the beach by the following factors:

- Protection from ocean waves based on broader offshore sheltering of the beach (to the 10m depth contour).
- Nearshore exposure, where the impact of rocky headlands, platforms, and reefs closer to shore (inshore of 15m depth contour) were considered.
- The presence of exposed rock within the intertidal zone.

A.2.2 Shoreline Recession Methodology

Simple application of beach erosion in isolation is only suitable for the "Present Day" timeframe. Over coming decades, the shoreline is expected to recede, with sea-level rise expected to become the dominant factor causing that recession.

When considering future timeframes, the patterns of ongoing recession of the 'normal' shoreline location are considered initially, with the storm demand (Section A.2.1) then added to that recession to derive the hazard lines. Similarly to the storm demand, the assessment of longer-term recession considers the likelihood of sand "volumes" lost from the upper beach profile (above mean sea level). There are two main components of long term which were considered:

- The continuation of historical rates of recession.
- Enhanced recession due to sea level rise.

The rate of historical recession was derived from the DEA Coastlines dataset[10], which is based on the analysis of satellite imagery dating back to 1988. The calculated recession rates were aggregated within each beach, or beach unit where longer beaches were divided into sections for analysis. From those aggregated rates a normal probability distribution was derived from which statistical sampling could be completed.

The recession arising from sea level rise has been estimated using careful application of the "Bruun Rule" which considers that, as sea level rises, there is a 'demand' for sand to fill the offshore beach profile to offset the rising sea level, and that demand is met from erosion of the more landward parts of the beach profile. Put simply, the entire beach profile from the dune to the offshore is translated upwards and landwards as sea levels rise.

[10] https://www.ga.gov.au/scientific-topics/dea/dea-data-and-products/dea-coastlines

One key factor for each location is the so called "Depth of Closure" which governs the distance offshore of the beach over which there is a 'demand' for sand. This required special consideration for areas such as perched beaches or areas with extensive offshore rocky reefs which limit the amount of additional sand that can be accommodated.

A.2.3 Locations Requiring Special Treatment

The approach outlined in A.2.1 and A.2.2 is reasonable for sandy beaches backed by sandy dunes, with a sandy offshore profile present to depths where the profile may alter due to sea-level rise. However, the Wollongong Coast is variable, and beaches dominated by sand are only present towards the southern end of Wollongong's coastline.

- Where materials such as clays, colluvium, or bedrock are present in the near vicinity at the rear of the beach, the amount of sand that could be eroded has been estimated based on available information. Information here is often limited and a conservative approach has been adopted where there is uncertainty.
- Once the available sand is depleted from a beach backed by clays or colluvium, storm erosion was limited, but ongoing recession was considered to continue. Locations where this method was applied include the back-beach scarp adjacent to properties on Coledale Avenue (south of Coledale Beach).
- Once the available sand is depleted from a beach backed by a bedrock foreshore, such as a cliff, it is assumed that beach erosion and shoreline recession cease. In these locations, the ultimate position of the future coastal hazard is better represented by the coastal cliff and slope instability hazard.
- The northern breakwater at the entrance to Lake Illawarra was constructed in 2007. Since that time, behaviour at the southern end of Windang Beach has been modified, and the shoreline now tends to sit further east than it did in the 1990's. While the DEA coastlines data indicates this as a pattern of accretion, care is needed as the rapid seaward movement which occurred immediately upon breakwater construction is unlikely to be sustained. The rate of shoreline movement within the southern sections of Windang Beach have been calculated using data captured after this rapid seaward movement.

A.2.4 Other Matters

There are several other matters which were considered in deriving the hazard lines for beach erosion and shoreline recession, but not included in the assessment:

- The way in which the coastal storm environment offshore of Wollongong is expected to change over time, because of climate change, was examined considering results from a range of global climate models (GCMs). Jeremy Benn Pacific (2025) found the results to suggest minimal change to wave direction and period from storms. Overall, the results indicated that extreme storm events may become less frequent. The GCM results were not significant enough to adjust future behaviour on account of expected changes to wave conditions. This is partly on account of the compartmentalised nature of Wollongong's coast, which means that sediment movement around headlands is minimal and unlikely to be affected by changes to the wave climate.

- Sandy beach compartments tend towards an equilibrium state, where overall sand movement is balanced, depending on the governing wave and water level environment. Noting that there has been minimal historical coastal recession on which to base this scaling along the Wollongong coast, the modelling adopted did not include any scaling to represent shoreline evolution slowing as it approached an equilibrium state.

A.2.5 Outputs

Probabilistic analysis of the recession and erosion components involved Monte Carlo modelling, a method of combining statistical inputs to derive statistical outputs. The concept is illustrated in Figure A-5, noting that:

- All the individual components are represented by losses of sand volume, m^3 of sand lost per metre of beach.
- The component q_y, representing future changes to the recession rate has not been used for the Wollongong coastline.
- All remaining components are considered for future timeframes (+20, +50 and +100 years).
- For the "Present Day" scenario, only the storm (event-based) erosion is considered.
- The distribution of combined volumes on the right-hand side of Figure A-5, is applied to individual beach profiles along the coast, to map the landward location of the Zone of Wave Impact (ZWI) along the beach for different likelihoods of exceedance.
- With the ZWI for different probabilities mapped, the local profile elevations can then be used to locate additional setbacks for the Zone of Slope Adjustment (ZSA) and the Zone of Reduced Foundation Capacity (ZRFC). These are the lines of most relevance for planning and engineering purposes.

The combination of these components is illustrated in Figure A-5.

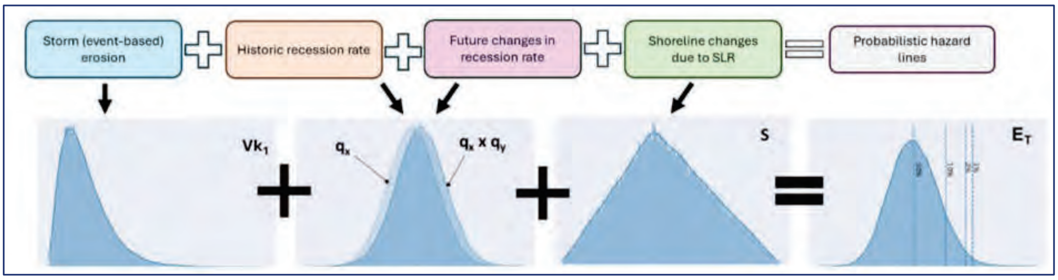

Figure A-5 Probabilistic Combination of Beach Erosion and Shoreline Recession Components (after Jeremy Benn Pacific (2025))

Example ZRFC hazard lines are illustrated in Figure A-6. Figure A-6 shows the probabilistic lines derived at the 50-year timeframe (2075) at the northern end of City Beach. Importantly, the ZRFC does not represent the extent to which the beach could erode but instead represents the landward extent behind the eroded beach where the design of building foundations needs special consideration.

A.3 Derivation of Hazards relating to Entrance Instability

The assessment of entrance instability (Salients, 2025b) included a review of recent and historical aerial imagery, water level records, and previous studies, focussing on watercourses which discharge to beaches and could potentially meander along the rear of the beach to impact beach access, dune stability, and nearby infrastructure.

A semi-automated image processing approach was used to map the wetted areas of entrances over time, from which inundation probability maps were generated and used to determine present-day hazard extents. The analysis focussed on entrance movement over the past 15 years, and the number of images available within this period varied between entrances from 33 to 56 images, with more images typically available for entrances closer to the Wollongong City centre.

Due to the dynamic nature of beach environments, there is some uncertainty in differentiating wetted areas caused by entrance movement versus wave action and varying tide levels. The approach erred conservatively, opting to map larger wetted areas.

From the present-day probability maps, hazard lines were derived for 80%, 50% 20%, 10%, 5% and 1% probabilities. These lines were provided as a GIS database accompanying this report. Example lines are shown in Figure A-7.

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Figure A-6 Example Beach Erosion and Shoreline Recession Hazard Zones (2075 ZRFC for City Beach North)

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For most entrances, the 80% present-day hazard line lies within the existing watercourse behind the beach, although some entrances are less frequently present on the beach (e.g., some entrances completely dry up) and, as a result, no 80% hazard line could be defined at those locations. Some creek entrances were shown to meander along the back of the beach. That meander is reflected in the 1% hazard lines. In some cases, this behaviour causes erosion of the present foredune and/or impedes pedestrian access. Examples where issues have been noted are Whartons Creek at Bulli Beach, Bellambi Gully at Bellambi Beach, and Fairy Creek near Stuart Park.

The present-day entrance instability hazard lines were projected forward for 20-, 50-, and 100-year timeframes using the findings of the beach erosion and shoreline recession analysis presented in Section A.2. The landward projection distance was determined from the difference between the present day 65% beach erosion / shoreline recession zone and the corresponding 65% zone for the timeframe being projected. This projection is shown conceptually in Figure A-7.

A.4 Derivation of Hazards relating to Coastal Inundation

Existing flood simulation models (using the TUFLOW software) were used for the assessment of hazards relating to coastal inundation and tidal inundation (Section A.6). Six pre-existing models were available from the following studies:

- Hewitts Creek Flood Study (WMA Water, 2019a).
- Collins Creek Flood Study (Catchment Simulation Solutions, 2019).
- Towradgi Creek Flood Study (WMA Water, 2019b).
- Fairy & Cabbage Tree Creeks Flood Study (Advisian (Worley Group), 2020).
- Wollongong City Flood Study (Jacobs, 2019).
- Allans Creek Flood Study (Advisian (Worley Group), 2019)

The pre-existing model extents are shown in Figure A-8. Importantly, the coastal boundaries of the different model domains do not match perfectly. As part of the analysis, Jeremy Benn Pacific (2025) merged the two southernmost model domains (Wollongong City and Allans Creek) to remove inconsistencies and allow for more robust representation of the coastal inundation hazard in particular.

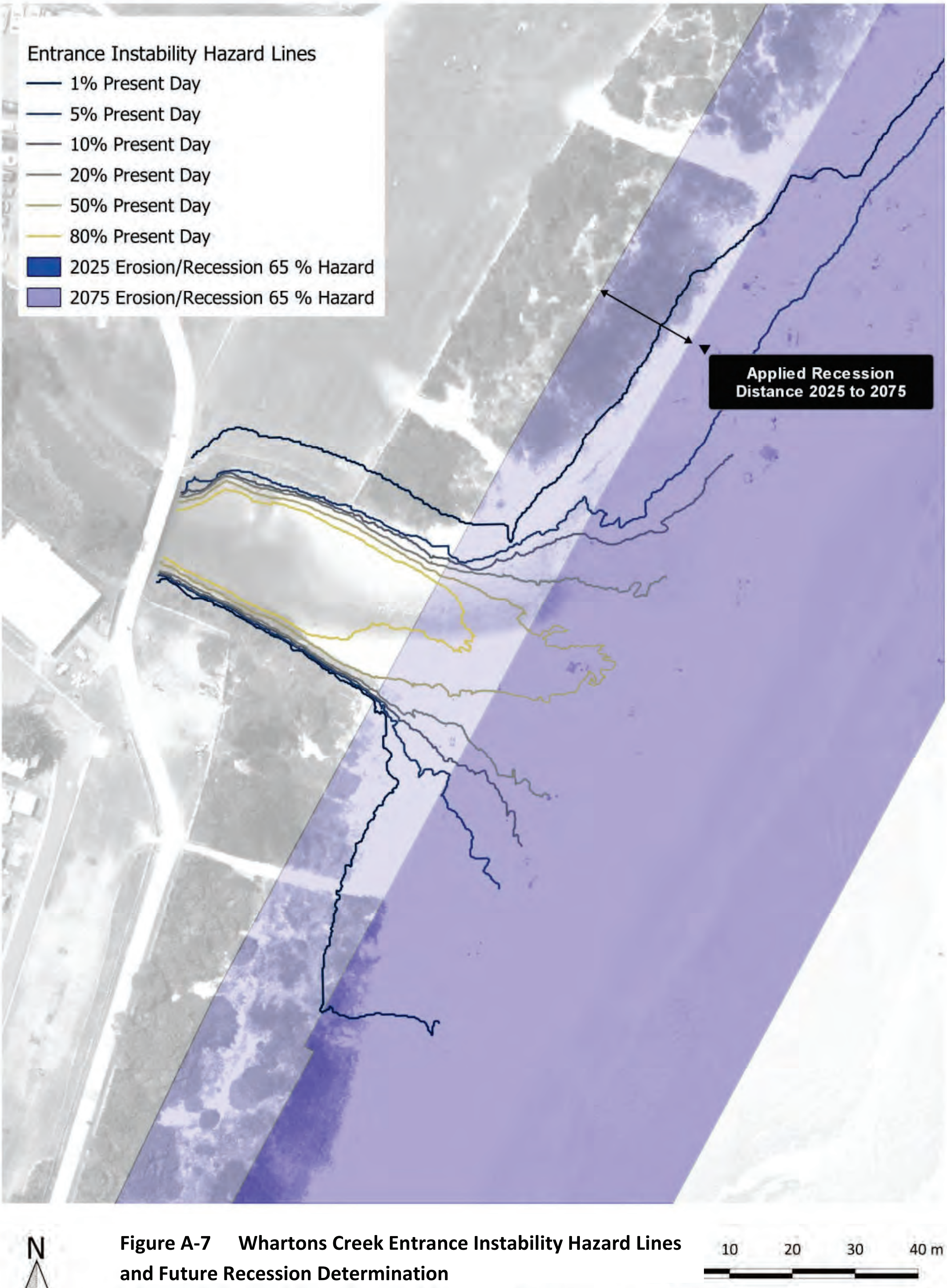

Figure A-7 Whartons Creek Entrance Instability Hazard Lines and Future Recession Determination

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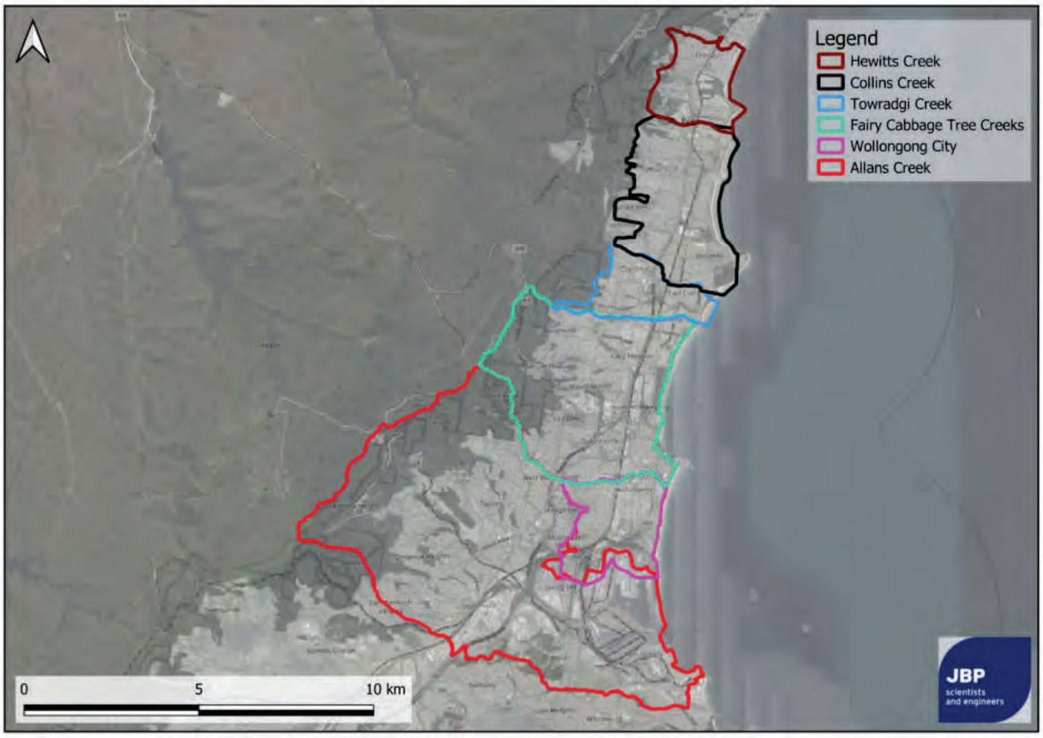

Figure A-8 Coverage of Pre-existing Flood Simulation Models (from Jeremy Benn Pacific (2025))

Furthermore, examination of Figure A-8 shows that available TUFLOW models did not cover the entire Wollongong coastline. Areas to the south of MM Beach at Port Kembla, and north of (approximately) Flanagans Creek at Thirroul were not covered. Instead of applying dynamic numerical simulations for those areas, a simplified but conservative "bathtub" modelling approach was adopted to assess both coastal and tidal inundation hazards.

Coastal inundation refers to the impact of "abnormal" coastal storm conditions, including storm surge, storm wave run-up, and overtopping of coastal barriers. All these processes were considered in the assessment. Open coast extreme "still" water levels (in the absence of wave action), based on literature review and presented in Table A.1, were adopted to represent water levels offshore of the coastline. When considering coastal inundation inside estuaries, these peak water levels are only directly applicable at relatively open entrances, where there is limited wave setup (referred to as a Type "A" entrances in Office of Environment and Heritage (2015)). The only entrance to which this 'open' condition applies within our study area is the entrance to Port Kembla, which is represented in the combined Wollongong City / Allans Creek model.

All other entrances in the study area are classified as Intermittently Closed and Open Lakes or Lagoons (ICOLLs: "Type C"), meaning that a sand barrier can build up at the entrance, closing the estuary off from the ocean. At these entrances, NSW Office of Environment and Heritage (2015) recommends that higher water levels be adopted to include the effects of wave setup (in the order of +1m) at the sand barrier.

The peak coastal storm water levels applied for the models have been adjusted to allow for recent sea level rise and are presented in Table A-1.

Table A-1 Adopted Ocean Still Water levels for various Exceedance Probabilities (Present day conditions)

Annual Exceedance Probability	Open Coast Still Water Elevation (m AHD)	ICOLL Entrance, Peak Water Level Elevation (m AHD)
63%	1.28	1.28[11]
5%	1.38	2.38
1%	1.45	2.58

For areas where TUFLOW models were available, detailed modelling was undertaken, adopting the HHWSS ocean boundary time series from Office of Environment and Heritage (2015) adjusted for sea level rise and storm surge. The storm surge adjustment was applied to result in the peak water levels from Table A-1, with the storm surge peak occurring at the same time as the underlying tidal peak. Based on analysis of storm surge at the Port Kembla tide gauge, the storm surge was assumed to rise steadily from zero over 36 hours to its peak, and to then fall steadily for 36 hours back to zero. In other words, the storm surge hydrograph is triangular over time.

In addition to the storm surge boundary, overtopping of barriers and other structures by waves was included in the analysis of coastal inundation. The first step was to identify the low points in the dune (or across structures such as present at the entrance to Port Kembla), and to characterise the nature of the area that would be overtopped. The commonly adopted EurOtop Manual (Van der Meer et al., 2018) was used to estimate overtopping rates. For eroded dunes, which the Eurotop Manual doesn't directly address, it was assumed that a near vertical, saturated scarp would form and that it would overtop in the same manner as a vertical seawall.

For each overtopping location, mean overtopping discharges were calculated for each storm event in a synthesised 10,000-year multivariate dataset. That dataset was derived based on statistical analysis of hindcast nearshore (-10m contour) wave model

[11] For the 63% (expected to be exceeded around once per year) event, the entrance of an ICOLL is assumed to be open.

results extracted from the NSW Nearshore Wave Tool[12] at the -10m contour. The mean storm overtopping discharge for different AEPs was estimated.

Acknowledging the uncertainty associated with overtopping rates, and the techniques and field data available to analyse them, checks were made considering historical video footage of an overtopping event at Wollongong Harbour and numerical simulations of dune overtopping at Fairy Meadow Beach. The comparisons were found to be reasonable, if imperfect, and the estimated overtopping rates from EurOtop were adopted for use in the subsequent TUFLOW simulations.

Where TUFLOW models were available, the calculated overtopping flows were applied as inflows to the rear of the dune or structure at the low points along the coastline. For consistency, the AEP of the overtopping rate and storm surge were matched within simulations. For example, a 1% AEP storm surge, which would cause coastal inundation through the entrance of a watercourse, was combined with a 1% AEP overtopping rate, which added supplementary inflow to the model domain, landward of the dune (or structure) crest at the low points along the coastline. The approach is reasonable, as the underpinning processes which cause overtopping waves also contribute to the storm surge. The approach is considered to provide a reasonable envelope of the storm-related coastal inundation.

For areas where no TUFLOW model was available the more conservative bathtub approach, including wave run-up, was applied to assess coastal inundation. Run-up was calculated using the run-up formula from Atkinson et al. (2017), with relevant annual exceedance probabilities for run-up determined by applying the 10,000-year wave dataset outlined above, alongside a probabilistic treatment of beach slope as presented in the dataset of Vos et al. (2022).

For the bathtub assessment, the relevant extreme wave run-up determined at the coast (corresponding to the required AEP) was added to the underlying peak still water level to determine a run-up elevation. This elevation was then projected inshore across an underlying digital elevation model to “flood” the area landward of the beach at the calculated run-up elevation.

The bathtub mapping process has resulted in isolated anomalous results, such as to the north of Flanagans Creek on Thirroul Beach, where a low-lying drainage basin discharging across the northern end of the beach is shown as extensively flooded, beyond that which would actually occur for the scenarios being considered. A better estimate could be achieved by extending the existing TUFLOW model, which only extends to just north of Flanagans Creek, and to incorporate overtopping of the adjacent low-lying back-beach areas, but this was beyond the scope of the project.

[12] https://nearshore.waves.nsw.gov.au/home/forecast

Due to constraints on computational times and a need to make the analysis tractable, the number of simulated scenarios was limited. Modelling was limited to selected scenarios, assuming either the 50^{th} or 95^{th} (5 % chance of exceedance) sea level rise projection. The full set of scenarios examined and mapped are presented in Table A-2.

Table A-2 Coastal Inundation Scenarios Considered

Year	SSP5-8.5 Sea Level Rise, chance of exceedance	Storm Likelihood (AEP)		
		63%	5%	1%
Present Day (2025)	n/a		X	
2045	5%	X	X	X
2075	5%	X	X	X
2125	5%		X	
2045	50%	X	X	X
2075	50%	X	X	X
2125	50%			

Results from the bathtub assessment areas, and the areas subjected to more detailed hydrodynamic modelling were combined into seamless datasets. Two primary outputs are provided for each dataset (i) a raster dataset showing depths of inundation; and (ii) polygons showing the extent of inundation for each scenario.

Figure A-9 indicates that, assuming the high emissions sea level rise scenarios (SSP5-8.5) that the coastal inundation threat is benign until 2045. By 2075, the increase in area inundated is marginal, except for storm tides extending a significant distance further upstream along a northern Tributary of Collins Creek, adjacent to Carrington St. and Lawrence St. By 2125, the change is marked. There is substantial out of bank inundation along the lower reaches of Collins St, and wave overtopping at the southern end of Sandon Point Beach causes inundation of the low-lying area to the west of Waniora Point and north of Whartons Creek.

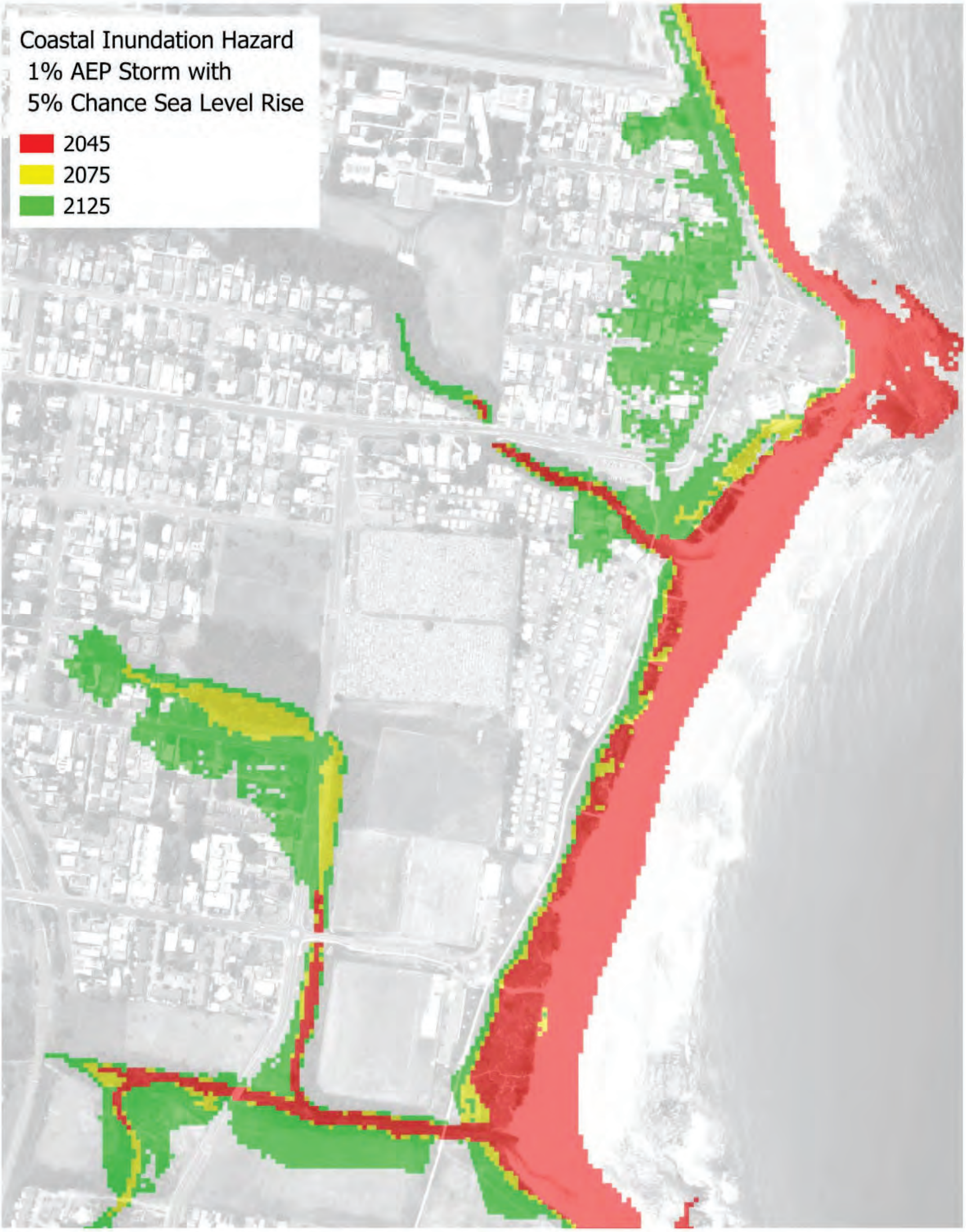

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Figure A-9 Example Coastal Inundation Hazard Mapping at Bulli

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A.5 Derivation of Hazards relating to Coastal Cliff / Slope Instability

Assessment of the coastal cliff / slope instability hazard along Wollongong's coastline is presented in Tetra Tech Coffey (2025), and addresses the recession and instability of rocky natural cliffs and headlands. Due to the nature of Wollongong's coast, these hazards are more prevalent towards the northern end of the LGA.

Along some stretches of coastline, such as the northern end of Stanwell Park Beach and the northern end of Coalcliff Beach, a sandy beach is backed by a near vertical rocky cliff. In such locations, both erosion/shoreline recession zones (Section A.1) and coastal cliff/instability hazard zones may be mapped. The future in these areas may well be eventual loss of the sandy beach fronting the sea cliffs after which ongoing recession slows.

The Illawarra Escarpment is prone to landslides, and, in many cases, there are known historical landslides along the coastline which could potentially be reactivated by collapse of coastal cliffs or bluff formations. 'Secondary' instability effects such as these have not been included in the mapped coastal cliff / slope instability hazard zones. The mapped hazard zones are intended to identify areas where more in-depth studies, such as site-specific investigations, should be conducted to make sure that the hazards are appropriately accounted for if development is being considered.

Tetra Tech Coffey (TTC, 2025) has built on the prior work of GHD (2010), which was prepared as part of the hazard assessment associated with Wollongong's Coastal Zone Management Plan (BMT WBM, 2017). That Plan was developed on behalf of Council under the NSW coastal management framework which existed prior to the commencement of the CM Act in April 2018. GHD's prior work was re-evaluated considering more recent elevation data, updates to landslip databases, drone imagery, recent aerial photography, and limited subsurface data compiled for the study team by Council.

In defining the hazard zones, TTC considered two broad models of how cliffs might recede with time:

- A time dependent hazard model of gradual cliff erosion, which assumes that the historical rate of recession will continue and potentially accelerate due to sea level rise. An allowance of two times the soil depth at the top of the rocky cliff is also included.
- An immediate hazard model which allows for the episodic attrition and collapse of cliffs (rock falls) at the coast (total of 8m of event-based recession). An allowance of two times the soil depth at the top of the rocky cliff is also included. This model is similar to a process which has been informally adopted by Council for several years and seems to have performed well.

The methods used to derive parameters for these models is summarised below.

Recession rates were determined based on literature review and analysis, varying from 0.1m / 100 years for the harder rocks of the Shoalhaven Group (extending from Wollongong to Port Kembla) to as high as 2.5m / 100 years for outcrops of the Illawarra Coal Measures and along the coastal plains (extending from North Scarborough through to North Wollongong).

The soil depths at the top of cliffs were estimated using the following methods (in preferential order):

1 Reference to reports currently held by Tetra Tech (undertaken by others).

2 Commentary within the UoW or WCC landslide databases (where available).

3 Depths estimated using a combination of LiDAR data, drone footage, and aerial imagery.

4 Ten (10) percent of the cliff height where no other information is available.

The method most used was consideration of drone footage and LiDAR data (3).

Sea level rise enhancement factors were only applied where the Illawarra Coal Measures outcropped on the coast, with values varying between 1.3 for a 25-year timeframe, up to 2.0 for a 100-year timeframe. The rate applied depended, not only on the timeframe being considered, but whether a platform and/or talus were present at the coast to provide additional protection against storm events combined with a rising mean sea level. At other locations along the coast, where harder rocks were present, a factor of 1.0 (no impact) was applied.

Initially, the existing top of cliff location was determined in GIS software using regularly spaced profiles along the coast extracted from a 1m gridded digital elevation model (DEM). The profiles were processed using the CliffMetrics[13] tool. Outputs from the automated process were imperfect and required checking and adjustment, in some locations, based on engineering judgement using other data (geological mapping, underlying DEM, aerial and drone imagery).

The most landward location output by either the "time dependent" or "immediate" model was adopted. It was uniformly found that the "immediate" recession extent sat landward of all time dependent extents, up to and including the 100-year (2125) timeframe.

A consequence of the immediate recession mechanism is that fallen debris is deposited at the base of the cliff. That debris lends a measure of protection to the base of the cliff from subsequent wave action (including undercutting) for some time. It

[13] https://saga-gis.sourceforge.io/saga_tool_doc/8.2.3/ta_cliffmetrics_0.html

follows that recession of the main cliff behind the fallen rock ceases for as long as the fallen rock provides that protection. Accordingly, for typical cliff line conditions, there is a very low probability that multiple "immediate" recession events over a 100-year period in any given location.

The logical conclusion is that, where immediate recession governs (as it does over the entire cliffed lengths of the Wollongong Coast) the extents of the coastal cliff / slope instability hazard for all timeframes up to and including 100 years are identical.

An example of the mapped coastal cliff / slope instability hazard is shown in Figure A-10. This shows the cliffed area south of Stanwell Park Beach and illustrates that the coastal cliff / instability hazard can be mapped concurrently in sandy areas that will be affected by beach erosion and shoreline recession, such as at the entrance to Stanwell Creek.

A.6 Derivation of Hazards relating to Tidal Inundation

The tidal inundation hazard refers to inundation by "pure" tides (in the absence of storm surge and other processes that superelevate water levels at the coast). Other terms commonly applied to tidal inundation are "*sunny day flooding*" and "*nuisance inundation*". For our assessment, we have considered the impact of sea level rise on the heights that tides will reach along the coast and inside estuaries. We have adopted the High High Water Solstice Springs (HHWSS) tidal plane, which represent the highest tides typically expected during the year, which occur several times annually during spring tide periods around the solstices. These are similar in height to the "King" tides which happen at this time of the year.

The tidal inundation hazard was examined using the similar methods outlined in Section A.4, namely:

- Hydrodynamic modelling using pre-existing TUFLOW numerical models for areas between Port Kembla and Flanagans Creek.
- Across other areas, bathtub modelling, whereby the HHWSS elevation was projected as a flat surface to inundate the landscape landward of the coast.

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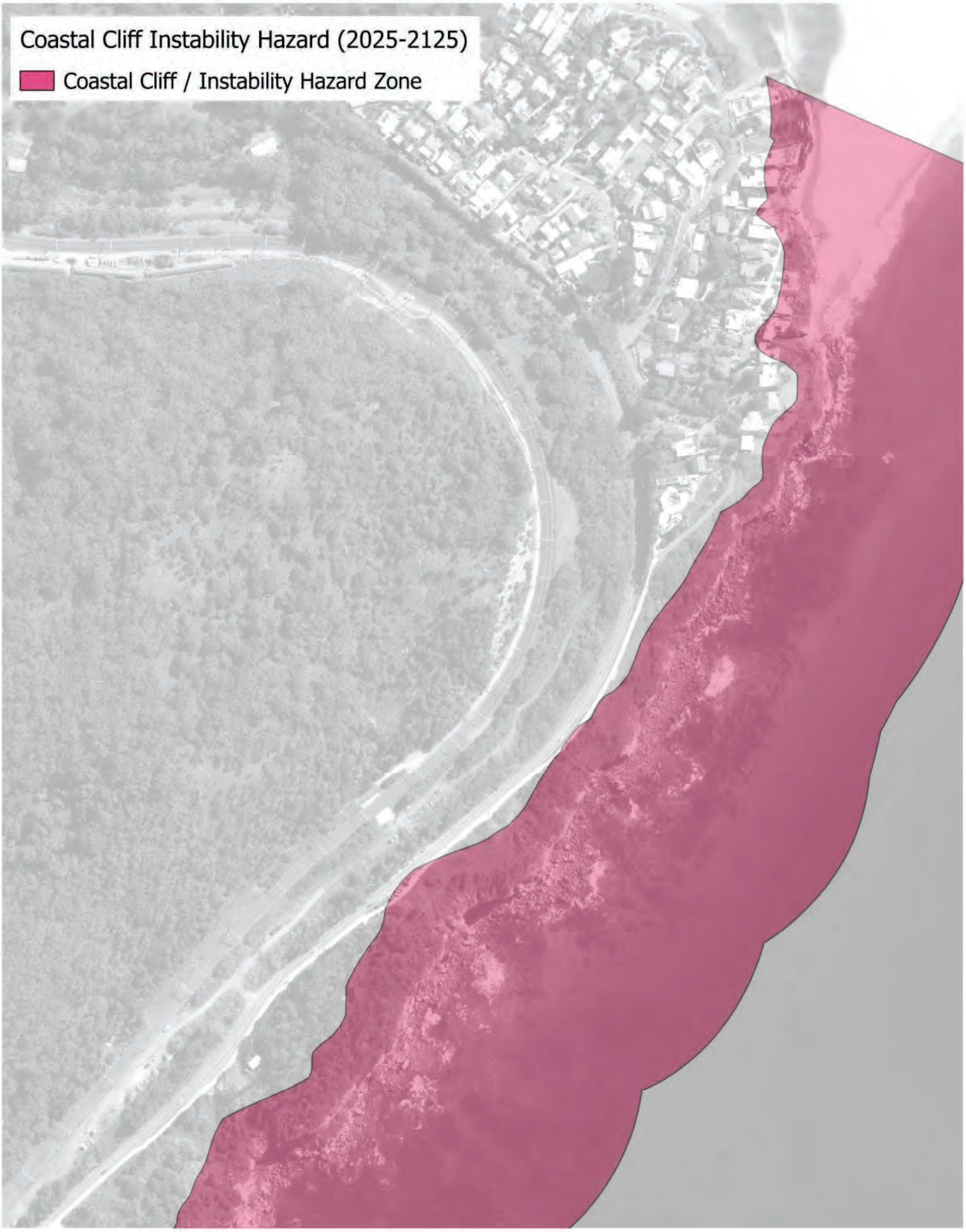

Figure A-10 Example Coastal Cliff / Slope Instability Hazard Zone to South of Stanwell Park Beach

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Conceptually, analysis of the tidal inundation hazard is simpler than the coastal inundation hazard as the driving "boundary" conditions for modelling and analysis only use normal astronomical tide elevations, and don't need to consider the probabilities associated with storm surge, nor the multivariate probabilities associated with waves and overtopping. The primary uncertainty is how much sea-level rise will occur over a given future timeframe.

The approach taken by the tidal inundation hazard assessment was to consider a variety of scenarios representing different increments of sea level rise. Based on agreement with the project Technical Steering Committee, sea level scenarios were:

- Incremented at 0.1m intervals up to 0.80m AHD (approximately equal to the 95th percentile, or 5% chance of exceedance, SSP5-8.5 mean sea level at 2075).
- One additional, upper limit sensitivity scenario executed at the 2125 95th percentile (5% chance of exceedance) mean sea level of 1.90m AHD.

The time series applied to the hydrodynamic model boundaries are shown in Figure A-11. Characteristics of the scenarios are summarised in Table A-3.

The adoption of a "simulation library" approach such as this is advantageous as it remains independent of any sea-level rise projection that may be adopted for planning or risk analysis. Should Council's selected projection be updated, perhaps when new information is published by the Intergovernmental Panel on Climate Change (IPCC), results from a simulation that are no more than 5cm in error from any chosen amount of sea level rise would be readily available. Therefore, suitable simulation results for a selected probability of sea level rise to examine risks at a selected future time could be extracted from the database of modelled results, without requiring new model simulations to be executed.

Figure A-12 shows some representative results of the tidal inundation hazard extents from around Fairy and Cabbage Tree Creeks. Inundation extents remain benign around this estuary at 0.8m of sea level rise (only 5% chance of exceedance at 2075). However, by 2125, the 5%chance of exceedance scenario results indicate that inundation could be expected several times per year in the following locations:

- Western parts of Stuart Park.
- Across the football field, PCYC Wollongong property and residential areas around Exeter and Achilles Avenues.
- Across much of the length of Squires Way to the north of Fairy Creek and adjacent to the UoW Innovation Campus.
- Along much of Montague St. to the south of Puckey Ave.

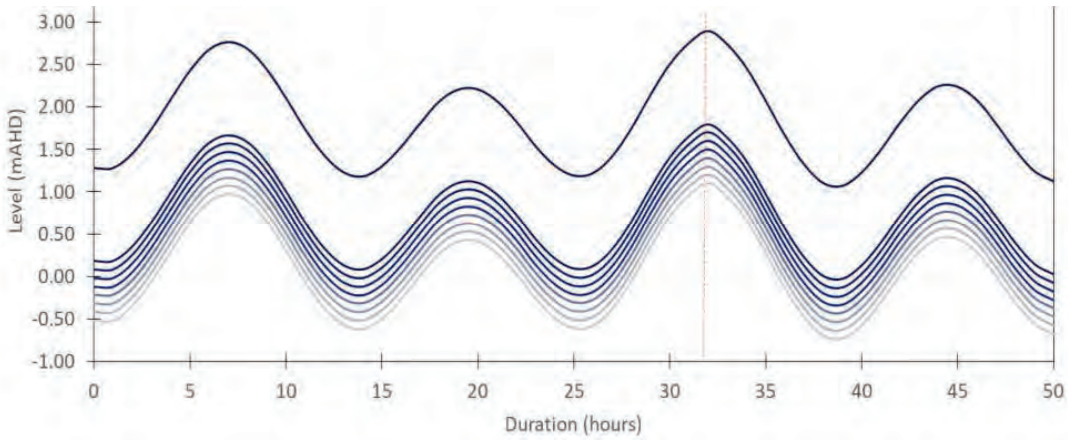

Figure A-11 Tidal Inundation Hazard Time Series applied at Boundaries of Hydrodynamic Models

Table A-3 Characteristics of Tidal Sea Level Rise Scenarios

Normalised MSL (m AHD)	HHWSS Level[14] (m AHD)	Approximate Equivalence to SSP5-8.5 Projection (Medium Confidence)
0.10	1.10	Present Day
0.20	1.20	2045 – 50% chance of being exceeded
0.30	1.30	↓ ↓ ↓
0.40	1.40	↓ ↓ ↓
0.50	1.50	↓ ↓ ↓
0.60	1.60	↓ ↓ ↓
0.70	1.70	↓ ↓ ↓
0.80	1.80	2075 – 5% chance of being exceeded
1.90	2.90	2125 – 5% chance of being exceeded

[14] This is the stationary water surface elevation applied during bathtub modelling.

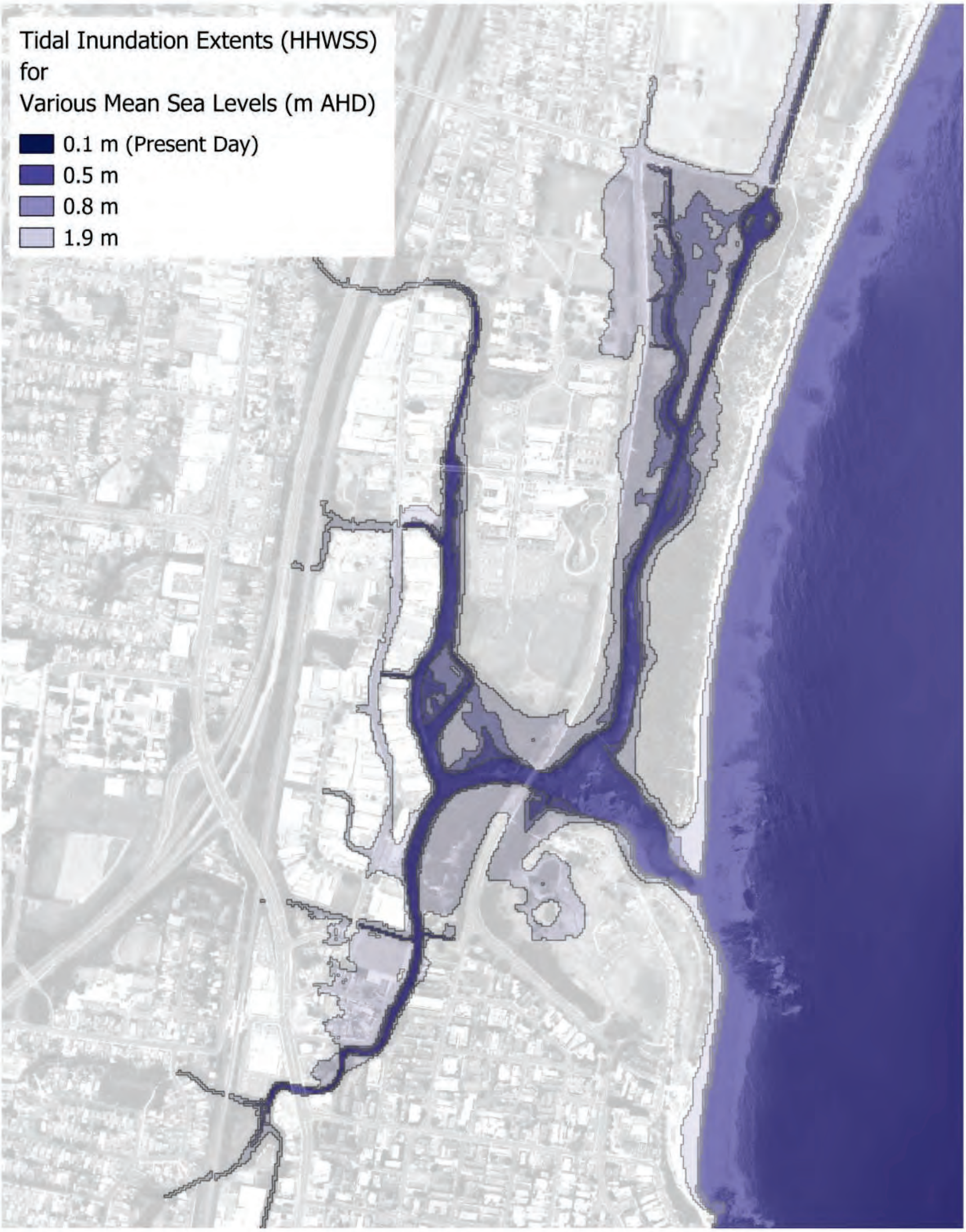

Figure A-12 Tidal Inundation Hazard Mapping Around Fairy/Cabbage Tree Creeks

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A.7 Derivation of Hazards relating to Estuary Foreshore Erosion

Estuary foreshore erosion hazards were assessed through desktop analysis followed by detailed site inspections for any sites of concern identified. A total of thirty-two sites were marked for inspection, and from the site inspections the locations classified as either:

- "Key sites", requiring detailed assessment and consideration of management interventions.
- "Sites of lesser concern", where low impact or no-regrets management options were considered.

Seven sites were identified as key sites which exhibited moderate to severe bank erosion.

For key sites, foreshore erosion hazard lines were derived where possible, considering historical and recent aerial imagery and the findings of our site inspections. For some locations, hazard lines could not be derived due to limited data available.

The locations of the seven key sites, including those where hazard lines were derived and those where information to estimate hazards was insufficient, are shown in Figure A-13.

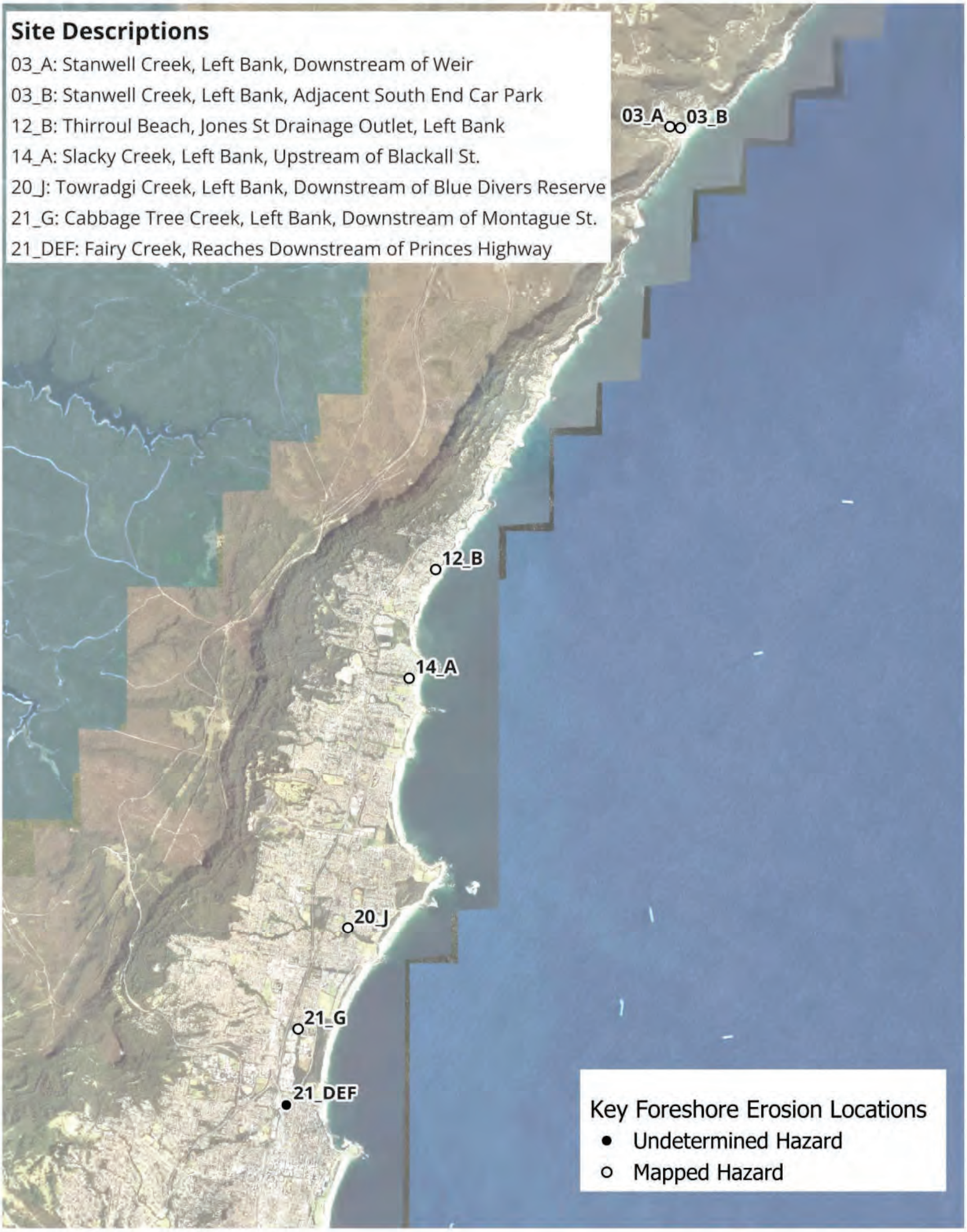
A.8 Supplementary Processing and Standardisation of Hazard Layers

Hazard mapping outputs were prepared by different subconsultants for different hazards. The original data outputs were delivered alongside the original hazard mapping studies. While each dataset was technically robust and fit for demonstrating the hazard extents, differences in file structure, naming conventions, geometry types, spatial extents, and presentation conventions required supplementary processing to integrate the outputs into a single, consistent hazard mapping package suitable for the risk assessment and subsequent use by Council as part of planning.

Post-processing and standardisation of the GIS layers was undertaken. This work did not detract from the integrity of the outputs nor involve any further modelling assumptions or substantially vary the assessed hazard extents. The work focused on resolving presentation inconsistencies, correcting minor technical issues, and ensuring consistency across hazard types and epochs and similarities in naming conventions.

A.8.1 Scope and Nature of Supplementary Processing

Across all hazard datasets, supplementary processing included the following common elements:



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0 1 2 3 4 km

Figure A-13 Key Foreshore Erosion Locations

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- **Standardised file naming and attribution:** File naming conventions were rationalised and standardised across all hazard types to clearly encode hazard type, planning epoch, probability or return period (where relevant), and scenario attributes. This removed inconsistencies in terminology (e.g. mislabelled "Depth" extents) and enables clear identification of layers during subsequent use.

- **Consistent spatial reference framework:** All vector datasets were confirmed or converted to a consistent horizontal coordinate reference system (GDA2020 / MGA Zone 56), consistent with Council's corporate GIS environment.

- **Geometry cleaning and conversion:** Where source datasets were supplied as line features, minor geometric issues such as overlaps, gaps, or irregular vertex numbering were corrected, and the data were converted to polygon representations where this improved usability for planning and risk assessment purposes. This was undertaken conservatively and informed by the original hazard definitions and local landscape context where any extension to hazard extents was made.

- **Harmonisation of spatial extents:** To provide consistent visual presentation and avoid apparent truncation of hazard layers at the coastal boundary, hazard polygons were extended (and locally clipped where required) to a uniform offshore distance beyond the Wollongong LGA boundary. This adjustment was explicitly cosmetic and did not change the landward extent or interpretation of any hazard. Any extension to the spatial extent was minimised to ensure, for example, proper coverage of both coastal cliff and slope instability, and beach erosion/shoreline recession hazards, where these two exist in near vicinity or overlap.

A.8.2 Hazard-specific Processing Considerations

In addition to the general steps above, hazard-specific supplementary processing was undertaken to address integration issues as follows:

- **Beach erosion and shoreline recession:** Naming conventions were updated to clearly distinguish probability levels and geomorphic components, including adoption of consistent terminology for the Zone of Reduced Foundation Capacity (ZRFC) and Zone of Slope Adjustment (ZSA). Minor offshore extensions were applied for presentation consistency only.

- **Coastal and tidal inundation:** Inundation extent layers were renamed to correctly reflect that they represent spatial extents rather than depth surfaces, aligning vector naming with the accompanying raster depth products. Scenario attributes such as return period, epoch and climate quantile were made explicit in file names to avoid ambiguity in interpretation.

- **Coastal watercourse entrance instability:** Hazard extents were consolidated by epoch into single layers covering all assessed entrances, facilitating consistent spatial interrogation. Buffered and adjusted extents were aligned with corresponding beach erosion ZRFC extents (at most, but not all entrances) to ensure internally consistent landward hazard limits across related hazard types.

- **Coastal cliff and slope instability:** Line-based hazard limits supplied in the original study were geometrically cleaned and converted into polygon extents to improve subsequent usability. Minor local adjustments were made to close small gaps between adjacent hazard layers, based on site morphology and conservative professional judgement. Identical extents were retained across all planning epochs in accordance with the episodic nature of the hazard mechanism described in the source study. In isolated locations, minor changes to extent were made based on the feedback from geotechnical engineering experts from Council.

A.8.3 Data Quality and Limitations

All supplementary processing was undertaken with reference to the original study documentation and metadata, and in accordance with relevant GIS and metadata standards. The processed datasets retain the limitations inherent in the original modelling and observational data and should be interpreted as indicative hazard extents suitable for strategic planning and risk assessment, rather than for site-specific engineering design.

No re-analysis of coastal processes, re-modelling, or reinterpretation of hazard likelihoods was undertaken as part of the supplementary processing work. The supplementary processing was limited to integration, standardisation, and quality improvement of the spatial datasets to support consistency and clarity for future use.

A.9 Derivation of Vulnerability Extents

Combined vulnerability layers have been created by generating the envelope of the different hazard extents. This vulnerability mapping is divided into areas affected by "current" and "future" hazards, and these are shown on the asset maps in Appendix C2. The vulnerability layers have been created from the layers listed in Table 4.

Current and future vulnerability layers have also been created for each hazard individually, to use for planning purposes and to facilitate notations on section 10.7 planning certificates'[15].

Council may elect to formally adopt a coastal vulnerability area, with the extents of the coastal vulnerability area being mapped under the RH SEPP.

[15] https://www.planning.nsw.gov.au/sites/default/files/2023-03/planning-circular-ps-21-033-planning-certificates-coastal-hazards.pdf

Combined current and future vulnerability layers have been created by generating the envelope of the different hazard extents, from the layers listed in Table 4.

Table 4 Layers Contributing to Combined Vulnerability Extents

Coastal Hazard	"Current" Hazard Layers	"Future" Hazard Layers
Beach Erosion and Recession	1% Chance in 2025 ZRFC Layer.	1% Chance in 2125 ZRFC Layer.
Coastal Watercourse Entrance Instability	2025 Entrance and Watercourse Instability Layer (as buffered and clipped).	2125 Entrance and Watercourse Instability Layer (as buffered and clipped).
Coastal Inundation	5% chance (1 in 20yr) storm surge with present mean sea level.[16]	1% chance (1 in 100yr) storm surge with 5% chance of sea level rise by 2125.
Coastal Cliff and Slope Instability	2025 Coastal Cliff and Slope Instability Layer	2125 Coastal Cliff and Slope Instability Layer[17]
Tidal Inundation	Tidal Inundation arising from a 1.1m HHWSS tide (corresponds to present Mean Sea level around 0.1m AHD)	Tidal Inundation arising from a 2.9m HHWSS tide (approximately 5% chance of sea level rise by 2125)

Maps which show the extent of vulnerability along the coast are presented on the following pages. An index figure is presented as Figure A-14, followed by 12 individual maps covering the coast from north to south (Figure A-15 through Figure A-26).

[16] With reference to Table A-2, a 1% scenario for 2025 was not simulated. Accordingly, we have adopted the 5% inundation, as the only "present-day" scenario modelled. Considering that sea levels are presently rising at between 4-5 mm /year, this will become outdated over time.
[17] The 2125 layer is identical to the 2025 layer, as outlined in Section A.5.

Combined Coastal Vulnerability Map Index

Wollongong Coastal Hazards

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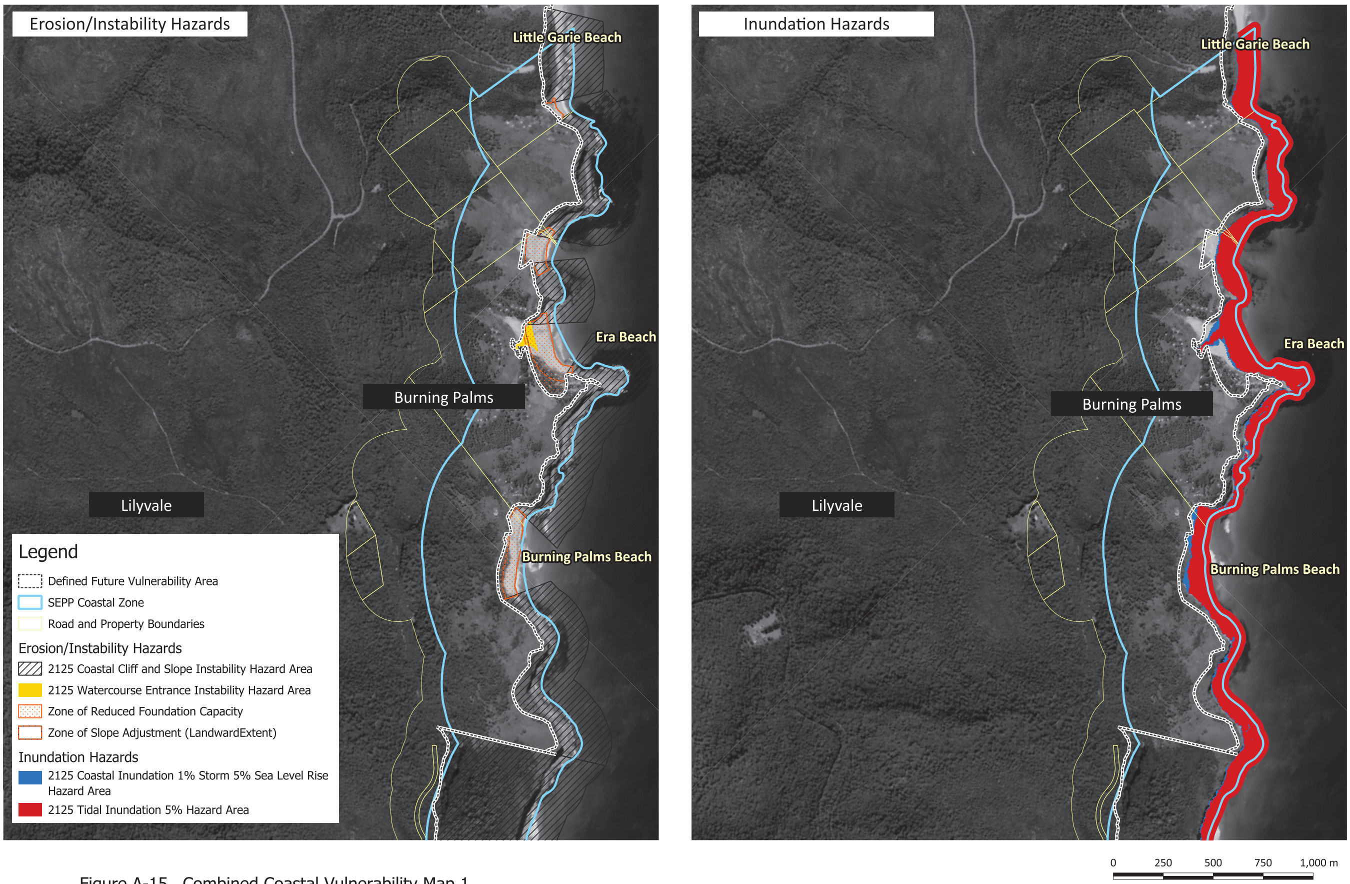

Figure A-15 Combined Coastal Vulnerability Map 1

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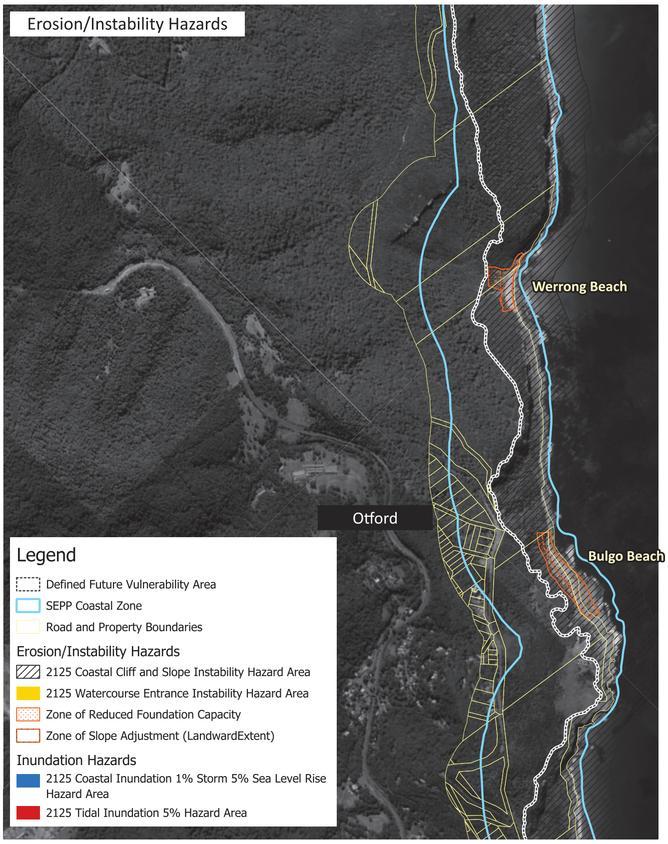

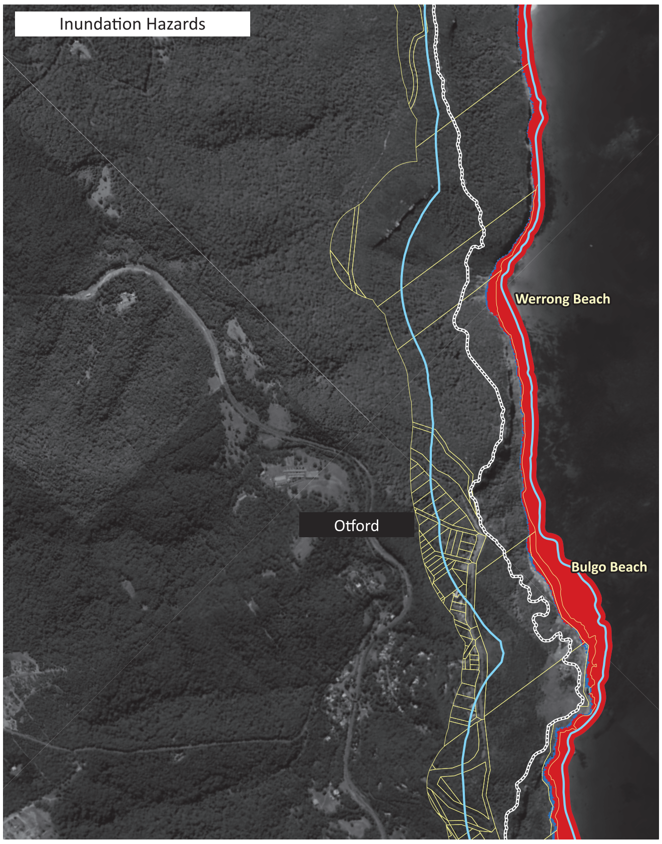

Figure A-16 Combined Coastal Vulnerability Map 2

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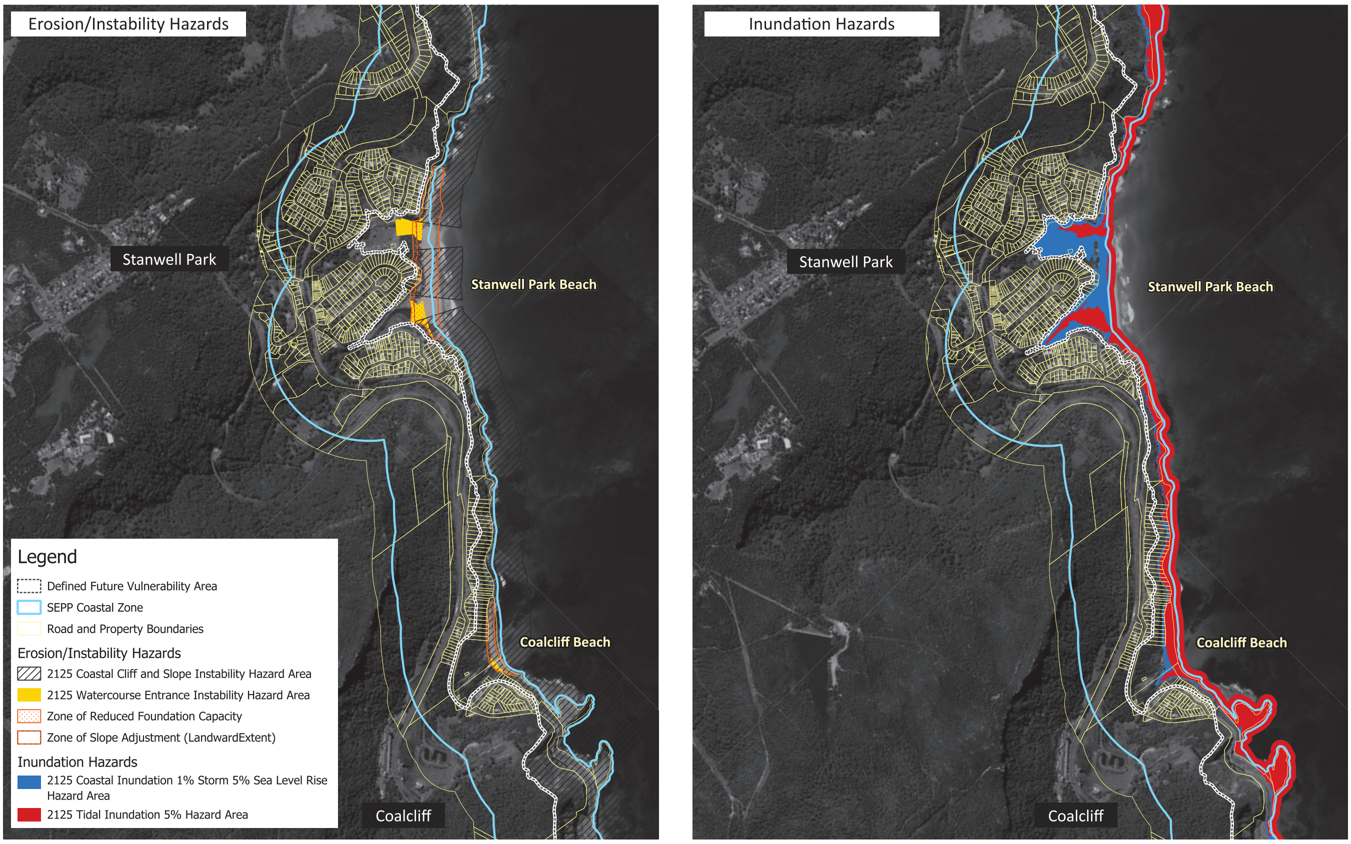

Figure A-17 Combined Coastal Vulnerability Map 3

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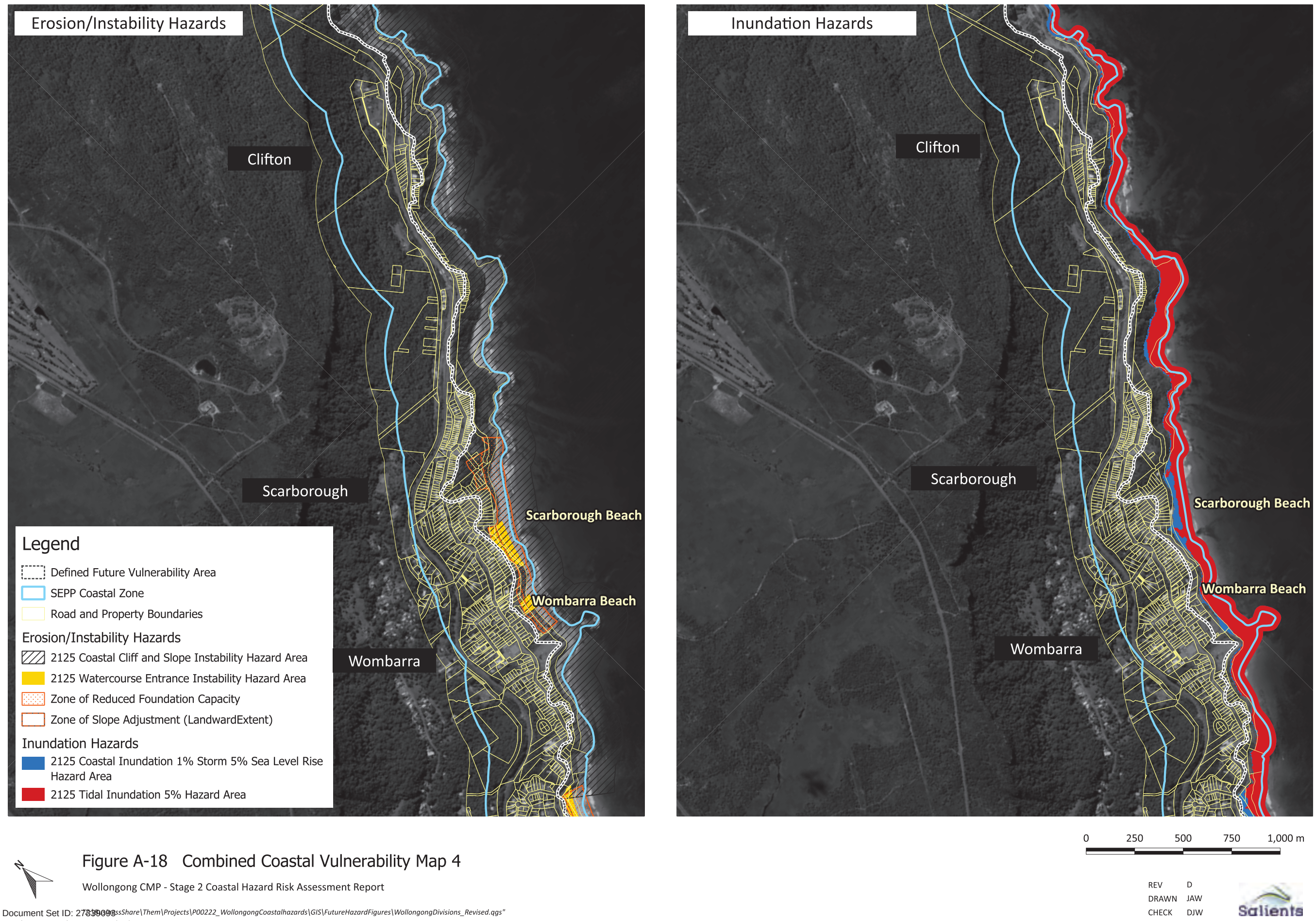

