BELLINGEN SHIRE COUNCIL

Salients

BELLINGEN SHIRE COASTAL MANAGEMENT PROGRAM STAGE 2 SUMARY REPORT

Prepared by Salients for Bellingen Shire Council

Final
17 June 2022

BELLINGEN SHIRE COASTAL MANAGEMENT PROGRAM STAGE 2 SUMMARY REPORT

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1 Introduction

1.1 Background

Salients was engaged, in consultation with Spectrum Comms, by Bellingen Shire Council (BSC) to prepare a Coastal Management Program (CMP) covering the entire coastal zone of the BSC Local Government Area (LGA).

The CMP is being prepared in accordance with the 5 stage process outlined in the Coastal Management Manual (CMM) as illustrated in Figure 1.

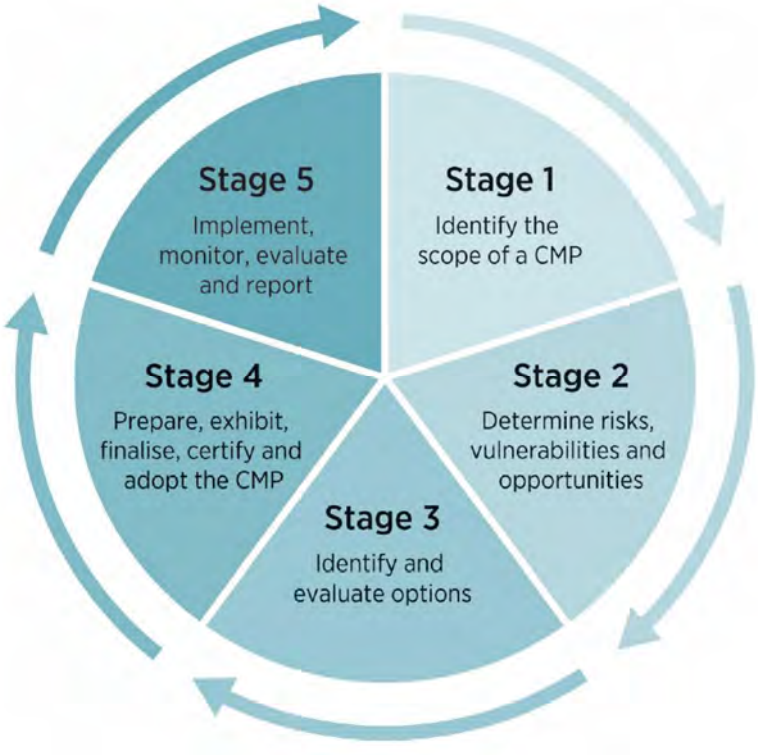

Figure 1 Stages in Preparing and Implementing a CMP (Source: (NSW Government, 2018)).

The Stage 1 Scoping Study is presented in Alluvium (2020). Among other matters, that document contains a "First Pass" risk assessment.

For Stage 2 of the CMP, Bellingen Shire Council requested an updated risk assessment incorporating a review of existing information, building on the contents of the Scoping Study, and inclusion of more recent information:

- The findings of the *Bellingen Water Quality Management Plan* which was completed, in parallel, during the completion of Stage 2 (Jeremy Benn Pacific, 2021)
- The outcomes of consultation completed by Salients and Spectrum Comms during Stage 2, and by Jeremy Benn Pacific in the development of the Water Quality Management Plan.

Much of this background information is presented in appendices to this report as follows:

- Appendix A - Physical and Biological Context
- Appendix B - Strategic Context
- Appendix C - Social Context

The outcomes of the revised risk assessment are outlined in the main body of this report. The identification, characterisation, and prioritisation of risks is needed to understand where action is required and, subsequently, what management actions are needed as part of Stage 3 of the CMP process.

1.2 CMPs and the role of Risk Management

The risk management context within which CMP's are prepared is underpinned by the requirements of the *Coastal Management Act 2016* (CM Act). Within that act, and through its interactions with the Coastal Management Manual and *State Environmental Planning Policy (Resilience and Hazards) 2021* (Resilience SEPP), obligations are imposed upon various stakeholders regarding their responsibilities under NSW legislation. When a council prepares a Coastal Management Program, The CM Act (S14) states:

"a local council must –

(a) Consider and promote the objects of this Act, and

(b) Give effect to the management objectives for the coastal management areas covered by the program."

The coastal management areas are discussed and presented in Section 1.3.

In undertaking risk identification and assessment, it is critically important that there is a shared understanding of the language used to describe the risk environment. We have adopted nomenclature from the international standard ISO 31000 (Standards Australia, 2009) and associated supporting documents as the baseline. While we understand that there are countless examples of that risk standard being extended for various purposes, our experience is that direct application of the standard results in a simpler, more transparent, and ultimately more defensible approach.

In our approach to the development of a CMP, we have equated the term "coastal management issues" used in the CM Act (e.g., S15(1)(a)), with those coastal management risks which are ultimately intolerable and require action. The primary purpose of this report is to define that set of risks.

ISO 31000 defines risk as:

"effect of uncertainty on objectives"

Most importantly, a complete risk assessment needs to avoid only considering risks through a negative lens. Under ISO 31000, if a risk arises, the effect may actually be positive. A complete risk management strategy should look to maximise the likelihood of such positive effects.

The objectives of importance to CMP development are those outlined in the CM Act for the different coastal management areas. The act notes that Council must "*give effect*" to those management objectives via the CMP. For this reason, the entire risk management approach we have adopted throughout Stage 2 (this report) and Stage 3, focusses on actions to achieve those management objectives.

In this way, the coastal management framework and, particularly, the management objectives largely set the external regulatory context within which a CMP is to be prepared. However, this does not imply that CMPs for different LGA's will contain similar actions. Each CMP prepared in NSW will be flavoured by their local context, influenced by factors such as:

- The local physical and biological environment.
- The internal organisation of different Councils.
- The regional prominence of state government agencies in coastal management matters, including the distribution of state funds.
- The demographics, desires, and values of the local community.

The context within which the Bellingen CMP is to be prepared is described in considerable detail within the attachments to this report.

When considering risks, it is important to understand that these need to be specific to enable the development of appropriately defined and targeted management actions that can be executed. Clear risk identification helps to develop management actions that are Specific, Measurable, Achievable, Relevant and Time-bound (or "SMART"). Non-specific or poorly defined management actions that cannot be budgeted or integrated cleanly into Council's (and other stakeholders) forward programming under the Integrated Planning and Reporting framework are inconsistent with the requirements of the CM Act and Manual.

Finally, noting that Stage 2 is formally regarded as involving "*Determining risks, vulnerabilities and opportunities*" we provide discussion on our adopted meanings of "vulnerabilities" and "opportunities".

In our consideration of risks, vulnerability is one facet which contributes to the nature of a risk. It can be defined in several different ways but assets that are more vulnerable are more prone to be affected by risks. This may be because the asset has a high degree of exposure to a hazard (i.e., high likelihood) that threatens the asset, or that they have minimal capacity to avoid the effects of being exposed to a hazard (i.e., high

consequence). Overall, we find "vulnerability" a difficult term to use in risk identification and assessment because of these differing interpretations. The concepts encapsulated by the term, however, are considered within our approaches to risk identification and assessment, respectively.

"Opportunities" may also refer to different concepts, such as:

1 The idea of "lost opportunity" when advantage isn't taken of risks with positive consequences as discussed above.

2 "Opportunities" referring to management actions that are available to address risks.

As noted above, our risk assessment methodology considers both positive and negative risks, which addresses Item 1. Item 2 is addressed in detail within Stage 3 of the CMP process where participants will be asked to identify potential management actions to address risks of concern.

1.3 The Bellingen Coastal Zone

The Resilience SEPP includes online maps which show the extents of the four different coastal management areas:

1 Coastal Wetland and Littoral Rainforest Areas.

2 Coastal Vulnerability Area (not presently mapped).

3 Coastal Environment Area.

4 Coastal Use Area

Combined, these areas comprise the Coastal Zone of the Bellingen Shire. Maps showing the extents of the Coastal Zone for the LGA are presented in Figure 2 through Figure 4. We note that no Coastal Vulnerability Area (CVA) is yet mapped within the SEPP. However, the existing coastal hazard information described in Appendix A will be used to review the need for a Planning Proposal to define the CVA within the Bellingen LGA.

The Scoping Study (Alluvium, 2020) does not contain clear direction on the geographical scope to be addressed by the CMP, nor a statement as to whether any coastal management areas would be excluded. In the absence of such statements, it seems reasonable to assume that:

- The entire coastal zone is to be included.

- That mapping for the CVA needs to be subject to a future planning proposal, and the CMP should pre-emptively consider the CVA related risks (or "issues") and those actions needed to manage risks.

Figure 2: Coastal Environment Area

0 1 2 3 4 km

APPROX SCALE

Bellingen Shire CMP	REV	DRAWN	CHECK
	A	ML	DJW

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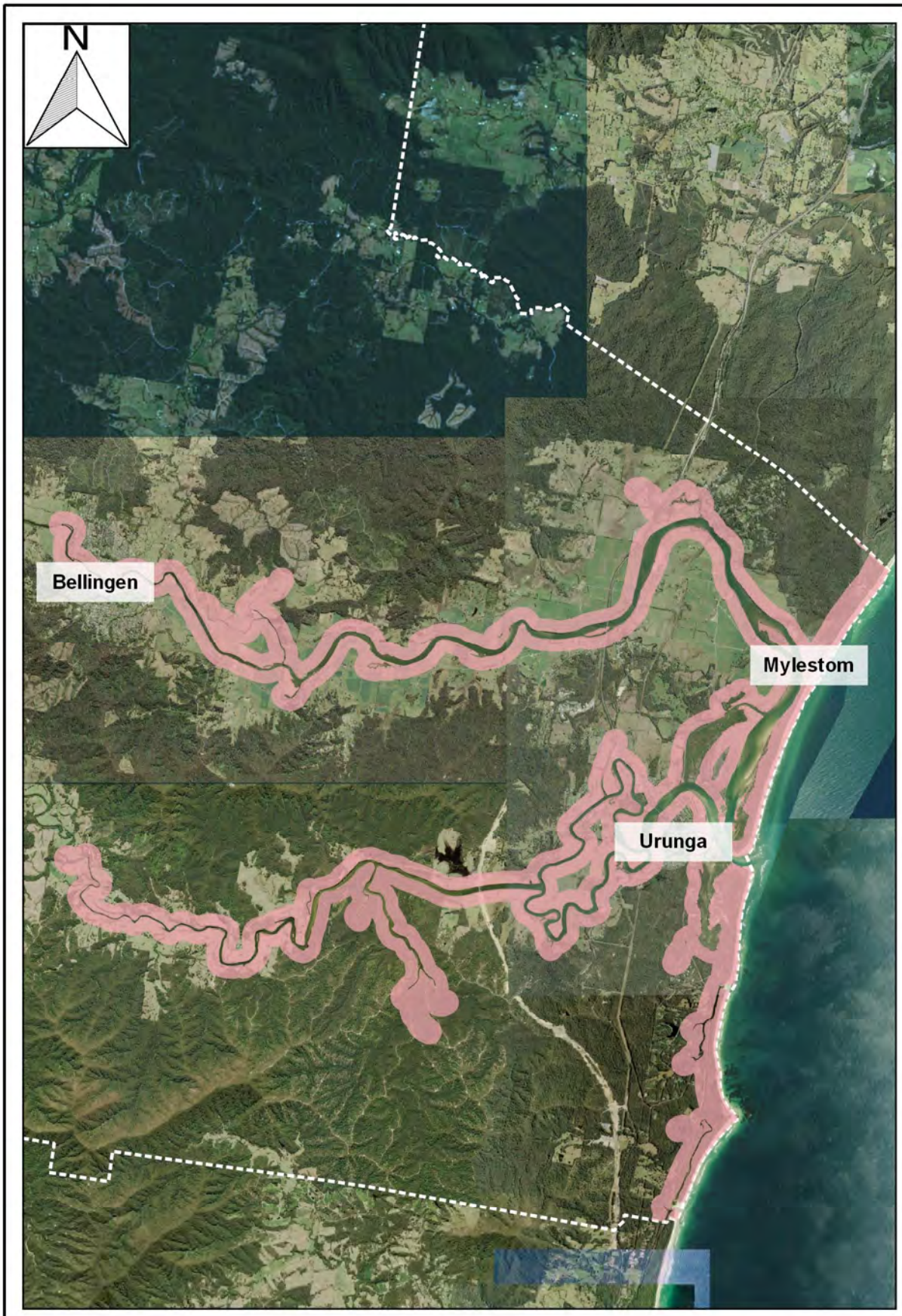

Figure 3: Coastal Use Area

0 1 2 3 4 km

APPROX SCALE

Bellingen Shire CMP	REV	DRAWN	CHECK
	A	ML	DJW

GIS File: "Z:\BusinessShare\Them\Projects\P00127 BellingenShireCMP\GIS\CoastalZoneFigures.qgz"

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Figure 4: Coastal Wetland and Littoral Rainforest Area

0 1 2 3 4 km

APPROX SCALE

Bellingen Shire CMP	REV A	DRAWN ML	CHECK DJW	Salients

GIS File: "Z:\BusinessShare\Them\Projects\P00127 BellingenShireCMP\GIS\CoastalZoneFigures.qgz"

2 Risk Identification

2.1 Methodology

A rigorous process has been undertaken to ensure that all potential risks have been identified. This process involved the following actions.