Figure A-18 Combined Coastal Vulnerability Map 4

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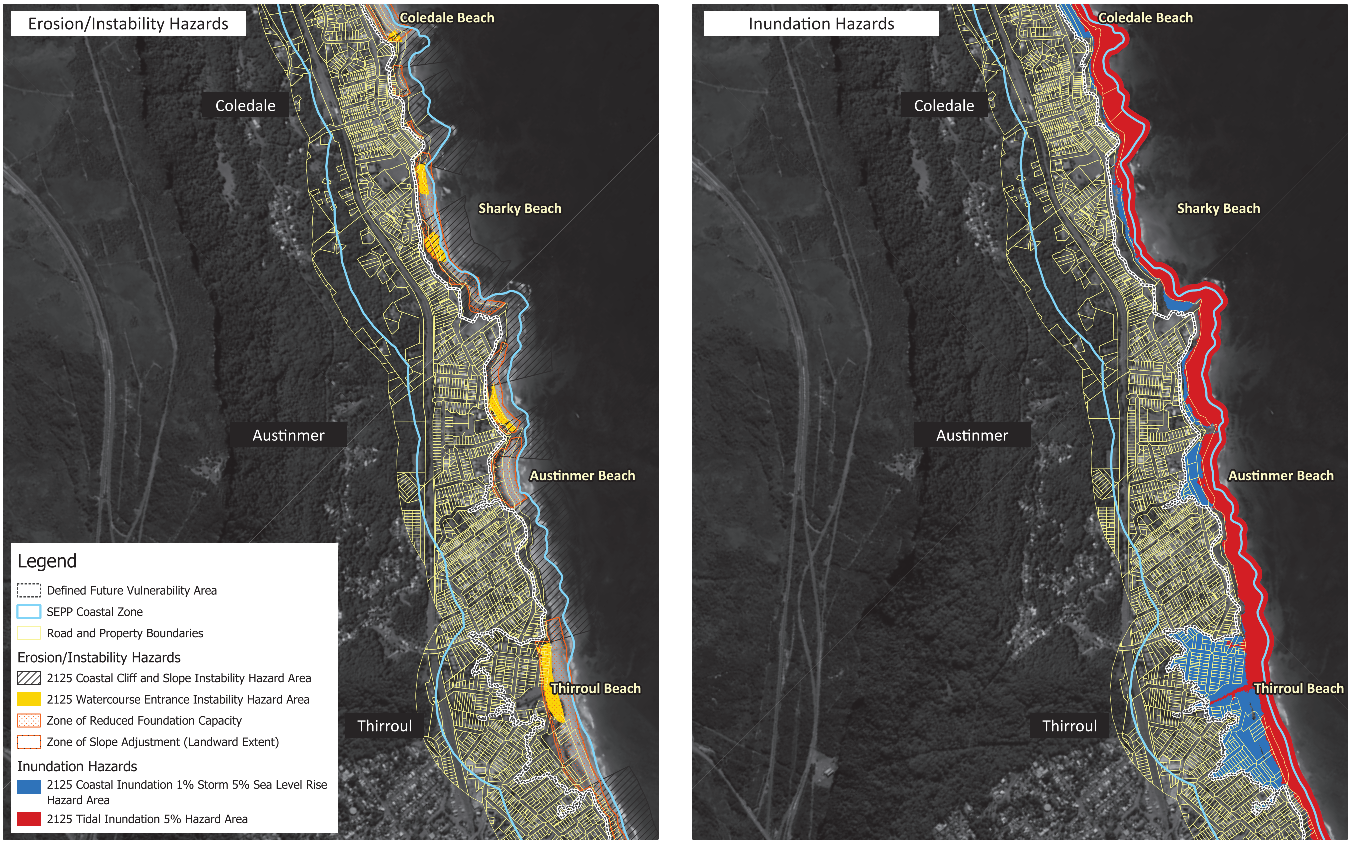

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Figure A-19 Combined Coastal Vulnerability Map 5

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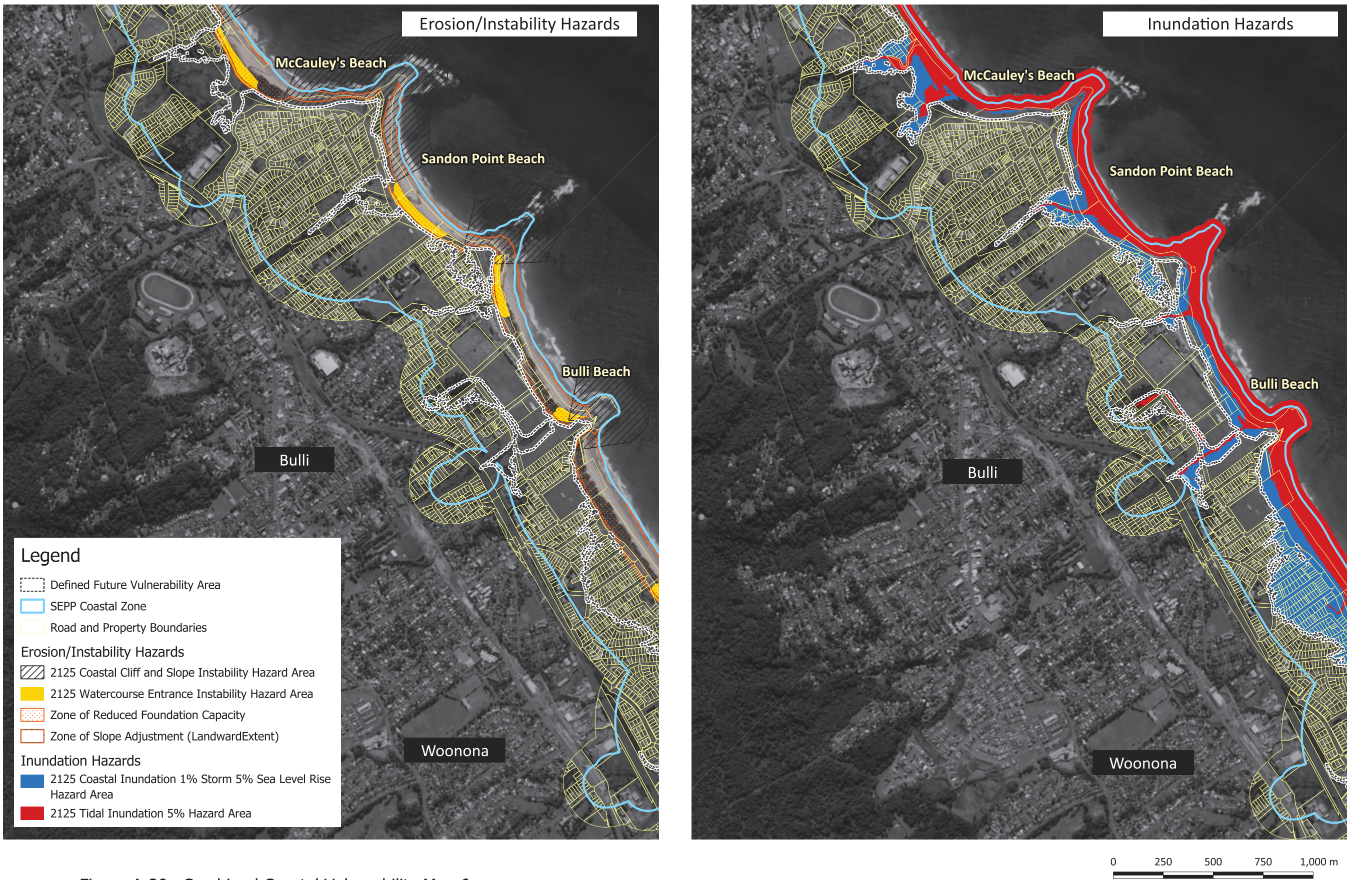

Figure A-20 Combined Coastal Vulnerability Map 6

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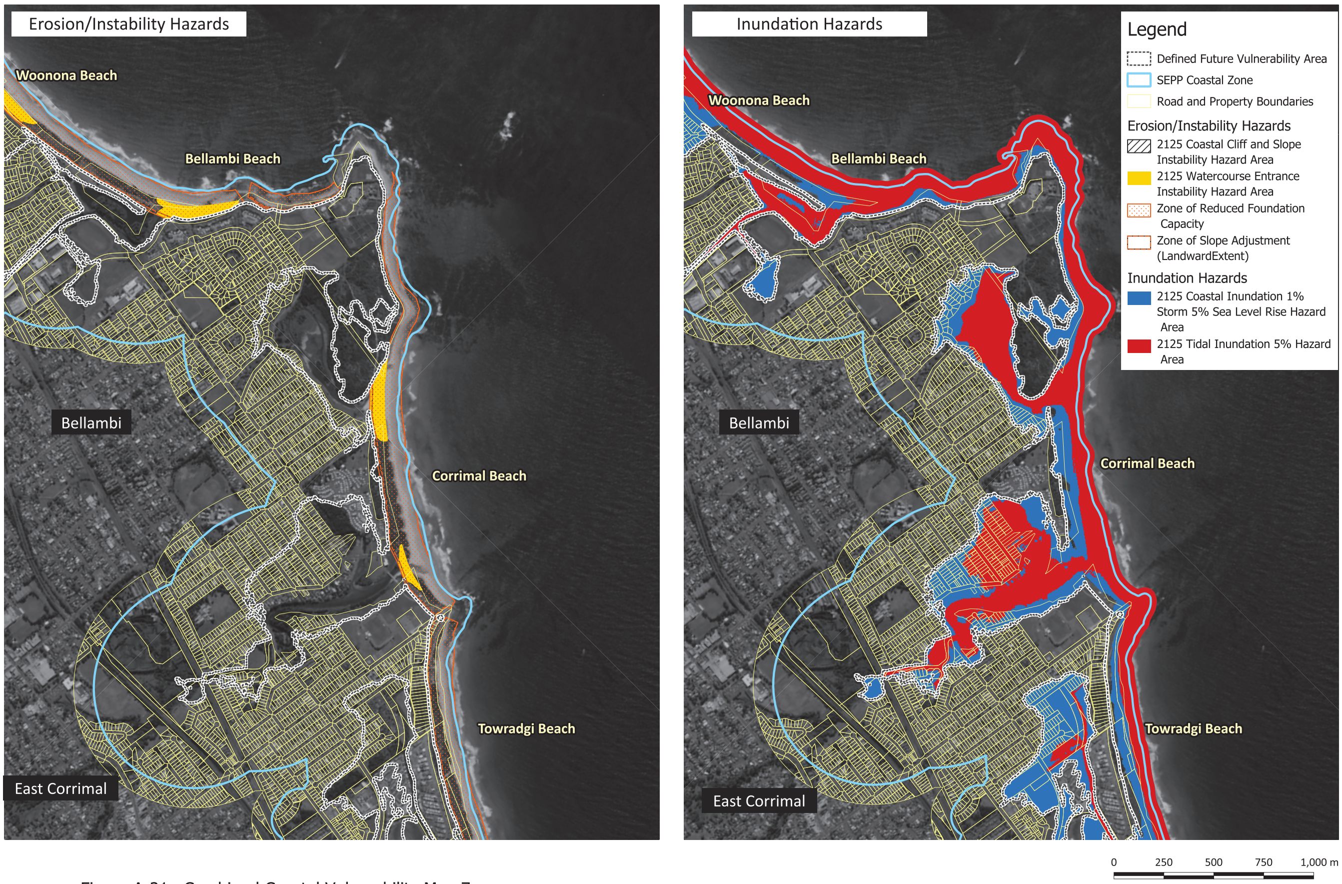

Figure A-21 Combined Coastal Vulnerability Map 7

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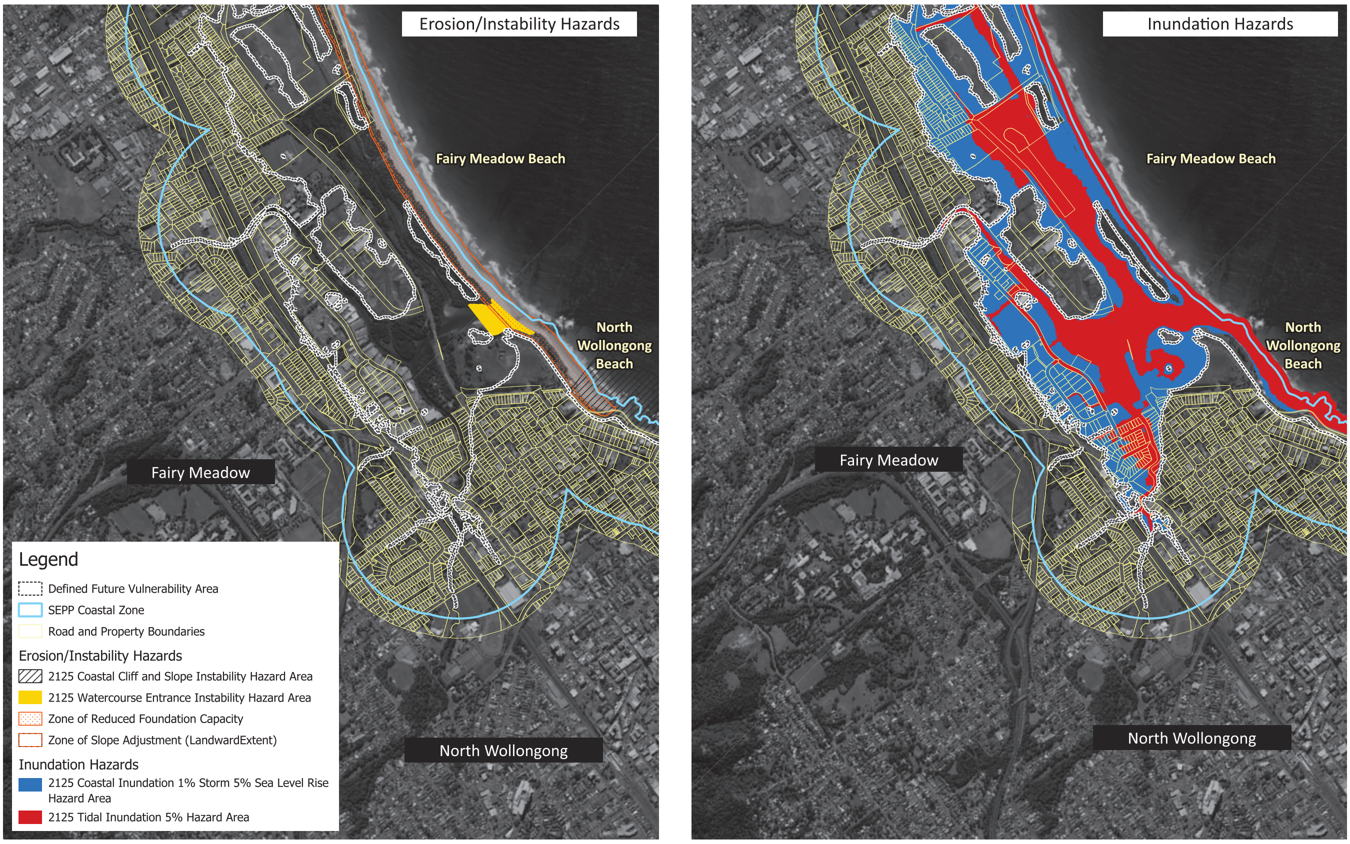

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Figure A-22 Combined Coastal Vulnerability Map 8

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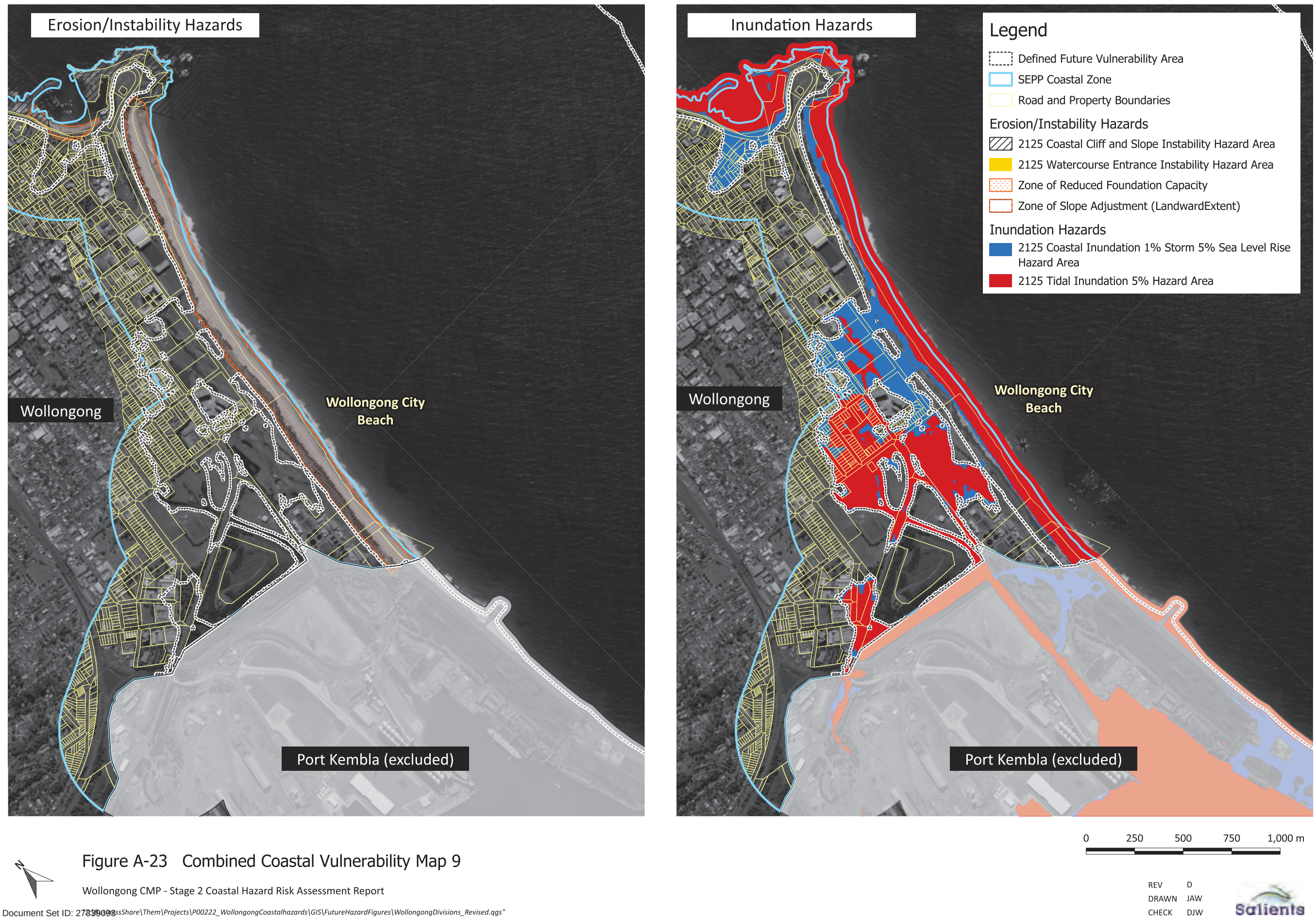

Figure A-23 Combined Coastal Vulnerability Map 9

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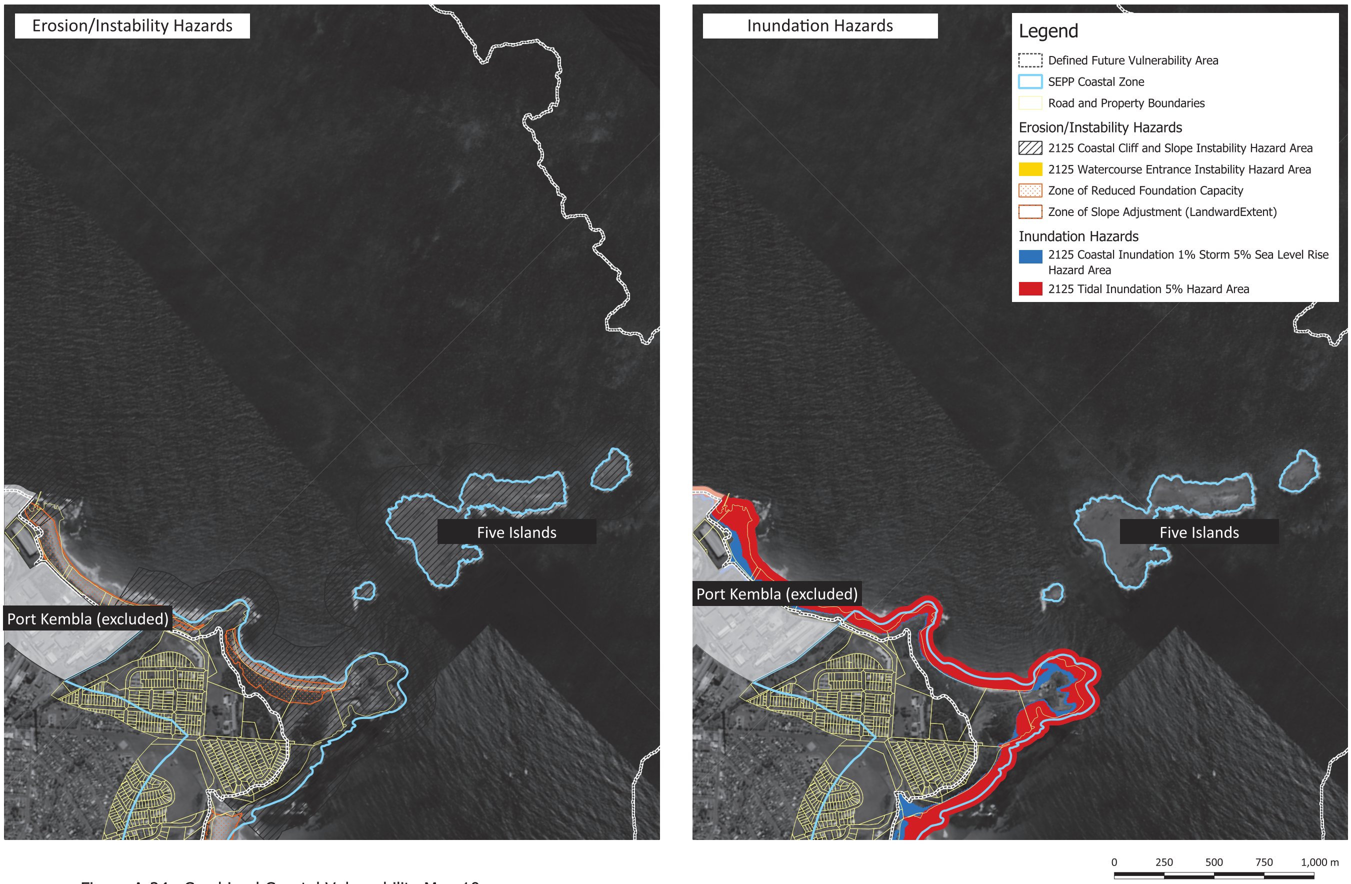

Figure A-24 Combined Coastal Vulnerability Map 10

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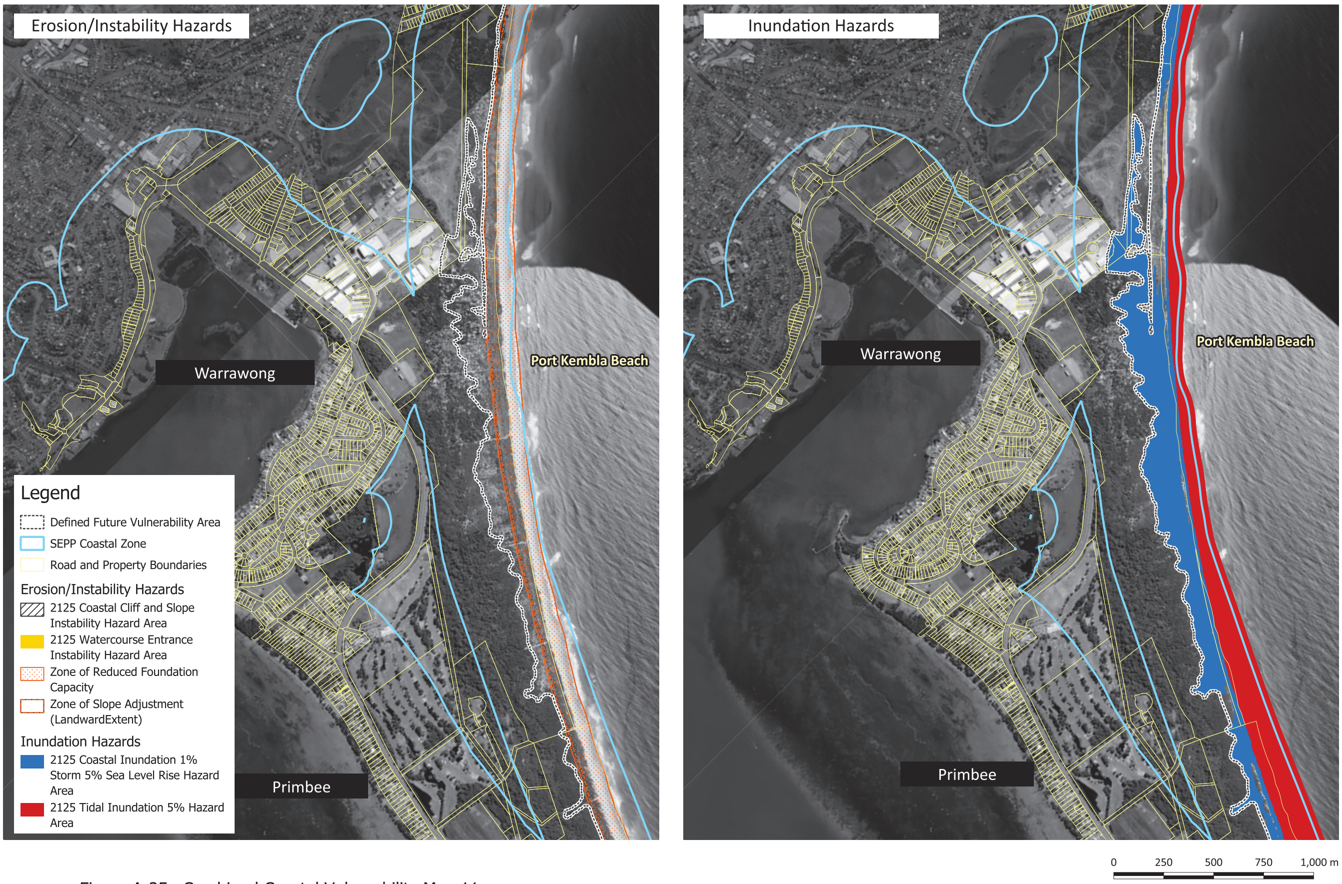

Figure A-25 Combined Coastal Vulnerability Map 11

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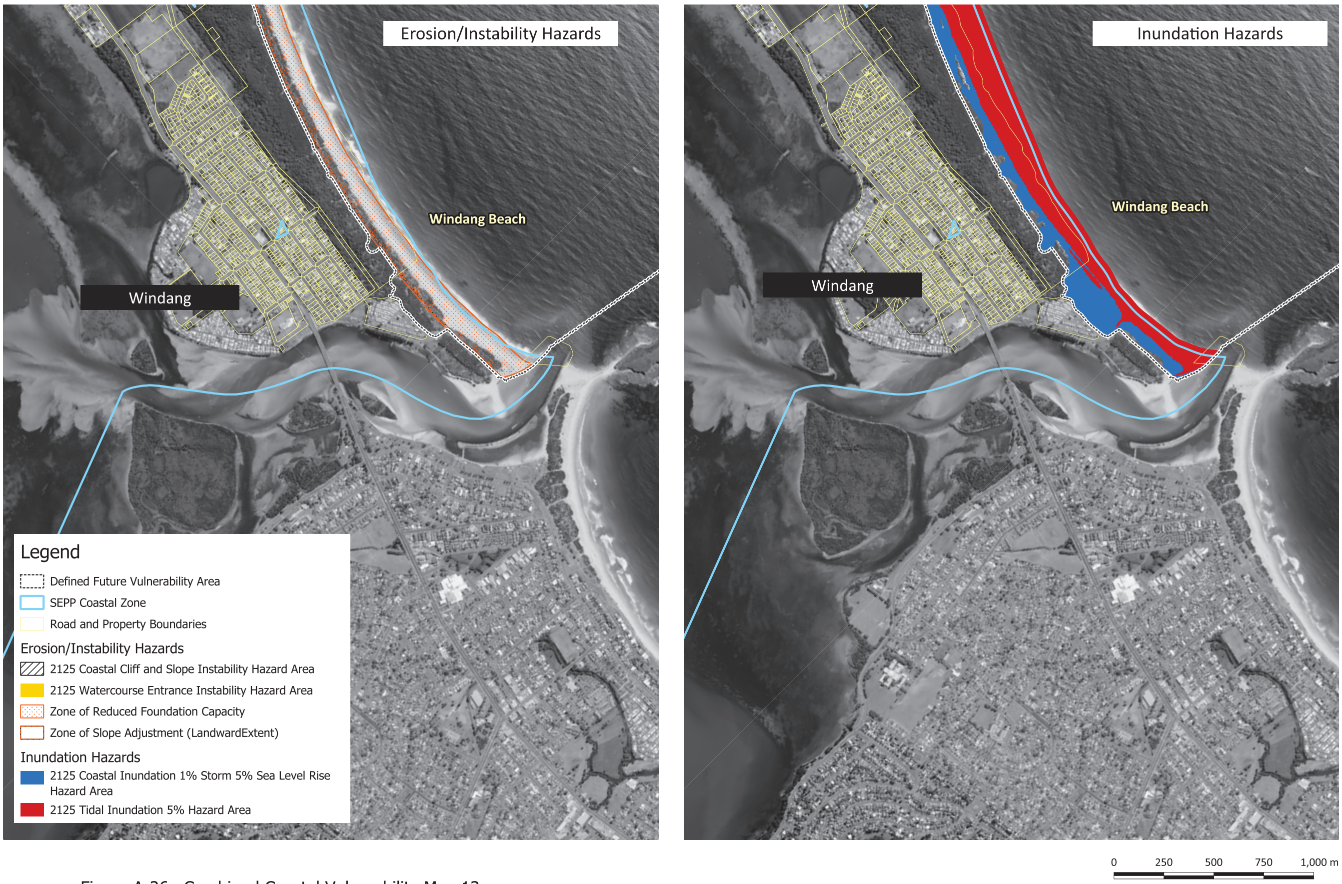

Figure A-26 Combined Coastal Vulnerability Map 12

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Appendix B Coastal Hazard Risk Workshops

B.1 Risk Assessment Workshops

The first step of this risk assessment process outlined in ISO 31000 (Standards Australia, 2018) is *risk identification*. Six workshops were held to assist with the formal identification of risks.

The risks that this study is concerned with are those arising from coastal hazards interacting with assets and public safety. In this regard, assets include both built assets (buildings, park furniture, roads etc.) and more natural or open space assets (beaches and dunes, natural areas, reserves, and parks).

The CM Act defines seven coastal hazards:

a) Beach erosion

b) Shoreline recession

c) Coastal lake or watercourse entrance instability

d) Coastal inundation

e) Coastal cliff or slope instability

f) Tidal inundation

g) Erosion and inundation of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters.

To help with risk identification, these hazards were divided into two overarching categories, relating to the main action which could have an impact on assets (either erosion/undermining, or inundation). This division is presented in Table B-1.

Table B-1 Classification of CM Act Hazards based on Damaging Action

Erosion/Undermining Hazards	Inundation Hazards
• Beach erosion / Shoreline Recession (considered together) • Coastal lake or watercourse entrance instability • Coastal cliff or slope instability • Erosion of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters.	• Coastal inundation • Tidal inundation • Inundation of foreshores caused by tidal waters and the action of waves, including the interaction of those waters with catchment floodwaters. (covered by coastal and tidal inundation)

To make the best use of workshop attendees' time during the workshops, an online introduction session was delivered on 6th March 2025 with all workshop attendees invited. That introduction session covered common background material relating to:

- The CMP Process.

- The seven coastal hazards.
- The risk assessment process, including the dimensions of likelihood and consequences (or 'severity').

Noting that the hazard assessments undertaken by this study address the 'likelihood' dimension, the workshop attendees were encouraged to focus on how severe the consequences of risks arising from erosion/undermining and inundation hazards could be, when considering a certain set of assets.

Each workshop focussed on a different set of assets. Details of the workshops, including the focus, date/time and attendees is presented in Table B-2

Table B-2 Risk Assessment Workshop Details

Asset Group	Date/Time	No. of Attendees	Represented Stakeholder Organisations
Stormwater and Transport	Wednesday 12 March 2025 9:00am-12:00pm	15	Transport for NSW, DCCEEW[18], WCC[19] (City Strategy, Infrastructure Strategy and Planning, Project Delivery).
Ecosystems	Wednesday 12 March 2025 2:00pm-4:30pm	14	Local Land Services, Department of Primary Industries and Regional Development (Fisheries), National Parks and Wildlife Service, DCCEEW, WCC (City Strategy, Open Space and Environmental Services).
Buildings and Residential Development	Thursday 13 March 2025 9:00am-12:00pm	23	State Emergency Services, DCCEEW, WCC (Infrastructure Strategy and Planning, Project Delivery, City Strategy, Development Assessment and Certification, Property and Recreation, Legal).
Water and Energy Services	Thursday 13 March 2025 2:00-4:30pm	5	Sydney Water, Endeavour Energy, DCCEEW, WCC (City Strategy),
Recreation and Open Space	Friday 14 March 2025 9:00am-12:00pm	18	Department of Planning, Housing and Infrastructure – Crown Lands, DCCEEW, WCC (Property and Recreation, City Strategy, City Works, Open Space and Environment Services, Project Delivery).
Royal National Park	Monday 24 March 2025 2:00-4:00 (online)	4	National Parks and Wildlife Service, DCCEEW, WCC (City Strategy).

Each workshop was split into two stages:

1 Brainstorming the nature of the risks.

2 Indicating a preliminary consequence level if the risk eventuates.

[18] Department of Climate Change, Energy, the Environment and Water.
[19] Wollongong City Council

In Stage 1, prompting questions to help participants identify and describe risks arising from both the erosion/undermining and inundation type hazards were provided. Questions varied between workshops, but were typically derived from the following generic questions:

- Is this type of asset/ecosystem resilient against the hazards?
- At what stage would the hazards start to impair function?
- At what stage would the hazards cause failure of the asset or irreversible damage to the ecosystem?
- Are there any knock-on effects?
- Could repeated exposure cause degradation?

In Stage 2, participants were asked to provide the preliminary consequence severity assessment based on the following three descriptors:

1 **Minor:** *"A bit concerning"* – Time to act.

2 **Major:** *"This is a problem"* – We should try to resolve prior to this.

3 **Catastrophic:** *"We've been irresponsible"* – Too late for strategic approach.

Participants at each workshop were typically split into 2-3 groups, and their responses during Stages 1 and 2 recorded for subsequent analysis. Participants were asked to take an open-minded approach to the task, noting that risks are, by their nature, uncertain, and that any process which aims to assess them will, to some extent, be imperfect. An outcome of the process is a set of notes relating to each category of assets, which provide more context around the risks associated with those assets and typical options that might be considered for managing the risk. The process captured a lot of information which has not necessarily been used in the present risk assessment but will prove useful during subsequent stages of the CMP process.

B.2 Workshop Outcomes: Risk Descriptions

The records from each group at each workshop took the form of either a video record (where a workshop was held online) or paper records from in-person workshops. Paper records were transcribed by Council and provided to the study team, and these were used as the primary source for formally identifying the risks.

Formal risk identification followed interpretation of the workshop outcomes to define risks using the following word formula:

There is a risk that a cause will lead to an event (or chain of events) resulting in an outcome with a set of consequences/impacts.

The following report sections are divided into the different asset groups addressed at the workshops. The "cause", "risk event" and "outcome/consequences/impacts" of the identified risks are tabulated in Section B.10, alongside the asset (or asset group) of concern and the assessed severity of the consequences. The cause of the risk is noted as either one of the specific coastal hazards, or more broadly as an erosion/undermining or inundation hazard. Additional notes are provided where relevant.

B.3 Coastal Hazard related Stormwater Risks

The stormwater assets considered during the workshop were:

- Culverts.
- Headwalls.
- Pits / Junctions / Converters.
- Pipes / Relines.
- Water Quality Devices.
- Weirs.
- Trash Racks.
- Scour Protection/Energy Dissipators/ Linings / Open Channels / Bank Support.
- Overland Flow Paths.

The tabulated risks from the workshop are listed in Table B-2, provided in Section B.10.

B.4 Coastal Hazard related Transport Risks

The transport assets considered during the workshop were:

- Roads.
- Retaining Walls.
- Pathways and Ramps.
- Road Furniture and Features (Roundabouts, Median Strips, Blisters, Speed Bumps, Guardrails, Pedestrian Islands., Bus Shelters).
- Car Parks and Parking Bays.
- Bridges.

The tabulated risks from the workshop are listed in Table B-3, provided in Section B.10.

B.5 Coastal Hazard related Ecosystem Risks

The different types of ecosystem assets considered during the workshop were:

- Coastal Wetlands - Saltmarshes (Coastal Saltmarsh EEC).
- Coastal Wetlands - Mangrove Forests.
- Coastal Wetlands - Freshwater (EEC: Sydney Freshwater Wetlands, Freshwater Wetlands on Coastal Floodplains).
- Coastal Wetlands - Coastal Swamp Forests (Swamp Oak Floodplain Forest, Swamp Sclerophyll Forest).
- Littoral Rainforests.
- Coastal Dunes (e.g. Bangalay Sand Forest EEC).
- Rock Platforms.
- Other EECs - Themeda Grasslands on Seacliffs.
- Other EECs - Southern Sydney Sheltered Forest.
- Other EECs - Illawarra Subtropical Rainforest.
- Other EECs - Illawarra Lowlands Grassy Woodland.

The tabulated risks from the workshop are listed in Table B-4, provided in Section B.10.

B.6 Coastal Hazard related Building and Residential Land Risks

The building and residential land assets considered during the workshop were:

- Residences.
- Residential Land.
- Amenities / Toilet Blocks / Administration Offices / Laundry.
- SLSC Buildings.
- Lifeguard Towers (Fixed).
- Lifeguard Towers (Relocatable).
- Boatsheds.
- Auxiliary Buildings (Pumphouse / Garage / Storage Shed).
- Kiosk / Café.

- Community Halls.
- Cabins (Tourist Park).
- Military / Heritage Features.

The tabulated risks from the workshop are listed in Table B-5, provided in Section B.10.

B.7 Coastal Hazard related Water, Wastewater and Energy Risks

The potable water supply and sewerage assets considered during the workshop were:

- Potable: Watermains and Fittings.
- Potable: Valves / Flowmeters, Gauges and Hydrants.
- Sewer: Treatment Plant.
- Sewer: Pressure Main, Fittings, Valves and Structures.
- Sewer: Conventional Main, Fittings, Valves, Gauges and Structures.
- Sewer: Low Pressure Pump System Components.
- Sewer: Chemical Dosing/Odour Control Units.
- Sewer: Pumping Station.
- Sewer: Overflow Storage Unit.

The study team do not have access to data mapping the assets of Endeavour Energy and those assets have not been subject to additional risk assessment. However, coastal hazard threats to Endeavour Energy assets were discussed more broadly, as in the notes to Table B-6, which lists the identified risks from the workshop and is provided in Section B.10.

B.8 Coastal Hazard related Recreation and Open Space Risks

The recreation and open space assets considered during the workshop were:

- Beaches.
- Parks, Reserves and Sportsgrounds (public land).
- Rock/Ocean Pools.
- Memorials.
- Playgrounds.
- Shelters / Picnic Facilities.

The tabulated risks from the workshop are listed in Table B-7, provided in Section B.10.

B.9 Coastal Hazard related Risks in the Royal National Park

The assets within the Royal National Park considered during the workshop were:

- Tracks / Steps
- Cabins/Shacks/Outhouses
- Camp Area
- EEC - Themeda Grassland on Seacliffs
- EEC - Littoral Rainforest

The tabulated risks from the workshop are listed in Table B-8, provided in Section B.10.

B.10 Preliminary Risk Register Tables

The risk register tables arising from interpretation of the information from the workshops is provided in subsequent sections.

Table B-2 Coastal Hazard Related Stormwater Infrastructure Risks

There is a risk that a *cause* will lead to an *event (or chain of events)* resulting in an *outcome* with a *set of consequences/impacts.*

ID	Asset / Asset Group	Cause	Event/Events	Outcome/ Consequences	Workshop Consequence Assessment	Notes
SW1	Stormwater Outlets	Erosion	Removes Sand / Undermines Structure	Less excavation required to effect retreat.		An erosion event which undermines an outlet, provides an opportunity to complete repairs without the need to remove excessive sand.
SW2	Stormwater Outlet / Pipe	Erosion	Erosion/Recession Process causes blockage inside pipes	Additional flooding.	Catastrophic	Sometimes storm events which cause erosion can also relocated sand to elsewhere on the beach and this may result in blockage of stormwater infrastructure
SW3	Stormwater Outlet / Pipe	Erosion	Erosion undermines structure	Collapse onto person or wash into ocean.	Catastrophic	c.f. SW1, the positive effect expressed by SW1 is negated if erosion is so severe that the outlet/pipe collapses.
SW4	Stormwater Outlet / Pipe	Erosion	Erosion undermines structure	Collapses and blockage of outlet.	Minor	For example, blockage of a beach outlet which drains a car park may cause prolonged inundation, which damages the pavement.
SW5	Stormwater Outlet / Pipe	Erosion	Erosion undermines structure, which discharges from pipe network running parallel to shore.	Collapses and blockage of outlet.	Moderate	Where the pipe is running parallel, an outlet may service a much larger catchment, meaning that the effectiveness of drainage from a larger area is impaired (therefore consequences greater than for SW4)
SW6	Stormwater Outlet /Pipe	Erosion	Erosion undermines structure	Irreparable damage and loss of asset.	Catastrophic	
SW7	Stormwater Outlet / Pipe	Erosion	Erosion undermines structure	Collapse, significant damage to adjacent assets and property, lasting for months.	Major	The secondary effects are important, again, because the stormwater infrastructure is often part of a broader 'development' or urban system comprising many interacting parts.
SW8	Seawalls and Creek Bank Support	Erosion	Erosion undermines structure, causing collapse.	Function lost, infrastructure being protected exposed.	Dependent (Case by Case Basis)	With these types of structures, the consequence is highly dependent on the assets that are being protected by the structure. This may include public risk, where formal beach access, such as stairs/ramps is integrated into the structure. Impacts may be on public or private property, cultural heritage, and possibly patches of vegetation (e.g. dune veg. next to a trained creek outlet). For an essential service (water/sewer/pump station etc.) if service is lost for more than 5 days, impact is considered Catastrophic.
SW9	Seawalls and Creek Bank Support	Erosion / Recession	Erosion on top of recession leads to collapse of structure. Replacement of "like for like" on a receding beach.	Loss of beach amenity (reduced width).	Dependant on Scale, may be catastrophic	In some locations along the Wollongong Coast, loss of beach width is likely to be irreversible. For example, northern end of Coalcliff Beach, where beach width in front of near vertical cliff is narrow.
SW10	All SW Assets	Erosion	Damage to infrastructure	Repairs implemented swiftly.	Minor	
SW11	Stormwater Outlet / Pipe	Erosion	Damage and blockage of outlet	Causes inundation of shared path for relatively short duration.	Minor	
SW12	Seawalls and Creek Bank Support	Erosion	Undermining and Failure of protective works	Damage to reserve being protected.	Minor	
SW13	Culverts / Pipes / Junctions / Pits	Inundation	Existing assets and networks not designed for extent of inundation	Degraded functionality over time	Minor	Issues are mostly minor if the impact is temporary. Can become problematic over time with increase frequency and/or severity (e.g. if combined with catchment rainfall)
SW14	Culverts / Pipes / Junctions / Pits	Inundation	Increased frequency of inundation by more saline water.	Loss of integrity (concrete and steel)	Variable	One example would be bolt jointed pipes. If these fail, ingress of bedding/backfill material into pipe can result in sinkholes and failure of the adjacent ground.
SW15	Overland Flow Paths	Inundation	Increased frequency of inundation by more saline water.	Loss of vegetation / change in vegetation community.	Variable	There are a suite of potential issues that could arise here. If vegetation which is relied upon for erosion protection is killed off, then erosion may be exacerbated. Alternatively, a previously grassed drainage swale may become intertidal and vegetation may change, increasing resistance to flow and exacerbating flooding.
SW16	Stormwater Outlet / Pipe	Inundation	Increased frequency of inundation by more saline water.	Degradation due to repeated inundation	Variable	Failure may cause issues with stormwater performance if blockage occurs.
SW17	Water Quality Devices	Inundation	Increased frequency means more resuspension of contaminated sediments.	Degraded performance, potential for perverse outcome of worse pollution	Variable	Proprietary items may not actually meet performance claims due to changed hydrologic environment. Potential to introduce environmental hazards (anaerobic conditions, introduction of nutrients)
SW18	Water Quality Devices	Inundation	Inundation by salt water and enhanced corrosion of metal parts and concrete.	Structural and functional failure.	Variable	
SW19	Weirs	Inundation	Tidal tailwater overtops weir crest.	Myriad of secondary factors upstream.	Variable	

Table B-2 Coastal Hazard Related Stormwater Infrastructure Risks

There is a risk that a *cause* will lead to an *event (or chain of events)* resulting in an *outcome* with a *set of consequences/impacts.*

ID	Asset / Asset Group	Cause	Event/Events	Outcome/ Consequences	Workshop Consequence Assessment	Notes
SW20	Scour Protection / Bank Support and Linings	Inundation	Gabion structures, wire cages corrode.	Failure of gabion elements, collapse.	Variable	Again, the consequences will depend on what the structure is protecting.
SW21	Scour Protection / Bank Support and Linings	Inundation	More rapid drawdown of groundwater, repetitive due to increased tidal variation.	Slumping of foreshore protection due to increased groundwater pressures	Variable	With these types of structures, the consequence is highly dependent on the assets that are being protected by the structure. This may include a difference between permanent loss of a recreation area (catastrophic) to minor (minimal damage that can be immediately remediated). There is potential for positive environmental impact, if the foreshore protection is removed and allowed to revert to a more natural foreshore protected by vegetation.
SW22	Stormwater Network	Inundation	Extreme or excessively repetitive inundation leads to failure of the network	Excessive property damage or injury/loss of life	Variable	This is variable, depending on the size of the network affected.
SW23	Stormwater Network	Inundation	Extreme or excessively repetitive inundation leads to failure of the network	Financial consequences of replacement	Variable	This is variable, depending on the size of the network affected.
SW24	WQDs/Trash Racks/ GPTs	Inundation	Excessively repetitive inundation results in loss of function	Pollution downstream of Device	Variable	Variability depends on scale of impact e.g. Catastrophic (investigation of EPA), Major (Ongoing and significant but repairable), Minor (Introduction of Litter across localised area).

Stormwater Risks Overarching and/or General Notes:

1. Function of stormwater infrastructure is generally robust providing that the system is not blocked.
2. Many headwalls at the coast don't have a formal apron, or there was once a rockfill apron which may have been eroded.
3. Stormwater infrastructure is often part of a larger system that works together. So adaptation needs to consider components of that larger system (roads, pathways, seawalls, car parks etc.). Retreat of the SW asset in isolation may not be practical and more broadscale planning may be required if the beach is suffering from chronic retreat.
4. Pipes around Austinmer SLSC are noted to not provide additional service (primarily for amenity). In this case consequence is likely minor.
5. Early planning for adaptation is important, if we aren't going to replace like for like. Without adaptation, we may end up with a lot of reactive maintenance.
6. An alternative to Stormwater quality improvement devices is to continue education within the community. Accordingly, these can potentially not be replaced (providing robust public education is undertaken)

7. Performance of stormwater system (cuverts, pipes, pits, junctions etc.) under inundation scenarios will depend largely on height and duration of inundation events.
8. For inundation risks, the frequency of the inundation is a major issue.
9. Reconfiguration of large stormwater networks could be expensive ($ millions order of magnitude)
10. A note was made that leachate from old landfill located within coastal and dune areas could be a problem with inundation risk. However, the geographical extent of these locations is not available.

Table B-3 Coastal Hazard Related Transport Infrastructure Risks

There is a risk that a _cause_ will lead to an _event (or chain of events)_ resulting in an _outcome_ with a _set of consequences/impacts._

ID	Asset / Asset Group	Cause	Event/Events	Outcome/ Consequences	Workshop Consequence Assessment	Notes
T1	Arterial Roads	Erosion/ Landslip	Causes collapse of structure/road (if not well protected)	Uncertainty around evacuation capability	Variable	Could be minor if travel lanes can still be driven on (but pedestrian movement impacted) Major impact - One lane impacted and/or detour available with limited capacity. Catastrophic - Road closed to traffic with no alternative.
T2	Collector Roads	Erosion/ Landslip	Causes collapse of structure/road (if not well protected)	Uncertainty around evacuation capability	Variable	Minor if travel lanes can still be driven on (but pedestrian movement impacted) Major impact - One lane impacted and/or detour available with limited capacity. Catastrophic - Road closed and local access can't be managed for greater than 24 hours
T3	Local Roads	Erosion/ Landslip	Causes collapse of structure/road (if not well protected)	Uncertainty around evacuation capability	Variable	Minor even if traffic can only move one-way Catastrophic - Access to >10 homes impacted for more than 24 hrs. For a smaller number of homes >5 days.
T4	Arterial Roads	Erosion/ Landslip	Causes collapse of structure/road (if not well protected)	Substantial expense to fix (has to be replaced)	Catastrophic	A corollary is the historical closure of the Lawrence Hargrave Drive due to risk, which eventually led to construction of the Sea Cliff Bridge.
T5	Local Roads	Erosion/ Landslip	Causes collapse of road (if not well protected)	Moderate expense to fix, vehicular property access affected but localised	Major	Likely to be fixable, but could still be quite expensive. Will need to be fixed. Pedestrian access is likely to remain.
T6	Local Roads	Erosion/ Landslip	Collapse of footpath	Need to organise diversion for pedestrians while being repaired + cost of repairs.	Minor	
T7	Local Roads	Erosion/ Landslip	Loss of Road Corridor	Increased exposure of private property.	Major	If a road is lost, you not only lose the asset, but access to private property is lost and there is potential exposure of that property to the hazard. Also, loss of services within the road corridor means that the property may not be properly serviced. There is a need to act in good faith to avoid this.
T8	Pathways/Cycle Ways	Beach Erosion	Loss of sections of pathway.	Loss of recreational function (also some commuting)	Variable	Most likely to be minor with retreat and reconfiguration often possible (not always). Major impact would be a long detour and increased travel time. Catastrophic - Route severed with no detour and no safe pedestrian options
T9	Retaining Wall	Erosion	Causes undermining	Loss of function	Variable	Refer to SW8. These structures tend to be expensive, but can be resilient (e.g. self launching toe and gradual failure). Minor, if undermined and requiring repair but still provides core function and stability. Major, Damaged such that detour and/or temporary support needed. Catastrophic, failure, movement and putting assets behind at risk.
T10	Road Pavement	Inundation	Consistent wetting via groundwater and inundation	Potholes and degradation.	Variable	
T11	Arterial Roads	Inundation	Water over Road	Impacts on haulage, Flood Evacuation capacity	Variable	Minor would be slight inundation around edges with speed reduction and warning signs. Major would be shoulder impacted, lane closure, reduction in capacity and aquaplaning risk. Catastrophic would be lanes not trafficable.
T12	Collector Roads	Inundation	Water over Road	Impacts on safety of drivers.	Variable	Monthly inundation would be a concern, can set a slower travel speed.
T13	Local Roads	Inundation	Water over Road	Impacts on safety of drivers.	Variable	Major Consequences would be $750 - 15M damage. Catastrophic impact would be not trafficable with road saturated for more than 24 hours and no ability to evacuate. Monthly inundation would be a concern, can set a slower travel speed. Eventually the depth would get too high, potential to aquaplane.
T14	Retaining Wall/Seawall	Inundation	Repeated Inundation effects on saturated soil.	Sudden collapse	Variable	The variability depends on the value of the asset being protected. In terms of the asset itself, a minor impact may result from inundation twice per year, major when the design capacity is exceeded and catastrophic could be more than five times in a year.
T15	Seawall	Inundation	Repeated Overtopping.	Loss of function	Variable	In terms of the asset function, a minor impact may result from inundation twice per year, major when the design capacity is exceeded and catastrophic could be more than five times in a year.
T16	Pathways/Cycle Ways	Inundation	Surface wetted	Safety issue (slips)	Minor	Could be more significant if a severe injury is sustained or someone lands awkwardly and knocks their head.

Table B-3 Coastal Hazard Related Transport Infrastructure Risks

There is a risk that a _cause_ will lead to an _event (or chain of events)_ resulting in an _outcome_ with a _set of consequences/impacts._

ID	Asset / Asset Group	Cause	Event/Events	Outcome/ Consequences	Workshop Consequence Assessment	Notes
T17	Pathways/Cycle Ways	Inundation	Pathway Materials deteriorate.	Need for earlier replacement	Minor	More frequent maintenance is an issue. Also, to reconstruct with different materials tends to be more expensive.
T18	Pathways/Cycle Ways	Inundation	Loss of sections of pathway.	Loss of recreational function (also some commuting)	Variable	Most likely to be minor with water over the surface, a minor inconvenience. Major impact would be a long detour and increased travel time. Catastrophic - Route severed with no detour and no safe pedestrian options, closed for a long time.

Transport Risks Overarching and/or General Notes:

1. Impacts would depend largely on how much the road erodes, i.e. is it just the edge of the road corridor, or part of the road shoulder or central lanes. Due to risks, erosion may not necessarily need to occur, the risk may already be too high before the road is directly impacted, resulting in closure.
2. It is difficult to separate impacts on the road (pavement) itself from other interacting infrastructure such as footpaths, curbs, buried services within the corridor.
3. Overall, it was considered that given current community expectations roads would not be allowed to be eroded, due to political pressure.
4. If a road becomes increasingly exposed to erosion events, it may need to be built to a higher standard to make it more robust.

5. Roads can be designed to withstand inundation (e.g. due to floods) but they use different materials and design techniques)
6. If roads are to be raised, we need to consider flood impacts of adjacent properties?
7. Inundation due to tides, where timing is well known is more manageable in terms of warnings and road closures, these could be planned for (if a warning system is set up).
8. There are several questions which need to be assessed by geotechnical engineers relating to the duration and frequency of saturation mthat might be acceptable, and the depth to groundwater and how this impacts pavement design. When is the pavemetn subgrade strength lost and how can inundation be designed for? Advice is that local and collector roads have issues when ground water gets within 500 to 600m of surface. For arterial roads, it tends to be if the groundwater gets to within 1.0m - as thicker pavements are present to take more load. It is possible to use an open grade top surface which allows some water in, but this is expensive.
9. For retaining structures, a design life of 100yrs is currently applied. Older structuer probably don't match that standard. Sudden collapse is possible following inundation.

Table B-4 Coastal Hazard Related Ecosystem Risks

There is a risk that a *cause* will lead to an *event (or chain of events)* resulting in an *outcome* with a *set of consequences/impacts.*

ID	Asset / Asset Group	Cause	Event/Events	Outcome/ Consequences	Workshop Consequence Assessment	Notes
E1	Coastal Saltmarsh	Tidal inundation	Rising tidal planes	Mangroves take over, meaning degradation of roosting/foraging habitat for migratory birds.		Coastal Saltmarsh tends to exist between MHWS and HAT, it will take some time for impact to be realised. Experience is showing, however, that saltmarsh is adept at colonising higher areas, providing there is no coastal squeeze effect (this is present at Towradgi Ck. Fairy Ck, Bellambi Lagoon.), and areas aren't mown.
E2	Swamp Oak Floodplain Forest	Tidal inundation	Rising tidal planes	Weeds may die off with increased salinity (positive risk).		Migration capability of swamp oak floodplain forest is limited, likely due to a lack of area to move. It can recover if left alone.
E3	Swamp Oak Floodplain Forest	Tidal inundation	Rising tidal planes	Increased / changed wave activity may affect seedling movement and survival.		
E4	Swamp Sclerophyll Forest	Tidal inundation	Rising tidal planes	Weeds (cockspur coral, asparagus fern) may die off with increased salinity (positive risk).		There is not much of this ecosystem left in Wollongong, Puckeys Estate is main example.
E5	Swamp Sclerophyll Forest	Tidal inundation	Rising tidal planes	Coastal Squeeze due to potential migration area being reclaimed.		Areas such as Bellambi and the Innovation Campus have been reclaimed.
E6	Bangalay Sand Forest	Groundwater Rise	Affects salinity in mesic, hind dune areas occupied by this community.	Migration, potential for coastal squeeze.		The effect may depend on local factors, such as existing groundwater salinity, local patches may already be tolerant?
E7	Bangalay Sand Forest	Erosion and Recession	Foredune lost	Community is damage by ongoing erosion, resulting in lost.		Once the remnant foredune is eroded, if the topography changes then there may end up being limited potential to adept in-situ and the composition of species may change. Potential dieback due to increased salinity.
E8	Freshwater Wetlands	Tidal Inundation	Weir dividing Bellambi Gully from Blue Lagoon overtopped by tides	Increasing salinity in Blue Lagoon, uncertain impacts on ecosystems relating to nutrients and anoxic material.		Note that the existing 'weirs' will be overtopped without too much additional sea level rise.
E9	Coastal Dunes	Recession	Dunes become gradually narrower	Area of dune vegetation lost over time		Across the Wollongong coast, there are many locations where the sand supply within the dune system is limited. This means that in some locations they may be lost for good.
E10	Rock Platforms	Recession	Rocky foreshores expand laterally as beaches disappear.	Rocky Platform ecosystems benefit as sand is scoured from underlying bedrock		Waves may become more active on rock platforms as well, resulting in the movement of rock, and the scouring and collapse of rock shelves.
E11	All Communities	Erosion/ Recession and inundation	Pressure on Ecosystems	Loss of 25% at a key location	Minor	In this instance there is potential to recover or remediate immediately with minimal resources and/or there is room to migrate. Also >25% loss can be considered minor if recovery is readily achievable.
E12	All Communities	Erosion/ Recession and inundation	Pressure on Ecosystems	>50% loss at a key location with damage continuing over the medium term, loss of connectivity.	Major	Significant effort would be required to accommodate change and/or repair/recover.

Table B-4 Coastal Hazard Related Ecosystem Risks

There is a risk that a _cause_ will lead to an _event (or chain of events)_ resulting in an _outcome_ with a _set of consequences/impacts._

ID	Asset / Asset Group	Cause	Event/Events	Outcome/ Consequences	Workshop Consequence Assessment	Notes
E13	All Communities	Erosion/ Recession and inundation	Pressure on Ecosystems	Complete, irreversible loss of a key (well presented & healthy) area of an ecosystem.	Catastrophic	Also affected by presence of room to move/ no capacity for regeneration.
E14	All Communities	Erosion/ Recession and inundation	Pressure on Ecosystems	Loss of protective functionality of a dune, including loss of vegetation	Catastrophic	

Ecosystem Risks Overarching and/or General Notes:
1. Overall, ecosystems do not fit cleanly inside the considerations of Coastal Vulnerability inside the coastal management act.
2. There is significant uncertainty surrounding response of key ecosystems to rising sea levels and it is difficult to assign specific consequences.
3. This risk identification exercise was undertaken with an open mind, noting that Ecosystems may need special consideration elsewhere in the CMP process.
4. There are opportunities to integrate saltmarsh into foreshore protection works, and/or to pre-emptively replace lawns with salt tolerant species that can be mown (e.g. *Sporobolus virginicus*).
5. There are exemplary patches between Windang and Primbee (behind Perkins Beach and around Bellambi Lagoon / Dunes).
6. Concern was raised about leachate from landfills at Perkins Beach, Bellambi and in dunes generally (not well recorded historically.
7. Loss of plant communities represents a reduction in carbon sequestration (impacts Council's climate change mitigation efforts).

Table B-5 Coastal Hazard Related Building and Residential/Commercial Land Asset Risks

There is a risk that a *cause* will lead to an *event (or chain of events)* resulting in an *outcome* *with a set of consequences/impacts.*

ID	Asset / Asset Group	Cause	Event/Events	Outcome/ Consequences	Workshop Consequence Assessment	Notes
BR1	Residential Land	Erosion/ Recession	Intense pressure for a seawall to be built and subsequent construction	Loss of beach width as the beach is squeezed between the seawall and the receding coastline, meaning that public access to the coast is diminished.		Access to the coast is an objective in the CM Act.
BR2	Residential Land	Erosion/ Recession	Residents who have purchased property along the coast (but were unaware of the risks) are concerned with risks as they arise	Pressure for council to spend money to "save" private land		
BR3	Buildings	Erosion/ Recession	Recession undermines Win Stadium	Very Expensive to protect /retrofit.		
BR4	Commercial Land	Erosion/ Recession	Erosion of Wollongong Golf Course	Holes are unplayable, need to be reconfigured.		
BR5	Hotels	Coastal Cliff Instability	Collapse of Cliffs	Hotels and adjacent areas become increasingly threatened.		There are several hotels located in the near vicinity of cliffs along the northern coastline of Wollongong. This also applies to schools such as at Scarborough.
BR6	Residence	Erosion/Instability	The erosion and instability progresses in vicinity of a property	Process is notable but has not encroached on the property and is not impacting access	Minor	
BR7	Residence	Erosion / Recession/ Instability	The erosion and instability progresses	Begins to impact on services to the property and use of open space around the house. Minor damage to building but can still live there.	Major	
BR8	Residence	Erosion / Recession/ Instability	The erosion and instability progresses	Residence is unsafe to live in.	Catastrophic	
BR9	School	Erosion / Recession/ Instability	The erosion and instability progresses	Disruption to operations	Minor	
BR10	School	Erosion / Recession/ Instability	The erosion and instability progresses	Instability to features such as playgrounds, close section of school yard or services impacted	Major	
BR11	School	Erosion / Recession/ Instability	The erosion and instability progresses	School is unsafe	Catastrophic	
BR12	Businesses (e.g. Golf Club/Hotel/Industrial	Erosion / Recession/ Instability	The erosion and instability progresses	Occasional disruption	Minor	

Table B-5 Coastal Hazard Related Building and Residential/Commercial Land Asset Risks

There is a risk that a *cause* will lead to an *event (or chain of events)* resulting in an *outcome* with a *set of consequences/impacts.*

ID	Asset / Asset Group	Cause	Event/Events	Outcome/ Consequences	Workshop Consequence Assessment	Notes
BR13	Businesses (e.g. Golf Club/Hotel/Industrial	Erosion / Recession/ Instability	The erosion and instability progresses	Properties become uninsurable / impracticably expensive.	Major	
BR14	SLSC Buildings	Erosion/ Recession/ Instability	Building damaged	Impact on Community events	Minor	
BR15	SLSC Buildings	Erosion/ Recession/ Instability	Building damaged	Impact on service delivery, expensive to repair, potential environmental contamination	Major	Also, knock on impact for staff, café's, functions and inability to use by community. Potential loss of income to Council $150-200K per year.
BR16	SLSC Buildings	Erosion/ Recession/ Instability	Building Severely Damaged	Closure	Catastrophic	There are other risks associated with fuel spills, failure of onsite wastewater systems and other services (grease trap from Kiosk?). SLSC buildings often don't have strong foundations. Plus reputational damage for Council due to unmet expectations. May have economic implications for SLS NSW.
BR17	Lifeguard Towers and Boatsheds	Erosion/ Recession/ Instability	Building damaged	Impact on service delivery, recreation, expensive to repair/replace	Variable	Some of these may be relocatable. Replacement of boatshed ~ $100-$300K, Portable lifeguard tower $40-$50K - generally can be done within a few weeks. Minor impact would be on WCC lifeguard services. Major impact arises when Community events are affected.
BR18	Tourist Park Cabins (Council owned)	Erosion/ Recession/ Instability	Damage or loss	Impact on income generation capacity for Council, noting front row cabins are most at risk.	Variable	Some of these may be relocatable.
BR19	Tourist Park Access (Council owned)	Erosion/ Recession/ Instability	Damage or loss	Impact on income generation capacity across entirety of park.	Variable	Potential impact on semi-permanent residents (also used for emergency accommodation). Loss of land value. Perception may influence viability of tourism overall.
BR20	Tourist Park Access (Private owned)	Erosion/ Recession/ Instability	Damage or loss	Major for owner /operator.	Major	Similar to council owned, except impact is likely more keenly felt by private owner.
BR21	Kiosk	Erosion/ Recession/ Instability	Minor Damage or Loss	Community/Social Impact	Minor	
BR22	Kiosk	Erosion/ Recession/ Instability	Major Damage or Loss	Loss of financial revenue (WCC), loss of uninsured asset	Major	
BR23	Kiosk	Erosion/ Recession/ Instability	Loss of Building	Loss of financial revenue (WCC), loss of uninsured asset	Catastrophic	
BR24	Tourist Park	Erosion/ Recession/ Instability	Undermines Building	Affect tourism to area, impact on staff / employment	Major	
BR25	Tourist Park	Erosion/ Recession/ Instability	Severe erosion	Loss of Life, economic impacts, social housing (also semi-permanent residents)	Catastrophic	
BR26	Heritage Buildings and items	Erosion/ Recession/ Instability	Damage or loss	Loss of heritage value.		Heritage value could also be lost if it is relocated. There would be costs for relocation or protection.
BR27	Heritage Buildings and items	Erosion/ Recession/ Instability	Minor damage	Minor repairs to maintain heritage values.	Minor	
BR28	Heritage Buildings and items	Erosion/ Recession/ Instability	Significant damage	Remediation and repair needed	Major	

Table B-5 Coastal Hazard Related Building and Residential/Commercial Land Asset Risks

There is a risk that a _cause_ will lead to an _event (or chain of events)_ resulting in an _outcome_ with a _set of consequences/impacts._

ID	Asset / Asset Group	Cause	Event/Events	Outcome/ Consequences	Workshop Consequence Assessment	Notes
BR29	Heritage Buildings and items	Erosion/ Recession/ Instability	Complete loss	Unsalvageable	Catastrophic	Note that rankings associated with heritage items will be contextual.
BR30	Residence	Inundation	Groundwater levels rise	Impacts to sewerage and drainage.	Minor	Groundwater levels around Windang are known to be high. People may look for a workaround such as illegal connections.
BR31	Residence	Inundation	Above floor level inundation (even just once)	Severe Damages result	Catastrophic	There are acknowledged impacts which follow from above floor inundation including mould, contamination by sewage and subsequent clean up costs.
BR32	Residence	Inundation	Groundwater levels rise	Destabilisation / disintegration of older style brick pier foundations	Major	
BR33	Residence	Inundation	More frequent, higher inundation of properties.	Damage external to house (power points, air-conditioning units, pool filters and pumps, hot water systems, meters and services)	Minor	
BR34	Residence	Inundation	More frequent, higher inundation of properties.	Small portion of yard affected	Minor	
BR35	Residence	Inundation	More frequent, higher inundation of properties.	Regular inundation of significant portion of yard / basement flooding.	Major	
BR36	SLSC Buildings	Inundation	Minor inundation (Surrounds / sheds)	Affects service delivery	Minor	
BR37	SLSC Buildings	Inundation	Over floor flooding	Potential environmental contamination, damage to building	Major	
BR38	Lifeguard Towers and Boatsheds	Inundation	Minor inundation (Shed floor)	Impact on Service delivery and potential impact of pollution (from materials stored in boatshed)	Minor	
BR39	Kiosks and Cafes	Inundation	Minor inundation (Surrounds, outdoor eating areas)	Community Impact	Minor	
BR40	Kiosks and Cafes	Inundation	Over floor inundation	Asset damage, lost ability to operate. Environmental contamination.	Major	There are both social and economic impacts related to business closure. Potential ongoing impact if there is repeated inundation events.
BR41	Tourist Parks	Inundation	Extensive and repeated ground inundation	Tourism losses and impacts to operation.	Major	
BR42	Tourist Parks	Inundation	Over floor flooding, inability to evacuate	Loss of life	Catastrophic	
BR43	All Buildings (council / utilitarian buildings)	Inundation	All levels of inundation	Rust and Decay of materials and rising damp	Variable	Depends on the scale of the impact and materials of construction. Impact way be slow to occur, and already being felt in some locations. Likely to become increasing burden.
BR44	All Buildings (council / utilitarian buildings)	Inundation	Internal Annual inundation	Minor cleaning required, no structural damage.	Minor	

Table B-5 Coastal Hazard Related Building and Residential/Commercial Land Asset Risks

There is a risk that a _cause_ will lead to an _event (or chain of events)_ resulting in an _outcome_ with a _set of consequences/impacts._

ID	Asset / Asset Group	Cause	Event/Events	Outcome/ Consequences	Workshop Consequence Assessment	Notes
BR45	All Buildings (council / utilitarian buildings)	Inundation	Increased severity of inundation	Structural damage, issues with integrity that can be repaired.	Major	The ongoing increase in impacts as sea levels rise may be offset by elevating or moving the structure.
BR46	All Buildings (council / utilitarian buildings)	Inundation	Extremely severe inundation.	Building unusable and needs to be demolished.	Catastrophic	In this instance, unlikely to safely relocate or elevate the structure. Complete rebuild required at different location.

<u>Buildings and Residential Land Overarching and/or General Notes:</u>
1. Expensive real estate is present along the coastline, and in some cases expensive solutions have already been put in place for newer development.
2. Older housing stock may be vulnerable to instability, alongside cliff top buildings.
3. The existing possibility of dual occupancies being built in at-risk areas is a concern.
4. It is noted that stormwater can contribute to instability (however this is not included as a coastal hazard in the CM Act).
5. There may be a lack of awareness of insurance costs rising in the future, or disbelief that the risks are real - leading to reluctance for action.
6. In some instances, there may be easy wins, such as raising power outlets in residential properties which are otherwise resilient to inundation.
7. There may be knock on effects (e.g. inundation en route to a business may limit foot traffic)
8. Generally speaking, memorials (there are limited examples) can be relocated if necessary.
9. There are threatened heritage buildings - boatsheds at Bulli (uncertainty around legality of these), and Military tunnels.

Table B-6 Coastal Hazard Related Utility, Potable Water and Wastewater Asset Risks

There is a risk that a *cause* will lead to an *event (or chain of events)* resulting in an *outcome* with a *set of consequences/impacts.*

ID	Asset / Asset Group	Cause	Event/Events	Outcome/ Consequences	Workshop Consequence Assessment	Notes
UW1	Electrical distribution	Erosion or Inundation	Damages local electricity network.	Isolates a row of houses	Minor	
UW2	Electrical distribution	Erosion or Inundation	Damages local electricity network.	Line down and electrocution risk introduced.	Major	Typically, the length of concern would be isolated and switched off as soon as possible, and this can be done remotely. Existing public safety awareness campaigns are also a control
UW3	Electrical distribution	Erosion or Inundation	Damages local electricity network.	Takes out water or sewer infrastructure (e.g. pumping station)	Major	Potential overflow and environmental pollution risk.
UW4	Water Service	Erosion	Collapse of line servicing particular area	Loss of service and need to replace.	Major	Example here is from experience in Austinmer, where a robust replacement line cost estimates were up to $6M per customer to resupply. Financial risks can be significant.
UW5	Wastewater System	Inundation	Wastewater Overflow	Environmental Impacts	Minor	
UW6	Wastewater System	Erosion	Loss of access to facilities	Costly to replace	Major	
UW7	Wastewater System	Erosion	Damage to submain	Discharge to lagoons resulting in Public Health impacts.	Major	
UW8	Wastewater System	Inundation	Repeated inundation of low lying WWTP at Wollongong	Facility becomes dysfunctional, needs replacement (expensive)	Catastrophic	$500M - $600M

Utilities, Potable Water and Wastewater Overarching and/or General Notes:

1. Only general discussion was provided regarding electricity services. Historically, Endeavour Energy has focussed on natural hazard risks from bushfire, floods, storms (wind and rain), and heat waves. EE assets around Wollongong typically involve 132kV transmission lines at the back of the escarpment, 33kV local sub-transmission down the escarpment and then 11kV high voltage for local distribution. Most high voltage distribution lines sit well back from the coast, so broad scale impacts from coastal erosion are considered a minor issue. There is one location where a pole is located in proximity to the coast (11kV line near Slacky Creek). Coastal Erosion is only likely to be a localised issue, with small groups of houses losing power during an event.
2. Regarding inundation, there may be some issues. Infrastructure is often squeezed into narrow available corridors along low lying land. Repeated inundation may have an impact on foundations, as dry compacted soils are required. Given the time frame for expected impact this can be planned for, but it may come at a cost - one solution is to take local distribution underground, but this is about 10X more expensive. Aside from poles and wires, substations (typically a transformer and switches, taking 11kV down to 400V for local distribution) may also be on low lying land.
3. The sewer system can have sections isolated (part of design, to manage WHS risk). However, water is more distributed.
4. On the flip side, the potable water system is better sealed.
5. There are known performances with the South Wollongong WW system, non compliant under the existing EPL.
6. Newer WW assets tend to be more resilient.
7. The Bellambi and Port Kembla Plants are "Stormwater Plants" - which only receives inflow during storm and undertakes primary treatment (screening) before discharge to the nearshore. They are part of the broader Wollongong System. Wollongong discharges to an ocean outfall offshore of Coniston Beach, following tertiary treatment. The Wollongong Plant is low lying.

Table B-7 Coastal Hazard Related Recreation and Open Space Asset Risks

There is a risk that a *cause* will lead to an *event (or chain of events)* resulting in an *outcome* with a *set of consequences/impacts.*

ID	Asset / Asset Group	Cause	Event/Events	Outcome/ Consequences	Workshop Consequence Assessment	Notes
RO1	Rock Pools	Erosion	Erosion landward of pool	Prevents access, outflanking of steps		
RO2	Rock Pools	Erosion	Loss of support from edges	Cracking and gradual failure		
RO3	Thirroul Pool	Erosion	Undermining of Seawall	Exposes parts of intake structure		
RO4	Beach	Erosion	Exposure of burial sites in back beach escarpment	Damage to cultural heritage		
RO5	Beach Access	Erosion	Collapse and loss of sand from bottom of access	Public Safety Risk. Potential beach closure	Minor	There are 120 formal walkways and repair (slumping) of these post storm events is a key focus of Council's dune crew. Issues are expected to accelerate with sea level rise. May eventually need to install stairs.
RO6	Beach	Recession	Beach recedes backwards with fixed landward barrier (e.g. cliff)	Complete loss of beach		
RO7	Beach Access	Erosion	Collapse and loss of sand from bottom of access	Public Safety Risk. Inability of first responders (SLS) to access beach.	Major	
RO8	Beach Access	Erosion	Sand scarp remains during storm.	Collapse and burial of children, loss of life.	Catastrophic	
RO9	Rock Pools	Erosion	Temporarily disconnects pool from landward access.	People can't access pool temporarily.	Minor	
RO10	Rock Pools	Erosion	Permanent loss of easy access to pool.	Pool functionally inaccessible. Also means that it can't be maintained.	Major	
RO11	Rock Pools	Erosion	Damage and loss of function	Loss of pool as an asset.	Catastrophic	
RO12	Beach Access	Erosion	Collapse and loss of sand from bottom of access	Public Safety Risk. Inability of first responders (SLS) to access beach.	Major	
RO13	Cemeteries	Erosion	Generally, issues would relate to loss of furniture and trees.	Money required for replacement	Minor	
RO14	Parks and Reserves	Erosion	Loss of recreation opportunities, Impacts on maintenance	Increased maintenance cost	Minor	
RO15	Parks and Reserves	Erosion	Relocation of major events	Reputational and public liability risks	Major	
RO16	Playgrounds	Erosion	Safety is compromised	Loss of important community service, or replacement elsewhere, reputational risk	Major	Possible issue with pollution if fill material on which playground was constructed is contaminated. This can also stretch Council resources. However, if managed appropriately, playgrounds are inherently relocatable (may be easier said than done when considering a receding shoreline (e.g. Windang).
RO17	Parks and Reserves - Furniture	Erosion	Threatens assets.	Need to relocate.	Minor	Bin enclosures, seats, tables, benches, signs, viewing platforms.
RO18	Fencing	Erosion	Loss / Damage of Asset	Need to relocate/replace	Minor	
RO19	Beach Access Tracks, Mats, Stairs	Erosion	Loss / Damage of Asset	Need to replace	Minor	
RO20	Beach Access Tracks, Mats, Stairs	Erosion	Affects usability of Accessway	Temporary Restricted Access	Minor	
RO21	Rock Pools	Inundation	Higher tidal inundation results in more infilling	Need for more maintenance.		There may be a need to re-design and raise pools - but access may be difficult.
RO22	Rock Pools	Inundation	Higher tides mean more wave overtopping	Pool becomes less safe and user friendly.		Once the pool is low (e.g. Austinmer) the cost for remedial works becomes high.
RO23	Ocean Pool (Thirroul)	Inundation	Higher tides mean more sand carried into outlet	More frequent need for maintenance, expensive.		
RO24	Rock Pools	Inundation	Higher tides mean landward facilities need remedial work.	Costly to rectify or function is lost.		

Table B-7 Coastal Hazard Related Recreation and Open Space Asset Risks

There is a risk that a *cause* will lead to an *event (or chain of events)* resulting in an *outcome* with a *set of consequences/impacts.*

ID	Asset / Asset Group	Cause	Event/Events	Outcome/ Consequences	Workshop Consequence Assessment	Notes
RO25	Beach	Inundation	Higher tides mean associated facilities become unusable.	Usability of beach by public is degraded		
RO26	Rock Pools	Inundation	Inundated a few days a year due to king tide, or temporary restrictions due to storm surge.	Minor interruption to usability	Minor	Probably not a great place to be during storm surge anyway.
RO27	Rock Pools	Inundation	More frequent inundation, during spring tides (say 1-2 times per month)	Frequent interruption to usability and maintenance becomes expensive and challenging.	Major	There will be a more frequent need to remove wildlife from pools.
RO28	Rock Pools	Inundation	Underwater every high tide	No longer functional nor maintainable. Likely too dangerous.	Catastrophic.	
RO29	Ocean Pools	Inundation	Increase in water levels may reduce the window available for maintenance.	Difficult to maintain.	Minor	
RO30	Ocean Pools	Inundation	Water levels render mechanical pumping system inoperable.	Complete reconfiguration/ re-engineering required.	Major	
RO31	Sports Ground	Inundation	Loss of Service / Recreation / failure of drainage system to operate.	Inoperable for hours/days. Increased cost of maintenance and reduction in asset life	Minor	It is difficult to consider which will have more impact: More frequent coastal storms on a higher water level? Or increased normal storm frequency.
RO32	Sports Ground	Inundation	Complete loss of functionality due to frequency of inundation	Loss of asset	Catastrophic	Replacement cost would be useful.
RO33	Trees	Inundation	Increased salinity	Death of Trees, need for replacement	Minor	

Recreation and Open Space Overarching and/or General Notes:
1. There are 9 rock pools all up they are expected to be well founded and resistant to erosion.
2. There are three other pools "Ocean Pools" - Continental, Thirroul and Port Kembla - which are more formal, not as integrated into a rock platform. Continental pool has had a recent seawall installed so expected to be robust against inundation.
3. Austinmer is the lowest level pool.
4. Sand Drift is an ongoing issue at some rock pools (Bulli, Towradgi) - but this process is not considered a hazard under the CM Act.
5. Based on historical experience, there is shallow bedrock at Puckeys (south of Fairy Ck.), McCauleys (rock and clay), Coalcliff, Sharkys, Sandon Point, and northern end of Coledale Beach.
6. At sandy beaches, recovery has historically been quick.
7. Beaches provide a protective function and sometimes, the value associated with loss will relate to the asset it is protecting (e.g. SLSC Club, WIN Stadium).
8. With regards to park furniture, assets etc. the provision of lifting lugs and other provisions to make relocation with a crane easier is a sensible design consideration.

Table B-8 Coastal Hazard Related Royal National Park Asset Risks

There is a risk that a _cause_ will lead to an _event (or chain of events)_ resulting in an _outcome_ with a _set of consequences/impacts._

ID	Asset / Asset Group	Cause	Event/Events	Outcome/ Consequences	Workshop Consequence Assessment	Notes
NP1	Shacks at Bulgo	Erosion/ Inundation	Inundation and erosion become more frequent and impactful with time	Shacks become uninhabitable.		Many of these shacks are already precariously located and exposed at the present time. This is going to get worse and there is very limited room for retreat. These are more at risk than the northern 3 communities (Burning Palms / Era and Little Garie are state heritage listed. More collaborative and engaged with the NPWS.
NP2	Shack Communities	Erosion (Mainly)/ some inundation	Unsewered sites, with long drop toilets, affected by cliff collapse / erosion	Untreated Sewage Pollution		
NP3	Roads (Garie)	Cliff Instability	Road Destabilised	Access Blocked		Destabilisation of the road down to Garie (north of LGA) has resulted in access shut for a few years now.
NP4	Era SLSC	Foreshore Erosion	Founding conditions destabilised	loss or damage to building.		Some photos available from newspaper reports looked like the situation was more of a concern than it actually is based on feedback from NPWS staff)
NP5	Burning Palms Boat Shed	Erosion	Beach Erosion	Boat shed undermined and collapses.		SLSC building is further up the hill.
NP6	Walking Tracks (particularly Royal Coast Site and Great Southern Walk)	Cliff Instability/ Erosion	Pathway is washed away	Walking Severs existing walking trail.		The coast track at Bulgo, has been relocated in the vicinity of the large landslide from 2022. Walking track down to Werrong has been closed for several years due to instability in the final 50-60m (cultural aspect is that this is a nude beach). This stuff is extremely costly.
NP7	Walking Track, Little Garie (middle rill)	Cliff Instability/ Erosion and Inundation	Collapse of cliff onto pathway	Trail Severed		There may be a need to relocate this track onto the headland? With sea level rise it will become right exposed.
NP8	Littoral Rainforest at Little Garie	Foreshore Erosion	Middle Rill Creek Line (Little Garie), banks eroding during storms (rain and coastal)	Loss of fringing Littoral Rainforest		
NP9	Figure 8 Pool	Inundation	Wave overtopping of the platform	Safety Impacts.		Public safety is the concern. At present recommended that people go with a registered third party guide. Most frequented remote location in the park. - Similar messages for Figure 8 pool could be used by council regarding their rock pools.
NP10	Era SLSC	Inundation	Potential over floor flooding in future	Damage to SLSC equipment / interruption of service.		Some photos available from newspaper reports looked like the situation was more of a concern than it actually is based on feedback from NPWS staff).
NP11	Walking Trails	Erosion/ Inundation	Damage or threat	Minor realignment of trails to maintain access	Minor	
NP12	Coastal Shacks	Erosion/ Inundation	Damage to single cabin (predictable and not catastrophic)	Shack would be removed.	Minor	
NP13	Coastal Walk	Erosion/ Inundation	Damage to large section of trail	Prolonged Closure (many years) and economic impact	Major	
NP14	Access Tracks	Erosion/ Inundation	Closure	Knock on impacts for surf club, kiosk.	Major	Example is what has happened at Garie, could be catastrophic at the "Garie" scale, but not the park as a whole.
NP15	Occupied Structure	Erosion/ Inundation	Unexpected loss.	Impact to human safety/ loss of life. Introduction of waste (e.g. asbestos) to environment.	Catastrophic	
NP16	Area of EEC	Erosion/ Inundation	Either undermining or inundation with salt water.	Complete loss of EEC Area	Catastrophic	
NP17	Significant Heritage Asset	Erosion/ Inundation	Undermining or degradation due to regular inundation.	Complete loss of Asset.	Catastrophic	

Royal National Park Overarching and/or General Notes:
1. NPWS are concerned about existing built assets in coastal hazard zones and aboriginal heritage assets as well. Also important in the planning of new assets.
2. There is an important Aboriginal heritage site at North Era.
3. Themeda Grasslands - no major concerns of modifications proposed. Interface between Themeda Grasslands and Littoral Rainforest an issue with Deer.
4. When shacks get lost, they normally aren't replaced / re licensed.
5. A lot of the demise of the shack communities has been predictable and partly planned for, therefore not catastrophic.

Appendix C Asset Data and Maps

Appendix C1 Preliminary Asset Data Processing

At the heart of the risk assessment process is the geographical intersection of hazard extents with the location of various assets. Council provided the study team with a wide variety of files, including GIS files and spreadsheets with asset data for linking. Originally a set of ESRI formatted shapefiles were derived for different asset types, as listed in Appendix E. Derivative files were subsequently prepared, including additional valuation information and subsets of the assets, depending on how they were to be treated during the GIS based intersection operation. Differences in the treatment (for example complete loss upon intersection vs. proportional loss) for different assets is explained in the tables presented in Appendix E. Sydney Water assed data were used for the risk assessment but not included on maps in Appendix C2.

It is the set of those derivative files which has been provided as a deliverable for this project. The different shapefiles and the source information used in their derivation is presented in Table C1. Often, GIS layers were linked with excel spreadsheets provided by Council, with the linking field being an asset ID number or similar, as advised to the study team by Council. During this process, it was clear that there was substantial valuation information missing, and values were introduced (either as per unit, per metre, or per square metre rates) to many layers as necessary to follow the process outlined in Appendix E. Finally, the vast proportion of fields present in the shapefiles (after linking) were deleted as those were of minimal interest to the risk assessment. Only fields useful for subsequent identification of individual assets (if present in the underlying data) were retained, to reduce the size of the datasets and to streamline subsequent processing.

Table C1 Source data and Processing of Asset Files for Risk Assessment

ID	Asset Class	Shapefile Name	Sources/Discussion
1.01	1. Stormwater	Stormwater_Lines_Risk_Final	"\HazardsCMP.gdb\Assetdata_MAPPING_Stormwater_pl", linked to "Stormwater.xlsx", mainly pipes and culverts with some creek reaches
1.02	1. Stormwater	Stormwater_Points_Risk_Final	"\HazardsCMP.gdb\Assetdata_MAPPING_Stormwater_pt", linked to "Stormwater.xlsx", mainly pits and junctions with some water quality devices.
1.03	1. Stormwater	Stormwater_Points_Risk_WQDEVICES_Final	Subset of 1.02, including only WQDEVICES, as these have a different interaction with inundation hazards.
1.04	1. Stormwater	Stormwater_Polygons_Risk_Final	"\HazardsCMP.gdb\Assetdata_MAPPING_Stormwater_po", linked to "Stormwater.xlsx", variety of assets including trash racks, weirs, and scour protection.
1.05	1. Stormwater	Stormwater_Polygons_Risk_COASTALINUNDATION_FREQUENCY_Final	Subset of 1.04, including only those assets deemed lost when coastal inundation exceeds a given frequency
1.06	1. Stormwater	Stormwater_Polygons_Risk_EROSION_PROPORTIONAL_Final	Subset of 1.04, including only those assets deemed proportionally lost by erosion type hazards

ID	Asset Class	Shapefile Name	Sources/Discussion
1.07	1. Stormwater	Stormwater_Polygons_Risk_EROSION_TOTAL_Final	Subset of 1.04, including only those assets deemed totally lost when intersected at all by erosion type hazards
1.08	1. Stormwater	Stormwater_Polygons_Risk_TIDALINUNDATION_COMPLETE_Final	Subset of 1.04, including only those assets deemed completely lost when any tidal inundation begins to occur
1.09	1. Stormwater	TfNSW_Culverts_Risk_Final	TfNSW_Culverts - containing culverts managed by TfNSW.
1.10	1. Stormwater	TfNSW_Pits_Risk_Final	TfNSW_Drainage_Pits - containing pits managed by TfNSW.
2.01	2. Transport	Transport_Lines_Risk_Final	"\HazardsCMP.gdb\Assetdata_MAPPING_Transport_pl", linked to "Transport.xlsx", Includes footpaths, fencing, ramps and retaining structures (some seawalls)
2.02	2. Transport	Transport_Lines_Risk_EROSIONCOMPLETE_Final	Subset of 2.01, including only those assets deemed totally lost when intersected at all by erosion type hazards
2.03	2. Transport	Transport_Lines_Risk_EROSIONPROPORTIONAL_Final	Subset of 2.01, including only those assets deemed proportionally lost by erosion type hazards
2.04	2. Transport	Transport_Lines_Risk_COASTALINUNDATION_FREQUENCY_Final	Subset of 2.01, including only those assets deemed lost when coastal inundation exceeds a given frequency
2.05	2. Transport	Transport_Lines_Risk_TIDALINUNDATION_COMPLETE_Final	Subset of 2.01, including only those assets deemed completely lost when any tidal inundation begins to occur
2.06	2. Transport	Transport_Lines_Risk_TIDALINUNDATION_PROPORTIONAL_Final	Subset of 2.01, including only those assets deemed proportionally lost by tidal inundation
2.07	2. Transport	Transport_Points_Risk_Final	"\HazardsCMP.gdb\Assetdata_MAPPING_Transport_pt", linked to "Transport.xlsx", Includes traffic calming devices, parking bays, roundabouts, bus shelters, speedhumps and the like.
2.08	2. Transport	Transport_Points_Risk_COASTALINUNDATION_FREQUENCY_Final	Subset of 2.07, including only those assets deemed lost when coastal inundation exceeds a given frequency
2.09	2. Transport	Transport_Points_Risk_TIDALINUNDATION_COMPLETE_Final	Subset of 2.07, including only those assets deemed completely lost when any tidal inundation begins to occur
2.10	2. Transport	Transport_Polygons_Risk_EROSIONCOMPLETE_Final	Subset of 2.07, including only those assets deemed totally lost when intersected at all by erosion type hazards
2.11	2. Transport	Transport_Polygons_Risk_EROSIONPROPORTIONAL_Final	Subset of 2.07, including only those assets deemed proportionally lost by erosion type hazards
2.12	2. Transport	Transport_Polygons_Risk_Final	"\HazardsCMP.gdb\Assetdata_MAPPING_Transport_po", linked to "Transport.xlsx", Includes car parks and retaining walls
2.13	2. Transport	Transport_Polygons_Risk_EROSIONCOMPLETE_Final	Subset of 2.12, including only those assets deemed totally lost when intersected at all by erosion type hazards
2.14	2. Transport	Transport_Polygons_Risk_EROSIONPROPORTIONAL_Final	Subset of 2.12, including only those assets deemed proportionally lost by erosion type hazards
2.15	2. Transport	Transport_Polygons_RoadSegments_Risk_Final	"\HazardsCMP.gdb\Assetdata_MAPPING_Transport_pl_RoadSegments", linked to "Transport.xlsx", Buffered by road width from spreadsheet to form polygons
3.01	3. Ecology	Ecology_CoastalWetlands_Risk_Final	Derived from RH SEPP Mapping of Coastal Wetlands
3.02	3. Ecology	Ecology_EEC_Risk_Final	\HazardsCMP.gdb\environmentdata_ENVIRONMENT_NP_EEC
3.03	3. Ecology	Ecology_LittoralRainforest_Risk_Final	Derived from RH SEPP Mapping of Littoral Rainforests

ID	Asset Class	Shapefile Name	Sources/Discussion
4.01	4. Buildings and Private Land	Buildings_Private_Risk_Final	The entirety of the Microsoft building footprint dataset was clipped to the coastal zone. The buildings were then intersected with the LEP zoning layers to only retain buildings within areas where privately owned buildings could be built. The buildings were then attributed with their suburb (based on published suburb boundaries) and value information based on market research.
4.02	4. Buildings and Private Land	Council_Cadastre_Private_Risk_Final	All land within non-public zoning areas (including the land underlying roads) was captured here and then attributed with land value information based on market research.
5.01	5. Utilities: Water and Wastewater	Sewer_Main_Centreline_Risk_Final	SewerMain_Centreline.shp, an all-encompassing rate including fittings, junctions etc. was used.
5.02	5. Utilities: Water and Wastewater	Sewer_PumpingStation_Risk_Final	Sewer_PumpingStation_Location.shp
5.03	5. Utilities: Water and Wastewater	Sewer_TreatmentPlant_Risk_Final	Sewer_Treatment_Plant_Coverage.shp
5.04	5. Utilities: Water and Wastewater	Water_Main_Centreline_Risk_Final	Watermain_Centreline.shp, an all-encompassing rate including fittings, junctions etc. was used.
6.01	6. Open Space and Recreation	Council_Buildings_Points_Risk_Final	"\HazardsCMP.gdb\Assetdata_MAPPING_Building_pt", linked to "Buildings.xlsx"
6.02	6. Open Space and Recreation	Council_Cadastre_Public_Risk_Final	All cadastral parcels within public zoning areas (including the land underlying roads) were captured here and then attributed with land value information based on market research. Land values were assumed to be the same as public land values.
6.03	6. Open Space and Recreation	Council_OpenSpace_Points_Risk_Final	"\HazardsCMP.gdb\Assetdata_MAPPING_OpenSpace_pt, linked to Open Space.xlsx. Includes assets such as playgrounds, shelters, and memorials.
6.04	6. Open Space and Recreation	Council_OpenSpace_Polygons_Risk_Final	"\HazardsCMP.gdb\Assetdata_MAPPING_OpenSpace_po, linked to Open Space.xlsx. Includes assets such as parks, reserves, sportsgrounds.
7.01	7. NPWS	NPWS_Buildings_Risk_Final	Buildings_Clip.shp - primarily shacks and outhouses within the Royal National Park
7.02	7. NPWS	NPWS_TrackSections_Risk_Final	Track_Section_Clip - An all-encompassing rate (including steps, bridges etc.) as included.
7.03	7. NPWS	NPWS_VisitorArea_Risk_Final	Visitor_Area_Clip This only related to a single camping area at Era.
S.01	Supplementary	CoastalRiskandMappingPolygon	Derived from RH SEPP mapping of the coastal zone buffered on the landward side to allow for potential extension of the tidal limits of creeks with sea level rise. Furthermore, NSW Ports land contained within Port Kembla was removed.
S.02	Supplementary	CoastalRiskandMappingDivisions_v3	Based on "CoastalRiskandMappingPolygon", separated into the twenty-seven divisions presented in Section 2.2.3 of main report.

Appendix C2 Asset Data Maps

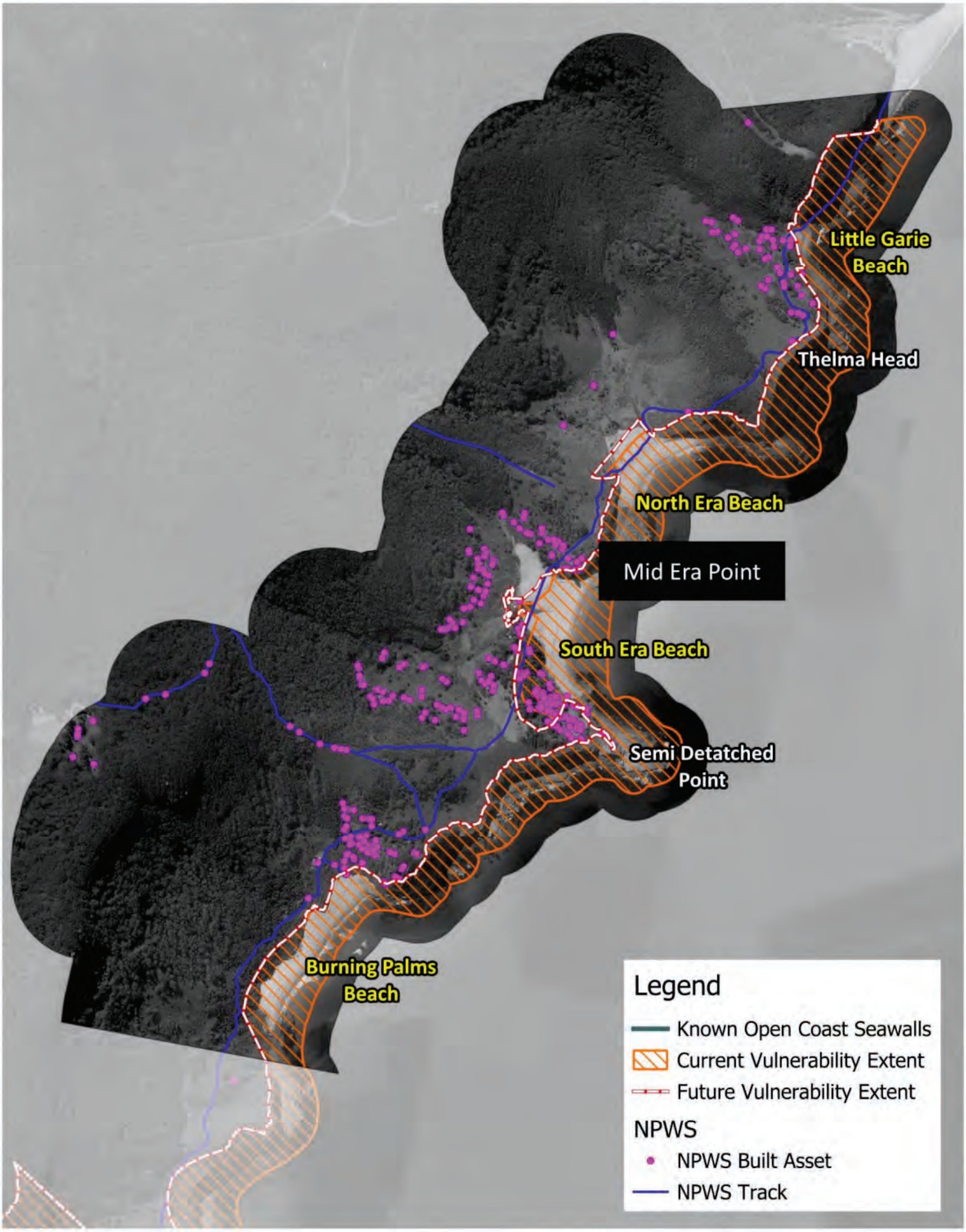

Figure C2-1 Asset Exposure for Division 1 – North Royal National Park, Built Assets

Wollongong CMP - Stage 2 Coastal Hazard Risk Assessment Report

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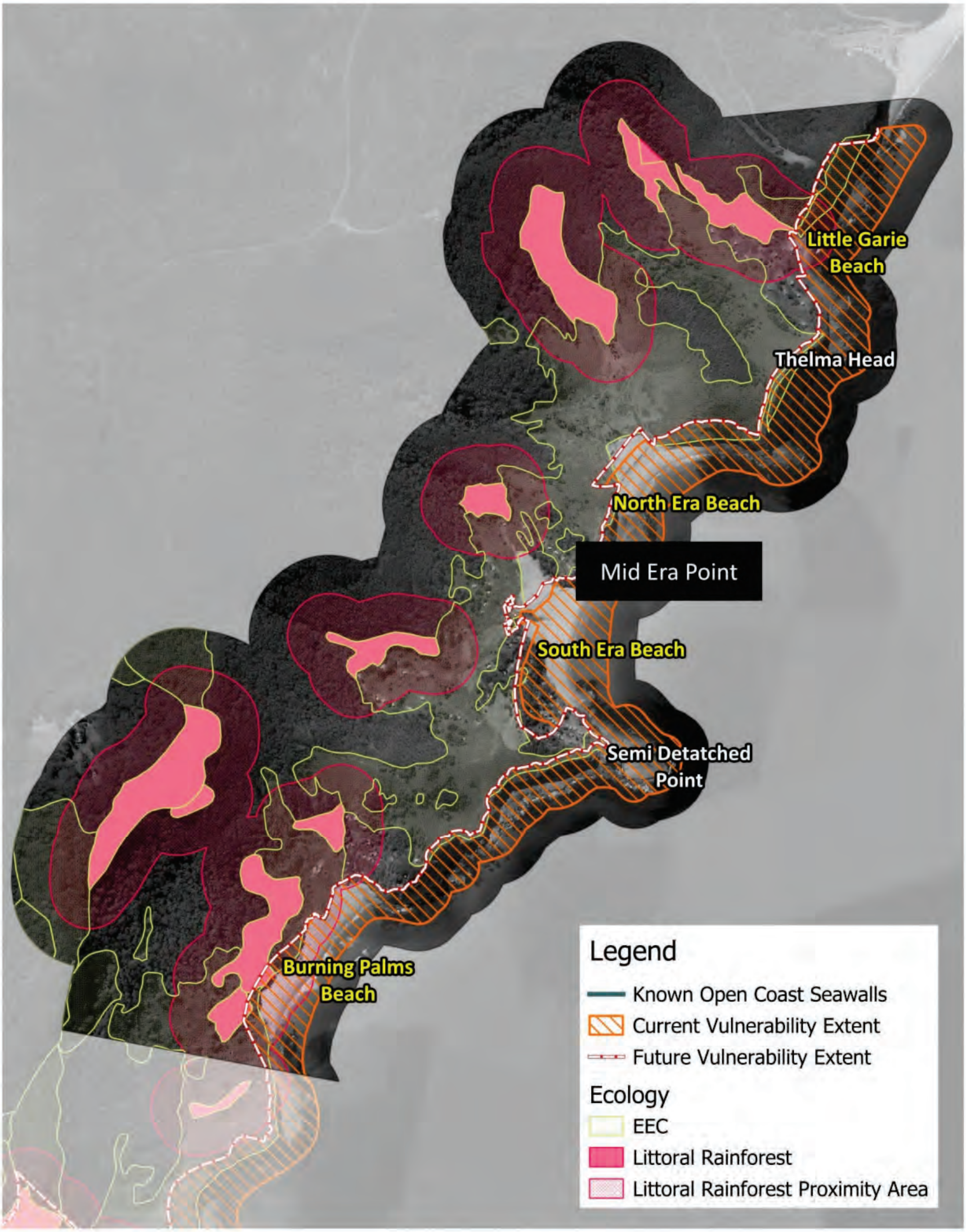

Figure C2-2 Asset Exposure for Division 1 – North Royal National Park, Ecology

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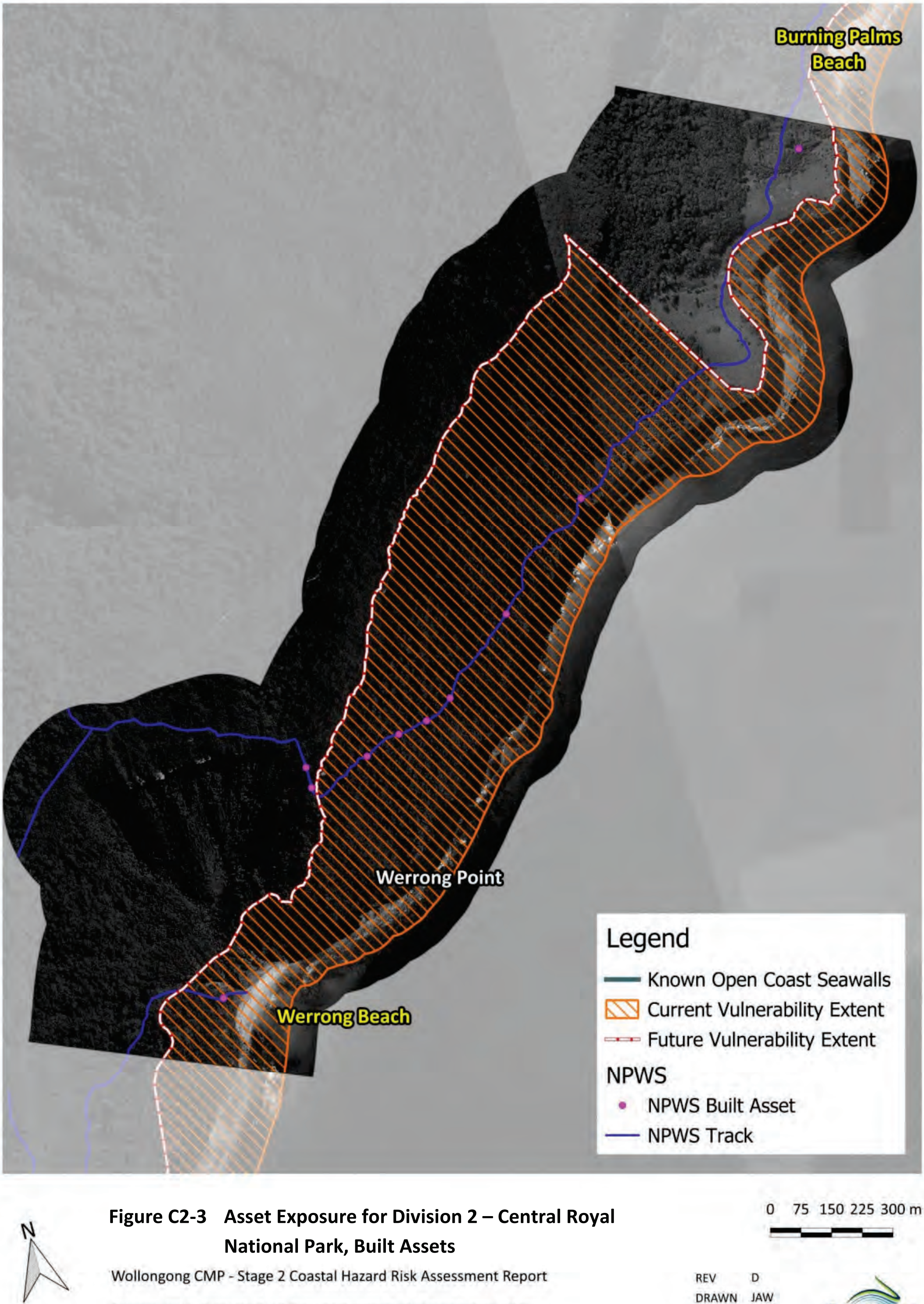

Figure C2-3 Asset Exposure for Division 2 – Central Royal National Park, Built Assets

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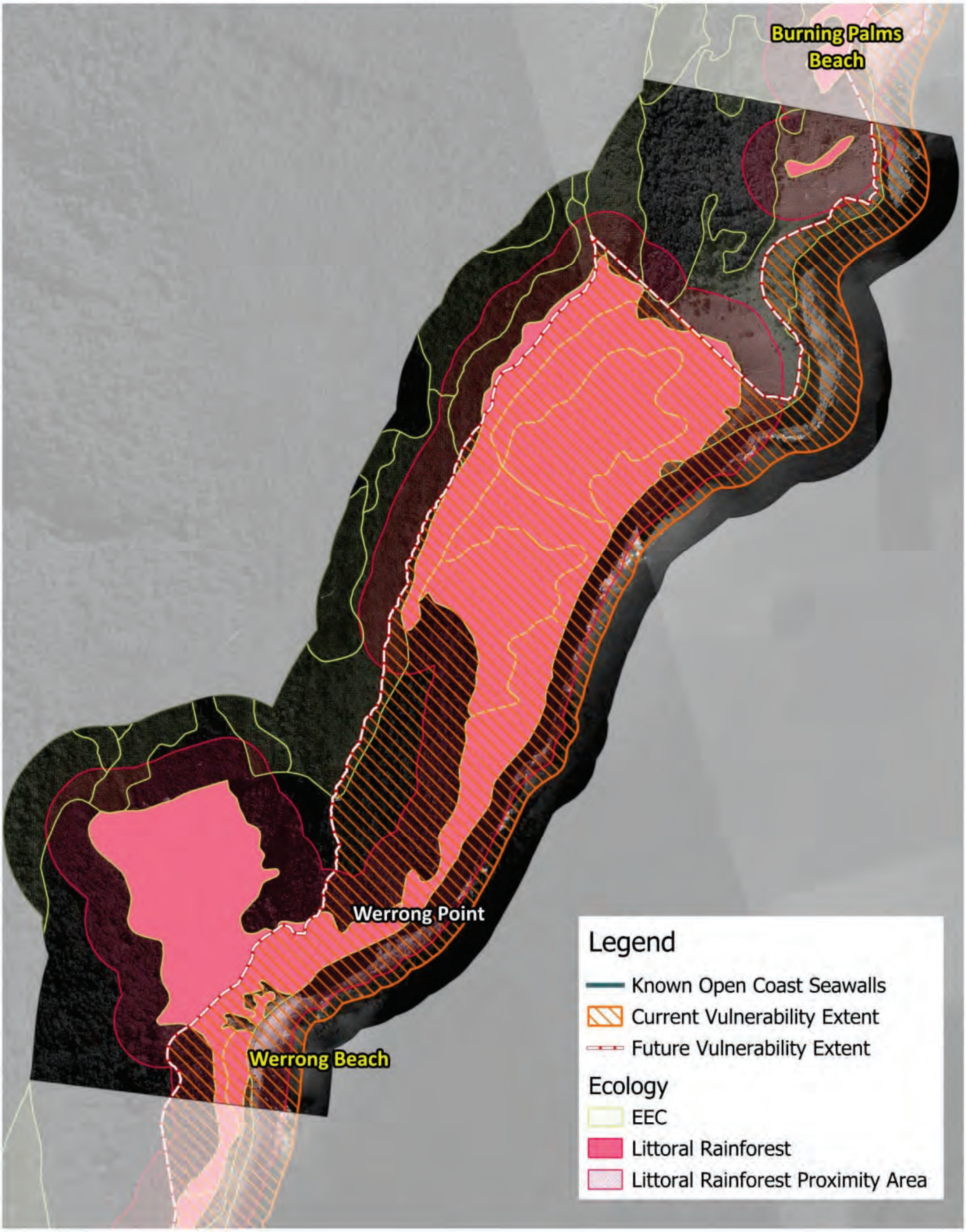

Figure C2-4 Asset Exposure for Division 2 – Central Royal National Park, Ecology

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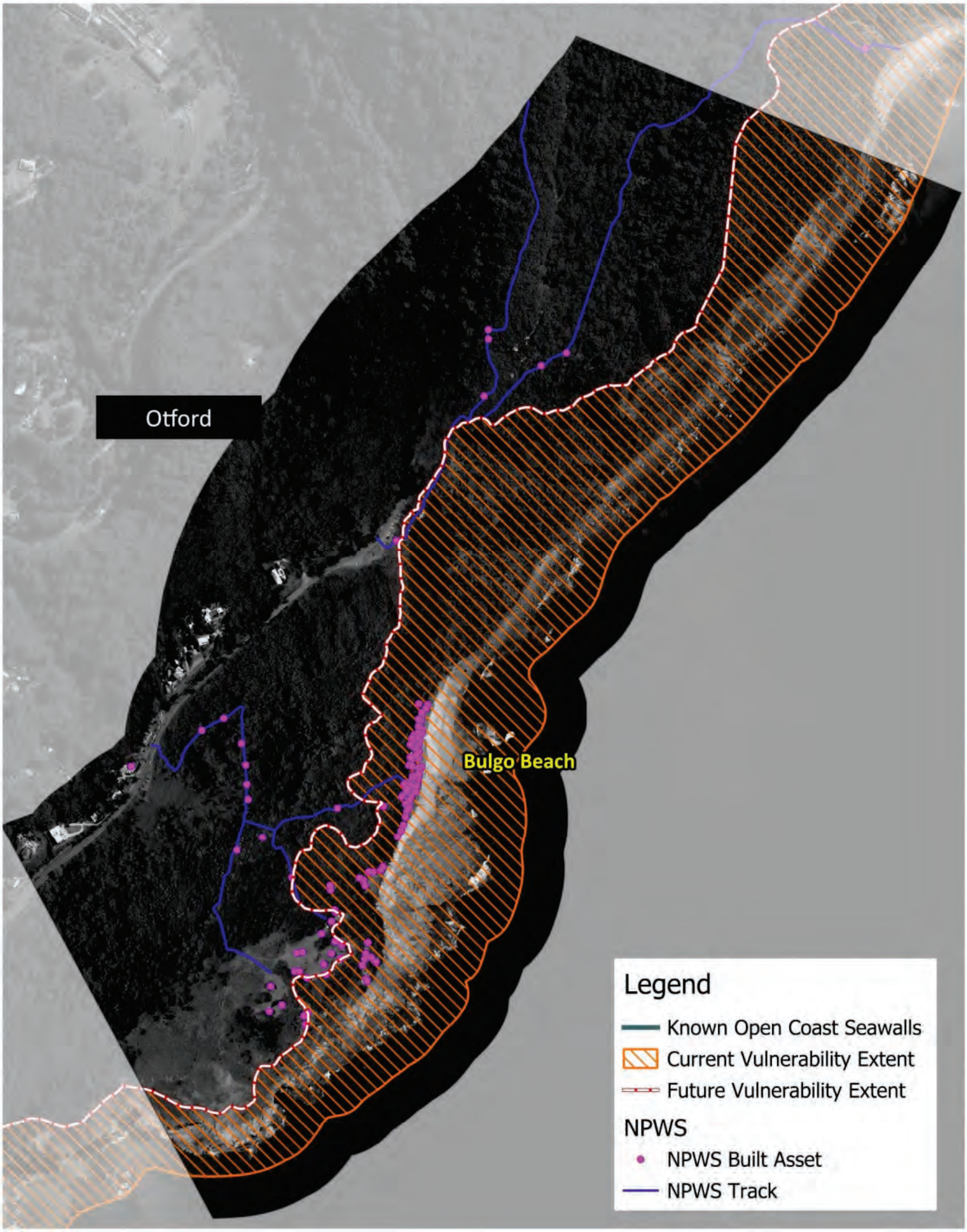

Figure C2-5 Asset Exposure for Division 3 – South Royal National Park, Built Assets

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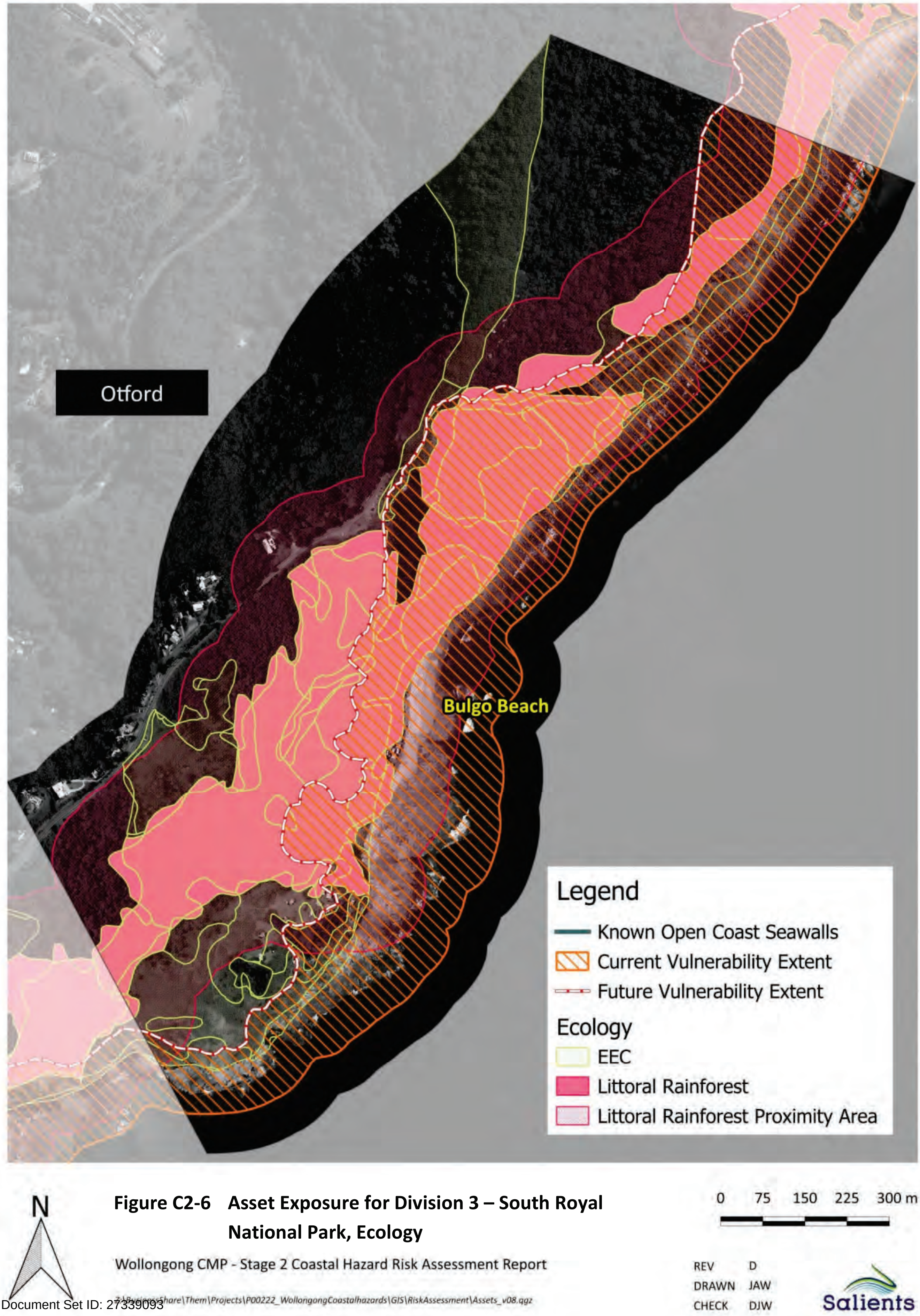

Figure C2-6 Asset Exposure for Division 3 – South Royal National Park, Ecology

Wollongong CMP - Stage 2 Coastal Hazard Risk Assessment Report

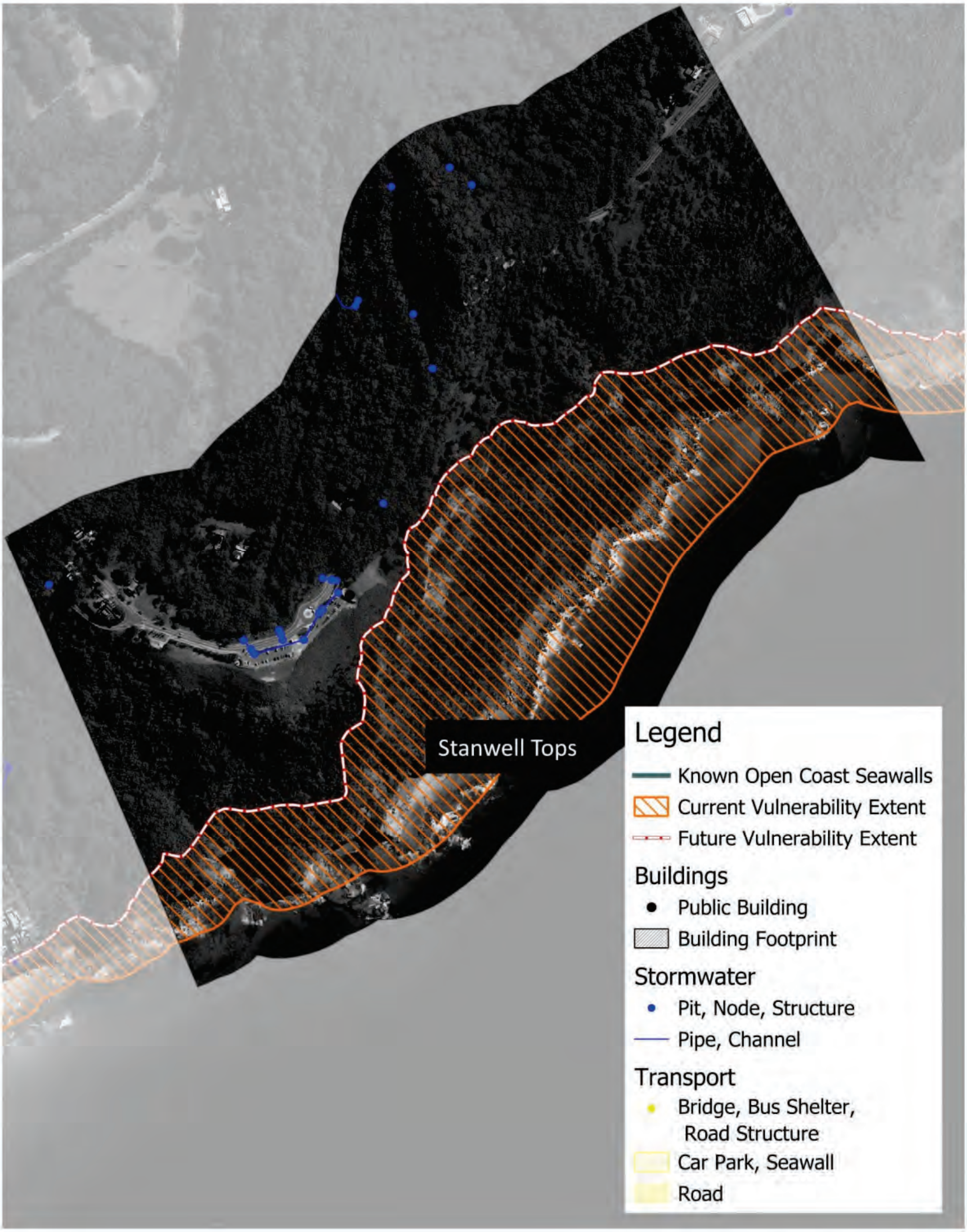

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Figure C2-7 Asset Exposure for Division 4 – Stanwell Tops, Built Assets

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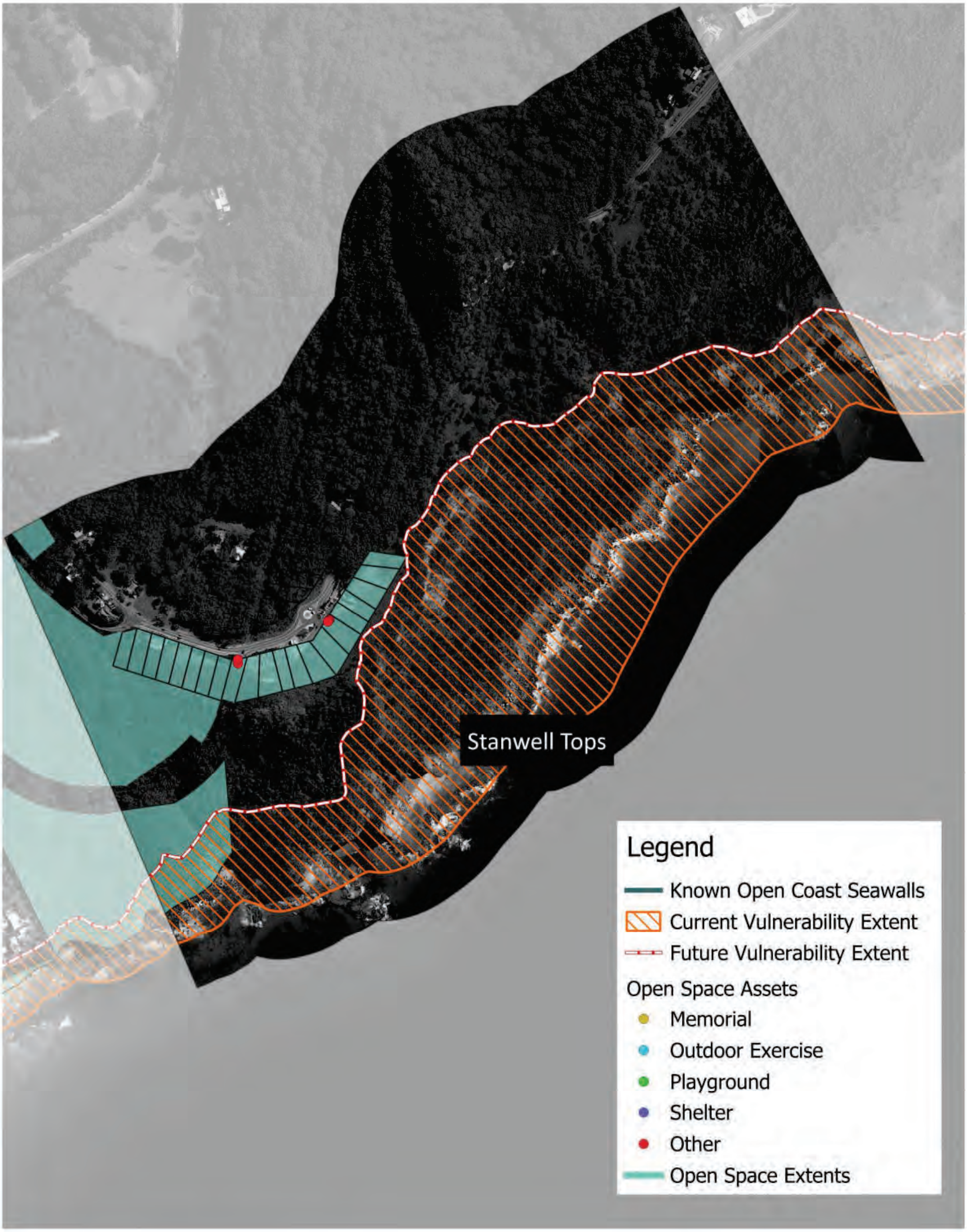

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Figure C2-8 Asset Exposure for Division 4 – Stanwell Tops, Open Space and Recreation

Wollongong CMP - Stage 2 Coastal Hazard Risk Assessment Report

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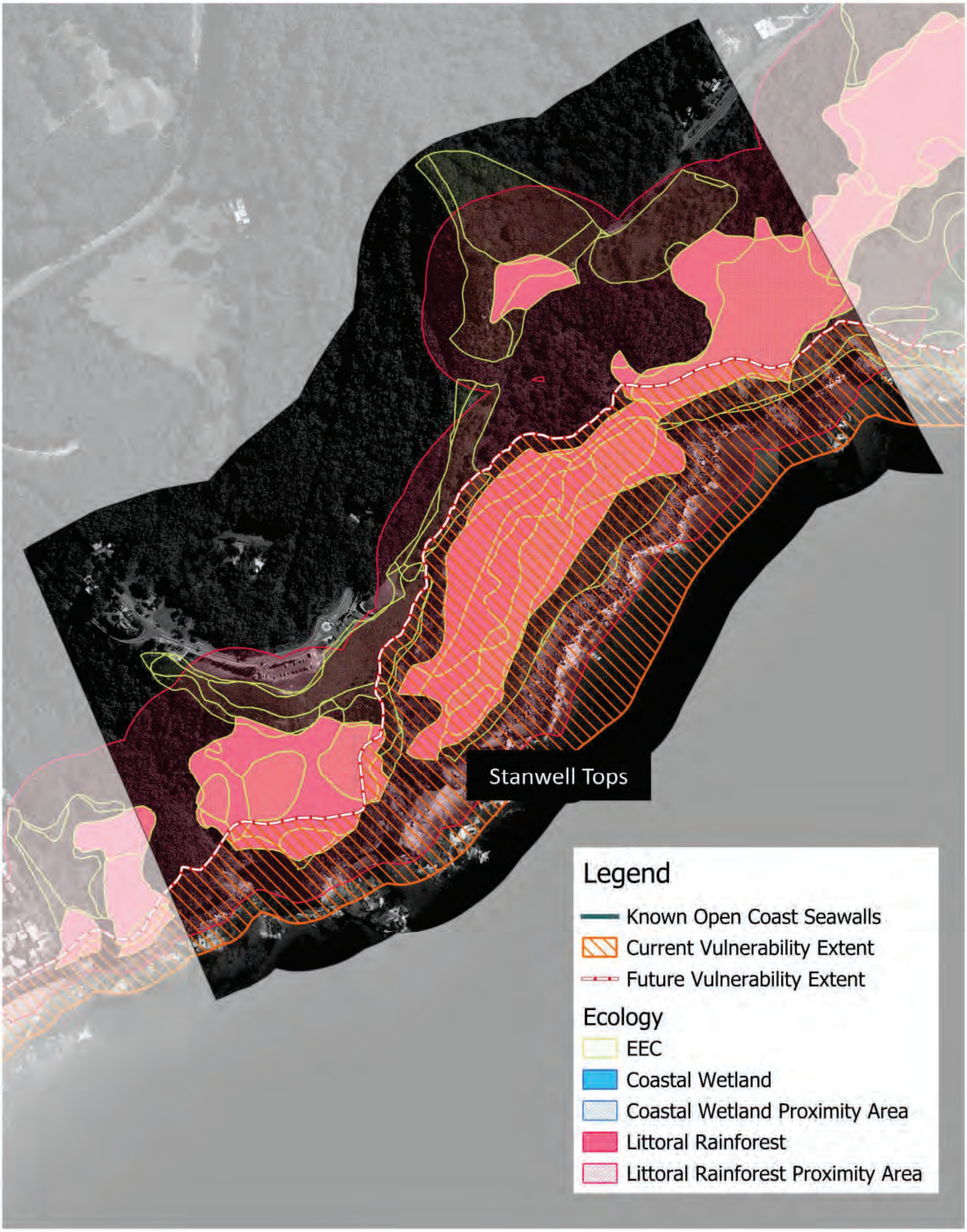

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Figure C2-9 Asset Exposure for Division 4 – Stanwell Tops, Ecology

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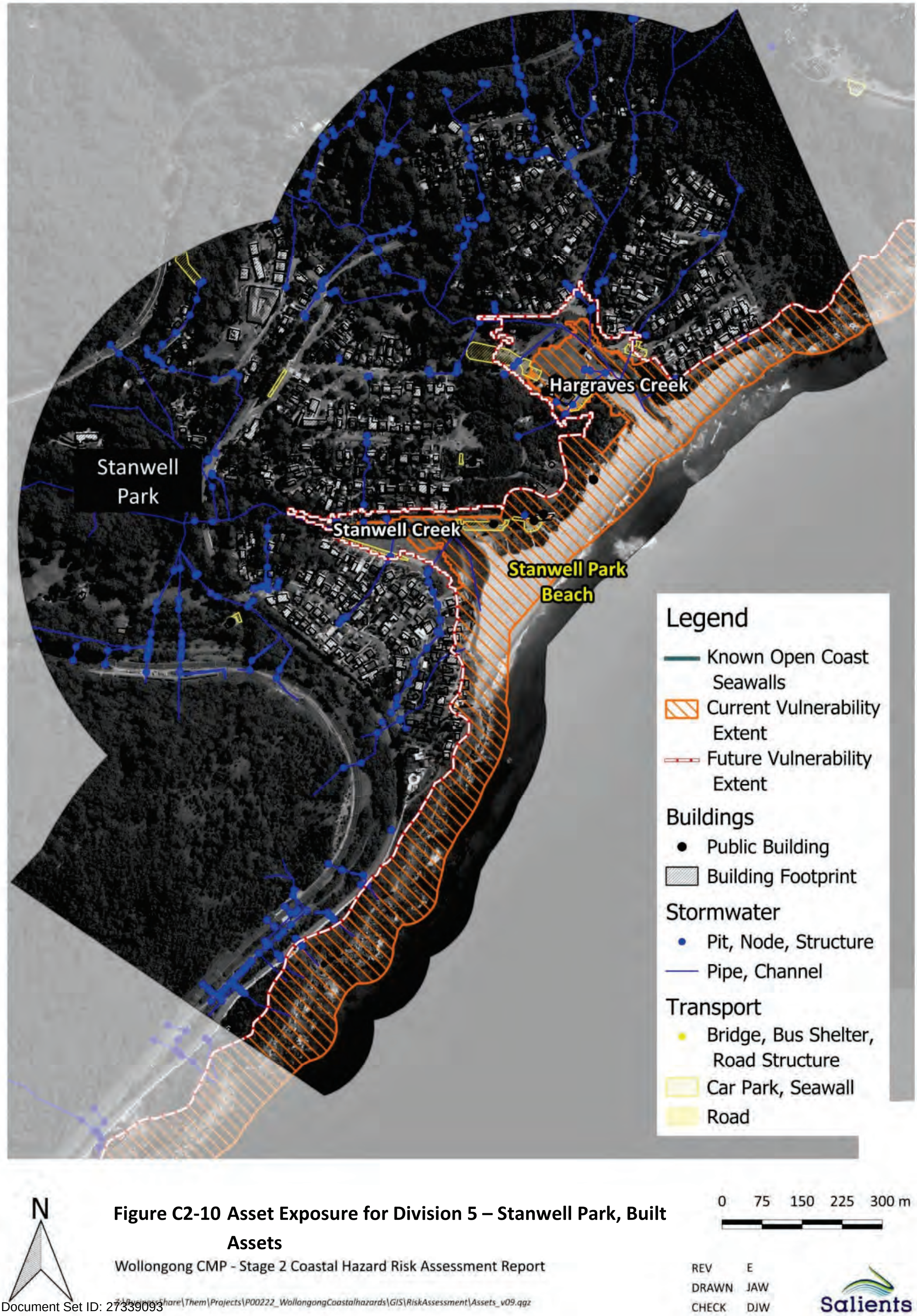

Figure C2-10 Asset Exposure for Division 5 – Stanwell Park, Built Assets

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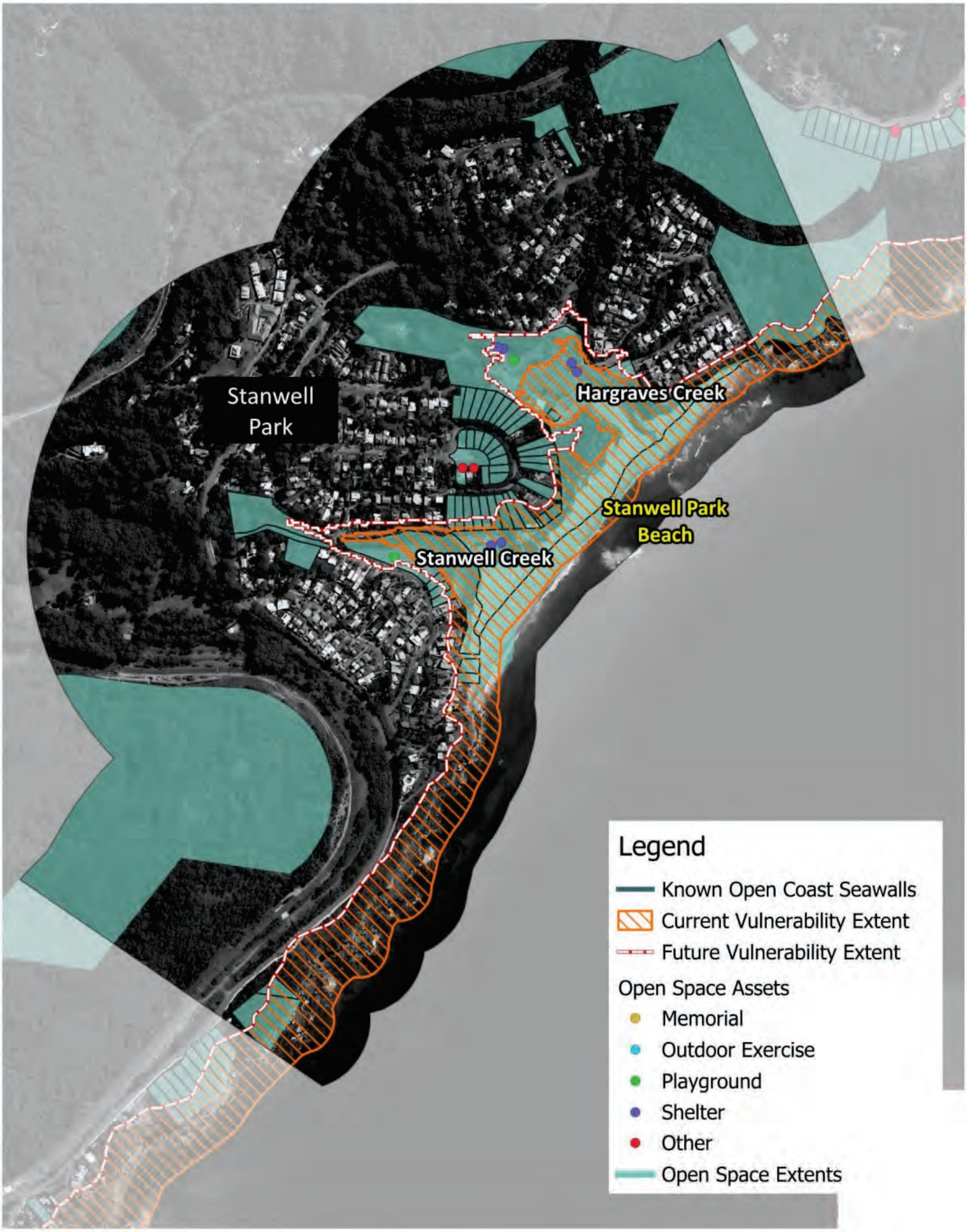

Figure C2-11 Asset Exposure for Division 5 – Stanwell Park, Open Space and Recreation

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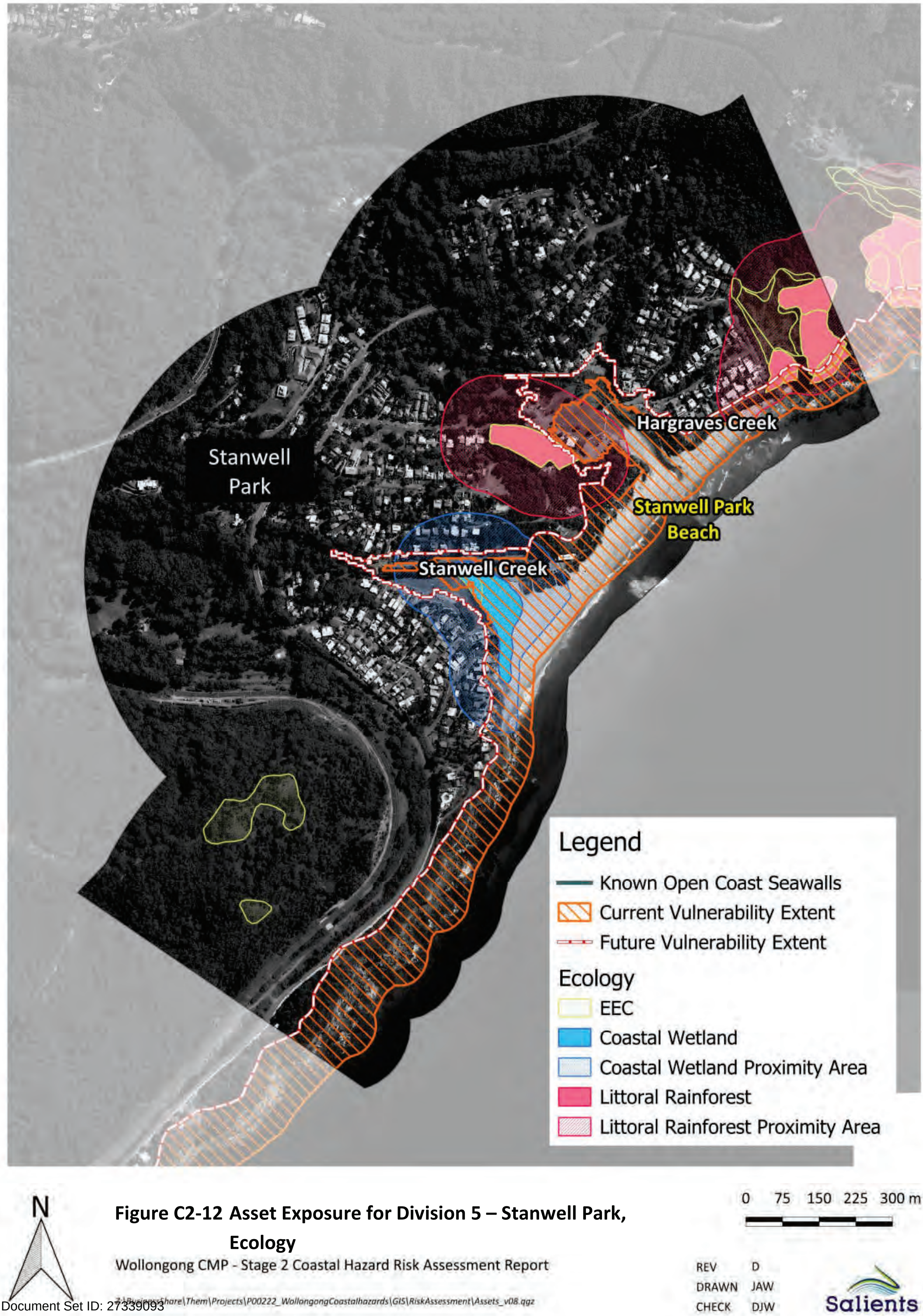