1 Background review of relevant information: Fifty-one reports spanning a thirty-nine year time period were reviewed. Seventy-seven potential risks were identified from this process.

2 Site Inspections: Two days of boat and land-based field work were completed in early December 2021 with staff from BSC (Ben Price and Justine Elder) and DPE (John Schmidt). Boat fieldwork involved inspection of the entire navigable reach of both the Bellinger and Kalang Rivers. A geo-referenced photographic record was taken of all sites of concern and contributing factors documented (i.e., cattle access, vegetation removal etc.). In addition, rehabilitation sites were documented, and successful outcomes recorded. Land based fieldwork involved on foot inspection of the entrances of estuaries and lagoons along the coastline. Assets likely to be subject to coastal hazards were recorded, as well as contributing threats to coastal condition such as weeds and four wheel drive access.

3 Stakeholder Interviews: Salients met with a range of staff from BSC across the operational works and strategic planning arms of Council. Council staff identified major infrastructure asset condition and reliance on grant funding as key concerns.

4 Community consultation: Due to Covid restrictions, consultation involved the use of an online interactive map where stakeholders could share comments and photos to identify issues, concerns, and ideas for improved management of the coastal zone. There were more than 140 comments and more than 250 reactions recorded on the map. Key issues of concern included riverbank erosion; management and loss of riparian vegetation; speed, noise and use of boats and jet-skis; 4WD access to beaches; impact of camping; litter and pollution, as well as noxious weeds, old signage that needs replacement and identification of passive recreation areas.

5 Risk Identification Workshop: A Risk Identification workshop was held with Council and agency staff, and other organisational stakeholders on March 11, 2022. Invitees included:

- Bowraville Local Aboriginal Land Council.
- Coffs Harbour Local Aboriginal Land Council.

- Nambucca Heads Local Aboriginal Land Council.
- Bellinger Landcare.
- Department of Primary Industries – Forestry.
- Department of Primary Industries – Fisheries.
- Department of Planning and Environment – Biodiversity & Conservation Division.
- Department of Planning & Environment - Crown Lands.
- Department of Planning & Environment – National Parks and Wildlife Service.
- Local Land Services.

Thirteen individuals participated in the online workshop. Participants provided feedback on the risks identified to date, added additional risks that had not yet been identified and discussed the cause and outcomes to come to a common understanding of these risks.

2.2 Outcomes

The initial compilation of issues/risks from the above activities resulted in a list of over 600 issues. This list was subsequently screened for duplication, resolved issues, and risks that cannot be dealt with under a CMP. Where possible and practical, issues were grouped for the purposes of risk assessment. A list of 198 risks remained for prioritisation following this process.

3 Risk Assessment

3.1 Assessment Methodology

Following the risk identification workshop, invitees were emailed a risk assessment table and web map viewer (mapped location of risks) containing all risks and attributes. In describing each risk, the following word formula was used to populate the risk table attributes.

> 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.*

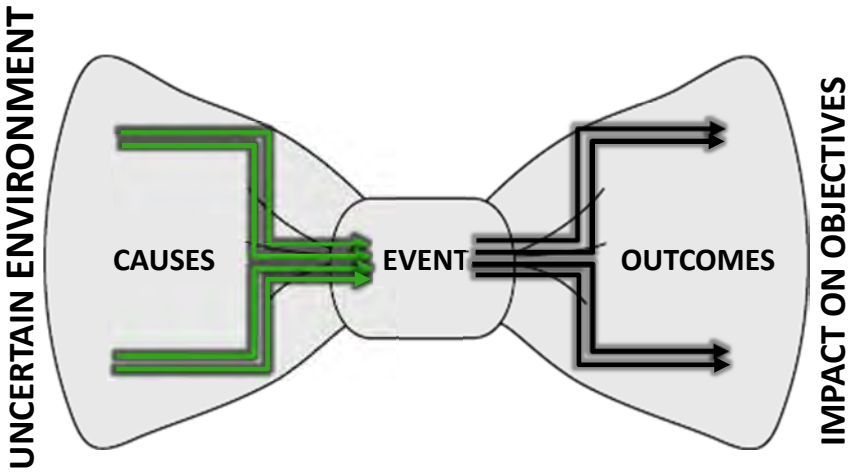

Figure 5 Bow Tie Model used to Guide Risk Description

Within the table provided, participants were asked to fill in "Likelihood", "Consequence" and "Comments" columns noting the following:

- Stakeholders were not required to give a rating for every risk and could limit their response to the risks that were of relevance to them or for which they have expertise.
- Risks relating to water quality were not included in the risk assessment table. These risks have been assessed and prioritised under the Bellingen Water Quality Management Plan and therefore were not duplicated for this exercise.
- Likelihood ratings were not required for coastal hazards or bank erosion. Indicative time frames of Immediate, 20, 50 and 100 years were provided for consideration of coastal hazard related risks.
- Stakeholders could provide additional comments on any risks.

The likelihoods of the identified risks were assessed qualitatively using the descriptors provided in Table 1 (adapted from AS5334 (Australian Standards, 2013)).

The consequences of the identified risks have been assessed qualitatively using the descriptors provided in Table 2 (adapted from AS5334 (Australian Standards, 2013)).

Table 1 Likelihood Assessment Table

Likelihood Rating	Recurrent Risks	Single Events
Almost Certain	Could occur several times per year	More likely than not - Probability greater than 50%
Likely	May arise about once a year	As likely as not - 50/50 chance
Possible	May arise once in ten years	Less likely than not but still appreciable - Probability less than 50% but still quite high
Unlikely	May arise once in ten to 25 years	Unlikely but not negligible - Probability low but noticeably greater than zero

Table 2 Consequences Assessment Table

Success Criteria	Consequence Rating				
	Insignificant	Minor	Moderate	Major	Catastrophic
A Maintain public safety	Appearance of a threat but no actual harm	Serious near misses or minor injuries	Small numbers of injuries	Isolated instances of serious injuries or loss of life	Large numbers of serious injuries or loss of lives
B Protect and enhance the local economy	Minor shortfall relative to current forecasts	Individually significant but isolated areas of reduction in economic performance relative to current forecasts	Significant general reduction in economic performance relative to current forecasts	Regional stagnation such that businesses are unable to thrive and employment does not keep pace with population growth	Regional decline leading to widespread business failure, loss of employment and hardship
C Protect existing community structures and the lifestyle enjoyed by the local people	There would be minor areas in which the region was unable to maintain its current services	Isolated but noticeable examples of decline in services	General appreciable decline in services	Severe and widespread decline in services and quality of life within the community	The region would be seen as very unattractive, moribund and unable to support its community
D Sustain and enhance the physical and natural environment	No environmental damage	Minor instances of environmental damage that could be reversed	Isolated but significant instances of environmental damage that might be reversed with intensive efforts	Severe loss of environmental amenity and a danger of continuing environmental damage	Major widespread loss of environmental amenity and progressive irrecoverable environmental damage
E Ensure sound public administration and governance	There would be minor instances of public administration being under more than usual stress but it could be managed	Isolated instances of public administration being under severe pressure	Public administration would be under severe pressure on several fronts	Public administration would struggle to remain effective and would be seen to be in danger of failing completely	Public administration would fall into decay and cease to be effective

Using the likelihoods and consequences descriptors presented above, evaluation of the risks has been completed using Table 3 (also adapted from AS5334 (Australian Standards, 2013)).

AS5334 regards that the following treatments are applicable:

- *Low* risks would typically be addressed through routine maintenance and day to day operations.
- *Moderate* risks would require a change to the design or maintenance regime of assets.
- *High* risks require detailed research and appropriate planning (or design).
- *Extreme* risks would require immediate action to mitigate.

Table 3 - Risk Rating Matrix

	Consequence				
Likelihood	**Insignificant**	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost Certain	MEDIUM	MEDIUM	HIGH	EXTREME	EXTREME
Likely	LOW	MEDIUM	HIGH	HIGH	EXTREME
Possible	LOW	MEDIUM	MEDIUM	HIGH	HIGH
Unlikely	LOW	LOW	MEDIUM	MEDIUM	MEDIUM
Rare	LOW	LOW	LOW	LOW	MEDIUM

3.2 Outcomes

Completed risk assessment tables were received from:

- Bellingen Shire Council Environment Department and Department of Planning and Environment – Biodiversity & Conservation Division (combined submission)
- Bellingen Shire Council Infrastructure
- Department of Primary Industries - Fisheries
- Department of Planning & Environment - Crown Lands
- Department of Planning & Environment – National Parks and Wildlife Service

In addition, email correspondence was received from Coffs Harbour LALC requesting several issues be rated as High Priority risks.

The consequence and likelihood ratings were represented numerically and then averaged across all responses. A simple multiplication of the averaged scores provided the final score and rating. The score was then transformed back to provide a final risk rating. Issues with a risk score of less than 4 were classed as low, between 4 and 10 as medium, between 10.1 and 15.9 as high and 16 or more as extreme.

Table 4 documents all issues that received an Extreme or High Rating and therefore will progress to Stage 3 of the CMP development. Appendix D provides the complete risk tables for all issues. Six issues were ranked as extreme risk and 34 received a high rating. There are some natural grouping of issues that will occur amongst these with the more obvious being around channel movement and foreshore management at Mylestom, four wheel drive access on beaches, rehabilitation of riparian foreshores on private land and future management of Urunga Island.