Figure C2-12 Asset Exposure for Division 5 – Stanwell Park, Ecology

Wollongong CMP - Stage 2 Coastal Hazard Risk Assessment Report

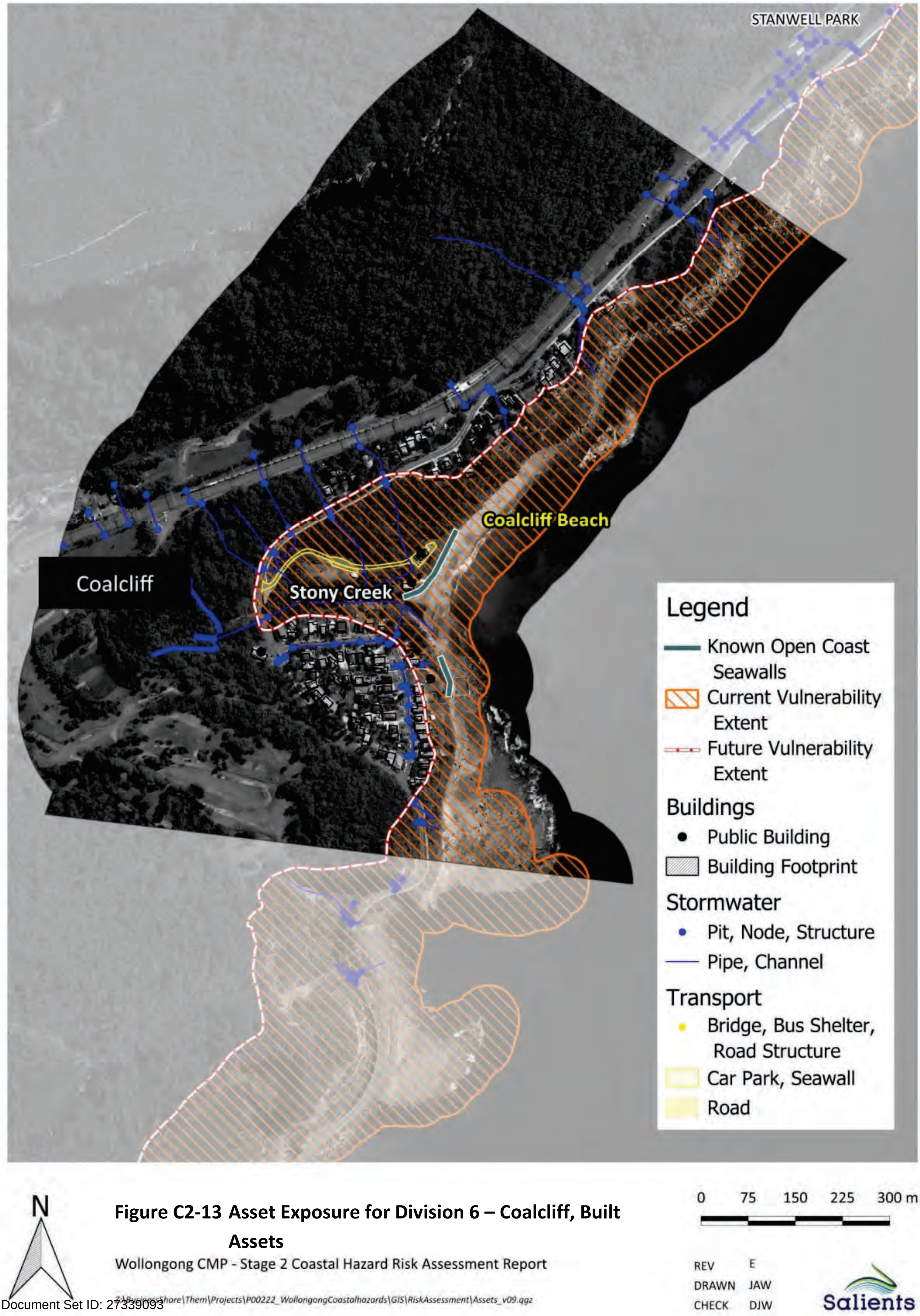

Figure C2-13 Asset Exposure for Division 6 – Coalcliff, Built Assets

Wollongong CMP - Stage 2 Coastal Hazard Risk Assessment Report

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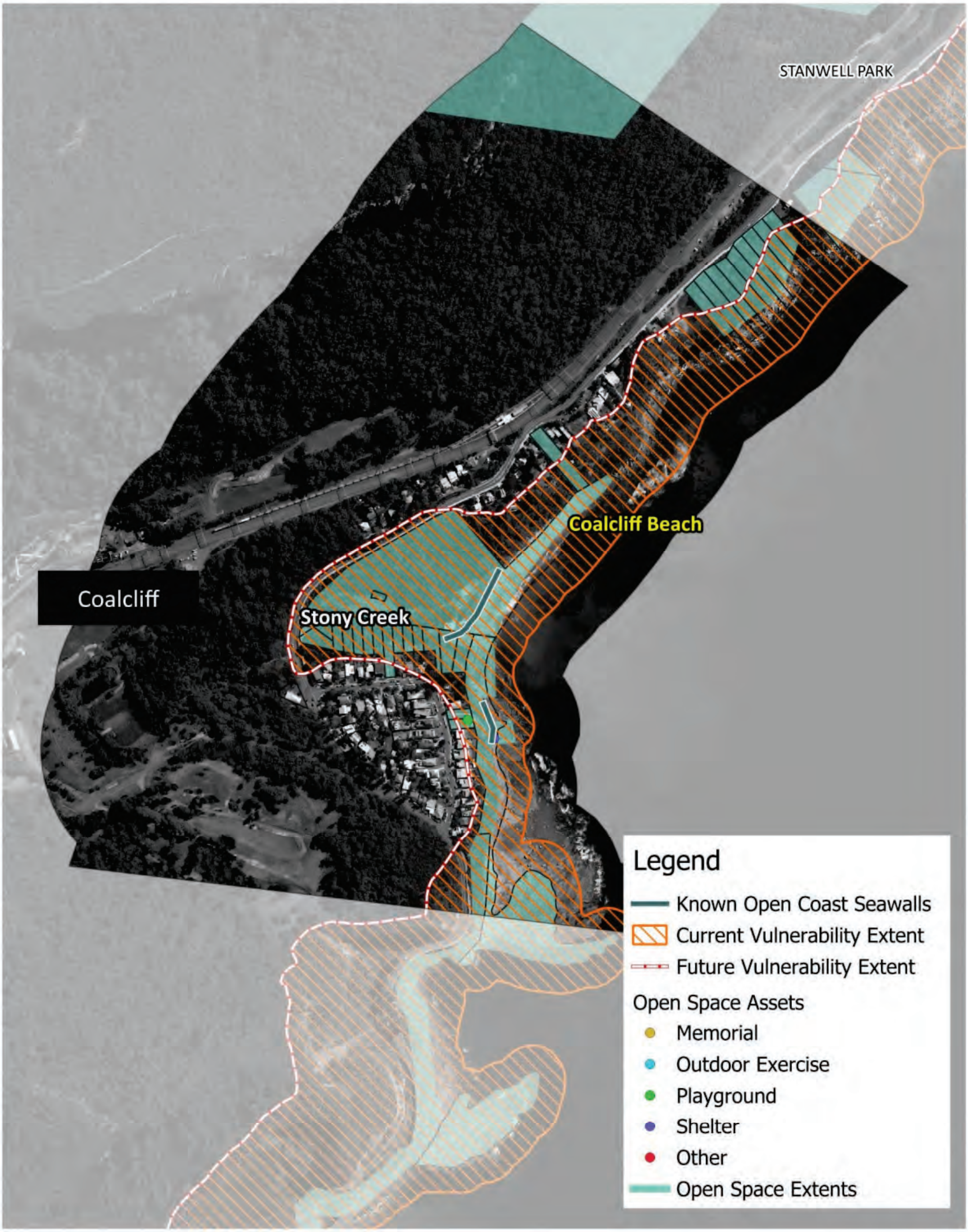

Figure C2-14 Asset Exposure for Division 6 – Coalcliff, Open Space and Recreation

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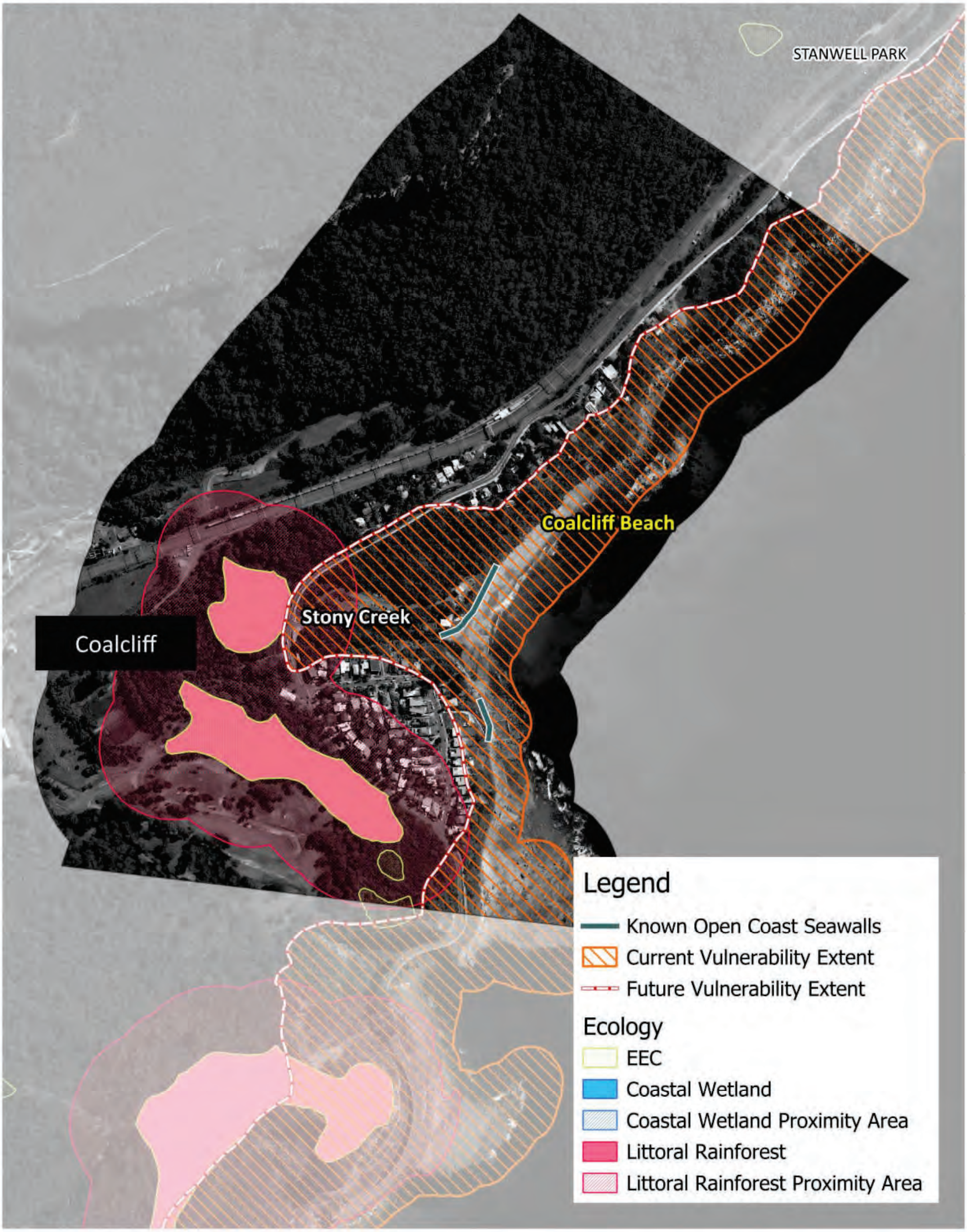

Figure C2-15 Asset Exposure for Division 6 – Coalcliff, Ecology

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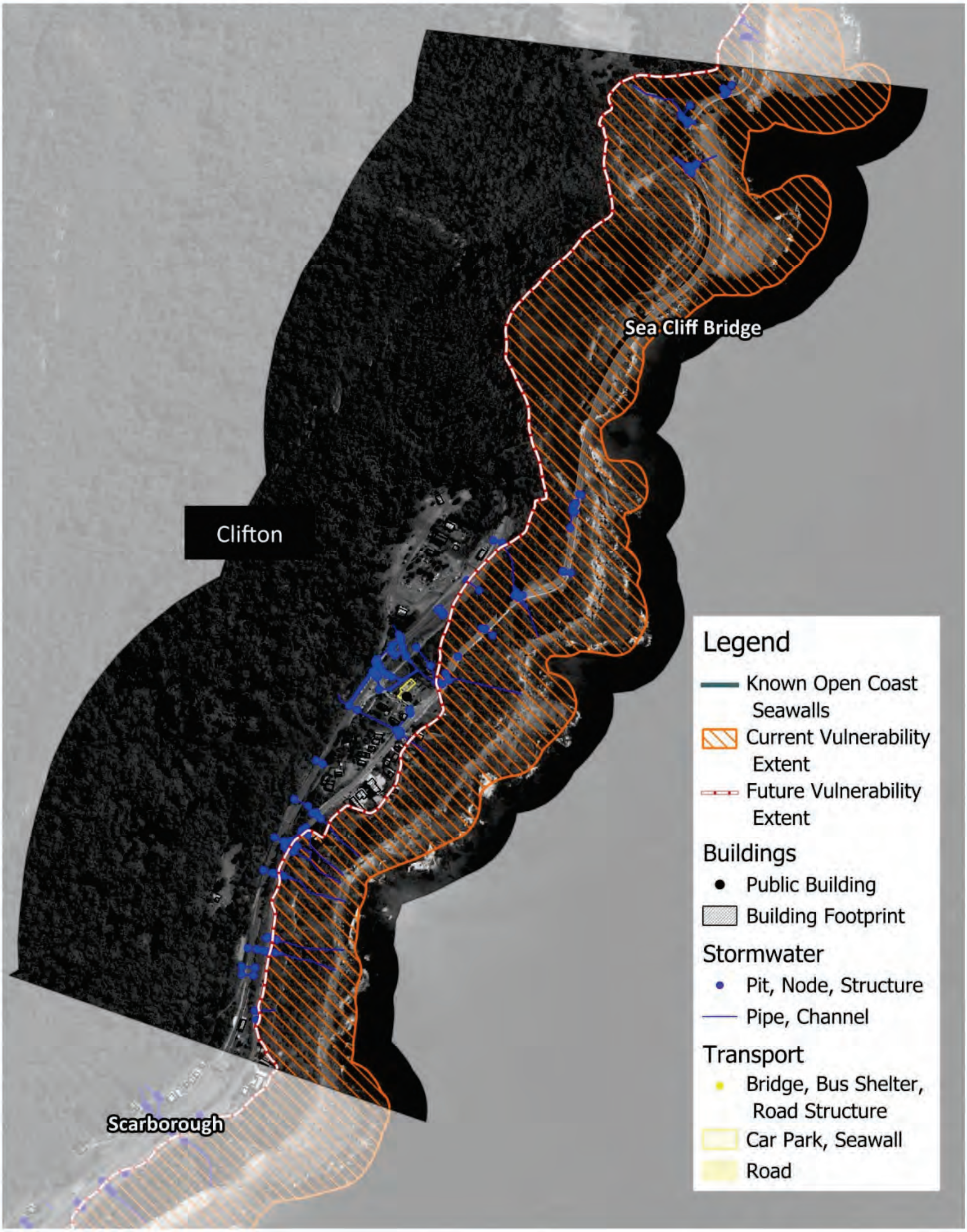

Figure C2-16 Asset Exposure for Division 7 – Clifton, Built Assets

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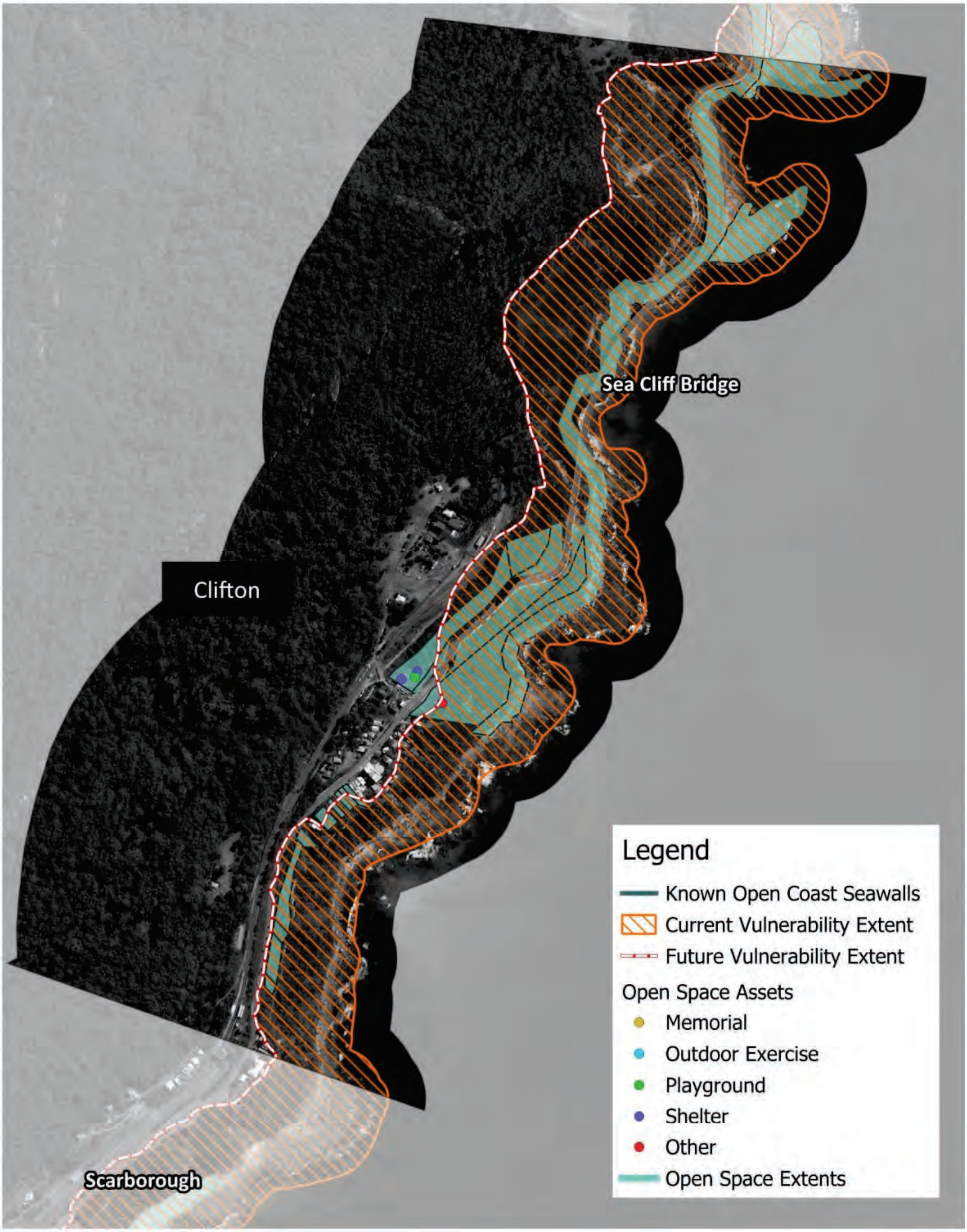

Figure C2-17 Asset Exposure for Division 7 – Clifton, Open Space and Recreation

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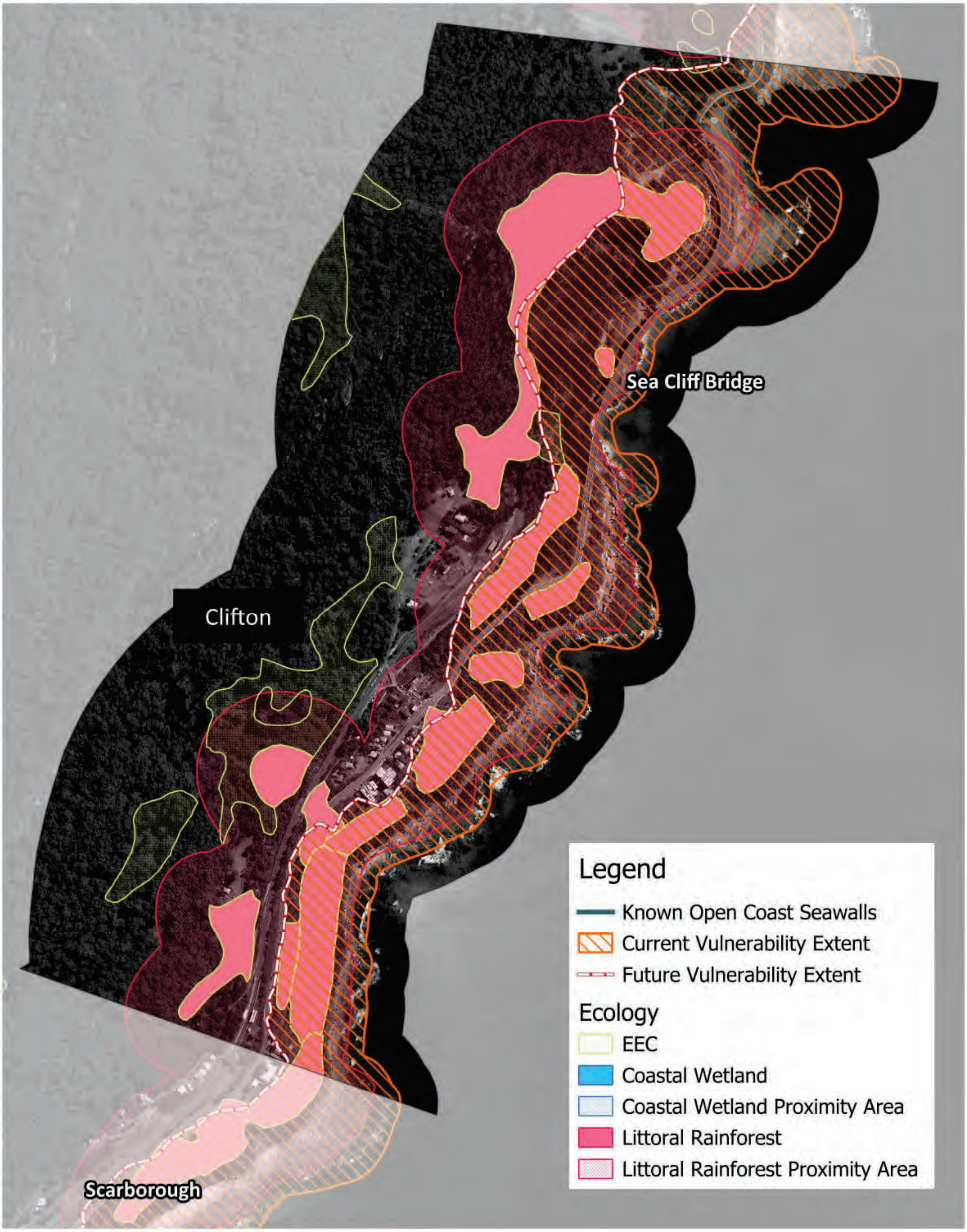

Figure C2-18 Asset Exposure for Division 7 – Clifton, Ecology

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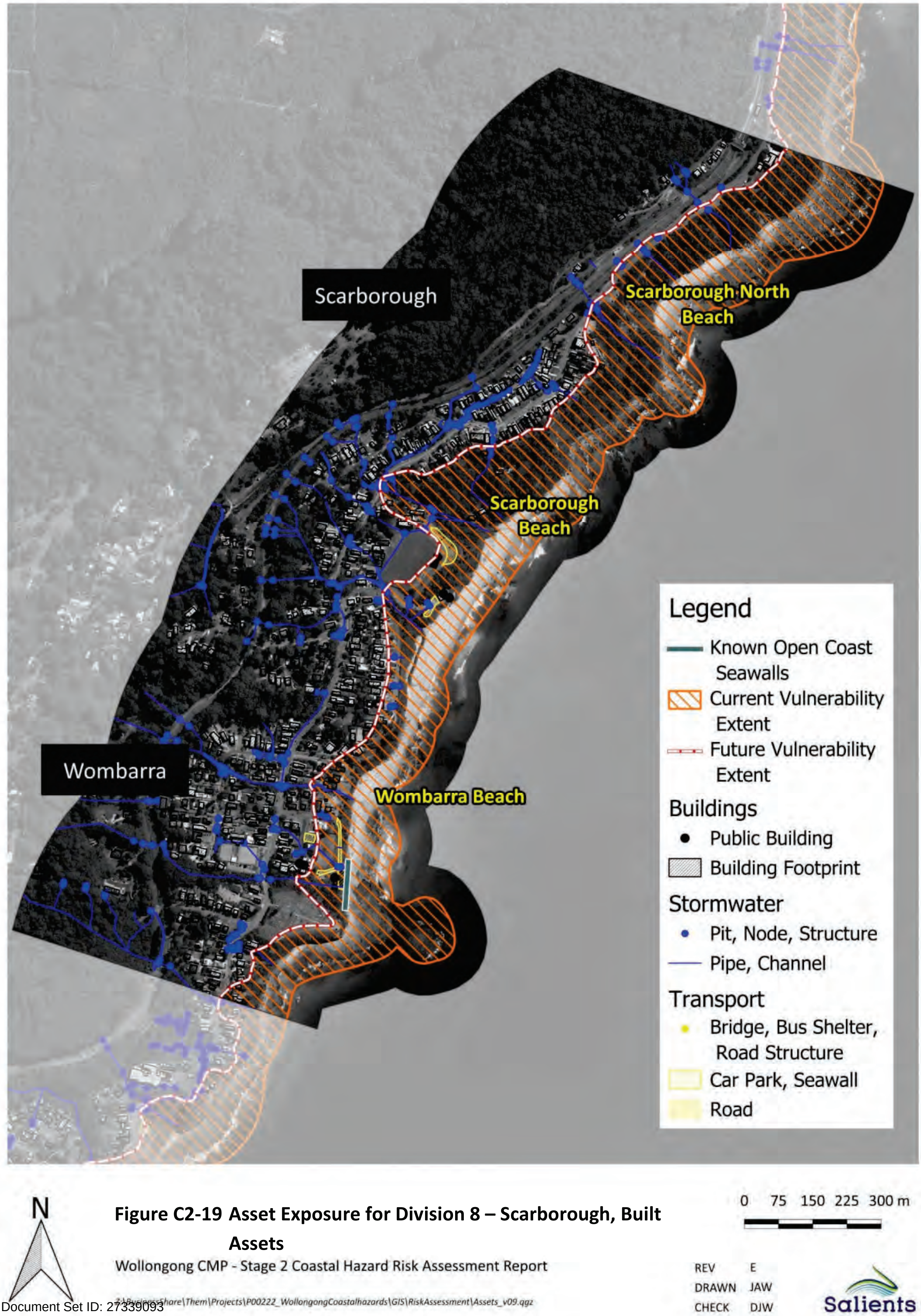

Figure C2-19 Asset Exposure for Division 8 – Scarborough, Built Assets

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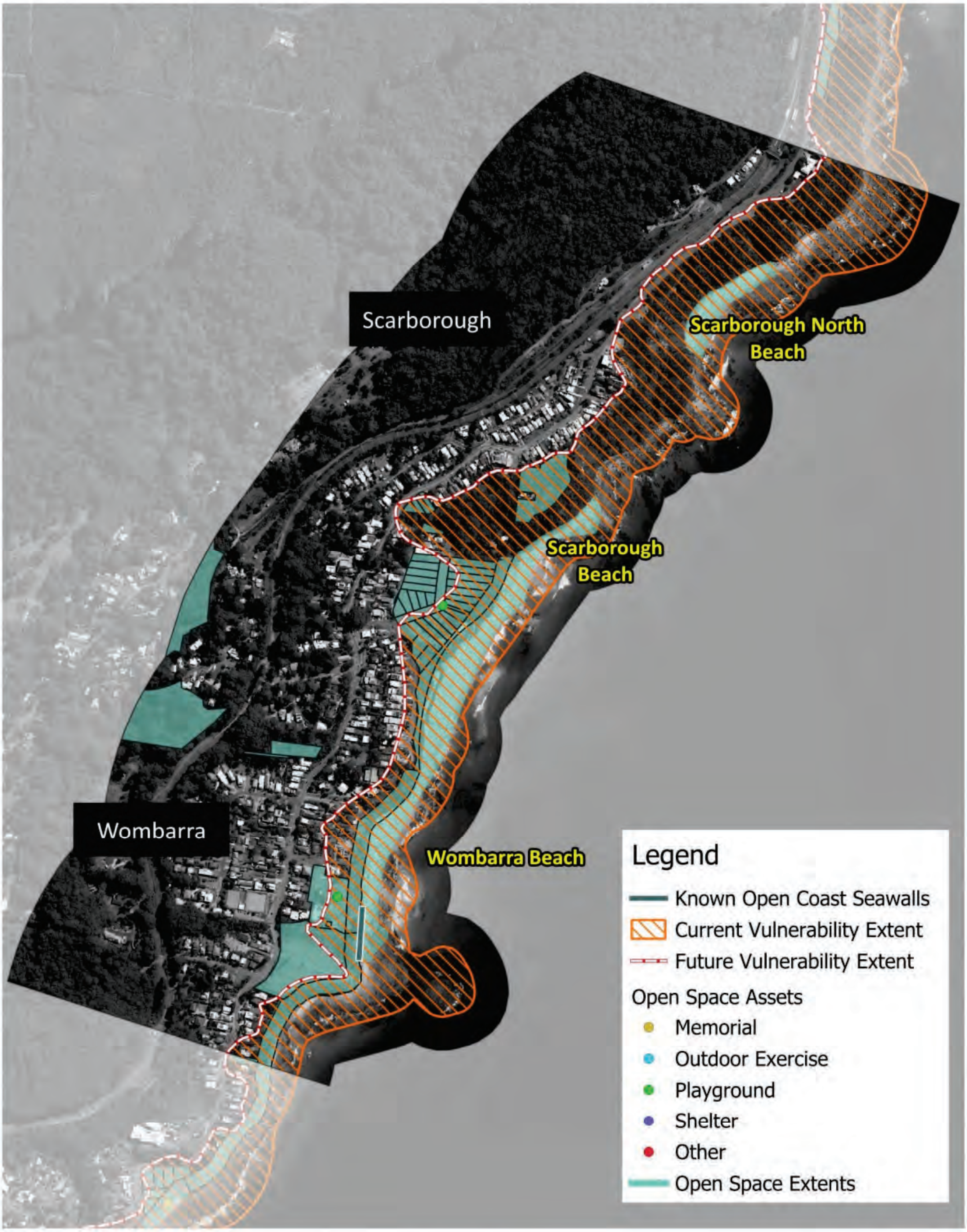

Figure C2-20 Asset Exposure for Division 8 – Scarborough, Open Space and Recreation

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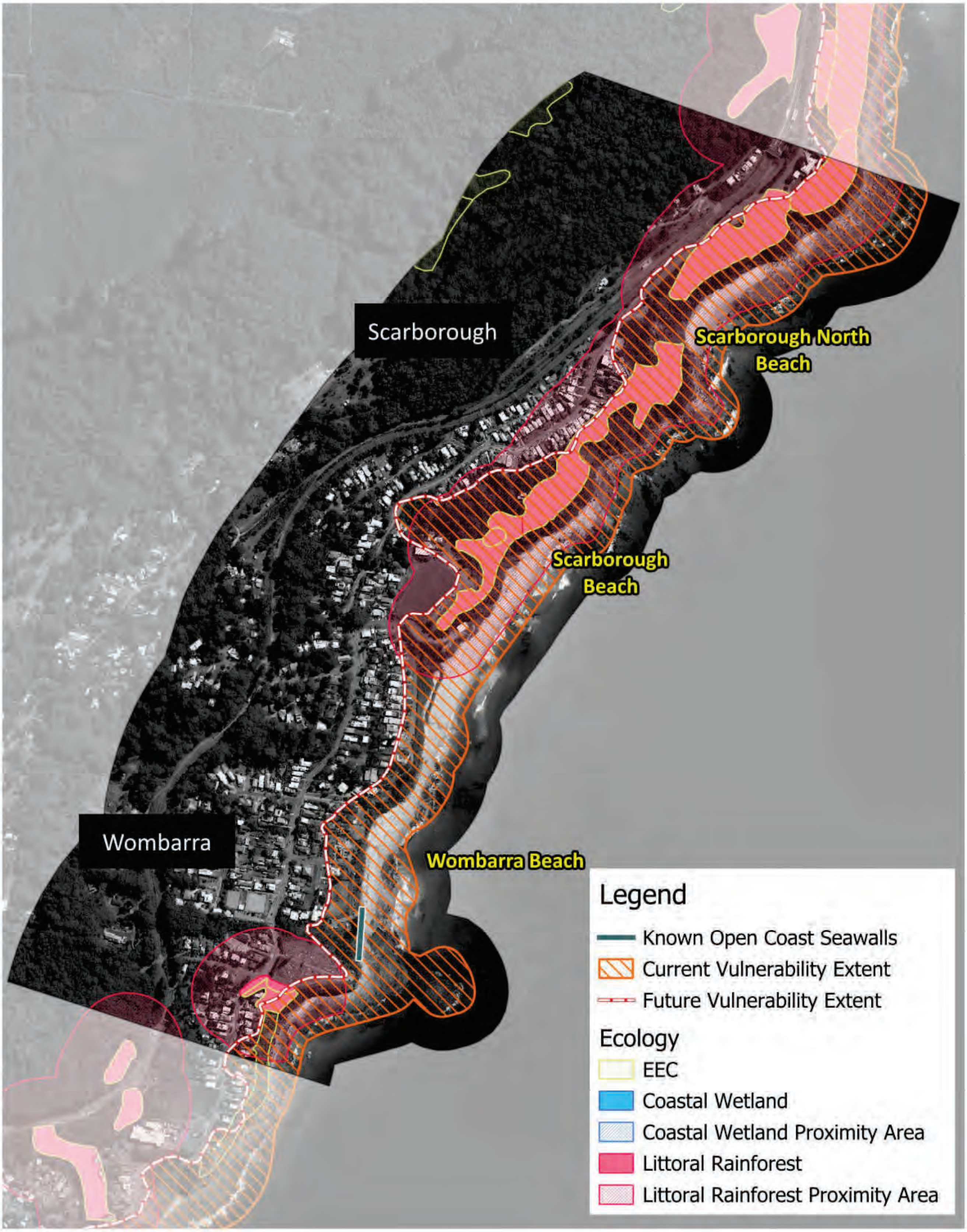

Figure C2-21 Asset Exposure for Division 8 – Scarborough, Ecology

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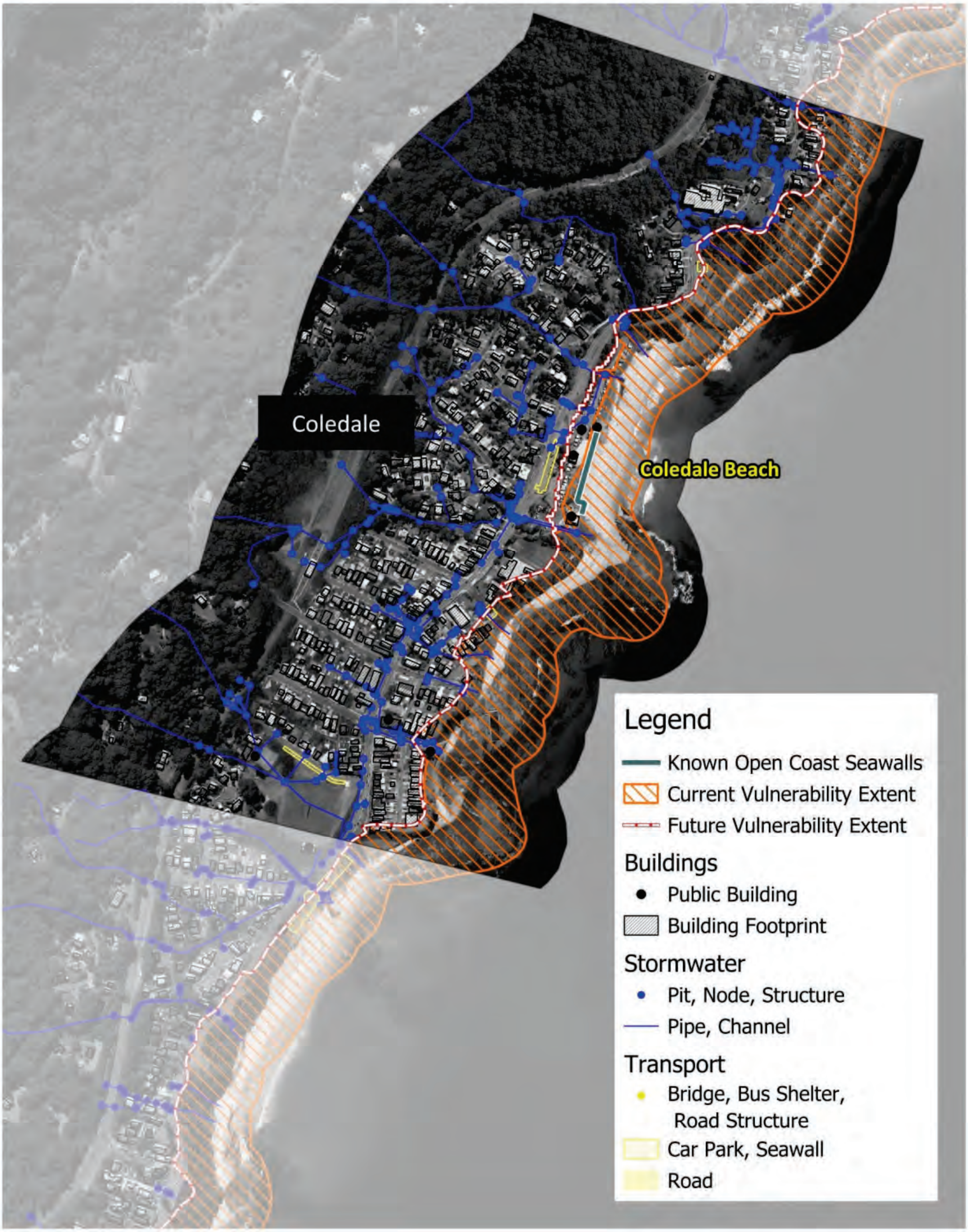

Figure C2-22 Asset Exposure for Division 9 – Coledale, Built Assets

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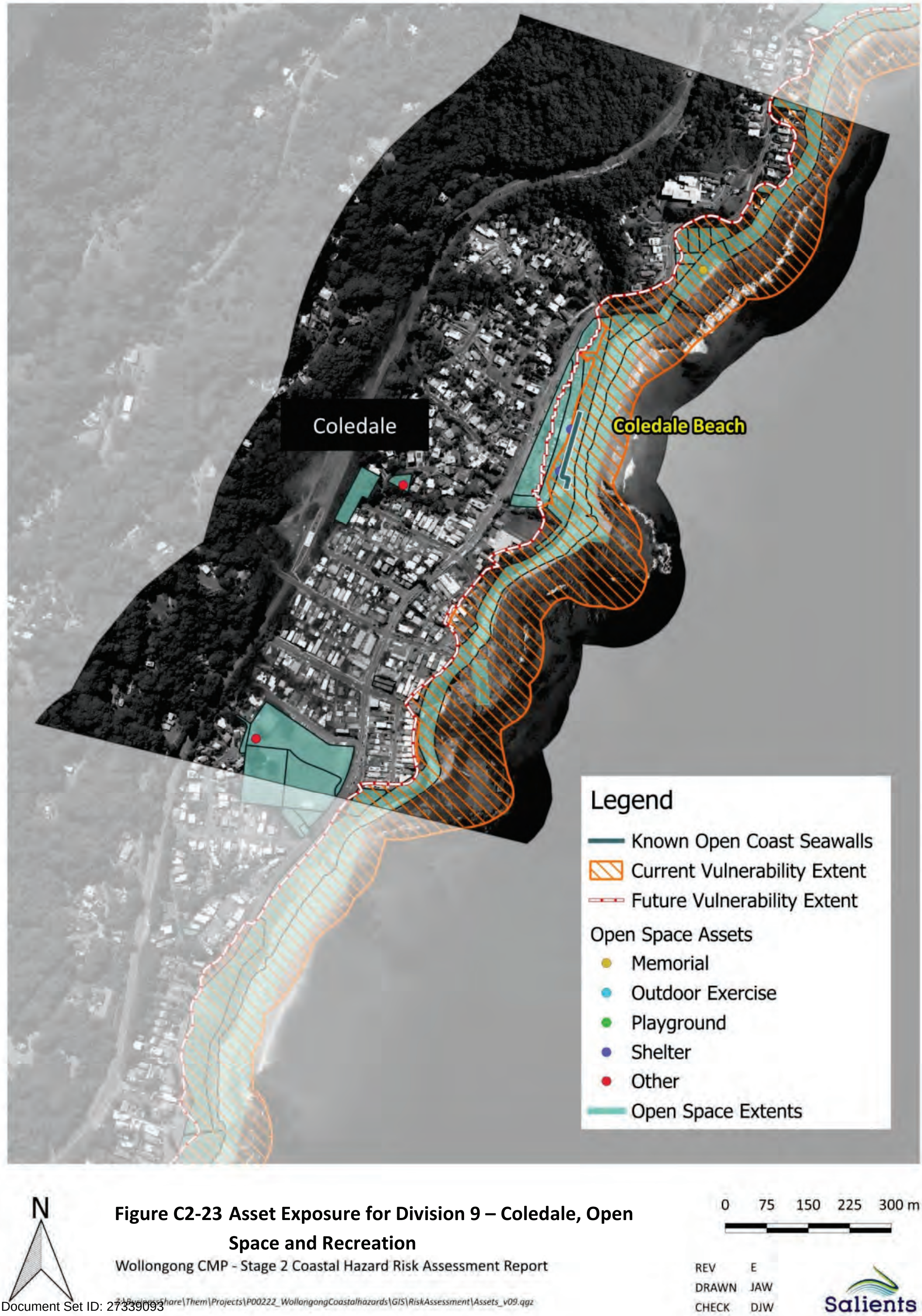

Figure C2-23 Asset Exposure for Division 9 – Coledale, Open Space and Recreation

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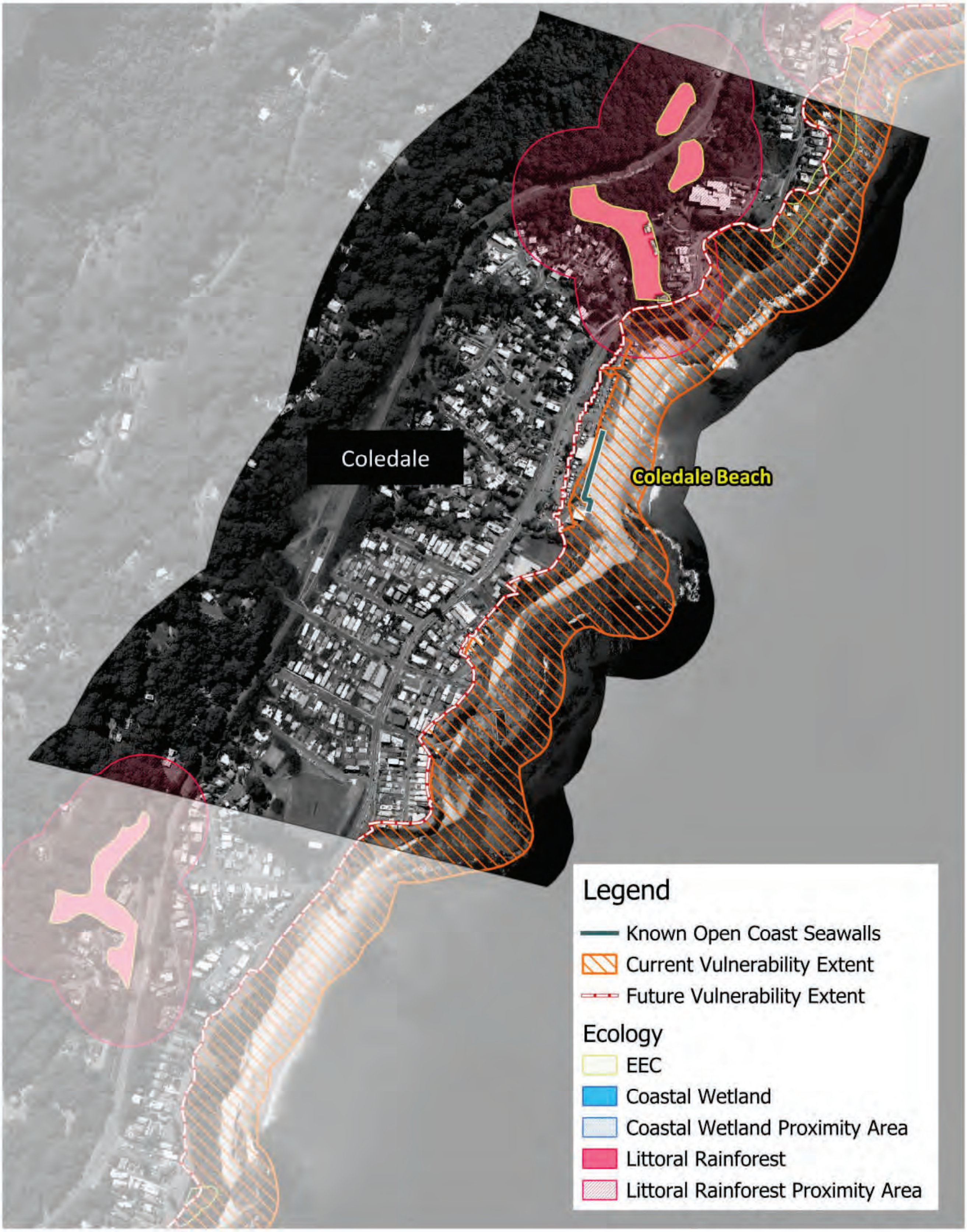

Figure C2-24 Asset Exposure for Division 9 – Coledale, Ecology

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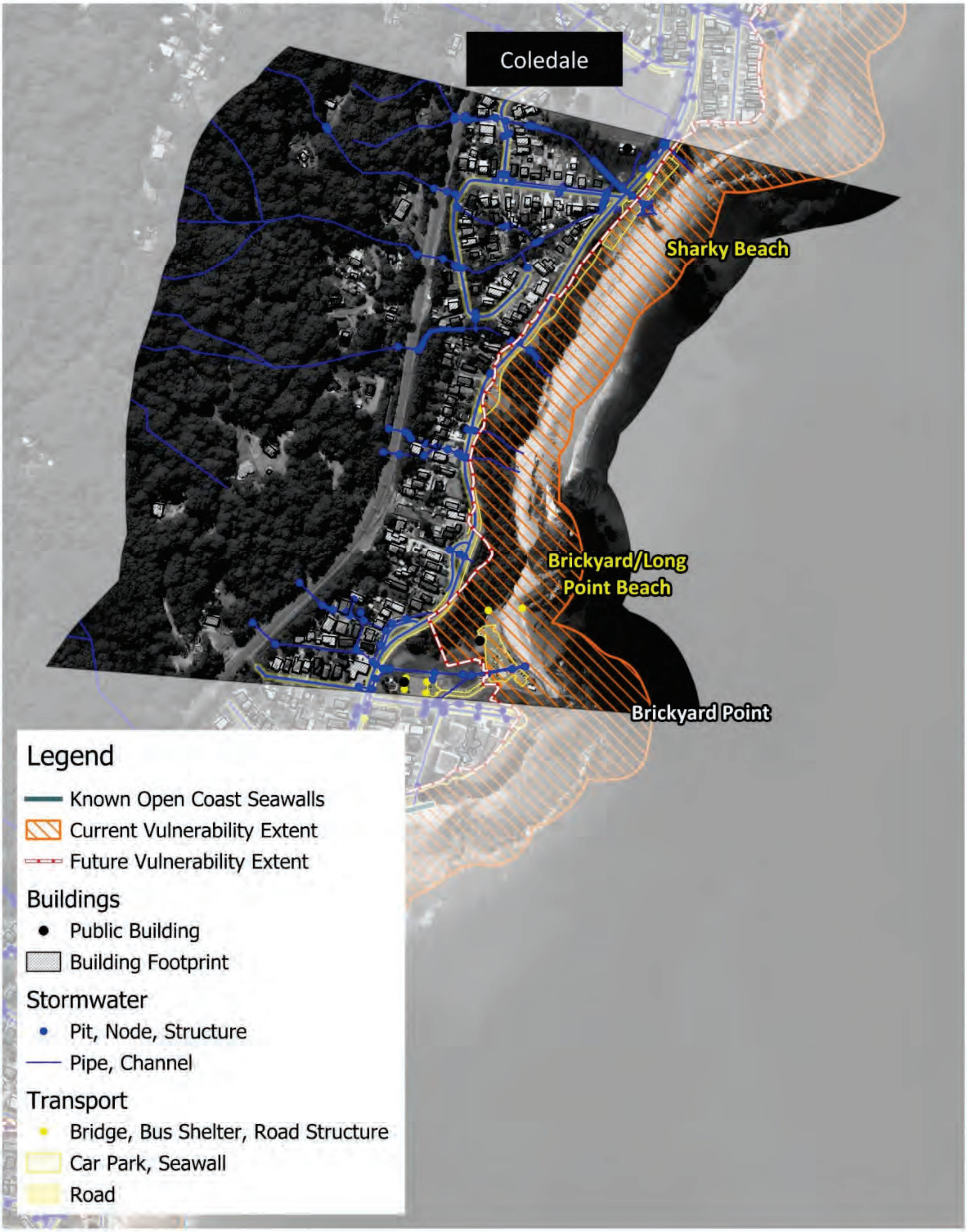

Figure C2-25 Asset Exposure for Division 10 – Sharky Beach, Built Assets

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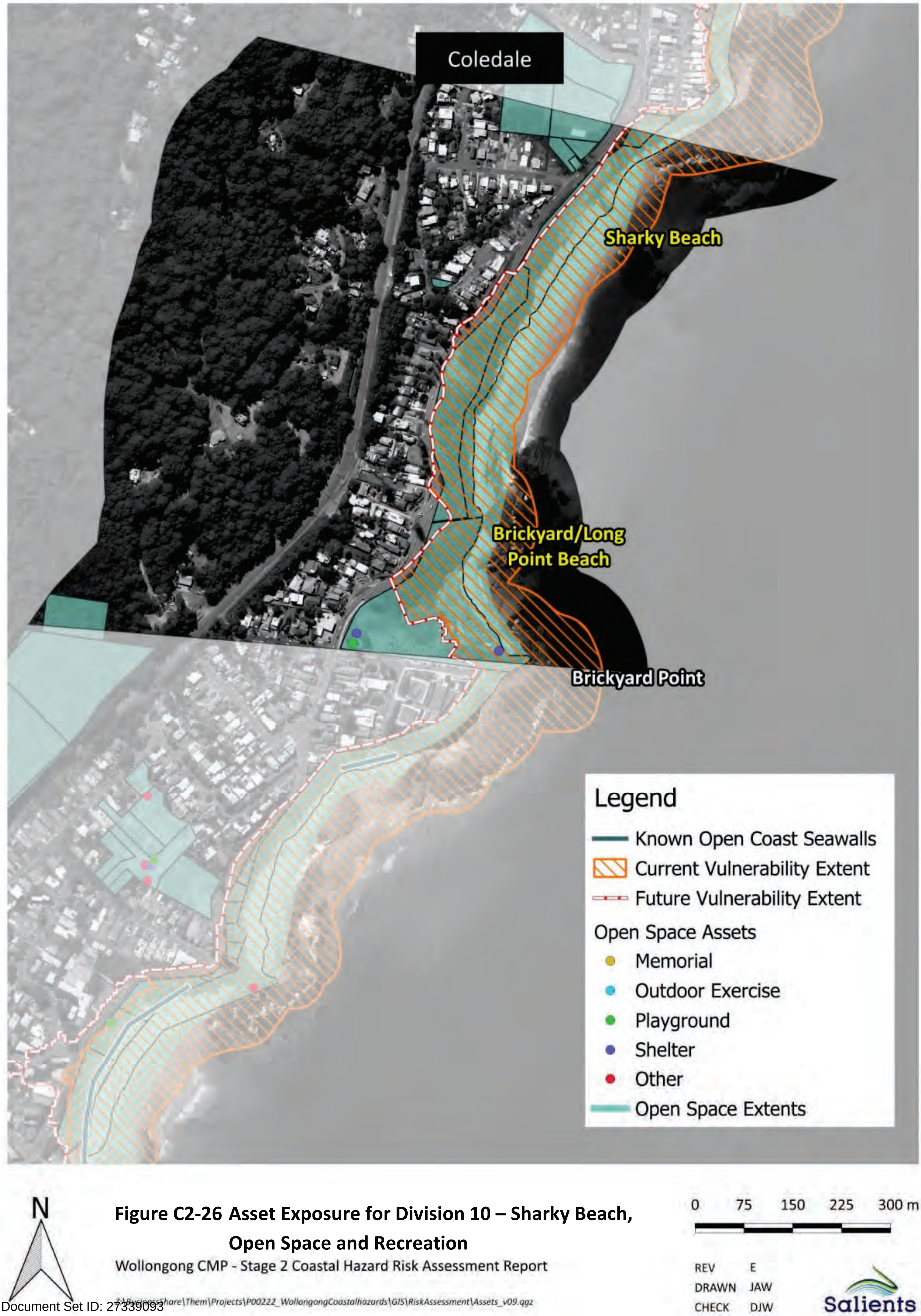

Figure C2-26 Asset Exposure for Division 10 – Sharky Beach, Open Space and Recreation

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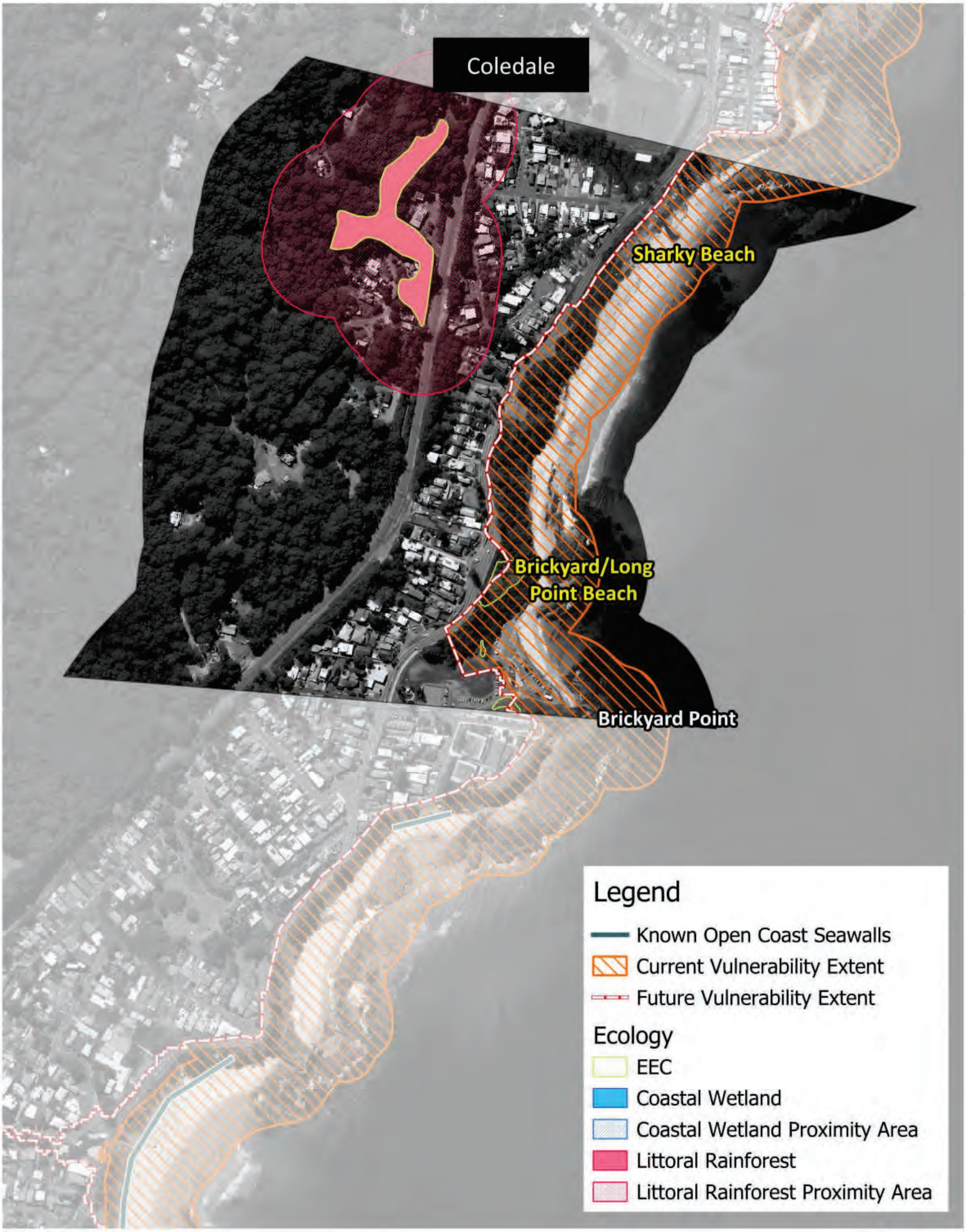

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Figure C2-27 Asset Exposure for Division 10 – Sharky Beach, Ecology

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Figure C2-28 Asset Exposure for Division 11 – Little Austinmer Beach, Built Assets

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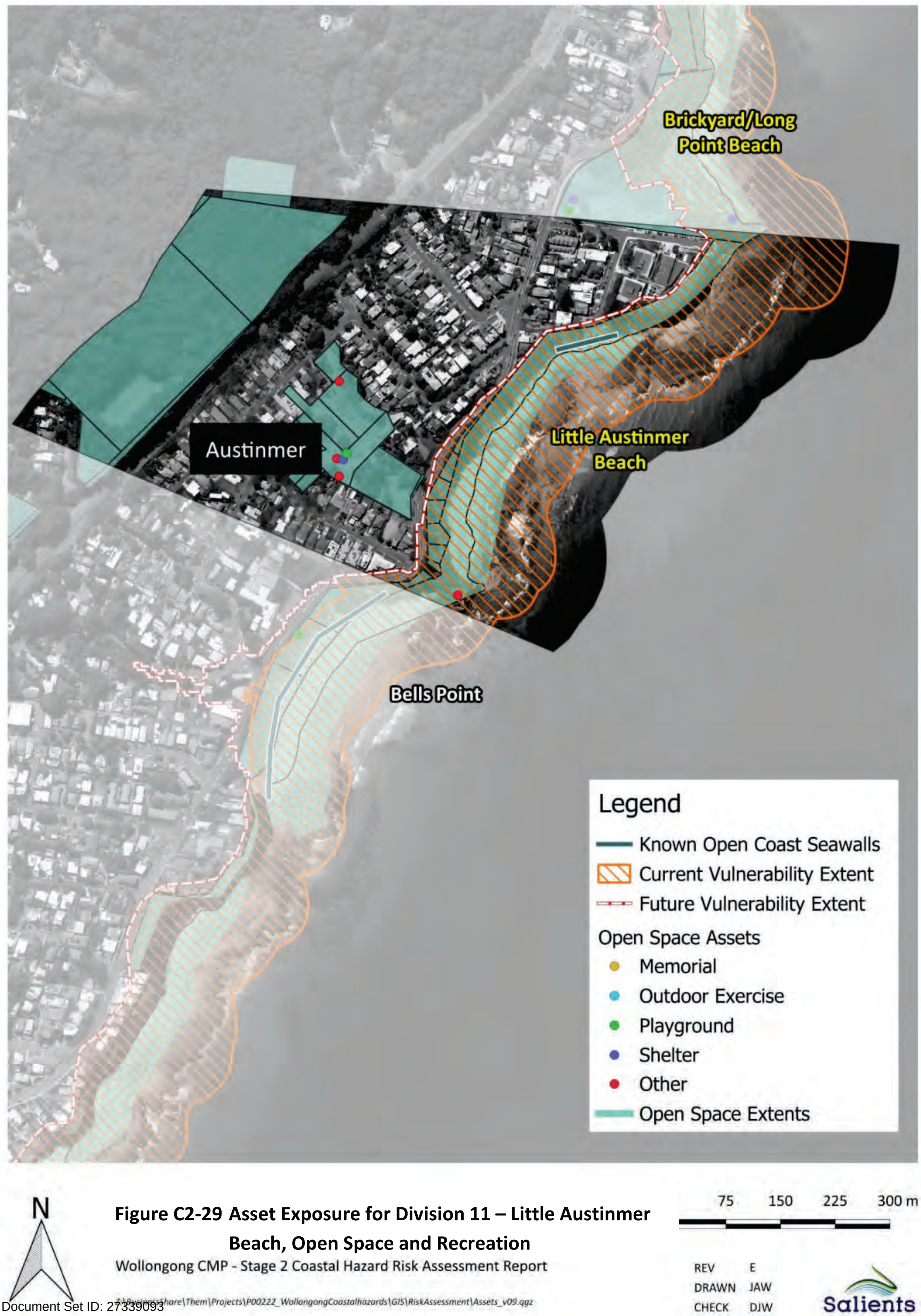

Figure C2-29 Asset Exposure for Division 11 – Little Austinmer Beach, Open Space and Recreation

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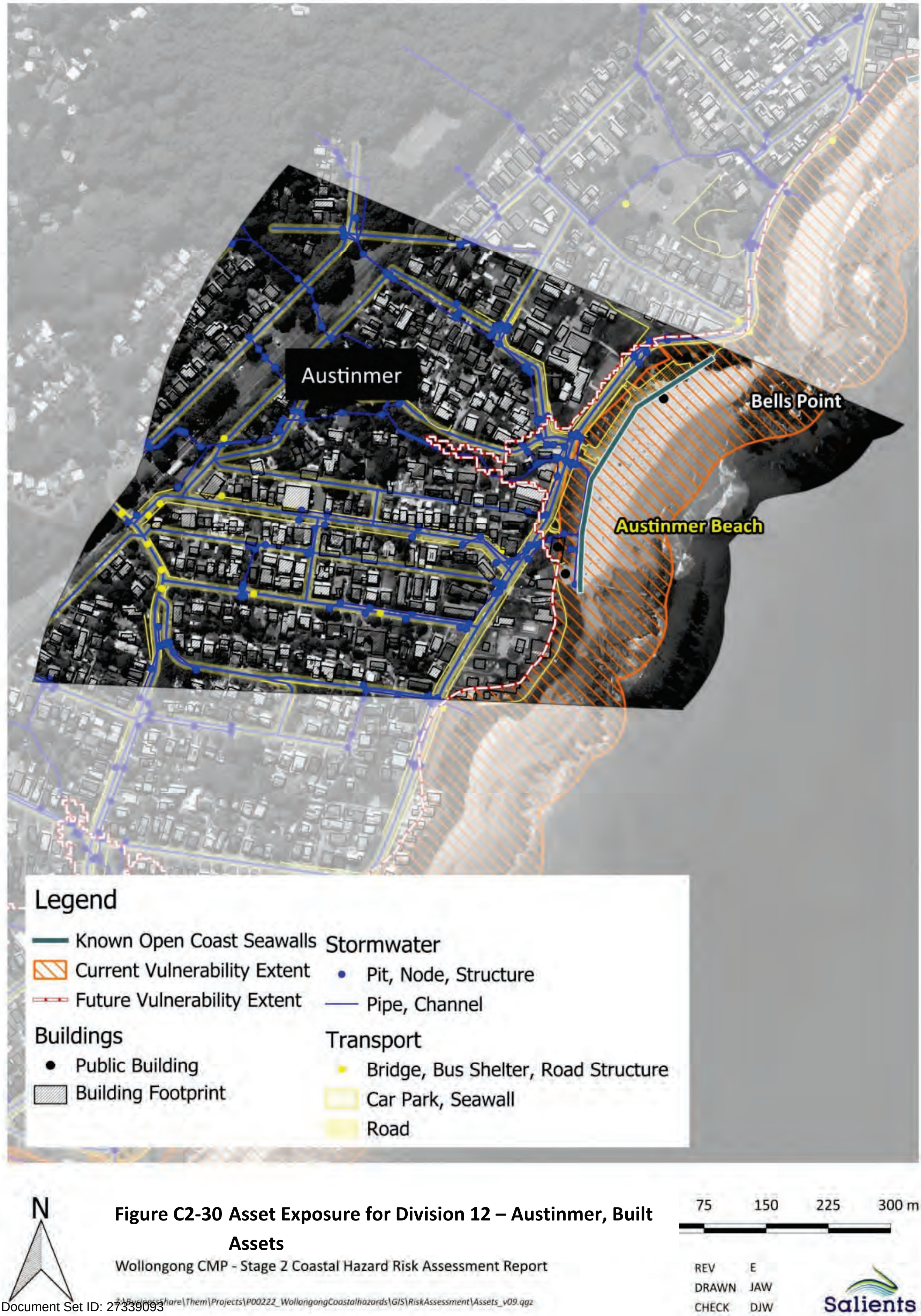

Figure C2-30 Asset Exposure for Division 12 – Austinmer, Built Assets

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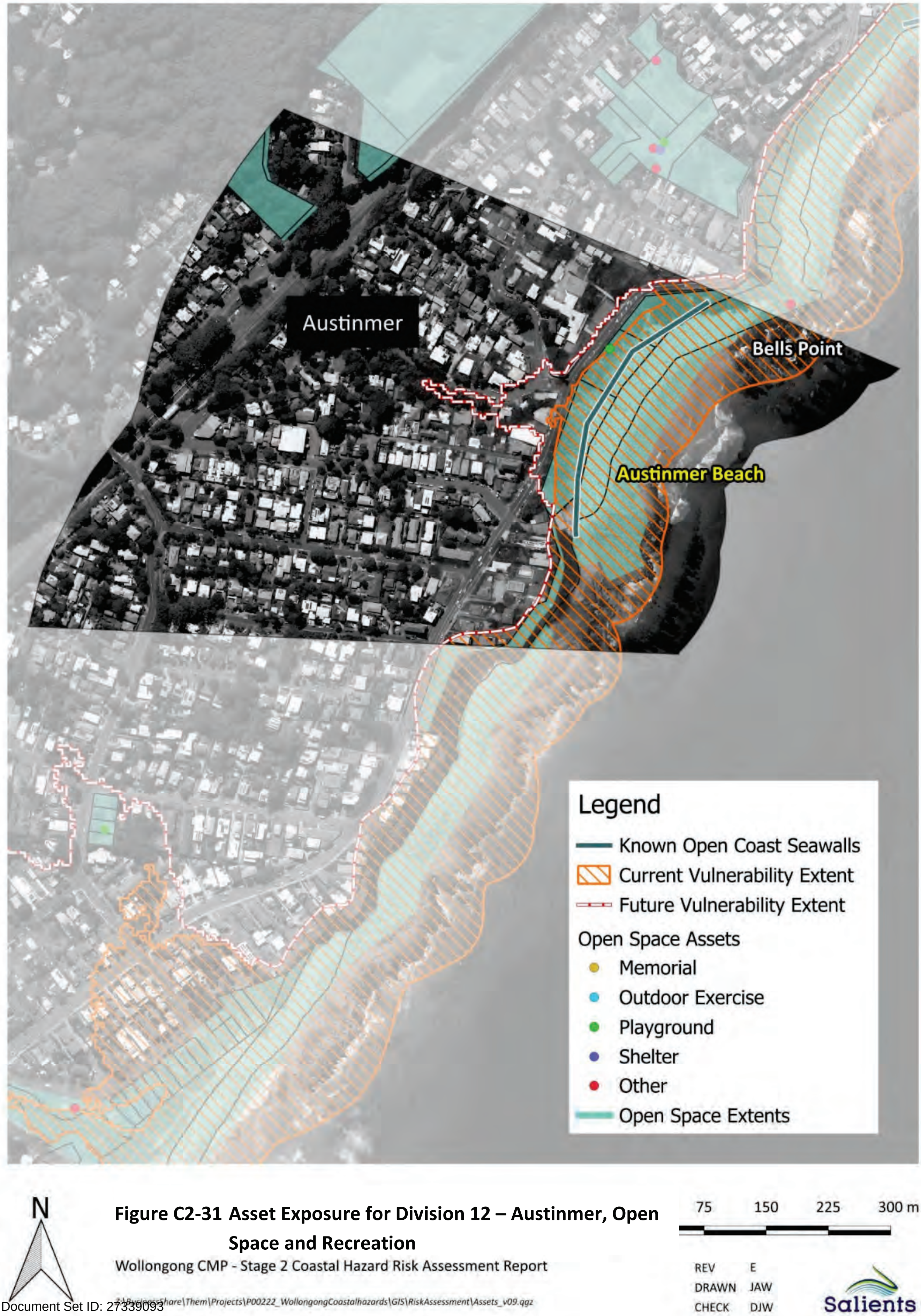

Figure C2-31 Asset Exposure for Division 12 – Austinmer, Open Space and Recreation

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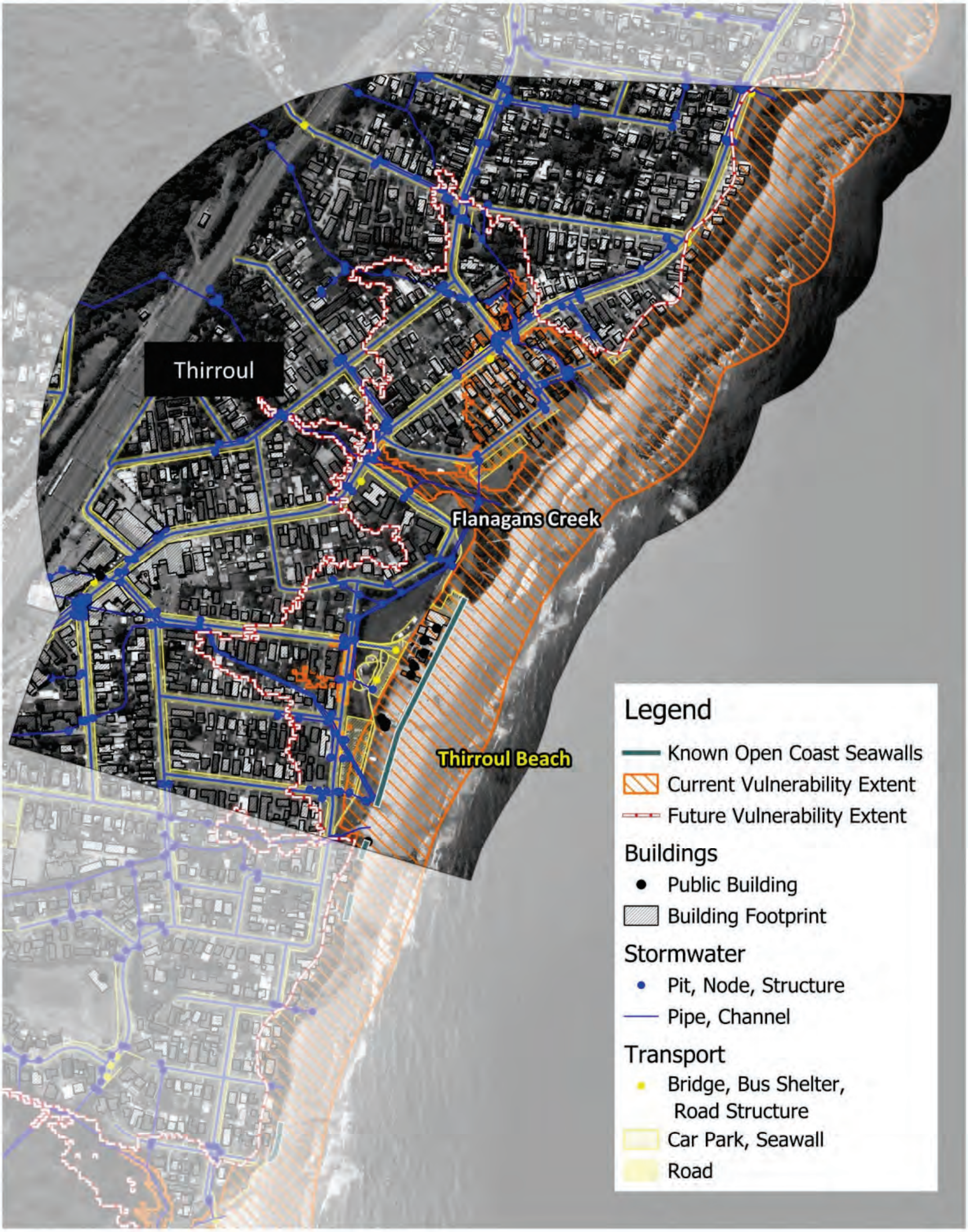

Figure C2-32 Asset Exposure for Division 13 – Thirroul, Built Assets

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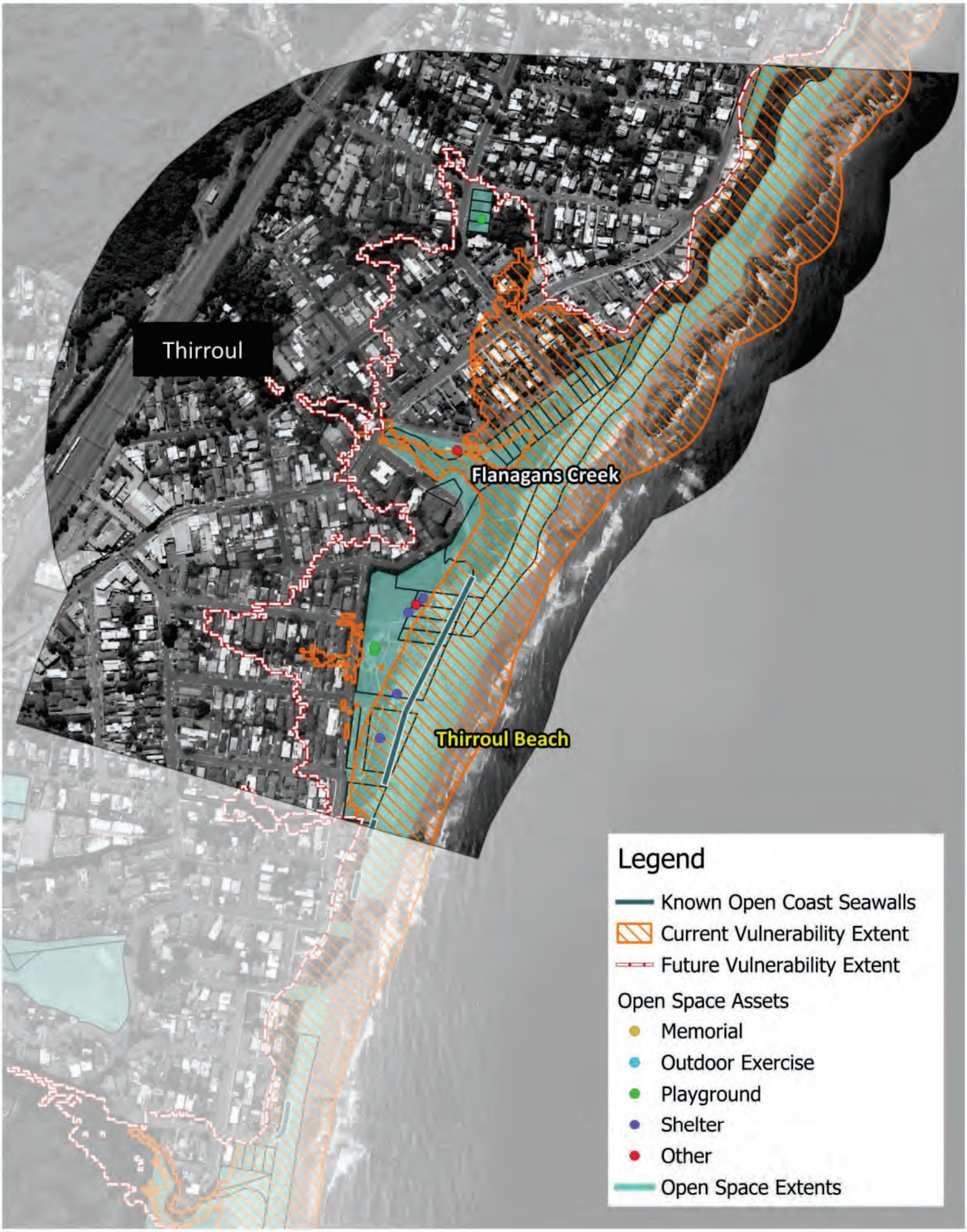

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Figure C2-33 Asset Exposure for Division 13 – Thirroul, Open Space and Recreation

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Figure C2-34 Asset Exposure for Division 14 – McCauleys Beach, Built Assets

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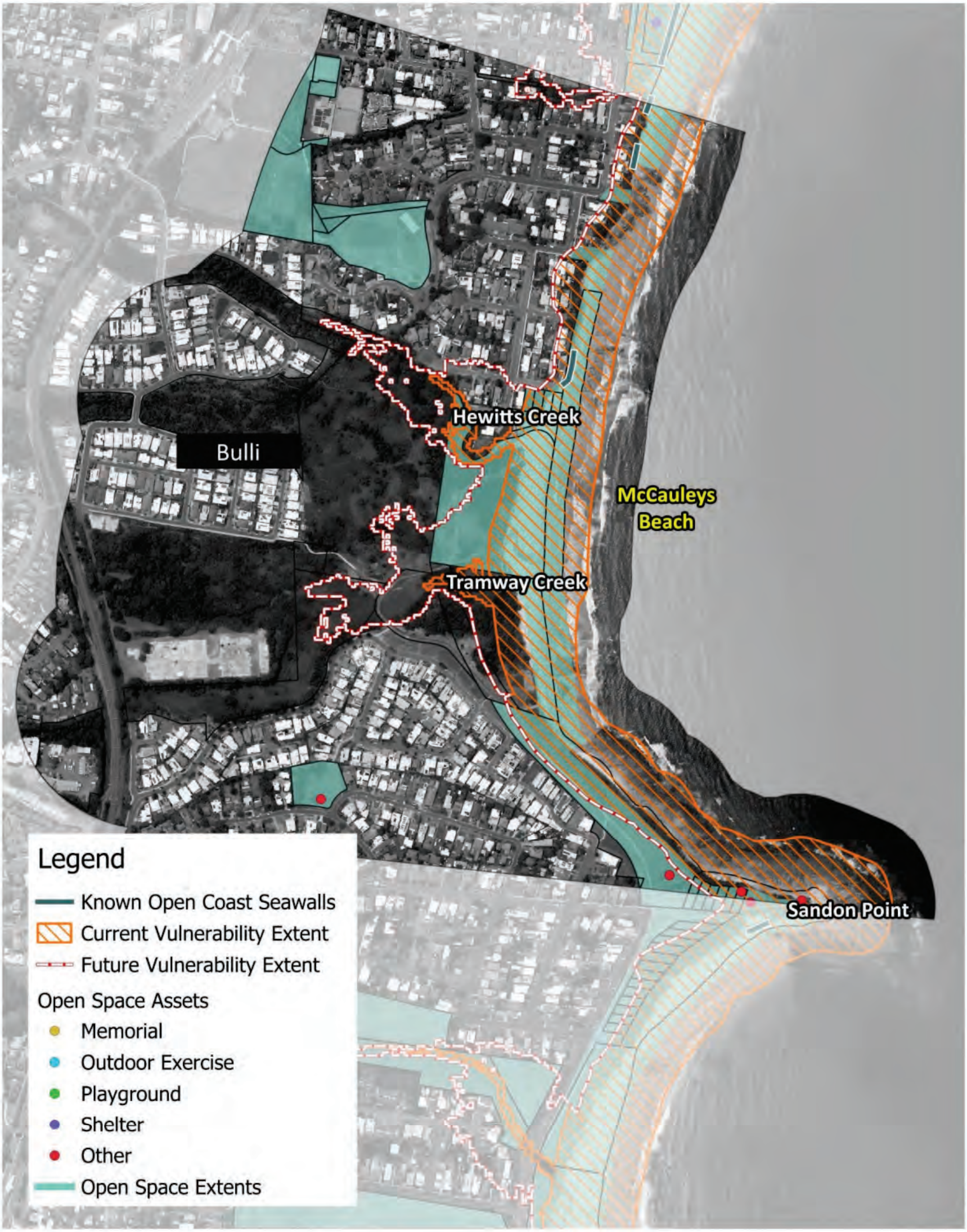

Figure C2-35 Asset Exposure for Division 14 – McCauleys Beach, Open Space and Recreation

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Figure C2-36 Asset Exposure for Division 14 – McCauleys Beach, Ecology

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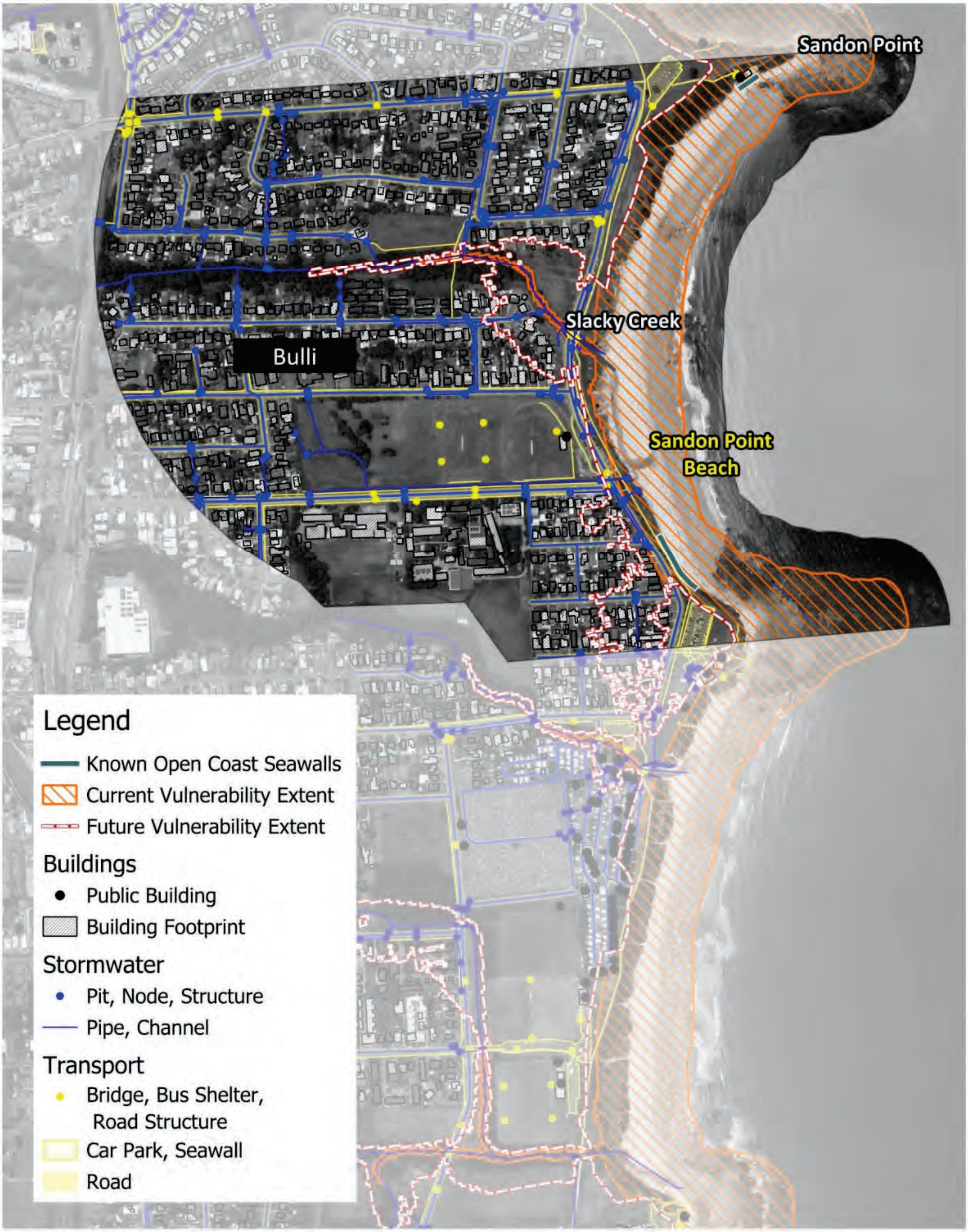

Figure C2-37 Asset Exposure for Division 15 – Sandon Point, Built Assets

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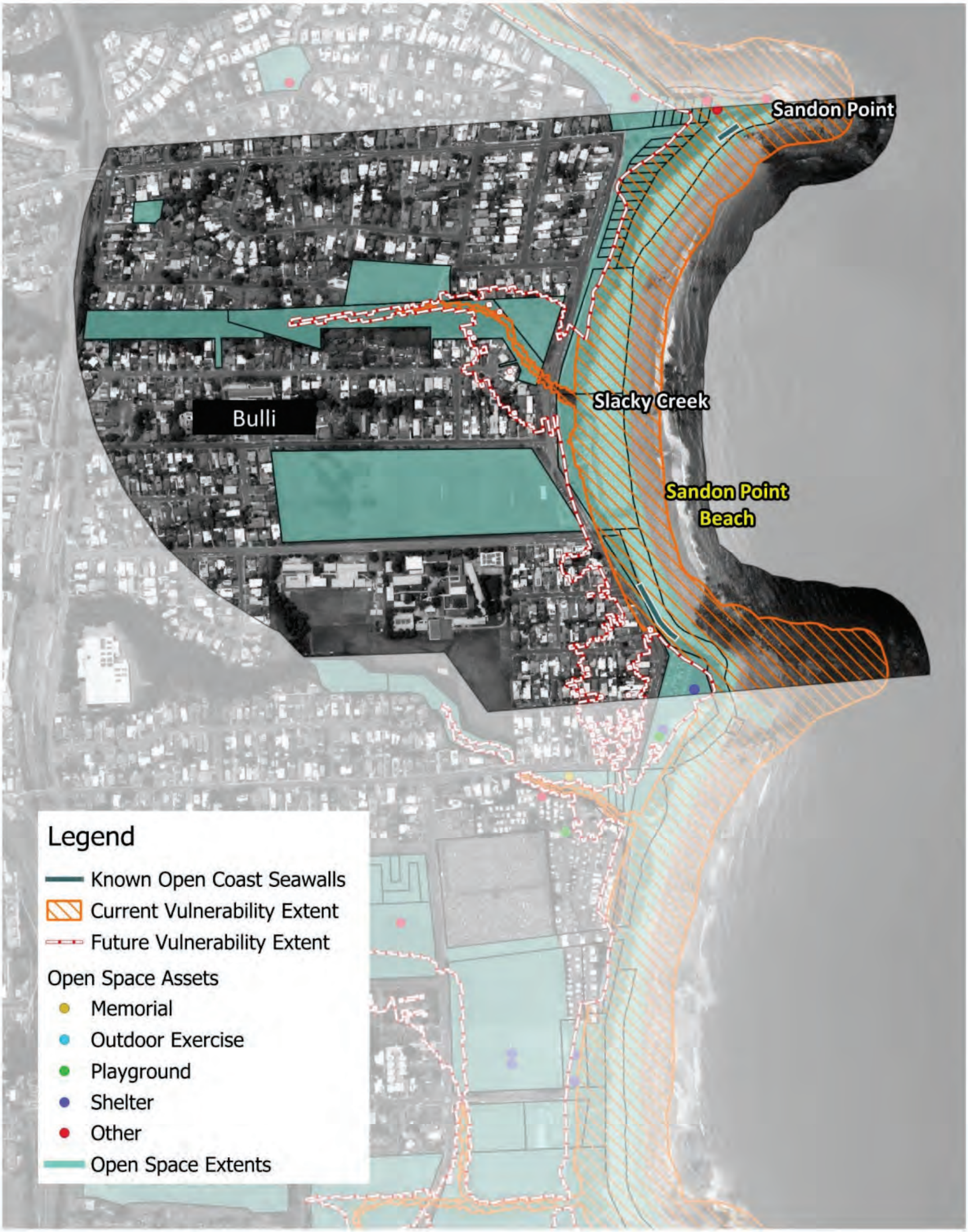

Figure C2-38 Asset Exposure for Division 15 – Sandon Point, Open Space and Recreation

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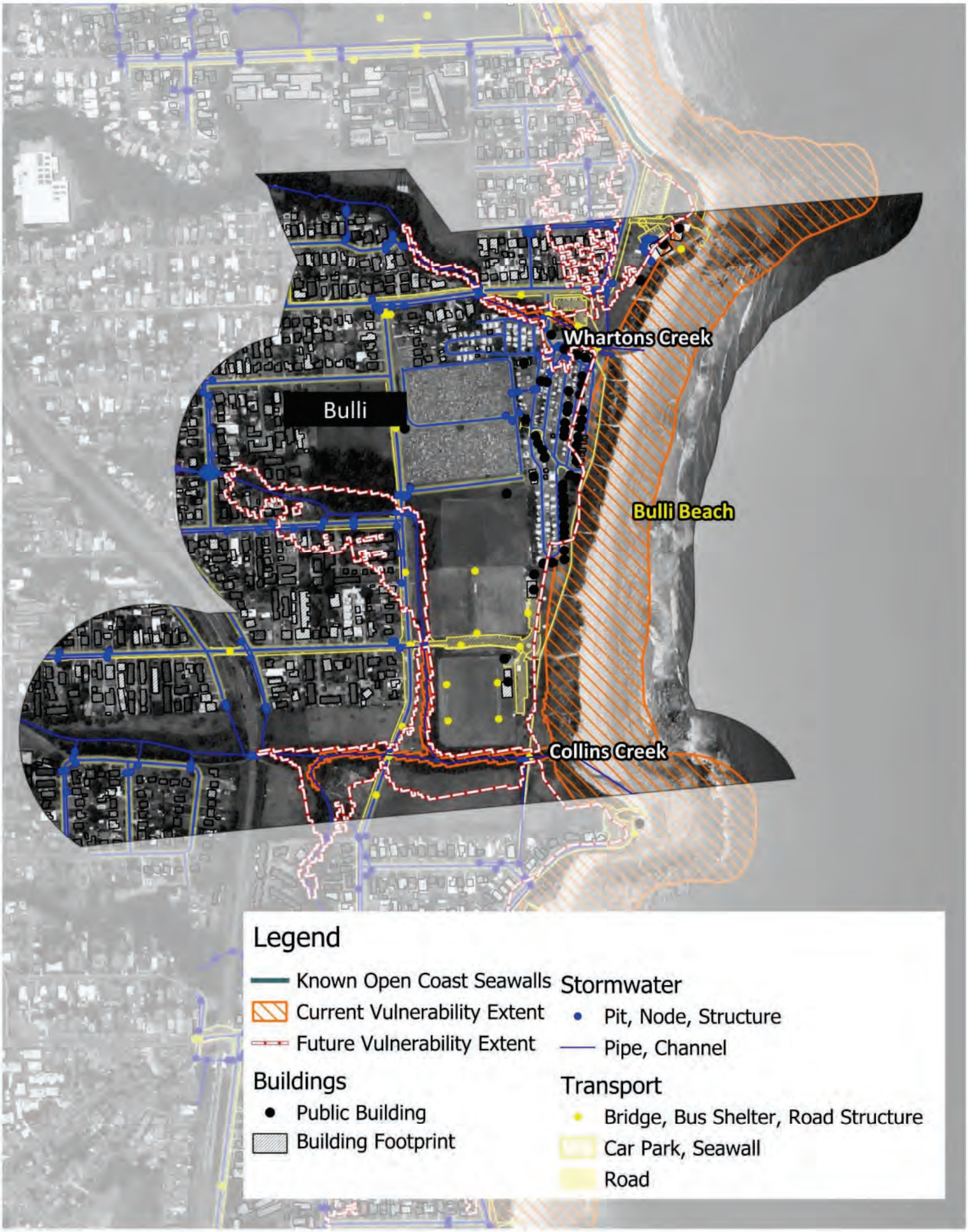

Figure C2-39 Asset Exposure for Division 16 – Bulli, Built Assets

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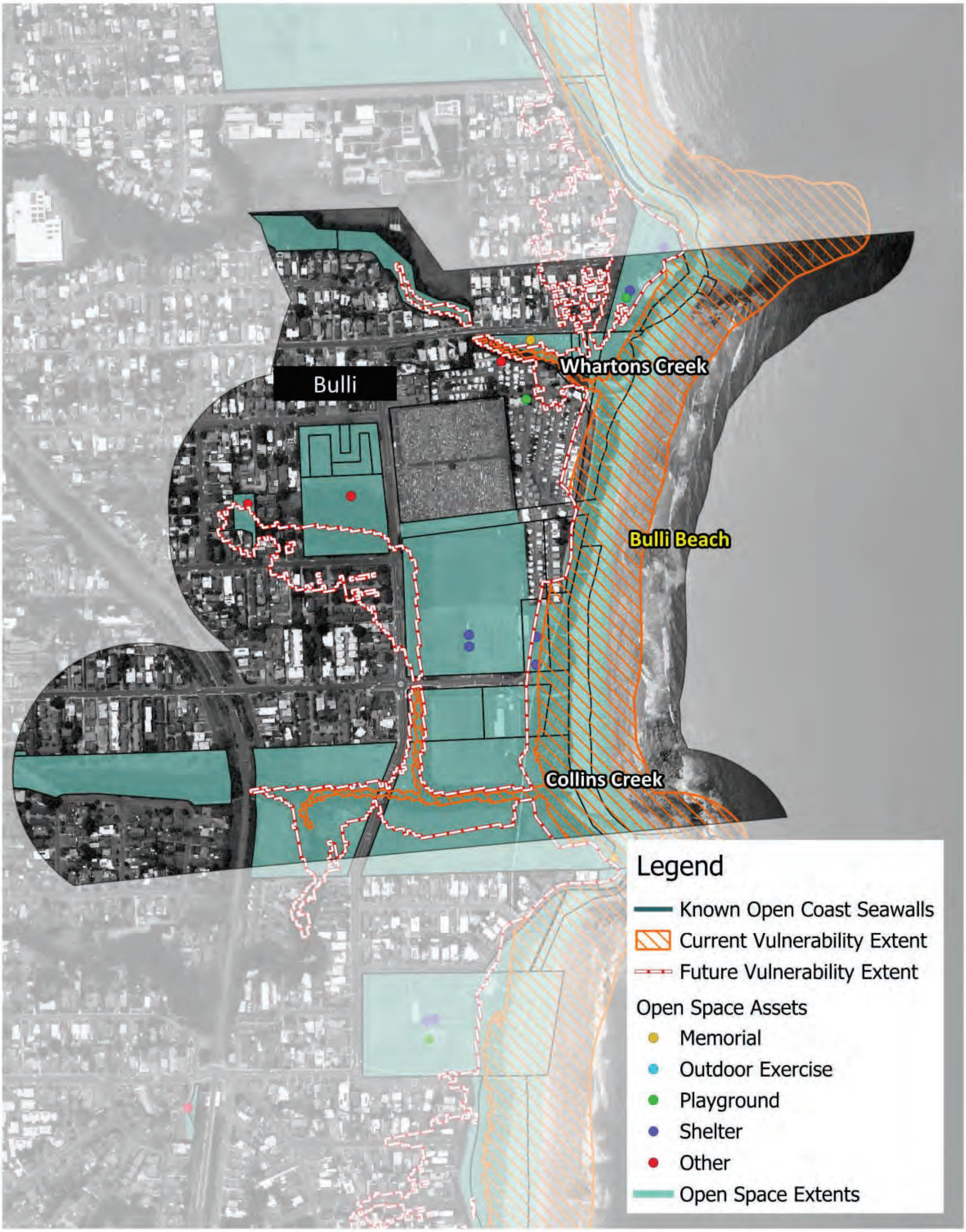

Figure C2-40 Asset Exposure for Division 16 – Bulli, Open Space and Recreation

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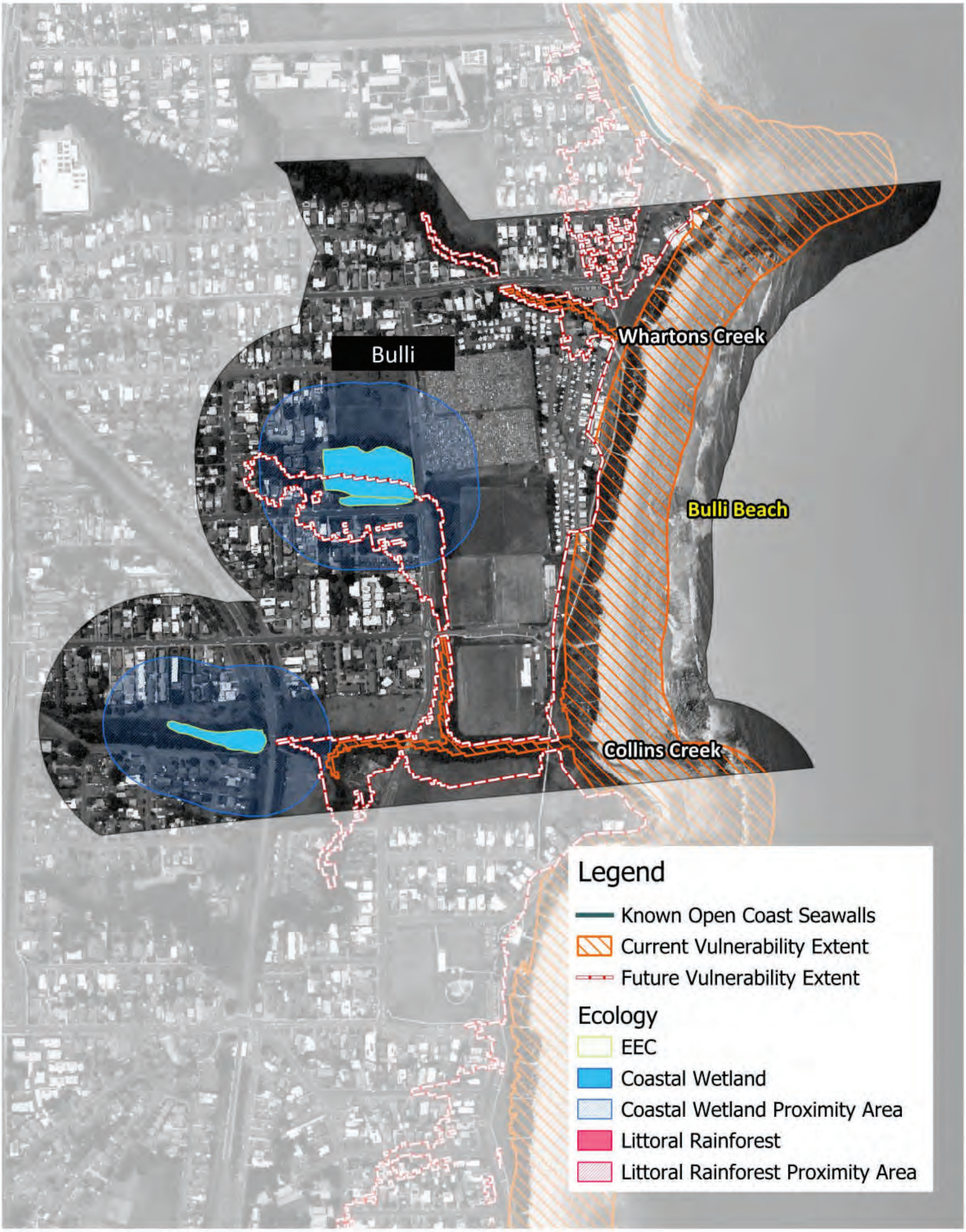

Figure C2-41 Asset Exposure for Division 16 – Bulli, Ecology

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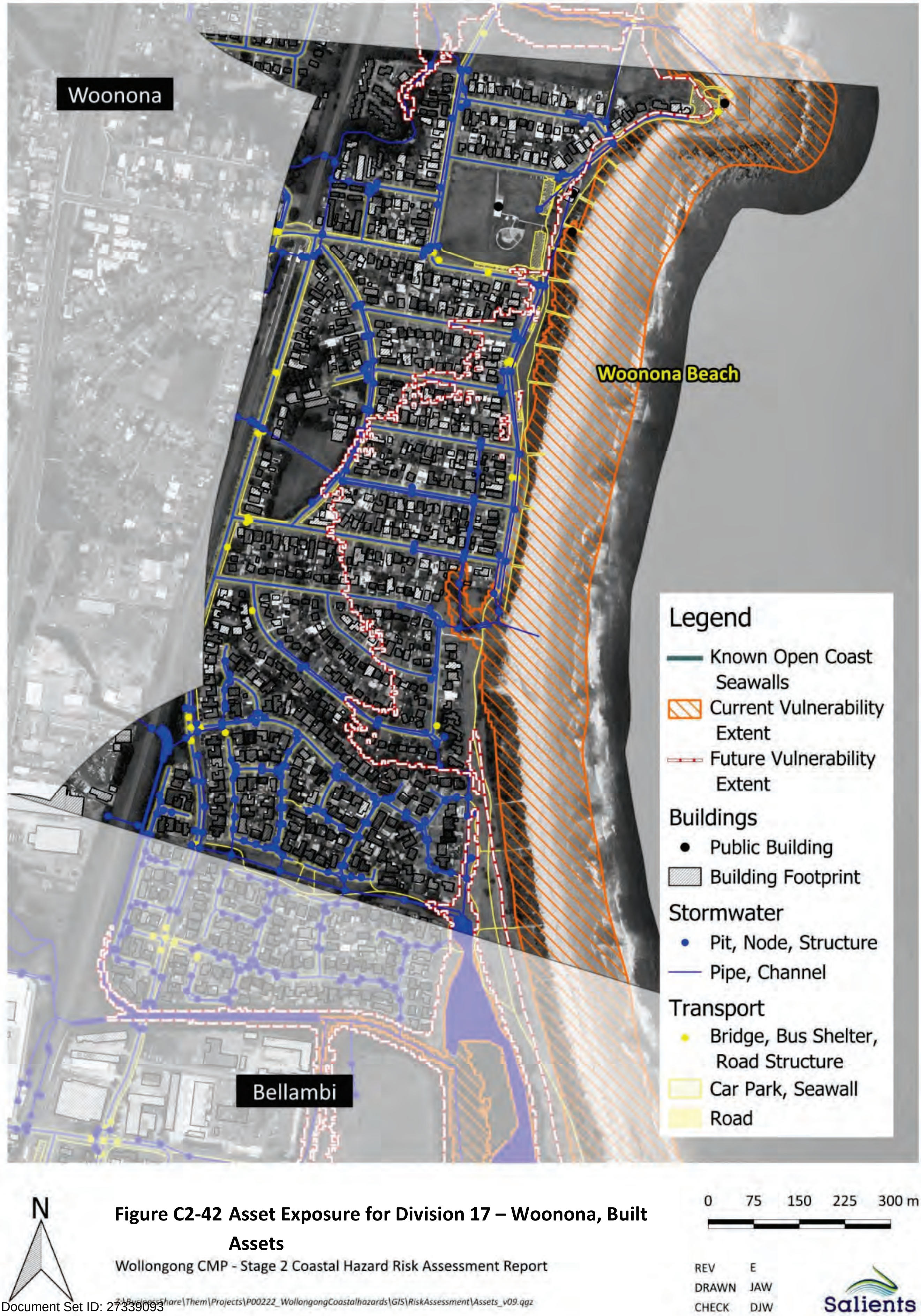

Figure C2-42 Asset Exposure for Division 17 – Woonona, Built Assets

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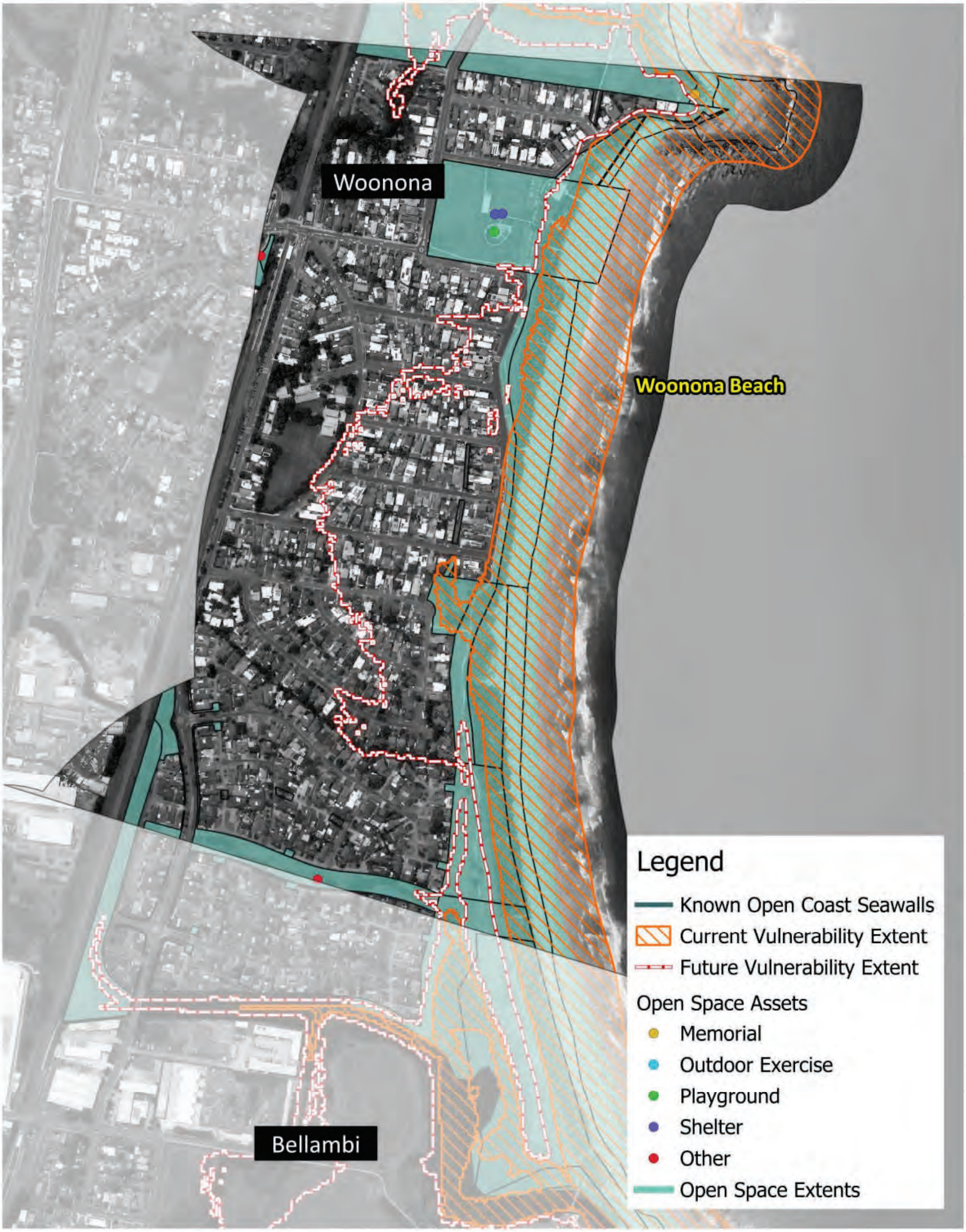

Figure C2-43 Asset Exposure for Division 17 – Woonona, Open Space and Recreation

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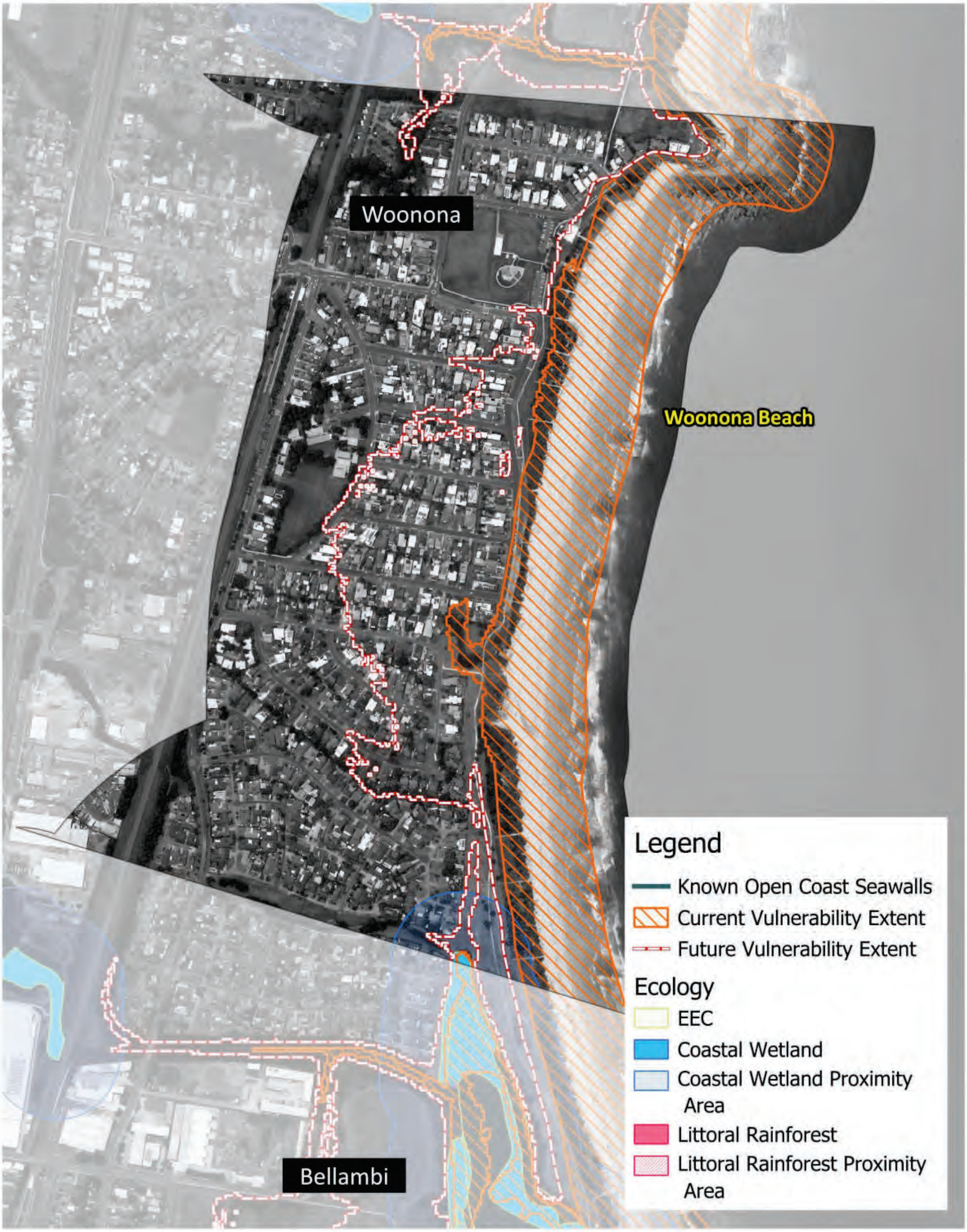

Figure C2-44 Asset Exposure for Division 17 – Woonona, Ecology

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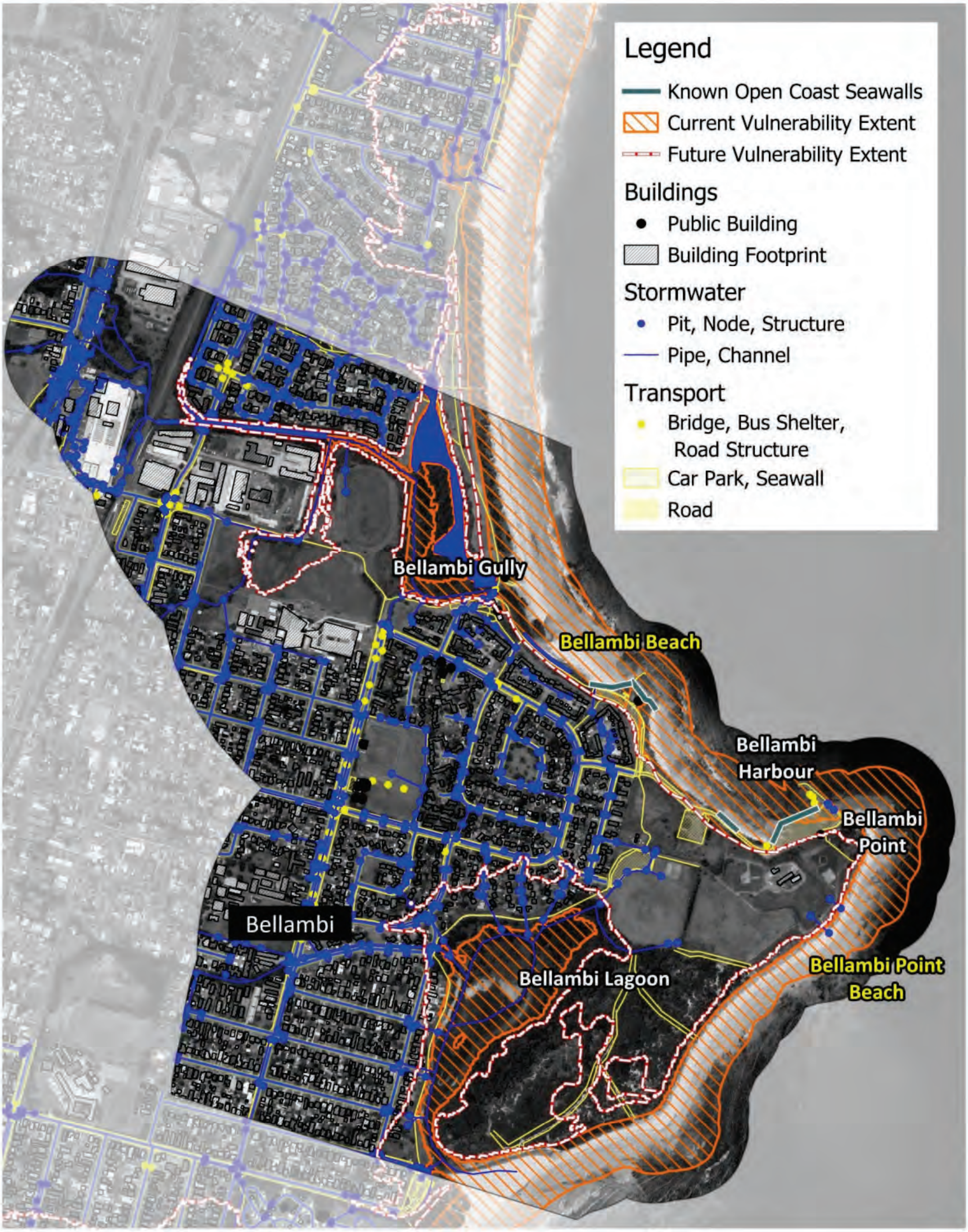

Figure C2-45 Asset Exposure for Division 18 – Bellambi, Built Assets

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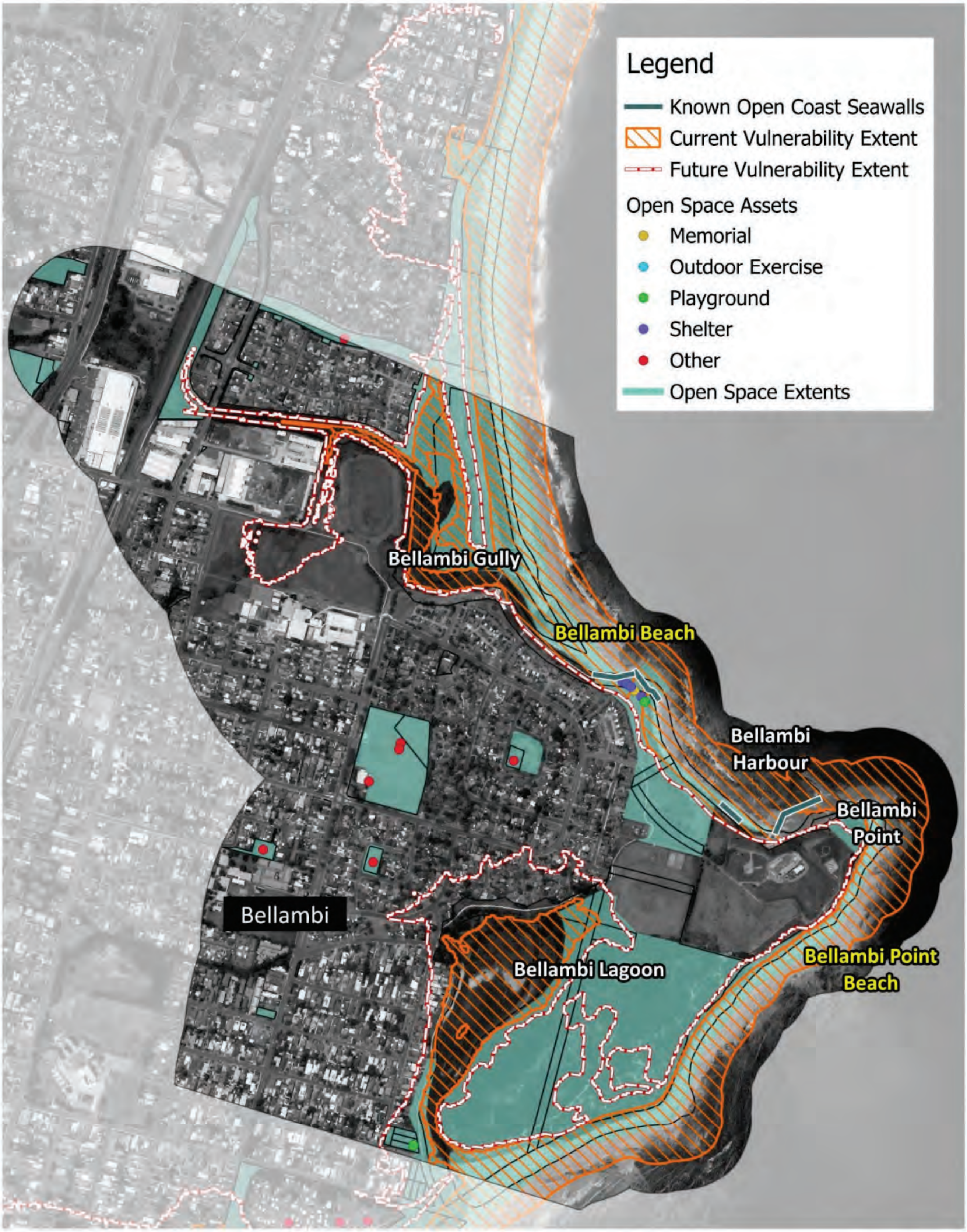

Figure C2-46 Asset Exposure for Division 18 – Bellambi, Open Space and Recreation

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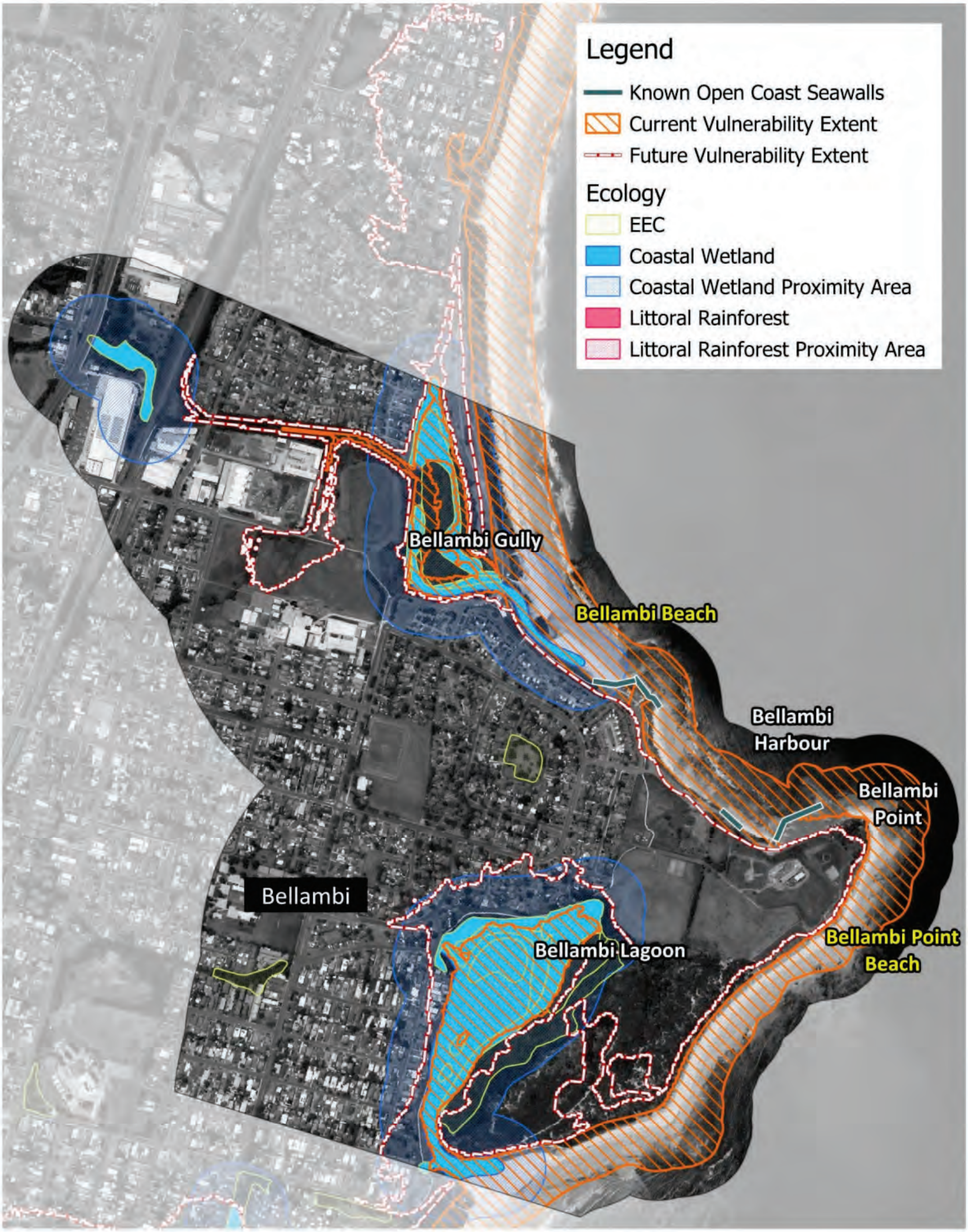

Figure C2-47 Asset Exposure for Division 18 – Bellambi, Ecology

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Figure C2-48 Asset Exposure for Division 19 – Corrimal, Built Assets

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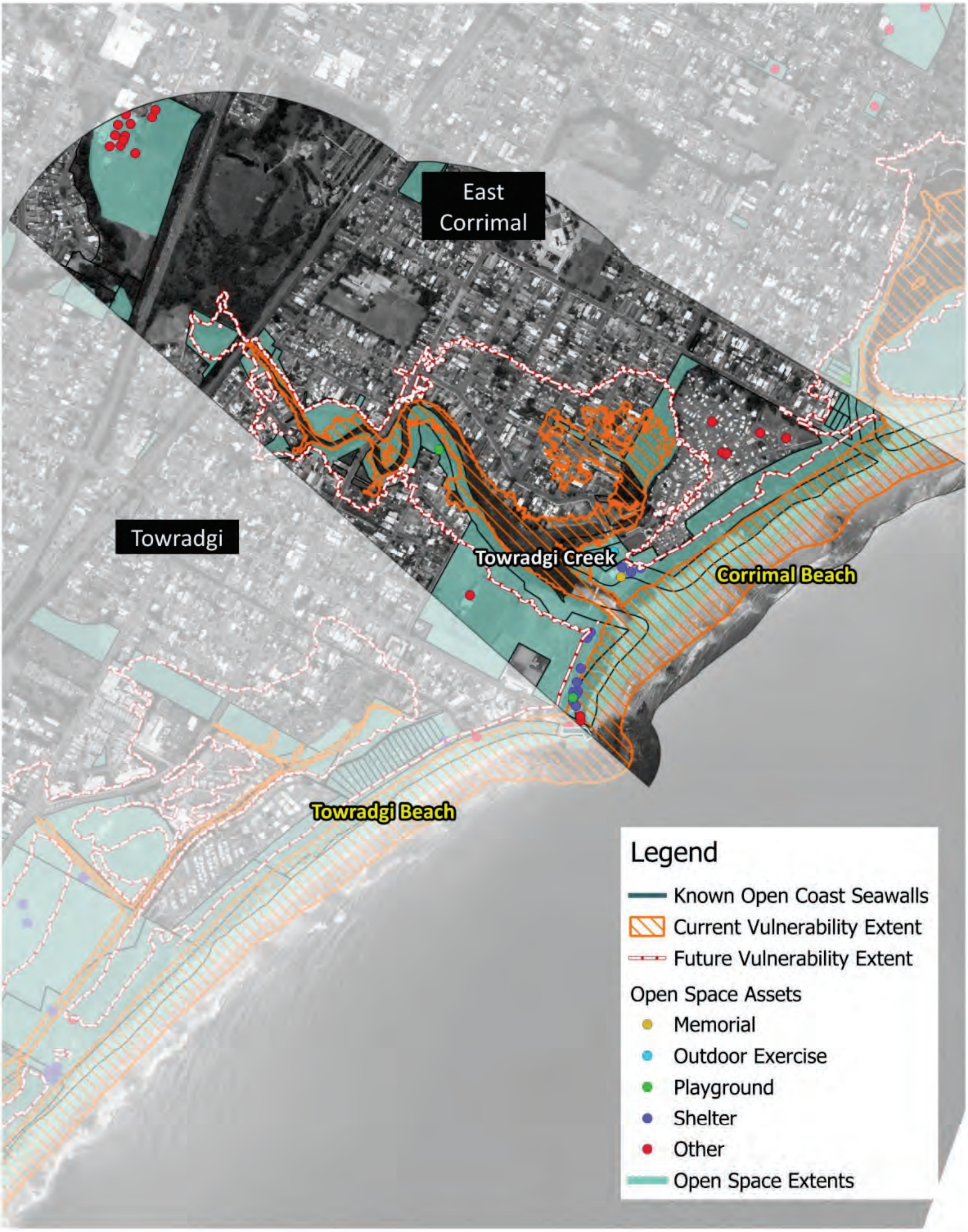

Figure C2-49 Asset Exposure for Division 19 – Corrimal, Open Space and Recreation

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Figure C2-50 Asset Exposure for Division 19 – Corrimal, Ecology

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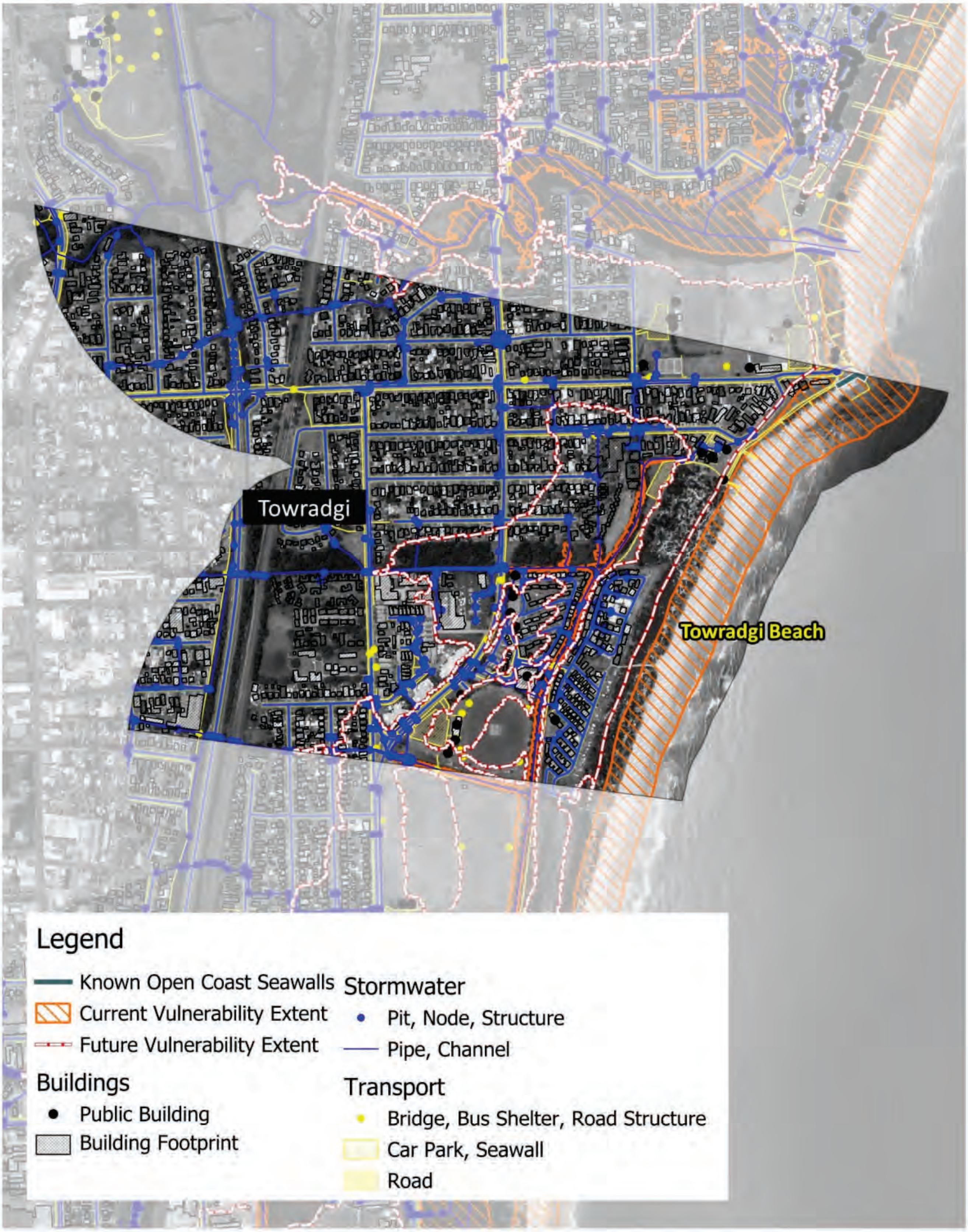

Figure C2-51 Asset Exposure for Division 20 – Towradgi, Built Assets

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Figure C2-52 Asset Exposure for Division 20 – Towradgi, Open Space and Recreation

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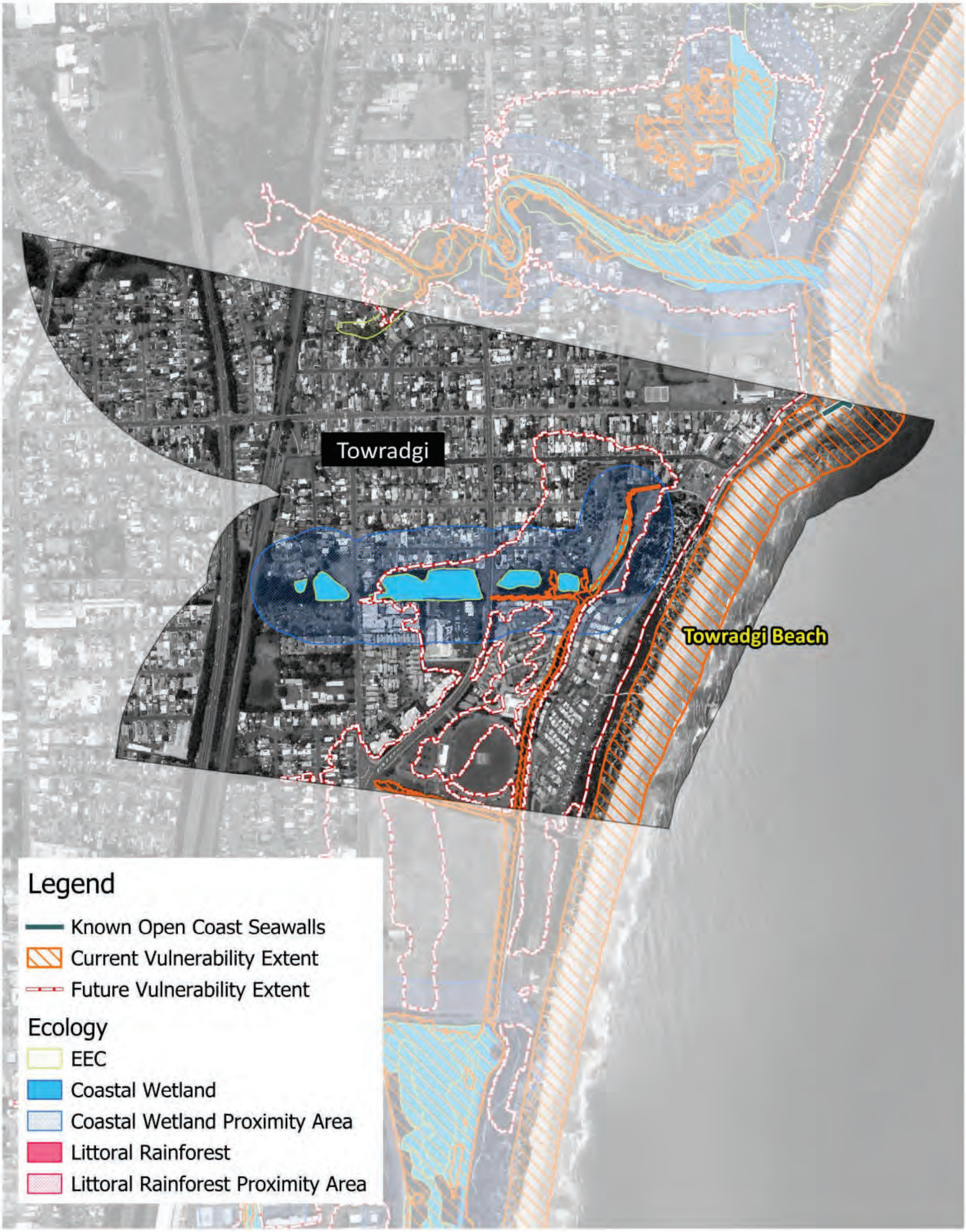

Figure C2-53 Asset Exposure for Division 20 – Towradgi, Ecology

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Figure C2-54 Asset Exposure for Division 21 – Fairy Meadow, Built Assets

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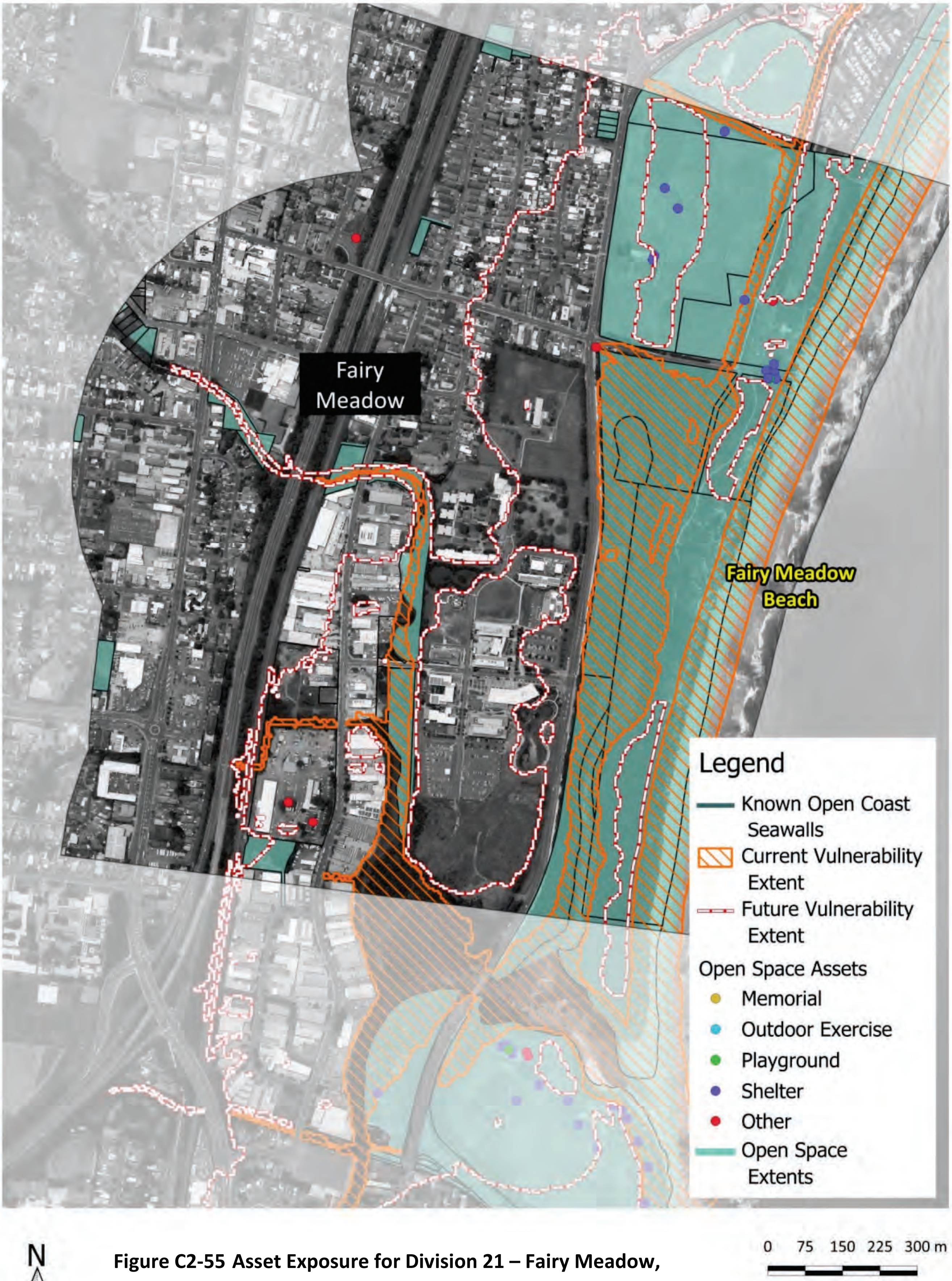

Figure C2-55 Asset Exposure for Division 21 – Fairy Meadow, Open Space and Recreation