Table 4 Risk rated Extreme or High

RISK ID	Location	Cause	Event	Outcome / Consequence	Final Risk Score	Final Risk Rating
G5	Shire wide	Small rates base in Bellingen Shire Council	Small budget to complete management actions in the coastal zone or match funds for government grants	Limitation to management actions that Council can reasonably undertake with current resourcing.	20	Extreme
W23	Coastal Zone	Most recent vegetation mapping not incorporated into SEPP mapping.	Littoral Rainforest and Coastal Wetlands not accurately identified.	Inability to fully utilise planning instruments to protect significant vegetation.	19.0	Extreme
E11	Mylestom Spit	Uncontrolled vehicle access	Vehicles driving on the foreshore and dunes	Loss of dune vegetation including EEC's (Coastal saltmarsh & Swamp Oak Forested Wetland of Hind-dunes) May alter beach/dune morphology	18.0	Extreme
E9	Urunga Island	Grazing by goats and horses	Decreased extent and condition of endangered ecological communities.	Destruction of habitat, riparian zone degradation (bank erosion), loss of genetic diversity, fragmentation of populations, disturbed habitat leading to spread of exotic species, habitat loss for fauna	17.5	Extreme
U5	Bellinger River	Damaged concrete steps	Trip / slip hazard for users	Decreased public safety and reduced accessibility.	17.5	Extreme
V1	Numerous Sites on the Bellinger River (private rural riparian land) where bank erosion is currently occurring.	Lack of Riparian Vegetation	High Flows during catchment flood and livestock access down riverbanks.	Poor ecological function of riparian areas combined with the delivery of eroded sediment to river resulting in turbidity/siltation/impacts on water quality.	16.7	Extreme
E8	Bellinger and Kalang River riparian area	Clearing of native vegetation for agriculture	Decreased extent and condition of native vegetation on the alluvial plain including several endangered ecological communities.	Destruction of habitat, riparian zone degradation (bank erosion and water quality impacts) loss of genetic diversity, fragmentation of populations, disturbed habitat leading to spread of exotic species, habitat loss for fauna	16.3	Extreme
E14	Raleigh	Off leash dogs	Chasing endangered shorebirds	Physical injury to birds, abandonment of nesting sites, trampling of eggs	15.9	High
E3	Urunga sandmass	Bitou infestation	Outcompetes native species	Serious threat to littoral rainforest. Listed as a Key Threatening Process under Threatened Species Conservation Act 1995. Reduces vegetation diversity and consequently habitat.	15.8	High

RISK ID	Location	Cause	Event	Outcome / Consequence	Final Risk Score	Final Risk Rating
E5	Hungry Head to Oyster Creek	Bitou infestation	Outcompetes native species	Serious threat to Littoral Rainforest & Themeda Grasslands on Sea Cliffs and Coastal Headlands (Both EECS). Listed as a Key Threatening Process under Threatened Species Conservation Act 1995	15.8	High
U1	Mylestom	Boat ramp is too close to the road	Dangerous traffic conditions	Decreased public safety	15.8	High
E2	Coastal vegetation corridor between Mylestom and Tuckers Rock	Morning Glory	Strangling Banksia, Tuckeroo, Beech Birdseye trees and Acacia rehabilitation areas.	Impact ecosystem structure and function, reduce native species richness, alter hydrological and fire regimes, change soil nutrient status and alter habitat.	15.6	High
E4	Inland from Wenonah Head	Loss of canopy trees in fire, garden escapees, bitou.	Outcompetes native species	Serious threat to Littoral Rainforest & Themeda Grasslands on Sea Cliffs and Coastal Headlands (Both EECS). Listed as a Key Threatening Process under Threatened Species Conservation Act 1995	15.6	High
W7	Urunga Island	Yellow Rock Island is in private ownership	Management practices of this important ecological and cultural land are not consistent with coastal zone objectives.	Reduction in extent and condition of coastal wetlands No ability to require remediation of ecologically and culturally significant land	15.0	High
W8	Urunga Island	Grazing by goats and horses	Decreased extent and condition of endangered ecological communities. .	Destruction of habitat, riparian zone degradation (bank erosion), loss of genetic diversity, fragmentation of populations, disturbed habitat leading to spread of exotic species, habitat loss for fauna	15.0	High
V2	Numerous Sites on the Kalang River (private rural riparian land) where bank erosion is currently occurring.	Lack of Riparian Vegetation	High Flows during catchment flood and livestock access down riverbanks.	Poor ecological function of riparian areas combined with the delivery of eroded sediment to river resulting in turbidity/siltation/impacts on water quality.	15.0	High
G6	Urunga Island	Yellow Rock Island is in private ownership	Management practices of this important ecological and cultural land are not consistent with coastal zone objectives.	Reduction in extent and condition of coastal wetlands No ability to require remediation of ecologically and culturally significant land Private ownership prevents cultural access and First Nations management.	15	High

RISK ID	Location	Cause	Event	Outcome / Consequence	Final Risk Score	Final Risk Rating
G9	Mylestom North Beach	There is no permit system for 4WDs	No regulation or monitoring of 4WD activity	User conflicts No revenue source for enforcement activities Unauthorised access to dunes and dune vegetation	15	High
E6	Lowland Rainforest EEC, Subtropical Coastal Floodplain EEC, Lowland Rainforest on Floodplain	Broadleaf paspalum, lantana, giant parramatta grass, molasses grass, bitou, morning glory, rhodes grass, mistflower, privet, madeira vine, balloon vine, tradescantia, castor oil.	Outcompetes native species	Impacts ecosystem structure and function, reduce native species richness, alter hydrological and fire regimes, change soil nutrient status and alter habitat. Alteration of the condition of the riverbank.	14.3	High
V4	Riverbank north of tidal pool and also from southern boat ramp to opposite toilet block Mylestom Park	Natural northward/eastward migration of the foreshore and ongoing failure of seawall (now at least 40 years old) - failure of some structural elements causing sink holes to rear and temporary fencing of areas from public access.	Ongoing waves cause additional failures and collapese, potential for injury to members of the public.	Loss of amenity, potential legal liability.	14.0	High
W4	Coastal wetland north-east of Burrawong Parade	Coastal Inundation 100yrs	Normal tides raised by 1.4m	The point north of the residential area is completely inundated by King Tides. This will affect much of the parcel at 40 Burrawong Parade.	13.5	High
W6	North Beach	Coastal Recession 100yr	1.4m of Sea Level Rise + Rare Erosion Event	As for 50 year, Plus Area A: an additional 0.1 ha (Around 15% total loss of this patch) Area B: the remaining 1/3 of the mapped littoral rainforest patches is affected (Some Swamp Oak & Swamp Sclerophyll Forest also impacted totalling around 400 sq.m) Area C: The remaining 500sq. m of this patch is lost.	13.5	High

RISK ID	Location	Cause	Event	Outcome / Consequence	Final Risk Score	Final Risk Rating
E20	Habitats of high ecological and conservation value	Clearing of native vegetation for agriculture	Decreased extent and condition of native vegetation on the alluvial plain including several endangered ecological communities.	Destruction of habitat, riparian zone degradation (bank erosion and water quality impacts) loss of genetic diversity, fragmentation of populations, disturbed habitat leading to spread of exotic species, habitat loss for fauna	13.5	High
E21	Alluvial Plain	Clearing of native vegetation for agriculture	Decreased extent and condition of native vegetation on the alluvial plain including several endangered ecological communities.	Destruction of habitat, riparian zone degradation (bank erosion and water quality impacts) loss of genetic diversity, fragmentation of populations, disturbed habitat leading to spread of exotic species, habitat loss for fauna	13.5	High
E7	Bongil Bongil National Park coast	Foxes, cats, covid species	Preying on Little Terns and their eggs	Decrease in an already threatened population. Potential local extinction.	13.4	High
V5	Urban residential properties all clustered around Newry Island	Naturally variable state of channel, particularly in meanders around Newry Island.	Erosion of residential property, followed by ad-hoc & uncoordinated foreshore protection works which are subsequently undermined	Highly variable and unsightly foreshore with poorly designed and ineffective protection works in many locations.	13.3	High
E13	Hungry Head	Uncontrolled vehicle access	Vehicles driving on the foredune	Loss of dune vegetation including EEC's (Littoral Rainforest) May alter beach/dune morphology	13.3	High
G10	Coastal zone	Unmanaged Council and Government owned reserves that are not incorporated into Bellinger State Park or similar	Less restoration and protection when compared to managed reserves	Inconsistent management of public land Biodiversity impacts Decreased rehabilitation potential	13.3	High

RISK ID	Location	Cause	Event	Outcome / Consequence	Final Risk Score	Final Risk Rating
W1	Valla Beach through to Hungry Head	Coastal Recession 100yr	1.4m of Sea Level Rise + Rare Erosion Event	A - As for 50 yr B - As for 50 yr, plus additional 0.38 ha loss C - Complete loss of 0.6ha patch of Littoral Rainforest D - Same as for 50yr E - Complete loss of 0.8 ha patch of Littoral Rainforest Minor additional Patches of saltmarsh ~ 400 sq.m fringing McGraths Creek also impacted, however, should this recession occur, the tidal dynamics will have changed markedly and saltmarsh areas will change dramatically.	13.0	High
G1	Alma Doepel Reserve and Mylestom Tidal Baths	Inaction on bank erosion	Seawall failing at multiple locations	Reduced available public land. Potential safety risks to users of the public recreation area. Reputational risk to Council.	12.5	High
G13	Kalang River, railway bridge	Broken water pipe leaking on railway pylon since 2020	Complaints to Council	Public frustration as council has advised that they cannot fix a pipe on a railway pylon.	12.5	***High***
V7	North Beach	Coastal Erosion & Recession (Immediate)	Formation of an erosion scarp and narrowing of the beach berm	Public access affected with steep drop to beach and resultant pedestrian safety issue.	12.0	High
V8	North Beach	Coastal Erosion & Recession (Immediate)	Formation of an erosion scarp and narrowing of the beach berm	Dangerous conditions for 4WD, safety impacts, more likelihood that 4WD will encroach upon foredunes/dunes, exacerbating erosion.	12.0	High
E10	Giinagay Way Urunga	Lack of governance or ineffective governance of rural land clearing.	Rural landholders degrading or clearing native vegetation.	Destruction of habitat, riparian zone degradation (bank erosion), loss of genetic diversity, fragmentation of populations, disturbed habitat leading to spread of exotic species, habitat loss for fauna	12.0	High
U4	Mylestom Spit foreshore on the river side	Wash from high speed boats and jet skis	Shoreline recession	Increased public safety risk due to steep embankments and scarps.	12.0	High
U15	North Beach Mylestom Spit	Insufficient signage or vehicles not complying with signage	Vehicles driving on the foreshore and dunes	Conflicts between vehicles and passive recreation.	11.3	High

RISK ID	Location	Cause	Event	Outcome / Consequence	Final Risk Score	Final Risk Rating
G11	Bellinger River	Inability to access information regarding dredging of the Bellinger River Who pays? How much is taken? Who monitors? How long since an EIS has been done? What effect does this dredging pose to our wildlife?	Decreased public knowledge of dredging impacts	Decreased public confidence that impacts of dredging are adequately monitored.	11.0	High
U7	Estuary Entrance	Shoals	Decreasing navigability for boats	Reduced safety for boat users.	10.6	High
V10	Left bank (Pacific Highway side) upstream of the Newry Island bridge	High flows	Turbulent eddies cause erosion adjacent to bridge abutment.	Eventual Erosion and undermining of Bridge abutment, failure of bridge	10.5	High
G8	Atherton Drive precinct	Lack of consultation with Gumbaynggir people	Plan of management developed without First Nations input or review.	Loss of cultural knowledge and significance of the site.	10.1	High

4 Progressing to Stage 3– Identification and Evaluation of Management Options

The revised risk assessment marks the completion of Stage 2. Moving forward all high, and extreme risks will be considered in Stage 3 of CMP development. Not all risks will progress to the Business Plan. Some risks may be best dealt with through other mechanisms and processes, whilst others may already have a program of action in train. Further, some of the risks advancing to Stage 3 may be determined as inappropriate for inclusion in the CMP. Furthermore, there are some 'moderate' risks which may still be suitable for inclusion if they can be managed by a relatively simple, 'no-regrets' action.

The final, 'filtered' set of risks will be investigated further in Stage 3, to identify and assess potential management options. Management options that meet this assessment will likely progress to the Business Plan and CMP.

5 References

Alluvium, 2020. Bellingen Shire Coastal Management Program - Stage 1 Scoping Study.
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Appendix A - Physical and Biological Context

APPENDIX A PHYSICAL AND BIOLOGICAL CONTEXT OF THE BELLINGEN COASTAL ZONE

BELLINGEN SHIRE COASTAL MANAGEMENT PROGRAM – STAGE 2

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Prepared For	Bellingen Shire Council
Version	FINAL
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1 Introduction

1.1 Background

This report forms an appendix to the Stage 2 summary report prepared during development of the Bellingen Shire Coastal Management Program (CMP). The key outcome of Stage 2 is a set of prioritised risks (or "issues") that should be managed by the CMP, where possible, within budgetary and other constraints.

As an initial step of the risk management process, a 'context' needs to be identified, with that context setting appropriate boundaries and informing the risk assessment completed during Stage 2.

The present appendix addresses the environmental context, comprising the physical nature of Bellingen's Coastal Zone (Section 2) and ecological nature of the estuaries and open coast (Section 3). The physical context is of relevance to the consideration of coastal hazards and risks within the *Coastal Vulnerability Area* whereas the ecological context is of relevance to risks within the *Coastal Wetland and Littoral Rainforest,* and the *Coastal Environment Areas*. Noting these points, however, there is overlap and a holistic approach is required.

It is important to note that this report does not address water quality. The Scoping Study (Alluvium, 2020) identified a knowledge gap in available water quality monitoring data. Specifically, that whilst water quality in the upper catchment is well monitored, there is insufficient water quality monitoring in the lower estuary. Subsequently Jeremy Benn Pacific have been contracted to develop a Water Quality Management Plan as part of Stage 2 of the CMP process. This Plan is currently in draft form and under review by BSC. The final WQMP will identify management actions for issues that are considered high priority. BSC will assess the management options in terms of viability, acceptability and feasibility. Therefore, the actions do not require further assessment as part of the CMP development. Instead, management actions from the WQMP will be transferred directly to the CMP having already met the requirements for inclusion.

Parallel appendices address the strategic context (Appendix B) and the social context (Appendix C).

2 Physical Context

2.1 Catchment, Topography and Hydrology

2.1.1 Catchment Extents and Topography

The extent of the overall catchments and their topography, and the presently mapped coastal zone with reference to the Bellingen LGA, are shown in Figure A-1. A closer view of the lower coastal floodplain, the confluence of the Bellinger and Kalang Rivers and the entrance are shown in Figure A-2.

The total catchment area for the Bellinger and Kalang Rivers is around 1110 km^2 with around 340 km^2 draining to the Kalang and the remaining 770 km^2 draining to the Bellingen. The catchments are both aligned in an east west direction with the headwaters rising in steep country of the Great Dividing Range, some 60km west of the coast. Point Lookout, at 1562m, is the highest point of the catchment, located near its westernmost extent. Some of the southernmost extents of the Bellinger/Kalang catchment are contained within the Nambucca Shire LGA although these represent a small proportion and are almost entirely forested.

The topography flattens closer the coast and a well-defined floodplain is present along the riverine extents of the estuary. The upstream extent of the Coastal Zone, as defined in the SEPP (Resilience and Hazards) 2021, is located at the limit of tidal influence. On the Bellinger River, this tidal limit is around 2km upstream of the centre of Bellingen (Figure A-3). On the Kalang, it is located some 500m upstream of Bowraville Road (Figure A-4).

Downstream of the tidal limits, the estuaries are contained within incised valleys for some distance before reaching the broader, low-lying coastal floodplain. The Bellinger River continues for some 15 km downstream to McGearys Island, where the landscape opens onto the broader coastal floodplain. Unsurprisingly, this is a depositional area, and the site of an ongoing sand extraction operation (Figure A-5).

The Kalang River also continues for some 15 km before splitting into two branches around Newry Island and then re-joining at Urunga upstream of the Ginnagay Way and North Coast Railway bridges. Newry Island is a depositional feature and its present day surface sediments are mostly of alluvial origin (Troedson et al., 2016).

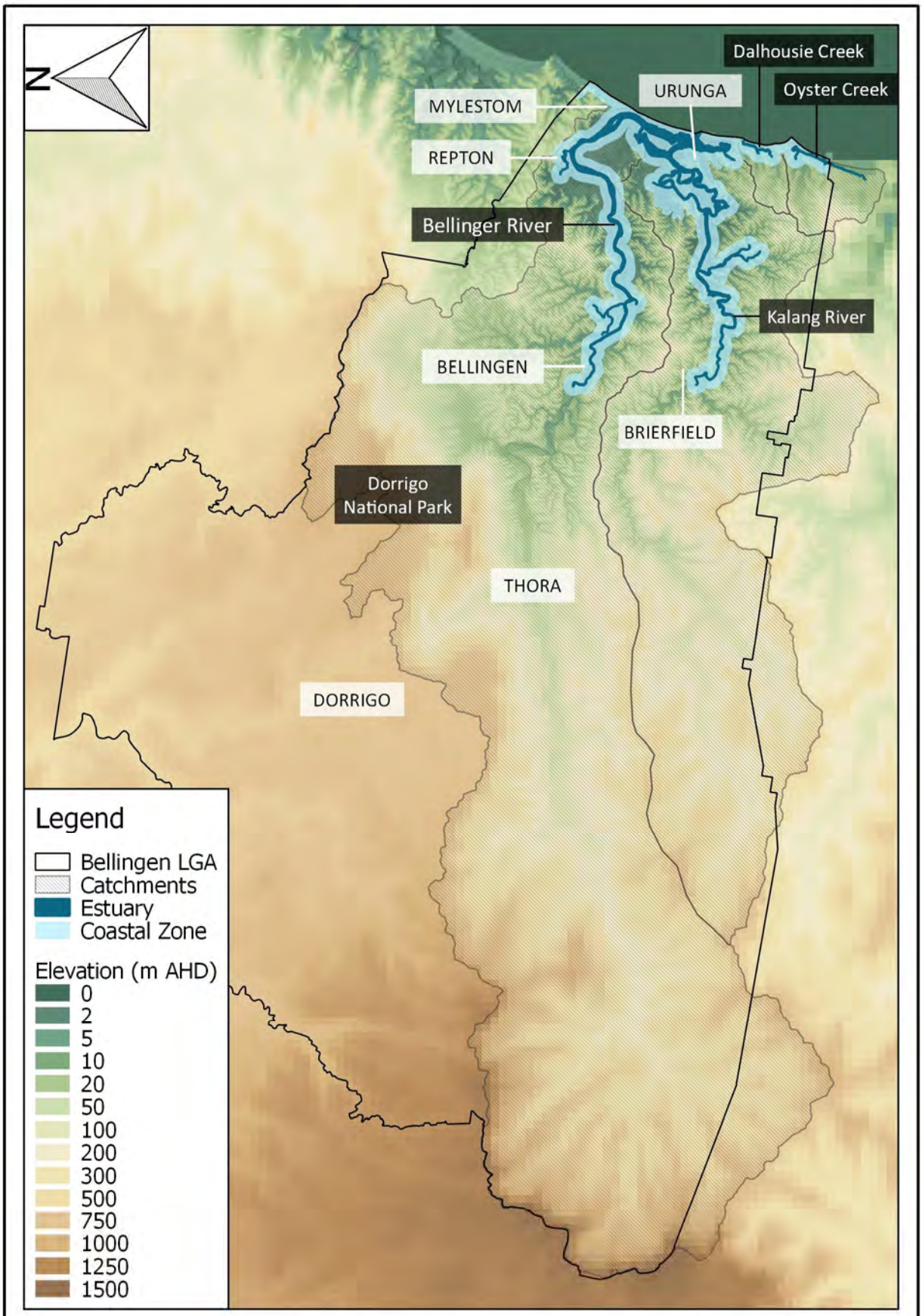

Figure A1: Catchment Topography

0 2.5 5 7.5 10 km

APPROX SCALE

Bellingen Shire CMP

REV	DRAWN	CHECK
A	EN	DJW

GIS File: Z:\BusinessShare\Them\Projects\P00127 BellingenShireCMP\GIS\Catchments.qgz

Salients

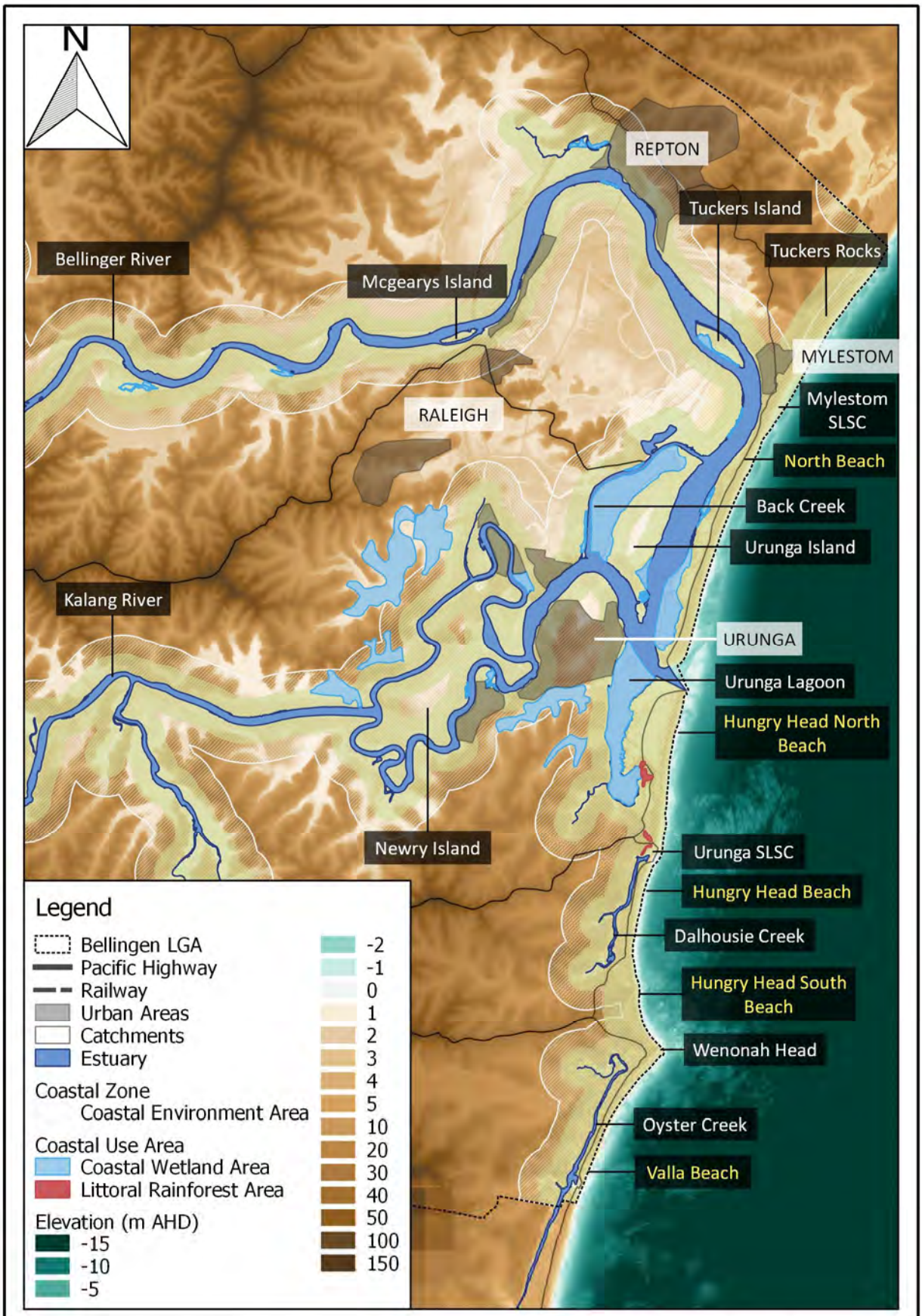

Figure A2: Coastal Zone

0 1 2 3 km

APPROX SCALE

Bellingen Shire CMP

REV	DRAWN	CHECK
A	EN	DJW

GIS File: Z:\BusinessShare\Them\Projects\P00127 BellingenShireCMP\GIS\Catchments.qgz

Salients

Figure A-3 Lavender Bridge at Bellingen, near Tidal Limit of Bellinger River (captured High Tide, 6 December 2021)

Figure A-4 Bowraville Road Bridge, near Tidal Limit of Kalang River at Brierfield (captured High Tide, 7 December 2021)

Figure A-5 Facility at Repton used to Process Sand Extracted from the Bellinger River downstream of the Pacific Highway

The coastal floodplain is largely cleared for agriculture but contains the significant township of Urunga (Kalang River) and smaller settlements at Mylestom, Raleigh and Repton (Bellinger River). The Bellinger River flows southwards from Mylestom (behind Mylestom Spit) to meet the Kalang River at Urunga, immediately upstream of the entrance. The entrance was trained between 1890 and 1905 and has been fixed in this location since that time. The entrance had previously moved north and south along the beach, reportedly entering the ocean near Hungry Head in the 1840's (Public Works Department New South Wales, 1983). While the entrance is fixed in place and remains open, it is heavily shoaled and not navigable. For this reason, navigational access between the Bellinger and Kalang is via Back Creek, which runs behind Urunga Island.