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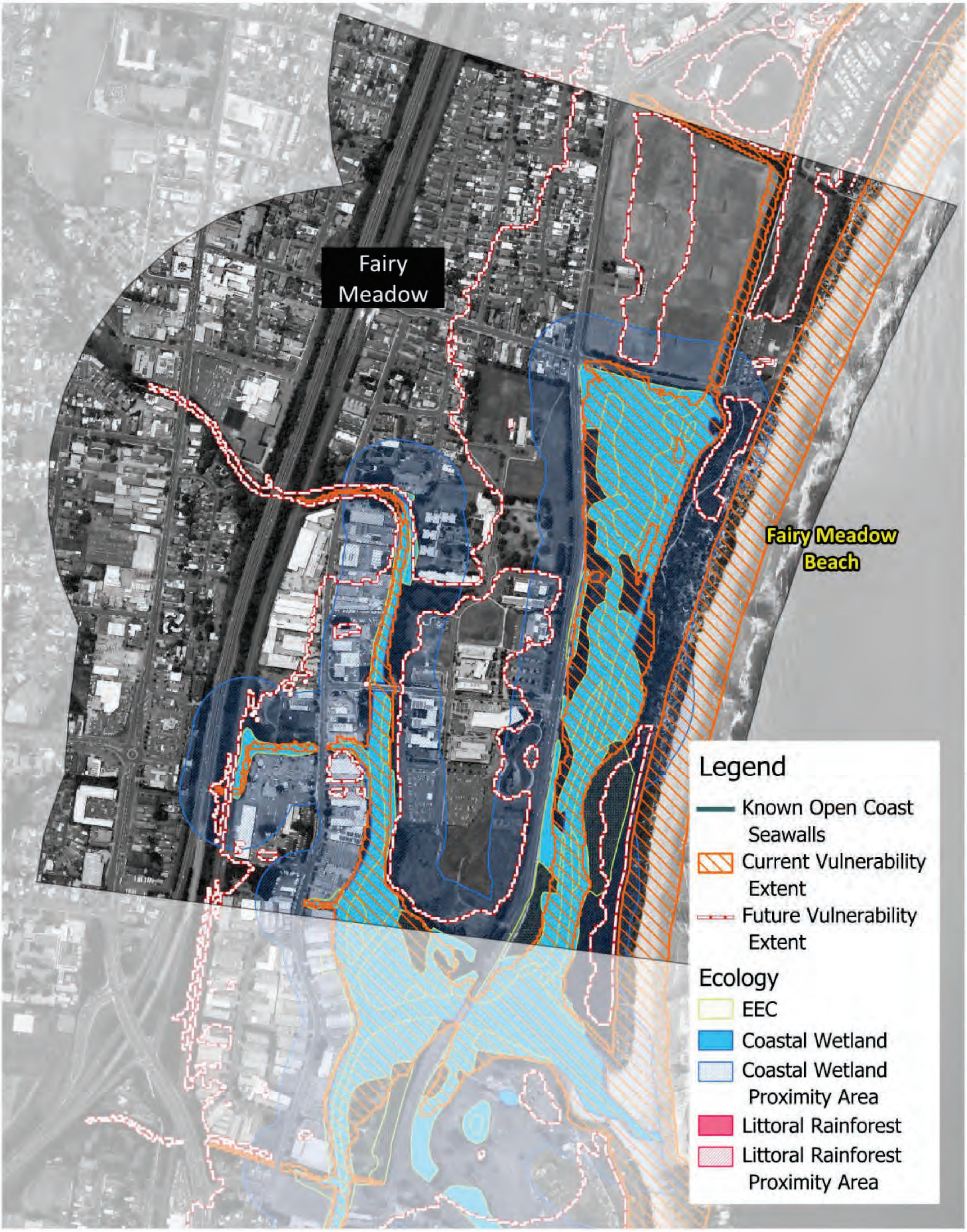

Figure C2-56 Asset Exposure for Division 21 – Fairy Meadow, Ecology

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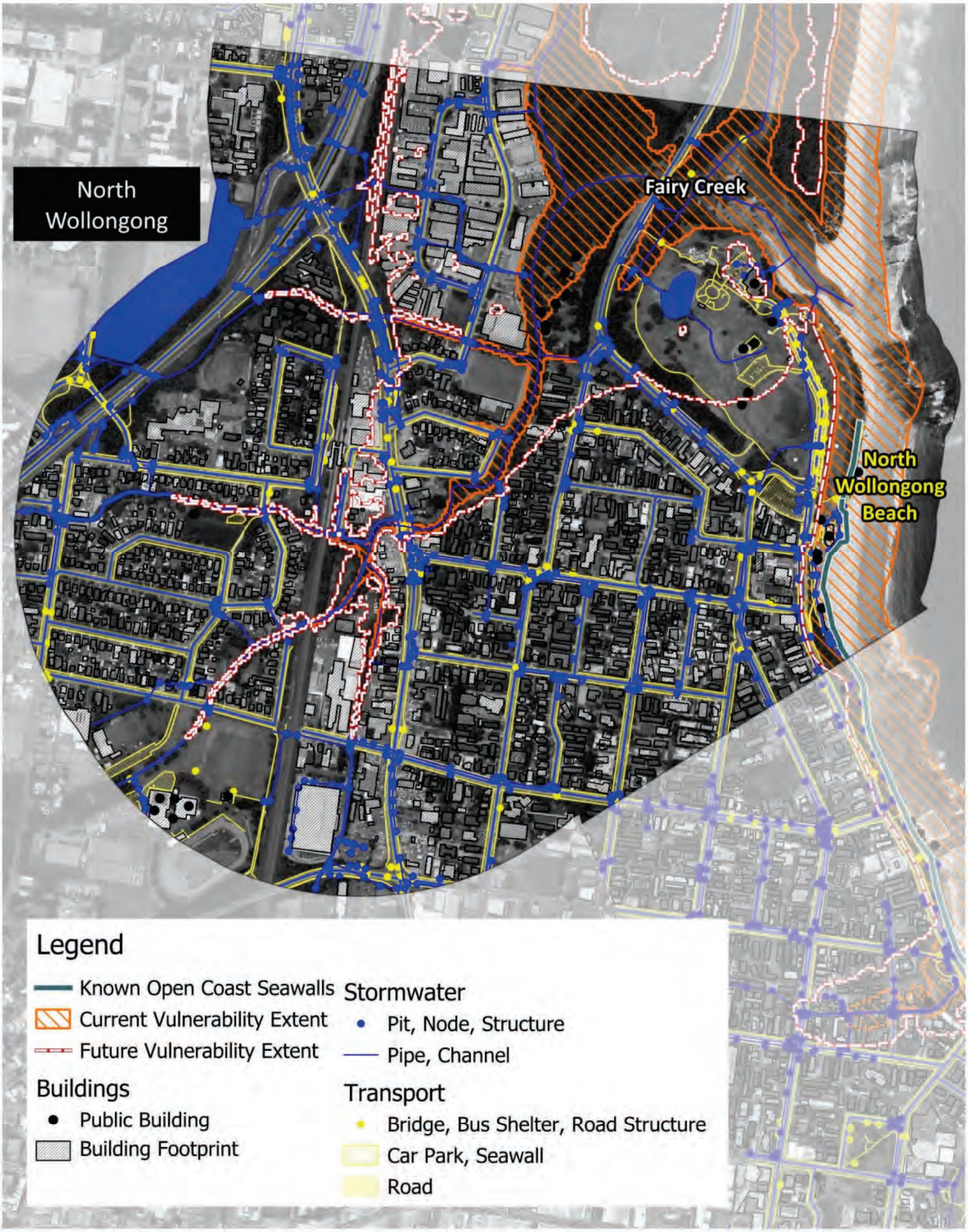

Figure C2-57 Asset Exposure for Division 22 – North Wollongong, Built Assets

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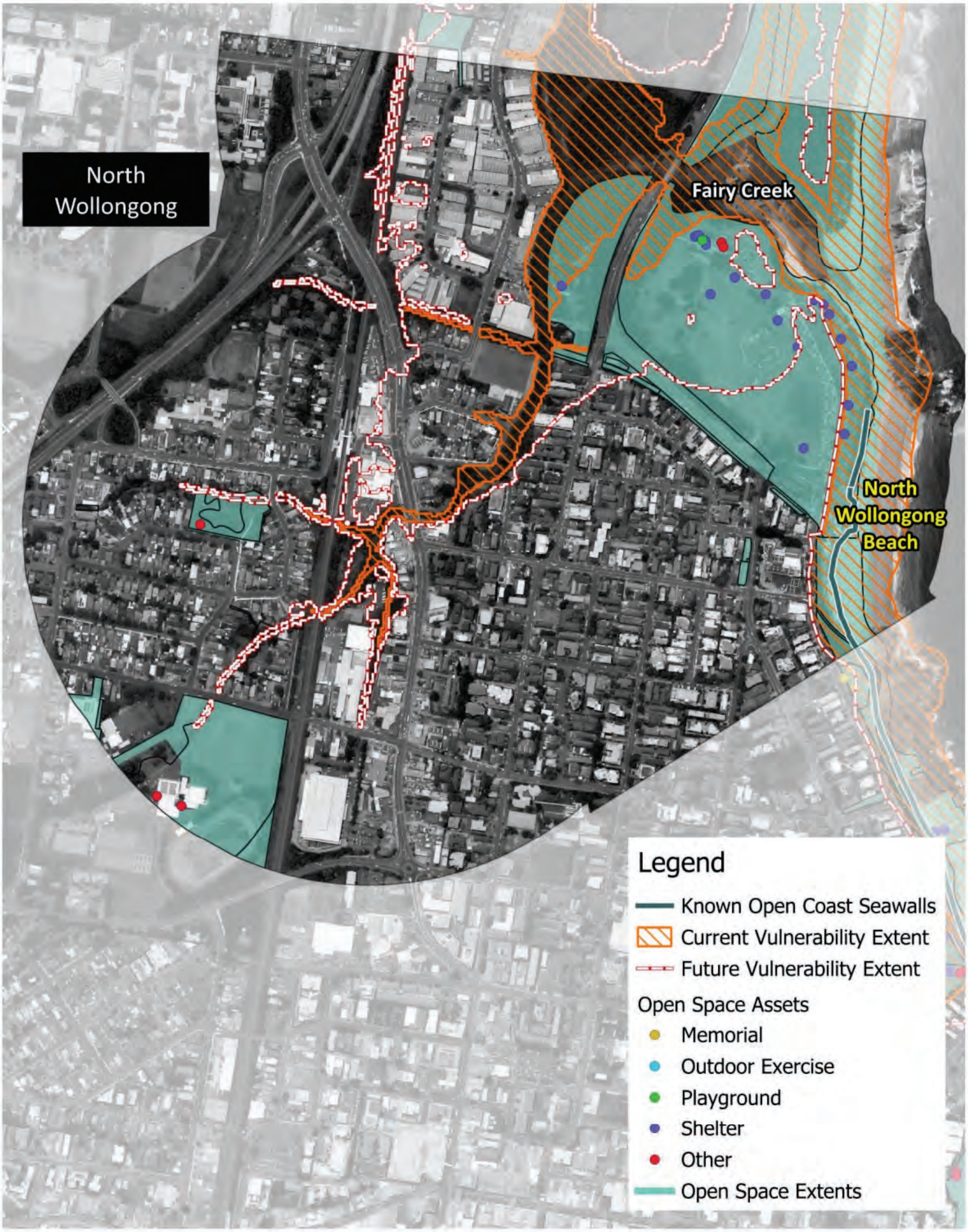

Figure C2-58 Asset Exposure for Division 22 – North Wollongong, Open Space and Recreation

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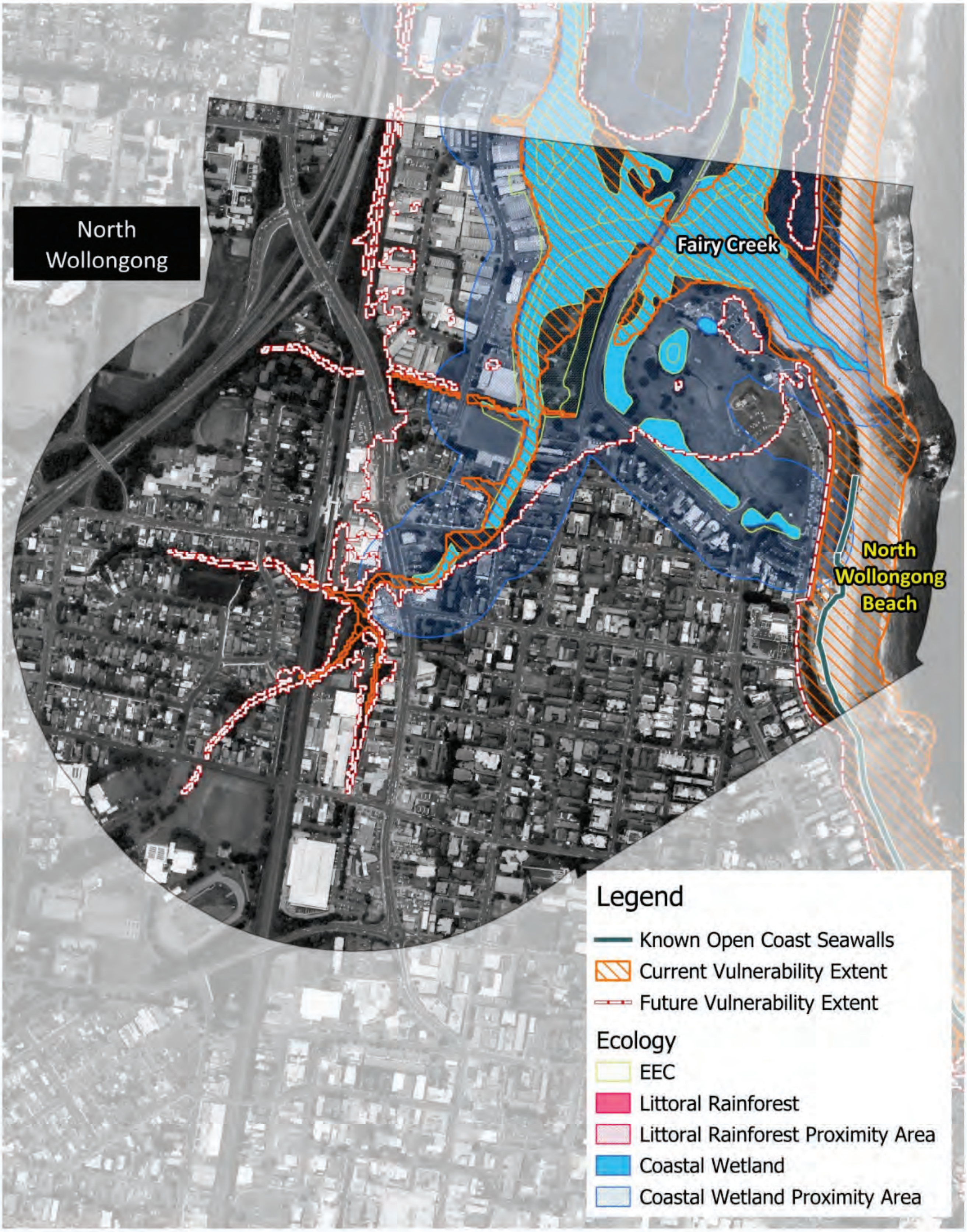

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Figure C2-59 Asset Exposure for Division 22 – North Wollongong, Ecology

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Figure C2-60 Asset Exposure for Division 23 – Central Wollongong, Built Assets

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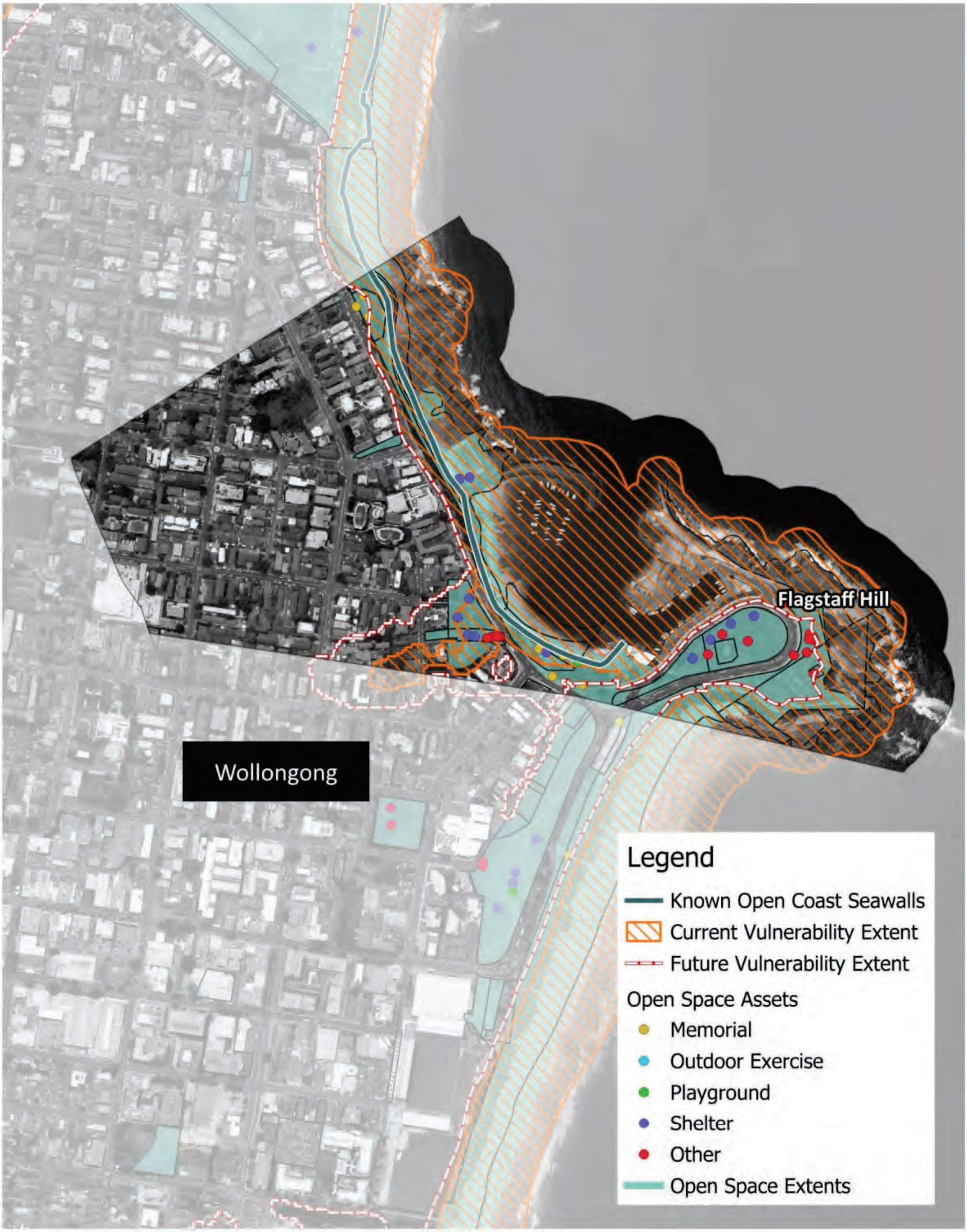

Figure C2-61 Asset Exposure for Division 23 – Central Wollongong, Open Space and Recreation

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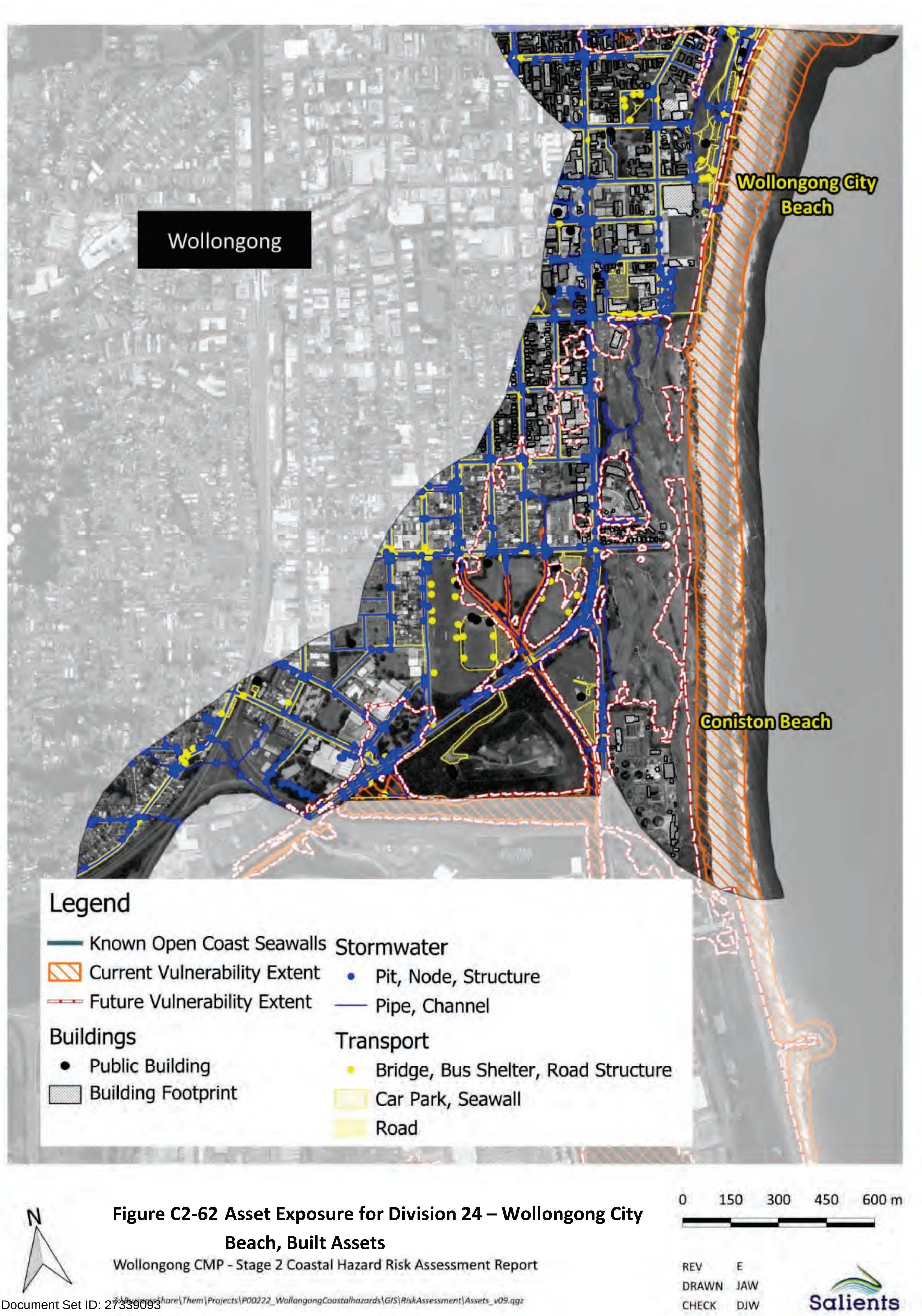

Figure C2-62 Asset Exposure for Division 24 – Wollongong City Beach, Built Assets

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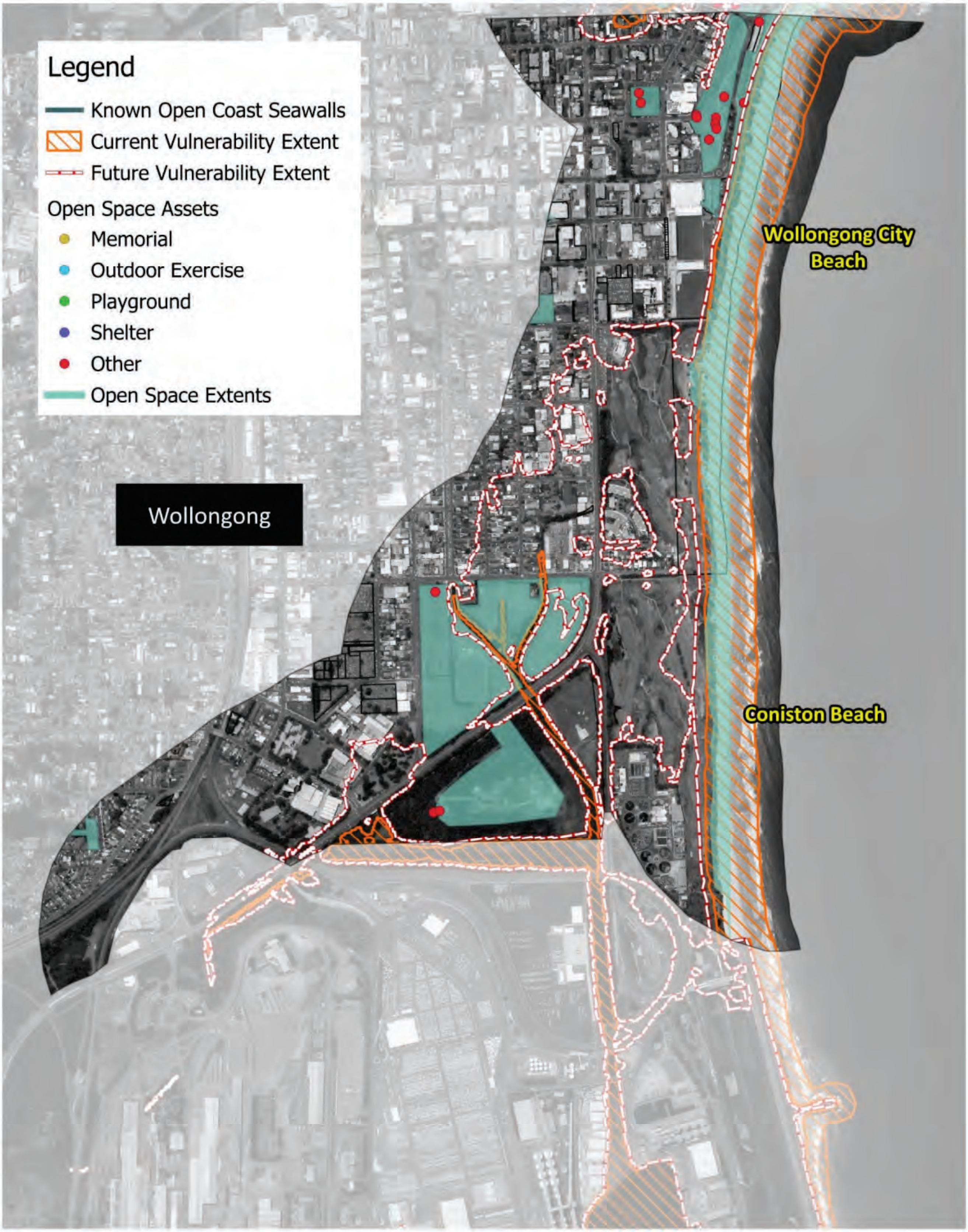

Figure C2-63 Asset Exposure for Division 24 – Wollongong City Beach, Open Space and Recreation

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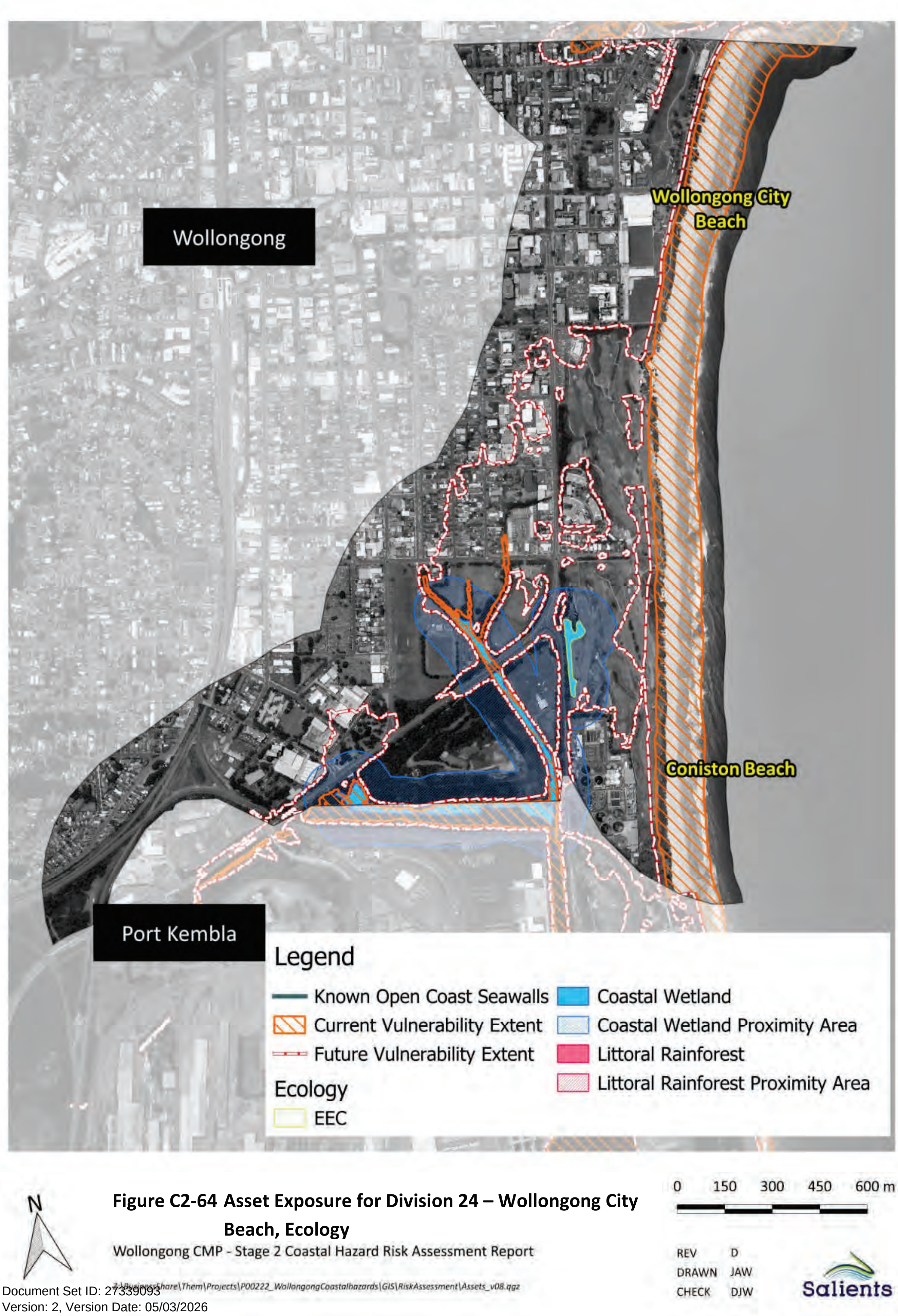

Figure C2-64 Asset Exposure for Division 24 – Wollongong City Beach, Ecology

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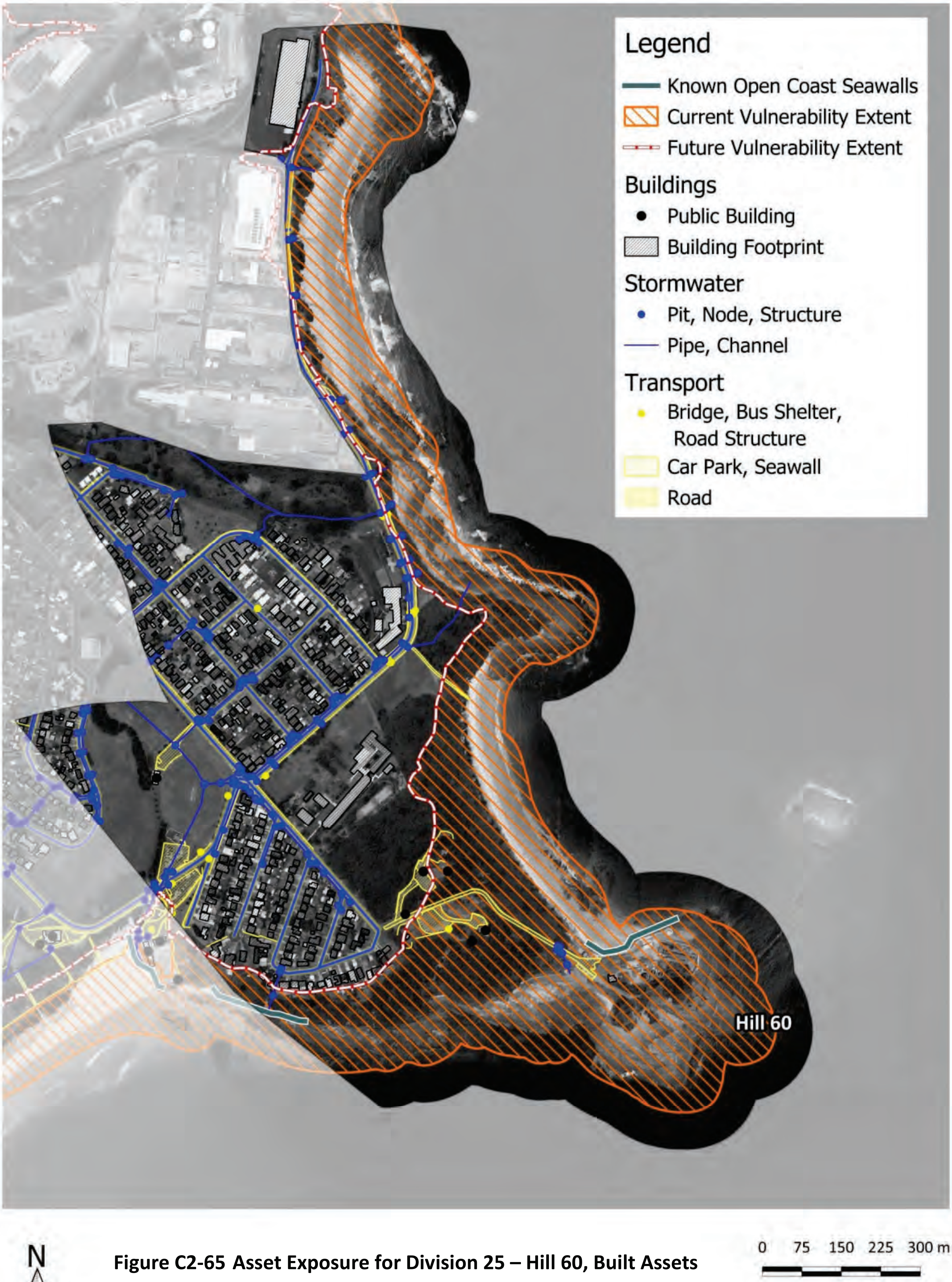

Figure C2-65 Asset Exposure for Division 25 – Hill 60, Built Assets

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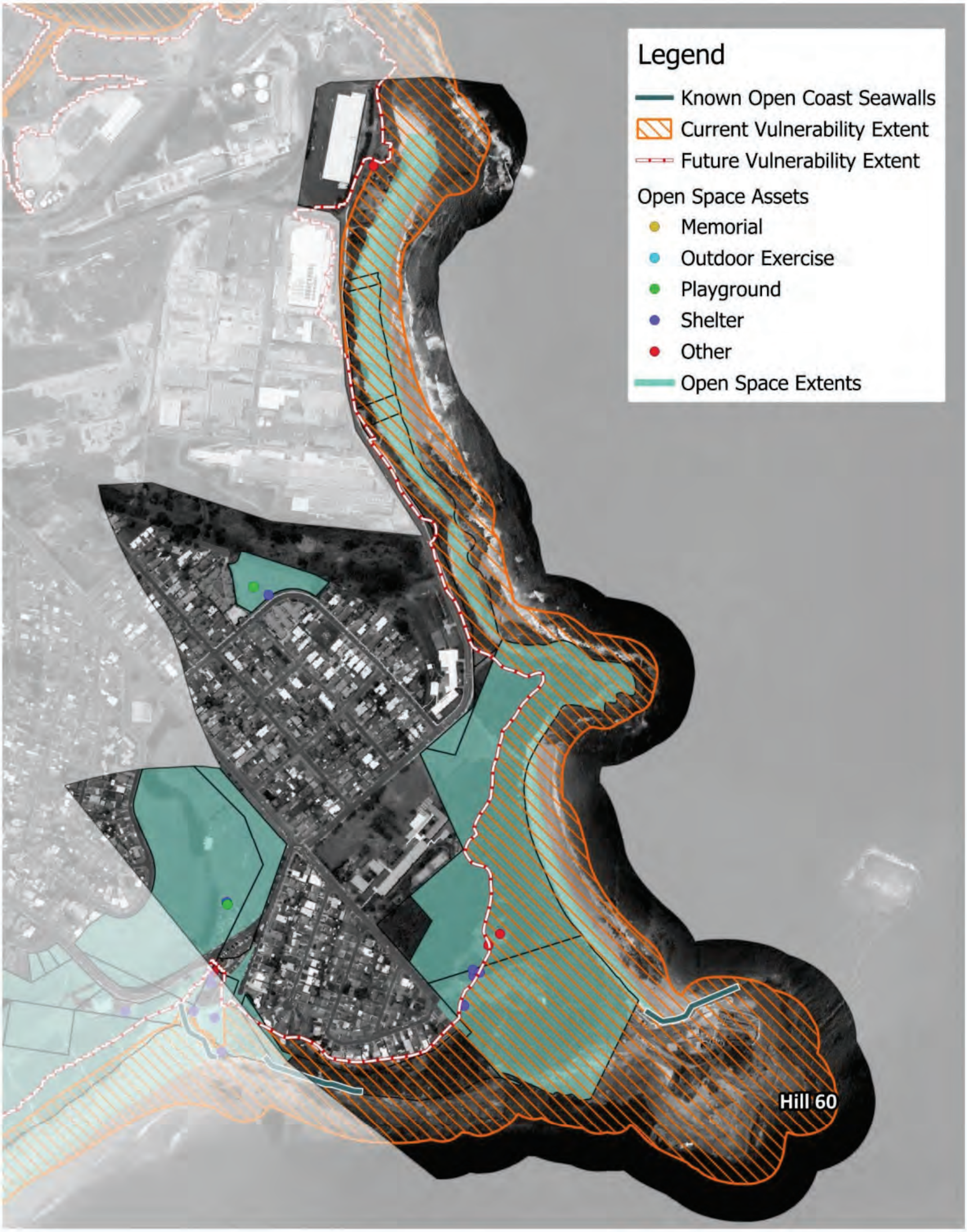

Figure C2-66 Asset Exposure for Division 25 – Hill 60, Open Space and Recreation

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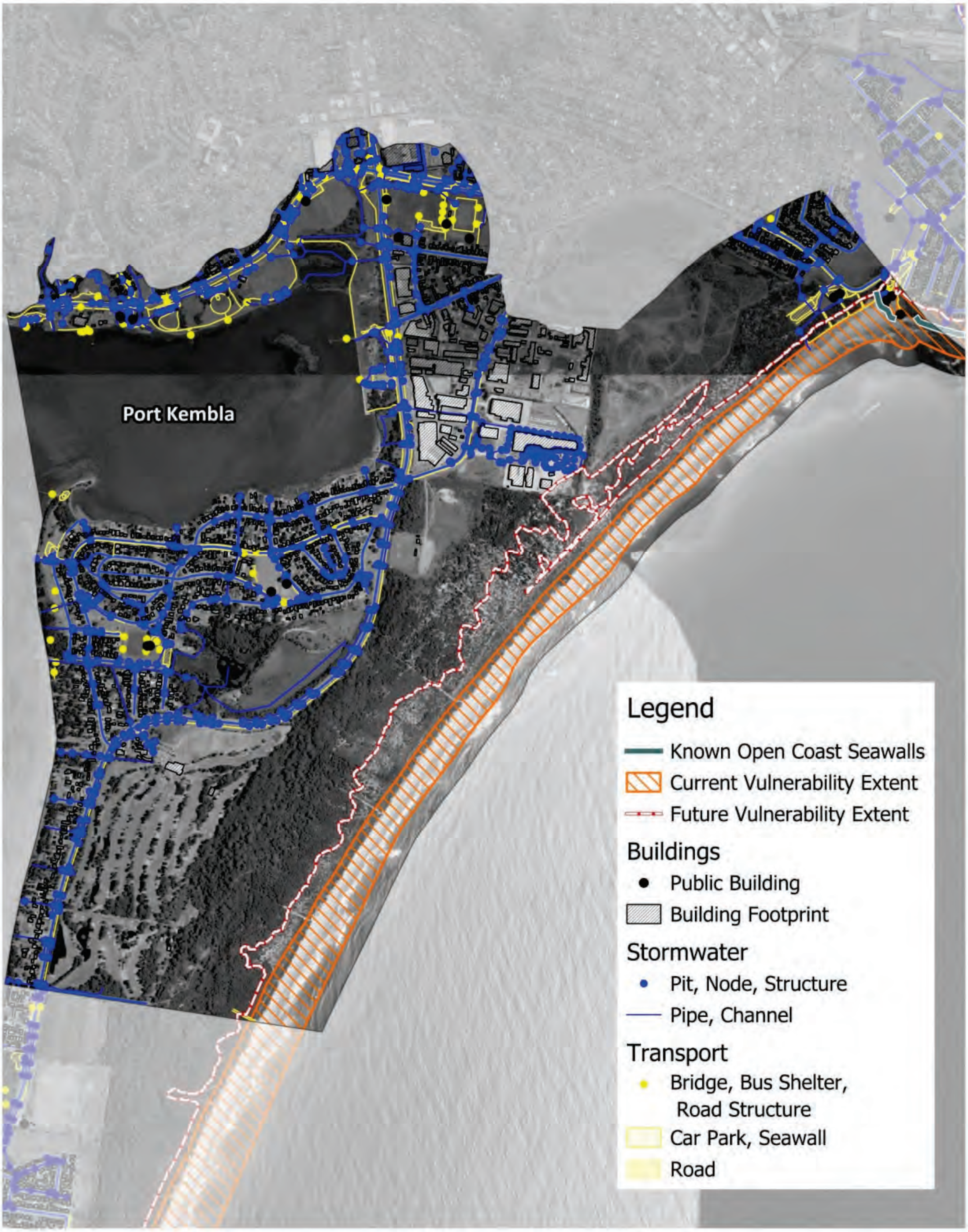

Figure C2-67 Asset Exposure for Division 26 – Port Kembla, Built Assets

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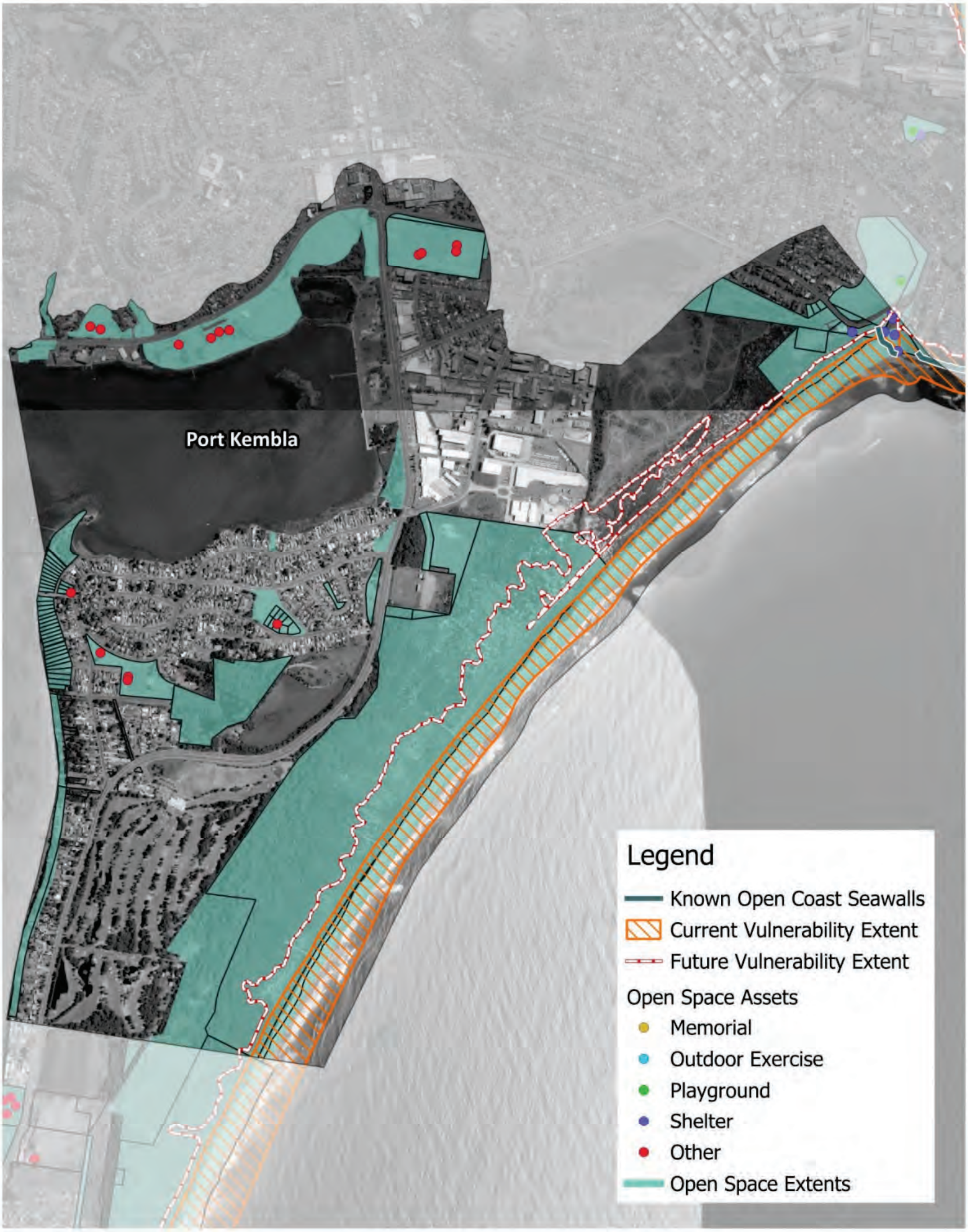

Figure C2-68 Asset Exposure for Division 26 – Port Kembla, Open Space and Recreation

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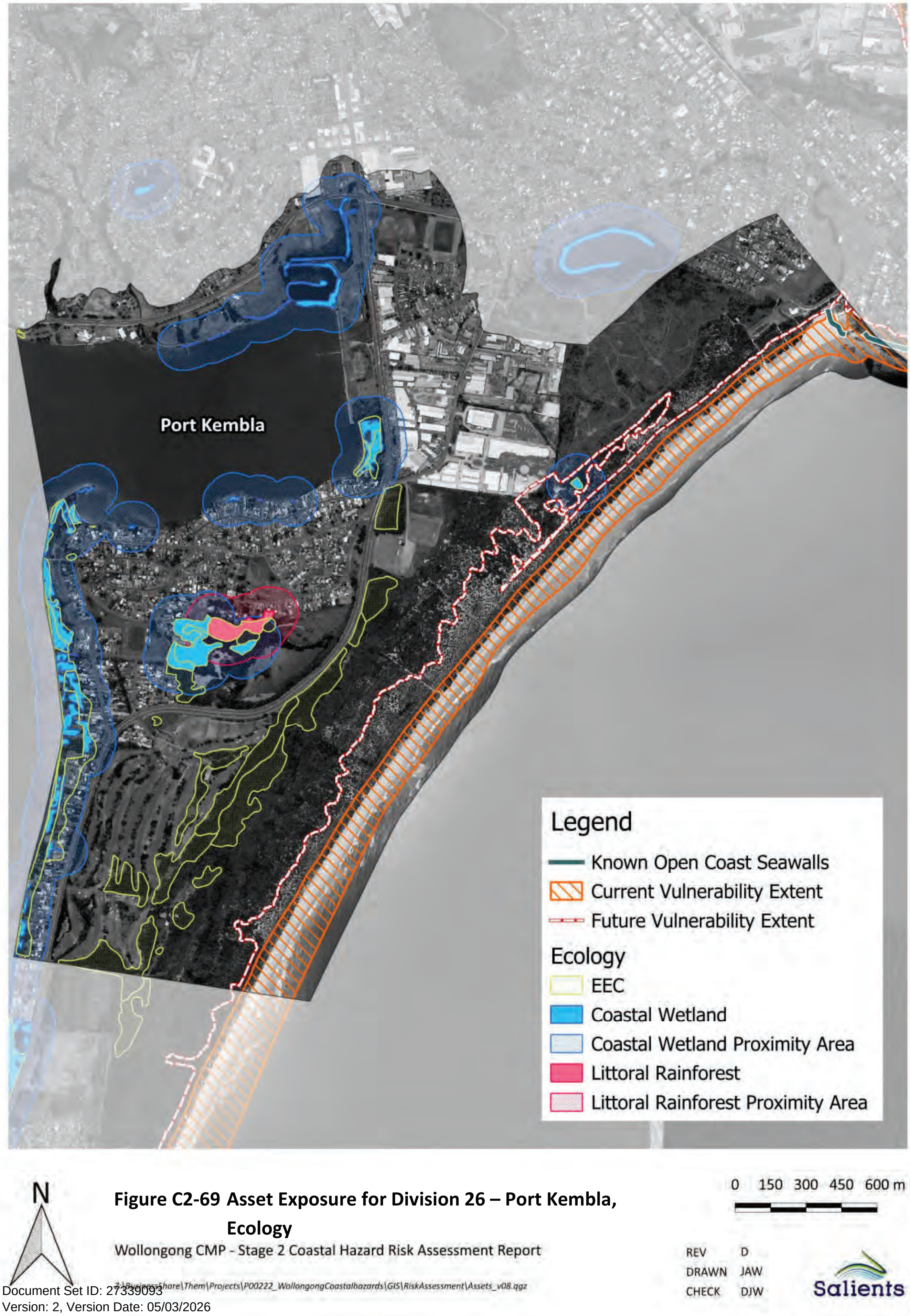

Figure C2-69 Asset Exposure for Division 26 – Port Kembla, Ecology

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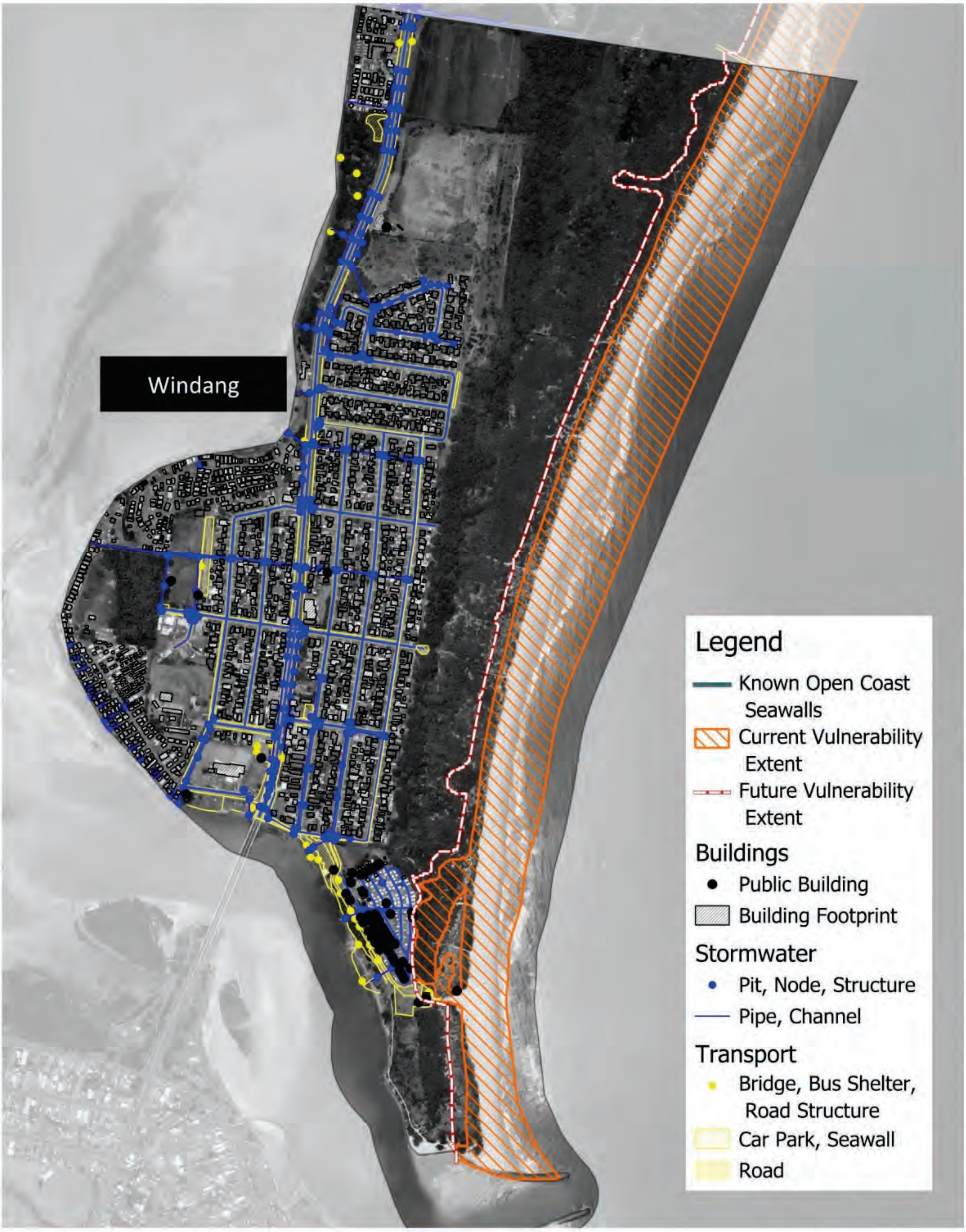

Figure C2-70 Asset Exposure for Division 27 – Windang, Built Assets

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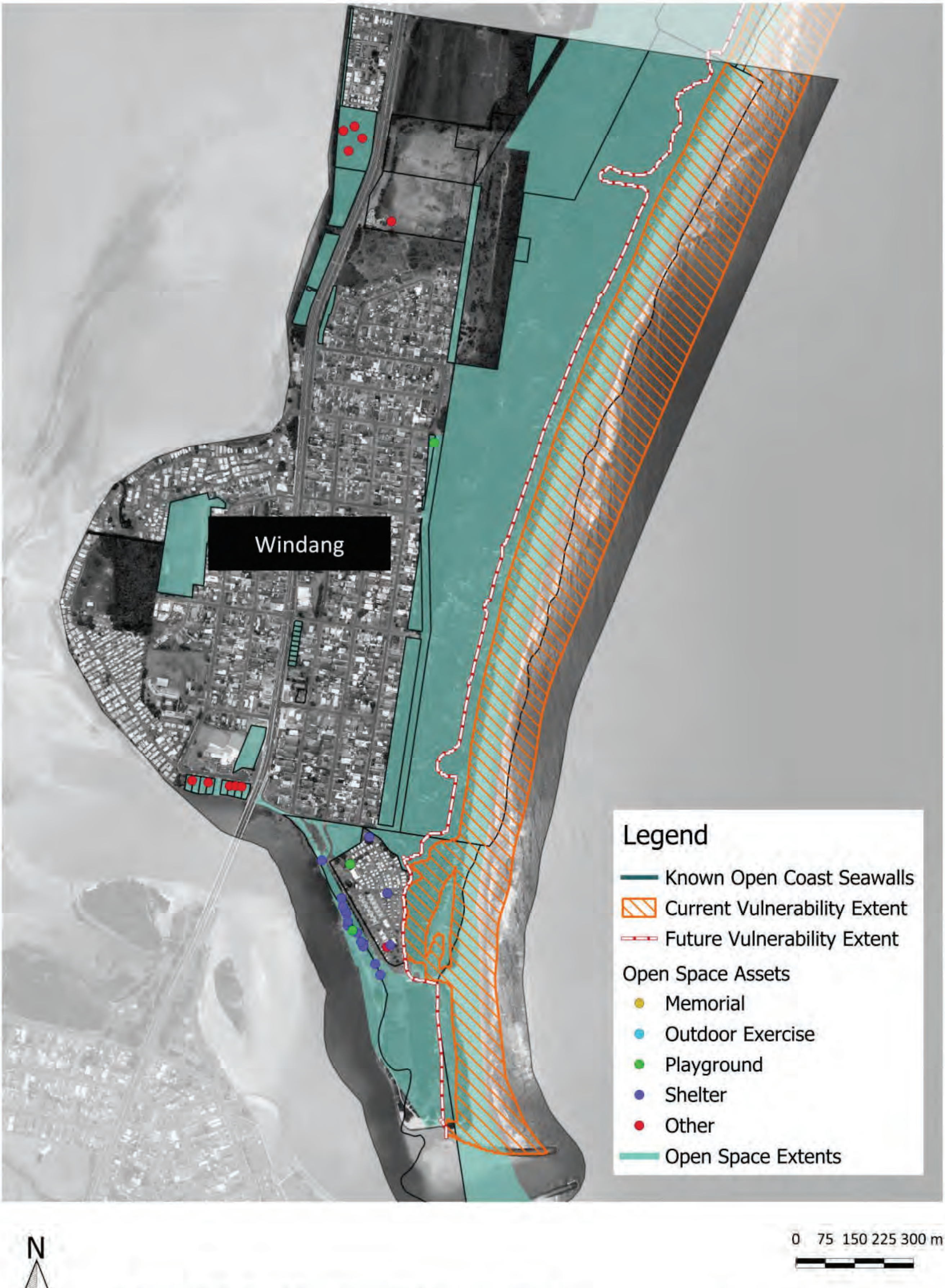

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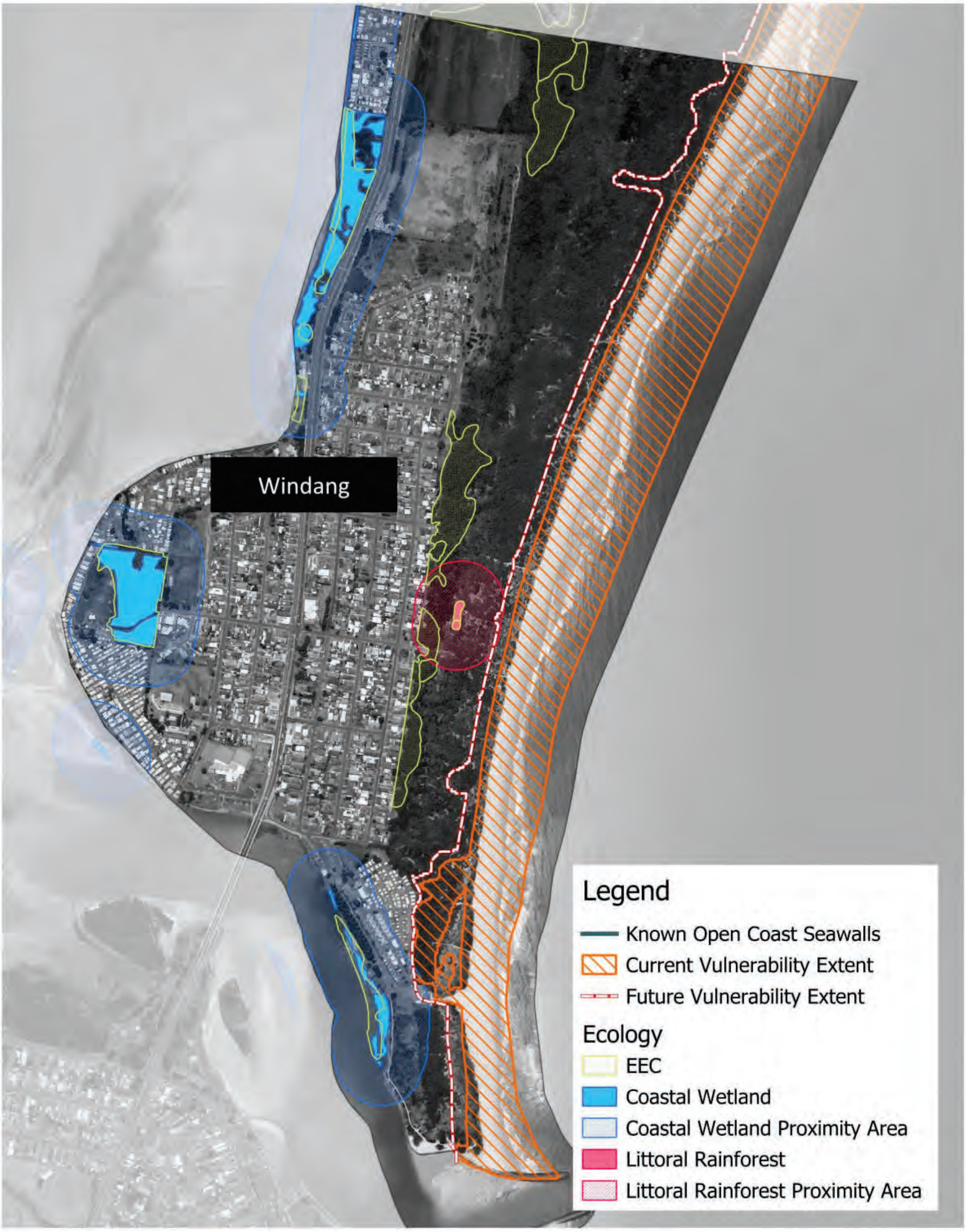

Figure C2-71 Asset Exposure for Division 27 – Windang, Ecology

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Appendix D Councils Risk Assessment Tables

Risk Rating Severity Table

Risk level	Insignificant	Minor	Moderate	Major	Catastrophic
People **People Risks associated with Safety, Organisational Culture and Organisational Change.** **Risks associated with injury to the public**	• Minor injury, e.g. cuts, abrasions, resulting in no lost time. • Isolated minor incidents where individual staff are unaware of the roles and responsibilities in relation to code of conduct or ethical behaviour. • Isolated incidents of temporary decline in individual staff morale and/or absenteeism.	• Minor injury where first aid treatment is required. • Difficulty (but not inability) in attracting and retaining key personnel. • Limited understanding by multiple staff in relation to code of conduct or ethical behaviour. • Short term decline in staff confidence and morale and/ or absenteeism.	• Injury or illness requiring treatment by a medical practitioner or short-term hospital visit. • Inability to attract and retain key personnel. • Limited understanding by several staff in relation to code of conduct or ethical behaviour. • Medium term decline in staff morale identified.	• Severe injury resulting in long-term hospitalisation. • Long-term partial disability. • Long term mental health impacts. • Any notifiable event relating to safety to WorkSafe NSW or other regulatory bodies. • Widespread lack of understanding in relation to code of conduct or ethical behaviour. • Low retention of key personnel along with inability to attract. • Medium term decline in staff morale identified and escalating across the organisation.	• Death/Life threatening event. • Permanent Disability. • Significant loss of several key personnel. • Significant levels of non-compliance with the code of conduct, or a high likelihood of corrupt/ unethical conduct. • Significant levels of ongoing lack of staff confidence and low staff morale across the organisation.
Reputation & Community Expectations **Risks associated with Councils perceived or actual reputation within the community, media exposure, social media and feedback from community and stakeholders.**	• One off (no more than 24 hours) negative local media publicity. • Some attention from minor stakeholders which are able to be resolved through routine management processes. • Positive reputation maintained with community and media stakeholders. • Isolated complaints from individual members of the community. • Minimal negative feedback. • Minimal impact on cultural safety and accessibility to staff and our community.	• Short term (Several days) local adverse publicity. • Limited damage to Council's reputation. • May cause some social media or formal complaints (justified or unjustified). • Positive relationship with media stakeholders maintained. • Complaints from a group in the community which is escalating into the public arena. • Minor impact on cultural safety and accessibility on an individual.	• Some negative publicity or short-term damage to Council's reputation at local or state media level. • Disruption to some core Council services resulting in the potential loss of public confidence in Council's processes. • Sustained reputation variances in the community. • Relationships with media stakeholders may be strained. • Significant social media and/ or formal complaints. • Moderate impact on cultural safety and accessibility on an individual or group within our community.	• Significant adverse Local and State media coverage. • Disruption to major council services resulting in loss of confidence in council processes. • Escalating community concerns and complaints. • Impacts requiring long-term remedial attention. Lasting damage to reputation and/or political standing. • Major compliance/ethics investigation of Council by oversight agency or regulator. • Significant impact on cultural safety and accessibility on an individual or group causing lasting relationship damage.	• Appointment of Administrator or Ministerial Intervention. • Significant adverse Major State or National Media Coverage. • Media Scrutiny severely affects service delivery. • Negative Publicity leads to senior staff resignations or sustained long term loss in public confidence in Council's processes. • Ongoing exposure may lead to audit, inquiry or legal proceedings. • "Viral" adverse social media coverage. • Irreversible political damage to brand and reputation.

Risk Rating Severity Table continued

Risk level	Insignificant	Minor	Moderate	Major	Catastrophic
Child Safety Risks associated with Child Safety in Councils Facilities and during the delivery of Council Services.	• Minor physical or mental health first aid required no future impact on child. E.g.: cut, scrapes, abrasions. • E.g. Concerning behaviour or compliance failure that has caused no direct impact on the child but may be indicative of where risk management controls should be reviewed.	• Medical treatment for minor mental injury or trauma. • Peer support required for stress or trauma event. • E.g. One-off event of poor behaviour by an adult, such as belittling the child.	• Hospital treatment (outpatient), less than 7 days lost time. • Stress or trauma event requiring professional support for the child, with a trauma impact period estimated to be less than 6 months. • Failure to implement/comply with child safe requirements or working with children checks. • Failure to obtain consent for child participation or photography. • E.g.: Bullying, intimidation, failing to provide an environment that prevents injury.	• Long term ongoing serious effects on a child's physical and mental wellbeing. Possible partial disability. • Stress or trauma event requiring medium to long term clinical support for the child, with a significant period of trauma impact. • Failure to securely store information and images relating to children. • E.g.: Sexual misconduct, grooming behaviour, physical assault, more than one episode of neglect or emotional abuse and failure to reduce or remove the risk of a child becoming a victim of abuse/failure to report.	• Death or permanent disability of the child. • Death or permanent disability of the child. • Stress or trauma event requiring extensive and ongoing clinical support for one or multiple individuals, with potential lifelong trauma impact. • E.g. sexual assault or abuse or serious physical assault, sustained neglect or emotional abuse, and actively concealing child abuse.
Financial Sustainability Financial risks associated with financial loss from any event, fraud, corruption, litigation, claims, contract management, cashflow and debt management, budgets and procurement.	• Loss of less than 1% of Divisional operational budget. • Loss of less than $50,000. • Budget variation manageable the short term. • Minor disruptions to delivery of products, services, or systems. .	• Loss of 1% to 5% of Divisional operational budget. • Loss of $50,000 to $250,000. • Budget variation manageable, absorbed over current financial year. • Temporary disruptions to delivery of products, services, or systems.	• Loss of 5% to 10% of Divisional operational budget. • Loss of $250,000 to $750,000. • Impact on budget beyond current financial year, but manageable within the next financial year. • Restriction or disruptions to delivery of products, services, or systems over a short period less than 6 months.	• Loss of 10% to 20% of Divisional operational budget. • Loss of $750,000 to $15mil. • Impact on budget with recovery over proceeding 2 or 3 financial years. • Severe delays or restriction to key products, services, or systems over a sustained period over 12 months.	• Loss of more than 20% of Divisional operational budget. • Loss of more than $15mil. • Impact on budget with recovery over proceeding 3 or more financial years. • Non delivery or loss of critical products, services, or systems over a sustained period over 12 months.

Risk Rating Severity Table continued

Risk level	Insignificant	Minor	Moderate	Major	Catastrophic
Environment Risks associated with Councils operations that have potential or actual negative environmental or ecological impacts.	• Minor breach of Council policy or procedures. • Negligible event with localised impact (e.g. street, precinct) with minimal environmental damage and no ongoing effect.	• Minor event with localised impact (e.g. street, precinct) which is easily remediated. • Minor environmental damage is immediately remediated with minimal resources.	• Medium-term, moderate-scale damage to habitat, heritage or environment able to be contained with specialist assistance. • Moderate impact on the environment; no long term or irreversible damage. • May incur cautionary notice or infringement notice. • Potential damage to identified indigenous heritage area or item.	• Severe Medium-term, moderate-scale damage to habitat, heritage or environment. • Environmental incident under Investigation by regulatory authorities. • Severe impact requiring remedial action and review of processes to prevent reoccurrence. • Penalties and/or direction or compliance order incurred. • Significant but repairable damage to indigenous heritage area or item.	• Long-Term, large-scale damage to habitat, heritage or environment. • Serious repeated breaches of legislation/licence conditions. • Cancelation of licence and/ or prosecution in relation to environmental matters. • Total destruction or loss.
Service Delivery Risks associated with delivering community services, events and facilities that have the potential to impact delivery of our programs to the community.	• Minor issues with communication, information systems, technology, assets, facilities or infrastructure. • Negligible impact on delivery of key service to the community. • Negligible impact on external customers. • Negligible impact on meeting Council objectives. .	• Temporary restriction of access or disruption to essential services or business functions for less than one day. • Slight or minor damage to assets/property or facilities. • Localised workforce availability issues. • Ad hoc impacts or restrictions on accessibility to assets, programs or services impacting only a very small portion of the population.	• Restriction of access or disruption to essential services or business functions for less than 2 days. • Multiple sites impacted workforce availability issues. • Moderate delays or impacts to delivery of key service to the community. • Moderate, but temporary, damage to assets, property/ facilities. • Moderate impacts or restrictions on accessibility to assets, programs or services impacting only a very small portion of the population.	• Restriction of access or disruption to essential services or business functions for 2 to 5 days. • Multiple sites impacted by significant workforce availability issues. • Some important objectives of the organisation cannot be met. • Sustained damage to assets or property/facilities lasting many months. Temporary closure a public facing facility or service. • Ongoing impacts or restrictions on accessibility to assets, programs or services impacting a portion of the population.	• Loss of access or disruption to essential services or critical business functions for more than 5 days. • Ongoing, significant workforce availability issues at multiple sites. • Councils' key objectives cannot be met. • Crisis Management Plan enacted. • Long Term or permanent loss of critical assets or property/ facilities. • Long-term closure a public facing facility or service.

Risk Score Matrix

Severity scale ▶

Likelihood ▼		Catastrophic 5	Major 4	Moderate 3	Minor 2	Insignificant 1
A	Almost Certain	E25	E20	E16	H10	M5
B	Likely	E20	E16	H12	M8	L4
C	Possible	H15	H12	M9	M6	L3
D	Unlikely	H10	M8	M6	L4	L2
E	Rare	M5	L4	L3	L3	L1

Likelihood

A	Almost Certain	• Event is expected to occur in over 95% of occasions. • The risk event will occur multiple times a year. • The risk event will occur in most circumstances.
B	Likely	• The risk event will occur in 75% - 90% of occasions. • The risk event will occur once every year. • The risk event will probably occur on most occasions.
C	Possible	• The risk event will occur in 30% - 75% of occasions. • The risk event will occur once every 1 to 5 years. • The risk event will likely occur at some time.
D	Unlikely	• The risk event will occur in 10% - 30% of occasions. • The risk event will occur once every 5 to 10 years. • The risk event may occur at some time.
E	Rare	• The risk event will occur in 0% - 10% of occasions. • The risk event may occur greater than every 10 years. • The risk event would only occur in exceptional circumstances.