2.1.2 Climate and Hydrology

Monthly climate data were obtained from the Bureau of Meteorology for the (now closed) weather station at Bellingen Post office, which was open between 1899 and 2002. While acknowledging that the climate is changing, temperature and rainfall statistics for this site are presented in Figure A-6.

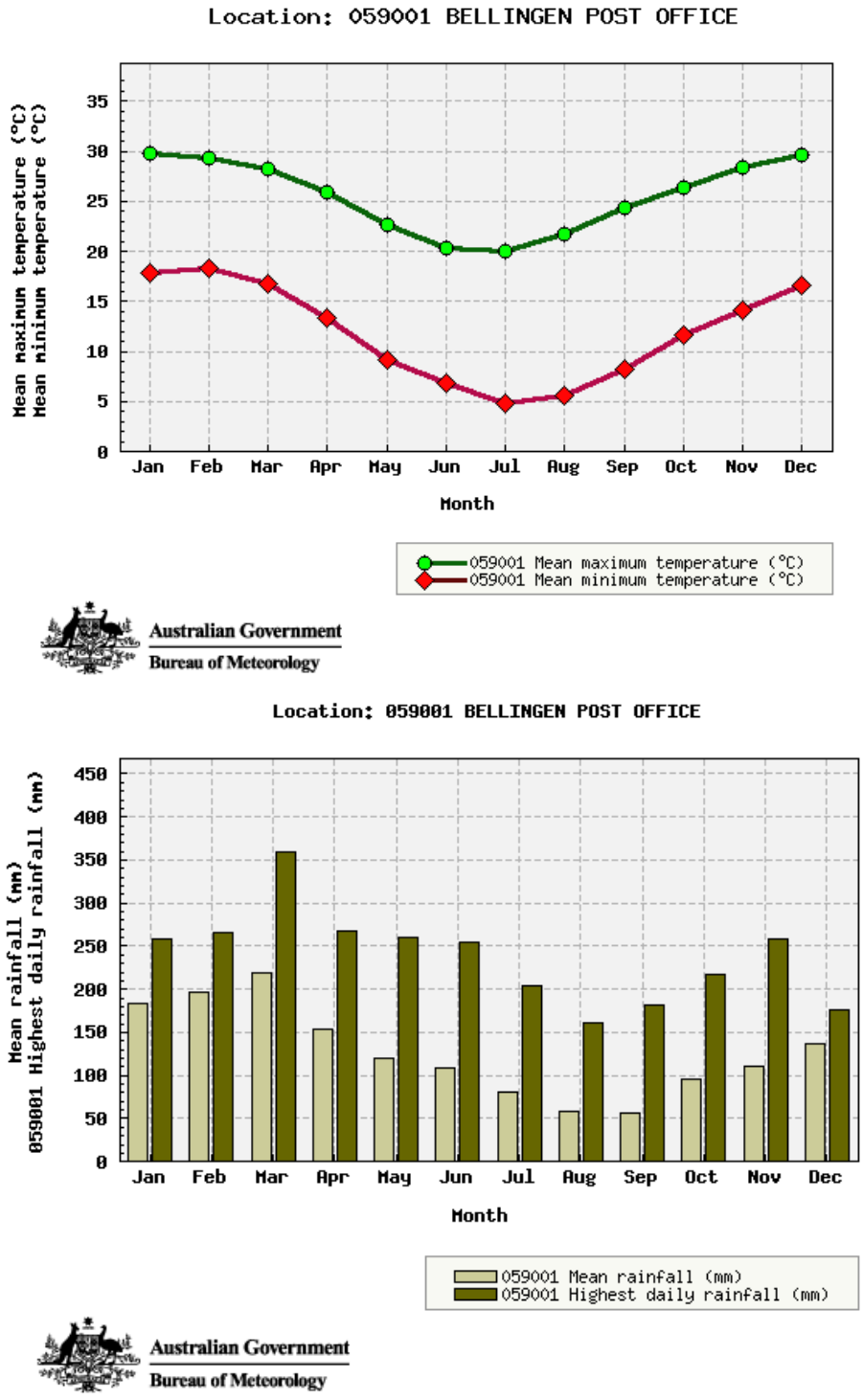

Figure A-6 Temperature (top) and Rainfall (bottom) Climate Statistics for Bellingen Post Office (Bureau of Meteorology site 059001)

Summers in the coastal parts of the Bellingen LGA are typically warm and humid warm and winters are short and cool. The hottest months are December and January at around 30 degrees mean daily maximum temperature with June and July the coldest at around 20 degrees mean daily minimum temperature. Typically, the first three months of the year are wettest, and the driest months are August and September. While significant flooding rainfall can occur at any time of the year, daily rainfalls exceeding 250mm are more likely, but still rare, during the first six months of the year.

Bellingen is also exposed to longer-term climate variations as measured using parameters such as the southern oscillation index (for El Nino / La Nina) and the Interdecadal Pacific Oscillation. These climate patterns are commonly assessed using the relative temperature within different parts of the global ocean and relate to periods of greater or less rainfall, and higher or lower temperatures in Eastern Australia. Similar to Eastern Australia in general, Bellingen can experience prolonged drought periods (commonly associated with El Nino periods) interspersed with stormier, wetter periods (associated with La Nina).

As is normal for a coastal river in NSW, water levels that break the banks and cause inundation of the floodplain are dominated along their entire length by catchment rainfall and runoff processes. Ocean storm surge events can affect water levels in the lower estuary, but catchment flooding is significantly more important for most of the river within the coastal zone. With ongoing sea level rise resulting from climate change, so-called "clear day" flooding may become problematic in future, as normal tides within the lower estuary become elevated enough to inundate adjacent low-lying land on the floodplain.

In a description of flood behaviour, WMAwater (2021a) noted that flooding along the Bellinger and Kalang rivers is generated by long duration rainstorm events. Floodplains downstream of Bellingen are regularly subjected to flood depths greater than 2m and long inundation times. Velocities during the 1% AEP event can exceed 4m/s. Along the Kalang River, the floodplain is narrower than along the Bellinger River. During rare events, high velocity flows can be experienced across Newry Island, where water levels become large enough to bypass the main meandering in-bank channels surrounding the Island. Eventual complete bypassing caused by ongoing tidal erosion and scour during a flood is a concern which may require consideration in the CMP.

Issues associated with catchment flooding of diminished relevance to a CMP given that they are under the separate Floodplain Risk Management process in NSW, as governed by the gazetted Floodplain Development Manual (NSW Government, 2005) and represented by the existing Management Plan for the Bellinger and Kalang (WMA Water, 2021b). The interaction of that management plan and the CMP needs

to be considered, for example, when addressing coastal hazards associated with inundation.

2.2 Geology and Geomorphology

2.2.1 Geology

The Bellingen Shire lies within the rocks of the New England Fold Belt (NEFB), the geological body which covers the easternmost parts of the Australian mainland, including most of the coast of NSW to the north of Sydney. The majority of the catchment for the Bellinger and Kalang estuaries lies within the "Bellingen Slate" rock unit, which is part of the broader "Nambucca Block". Within the coastal zone at the lower end of the estuaries, quartenary alluvium forms the river channels and immediate floodplain. The gravel bed of the Bellinger River has a mix of metasediments, whereas the Kalang River is dominated by a much finer grain-size comprised of phyllite and vein quartz (Telfer and Cohen, 2010). Hungry Head and Wenonah Head, and the Dalhousie Creek and Oyster Creek ICOLLs are located within the "Nambucca Beds" Rock unit.

The underlying rocks and catchment size affect the coastal topography. Figure A2 shows the broad low coastal floodplain surrounding the Bellinger/Kalang Estuary, whereas topography around Hungry Head and further south along the coastline is much steeper adjacent to the coastline. The alongshore distinction is also present in the mapping of coastal reefs (Linklater et al., 2019) which demonstrate extensive underwater reefs close to shore south of Hungry Head and a broader sandy plain present offshore of the area between Urunga Lagoon and Mylestom.

Noting that the estuarine floodplain is largely contained within the coastal zone defined by the SEPP (Resilience and Hazards) 2021, the coastal parts of the catchment are dominated by a soil type known as "Pine Creek". Pine Creek soils are contained within rolling hills and side slopes in the lower catchment overlying the Bellingen Slates. Soils are typically silty to clayey loams and light clays. The Pine Creek areas are partly cleared but mostly forested.

Higher parts of the catchment between the Kalang and Bellingen River, and to the south of the Kalang River are dominated by the "Diehappy" soil landscape which occurs on relatively narrow ridges and includes loams and silty clays, also derived from the underlying Bellingen Slate. The Diehappy areas are almost completely forested.

In comparison, upper parts of the catchment to the north of the Bellinger River coastal zone are covered by the "Valery" soil landscape which overlies the Gleniffer Monzogranite rock unit (distinct from the Bellinger Slate). These soils typically comprise brown loams and clay loams and orange silty clay loams. In the context of

the Coastal Zone, these are at the upper reaches of Hydes Creek, which runs into the northern bank of the Bellingen River at Fernmount. Again, the Valery soils are largely forested.

The uppermost, steeper (western) parts of the catchment for both the Kalang and Bellinger Rivers are dominated by the "Snowy Range" soil landscape, comprising brown to brownish-black clay loams derived from the underlying Bellingen Slate. The Snowy Range areas are remain almost entirely forested.

From the above descriptions, much of the slopes, upper reaches and ridge lines of the Bellinger Kalang catchment are forested, and, presuming that any areas which are disturbed, such as for forestry, have controls established which mitigate suitably against erosion, management actions specific to the higher parts of the catchment are unlikely to be required in the CMP.

Land management decisions on the floodplain, the estuarine parts of which are largely contained within the Coastal Zone, are more likely to have an impact on the objectives of the CM Act and are therefore of more interest to the CMP. Decisions relating to land use on floodplain upstream of the defined Coastal Zone may also be of importance noting that these can, for example, impact on water quality and the amount of sediment that is delivered to the rivers and eventually to the coastal zone. Relevance of these issues to a CMP addressing the Bellinger and Kalang estuaries, however, diminishes with distance upstream of the coastal zone.

The catchment size and shape, underlying rocks, and the soils present significantly influence on the fluvial geomorphology which is discussed in the following section.

Following the underlying geology, the dominant soils which influence the ICOLLs to the south of Urunga Lagoon, differ from those that affect the Bellinger and Kalang rivers. The dominant landscape is "Newry", comprising soils derived from the Nambucca Beds unit. Newry soils are typically located within near-coastal areas between the Bellingen and Nambucca River entrances on undulating hills at elevations of between 5-40 m. While mostly forested, there is clearing on agricultural land near the ICOLLs, and along corridors for the Pacific Motorway and Highway, and along corridors for electricity transmission and the northern railway line. Soils are characterised as loams, silty clays, and structured clays. Soils in low areas and subsoils may be poorly drained and become waterlogged, with possible groundwater discharge occurring on foot slopes.

2.2.2 Fluvial Geomorphology

Telfer and Cohen (2010) provide an excellent overview and classification of different sections of the Bellinger / Kalang system, which is reproduced Figure A-7. Beyond the fluvially dominated zones (A and B) which cover these rivers where they flow within incised valleys, Telfer and Cohen also define a "Fluvial Transition Zone" and

a "Marine Tidal Delta Zone". The Marine Tidal Delta Zone is discussed under in the following section.

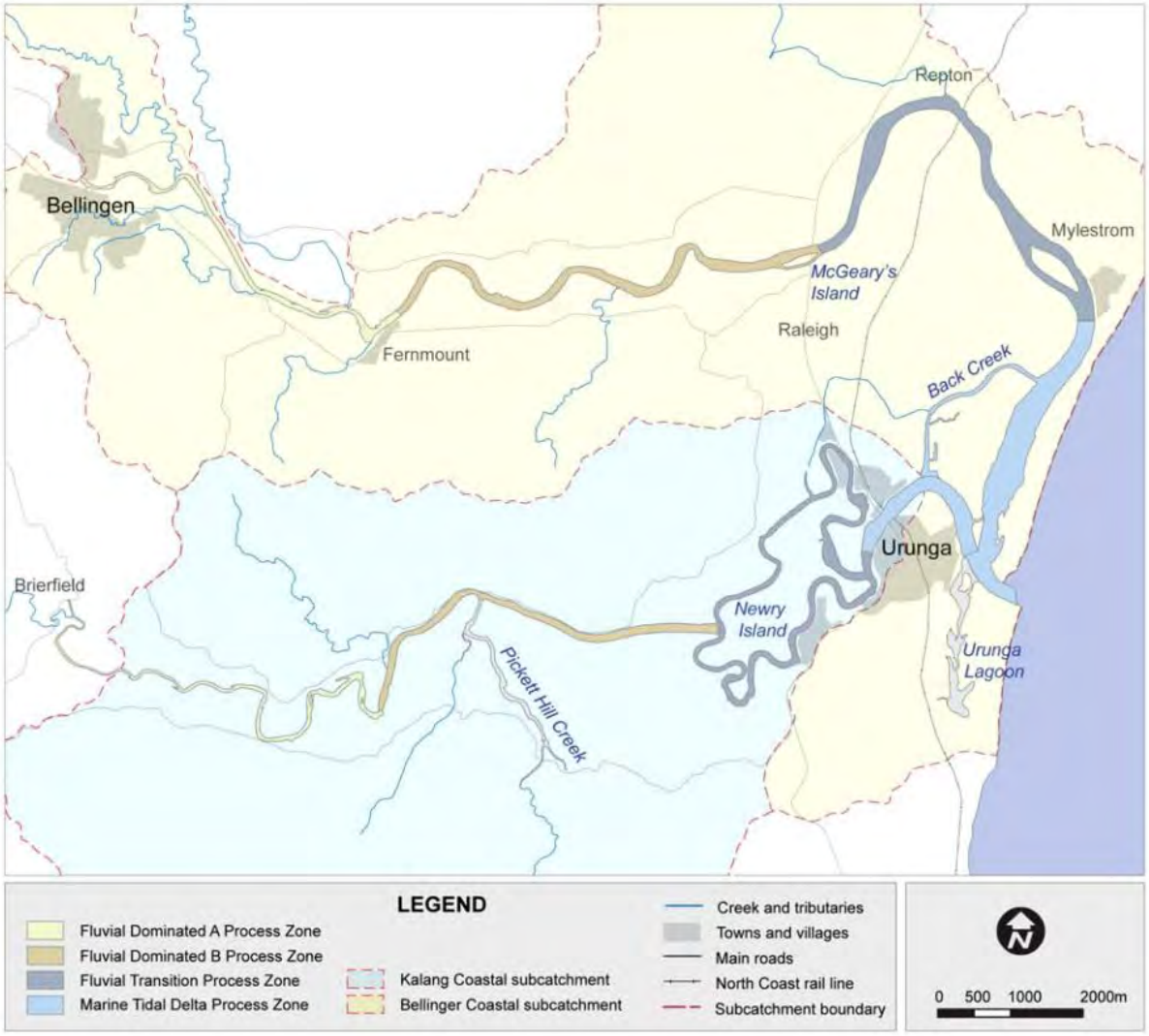

Figure A-7 Geomorphic Process Zones (as presented by Telfer and Cohen (2010))

Bellinger River

In terms of the fluvially influenced parts of the system, the Fluvial "A" zone on the Bellinger is characterised by mixed sediment transport (including gravel) with a valley floor width of around 1km, with the meanders of the main channel and active occupying around 300 to 500m of that width. A gravel deposit at Fernmount represents the transition to the Fluvial "B" zone, which has less variable floodplain topography and a lower stream gradient.

The fluvial transition zone is indicated, by Telfer and Cohen, as having a *"pronounced marine influence, while still exhibiting a fluvial form"* Compared to the fluvial zones, floodplains in the transition zone are lower relative to normal tidal water levels (1.5m to 2.0m above mean tide) and flatter. On the Bellinger River, the region is dominated by depositional features, including McGearys Island, shoals around Raleigh/Repton,

Tuckers Island opposite Mylestom and much of the floodplain between Mylestom and Raleigh, which has been incrementally filled by alluvial sediments. Data presented by Troedson et al. (2016) across the floodplain in this area and across the floodplain further south, show evidence of alluvial plains, naturally formed levees and estuarine paleochannels, consistent with this infilling process.

Kalang River

The Fluvial "A" zone on the Kalang is highly influenced by confinement of the stream by bedrock and has a narrower floodplain than the Bellinger (typically less than 500m width). The Fluvial "B" zone contains relatively straight reaches of channel, again within a constrained valley floor (< 500m wide) and is subject to high energy flood flows, consistent with the findings of the WMAWater (2021a).

The data of Troedson et al. (2016) demonstrate that the Kalang's fluvial transition zone defined as the area around Newry Island by Telfer and Cohen (2010), is characterised by more recent (last 2000 years or so) alluvial deposits over pre-existing Pleistocene features (deposited more than tens to hundreds of thousands of years before present). Pleistocene sediments are present at the surface of the northern, more elevated parts of Newry Island and between Newry Island and Back Creek. These deposits are indicative of those areas being located to the rear of coastal dunes at some time in the distant past, broadly consistent with earlier descriptions of the way the coast plain has evolved and infilled over tens to hundreds of thousands of years (Public Works Department New South Wales, 1983; Telfer and Cohen, 2010).

2.2.3 Coastal Geomorphology

The "Active Marine Delta Zone" is characterised by significant movement of quartzose marine sand in and out of the entrance and along the most downstream channels of the estuaries.

Bellinger/Kalang System

Prior to training of the entrance in the late 1800's and early 1900's, the entrance is reasoned to have moved north and south along the coast between Hungry Head and Mylestom (Public Works Department New South Wales, 1983). Training has effectively fixed the location of the entrance, dividing the beach barrier which separates the estuary from the ocean into (i) Mylestom Spit, behind which the downstream reaches of the Bellinger River flow before turning eastwards to discharge into the ocean, and (ii) Northern Hungry Head Beach, which separates Urunga Lagoon from the Ocean.

Large catchment floods transport marine sand out through the entrance, where it deposits in the nearshore zone. The sand is then reworked and carried either alongshore, transported by waves as littoral drift, or by incoming tidal currents to

reform the shoals which were originally washed out by the flood. These active entrance shoals are typically limited to the downstream confluence of Back Creek with the Kalang River, and around 250m upstream on the Bellinger, from its junction with the Kalang (i.e., the "V-Wall"). A major flood tide shoal tends to form adjacent to the southern training wall near the southernmost extents of the Urunga Golf Club. A second major shoal tends to form to the south of and either side of the apex of the V-Wall. There is significant variability in the shape and extent of these two major internal shoals over time but the overall system has been assessed as being in balance in that the sand washed out of the entrance by floods equals that which is carried back in by the tides when averaged over longer time frames (Public Works Department New South Wales, 1983). In other words, the mass balance of sand in the entrance compartment is in equilibrium.

While these two shoals represent the upstream extents of marine shoaling, active transport of marine sand along the bed of the river channels does happen further upstream, extending to the confluence of Back Creek with the Bellinger River, and upstream of the Railway/Pacific Highway Bridges at Urunga. These extents are consistent with the boundary between the Fluvial Transition and Marine Tidal Delta Zones defined by Telfer and Cohen (2010).

The Marine Tidal Delta Zone also contains most of the coastal wetland areas currently defined in the SEPP (Resilience and Hazards) 2021 maps including significant patches protected from tidal flows behind the southern extent of Mylestom Spit (behind the inner eastern training wall of the Bellinger River), within Urunga Lagoon, and along Back Creek (western side of Urunga Island). Other patches, including several fragments which may be threatened by human impacts and climate change, are located adjacent to the north and south arms of the Kalang River, where it flows around Newry Island.

Dalhousie and Oyster Creeks

Coastal geomorphology around the smaller ICOLLs of the southern coastline of the LGA is heavily constrained by the comparatively steep topography forced by the underlying Nambucca Beds rock unit. That topography results in relatively small catchments (~6.3 km^2 and 16.8 km^2 for Dalhousie and Oyster Creeks respectively) and these limited catchments are significant factors influencing the intermittent nature of these two entrances.

The waterbody of both ICOLLs is located within coastline parallel swales constrained by the existing beach barrier and the steeper landward topography of the coastline. The surrounding sediments are dominated by dune sands, with small patches of estuarine muds (wetlands) and saltmarsh. Small alluvial deposits have commonly formed where minor side tributaries enter the main waterbodies.

Open Coast

The Bellingen open coast is influenced by the humid warm to cool temperate climate alongside coastal environmental process such as the micro tidal climate (maximum astronomical tidal range of around 2.0m), swell waves predominantly from the southeast (averaging around 1.5m with rare events exceeding 7-8m) and easterly seas[1], although large waves can approach from all offshore directions. Other influencing processes include weather systems such as east coast lows and mid latitude cyclones, the occurrence of which is moderated by broad scale climate patterns such as the El Nino Southern Oscillation.

The open coastline is characterised by an uninterrupted beach, where sand is freely transported past headlands such as Wenonah Head and Hungry Head. The Lower Bellinger Waterway Study (Public Works Department New South Wales, 1983) indicates that south to north coastal alongshore sediment transport rates in the vicinity of Coffs Harbour average around 75,000m^3/yr, with BMT WBM (2012) indicating that annualised value 60,000 m^3 could be more appropriate for the Bellingen Coast. Since construction of the entrance breakwaters, the northern end of Hungry Head Beach has accreted and the coastline has adjusted with an approximate equilibrium, based on photogrammetric analyses, reached by around 1970 (BMT WBM, 2012).

At the present time, littoral drift is no longer significantly interrupted by the presence of the southern entrance breakwater and an annual average alongshore transport of around 60,000m^3 (net) could be expected to pass northwards across the entrance, noting that some 40,000m^3 is also expected to wash in and out of the entrance annually, as discussed above.

There is limited reported historical evidence of chronic coastal erosion along this length of the coast, although that is projected to change with future sea level rise.

In terms of the Coastal Management Act, the Bellingen Shire open coast is completely contained within the Coffs-Nambucca sediment compartment, which it shares with Councils to both the north (Coffs Harbour City) and south (Nambucca Shire). The CM Act requires that Bellingen Shire must consult with those councils, but only if the Bellingen shire contains land within the *Coastal Vulnerability Area*.

It would seem prudent to consult with those Councils on the CMP, even if the CMP only provides actions to support a planning proposal to map the Coastal Vulnerability Area. Similarly, Nambucca Shire should be consulted with to discuss the management of Oyster Creek.

[1] https://coastadapt.com.au/sites/default/files/docs/sediment_compartments/NSW01.02.04.pdf

2.3 Coastal Hazards within the Bellingen Coastal Zone

2.3.1 Introduction

The *Coastal Vulnerability Area* (CVA) is defined by the CM Act as being land subject to *coastal hazards*. There are seven coastal hazards defined by the CM Act:

1. Beach erosion.
2. Shoreline recession.
3. Coastal lake or watercourse instability.
4. Coastal inundation.
5. Coastal cliff or slope instability.
6. Tidal inundation.
7. Erosion and inundation of foreshores caused by tidal waters and the action of waves including the interaction of those waters with catchment floodwaters.

However, as of early 2022, no CVA has been mapped under the SEPP (Resilience and Hazards) 2021 in NSW. As part of the CMP, a planning proposal which presents the extent of the Coastal Vulnerability Area for the Bellingen LGA will be prepared to modify maps in the SEPP (Resilience and Hazards) 2021.