Risk level ▼	Action you should take
Extreme (E16-25)	Avoid the related activities that relate to this risk. If, however, activities related to this risk are required for Council then: • Cease activity to determine if risk can be managed or avoided • Review and introduce additional or improved controls to reduce the risk to an acceptable level before proceeding (or avoid the risk) • Monitor and maintain control effectiveness if activity proceeds. Treatment actions to reduce the risk must be identified and tracked to completion. Escalation is required to the Director and General Manager and Enterprise Risk Management Committee for further review and approval.
High (H10-15)	Treatment actions to reduce the risk and / or prevent the risk from increasing, must be identified and tracked to completion. Escalation is required to the responsible Director for further review and approval. Consider ceasing activity temporarily to consider alternative options to manage the risk and to ensure risk can be managed appropriately. Escalation is required to the Director for further review and approval.
Moderate (M5-9)	Review controls to determine adequacy and effectiveness. Consider implementation of additional or improved controls to reduce the risk if deemed necessary. Continue to monitor and maintain control effectiveness
Low (L1-4)	Risk is managed by existing Controls, routine operations and procedures, with ongoing monitoring to ensure control effectiveness.

Appendix E Assumptions relating to Risk Analysis and Valuation

E.1 Analysis of Risks associated with Stormwater Infrastructure

Five GIS files were developed, based on original files provided by Council and TfNSW:

- *Stormwater_Points.shp:* including features such as pits, junctions, and water quality devices.
- *Stormwater_Polylines.shp:* including features such as pipes and culverts.
- *Stormwater_Polygons.shp:* including features such as channel linings, basins, and scour protection.
- *TfNSW_Pits.shp:* including a variety of pit and junction assets owned and managed by Transport for NSW. Of most interest to the present study are assets along Lawrence Hargrave Drive.
- *TfNSW_Culverts.shp:* including culvert assets owned and managed by Transport for NSW. Of most interest to the present study are assets along Lawrence Hargrave Drive.

The values attributed to the different types of stormwater assets in the risk assessment assume that the asset will need to be replaced if impacted, and the reasoning behind the valuation is presented in Table E.1.

Table E.1 Stormwater Feature Valuation for Risk Assessment

Asset 'Label' (as provided by Council)	Value applied[20]	Basis
	Stormwater Point Features	
Water Quality Device	$84,800	Average cost per unit from council's data. Note around one-third of water quality devices had no value information.
Stormwater Pit, Nodes and Converters	$4080	Based on average cost per pit, where cost was present in Council's data. More than 80% of pits were uncosted in the database. There was no cost information for "nodes" or "converters", so these were assumed to have similar character to pits and have a similar (order of magnitude) cost.
Culvert	$40000	It appears some minor culverts were present as point feature. It was assumed that these were around 10m long (2 lane road), and the rate applied for culvert polyline features was used.
Headwall	$4590	Based on average cost per headwall, where cost was present in database. Note that around 25% of the headwalls were uncosted in the database.
	Stormwater Polyline Features	

[20] This is the value applied if there was no cost amount assigned to the asset in the data provided by Council, rates have been determined on values for other features, or experience.

Asset 'Label' (as provided by Council)	Value applied[20]	Basis
Creek Reach	N/A, report via metre.	Difficult to put a price on as these tend to be a natural resource feature, reported as m lost. No price provided in GIS linked data.
Culvert	$6100/m	Average rate of council data, where cost was provided. Note that over 20% of the length of pipes was not costed in the GIS linked data.
Pipe	$1700/m	Average rate of council data, where cost was provided. Note that over 70% of the length of pipes was not costed in the GIS linked data.
Pipe Reline	All Coastal Examples costed in linked GIS files.	
Stormwater Polygon Features		
Weirs (Polygon Feature)	$800/m^2	Average rate of council data, where cost was provided.
Trash Rack (Polygon Feature)	$170/m^2	Average rate of council data, where cost was provided.
Spillway	All Coastal Examples costed in linked GIS files.	
Sediment Trap (Polygon Feature)	All Coastal Examples costed in linked GIS files.	
Scour Protection (Polygon Feature)	$1740/m^2	Average rate of council data, where cost was provided.
Flood Diversion Mound (Polygon Feature)	All Coastal Examples costed in linked GIS files.	
Energy Dissipator (Polygon Feature)	$30/m^2	Average rate of council data, where cost was provided.
Channel Lining (Polygon Feature)	$1640/m^2	Average rate of council data, where cost was provided.
Dam Wall (Polygon Feature)	All Coastal Examples costed in linked GIS files.	
Basin Storage (Polygon Feature)	$300/m^2	No values data were provided within Council's data. This estimate based on Salients' experience and represented a rate which is greater than a typical retention basin but allows for some more complicated construction such as biofiltration or wetlands.
Bank Support	$5200/m^2	Average rate of council data, where cost was provided. Note that around 11% of "Bank Support" labelled area had no cost value recorded in the data.
Access Ramp	All Coastal Examples costed in linked GIS files	
TfNSW Pit Features		
Pit	$6,000	TfNSW spatial data had no cost information. Assumed the same value applied for local councils, uplifted by 50% (larger infrastructure, more lanes etc.)
TfNSW Culvert Features		
Culvert	(calculated based on geometry)	TfNSW spatial data had no cost information. Assumed per m value applied for local council data, uplifted by 50% (larger infrastructure, more lanes etc. - $9000/m). This was then multiplied by the length and number of cells in the culvert and stored in the GIS file.

There was a substantial number of geographically mapped features, where information was not available regarding the type of asset (a "Null" feature). We have assumed that these represent physical assets, and they have been costed at the weighted average of items where the type had been identified, and a cost provided. The applied values were as follows:

- Null Point Features: $4760/item (applied to 651 items, 9.8% of total)
- Null Line Features: $1700/m (assumed to be pipes, applied to 851 items, 10.4% of total)
- Null Polygon Features: $1610/m² (applied to 209 features, 54.2% of total)

Following determination of the value of each feature, its interaction with hazards and the amount of value lost was determined based on the approach outlined in Table E.2.

Table E.2 Stormwater Feature Hazard Interaction Treatment

Asset 'Label' (as provided by Council)	Interaction with Inundation	Interaction with Erosion Hazards
	Point Features	
Water Quality Device	Coastal: Lost once any part intersected by 63% event (too frequent). Tidal: Lost once any part inundated by HHWSS (functionality probably lost – resuspension etc.).	Lost once intersects with hazard extent
Stormwater Pit	Resilient to Inundation	Lost once intersects with hazard extent
Culvert	Resilient to Inundation	Lost once intersects with hazard extent
Headwall	Resilient to Inundation	Lost once intersects with hazard extent
	Polyline Features	
Creek Reach	Resilient to Inundation	Proportionally lost once intersects with hazard extent.
Culvert	Resilient to Inundation	Proportionally lost once intersects with hazard extent.
Pipe	Resilient to Inundation	Proportionally lost once intersects with hazard extent.
Pipe Reline	Resilient to Inundation	Proportionally lost once intersects with hazard extent.
	Polygon Features	
Weirs (Polygon Feature)	Coastal: Resilient to Inundation Tidal: Resilient until overtopped by HHWSS, tailwater too high and weir likely submerged.	Entirely lost once any part of polygon intersects hazard.
Trash Rack (Polygon Feature)	Coastal: Lost once any part intersected by 63% event (too frequent). Tidal: Lost once any part inundated by HHWSS (functionality probably lost – resuspension etc.).	Entirely lost once any part of polygon intersects hazard.
Spillway	Coastal: Lost once any part intersected/bypassed by 63% event (too frequent, functionality reduced). Tidal: Similarly, lost once inundated by HHWSS.	Entirely lost once any part of polygon intersects hazard.

Asset 'Label' (as provided by Council)	Interaction with Inundation	Interaction with Erosion Hazards
Sediment Trap (Polygon Feature)	Coastal: Lost once any part intersected by 63% event (too frequent). Tidal: Lost once inundated by HHWSS (functionality probably lost – resuspension etc.	Entirely lost once any part of polygon intersects hazard.
Scour Protection (Polygon Feature)	Resilient to Inundation (assume well designed).	Proportionally lost once any part of hazard intersects.
Flood Diversion Mound (Polygon Feature)	Coastal: Lost once overtopped by 63% event (breach potential). Tidal: Similarly, lost once inundated by HHWSS.	Entirely lost once any part of hazard intersects (i.e. could breach, functionality lost).
Energy Dissipator (Polygon Feature)	Resilient to Inundation (assume well designed).	Entirely lost once hazard intersects.
Channel Lining (Polygon Feature)	Resilient to Inundation (assume well designed).	Proportionally lost once any erosion type hazard intersects.
Dam Wall (Polygon Feature)	Coastal: Lost once overtopped by 63% event (breach potential). Tidal: Similarly, lost once inundated by HHWSS.	Entirely lost once any part of hazard intersects (i.e. could breach, functionality lost).
Basin Storage (Polygon Feature)	Coastal: Lost once overtopped by 63% event (breach potential). Tidal: Similarly, lost once inundated by HHWSS.	Entirely lost once any part of hazard intersects (i.e. breach of boundary enables storage to empty)
Bank Support	Resilient to Inundation (assume well designed)	Proportionally lost once any hazard intersects.
Access Ramp	Resilient to Inundation (assume well designed) – n.b. feature being accessed may be impaired due to too frequent inundation	Entirely lost once any part of hazard intersects (i.e. ramp becomes unstable/unsafe).

E.2 Analysis of Risks associated with Transport Infrastructure

Four GIS files were developed, based on original files provided by Council and TfNSW:

- *Transport_Points.shp:* including features such as speedhumps, bus shelters, bridges, and parking bays.
- *Transport_Polylines.shp:* including features such as pathways, retaining walls, and access ramps.
- *Transport_Polylines_RoadSegments.shp:* including road pavements.
- *Transport_Polygons.shp:* primarily comprising carparks.
- *TfNSW_Roads.shp:* including road corridor/pavement lengths. The source data from TfNSW appeared to be mostly duplicated, based on geometries and widths of actual features. The duplicates were deleted.

The values attributed to the different types of transport assets in the risk assessment assumed that the asset would need to be replaced if impacted, and the reasoning behind the valuation is presented in Table E.3.

Table E.3 Transport Feature Valuation for Risk Assessment

Asset 'Label' (as provided by Council)	Value applied[21]	Basis
	Transport Point Features	
Speedhump, Blisters, Raised Crossings, Roundabouts and Pedestrian Islands	All Coastal Examples costed in linked GIS files	
Parking Bays and Medians	All Coastal Examples costed in linked GIS files	
Bus Shelters	All Coastal Examples costed in linked GIS files	
Bridges	\$820000	No cost data provided for bridges. However, average size of bridges (where provided) was just over 130m^2. All-inclusive rate of \$6,250[22] adopted for calculation, rounded up.
	Transport Polyline Features	
Roads	(calculated based on geometry)	In GIS, the area of the road was calculated. This was achieved by calculating the length in GIS and multiplying by two times the buffer, which approximated the width. A per m^2 rate of \$320[23] was applied to the resulting pavement area.
Access Ramp	\$3060/m	Average rate of council data, where cost was provided. Note that over 50% of the length of access ramps was not costed in the GIS linked data.
Access Stairs	\$6500/m	No values in database, however example from Sandon Point in 2020[24], indicates a rate of \$6500 per m (inflated to present day).
Boat Ramp	All coastal examples costed in linked GIS files	
Fencing	\$1020/m	Average rate of council data, where cost was provided.
Footpath	\$930/m	Average rate of council data, where cost was provided.
Guardrail	All coastal examples costed in linked GIS files	
Retaining Wall	\$3510/m	Average rate of council data, where cost was provided. Note that around 15% of the length of retaining structures was not costed in the GIS linked data.
Shared Path	All coastal examples costed in linked GIS files	
	Transport Polygon Features	
Car Park	\$320/m^2	Same as road rate
Retaining Wall	All coastal examples costed in linked GIS files	
	TfNSW Road Features	

[21] This is the value applied if there was no cost amount assigned to the asset in the data provided by Council, rates have been determined on values for other features, or experience.
[22] Cardno (2021), indicates a range of 4,000 to 6,000 per sq.m. Inflation since 2021, based on ABS PPI for Bridge and Road construction is +25%. Use \$6250/m^2.
[23] Cardno (2021), indicates \$2300/m of local road (9m wide) Inflation since 2021, based on ABS PPI for Bridge and Road construction is +25%. Use \$320/m^2.
[24] https://www.wollongong.nsw.gov.au/__data/assets/pdf_file/0017/118160/Item-12-Tender-T20-32-Sandon-Point-Beach-Access-Stairs-Multiple-and-Erosion-Control.pdf, accessed 18/06/2025. Tender of 365K, for around 70m of stairs across four accessways, around 25% inflation since that time ~\$6500/m

Asset 'Label' (as provided by Council)	Value applied[21]	Basis
Roads	(calculated based on geometry)	In the TfNSW GIS data, the area of each road segment was provided. The area was multiplied by $500 to calculate the total value of each segment.

There was a substantial number of geographically mapped features, where information was not available regarding the type of asset (a "Null" feature). We have assumed that these are real assets, and they have been costed at the weighted average of items where the type had been identified, and a cost provided in the original data. The applied values were as follows:

- Null Point Features: $25,290/item (applied to 478 items, around 70% of total).
- Null Line Features: $1,150/m (applied to 1162 items, 64.5% of total).
- Null Polygon Features: All assumed to be car parks at $160/m² (47 items, 30.5% of total).

Following determination of the value of each feature, its interaction with hazards and the amount of value lost was determined based on the approach outlined in Table E.4.

Table E.4 Transport Feature Hazard Interaction Treatment

Asset 'Label' (as provided by Council)	Interaction with Inundation	Interaction with Erosion Hazards
	Point Features	
Speedhump, Blisters, Raised Crossings, Roundabouts and Pedestrian Islands	Coastal: Lost once any part intersected by 63% event (too frequent). Tidal: Lost once inundated by HHWSS (too frequent).	Lost once intersects with hazard extent.
Bridges	Coastal: Resilient to Coastal Inundation. Tidal: Lost once inundated by HHWSS (too frequent).	Lost once intersects with hazard extent.
	Polyline Features	
Roads	Coastal: Proportionally lost once any part intersected by 63% event (too frequent). Tidal: Proportionally lost once inundated by HHWSS (too frequent).	Proportionally lost once intersects with hazard extent
Access Ramp	Resilient to inundation	Lost once any part intersects with hazard extent
Access Stairs	Resilient to inundation	Lost once any part intersects with hazard extent
Boat Ramp	Resilient to inundation	Lost once any part intersects with hazard extent

Asset 'Label' (as provided by Council)	Interaction with Inundation	Interaction with Erosion Hazards
Fencing	Coastal: Proportionally lost once any part intersected by 63% event (too frequent). Tidal: Proportionally lost once inundated by HHWSS (too frequent).	Proportionally lost upon intersection with hazard extent.
Footpath	Coastal: Resilient Tidal: Proportionally lost once inundated by HHWSS (too frequent).	Proportionally lost upon intersection with hazard extent.
Guardrail	Resilient to Inundation	Proportionally lost upon intersection with hazard extent.
Retaining Wall	Coastal: Resilient. Tidal: Lost once inundated by HHWSS (assume it fails due to groundwater impacts).	Likely to unravel once erosion begins. So complete loss once hazard intersects.
Shared Path	Resilient to inundation	Proportionally lost once intersects with hazard extent.
	Polygon Features	
Carpark	Coastal: Resilient Tidal: Proportionally lost once inundated by HHWSS (too frequent).	Proportionally lost upon intersection with hazard extent
Retaining Wall	Coastal: Resilient Tidal: Lost once inundated by HHWSS (assume it fails).	Likely to unravel once erosion begins. So complete loss once hazard intersects.

E.3 Analysis of Risks associated with Ecosystems

The analysis of risks associated with ecosystems is difficult, primarily because these types of 'assets' are very difficult to derive a 'value' for. For our assessment, we have calculated the area of the ecosystem lost based on available mapping datasets. Several datasets of vegetation mapping were provided to the study team. The study team has focussed on those ecosystems provided with protection under the *Coastal Management Act 2016* (Coastal Wetlands and Littoral Rainforests) and the *Biodiversity Conservation Act 2016* (Endangered Ecological Communities). There is substantial overlap ("Littoral Rainforest" is its own EEC, and the definition of coastal wetlands include EECs such as Coastal Saltmarsh and Swamp Oak Floodplain Forest).

Two GIS files were developed:

- *Ecology_EEC.shp*: This was based on a file provided by Council, and including close to 775 hectares of land within the mapped coastal zone, comprising around 325 hectares of Littoral Rainforest (mostly to the north of Scarborough and within the Royal National Park, RNP), 200 hectares of Southern Sydney Sheltered Forest (mostly within the RNP, along the top of the Escarpment), around 120 hectares of Themeda Grassland (clustered on headlands in the RNP) and 40 hectares of

Bangalay Sand Forest (to the rear of Dunes at Bellambi Lagoon, and along the Windang Peninsula).

- *Ecology_CoastalWetlands.shp:* Containing the extents of coastal wetlands as mapped under the CM SEPP. There were notable inconsistencies between these extents and the extents of component EECs within the *Ecology_EEC.shp* data, they have therefore been considered separately.

A visual check of the Littoral Rainforest areas mapped under the CM Act determined that all patches were included in the *Ecology_EEC.shp* data. Accordingly, the SEPP mapping of Littoral Rainforests was not considered separately.

In terms of resilience to erosion, all ecosystems were treated as proportionally lost once intersected by erosion.

In terms of resilience to inundation, only general inferences can be made as the future of EECs associated with coastal wetlands depends on the ability of different ecosystems to move upslope as sea levels rise. Such an assessment is beyond the scope of the present study.

We note that dune vegetation was not provided as a separate layer, and there are some locations where remaining foredunes will be threatened by shoreline recession and erosion in future. The sensitivity of the dune vegetation will largely depend on the prevailing geomorphology of each embayment, and this is discussed where relevant, in Section 5, under each geographical division.

E.4 Analysis of Risks associated with Buildings and Private Land

Two GIS files were developed:

- *Council_Cadastre_Private.shp* This was based on a file provided by Council. The polygons had three types: “parcel”: comprising either privately owned or Crown land, “road”: assumed to include land dedicated as a public road, and “path”: which in our assessment we have treated in the same manner as roads. The land zoning and suburb of each parcel was determined by intersecting with supplementary layers. Any polygons with resulting zonings of W1, W2 or W3 were removed, under the assumption that erosion and inundation are ongoing processes that are intrinsic to waterways. The dataset was then split into separate “Public” and “Private” files. Private land comprised parcels (excluding roads and paths) which were zoned Residential, Business, Industrial and Rural (dealt with here). Public Land comprised parcels zoned in Environment and Recreation, and any remaining Special Zones or Waterways. Public lands have been considered in Section E.6.

- *Buildings_Private.shp:* This was derived from the Microsoft Australia building footprint dataset, with any buildings not sitting on private land deleted.

Table E.5 Private Land and Building Feature Valuation for Risk Assessment

Item	Value applied	Basis
Private Land Parcels	Varied based on suburb	The ten most recent sales for each coastal suburb (or adjacent suburbs where there were insufficient recent sales – post 2020) were acquired from online sources[25]. Sales prices were adjusted to present day based on increased value of median properties in the area since the sale. The unimproved (rateable) value of the land parcel was determined from Office of the Valuer General data, and these were added together on a suburb-by-suburb basis and divided by the total area of the land parcels sold to derive a /m^2 value rate for unimproved land in each suburb. The difference between sales values and land values was calculated for each property to estimate the value of the residential building. A representative building value was then calculated for each suburb.
Private Buildings	Varied based on suburb	

Valuation Data

Coastal Suburb	Representative Building Value	Rateable Land Value
Stanwell Park	$1,810,000.00	$3,400.00
Coalcliff	$4,790,000.00	$1,800.00
Clifton	$5,140,000.00	$1,400.00
Scarborough	$2,070,000.00	$2,100.00
Wombarra	$2,910,000.00	$3,600.00
Coledale	$1,920,000.00	$3,500.00
Austinmer	$1,910,000.00	$2,900.00
Thirroul	$2,910,000.00	$3,200.00
Bulli	$2,060,000.00	$3,600.00
Woonona	$1,140,000.00	$4,000.00
Bellambi	$1,620,000.00	$1,300.00
East Corrimal	$1,880,000.00	$1,700.00
Towradgi	$2,630,000.00	$1,700.00
Fairy Meadow	$1,740,000.00	$1,800.00
North Wollongong	$2,610,000.00	$3,500.00
Wollongong	$1,920,000.00	$3,400.00
Port Kembla	$1,300,000.00	$1,100.00
Primbee	$2,240,000.00	$700.00
Windang	$1,770,000.00	$1,600.00

[25] https://www.property.com.au/search

The values attributed to the private land parcels and buildings in the risk assessment are outlined in Table E.5. The valuation of land and private buildings is based on recent residential sales, with the land value is treated separately from the building value.

There is substantial uplift in residential property value if it has a water view, but there was no tractable way to consider this within the present study. Similarly, there is complexity where loss of a more seaward building will open water views for landward properties, so the "beachfront" property premium isn't expected to be lost, just transferred further landward. While not directly addressing this complexity, our adopted approach is considered a reasonable proxy when averaged across the suburb.

The private land values have also been adopted in costing the loss of roads and public land (Section E.6).

Following determination of the value of each feature, its interaction with hazards and the amount of value lost was determined based on the approach outlined in Table E.6.

Table E.6 Private Land and Building Feature Hazard Interaction Treatment

Item	Interaction with Inundation	Interaction with Erosion Hazards
Private Land Parcels	Coastal: Proportional loss of any part intersected by 63% event. Tidal: Proportionally lost once inundated by HHWSS (too frequent).	Proportionally lost upon intersection with hazard extent
Private Buildings	Coastal: Proportional loss of any part intersected by 63% event. Tidal: Proportionally lost once inundated by HHWSS (too frequent).	Building is considered 100% lost when 25% of its footprint is intersected by erosion. This scales proportionally, e.g., 10% intersection of footprint = 40% loss of value. Experience has shown that beachfront property prices can remain elevated even when the erosion is very close to the building. However, once undermining begins it is expected that value will diminish rapidly.

E.5 Analysis of Risks associated with Utilities: Potable Water and Wastewater Infrastructure

GIS data were provided by Sydney Water for both water and wastewater services. The values attributed to the water and wastewater assets considered in the risk assessment are presented in Table E.7. Assets have generally been lumped into an all-inclusive rate per metre of service main, using the Modern Engineering Equivalent Replacement Asset (MEERA) rates presented in Sydney Water (2023) to cover the main network components (including pipes, gauges valves, meters, fittings and associated structures). Other significant elements such as sewer pumping stations and the Wollongong wastewater treatment plant are treated separately.

Table E.7 Water and Sewer Asset Valuation for Risk Assessment

Asset Type	Adopted rate	Basis
Sewer Pumping Station	$20,000,000	Note no value data supplied. Limited published information available, but online sources[26], indicate ~$20M for what are expected to be large pumping stations in growth areas of Western Sydney. On balance considering smaller population density along Wollongong's coast, this may be high, but difficulties with construction and linear nature of Wollongong's coastal development, means we have adopted that rate, although it may be conservative.
Sewer Mains (inclusive rate)	$470/m	Based on MEERA rates. Also applied as indicative to low pressure sewerage systems around Coalcliff and Stanwell Park, and further north. Sewer lines are overwhelmingly laid at depths less than 2m. Some are notably deeper, but rare. Rate for 2m depth used as a base. Most mains are 150 to 300 mm diameter. Adopt 300mm representative rate. $300 for Gravity Main / $260 for pressure main ($280 in 2006 dollars). Inflation from 2006 to 2025 = Uplift factor of 1.67 (ABS Civil engineering index) results in $470/m.
Wollongong Wastewater Treatment Plant	$500M – $600M	Based on advice provided by Sydney Water.
Water Mains (inclusive Rate)	$480/m	Based on MEERA rates. Most water mains are 100-150 mm diameter. Assume steel pressure main of 150 mm diameter, indexing 2006 rates by factor of 1.67 to present day.

Following determination of the value of each feature, its interaction with hazards and the amount of value lost was determined based on the approach outlined in Table E.8.

Table E.8 Water and Sewer Asset Hazard Interaction Treatment

Item	Interaction with Inundation	Interaction with Erosion Hazards
Sewer Pumping Station	Resilient to inundation. If electrical boards remain elevated above inundation level.	Lost if erosion hazard intersects.
Sewer Mains (inclusive Rate)	Resilient to inundation. If groundwater levels get high, there may be additional ingress of water increasing operational costs.	Requires replacement if erosion hazard intersects anywhere along length.
Wollongong Wastewater Treatment Plant	Resilient until frequently inundated: Coastal: Assume requires relocation when any part intersected by 63% event. Tidal: Assume requires relocation once inundated by HHWSS (too frequent).	Assume will need to be relocated if erosion hazard intersects any part of the property.
Water Mains (inclusive Rate)	Resilient to inundation	Requires replacement if erosion hazard intersects anywhere along length.

[26] https://www.pumpindustry.com.au/major-investment-in-new-sydney-water-infrastructure-2

E.6 Analysis of Risks associated with Recreation, Open Space and Public Building Assets

Valuation of public land has been based on the fair rate at which it could be sold (if this were legally allowed). All public land remaining after private land was removed from the cadastre (Section E.4) has been treated in this manner. In this instance, we have separated out the value of land managed as an asset by council and reported the affected areas of land classified as "Sportsgrounds", "Reserves", and "Parks" affected.

We note that rock pools and beaches are also considered in Council's open space asset data. It makes little sense to report these as being subject to hazards as they are, by their nature, within continually active areas of the coastal zone. However, these assets are considered specifically in each subsection, where relevant, within Chapter 5.

The following datasets have been considered:

- *Council_Cadastre_Public.shp* including land polygons remaining following the removal of private land. This was used to calculate the value of all public land lost (includes the land on which roads are built).
- *Council_OpenSpace_Polygons* used to calculate the total area of reserves, parks and sportsgrounds lost.
- *Council_OpenSpace_Points* used to identify locations of picnic shelters and playgrounds which could be lost.
- *Council_Buildings_Points* used to identify locations where buildings could be lost, including amenity blocks, SLSC buildings, boat sheds, community halls, tourist park cabins, and auxiliary buildings.

Not all open space mapped in the available data set is owned by Council, with some parcels owned by, for example, NSW Crown Lands (NSW Department of Planning, Housing and Infrastructure) and Homes NSW (Department of Communities and Justice). Also, the data set used was derived from a data set applied by Council for asset management and does not include all public land (e.g. some parts of beaches, rock platforms, cliffs, and waterways are not included). Furthermore, some "land" assets comprising maritime structures such as breakwaters are owned by Transport for NSW.

While not captured directly by the analysis, discussion of risks associated with many of these open space features is provided qualitatively within the assessment.

The values attributed to public open space and recreation assets in the risk assessment are outlined in Table E.9.

Table E.9 Public Open Space and Recreation Asset Valuation for Risk Assessment

Asset 'Label' (as provided by Council)	Value applied	Basis
All Public Land	Varies based on suburb (see Section E.4	Refer to Section E.4. Assumes equivalence to private land (i.e. would have the same value as if it were sellable on the private market).
Public Land Managed by Council	Collated Area only reported	Value lost will be captured in "All Public Land". Here, areas are reported to identify scale of loss to Council's assets (Parks, Sportsgrounds, Reserves).
Public Buildings	Costs as provided	If the cost of the building wasn't provided, the average price of all other buildings was used. Building cost data were typically provided, this was increased by
Park Features	Costs as provided	This covers shelters and playgrounds. If the cost of the feature wasn't provided, the average price of all other features was used.

Following determination of the value of each feature, its interaction with hazards and the amount of value lost was determined based on the approach outlined in Table E.10.

Table E.10 Public Open Space and Recreation Asset Hazard Interaction Treatment

Asset 'Label' (as provided by Council)	Interaction with Inundation	Interaction with Erosion Hazards
All Public Land	Coastal: Proportionally lost once any part intersected by 63% event (too frequent). Tidal: Proportionally Lost once inundated by HHWSS (too frequent).	Proportionally Lost once intersects with hazard extent
Public Buildings	Coastal: Lost once it intersects the 63% event (too frequent). Tidal: Lost once inundated by HHWSS (too frequent).	100% lost once intersects with hazard extent (note, provided as point data, footprints not available in many cases)
Park Features	Coastal: Lost once it intersects the 63% event (too frequent). Tidal: Lost once inundated by HHWSS (too frequent).	100% lost once intersects with hazard extent (note, provided as point data)

E.7 Analysis of Risks associated with Royal National Park Assets

The NPWS provided spatial asset data, and we have considered the risks to those assets contained in those portions of the Royal National Park within the Wollongong LGA. The following layers have been processed:

- *NPWS_VisitorArea.shp*: This contains a single camping area to the rear of North Era Beach.
- *NPWS_ TrackSections*: This contains maps of tracks. These have been costed on an all-inclusive, per metre rate (including steps, elevated walkways, creek crossings). At Era and North Era Beaches, the walkway crosses the sandy beach, and these sections were removed from the calculation.

- *NPWS_ Buildings:* These mostly comprise cabins and associated toilets at Burning Palms, Era, Little Garie (all heritage listed), and Bulgo (not heritage listed).

The values attributed to public open space and recreation assets in the risk assessment are outlined in Table E.11.

Table E.11 Royal National Park Asset Valuation for Risk Assessment

Asset Type	Value applied	Basis
Visitor Area	Loss Reported Only	Limited details were provided on the campground at North Era (area, theoretical number of campsites etc.). Therefore, it has simply been noted as lost if affected by Coastal Hazards.
Walking Track	$800/m	All-inclusive rate based on comprehensive reported cost[27] of $10M for a recently constructed 19km track in the Blue Mountains. That was a large project and piecemeal fixes to tracks damaged by coastal hazards likely to be less efficient, cost was uplifted by a factor of 1.5. and rounded.
Buildings	Loss Reported Only	We note that cabins and toilets are unlikely to be replaced, once threatened by coastal hazards. Furthermore, the nature of cabins is extremely nonstandard and variable so extremely difficult to estimate a replacement cost. Numbers of cabins / toilets lost is reported and not evaluated.

Following determination of the value of each feature, its interaction with hazards and the amount of value lost was determined based on the approach outlined in Table E.12.

Table E.12 Royal National Park Asset Hazard Interaction Treatment

Asset 'Label' (as provided by Council)	Interaction with Inundation	Interaction with Erosion Hazards
Visitor Area	Coastal: lost once point feature intersected by 63% event (too frequent). Tidal: Lost once point feature inundated by HHWSS (too frequent).	Point feature lost once intersects with hazard extent
Walking Track	Coastal: Proportionally lost once it intersects the 63% event (too frequent). Tidal: Proportionally lost once inundated by HHWSS (too frequent).	Proportionally lost once intersects with hazard extent.
Building	Coastal: Lost once it intersects the 63% event (too frequent). Tidal: Lost once inundated by HHWSS (too frequent).	100% lost once it intersects with hazard extent (note, provided as point data)

[27] https://www.theguardian.com/australia-news/2024/mar/25/blue-mountains-grand-cliff-top-walk-opening

Appendix F Risk Summary Tables (Detailed, All Divisions)

Wollongong Open Coast Stormwater Coastal Hazard Risk Summary - Erosion and Recession ($ Values)

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125				Expected Creek Length Lost (in m)			
	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	2025	2045	2075	2125
Division																				
01 Little Garie to Burning Palms	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	-
02 Burning Palms to Werrong	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	-
03 Bulgo Beach	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	-
04 Stanwell Tops	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	-
05 Stanwell Park	-	24	41	**9**	-	26	44	**10**	-	33	52	**12**	19	55	79	**32**	9	10	12	32
06 Coalcliff	23	41	41	**29**	32	41	41	**35**	41	41	41	**41**	41	41	41	**41**	29	35	41	41
07 Clifton	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	-
08 Scarborough-Wombarra	20,518	87,125	140,575	**44,768**	24,191	91,680	146,923	**48,794**	33,127	112,731	160,339	**61,621**	52,621	147,417	178,923	**85,796**	12	13	17	29
09 Coledale	16,985	85,933	109,299	**41,128**	22,582	90,625	117,069	**46,510**	35,023	101,275	145,372	**58,872**	68,882	134,126	197,845	**92,977**	55	57	61	75
10 Sharky Beach	35,807	202,316	837,717	**111,482**	40,435	204,439	837,717	**115,195**	54,693	670,006	837,717	**268,930**	94,641	837,717	837,717	**347,286**	71	71	87	122
11 Little Austinmer Beach	32,404	129,339	129,364	**65,363**	35,955	129,364	129,364	**67,714**	44,592	129,364	129,364	**73,414**	95,279	129,364	129,364	**106,868**	9	9	10	20
12 Austinmer	-	3,151,005	3,550,878	**1,083,338**	-	3,249,066	3,637,510	**1,116,336**	-	3,450,063	3,809,716	**1,183,811**	2,939,617	3,811,770	4,040,074	**3,242,998**	-	-	-	-
13 Thirroul Beach	1,021,058	2,339,945	2,568,381	**1,476,332**	1,696,940	2,417,974	2,657,555	**1,949,279**	2,097,069	2,589,186	2,833,152	**2,271,707**	2,379,721	2,959,637	3,749,321	**2,600,583**	12	16	22	44
14 McCauleys Beach	40,475	40,560	40,631	**40,506**	40,479	40,594	40,638	**40,519**	40,491	40,630	40,656	**40,539**	40,604	40,674	40,738	**40,629**	31	45	64	155
15 Sandon Point Beach	-	5,653	31,572	**2,700**	-	7,710	40,592	**3,608**	-	29,179	66,859	**11,051**	7,621	126,372	258,701	**51,966**	0	0	3	9
16 Bulli Beach	70	524,425	616,265	**181,106**	78	538,825	639,121	**186,261**	103	596,284	1,362,351	**225,786**	521,470	1,459,736	1,917,360	**854,210**	97	104	124	161
17 Woonona Beach	14	56	70	**29**	17	58	72	**32**	29	66	477,721	**14,371**	53	517,734	898,455	**187,486**	29	32	43	70
18 Bellambi	429,686	1,818,321	2,123,682	**910,982**	452,690	1,881,834	2,125,484	**945,909**	495,926	2,047,873	2,129,240	**1,026,029**	1,429,335	2,131,495	2,586,356	**1,681,715**	7	7	11	22
19 Corrimal Beach	209	2,932,060	3,204,728	**1,005,218**	1,382	3,006,528	4,628,324	**1,071,785**	1,603	3,257,540	5,061,706	**1,162,746**	3,194,725	5,613,179	6,089,725	**4,031,295**	15	21	34	59
20 Towradgi	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	7,180	**215**	-	-	-	-
21 Fairy Meadow	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	-
22 North Wollongong	56,811	214,705	380,152	**115,459**	69,320	322,261	384,364	**157,183**	85,263	347,302	438,040	**177,079**	104,543	372,403	494,189	**199,269**	27	29	34	43
23 Wollongong Central	33,309	112,213	212,567	**63,147**	36,020	146,926	298,146	**78,265**	39,486	260,287	387,249	**118,367**	143,221	430,017	510,196	**243,137**	-	-	-	-
24 City Beach	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	18,250	**548**	-	-	-	-
25 Hill 60 - Red Point	3,549	45,193	97,936	**19,290**	12,706	55,618	131,211	**29,564**	33,044	85,604	144,559	**52,683**	59,718	149,200	171,899	**90,823**	6	7	13	26
26 Port Kembla	-	55,149	55,158	**18,751**	-	55,151	55,160	**18,752**	-	55,156	55,165	**18,753**	55,152	55,171	55,184	**55,159**	1	1	3	11
27 Windang	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	-
Totals	1,690,917	11,744,063	14,099,058	**5,179,636**	2,432,830	12,238,719	15,869,335	**5,875,751**	2,960,490	13,772,620	18,079,298	**6,765,814**	11,187,264	18,916,107	22,181,598	**13,913,035**	410	456	580	919

Wollongong Open Coast Stormwater Coastal Hazard Risk Summary - Other ($ Values)

	Cliff and Slope Instability - Time Frame Totals				Coastal Inundation - Expected Losses				Tidal Inundation - Expected Losses			
Division	Immediate	2045	2075	2125	2025	2045	2075	2125	2025	2045	2075	2125
01 Little Garie to Burning Palms	-	-	-	-	-	-	-	-	-	-	-	-
02 Burning Palms to Werrong	-	-	-	-	-	-	-	-	-	-	-	-
03 Bulgo Beach	-	-	-	-	-	-	-	-	-	-	-	-
04 Stanwell Tops	-	-	-	-	-	-	-	-	-	-	-	-
05 Stanwell Park	4,159	16,635	41,588	66,516	-	-	-	-	-	-	-	-
06 Coalcliff	38,319	153,275	383,186	621,259	-	-	-	-	-	-	-	-
07 Clifton	130,851	523,406	1,308,514	2,235,634	-	-	-	-	-	-	-	-
08 Scarborough-Wombarra	111,688	446,751	1,116,876	2,055,252	-	-	-	-	-	-	-	-
09 Coledale	29,657	118,628	296,571	521,796	-	-	-	-	-	-	-	92
10 Sharky Beach	24,258	97,032	242,579	472,463	-	-	160	638	-	-	-	34,737
11 Little Austinmer Beach	8,630	34,520	86,301	172,601	-	-	-	-	-	-	-	-
12 Austinmer	49,860	199,441	498,603	970,569	-	-	-	-	-	-	-	-
13 Thirroul Beach	3,606	14,422	36,055	68,030	-	-	-	-	-	-	-	90,579
14 McCauleys Beach	4,627	18,506	46,266	84,094	-	-	-	-	-	-	-	-
15 Sandon Point Beach	-	-	-	-	-	-	-	-	-	-	10,117	74,092
16 Bulli Beach	4	14	36	71	-	-	-	-	-	199,949	1,070,980	1,503,561
17 Woonona Beach	0	1	2	4	-	-	-	-	-	-	-	14,424
18 Bellambi	-	-	-	-	-	5,849,577	5,849,816	5,854,158	-	1,139,293	2,033,673	5,107,123
19 Corrimal Beach	-	-	-	-	-	-	-	-	-	4,328,549	4,642,058	5,273,909
20 Towradgi	-	-	-	-	-	-	551,076	551,076	-	-	-	81,132
21 Fairy Meadow	-	-	-	-	-	399	289,254	384,116	-	4,155,447	4,173,071	4,249,757
22 North Wollongong	35,363	141,453	353,633	582,842	-	-	-	1,117,677	-	2,455,899	2,644,599	3,325,381
23 Wollongong Central	43,802	175,207	438,016	715,251	-	1,245	1,245	1,245	-	-	-	90,267
24 City Beach	-	-	-	-	-	101,771	102,314	103,990	-	458,313	593,740	688,171
25 Hill 60 - Red Point	19,260	77,041	192,603	336,621	-	-	-	-	-	-	-	-
26 Port Kembla	-	-	-	-	-	-	-	-	-	-	-	-
27 Windang	-	-	-	-	-	-	-	-	-	-	-	-
Totals	504,083	2,016,331	5,040,828	8,903,001	-	5,952,992	6,793,865	8,012,900	-	12,737,451	15,168,239	20,533,225

Wollongong Open Coast Stormwater Coastal Hazard Risk Ranking Summary - Erosion and Recession

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125				Expected Creek Length Lost (in m)			
Probabilities	63	5	1	Adopted	63	5	1	Adopted	63	5	1	Adopted	63	5	1	Adopted				
Division																	2025	2045	2075	2125
01 Little Garie to Burning Palms	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	-	-	-	-
02 Burning Palms to Werrong	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	-	-	-	-
03 Bulgo Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	-	-	-	-
04 Stanwell Tops	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	-	-	-	-
05 Stanwell Park	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	9	10	12	32
06 Coalcliff	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	29	35	41	41
07 Clifton	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	-	-	-	-
08 Scarborough-Wombarra	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	High	Moderate	Low	**High**	12	13	17	29
09 Coledale	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	High	Moderate	Low	**High**	55	57	61	75
10 Sharky Beach	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	High	Moderate	Low	**High**	High	High	Low	**High**	71	71	87	122
11 Little Austinmer Beach	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	High	Moderate	Low	**High**	9	9	10	20
12 Austinmer	Low	High	Low	**High**	Low	High	Low	**High**	Low	High	Low	**High**	Extreme	High	Low	**Extreme**	-	-	-	-
13 Thirroul Beach	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	12	16	22	44
14 McCauleys Beach	Moderate	Low	Low	**Moderate**	Moderate	Low	Low	**Moderate**	Moderate	Low	Low	**Moderate**	Moderate	Low	Low	**Moderate**	31	45	64	155
15 Sandon Point Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Moderate	Moderate	Low	**Moderate**	0	0	3	9
16 Bulli Beach	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	Extreme	High	Low	**Extreme**	97	104	124	161
17 Woonona Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Moderate	Low	**Moderate**	29	32	43	70
18 Bellambi	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	7	7	11	22
19 Corrimal Beach	Low	High	Low	**High**	Moderate	High	Low	**High**	Moderate	High	Low	**High**	Extreme	High	Low	**Extreme**	15	21	34	59
20 Towradgi	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	-	-	-	-
21 Fairy Meadow	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	-	-	-	-
22 North Wollongong	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**	27	29	34	43
23 Wollongong Central	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	High	Moderate	Low	**High**	-	-	-	-
24 City Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	-	-	-	-
25 Hill 60 - Red Point	Moderate	Low	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	High	Moderate	Low	**High**	6	7	13	26
26 Port Kembla	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	High	Moderate	Low	**High**	1	1	3	11
27 Windang	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	-	-	-	-

Wollongong Open Coast Stormwater Coastal Hazard Risk Ranking Summary - Other

	Cliff and Slope Instability - Time Frame Totals				Coastal Inundation - Expected Losses				Tidal Inundation - Expected Losses			
Division	Immediate	2045	2075	2125	2025	2045	2075	2125	2025	2045	2075	2125
01 Little Garie to Burning Palms	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
02 Burning Palms to Werrong	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
03 Bulgo Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
04 Stanwell Tops	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
05 Stanwell Park	Low	Low	Low	Moderate	Low	Low	Low	Low	Low	Low	Low	Low
06 Coalcliff	Low	Moderate	High	High	Low	Low	Low	Low	Low	Low	Low	Low
07 Clifton	Moderate	High	Extreme	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
08 Scarborough-Wombarra	Moderate	High	Extreme	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
09 Coledale	Low	Moderate	High	High	Low	Low	Low	Low	Low	Low	Low	Low
10 Sharky Beach	Low	Moderate	Moderate	High	Low	Low	Low	Low	Low	Low	Low	Low
11 Little Austinmer Beach	Low	Low	Moderate	Moderate	Low	Low	Low	Low	Low	Low	Low	Low
12 Austinmer	Low	Moderate	High	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
13 Thirroul Beach	Low	Low	Low	Moderate	Low	Low	Low	Low	Low	Low	Low	Moderate
14 McCauleys Beach	Low	Low	Low	Moderate	Low	Low	Low	Low	Low	Low	Low	Low
15 Sandon Point Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Moderate
16 Bulli Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Moderate	Extreme	Extreme
17 Woonona Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18 Bellambi	Low	Low	Low	Low	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
19 Corrimal Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Extreme	Extreme	Extreme
20 Towradgi	Low	Low	Low	Low	Low	Low	High	High	Low	Low	Low	Moderate
21 Fairy Meadow	Low	Low	Low	Low	Low	Low	High	High	Low	Extreme	Extreme	Extreme
22 North Wollongong	Low	Moderate	High	High	Low	Low	Low	Extreme	Low	Extreme	Extreme	Extreme
23 Wollongong Central	Low	Moderate	High	High	Low	Low	Low	Low	Low	Low	Low	Moderate
24 City Beach	Low	Low	Low	Low	Low	Moderate	Moderate	Moderate	Low	High	High	High
25 Hill 60 - Red Point	Low	Moderate	Moderate	High	Low	Low	Low	Low	Low	Low	Low	Low
26 Port Kembla	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
27 Windang	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

Wollongong Open Coast Transport Coastal Hazard Risk Summary - Erosion and Recession ($ Values)

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125			
	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**
Division																
01 Little Garie to Burning Palms	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
02 Burning Palms to Werrong	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
03 Bulgo Beach	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
04 Stanwell Tops	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
05 Stanwell Park	-	218,308	386,066	**79,258**	-	218,308	386,466	**79,270**	-	386,066	442,156	132,945	218,308	470,939	588,763	307,738
06 Coalcliff	1,741,426	1,741,426	1,741,426	**1,741,426**	1,741,426	1,741,426	1,741,426	**1,741,426**	1,741,426	1,741,426	1,741,426	1,741,426	1,741,426	1,741,426	1,741,426	1,741,426
07 Clifton	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
08 Scarborough-Wombarra	219,862	571,959	728,140	**344,261**	244,195	586,812	755,034	**365,731**	300,903	618,516	814,313	414,765	484,668	746,554	924,834	579,057
09 Coledale	-	412,758	455,511	**141,620**	54	418,192	459,232	**143,452**	9,726	432,849	476,185	154,888	42,155	462,370	761,142	193,991
10 Sharky Beach	508,181	1,109,185	1,258,563	**717,003**	518,450	1,122,275	1,258,563	**727,839**	592,318	1,146,460	1,258,563	784,089	900,464	1,258,563	1,258,563	1,022,218
11 Little Austinmer Beach	250,788	440,616	440,757	**315,334**	257,307	440,757	440,757	**319,680**	276,484	440,757	440,757	332,337	352,216	440,757	440,757	382,320
12 Austinmer	-	784,802	1,336,583	**283,386**	-	898,151	1,396,392	**320,319**	-	1,174,894	1,559,644	411,007	672,987	1,560,268	1,932,513	985,830
13 Thirroul Beach	1,148,095	1,346,379	1,685,844	**1,225,695**	1,148,095	1,456,183	1,854,055	**1,264,781**	1,171,016	1,722,762	2,247,256	1,374,345	1,379,912	2,765,714	3,909,475	1,885,398
14 McCauleys Beach	222,364	222,364	222,364	**222,364**	222,364	222,364	222,364	**222,364**	222,364	222,364	252,863	223,279	222,364	1,108,041	1,135,747	524,325
15 Sandon Point Beach	458,009	551,346	793,548	**497,010**	458,009	589,013	875,542	**511,146**	458,009	748,377	1,149,259	568,760	585,532	1,307,339	1,670,762	841,849
16 Bulli Beach	-	239,107	425,898	**86,900**	63,197	300,408	444,258	**148,164**	63,197	383,462	480,772	175,006	169,571	492,845	664,432	284,632
17 Woonona Beach	14,369	772,896	1,625,470	**297,845**	24,177	1,094,276	1,643,087	**404,475**	37,659	1,345,422	2,268,658	509,995	772,896	2,549,484	3,846,961	1,415,860
18 Bellambi	1,396,855	2,628,152	3,103,306	**1,829,751**	1,483,776	2,677,990	3,174,602	**1,904,707**	2,489,298	2,919,205	4,005,078	2,668,043	2,623,954	3,899,808	4,128,296	3,064,599
19 Corrimal Beach	92,993	1,991,807	2,066,530	**740,831**	92,993	1,991,807	2,072,000	**740,995**	736,707	2,070,746	2,080,017	1,190,559	2,066,666	2,172,728	2,208,514	2,103,801
20 Towradgi	138,248	631,809	864,148	**313,029**	138,248	634,014	868,102	**313,831**	242,460	855,150	878,003	451,460	853,621	900,121	1,218,095	878,970
21 Fairy Meadow	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
22 North Wollongong	596,008	7,133,382	7,183,122	**2,820,207**	6,487,539	7,139,085	7,185,891	**6,710,469**	6,730,273	7,142,851	7,194,701	6,872,105	6,857,301	7,178,131	7,410,912	6,973,366
23 Wollongong Central	706,236	1,271,813	1,457,253	**904,096**	1,030,980	1,362,877	1,525,001	**1,148,689**	1,037,708	1,487,306	1,733,607	1,197,960	1,213,153	1,919,148	2,083,338	1,458,117
24 City Beach	-	25,963	308,647	**17,308**	-	25,963	323,644	**17,758**	-	55,192	801,875	41,166	-	820,041	1,117,639	287,742
25 Hill 60 - Red Point	485,701	1,173,416	1,445,572	**727,689**	485,701	1,193,764	1,544,675	**736,970**	1,171,299	1,392,214	1,758,142	1,257,388	1,217,468	1,873,872	1,923,627	1,442,138
26 Port Kembla	141,975	141,975	370,161	**148,821**	141,975	141,975	370,161	**148,821**	141,975	370,161	370,161	219,558	141,975	993,054	1,213,533	437,956
27 Windang	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
Totals	8,121,110	23,409,463	27,898,909	**13,453,833**	14,538,486	24,255,640	28,541,252	**17,970,887**	17,422,823	26,656,182	31,953,435	**20,721,083**	22,516,637	34,661,205	40,179,331	**26,811,334**

Wollongong Open Coast Transport Coastal Hazard Risk Summary - Other ($ Values)

	Cliff and Slope Instability - Time Frame Totals				Coastal Inundation - Expected Losses				Tidal Inundation - Expected Losses			
Division	Immediate	2045	2075	2125	2025	2045	2075	2125	2025	2045	2075	2125
01 Little Garie to Burning Palms	-	-	-	-	-	-	-	-	-	-	-	-
02 Burning Palms to Werrong	-	-	-	-	-	-	-	-	-	-	-	-
03 Bulgo Beach	-	-	-	-	-	-	-	-	-	-	-	-
04 Stanwell Tops	-	-	-	-	-	-	-	-	-	-	-	-
05 Stanwell Park	92,100	368,399	920,998	1,841,995	-	270,405	425,644	1,491,189	-	5,451	11,544	135,918
06 Coalcliff	347,100	1,388,401	3,471,003	6,942,007	-	-	-	-	-	24,938	165,117	342,924
07 Clifton	488,831	1,955,323	4,888,308	9,776,616	-	1,193,718	1,269,760	1,649,341	-	453,830	607,194	753,685
08 Scarborough-Wombarra	244,044	976,175	2,440,439	4,880,877	-	-	-	-	-	58,084	86,845	88,882
09 Coledale	76,721	306,882	767,206	1,534,412	-	5,139	161,223	881,240	-	-	-	-
10 Sharky Beach	128,340	513,359	1,283,398	2,566,796	-	501,602	501,602	526,892	-	501,602	501,602	503,340
11 Little Austinmer Beach	53,260	213,042	532,604	1,065,208	-	-	-	-	-	-	-	24,608
12 Austinmer	51,014	204,055	510,137	1,020,275	-	2,958	436,401	1,643,666	-	65,466	526,002	592,149
13 Thirroul Beach	31,329	125,317	313,293	626,585	-	1,930,078	2,694,673	8,099,972	-	-	285,907	891,714
14 McCauleys Beach	29,379	117,516	293,789	587,578	-	-	-	-	-	896,016	898,027	922,014
15 Sandon Point Beach	81,053	324,212	810,531	1,621,061	-	901	36,396	1,377,309	-	93,323	1,032,968	1,832,120
16 Bulli Beach	7,985	31,942	79,854	159,708	-	-	14,898	788,354	-	-	648,679	2,284,793
17 Woonona Beach	50,227	200,906	502,266	1,004,531	-	55,744	415,601	8,237,137	-	-	319	99,219
18 Bellambi	-	-	-	-	-	764,107	764,107	1,058,380	-	3,790,216	3,958,181	4,565,989
19 Corrimal Beach	-	-	-	-	-	78,873	104,346	7,307,246	-	2,567,383	3,230,547	4,732,353
20 Towradgi	-	-	-	-	-	-	21,868	98,381	-	108,673	396,903	968,241
21 Fairy Meadow	-	-	-	-	-	5,108	307,431	8,167,502	-	1,644,033	2,289,531	3,921,353
22 North Wollongong	494,384	1,977,536	4,943,840	9,887,680	-	358,683	376,235	6,324,961	-	2,909,643	2,923,537	4,491,075
23 Wollongong Central	591,278	2,365,112	5,912,780	11,825,560	-	615,313	864,220	2,375,079	-	382	902,120	2,829,185
24 City Beach	-	-	-	-	-	258,177	328,890	20,130,920	-	1,055,826	1,183,062	3,423,169
25 Hill 60 - Red Point	283,360	1,133,440	2,833,599	5,667,198	-	-	26	548,342	-	-	-	123,555
26 Port Kembla	3,541	14,165	35,413	70,826	-	-	-	25,290	-	242	3,814	19,428
27 Windang	-	-	-	-	-	-	-	25,290	-	-	-	-
Totals	3,053,946	12,215,783	30,539,457	61,078,913	-	6,040,806	8,723,320	70,756,490	-	14,175,108	19,651,900	33,545,713

Wollongong Open Coast Transport Coastal Hazard Risk Ranking Summary - Erosion and Recession

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125			
Probabilities	63	5	1	**Adopted**	63	5	1	**Adopted**	63	5	1	**Adopted**	63	5	1	**Adopted**
Division																
01 Little Garie to Burning Palms	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
02 Burning Palms to Werrong	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
03 Bulgo Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
04 Stanwell Tops	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
05 Stanwell Park	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	High	Moderate	Low	**High**
06 Coalcliff	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
07 Clifton	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
08 Scarborough-Wombarra	High	Moderate	Low	**High**	High	Moderate	Low	**High**	Extreme	Moderate	Low	**Extreme**	Extreme	Moderate	Low	**Extreme**
09 Coledale	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**
10 Sharky Beach	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
11 Little Austinmer Beach	Extreme	Moderate	Low	**Extreme**	Extreme	Moderate	Low	**Extreme**	Extreme	Moderate	Low	**Extreme**	Extreme	Moderate	Low	**Extreme**
12 Austinmer	Low	High	Low	**High**	Low	High	Low	**High**	Low	High	Low	**High**	Extreme	High	Low	**Extreme**
13 Thirroul Beach	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
14 McCauleys Beach	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	High	Low	**High**
15 Sandon Point Beach	Extreme	Moderate	Low	**Extreme**	Extreme	Moderate	Low	**Extreme**	Extreme	Moderate	Low	**Extreme**	Extreme	High	Low	**Extreme**
16 Bulli Beach	Low	Moderate	Low	**Moderate**	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**
17 Woonona Beach	Moderate	High	Low	**High**	Moderate	High	Low	**High**	Moderate	High	Low	**High**	Extreme	High	Low	**Extreme**
18 Bellambi	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
19 Corrimal Beach	High	High	Low	**High**	High	High	Low	**High**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
20 Towradgi	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	High	Low	**High**	Extreme	High	Low	**Extreme**
21 Fairy Meadow	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
22 North Wollongong	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
23 Wollongong Central	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
24 City Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Moderate	Low	**Moderate**	Low	High	Low	**High**
25 Hill 60 - Red Point	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
26 Port Kembla	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	High	Low	**High**
27 Windang	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**

Wollongong Open Coast Transport Coastal Hazard Risk Ranking Summary - Other

	Cliff and Slope Instability - Time Frame Totals				Coastal Inundation - Expected Losses				Tidal Inundation - Expected Losses			
Division	Immediate	2045	2075	2125	2025	2045	2075	2125	2025	2045	2075	2125
01 Little Garie to Burning Palms	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
02 Burning Palms to Werrong	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
03 Bulgo Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
04 Stanwell Tops	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
05 Stanwell Park	Moderate	High	Extreme	Extreme	Low	High	High	Extreme	Low	Low	Low	Moderate
06 Coalcliff	High	Extreme	Extreme	Extreme	Low	Low	Low	Low	Low	Low	Moderate	High
07 Clifton	High	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	High	High	Extreme
08 Scarborough-Wombarra	Moderate	Extreme	Extreme	Extreme	Low	Low	Low	Low	Low	Moderate	Moderate	Moderate
09 Coledale	Moderate	High	Extreme	Extreme	Low	Low	Moderate	Extreme	Low	Low	Low	Low
10 Sharky Beach	Moderate	High	Extreme	Extreme	Low	High	High	High	Low	High	High	High
11 Little Austinmer Beach	Moderate	Moderate	High	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
12 Austinmer	Moderate	Moderate	High	Extreme	Low	Low	High	Extreme	Low	Moderate	High	High
13 Thirroul Beach	Low	Moderate	High	High	Low	Extreme	Extreme	Extreme	Low	Low	High	Extreme
14 McCauleys Beach	Low	Moderate	High	High	Low	Low	Low	Low	Low	Extreme	Extreme	Extreme
15 Sandon Point Beach	Moderate	High	Extreme	Extreme	Low	Low	Low	Extreme	Low	Moderate	Extreme	Extreme
16 Bulli Beach	Low	Low	Moderate	Moderate	Low	Low	Low	Extreme	Low	Low	High	Extreme
17 Woonona Beach	Moderate	Moderate	High	Extreme	Low	Moderate	High	Extreme	Low	Low	Low	Moderate
18 Bellambi	Low	Low	Low	Low	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
19 Corrimal Beach	Low	Low	Low	Low	Low	Moderate	Moderate	Extreme	Low	Extreme	Extreme	Extreme
20 Towradgi	Low	Low	Low	Low	Low	Low	Low	Moderate	Low	Moderate	High	Extreme
21 Fairy Meadow	Low	Low	Low	Low	Low	Low	High	Extreme	Low	Extreme	Extreme	Extreme
22 North Wollongong	High	Extreme	Extreme	Extreme	Low	High	High	Extreme	Low	Extreme	Extreme	Extreme
23 Wollongong Central	High	Extreme	Extreme	Extreme	Low	High	Extreme	Extreme	Low	Low	Extreme	Extreme
24 City Beach	Low	Low	Low	Low	Low	High	High	Extreme	Low	Extreme	Extreme	Extreme
25 Hill 60 - Red Point	High	Extreme	Extreme	Extreme	Low	Low	Low	High	Low	Low	Low	Moderate
26 Port Kembla	Low	Low	Low	Moderate	Low	Low	Low	Low	Low	Low	Low	Low
27 Windang	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

Wollongong Open Coast Open Space (Built) Coastal Hazard Risk Summary - Erosion and Recession ($ Values)

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125			
Division	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**
01 Little Garie to Burning Palms	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
02 Burning Palms to Werrong	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
03 Bulgo Beach	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
04 Stanwell Tops	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
05 Stanwell Park	23,655	50,217	135,807	**35,254**	25,563	51,346	136,713	**36,890**	30,944	133,059	139,554	65,858	46,915	140,501	5,773,028	247,710
06 Coalcliff	13,148	14,690	14,690	**13,672**	13,959	14,690	14,690	**14,207**	14,690	14,690	14,690	14,690	14,690	14,690	14,690	14,690
07 Clifton	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
08 Scarborough-Wombarra	44,579	58,827	61,667	**49,508**	45,922	59,373	62,178	**50,580**	48,935	60,460	889,157	77,714	54,149	888,666	890,637	337,944
09 Coledale	14,213	27,538	65,885	**19,894**	15,027	28,038	66,289	**20,598**	17,231	29,504	3,292,077	119,281	22,410	66,866	3,416,108	138,002
10 Sharky Beach	39,870	91,119	93,696	**57,372**	40,045	91,196	93,696	**57,511**	78,554	92,244	93,696	83,252	85,980	93,696	93,696	88,603
11 Little Austinmer Beach	22,206	130,295	130,297	**58,957**	22,792	130,297	130,297	**59,343**	24,084	130,297	130,297	60,196	29,258	130,297	130,297	63,611
12 Austinmer	14,617	102,228	106,167	**44,523**	15,882	103,024	106,863	**45,626**	18,636	104,977	108,433	48,096	101,101	108,454	997,902	130,284
13 Thirroul Beach	345,842	14,177,561	14,963,971	**5,072,219**	351,981	14,730,298	14,967,297	**5,247,719**	360,246	14,964,373	14,973,575	5,325,925	14,222,238	14,978,681	15,134,305	14,484,097
14 McCauleys Beach	382,675	393,490	397,195	**386,463**	384,659	394,563	398,149	**388,134**	388,834	397,064	400,433	391,733	395,079	402,660	405,605	397,745
15 Sandon Point Beach	33,680	57,083	61,578	**41,772**	38,163	58,534	62,959	**45,222**	47,214	61,729	65,629	52,266	58,787	67,305	69,824	61,758
16 Bulli Beach	30,593	61,196	68,923	**41,229**	34,075	62,635	70,315	**44,016**	42,589	66,195	939,963	76,829	58,179	941,134	1,394,225	371,977
17 Woonona Beach	35,408	89,783	107,175	**54,417**	39,025	91,984	108,756	**57,534**	55,854	100,997	116,427	71,666	84,707	119,235	582,577	110,347
18 Bellambi	73,302	343,056	669,295	**174,806**	80,377	661,083	669,784	**278,078**	255,162	665,185	673,620	394,823	336,719	674,641	682,156	451,838
19 Corrimal Beach	37,994	150,833	866,257	**97,822**	44,793	485,657	949,503	**208,602**	136,272	946,814	1,722,688	435,132	862,658	2,119,390	2,207,215	1,292,582
20 Towradgi	15,250	48,979	60,030	**27,050**	19,476	50,785	62,082	**30,460**	27,067	54,973	66,256	36,893	53,708	73,092	236,307	65,195
21 Fairy Meadow	38,969	86,500	104,789	**55,678**	42,631	88,739	391,202	**67,382**	51,827	94,571	396,778	75,426	75,089	396,578	414,313	184,928
22 North Wollongong	112,565	139,440	12,518,901	**493,086**	114,449	140,763	12,519,667	**494,763**	118,859	143,369	17,643,483	652,196	127,422	12,518,630	17,762,892	4,497,761
23 Wollongong Central	604,628	748,676	1,948,665	**689,604**	605,684	749,156	1,948,890	**690,457**	669,950	1,948,364	1,949,360	1,104,640	748,383	1,949,526	2,532,375	1,174,257
24 City Beach	42,073	133,890	157,313	**73,993**	48,292	137,351	159,450	**79,235**	78,368	150,554	166,776	103,398	131,812	168,928	177,472	144,688
25 Hill 60 - Red Point	59,920	64,999	64,999	**61,647**	63,066	64,999	64,999	**63,723**	64,891	64,999	64,999	64,928	64,999	64,999	139,999	67,249
26 Port Kembla	136,087	239,032	266,359	**171,908**	161,017	248,257	276,722	**191,533**	200,769	269,724	299,517	225,107	263,307	336,308	369,604	289,126
27 Windang	60,485	148,712	177,237	**91,338**	63,895	150,282	179,910	**94,155**	92,386	167,122	198,777	118,746	157,263	392,963	427,439	238,435
Totals	2,181,759	17,358,145	33,040,894	**7,812,213**	2,270,774	18,593,049	33,440,411	**8,265,768**	2,823,360	20,661,265	44,346,183	**9,598,796**	17,994,854	36,647,242	53,852,666	**24,852,828**

Wollongong Open Coast Open Space (Built) Coastal Hazard Risk Summary - Other ($ Values)

	Cliff and Slope Instability - Time Frame Totals				Coastal Inundation - Expected Losses				Tidal Inundation - Expected Losses			
	Immediate	2045	2075	2125	2025	2045	2075	2125	2025	2045	2075	2125
Division												
01 Little Garie to Burning Palms	-	-	-	-	-	-	-	-	-	-	-	-
02 Burning Palms to Werrong	-	-	-	-	-	-	-	-	-	-	-	-
03 Bulgo Beach	-	-	-	-	-	-	-	-	-	-	-	-
04 Stanwell Tops	428	1,710	4,276	8,552	-	625	773	1,225	-	188	209	269
05 Stanwell Park	289,437	1,157,747	2,894,368	5,788,736	-	2,756,481	2,762,660	3,446,827	-	23,932	26,394	30,812
06 Coalcliff	166,371	665,482	1,663,706	3,327,412	-	93,857	94,318	97,183	-	12,874	14,547	16,244
07 Clifton	9,724	38,897	97,242	194,485	-	29,972	31,001	37,467	-	17,649	21,305	24,236
08 Scarborough-Wombarra	218,833	875,331	2,188,328	4,376,656	-	57,361	59,318	70,751	-	29,653	33,914	38,548
09 Coledale	25,712	102,847	257,117	514,234	-	38,283	39,426	2,642,083	-	14,369	19,092	24,016
10 Sharky Beach	14,364	57,455	143,638	287,276	-	32,621	36,023	181,168	-	15,778	18,962	22,812
11 Little Austinmer Beach	9,934	39,734	99,336	198,672	-	24,172	25,579	29,391	-	8,991	11,413	14,047
12 Austinmer	133,848	535,392	1,338,481	2,676,961	-	73,435	75,326	2,504,174	-	13,732	15,340	17,164
13 Thirroul Beach	16,765	67,061	167,653	335,307	-	505,333	5,739,173	8,572,456	-	37,747	42,816	49,104
14 McCauleys Beach	26,104	104,418	261,044	522,089	-	44,145	45,663	232,448	-	39,974	42,848	46,390
15 Sandon Point Beach	132,996	531,984	1,329,960	2,659,920	-	55,633	57,345	1,365,963	-	20,333	25,752	32,772
16 Bulli Beach	241,713	966,852	2,417,131	4,834,261	-	54,800	60,817	92,031	-	12,546	16,334	23,814
17 Woonona Beach	54,149	216,598	541,495	1,082,989	-	317,545	328,055	365,666	-	6,686	10,526	20,416
18 Bellambi	-	-	-	-	-	112,959	241,877	934,751	-	54,423	64,556	83,602
19 Corrimal Beach	-	-	-	-	-	72,709	78,016	1,122,318	-	34,724	41,556	60,035
20 Towradgi	-	-	-	-	-	36,328	43,734	165,353	-	2,044	4,047	11,093
21 Fairy Meadow	-	-	-	-	-	117,502	249,847	1,978,630	-	59,096	88,572	149,381
22 North Wollongong	401,108	1,604,431	4,011,079	8,022,157	-	61,779	97,787	3,935,836	-	24,209	30,927	286,180
23 Wollongong Central	357,750	1,431,001	3,577,502	7,155,005	-	1,993,990	4,715,744	5,931,791	-	7,890	24,059	830,913
24 City Beach	-	-	-	-	-	65,953	77,407	551,745	-	7,691	15,264	115,165
25 Hill 60 - Red Point	98,631	394,523	986,307	1,972,613	-	72,548	74,252	81,456	-	28,662	37,454	46,791
26 Port Kembla	6,389	25,555	63,887	127,775	-	266,977	275,335	4,195,503	-	61,638	78,752	103,257
27 Windang	-	-	-	-	-	273,255	288,380	2,154,784	-	24,754	32,159	43,142
Totals	2,204,255	8,817,020	22,042,550	44,085,099	-	7,158,263	15,497,856	40,690,999	-	559,582	716,797	2,090,204

Wollongong Open Coast Open Space (Built) Coastal Hazard Risk Ranking Summary - Erosion and Recession

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125			
Probabilities	63	5	1	**Adopted**	63	5	1	**Adopted**	63	5	1	**Adopted**	63	5	1	**Adopted**
Division																
01 Little Garie to Burning Palms	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
02 Burning Palms to Werrong	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
03 Bulgo Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
04 Stanwell Tops	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
05 Stanwell Park	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**
06 Coalcliff	Moderate	Low	Low	**Moderate**	Moderate	Low	Low	**Moderate**	Moderate	Low	Low	**Moderate**	Moderate	Low	Low	**Moderate**
07 Clifton	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
08 Scarborough-Wombarra	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	High	High	Low	**High**
09 Coledale	Moderate	Low	Low	**Moderate**	Moderate	Low	Low	**Moderate**	Moderate	Low	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**
10 Sharky Beach	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	High	Moderate	Low	**High**	High	Moderate	Low	**High**
11 Little Austinmer Beach	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**
12 Austinmer	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	High	Moderate	Low	**High**
13 Thirroul Beach	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Moderate	**Extreme**
14 McCauleys Beach	Extreme	Moderate	Low	**Extreme**	Extreme	Moderate	Low	**Extreme**	Extreme	Moderate	Low	**Extreme**	Extreme	Moderate	Low	**Extreme**
15 Sandon Point Beach	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	High	Moderate	Low	**High**
16 Bulli Beach	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	High	High	Low	**High**
17 Woonona Beach	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	High	Moderate	Low	**High**	High	Moderate	Low	**High**
18 Bellambi	High	Moderate	Low	**High**	High	Moderate	Low	**High**	Extreme	Moderate	Low	**Extreme**	Extreme	Moderate	Low	**Extreme**
19 Corrimal Beach	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	High	High	Low	**High**	Extreme	High	Low	**Extreme**
20 Towradgi	Moderate	Low	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	High	Moderate	Low	**High**
21 Fairy Meadow	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	High	Moderate	Low	**High**	High	Moderate	Low	**High**
22 North Wollongong	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Moderate	**High**	High	High	Moderate	**High**
23 Wollongong Central	Extreme	Moderate	Low	**Extreme**	Extreme	Moderate	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
24 City Beach	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	High	Moderate	Low	**High**	High	Moderate	Low	**High**
25 Hill 60 - Red Point	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**
26 Port Kembla	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**	Extreme	Moderate	Low	**Extreme**
27 Windang	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**

Wollongong Open Coast Open Space (Built) Coastal Hazard Risk Ranking Summary - Other