The CVA comprises land affected by both current and potential future coastal hazards. Appropriate development controls should, because of the CMP process, be applied to the CVA to inform land use decisions including consideration of the risk to human life, infrastructure, public and private property; both for the present and in the future.

A common approach would be to define the CVA as part of Stage 2 studies. In the case of the Bellingen Shire, such studies are mentioned in the Scoping Study (Alluvium, 2020), but the forward program presented therein did not allow for completion of those studies.

We understand that Council's intention is to generate a CVA extent from existing hazard information. The applicability of that existing hazard information is discussed within the following sections. Whether or not existing hazard information is fit for purpose depends significantly on the nature of assets that could be threatened by various coastal hazards, and this is also considered where relevant.

2.3.2 Impact of Sea Level Rise

Coastal hazards will be exacerbated by future sea level rise and this needs to be considered and planned for. Over the past decade, most coastal councils in NSW

have continued to adopt prior "benchmarks" from a since abandoned policy of the NSW state government (NSW Department of Environment, Climate Change and Water, 2009). Those benchmarks comprised the following mean sea level rise projections relative to 1990 conditions:

1 0.4m by 2050.

2 0.9m by 2100.

The benchmarks were based on the upper limits of a fossil fuel intensive global economic development scenario, known as "A1FI" from the IPCC's Assessment Report 4 (IPCC, 2007). The NSW government withdrew the policy in 2012.

There are a few important factors that presently need to be considered in pragmatically assessing the effect of sea level rise on coastal hazards:

- The most reliable and widely accepted projections for sea level rise now comprise those available from the most recent IPCC Assessment Report (AR6: 2021).
- Councils have continued to favour "upper limits" of sea level rise for planning purposes over the past decade, with most continuing to apply values from the previous NSW government policy.
- Part A of the CMM (NSW Government, 2018) sets Mandatory Requirements as follows:
    - MR2: *"A CMP is to consider a range of timeframes and planning horizons including immediate, 20 years, 50 years, 100 years and (if council considers it relevant based on expert advice) beyond"*.
    - MR13: *"A CMP must demonstrate how a council has considered: (i) current and future risks at timeframes of immediate, 20 years, 50 years, 100 years and (if council considers it relevant based on expert advice) beyond"*.

For the present CMP, sea level rise projections at 2040, 2070 and 2120 can be considered representative of the 20-, 50- and 100-year timeframes. Previous analyses corresponding to 2050 and 2100 are no longer relevant and need to be reconsidered.

Unlike previous IPCC reports, data released alongside AR6 has provided localised relative mean sea level rise projections (including local oceanographic effects, isostatic rebound and other factors). The most comparable high emissions scenario from AR6 is known as the medium confidence SSP5-8.5 scenario. Projected sea level rise amounts, relative to 2005 (1995-2014 baseline) for Yamba[2] are presented in Table A-1.

[2] Acquired from https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool?psmsl_id=310, 20/02/2022

Table A-1 Projected Sea Level Rise under SSP5-8.5 (medium confidence) for Yamba for 2040, 2070 and 2120, relative to baseline of 1995-2014

Timeframe	Sea level rise amounts (in m) for different probabilities of being exceeded		
	50%	17%	5%
2040	0.17	0.22	0.27
2070	0.43	0.57	0.70
2120	1.05	1.48	1.82

Wainwright et al. (2014) showed an estimated mean sea level of around 4-5 cm above Australian Height Datum by 2005. This allowance is not included in Table A-1. From this table, and considering uncertainty, a sea level rise of ~0.35-0.4m could be considered indicative of 2040 conditions, a sea level rise of ~0.7m could be considered indicative of 2070 conditions and a value of ~1.4 - 1.5m would be a reasonable touchstone for considering conditions at 2120.

2.3.3 Beach Erosion and Shoreline Recession

Coastal hazard lines incorporating Beach Erosion and Shoreline Recession were derived by BMT WBM (2012). While these hazard lines would not meet present day standards for a detailed assessment (i.e., several lines with numerical probabilities attached), we note that their assessment also included hazard lines relating to reasonable sea level rise amounts as shown in Table A-2.

Table A-2 Hazard Lines from BMT WBM (2012b) that are Reasonable for Present Day Coastal Erosion and Recession Risk Assessment

Timeframe	Indicative Amount of Sea Level Rise (m)	BMT WBM Hazard Line
2040	0.4	2050 “unlikely”
2070	0.7	2050 “rare”
2120	1.4	2100 “rare”

The alignment of the sea level rise amounts included with the best current sea level rise projections of AR6 are not perfect but, given the limited infrastructure and development threatened by open coast hazards along the Bellingen Coast, these are acceptable.

BMT WBMs assessment of storm erosion contained within their hazard lines was non-standard considering methods of assessment that had been more commonly applied in preceding decades (for discussion of standard NSW practice at the time,

refer to Wainwright et al., 2014). The schema typically applied to analyse an eroded beach profile and to set zones where building and development constraints should apply was published by Nielsen et al. (1992) with the basis of the assessment illustrated in Figure A-8.

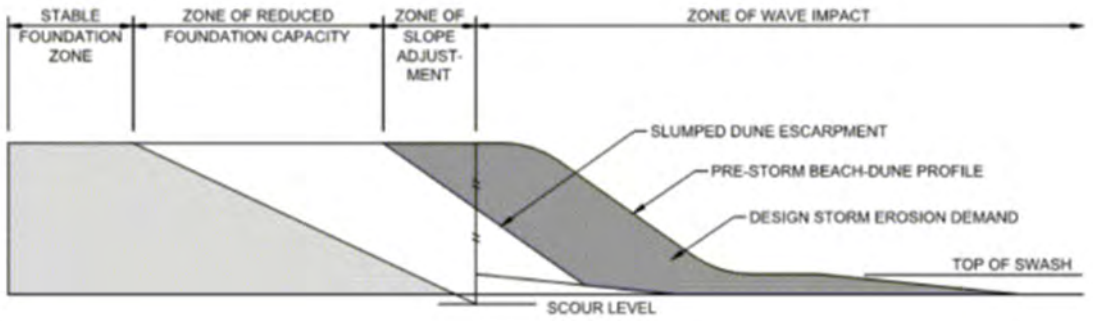

Figure A-8 Dune Stability assuming Homogenous Sand and No Water Table Gradients (SMEC, 2013, based on Nielsen et al., 1992)

The lines developed by BMT WBM seem to have been largely based on changes to the horizontal location of the 4m contour as indicated on photogrammetric profiles available at the time. For the most part, it is unlikely that this location represents the steep vertical scarp that remains following erosion by a storm (zone of wave impact). It is more likely that the scarp has collapsed and the 4m elevation line considered by BMT WBM typically sits somewhere within the "Zone of Slope Adjustment" shown on Figure A-8.

Ultimately, the landward extent of the CVA associated with coastal erosion and recession should relate to the Zone of Reduced Foundation Capacity (ZRFC) associated with a 100-year planning time frame (i.e., 2120 conditions), although a more risk averse position should be taken, ideally, for critical emergency facilities such as hospitals and/or evacuation centres.

While BMT WBM (2012) did not incorporate an allowance for the ZRFC in their hazard lines, they provided indicative values of the amount of the allowance, assuming a flat topped dune and homogenous dune sand with a 35° angle of repose. This allowance would need to be assessed along the coast, utilising the profile of the dune, if the CVA is to be mapped and suitable clauses drafted for Councils Development Control Plan. This would comprise a relatively cheap, GIS based assessment using more recently available LiDAR and could be completed prior to submission of a planning proposal to modify the SEPP (Resilience and Hazards) 2021.

In some cases, where there is development threatened within the projected extent of future coastal hazards, a more localised, but detailed study which meets present

standards should be considered. Along the Bellingen coastline, however, these locations are limited in extent.

2.3.4 Inundation (Coastal and Tidal)

Inundation has complex, interacting causes associated with catchment flooding, storm surge and other ocean water elevation anomalies, tides and coastal barrier overtopping by waves. The issue of inundation spans hazards 4, 6 and 7 from the CM Act (listed in Section 2.3.1)

Extreme Event Inundation and Comparison with Catchment Flooding

In the context of planning for hazards associated with the coastal zone it is clear, at least for the Bellinger and Kalang Rivers, that inundation related planning controls for these two rivers will be overwhelmingly dominated by fluvial flooding.

WMAWater (2021a) demonstrated that any significant impact of 0.9m of sea level rise on catchment flooding elevations is limited geographically, largely constrained to the area downstream of the Golf Course at Urunga and extending only 500m upstream along the Bellinger River (relative to its confluence with the Kalang). This is illustrated in Figure A-9.

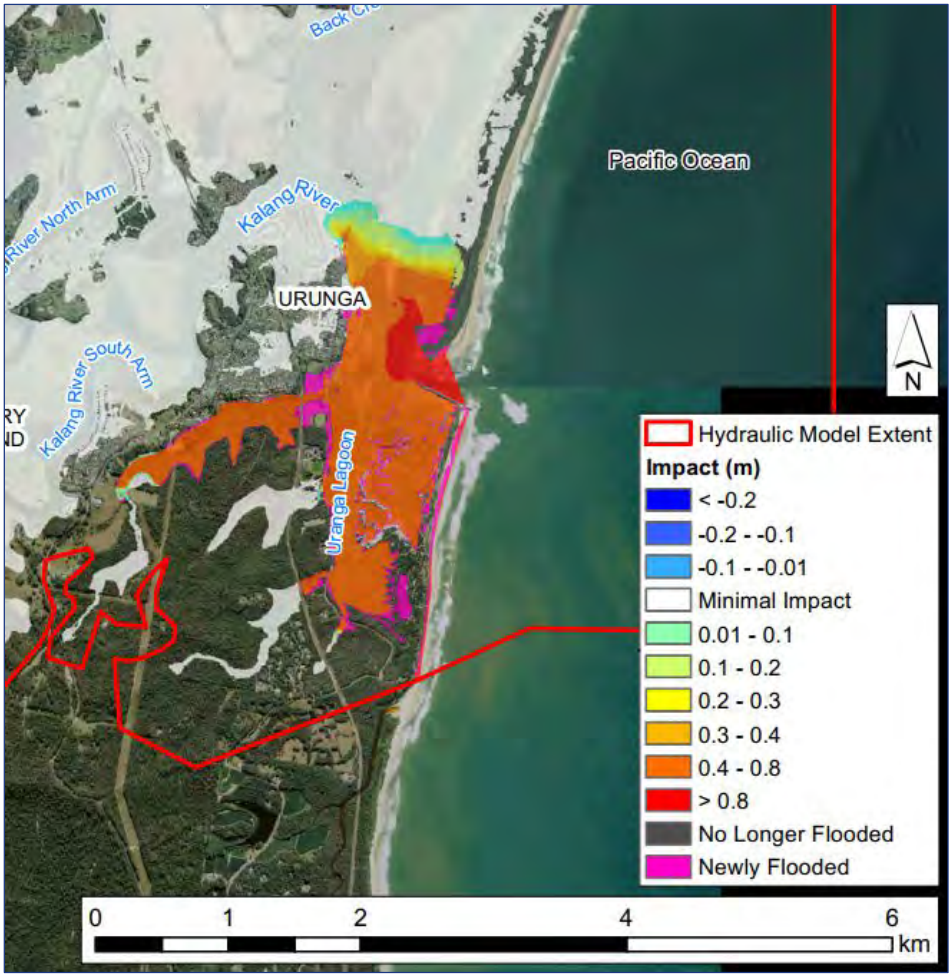

Figure A-9 Extract of Figure from WMA Water 2021, showing the impact of 0.9m of sea level rise on the 1% AEP flood elevation.

In a separate study BMT WBM (2015), also executed model simulations which provided a more detailed assessment of inundation caused exclusively by downstream sources (i.e., storm surge combined with sea level rise). Comparison of results arising from WMA Water's *Floodplain Risk Management Study* (i.e., the Flood Planning Area Extent) with BMT WBM's *Estuary Inundation Study* is also interesting. BMT WBM considered several different amounts of sea level rise in their analysis alongside 5% and 1% AEP coastal storm surge and king tide events.