	Cliff and Slope Instability - Time Frame Totals				Coastal Inundation - Expected Losses				Tidal Inundation - Expected Losses			
Division	Immediate	2045	2075	2125	2025	2045	2075	2125	2025	2045	2075	2125
01 Little Garie to Burning Palms	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
02 Burning Palms to Werrong	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
03 Bulgo Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
04 Stanwell Tops	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
05 Stanwell Park	High	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Low	Low	Low
06 Coalcliff	Moderate	High	Extreme	Extreme	Low	Moderate	Moderate	Moderate	Low	Low	Low	Low
07 Clifton	Low	Low	Moderate	Moderate	Low	Low	Low	Low	Low	Low	Low	Low
08 Scarborough-Wombarra	Moderate	Extreme	Extreme	Extreme	Low	Moderate	Moderate	Moderate	Low	Low	Low	Low
09 Coledale	Low	Moderate	High	High	Low	Low	Low	Extreme	Low	Low	Low	Low
10 Sharky Beach	Low	Moderate	Moderate	High	Low	Low	Low	Moderate	Low	Low	Low	Low
11 Little Austinmer Beach	Low	Low	Moderate	Moderate	Low	Low	Low	Low	Low	Low	Low	Low
12 Austinmer	Moderate	High	Extreme	Extreme	Low	Moderate	Moderate	Extreme	Low	Low	Low	Low
13 Thirroul Beach	Low	Moderate	Moderate	High	Low	High	Extreme	Extreme	Low	Low	Low	Low
14 McCauleys Beach	Low	Moderate	High	High	Low	Low	Low	Moderate	Low	Low	Low	Low
15 Sandon Point Beach	Moderate	High	Extreme	Extreme	Low	Moderate	Moderate	Extreme	Low	Low	Low	Low
16 Bulli Beach	Moderate	Extreme	Extreme	Extreme	Low	Moderate	Moderate	Moderate	Low	Low	Low	Low
17 Woonona Beach	Moderate	Moderate	High	Extreme	Low	High	High	High	Low	Low	Low	Low
18 Bellambi	Low	Low	Low	Low	Low	Moderate	Moderate	Extreme	Low	Moderate	Moderate	Moderate
19 Corrimal Beach	Low	Low	Low	Low	Low	Moderate	Moderate	Extreme	Low	Low	Low	Moderate
20 Towradgi	Low	Low	Low	Low	Low	Low	Low	Moderate	Low	Low	Low	Low
21 Fairy Meadow	Low	Low	Low	Low	Low	Moderate	Moderate	Extreme	Low	Moderate	Moderate	Moderate
22 North Wollongong	High	Extreme	Extreme	Extreme	Low	Moderate	Moderate	Extreme	Low	Low	Low	High
23 Wollongong Central	High	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Low	Low	Extreme
24 City Beach	Low	Low	Low	Low	Low	Moderate	Moderate	High	Low	Low	Low	Moderate
25 Hill 60 - Red Point	Moderate	High	Extreme	Extreme	Low	Moderate	Moderate	Moderate	Low	Low	Low	Low
26 Port Kembla	Low	Low	Moderate	Moderate	Low	High	High	Extreme	Low	Moderate	Moderate	Moderate
27 Windang	Low	Low	Low	Low	Low	High	High	Extreme	Low	Low	Low	Low

Wollongong Open Coast Open Space (Land) Coastal Hazard Risk Summary - Erosion and Recession ($ Values)

Division	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045			
	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**
01 Little Garie to Burning Palms	-	64,971,137	85,198,803	**23,101,570**	13,496,688	71,726,537	91,090,218	**34,263,021**
02 Burning Palms to Werrong	-	1,339,685	1,339,685	**455,493**	1,339,685	1,339,685	1,339,685	**1,339,685**
03 Bulgo Beach	-	5,469,119	5,469,119	**1,859,500**	1,441,422	5,469,119	5,469,119	**2,810,839**
04 Stanwell Tops	-	-	-	-	-	-	-	-
05 Stanwell Park	-	69,472,391	92,354,709	**24,764,729**	3,408,196	73,079,523	95,086,715	**28,196,807**
06 Coalcliff	-	2,687,875	2,687,875	**913,877**	1,460,220	2,687,875	2,687,875	**1,877,622**
07 Clifton	-	-	-	-	-	-	-	-
08 Scarborough-Wombarra	-	30,157,314	40,588,668	**10,775,054**	2,303,353	32,167,503	42,682,217	**12,982,900**
09 Coledale	-	40,960,077	55,956,904	**14,676,267**	1,603,774	42,789,164	57,410,454	**16,337,871**
10 Sharky Beach	-	53,006,652	61,242,330	**18,434,046**	511,185	53,229,965	61,242,330	**18,836,188**
11 Little Austinmer Beach	-	29,466,712	29,472,032	**10,018,948**	1,663,880	29,472,032	29,472,032	**11,118,651**
12 Austinmer	-	26,880,390	38,301,128	**9,710,369**	3,664,761	29,189,111	40,320,582	**12,899,614**
13 Thirroul Beach	-	83,857,496	111,918,632	**29,914,605**	20,227,486	93,948,476	121,236,983	**46,657,048**
14 McCauleys Beach	-	55,703,006	77,129,215	**20,010,333**	8,952,237	62,115,406	82,817,871	**28,062,838**
15 Sandon Point Beach	-	83,494,477	101,488,279	**29,287,812**	15,630,772	89,009,587	107,044,003	**41,481,290**
16 Bulli Beach	-	88,242,869	121,535,525	**31,667,208**	7,256,313	94,050,171	127,714,426	**38,449,438**
17 Woonona Beach	-	204,059,807	263,806,783	**72,367,683**	11,552,733	212,771,349	269,523,735	**82,804,681**
18 Bellambi	-	123,889,703	149,758,840	**43,415,956**	15,986,957	125,565,738	151,099,479	**54,520,430**
19 Corrimal Beach	-	42,300,110	61,125,109	**15,323,287**	3,750,989	47,671,969	66,192,194	**19,610,134**
20 Towradgi	-	50,310,266	69,717,002	**18,075,827**	4,385,416	53,478,729	73,326,127	**22,069,512**
21 Fairy Meadow	-	104,251,016	154,686,135	**37,967,102**	6,066,224	110,228,149	160,995,393	**44,019,640**
22 North Wollongong	-	85,352,009	117,544,501	**30,629,308**	4,330,740	89,763,159	120,115,399	**34,895,375**
23 Wollongong Central	-	21,031,440	27,109,996	**7,454,617**	2,639,272	22,991,476	28,391,121	**9,829,004**
24 City Beach	-	281,356,391	366,138,839	**99,900,295**	18,088,240	293,221,508	376,437,590	**115,794,355**
25 Hill 60 - Red Point	-	19,949,190	24,722,884	**7,021,409**	5,795,623	21,252,276	25,802,767	**11,278,410**
26 Port Kembla	-	18,794,163	39,341,160	**7,417,365**	477,878	24,246,386	48,895,315	**9,791,617**
27 Windang	-	102,845,325	136,870,194	**36,668,654**	6,253,219	105,530,707	141,077,906	**41,784,925**
Totals	-	1,689,848,621	2,235,504,345	**601,831,317**	162,287,264	1,786,995,599	2,327,471,536	**741,711,895**

Division	Erosion/Recession Totals 2075				Erosion/Recession Totals 2125			
	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**
01 Little Garie to Burning Palms	37,656,256	87,309,683	103,544,022	**55,350,138**	80,803,331	117,268,261	131,304,030	**93,903,195**
02 Burning Palms to Werrong	1,339,685	1,339,685	1,339,685	**1,339,685**	1,339,685	1,339,685	1,349,804	**1,340,191**
03 Bulgo Beach	2,132,759	5,469,119	5,469,119	**3,267,121**	4,095,223	5,469,119	5,467,826	**4,562,283**
04 Stanwell Tops	-	-	-	-	-	-	-	-
05 Stanwell Park	14,005,141	83,755,493	103,622,919	**38,713,632**	58,731,567	106,261,961	119,475,942	**75,552,600**
06 Coalcliff	2,687,875	2,687,875	2,687,875	**2,687,875**	2,687,875	2,687,875	2,687,875	**2,687,875**
07 Clifton	-	-	-	-	-	-	-	-
08 Scarborough-Wombarra	7,277,797	36,296,803	45,925,435	**17,625,691**	18,624,924	43,574,701	51,879,829	**27,523,104**
09 Coledale	5,792,537	47,872,595	61,463,974	**20,779,325**	23,040,121	59,468,583	70,419,541	**35,973,346**
10 Sharky Beach	11,689,495	56,629,954	61,242,330	**27,199,869**	36,610,248	61,242,330	61,242,330	**44,985,156**
11 Little Austinmer Beach	5,405,550	29,472,032	29,472,032	**13,588,154**	20,412,368	29,472,032	29,472,032	**23,492,654**
12 Austinmer	11,655,051	34,850,649	44,996,929	**20,048,868**	23,611,544	45,068,156	52,486,467	**31,277,708**
13 Thirroul Beach	46,722,832	113,011,675	138,008,136	**70,510,862**	88,840,615	151,380,298	174,698,227	**111,270,004**
14 McCauleys Beach	29,141,655	76,360,545	97,125,230	**46,234,312**	65,105,315	111,546,232	131,698,926	**81,902,862**
15 Sandon Point Beach	47,887,578	101,659,815	119,081,557	**67,041,225**	89,896,614	127,476,893	141,078,874	**103,354,008**
16 Bulli Beach	26,072,029	108,914,577	142,965,761	**55,941,055**	74,834,682	148,142,742	178,342,579	**101,269,414**
17 Woonona Beach	71,870,007	243,299,113	297,773,700	**132,879,632**	184,689,351	308,146,309	362,656,553	**229,390,229**
18 Bellambi	49,207,634	138,123,754	162,254,903	**80,645,672**	102,313,146	166,350,842	189,862,625	**125,261,552**
19 Corrimal Beach	22,503,343	62,480,362	81,270,536	**37,035,038**	57,041,452	98,802,670	117,561,794	**72,178,222**
20 Towradgi	14,603,486	60,838,812	80,676,574	**31,315,385**	58,604,265	96,003,131	117,059,531	**72,372,700**
21 Fairy Meadow	22,810,324	125,806,373	177,170,657	**60,397,195**	74,134,080	175,159,388	228,210,758	**111,135,253**
22 North Wollongong	17,671,265	98,429,770	126,906,085	**46,552,972**	45,494,811	116,541,840	145,217,864	**71,084,602**
23 Wollongong Central	9,136,161	26,348,747	31,258,054	**15,233,906**	20,317,383	33,049,047	37,418,640	**24,864,628**
24 City Beach	110,604,867	343,893,506	425,453,057	**194,000,982**	278,236,479	468,923,335	547,962,918	**347,021,989**
25 Hill 60 - Red Point	12,386,175	24,233,211	27,830,084	**16,594,011**	21,487,394	29,089,175	30,202,305	**24,127,656**
26 Port Kembla	4,025,053	42,650,183	73,959,402	**18,723,058**	37,072,585	116,159,682	154,463,685	**65,877,398**
27 Windang	36,603,774	124,416,533	164,114,784	**68,445,024**	112,010,046	196,010,299	245,008,611	**143,020,048**
Totals	620,888,327	2,076,150,863	2,605,612,839	**1,142,150,688**	1,580,035,103	2,814,634,586	3,327,229,565	**2,025,428,676**

Wollongong Open Coast Open Space (Land) Coastal Hazard Risk Summary - Other ($ Values)

	Cliff and Slope Instability - Time Frame Totals				Coastal Inundation - Expected Losses				Tidal Inundation - Expected Losses			
Division	Immediate	2045	2075	2125	2025	2045	2075	2125	2025	2045	2075	2125
01 Little Garie to Burning Palms	-	140,678,314	422,034,942	890,962,655	-	659,752,088	688,270,124	887,420,689	-	518,194,244	585,926,588	649,204,163
02 Burning Palms to Werrong	-	461,236,855	1,383,710,566	2,921,166,751	-	343,594,674	359,565,836	450,453,270	-	235,289,334	278,284,031	319,958,397
03 Bulgo Beach	-	163,615,779	490,847,337	1,036,233,268	-	144,930,642	151,054,855	194,186,590	-	72,105,138	90,793,839	111,383,684
04 Stanwell Tops	-	104,759,682	314,279,045	663,477,984	-	91,483,727	94,910,336	111,245,516	-	28,532,331	40,091,968	49,434,813
05 Stanwell Park	-	34,831,507	104,494,522	220,599,547	-	211,558,042	229,236,389	325,595,696	-	34,276,607	39,119,995	47,368,531
06 Coalcliff	-	29,281,592	87,844,775	185,450,080	-	71,758,302	73,014,992	81,012,958	-	31,010,919	36,026,786	40,922,301
07 Clifton	-	83,769,304	251,307,911	530,538,923	-	70,381,194	72,760,821	84,624,391	-	38,414,443	46,592,342	53,603,453
08 Scarborough-Wombarra	-	87,535,520	262,606,561	554,391,628	-	114,617,126	118,399,868	144,579,041	-	73,836,262	81,424,451	89,288,538
09 Coledale	-	35,739,989	107,219,967	226,353,263	-	158,756,113	162,834,955	220,228,062	-	70,054,974	93,399,995	109,715,847
10 Sharky Beach	-	21,476,094	64,428,282	136,015,261	-	8,652,186	14,310,952	55,725,543	-	416,054	779,409	2,423,006
11 Little Austinmer Beach	-	9,724,098	29,172,293	61,585,951	-	30,472,589	34,550,443	45,560,191	-	5,086,200	7,360,196	10,901,638
12 Austinmer	-	4,789,672	14,369,015	30,334,587	-	57,357,479	65,976,843	94,239,517	-	3,650,552	6,045,004	10,209,810
13 Thirroul Beach	-	8,778,518	26,335,553	55,597,278	-	188,707,164	211,189,128	295,745,687	-	34,858,672	44,893,927	60,992,957
14 McCauleys Beach	-	17,044,965	51,134,896	107,951,448	-	137,933,878	145,771,762	236,794,453	-	104,103,205	115,891,509	134,853,592
15 Sandon Point Beach	-	21,915,534	65,746,603	138,798,384	-	155,406,417	161,852,667	227,462,153	-	32,789,348	49,168,310	73,820,374
16 Bulli Beach	-	3,799,761	11,399,283	24,065,153	-	112,068,162	133,121,670	243,742,475	-	11,301,918	17,665,202	34,851,949
17 Woonona Beach	-	13,381,795	40,145,384	84,751,367	-	315,065,088	349,499,903	475,845,163	-	49,180,544	55,193,738	79,927,676
18 Bellambi	-	-	-	-	-	168,813,201	194,047,720	455,735,680	-	67,255,157	81,097,522	123,376,454
19 Corrimal Beach	-	-	-	-	-	51,704,386	59,590,901	241,698,644	-	21,874,588	30,063,459	50,163,892
20 Towradgi	-	-	-	-	-	31,006,838	52,463,994	141,232,322	-	188,959	6,031,911	17,992,948
21 Fairy Meadow	-	-	-	-	-	234,609,245	641,895,793	1,312,797,312	-	137,417,663	219,083,497	388,793,463
22 North Wollongong	-	11,091,457	33,274,372	70,245,896	-	92,386,421	137,027,805	708,595,206	-	24,648,815	51,477,236	131,676,935
23 Wollongong Central	-	58,650,723	175,952,168	371,454,577	-	264,396,534	284,437,159	362,968,593	-	110,574,191	129,189,465	151,579,067
24 City Beach	-	43,125	129,374	273,123	-	311,188,799	358,147,031	1,901,885,224	-	152,117,355	197,156,300	313,070,028
25 Hill 60 - Red Point	-	43,566,778	130,700,335	275,922,929	-	116,576,242	121,608,316	151,642,830	-	41,639,467	52,740,314	65,571,543
26 Port Kembla	-	1,338,581	4,015,744	8,477,683	-	7,473,006	9,188,178	295,282,829	-	127	40,911	447,836
27 Windang	-	-	-	-	-	285,091,826	299,477,728	478,111,316	-	136,681,318	146,882,280	159,263,311
Totals	-	1,357,049,643	4,071,148,928	8,594,647,737	-	4,435,741,370	5,224,206,169	10,224,411,351	-	2,035,498,384	2,502,420,185	3,280,796,204

Wollongong Open Coast Open Space (Land) Coastal Hazard Risk Ranking Summary - Erosion and Recession

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125			
Probabilities	63	5	1	**Adopted**	63	5	1	**Adopted**	63	5	1	**Adopted**	63	5	1	**Adopted**
Division																
01 Little Garie to Burning Palms	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
02 Burning Palms to Werrong	Low	High	Low	**High**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
03 Bulgo Beach	Low	High	Low	**High**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
04 Stanwell Tops	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
05 Stanwell Park	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
06 Coalcliff	Low	High	Low	**High**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
07 Clifton	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
08 Scarborough-Wombarra	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
09 Coledale	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
10 Sharky Beach	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
11 Little Austinmer Beach	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
12 Austinmer	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
13 Thirroul Beach	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
14 McCauleys Beach	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
15 Sandon Point Beach	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
16 Bulli Beach	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
17 Woonona Beach	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
18 Bellambi	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
19 Corrimal Beach	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
20 Towradgi	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
21 Fairy Meadow	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
22 North Wollongong	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
23 Wollongong Central	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
24 City Beach	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
25 Hill 60 - Red Point	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
26 Port Kembla	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**
27 Windang	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**	Extreme	High	Moderate	**Extreme**

Wollongong Open Coast Open Space (Land) Coastal Hazard Risk Ranking Summary - Other

	Cliff and Slope Instability - Time Frame Totals				Coastal Inundation - Expected Losses				Tidal Inundation - Expected Losses			
Division	Immediate	2045	2075	2125	2025	2045	2075	2125	2025	2045	2075	2125
01 Little Garie to Burning Palms	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
02 Burning Palms to Werrong	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
03 Bulgo Beach	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
04 Stanwell Tops	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
05 Stanwell Park	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
06 Coalcliff	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
07 Clifton	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
08 Scarborough-Wombarra	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
09 Coledale	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
10 Sharky Beach	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	High	Extreme	Extreme
11 Little Austinmer Beach	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
12 Austinmer	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
13 Thirroul Beach	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
14 McCauleys Beach	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
15 Sandon Point Beach	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
16 Bulli Beach	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
17 Woonona Beach	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
18 Bellambi	Low	Low	Low	Low	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
19 Corrimal Beach	Low	Low	Low	Low	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
20 Towradgi	Low	Low	Low	Low	Low	Extreme	Extreme	Extreme	Low	Moderate	Extreme	Extreme
21 Fairy Meadow	Low	Low	Low	Low	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
22 North Wollongong	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
23 Wollongong Central	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
24 City Beach	Low	Low	Moderate	High	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
25 Hill 60 - Red Point	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
26 Port Kembla	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Low	Low	High
27 Windang	Low	Low	Low	Low	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme

Wollongong Open Coast Private Buildings Coastal Hazard Risk Summary - Erosion and Recession ($ Values)

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125			
	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**
Division																
01 Little Garie to Burning Palms	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02 Burning Palms to Werrong	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03 Bulgo Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04 Stanwell Tops	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05 Stanwell Park	-	-	237,815	**7,134**	-	-	734,566	**22,037**	-	-	1,810,000	54,300	-	1,810,000	1,810,000	615,400
06 Coalcliff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07 Clifton	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08 Scarborough-Wombarra	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09 Coledale	-	3,908,536	6,157,892	**1,396,383**	-	3,984,934	6,628,038	**1,434,171**	-	4,346,674	7,387,527	1,569,095	523,286	6,968,302	7,680,000	2,735,943
10 Sharky Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 Little Austinmer Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12 Austinmer	-	-	944,217	**28,327**	-	-	1,669,841	**50,095**	-	3,543	1,788,282	54,747	-	1,788,276	1,788,280	608,014
13 Thirroul Beach	-	-	-	-	-	-	-	-	-	-	2,651,358	79,541	-	2,910,000	4,582,918	1,039,588
14 McCauleys Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,431,587	42,948
15 Sandon Point Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,405,664	72,170
16 Bulli Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17 Woonona Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18 Bellambi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19 Corrimal Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20 Towradgi	-	15,339	1,094,234	**37,582**	-	75,780	1,492,941	**68,280**	-	393,132	2,630,000	200,771	304,512	3,814,007	7,220,069	1,599,922
21 Fairy Meadow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22 North Wollongong	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23 Wollongong Central	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24 City Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25 Hill 60 - Red Point	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26 Port Kembla	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27 Windang	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Totals	-	3,923,874	8,434,157	**1,469,426**	-	4,060,715	10,525,386	**1,574,583**	-	4,743,348	16,267,167	**1,958,453**	827,798	17,290,586	26,918,518	**6,713,984**

Wollongong Open Coast Private Buildings Coastal Hazard Risk Summary - Other ($ Values)

	Cliff and Slope Instability - Time Frame Totals				Coastal Inundation - Expected Losses				Tidal Inundation - Expected Losses			
	Immediate	2045	2075	2125	2025	2045	2075	2125	2025	2045	2075	2125
Division												
01 Little Garie to Burning Palms	-	-	-	-	-	-	-	-	-	-	-	-
02 Burning Palms to Werrong	-	-	-	-	-	-	-	-	-	-	-	-
03 Bulgo Beach	-	-	-	-	-	-	-	-	-	-	-	-
04 Stanwell Tops	-	-	-	-	-	-	-	-	-	-	-	-
05 Stanwell Park	620,760	2,483,042	6,207,605	12,415,210	-	-	29,252	1,701,306	-	-	-	-
06 Coalcliff	3,614,201	14,456,805	36,142,012	72,284,024	-	-	-	-	-	-	-	-
07 Clifton	636,295	2,545,182	6,362,955	12,725,910	-	-	-	-	-	-	-	-
08 Scarborough-Wombarra	3,998,366	15,993,463	39,983,657	79,967,315	-	-	-	-	-	-	-	-
09 Coledale	1,591,683	6,366,732	15,916,830	31,833,660	-	-	-	-	-	-	-	-
10 Sharky Beach	-	-	-	-	-	-	-	-	-	-	-	-
11 Little Austinmer Beach	20,151	80,605	201,514	403,027	-	-	-	-	-	-	-	-
12 Austinmer	405,670	1,622,680	4,056,700	8,113,401	-	-	632,026	2,781,930	-	-	-	-
13 Thirroul Beach	1,544,272	6,177,088	15,442,720	30,885,439	-	10,163,290	16,639,619	42,870,231	-	-	-	44,964
14 McCauleys Beach	3,029,061	12,116,243	30,290,607	60,581,215	-	-	-	-	-	-	-	-
15 Sandon Point Beach	-	-	-	-	-	-	-	11,164,360	-	-	-	-
16 Bulli Beach	-	-	-	-	-	-	-	3,799,400	-	-	-	-
17 Woonona Beach	-	-	-	-	-	126,002	1,587,243	80,745,586	-	-	-	-
18 Bellambi	-	-	-	-	-	-	-	29,620	-	-	-	-
19 Corrimal Beach	-	-	-	-	-	-	14,646	46,401,526	-	-	6,580	4,610,970
20 Towradgi	-	-	-	-	-	-	130	642,886	-	-	-	23,937
21 Fairy Meadow	-	-	-	-	-	-	177,556	4,648,165	-	-	34,667	517,780
22 North Wollongong	-	-	-	-	-	-	-	17,592,465	-	-	-	1,272,850
23 Wollongong Central	-	-	-	-	-	2,248,134	4,662,485	10,782,685	-	-	-	-
24 City Beach	-	-	-	-	-	1,373,201	2,998,899	88,852,278	-	-	756	6,751,783
25 Hill 60 - Red Point	237,722	950,889	2,377,223	4,754,445	-	-	-	-	-	-	-	-
26 Port Kembla	-	-	-	-	-	-	-	-	-	-	-	-
27 Windang	-	-	-	-	-	-	-	-	-	-	-	-
Totals	15,698,182	62,792,729	156,981,822	313,963,644	-	13,910,627	26,741,858	312,012,437	-	-	42,003	13,222,284

Wollongong Open Coast Private Buildings Coastal Hazard Risk Ranking Summary - Erosion and Recession

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125			
Probabilities	63	5	1	**Adopted**	63	5	1	**Adopted**	63	5	1	**Adopted**	63	5	1	**Adopted**
Division																
01 Little Garie to Burning Palms	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
02 Burning Palms to Werrong	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
03 Bulgo Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
04 Stanwell Tops	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
05 Stanwell Park	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	High	Low	**High**
06 Coalcliff	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
07 Clifton	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
08 Scarborough-Wombarra	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
09 Coledale	Low	High	Low	**High**	Low	High	Low	**High**	Low	High	Low	**High**	Extreme	High	Low	**Extreme**
10 Sharky Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
11 Little Austinmer Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
12 Austinmer	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	High	Low	**High**
13 Thirroul Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	High	Low	**High**
14 McCauleys Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
15 Sandon Point Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
16 Bulli Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
17 Woonona Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
18 Bellambi	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
19 Corrimal Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
20 Towradgi	Low	Low	Low	**Low**	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	Extreme	High	Low	**Extreme**
21 Fairy Meadow	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
22 North Wollongong	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
23 Wollongong Central	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
24 City Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
25 Hill 60 - Red Point	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
26 Port Kembla	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
27 Windang	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**

Wollongong Open Coast Transport Coastal Hazard Risk Ranking Summary - Other

	Cliff and Slope Instability - Time Frame Totals				Coastal Inundation - Expected Losses				Tidal Inundation - Expected Losses			
Division	Immediate	2045	2075	2125	2025	2045	2075	2125	2025	2045	2075	2125
01 Little Garie to Burning Palms	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
02 Burning Palms to Werrong	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
03 Bulgo Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
04 Stanwell Tops	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
05 Stanwell Park	High	Extreme	Extreme	Extreme	Low	Low	Low	Extreme	Low	Low	Low	Low
06 Coalcliff	Extreme	Extreme	Extreme	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
07 Clifton	High	Extreme	Extreme	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
08 Scarborough-Wombarra	Extreme	Extreme	Extreme	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
09 Coledale	Extreme	Extreme	Extreme	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
10 Sharky Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
11 Little Austinmer Beach	Low	Moderate	Moderate	High	Low	Low	Low	Low	Low	Low	Low	Low
12 Austinmer	High	Extreme	Extreme	Extreme	Low	Low	High	Extreme	Low	Low	Low	Low
13 Thirroul Beach	Extreme	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Low	Low	Low
14 McCauleys Beach	Extreme	Extreme	Extreme	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
15 Sandon Point Beach	Low	Low	Low	Low	Low	Low	Low	Extreme	Low	Low	Low	Low
16 Bulli Beach	Low	Low	Low	Low	Low	Low	Low	Extreme	Low	Low	Low	Low
17 Woonona Beach	Low	Low	Low	Low	Low	Moderate	Extreme	Extreme	Low	Low	Low	Low
18 Bellambi	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
19 Corrimal Beach	Low	Low	Low	Low	Low	Low	Low	Extreme	Low	Low	Low	Extreme
20 Towradgi	Low	Low	Low	Low	Low	Low	Low	High	Low	Low	Low	Low
21 Fairy Meadow	Low	Low	Low	Low	Low	Low	Moderate	Extreme	Low	Low	Low	High
22 North Wollongong	Low	Low	Low	Low	Low	Low	Low	Extreme	Low	Low	Low	Extreme
23 Wollongong Central	Low	Low	Low	Low	Low	Extreme	Extreme	Extreme	Low	Low	Low	Low
24 City Beach	Low	Low	Low	Low	Low	Extreme	Extreme	Extreme	Low	Low	Low	Extreme
25 Hill 60 - Red Point	Moderate	Extreme	Extreme	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
26 Port Kembla	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
27 Windang	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

Wollongong Open Coast Private Land Coastal Hazard Risk Summary - Erosion and Recession ($ Values)

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125			
Division	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**
01 Little Garie to Burning Palms	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**
02 Burning Palms to Werrong	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**
03 Bulgo Beach	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**
04 Stanwell Tops	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**
05 Stanwell Park	-	2,336,783	2,514,937	**799,851**	124,827	2,360,383	2,596,092	**891,987**	275,406	2,431,089	2,893,330	**1,022,205**	2,063,698	2,961,894	3,307,565	**2,379,455**
06 Coalcliff	-	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
07 Clifton	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**
08 Scarborough-Wombarra	-	3,228,593	5,319,057	**1,160,436**	172,048	3,500,301	5,598,635	**1,366,604**	607,399	4,029,562	6,468,245	**1,844,095**	2,107,819	5,851,916	8,333,493	**3,455,259**
09 Coledale	-	5,828,612	8,423,487	**2,059,574**	441,452	6,144,897	8,784,511	**2,459,812**	1,325,779	7,087,043	9,632,546	**3,360,974**	3,660,192	9,548,897	11,843,833	**5,731,200**
10 Sharky Beach	-	1,303,133	2,039,392	**465,153**	-	1,303,133	2,039,499	**465,156**	-	1,569,284	2,039,392	**547,660**	255,064	2,039,392	2,039,392	**861,735**
11 Little Austinmer Beach	-	433,351	434,198	**147,365**	-	434,198	434,198	**147,627**	-	434,198	434,198	**147,627**	-	434,198	434,198	**147,627**
12 Austinmer	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**
13 Thirroul Beach	-	258,353	919,385	**107,671**	2,195	258,353	2,268,098	**149,581**	258,353	1,113,079	5,776,289	**688,856**	258,353	8,967,280	19,054,248	**3,521,997**
14 McCauleys Beach	-	969,759	1,206,611	**336,823**	241,019	1,036,959	1,253,204	**518,126**	691,673	1,204,305	1,368,717	**870,900**	1,058,561	1,483,285	2,104,506	**1,221,604**
15 Sandon Point Beach	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	162,518	1,790,886	**104,107**
16 Bulli Beach	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**
17 Woonona Beach	-	3,434,070	13,880,164	**1,480,967**	-	3,523,567	15,353,542	**1,552,912**	-	9,053,996	22,900,812	**3,493,763**	2,502,003	25,574,750	43,188,368	**10,875,146**
18 Bellambi	-	5,480,798	6,324,893	**1,888,794**	1,929,559	5,577,967	6,481,005	**3,197,109**	4,460,800	6,058,444	7,018,724	**5,032,808**	4,982,554	7,454,094	7,523,770	**5,824,968**
19 Corrimal Beach	-	-	696	**21**	-	-	18,403	**552**	-	-	288,340	**8,650**	-	507,796	984,900	**186,964**
20 Towradgi	-	-	69,544	**2,086**	-	-	112,487	**3,375**	-	8,589	286,030	**11,243**	3,840	1,165,505	2,517,152	**439,355**
21 Fairy Meadow	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**
22 North Wollongong	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**
23 Wollongong Central	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**
24 City Beach	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**
25 Hill 60 - Red Point	-	313,809	313,809	**106,695**	247,207	313,809	313,809	**269,852**	313,809	313,809	313,809	**313,809**	313,809	314,559	693,594	**325,435**
26 Port Kembla	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**
27 Windang	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**
Totals	-	23,587,262	41,446,173	**8,555,436**	3,158,308	24,453,567	45,253,484	**11,022,694**	7,933,219	33,303,398	59,420,433	**17,342,591**	17,205,892	66,466,085	103,815,905	**35,074,852**

Wollongong Open Coast Private Land Coastal Hazard Risk Summary - Other ($ Values)

	Cliff and Slope Instability - Time Frame Totals				Coastal Inundation - Expected Losses				Tidal Inundation - Expected Losses			
	Immediate	2045	2075	2125	2025	2045	2075	2125	2025	2045	2075	2125
Division												
01 Little Garie to Burning Palms	-	-	-	-	-	-	-	-	-	-	-	-
02 Burning Palms to Werrong	-	-	-	-	-	-	-	-	-	-	-	-
03 Bulgo Beach	-	-	-	-	-	-	-	-	-	-	-	-
04 Stanwell Tops	-	-	-	-	-	-	-	-	-	-	-	-
05 Stanwell Park	-	8,925,251	26,775,752	56,526,587	-	14,609,205	19,005,715	45,682,482	-	4,172,421	6,012,717	8,109,005
06 Coalcliff	-	11,016,390	33,049,171	69,770,471	-	13,469,582	13,853,236	15,240,623	-	2,988,729	4,125,988	5,387,871
07 Clifton	-	2,166,631	6,499,894	13,721,998	-	-	-	-	-	-	-	-
08 Scarborough-Wombarra	-	24,238,015	72,714,046	153,507,431	-	-	-	-	-	-	-	-
09 Coledale	-	6,044,685	18,134,056	38,283,007	-	143,565	529,953	793,536	-	-	-	18,480
10 Sharky Beach	-	1,922	5,767	12,175	-	-	-	199,308	-	-	-	-
11 Little Austinmer Beach	-	220,445	661,334	1,396,149	-	-	-	-	-	-	-	-
12 Austinmer	-	914,547	2,743,641	5,792,131	-	-	2,013,155	10,178,451	-	-	-	-
13 Thirroul Beach	-	3,288,686	9,866,057	20,828,342	-	61,581,517	92,478,195	270,459,841	-	1,426,779	1,426,779	1,870,033
14 McCauleys Beach	-	9,594,412	28,783,237	60,764,612	-	13,301,098	13,907,241	17,885,722	-	6,597,599	8,293,793	9,877,200
15 Sandon Point Beach	-	-	-	-	-	-	-	43,668,412	-	-	-	17,214
16 Bulli Beach	-	-	-	-	-	-	441,740	32,179,566	-	-	73,366	1,664,471
17 Woonona Beach	-	629,080	1,887,239	3,984,172	-	1,586,636	13,439,071	422,206,066	-	-	-	238,647
18 Bellambi	-	-	-	-	-	3,261,007	16,171,281	132,273,688	-	40,527	3,554,822	20,146,375
19 Corrimal Beach	-	-	-	-	-	541,733	1,324,387	208,830,119	-	451,921	827,368	22,565,770
20 Towradgi	-	-	-	-	-	-	12,401	4,364,495	-	-	-	233,406
21 Fairy Meadow	-	-	-	-	-	3,841,742	6,103,096	75,521,869	-	3,588,475	4,533,911	12,245,471
22 North Wollongong	-	470	1,410	2,978	-	9,375,701	17,107,188	197,741,746	-	7,805,950	11,819,829	32,635,314
23 Wollongong Central	-	-	-	-	-	12,556,361	21,121,017	49,324,265	-	-	-	-
24 City Beach	-	-	-	-	-	9,767,122	22,237,341	417,284,758	-	2,113,006	5,819,854	45,874,482
25 Hill 60 - Red Point	-	1,977,698	5,933,094	12,525,421	-	3,472,873	3,531,558	4,188,257	-	2,826,307	2,987,904	3,124,771
26 Port Kembla	-	-	-	-	-	-	-	9,276,962	-	-	-	-
27 Windang	-	-	-	-	-	-	-	-	-	-	-	-
Totals	-	69,018,232	207,054,697	437,115,472	-	147,508,142	243,276,574	1,957,300,167	-	32,011,715	49,476,330	164,008,510

Wollongong Open Coast Private Land Coastal Hazard Risk Ranking Summary - Erosion and Recession

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125			
Probabilities	63	5	1	Adopted	63	5	1	Adopted	63	5	1	Adopted	63	5	1	Adopted
Division																
01 Little Garie to Burning Palms	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
02 Burning Palms to Werrong	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
03 Bulgo Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
04 Stanwell Tops	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
05 Stanwell Park	Low	High	Low	**High**	High	High	Low	**High**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
06 Coalcliff	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
07 Clifton	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
08 Scarborough-Wombarra	Low	High	Low	**High**	High	High	Low	**High**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
09 Coledale	Low	High	Low	**High**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
10 Sharky Beach	Low	High	Low	**High**	Low	High	Low	**High**	Low	High	Low	**High**	Extreme	High	Low	**Extreme**
11 Little Austinmer Beach	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**
12 Austinmer	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
13 Thirroul Beach	Low	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	Extreme	High	Low	**Extreme**	Extreme	High	Moderate	**Extreme**
14 McCauleys Beach	Low	High	Low	**High**	High	High	Low	**High**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
15 Sandon Point Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Moderate	Low	**Moderate**
16 Bulli Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
17 Woonona Beach	Low	High	Low	**High**	Low	High	Moderate	**High**	Low	High	Moderate	**High**	Extreme	High	Moderate	**Extreme**
18 Bellambi	Low	High	Low	**High**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
19 Corrimal Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Moderate	Low	**Moderate**
20 Towradgi	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Moderate	High	Low	**High**
21 Fairy Meadow	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
22 North Wollongong	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
23 Wollongong Central	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
24 City Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
25 Hill 60 - Red Point	Low	Moderate	Low	**Moderate**	High	Moderate	Low	**High**	Extreme	Moderate	Low	**Extreme**	Extreme	Moderate	Low	**Extreme**
26 Port Kembla	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
27 Windang	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**

Wollongong Open Coast Private Land Coastal Hazard Risk Ranking Summary - Other

	Cliff and Slope Instability - Time Frame Totals				Coastal Inundation - Expected Losses				Tidal Inundation - Expected Losses			
Division	Immediate	2045	2075	2125	2025	2045	2075	2125	2025	2045	2075	2125
01 Little Garie to Burning Palms	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
02 Burning Palms to Werrong	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
03 Bulgo Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
04 Stanwell Tops	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
05 Stanwell Park	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
06 Coalcliff	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
07 Clifton	Low	Extreme	Extreme	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
08 Scarborough-Wombarra	Low	Extreme	Extreme	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
09 Coledale	Low	Extreme	Extreme	Extreme	Low	Moderate	High	Extreme	Low	Low	Low	Low
10 Sharky Beach	Low	Low	Low	Low	Low	Low	Low	Moderate	Low	Low	Low	Low
11 Little Austinmer Beach	Low	Moderate	High	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
12 Austinmer	Low	Extreme	Extreme	Extreme	Low	Low	Extreme	Extreme	Low	Low	Low	Low
13 Thirroul Beach	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
14 McCauleys Beach	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
15 Sandon Point Beach	Low	Low	Low	Low	Low	Low	Low	Extreme	Low	Low	Low	Low
16 Bulli Beach	Low	Low	Low	Low	Low	Low	High	Extreme	Low	Low	Moderate	Extreme
17 Woonona Beach	Low	High	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Low	Low	Moderate
18 Bellambi	Low	Low	Low	Low	Low	Extreme	Extreme	Extreme	Low	Low	Extreme	Extreme
19 Corrimal Beach	Low	Low	Low	Low	Low	High	Extreme	Extreme	Low	High	Extreme	Extreme
20 Towradgi	Low	Low	Low	Low	Low	Low	Low	Extreme	Low	Low	Low	Moderate
21 Fairy Meadow	Low	Low	Low	Low	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
22 North Wollongong	Low	Low	Low	Low	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
23 Wollongong Central	Low	Low	Low	Low	Low	Extreme	Extreme	Extreme	Low	Low	Low	Low
24 City Beach	Low	Low	Low	Low	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
25 Hill 60 - Red Point	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme	Low	Extreme	Extreme	Extreme
26 Port Kembla	Low	Low	Low	Low	Low	Low	Low	Extreme	Low	Low	Low	Low
27 Windang	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

Wollongong Open Coast Coastal Wetlands Coastal Hazard Risk Summary - Erosion and Recession (m^2)

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125			
	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**
Division																
01 Little Garie to Burning Palms	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02 Burning Palms to Werrong	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03 Bulgo Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04 Stanwell Tops	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05 Stanwell Park	666	2,572	3,470	1,341	806	2,699	3,641	1,478	1,230	3,049	4,106	1,880	2,345	4,324	5,552	3,055
06 Coalcliff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07 Clifton	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08 Scarborough-Wombarra	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09 Coledale	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10 Sharky Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 Little Austinmer Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12 Austinmer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13 Thirroul Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14 McCauleys Beach	-	1,490	2,599	540	-	1,850	2,877	660	128	2,561	3,505	983	1,998	3,942	4,736	2,683
15 Sandon Point Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16 Bulli Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17 Woonona Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18 Bellambi	-	4,463	5,881	1,560	49	4,639	5,936	1,649	648	5,284	6,381	2,257	2,777	6,384	7,784	4,046
19 Corrimal Beach	-	7	227	9	-	54	334	27	-	287	741	111	217	1,298	1,804	599
20 Towradgi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21 Fairy Meadow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22 North Wollongong	1,122	1,822	2,076	1,368	1,183	1,849	2,100	1,417	1,331	1,921	2,161	1,539	1,593	2,094	2,362	1,772
23 Wollongong Central	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24 City Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25 Hill 60 - Red Point	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26 Port Kembla	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27 Windang	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Totals	1,788	10,354	14,252	**4,817**	2,039	11,092	14,889	**5,231**	3,337	13,102	16,894	**6,771**	8,930	18,042	22,238	**12,154**

Wollongong Open Coast Coastal Wetlands Coastal Hazard Risk Summary - Other (m^2)

	Cliff and Slope Instability - Time Frame Totals			
	Immediate	2045	2075	2125
Division				
01 Little Garie to Burning Palms	-	-	-	-
02 Burning Palms to Werrong	-	-	-	-
03 Bulgo Beach	-	-	-	-
04 Stanwell Tops	-	-	-	-
05 Stanwell Park	150	600	1,501	3,002
06 Coalcliff	-	-	-	-
07 Clifton	-	-	-	-
08 Scarborough-Wombarra	-	-	-	-
09 Coledale	-	-	-	-
10 Sharky Beach	-	-	-	-
11 Little Austinmer Beach	-	-	-	-
12 Austinmer	-	-	-	-
13 Thirroul Beach	-	-	-	-
14 McCauleys Beach	-	-	-	-
15 Sandon Point Beach	-	-	-	-
16 Bulli Beach	-	-	-	-
17 Woonona Beach	-	-	-	-
18 Bellambi	-	-	-	-
19 Corrimal Beach	-	-	-	-
20 Towradgi	-	-	-	-
21 Fairy Meadow	-	-	-	-
22 North Wollongong	-	-	-	-
23 Wollongong Central	-	-	-	-
24 City Beach	-	-	-	-
25 Hill 60 - Red Point	-	-	-	-
26 Port Kembla	-	-	-	-
27 Windang	-	-	-	-
Totals	150	600	1,501	3,002

Wollongong Open Coast EEC Coastal Hazard Risk Summary - Erosion and Recession (m^2)

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125			
	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**
Division																
01 Little Garie to Burning Palms	317	1,847	1,909	**839**	381	1,872	1,966	**891**	777	1,965	2,121	1,186	1,941	2,391	2,633	2,101
02 Burning Palms to Werrong	5,077	5,471	5,471	**5,211**	5,471	5,471	5,471	**5,471**	5,471	5,471	5,471	5,471	5,471	5,471	5,471	5,471
03 Bulgo Beach	8,432	10,290	10,290	**9,064**	9,407	10,290	10,290	**9,707**	9,515	10,290	10,290	9,778	9,916	10,290	10,290	10,043
04 Stanwell Tops	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05 Stanwell Park	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06 Coalcliff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07 Clifton	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08 Scarborough-Wombarra	3,563	6,389	7,787	**4,566**	3,635	6,595	7,954	**4,682**	3,949	7,165	8,071	5,069	5,040	7,574	8,407	5,927
09 Coledale	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10 Sharky Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 Little Austinmer Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12 Austinmer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13 Thirroul Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14 McCauleys Beach	165	3,866	6,260	**1,495**	366	4,594	6,898	**1,872**	1,477	6,173	8,415	3,141	4,922	9,673	11,771	6,600
15 Sandon Point Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16 Bulli Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17 Woonona Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18 Bellambi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	83	2
19 Corrimal Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20 Towradgi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21 Fairy Meadow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22 North Wollongong	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23 Wollongong Central	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24 City Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25 Hill 60 - Red Point	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26 Port Kembla	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27 Windang	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Totals	17,554	27,862	31,717	**21,174**	19,259	28,822	32,579	**22,623**	21,188	31,064	34,368	**24,645**	27,290	35,399	38,655	**30,145**

Wollongong Open Coast EEC Coastal Hazard Risk Summary - Other (m^2)

Division	Cliff and Slope Instability - Time Frame Totals			
	Immediate	2045	2075	2125
01 Little Garie to Burning Palms	2,212	8,849	22,122	44,245
02 Burning Palms to Werrong	27,846	111,384	278,459	556,918
03 Bulgo Beach	32,579	130,318	325,794	651,588
04 Stanwell Tops	12,414	49,657	124,143	248,287
05 Stanwell Park	394	1,576	3,939	7,878
06 Coalcliff	6	23	57	113
07 Clifton	10,382	41,528	103,819	207,638
08 Scarborough-Wombarra	7,330	29,321	73,301	146,603
09 Coledale	339	1,355	3,387	6,775
10 Sharky Beach	112	450	1,124	2,248
11 Little Austinmer Beach	0	0	1	2
12 Austinmer	-	-	-	-
13 Thirroul Beach	-	-	-	-
14 McCauleys Beach	-	-	-	-
15 Sandon Point Beach	-	-	-	-
16 Bulli Beach	-	-	-	-
17 Woonona Beach	-	-	-	-
18 Bellambi	-	-	-	-
19 Corrimal Beach	-	-	-	-
20 Towradgi	-	-	-	-
21 Fairy Meadow	-	-	-	-
22 North Wollongong	-	-	-	-
23 Wollongong Central	-	-	-	-
24 City Beach	-	-	-	-
25 Hill 60 - Red Point	-	-	-	-
26 Port Kembla	-	-	-	-
27 Windang	-	-	-	-
Totals	93,615	374,459	936,147	1,872,293

Wollongong Open Coast Sewer/Water Coastal Hazard Risk Summary - Erosion and Recession ($ Values)

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125			
Division	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**
01 Little Garie to Burning Palms	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
02 Burning Palms to Werrong	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
03 Bulgo Beach	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
04 Stanwell Tops	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
05 Stanwell Park	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
06 Coalcliff	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
07 Clifton	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
08 Scarborough-Wombarra	186,993	280,747	280,747	**218,870**	186,993	280,747	280,747	**218,870**	189,965	280,747	324,006	222,129	280,747	280,747	361,645	283,174
09 Coledale	204,783	298,781	324,984	**237,528**	211,157	305,873	331,359	**244,125**	242,891	342,034	367,520	277,364	249,984	367,520	367,520	289,946
10 Sharky Beach	-	19,995	52,582	**7,776**	-	19,995	52,582	**7,776**	-	52,582	52,582	17,878	-	52,582	52,582	17,878
11 Little Austinmer Beach	65,682	526,555	526,555	**222,379**	65,682	526,555	526,555	**222,379**	118,724	526,555	526,555	257,387	258,266	526,555	526,555	349,484
12 Austinmer	-	143,281	224,552	**51,154**	-	143,281	224,552	**51,154**	-	215,049	319,505	76,250	108,504	319,505	800,948	194,688
13 Thirroul Beach	-	67,437	270,524	**29,021**	-	67,437	270,524	**29,021**	-	270,524	558,171	100,608	67,437	653,006	958,190	275,686
14 McCauleys Beach	-	-	655,541	**19,666**	-	126,394	677,155	**59,497**	-	577,295	677,155	199,276	126,394	677,155	677,155	313,653
15 Sandon Point Beach	77,723	168,555	181,331	**108,989**	77,723	168,555	181,331	**108,989**	77,723	181,331	282,312	115,979	168,555	286,574	339,020	210,255
16 Bulli Beach	-	274,669	300,565	**94,164**	209,607	274,669	300,565	**232,505**	209,607	300,565	300,565	240,533	274,669	300,565	361,824	285,311
17 Woonona Beach	-	158,272	263,335	**56,964**	-	159,552	263,335	**57,361**	-	263,335	362,011	92,494	158,272	383,145	757,656	245,964
18 Bellambi	160,937	244,671	244,671	**189,406**	160,937	244,671	244,671	**189,406**	244,671	244,671	244,671	244,671	244,671	244,671	244,671	244,671
19 Corrimal Beach	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	39,337	1,180
20 Towradgi	-	38,916	67,415	**14,086**	-	38,916	81,753	**14,517**	-	38,916	81,753	14,517	38,916	81,753	160,576	55,846
21 Fairy Meadow	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
22 North Wollongong	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
23 Wollongong Central	763,985	852,148	852,148	**793,960**	804,031	852,148	852,148	**820,391**	852,148	852,148	852,148	852,148	852,148	852,148	1,039,755	857,776
24 City Beach	109,329	300,198	300,198	**174,225**	171,334	300,198	300,198	**215,148**	171,334	300,198	300,198	215,148	300,198	300,198	300,198	300,198
25 Hill 60 - Red Point	-	36,759	124,092	**15,118**	-	75,075	124,092	**26,996**	-	124,092	208,589	44,726	75,075	208,589	221,598	120,860
26 Port Kembla	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
27 Windang	-	-	-	**-**	-	-	-	**-**	-	-	-	-	-	-	-	-
Totals	1,569,432	3,410,985	4,669,243	**2,233,308**	1,887,464	3,584,066	4,711,568	**2,498,134**	2,107,064	4,570,044	5,457,741	**2,971,108**	3,203,836	5,534,714	7,209,228	**4,046,570**

Wollongong Open Coast Sewer/Water Coastal Hazard Risk Summary - Other ($ Values)

	Cliff and Slope Instability - Time Frame Totals				Coastal Inundation - Expected Losses				Tidal Inundation - Expected Losses			
	Immediate	2045	2075	2125	2025	2045	2075	2125	2025	2045	2075	2125
Division												
01 Little Garie to Burning Palms	-	-	-	-	-	-	-	-	-	-	-	-
02 Burning Palms to Werrong	-	-	-	-	-	-	-	-	-	-	-	-
03 Bulgo Beach	-	-	-	-	-	-	-	-	-	-	-	-
04 Stanwell Tops	-	-	-	-	-	-	-	-	-	-	-	-
05 Stanwell Park	32,543	130,172	325,429	650,859	-	-	-	-	-	-	-	-
06 Coalcliff	62,785	251,140	627,850	1,255,700	-	-	-	-	-	-	-	-
07 Clifton	8,848	35,392	88,479	176,958	-	-	-	-	-	-	-	-
08 Scarborough-Wombarra	67,373	269,492	673,730	1,347,460	-	-	-	-	-	-	-	-
09 Coledale	44,985	179,939	449,848	899,695	-	-	-	-	-	-	-	-
10 Sharky Beach	47,657	190,628	476,569	953,138	-	-	-	-	-	-	-	-
11 Little Austinmer Beach	38,710	154,841	387,103	774,206	-	-	-	-	-	-	-	-
12 Austinmer	37,093	148,372	370,929	741,858	-	-	-	-	-	-	-	-
13 Thirroul Beach	45,272	181,089	452,722	905,444	-	-	-	-	-	-	-	-
14 McCauleys Beach	36,631	146,526	366,314	732,629	-	-	-	-	-	-	-	-
15 Sandon Point Beach	8,942	35,770	89,424	178,848	-	-	-	-	-	-	-	-
16 Bulli Beach	5,161	20,645	51,613	103,226	-	-	-	-	-	-	-	-
17 Woonona Beach	3,375	13,498	33,746	67,492	-	-	-	-	-	-	-	-
18 Bellambi	-	-	-	-	-	-	-	-	-	-	-	-
19 Corrimal Beach	-	-	-	-	-	-	-	-	-	-	-	-
20 Towradgi	-	-	-	-	-	-	-	-	-	-	-	-
21 Fairy Meadow	-	-	-	-	-	-	-	-	-	-	-	-
22 North Wollongong	2,525	10,099	25,249	50,497	-	-	-	-	-	-	-	-
23 Wollongong Central	61,668	246,673	616,682	1,233,363	-	-	-	-	-	-	-	-
24 City Beach	-	-	-	-	-	-	-	1,000,000,000	-	-	-	110,000,000
25 Hill 60 - Red Point	83,984	335,936	839,840	1,679,679	-	-	-	-	-	-	-	-
26 Port Kembla	3,581	14,325	35,813	71,625	-	-	-	-	-	-	-	-
27 Windang	-	-	-	-	-	-	-	-	-	-	-	-
Totals	591,134	2,364,536	5,911,340	11,822,679	-	-	-	1,000,000,000	-	-	-	110,000,000

Wollongong Open Coast Water/Sewer Coastal Hazard Risk Ranking Summary - Erosion and Recession

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125			
Probabilities	63	5	1	**Adopted**	63	5	1	**Adopted**	63	5	1	**Adopted**	63	5	1	**Adopted**
Division																
01 Little Garie to Burning Palms	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
02 Burning Palms to Werrong	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
03 Bulgo Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
04 Stanwell Tops	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
05 Stanwell Park	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
06 Coalcliff	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
07 Clifton	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
08 Scarborough-Wombarra	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**	Extreme	Moderate	Low	**Extreme**
09 Coledale	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**
10 Sharky Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**
11 Little Austinmer Beach	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**	Extreme	Moderate	Low	**Extreme**
12 Austinmer	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	High	Moderate	Low	**High**
13 Thirroul Beach	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	High	Moderate	Low	**High**
14 McCauleys Beach	Low	Low	Low	**Low**	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	High	Moderate	Low	**High**
15 Sandon Point Beach	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**
16 Bulli Beach	Low	Moderate	Low	**Moderate**	High	Moderate	Low	**High**	High	Moderate	Low	**High**	Extreme	Moderate	Low	**Extreme**
17 Woonona Beach	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	High	Moderate	Low	**High**
18 Bellambi	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**
19 Corrimal Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
20 Towradgi	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Moderate	Moderate	Low	**Moderate**
21 Fairy Meadow	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
22 North Wollongong	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
23 Wollongong Central	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**	Extreme	High	Low	**Extreme**
24 City Beach	High	Moderate	Low	**High**	High	Moderate	Low	**High**	High	Moderate	Low	**High**	Extreme	Moderate	Low	**Extreme**
25 Hill 60 - Red Point	Low	Low	Low	**Low**	Low	Moderate	Low	**Moderate**	Low	Moderate	Low	**Moderate**	High	Moderate	Low	**High**
26 Port Kembla	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
27 Windang	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**

Wollongong Open Coast Water/Sewer Coastal Hazard Risk Ranking Summary - Other

	Cliff and Slope Instability - Time Frame Totals				Coastal Inundation - Expected Losses				Tidal Inundation - Expected Losses			
Division	Immediate	2045	2075	2125	2025	2045	2075	2125	2025	2045	2075	2125
01 Little Garie to Burning Palms	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
02 Burning Palms to Werrong	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
03 Bulgo Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
04 Stanwell Tops	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
05 Stanwell Park	Low	Moderate	High	High	Low	Low	Low	Low	Low	Low	Low	Low
06 Coalcliff	Moderate	High	High	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
07 Clifton	Low	Low	Moderate	Moderate	Low	Low	Low	Low	Low	Low	Low	Low
08 Scarborough-Wombarra	Moderate	High	High	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
09 Coledale	Low	Moderate	High	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
10 Sharky Beach	Low	Moderate	High	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
11 Little Austinmer Beach	Low	Moderate	High	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
12 Austinmer	Low	Moderate	High	High	Low	Low	Low	Low	Low	Low	Low	Low
13 Thirroul Beach	Low	Moderate	High	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
14 McCauleys Beach	Low	Moderate	High	High	Low	Low	Low	Low	Low	Low	Low	Low
15 Sandon Point Beach	Low	Low	Moderate	Moderate	Low	Low	Low	Low	Low	Low	Low	Low
16 Bulli Beach	Low	Low	Moderate	Moderate	Low	Low	Low	Low	Low	Low	Low	Low
17 Woonona Beach	Low	Low	Low	Moderate	Low	Low	Low	Low	Low	Low	Low	Low
18 Bellambi	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
19 Corrimal Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
20 Towradgi	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
21 Fairy Meadow	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
22 North Wollongong	Low	Low	Low	Moderate	Low	Low	Low	Low	Low	Low	Low	Low
23 Wollongong Central	Moderate	Moderate	High	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
24 City Beach	Low	Low	Low	Low	Low	Low	Low	Extreme	Low	Low	Low	Extreme
25 Hill 60 - Red Point	Moderate	High	Extreme	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
26 Port Kembla	Low	Low	Low	Moderate	Low	Low	Low	Low	Low	Low	Low	Low
27 Windang	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low

Wollongong Open Coast NPWS Coastal Hazard Risk Summary - Erosion and Recession (Track Loss $ Values)

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125			
	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**
Division																
01 Little Garie to Burning Palms	-	65,179	122,597	**23,883**	1,514	112,901	126,516	**39,794**	6,976	126,478	131,557	47,759	125,438	140,411	151,477	130,861
02 Burning Palms to Werrong	9,273	9,273	9,273	**9,273**	9,273	9,273	9,273	**9,273**	9,273	9,273	9,273	9,273	9,273	9,273	9,273	9,273
03 Bulgo Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
04 Stanwell Tops	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05 Stanwell Park	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06 Coalcliff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07 Clifton	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08 Scarborough-Wombarra	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09 Coledale	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10 Sharky Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 Little Austinmer Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12 Austinmer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13 Thirroul Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14 McCauleys Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15 Sandon Point Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16 Bulli Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17 Woonona Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18 Bellambi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19 Corrimal Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20 Towradgi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21 Fairy Meadow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22 North Wollongong	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23 Wollongong Central	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24 City Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25 Hill 60 - Red Point	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26 Port Kembla	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27 Windang	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Totals	9,273	74,452	131,870	**33,157**	10,787	122,174	135,790	**49,067**	16,249	135,751	140,830	**57,032**	134,712	149,684	160,750	**140,134**

Wollongong Open Coast NPWS Coastal Hazard Risk Summary - Other (Track Loss $ Values)

	Cliff and Slope Instability - Time Frame Totals				Coastal Inundation - Expected Losses				Tidal Inundation - Expected Losses			
	Immediate	2045	2075	2125	2025	2045	2075	2125	2025	2045	2075	2125
Division												
01 Little Garie to Burning Palms	14,567	58,269	145,674	291,347	-	-	473	155,019	-	-	-	3,925
02 Burning Palms to Werrong	69,402	277,606	694,015	1,388,031	-	-	-	5,502	-	-	-	-
03 Bulgo Beach	13,977	55,906	139,765	279,530	-	-	-	-	-	-	-	-
04 Stanwell Tops	-	-	-	-	-	-	-	-	-	-	-	-
05 Stanwell Park	-	-	-	-	-	-	-	-	-	-	-	-
06 Coalcliff	-	-	-	-	-	-	-	-	-	-	-	-
07 Clifton	-	-	-	-	-	-	-	-	-	-	-	-
08 Scarborough-Wombarra	-	-	-	-	-	-	-	-	-	-	-	-
09 Coledale	-	-	-	-	-	-	-	-	-	-	-	-
10 Sharky Beach	-	-	-	-	-	-	-	-	-	-	-	-
11 Little Austinmer Beach	-	-	-	-	-	-	-	-	-	-	-	-
12 Austinmer	-	-	-	-	-	-	-	-	-	-	-	-
13 Thirroul Beach	-	-	-	-	-	-	-	-	-	-	-	-
14 McCauleys Beach	-	-	-	-	-	-	-	-	-	-	-	-
15 Sandon Point Beach	-	-	-	-	-	-	-	-	-	-	-	-
16 Bulli Beach	-	-	-	-	-	-	-	-	-	-	-	-
17 Woonona Beach	-	-	-	-	-	-	-	-	-	-	-	-
18 Bellambi	-	-	-	-	-	-	-	-	-	-	-	-
19 Corrimal Beach	-	-	-	-	-	-	-	-	-	-	-	-
20 Towradgi	-	-	-	-	-	-	-	-	-	-	-	-
21 Fairy Meadow	-	-	-	-	-	-	-	-	-	-	-	-
22 North Wollongong	-	-	-	-	-	-	-	-	-	-	-	-
23 Wollongong Central	-	-	-	-	-	-	-	-	-	-	-	-
24 City Beach	-	-	-	-	-	-	-	-	-	-	-	-
25 Hill 60 - Red Point	-	-	-	-	-	-	-	-	-	-	-	-
26 Port Kembla	-	-	-	-	-	-	-	-	-	-	-	-
27 Windang	-	-	-	-	-	-	-	-	-	-	-	-
Totals	97,945	391,782	979,454	1,958,908	-	-	473	160,521	-	-	-	3,925

Wollongong Open Coast NPWS Coastal Hazard Risk Summary - Erosion and Recession (Building Counts)

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125			
Division	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**	63% Chance	5% Chance	1% Chance	**Weighted**
01 Little Garie to Burning Palms	1	4	6	**2**	1	5	7	**2**	1	6	9	3	6	11	16	8
02 Burning Palms to Werrong	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
03 Bulgo Beach	2	12	12	**5**	3	12	12	**6**	5	12	12	7	8	12	12	9
04 Stanwell Tops	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
05 Stanwell Park	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
06 Coalcliff	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
07 Clifton	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
08 Scarborough-Wombarra	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09 Coledale	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10 Sharky Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11 Little Austinmer Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12 Austinmer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13 Thirroul Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14 McCauleys Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15 Sandon Point Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16 Bulli Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17 Woonona Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18 Bellambi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19 Corrimal Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20 Towradgi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21 Fairy Meadow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22 North Wollongong	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23 Wollongong Central	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24 City Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25 Hill 60 - Red Point	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26 Port Kembla	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27 Windang	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Totals	3	16	18	**7**	4	17	19	**8**	6	18	21	**10**	14	23	28	**17**

Wollongong Open Coast NPWS Coastal Hazard Risk Summary - Other (Building Counts)

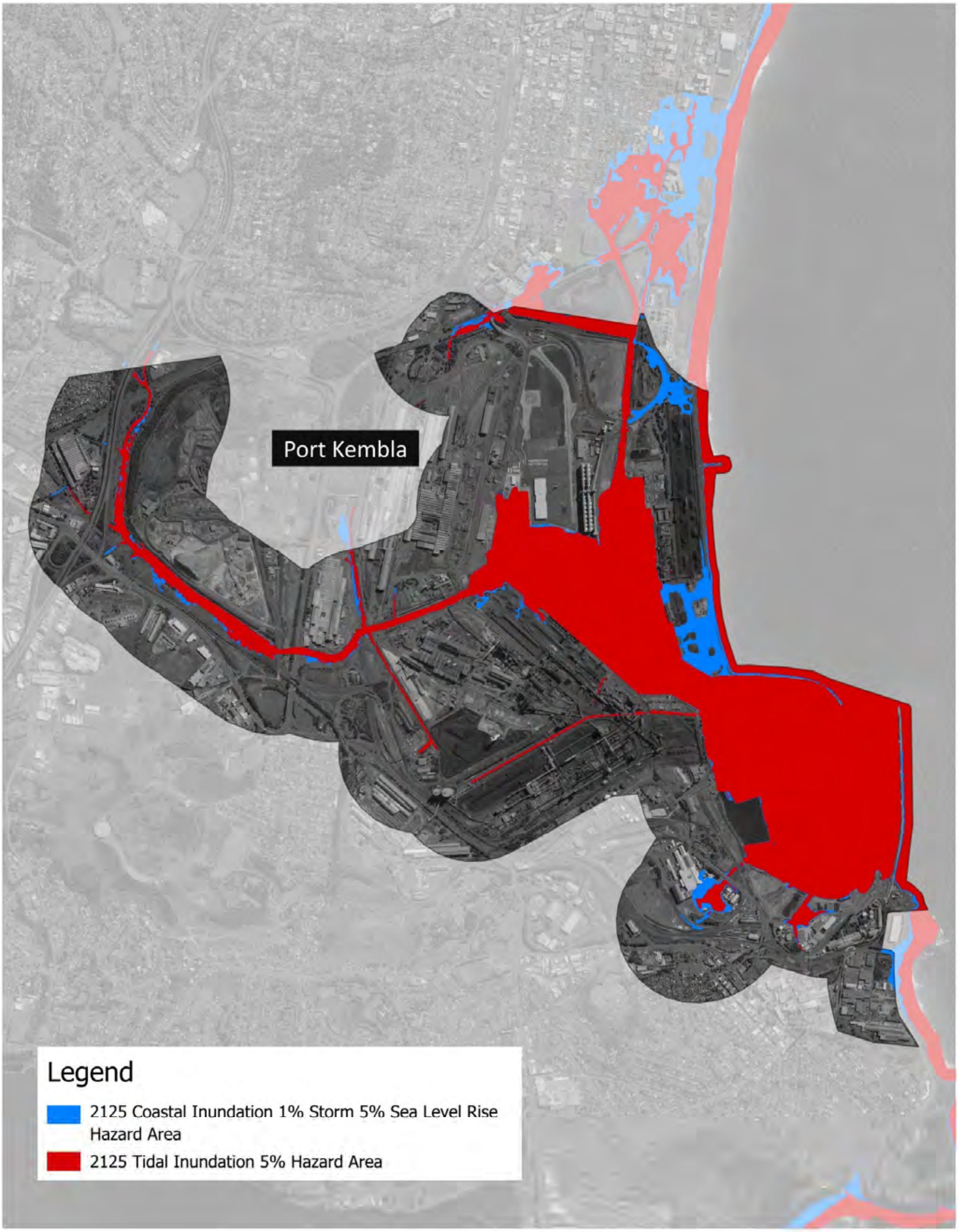
	Cliff and Slope Instability - Time Frame Totals				Coastal Inundation - Expected Losses				Tidal Inundation - Expected Losses			
Division	Immediate	2045	2075	2125	2025	2045	2075	2125	2025	2045	2075	2125
01 Little Garie to Burning Palms	0	2	5	9	-	-	-	-	-	-	-	-
02 Burning Palms to Werrong	-	-	-	-	-	-	-	-	-	-	-	-
03 Bulgo Beach	4	17	42	84	-	-	2	4	-	-	-	0
04 Stanwell Tops	-	-	-	-	-	-	-	-	-	-	-	-
05 Stanwell Park	-	-	-	-	-	-	-	-	-	-	-	-
06 Coalcliff	-	-	-	-	-	-	-	-	-	-	-	-
07 Clifton	-	-	-	-	-	-	-	-	-	-	-	-
08 Scarborough-Wombarra	-	-	-	-	-	-	-	-	-	-	-	-
09 Coledale	-	-	-	-	-	-	-	-	-	-	-	-
10 Sharky Beach	-	-	-	-	-	-	-	-	-	-	-	-
11 Little Austinmer Beach	-	-	-	-	-	-	-	-	-	-	-	-
12 Austinmer	-	-	-	-	-	-	-	-	-	-	-	-
13 Thirroul Beach	-	-	-	-	-	-	-	-	-	-	-	-
14 McCauleys Beach	-	-	-	-	-	-	-	-	-	-	-	-
15 Sandon Point Beach	-	-	-	-	-	-	-	-	-	-	-	-
16 Bulli Beach	-	-	-	-	-	-	-	-	-	-	-	-
17 Woonona Beach	-	-	-	-	-	-	-	-	-	-	-	-
18 Bellambi	-	-	-	-	-	-	-	-	-	-	-	-
19 Corrimal Beach	-	-	-	-	-	-	-	-	-	-	-	-
20 Towradgi	-	-	-	-	-	-	-	-	-	-	-	-
21 Fairy Meadow	-	-	-	-	-	-	-	-	-	-	-	-
22 North Wollongong	-	-	-	-	-	-	-	-	-	-	-	-
23 Wollongong Central	-	-	-	-	-	-	-	-	-	-	-	-
24 City Beach	-	-	-	-	-	-	-	-	-	-	-	-
25 Hill 60 - Red Point	-	-	-	-	-	-	-	-	-	-	-	-
26 Port Kembla	-	-	-	-	-	-	-	-	-	-	-	-
27 Windang	-	-	-	-	-	-	-	-	-	-	-	-
Totals	5	19	47	93	-	-	2	4	-	-	-	0

Wollongong Open Coast NPWS Tracks Coastal Hazard Risk Ranking Summary - Erosion and Recession

	Erosion/Recession Totals 2025				Erosion/Recession Totals 2045				Erosion/Recession Totals 2075				Erosion/Recession Totals 2125			
Probabilities	63	5	1	**Adopted**	63	5	1	**Adopted**	63	5	1	**Adopted**	63	5	1	**Adopted**
Division																
01 Little Garie to Burning Palms	Low	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	Moderate	Moderate	Low	**Moderate**	High	Moderate	Low	**High**
02 Burning Palms to Werrong	Moderate	Low	Low	**Moderate**	Moderate	Low	Low	**Moderate**	Moderate	Low	Low	**Moderate**	Moderate	Low	Low	**Moderate**
03 Bulgo Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
04 Stanwell Tops	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
05 Stanwell Park	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
06 Coalcliff	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
07 Clifton	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
08 Scarborough-Wombarra	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
09 Coledale	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
10 Sharky Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
11 Little Austinmer Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
12 Austinmer	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
13 Thirroul Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
14 McCauleys Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
15 Sandon Point Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
16 Bulli Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
17 Woonona Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
18 Bellambi	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
19 Corrimal Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
20 Towradgi	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
21 Fairy Meadow	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
22 North Wollongong	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
23 Wollongong Central	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
24 City Beach	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
25 Hill 60 - Red Point	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
26 Port Kembla	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**
27 Windang	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**	Low	Low	Low	**Low**

Wollongong Open Coast NPWS Tracks Coastal Hazard Risk Ranking Summary - Other

	Cliff and Slope Instability - Time Frame Totals				Coastal Inundation - Expected Losses				Tidal Inundation - Expected Losses			
Division	Immediate	2045	2075	2125	2025	2045	2075	2125	2025	2045	2075	2125
01 Little Garie to Burning Palms	Low	Moderate	Moderate	High	Low	Low	Low	Moderate	Low	Low	Low	Low
02 Burning Palms to Werrong	Moderate	High	High	Extreme	Low	Low	Low	Low	Low	Low	Low	Low
03 Bulgo Beach	Low	Moderate	Moderate	High	Low	Low	Low	Low	Low	Low	Low	Low
04 Stanwell Tops	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
05 Stanwell Park	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
06 Coalcliff	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
07 Clifton	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
08 Scarborough-Wombarra	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
09 Coledale	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
10 Sharky Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
11 Little Austinmer Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
12 Austinmer	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
13 Thirroul Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
14 McCauleys Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
15 Sandon Point Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
16 Bulli Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
17 Woonona Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
18 Bellambi	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
19 Corrimal Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
20 Towradgi	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
21 Fairy Meadow	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
22 North Wollongong	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
23 Wollongong Central	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
24 City Beach	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
25 Hill 60 - Red Point	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
26 Port Kembla	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
27 Windang	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low



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Supplementary Figure: Port Kembla Inundation Hazards

Wollongong CMP - Stage 2 Coastal Hazard Risk Assessment Report

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REV	B
DRAWN	JAW
CHECK	DJW

Salients