A comparison of the BMT WBM derived 1% Storm Surge inundation extent results including 1.4m of sea level rise with the flood planning area derived by WMA Water shows that this subsequently adopted flood planning area completely contains the 1% AEP Storm surge / 1.4m sea level rise extent.

For these very rare types of inundation events, the hazard has a similar nature, with water levels rising in the river and then escaping onto the floodplain and flowing

over land over a period of several hours to a few days, with a similar period likely to be available to provide warning of the impending hazard.

Based on the preceding paragraphs, it is reasonable for Council to assume that the Coastal Inundation risk associated with planning for abnormal ocean water levels is adequately managed by the flood planning area presently established for the Bellinger/Kalang Rivers. However, it will be worthwhile consulting with the emergency services sector to ensure that flood emergency planning and actions consider inundation patterns which could arise from events dominated by coastal flooding.

Inundation around ICOLLs

There are several small intermittent coastal inlets (known as "ICOLLs") along the Bellingen Coast, the most significant of which are Oyster Creek and Dalhousie Creek. These ICOLLs have no permanent water record on which to base the hazard assessment. There are two sets of analyses which have aimed to address inundation hazard surrounding these ICOLLs in the past decade:

1 BMT WBM (2012).

2 BMT WBM (2015).

More recent analysis was carried out on a statewide basis, but did not include Oyster nor Dalhousie Creeks (OEH, 2018).

BMT WBM (2012) adopted, an "Unlikely" inundation level of 2.7m for both Dalhousie and Oyster Creeks comprising a still water level of 1.44m AHD (1% AEP) and an allowance for wave setup of 1.23m (15% of 8.2m significant wave height). A corresponding "Rare" value of 2.9m AHD was adopted, with 0.2m added to the underlying unlikely still water level.

For 2050 and 2100, corresponding values which included allowances of the impact of sea level rise and different "climatic conditions" were also determined and are shown in Table A-3.

Table A-3 Coastal Inundation Levels for ICOLLs (in mAHD, from BMT WBM (2012))

Likelihood	2011	2050	2100
Almost Certain	2.5	2.5[3]	2.5
Unlikely	2.7	3.1[4]	3.7[5]
Rare	2.9	3.4[6]	4.2[7]

[3] No Allowance for Sea Level Rise
[4] 0.4m of Sea Level Rise
[5] ~0.9m of Sea Level Rise
[6] ~0.7m of Sea Level Rise

In comparison, BMT WBM (2015), which also used a "Bathtub" (i.e. flat water surface) approach but used a different method to define the water levels.

BMT WBM (2015) concluded that, around Dalhousie and Oyster Creeks:

> *"inundation extents are largely confined to the main waterway and adjacent low-lying intertidal area. Private properties and other infrastructure are not expected to experience any significant inundation during infrequent tidal inundation events (i.e., with 20-year and 100-year ARIs) even with 1.4 metres of sea level rise."*

BMT WBM (2015) make the valid observation the entrance berm level increases when shut through the action of wave runup and, given that wave runup extent will increase in line with any sea level rise, that the height of the barrier which holds back water in an ICOLL before it can breach will also rise commensurately and therefore that the design water levels will increase in line with sea level rise. BMT WBM then used water level records from other NSW ICOLLs with similar catchment: waterway area ratios (Curl and Werri Lagoons) to estimate water level exceedance statistics for the current day condition. Somewhat incorrectly however, based on the catchment: waterway area ratio, they assumed that the waterways would open "several times per year". This does not seem to reflect local experience with either Oyster Creek (NPWS, 2008) or Dalhousie Creek (Hydrosphere Consulting, 2018a).

[7] ~1.4m of Sea Level Rise

Table A-4 Coastal Inundation Levels for ICOLLs (in mAHD, from BMT WBM (2015))

Event	Amount of Sea Level Rise (m)				
	0.0	0.4	0.7	0.9	1.4
Infrequent (5% AEP)	2.2	2.6	2.9	3.1	3.6
Rare (1% AEP)	2.6	3.0	3.3	3.5	4.0

BMT WBM's 2015 analysis has resulted in estimates that are 0.1 to 0.3 lower than their earlier work and there is, apparently, no rationalisation of those differences. The logic behind the approach differs, with the earlier work relating to water from the ocean overtopping and flooding the area behind the barrier, and the later work relating to wave runup building a barrier at the entrance which subsequently holds back catchment flood waters.

We have examined LADS/LiDAR data captured in late 2018 for the NSW Government (Fugro, 2019). Interrogation of the digital elevation models derived from that data indicated a barrier height of up to 2.6m in areas adjacent to Oyster Creek, and around 2.5m along the beach adjacent to Dalhousie Creek. Acknowledging the extremely dry conditions experienced during the period when the statewide data were captured hints that these barrier heights may be close to the highest that could be experienced. This doesn't exclude the possibility that the barrier could still be overtopped by wave runup, however.

The approach of OEH (2018), used a measure of local sand grain size to estimate the berm height that could be obtained at a barrier fronting an ICOLL. The reasoning here is that larger grain sizes represent areas more exposed to wave runup. The closest beach sediment sample that could be found was from Valla Beach (Troedson et al., 2016), and use of that sample to calculate a berm height, using the methods of OEH (2018) resulted in a 'saddle' berm height of 2.2m AHD. However, considering the data upon which this is apparently based, as reported in Hanslow et al. (2000) a "Potential" elevation of 2.5m could be expected. Admittedly, this is based on a sample taken from a more sheltered area further south on Valla Beach and may be an underestimate for Oyster and Dalhousie Creeks.

There is uncertainty surrounding appropriate design elevations, but it does seem unlikely that the barrier would exceed 2.6m AHD at present day sea levels for both Oyster and Dalhousie Creek. As uncertainty encourages a degree of conservatism, the values in Table A-3 are appropriate as a touchstone for assessing risks, and for defining the coastal vulnerability area.

We note that an entrance management strategy has been adopted for Dalhousie Creek (Hydrosphere Consulting, 2018b), which includes artificial opening at "agreed trigger criteria" although opening due to "High Water Level" is not considered a

likely trigger as there were no known public or private assets known to be threatened. The main triggers for opening the entrance to Dalhousie Creek revolve around amenity issues and beach access. There is no formal entrance management strategy for Oyster Creek. At Oyster Creek, it can be assumed that the entrance barrier reaches its full height without breaching.

Oyster Creek presents some complexity relating to management. The entrance to the creek, based on perusal of satellite imagery from the past decade, is closed for more than half of the time. The plan of management for the Jagun Nature Reserve (NPWS, 2008) notes that the creek stays shut for long periods and that the entrance is of significance to the Gumbaynggirr First Nations People.

The entrance, when open, can meander north and south along the entrance barrier. When more southwards, the entrance channel crosses the boundary into Jagun Nature Reserve. To the north, the entrance is contained within the Bellingen Coast Regional Crown Reserve. Oyster Creek comprises that part of the waterway which extends behind the beach barrier towards the south whereas the part which extends northwards is known as McGraths Creek. Furthermore, the properties most threatened by inundation are in Valla Beach, some 2.5-3.0km south of the entrance, and within the Nambucca Shire LGA. Responsibility for entrance management is not entirely clear.

Tidal Inundation and Impact of Sea Level Rise

As noted above under *Extreme Event Inundation*, the Flood Planning Area established for catchment flooding under the Floodplain Risk Management Process completely contains the coastal storm surge event extent, even with 1.4m of sea level rise. Accordingly, extreme flooding from storm surge is covered under that existing process and it would be counterproductive to include related actions in the CMP.

The impact of sea level rise on the inundation that will occur during normal tides was examined using a hydrodynamic tidal model by BMT WBM (2015). Consistent with Table A-2, results presented by BMT WBM for sea level rise of 0.4m (indicative of a 20-year time frame), 0.7m (50yr) and 1.4m (100yr) have been considered and compared to a scenario with no sea level rise. Figures showing modelled king tide inundations for both the lower coastal floodplain and surrounds (Figure A-10) and the entire coastal zone (Figure A-11) are provided to facilitate the discussion provided below. We note that there are several anomalies where BMT WBM's modelling does not seem to incorporate cross drainage underneath roads and king tide inundation under present day conditions may be underpredicted at those locations. However, with higher amounts of sea level rise, these limitations are not present, as the roads themselves are overtopped by king tides.

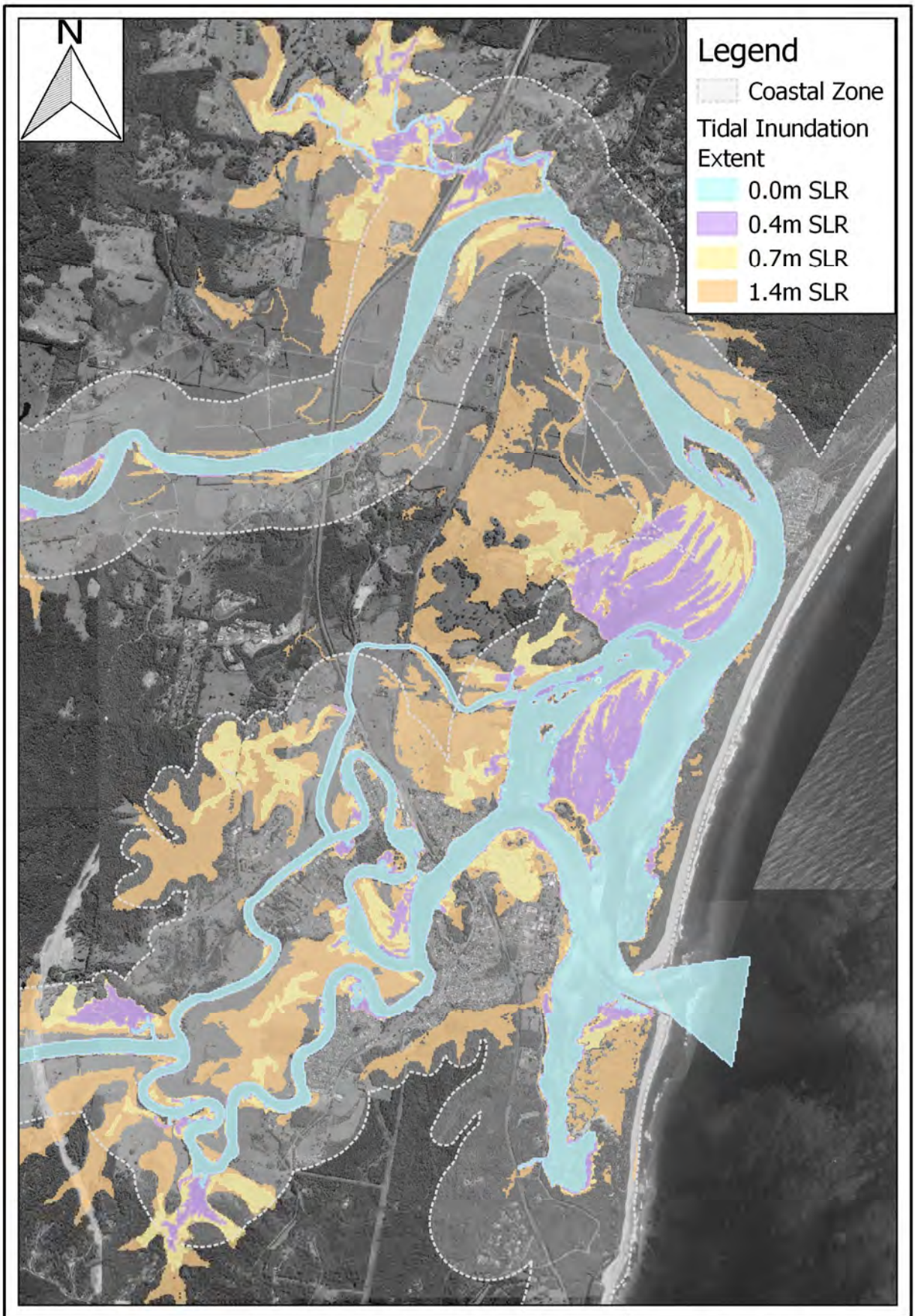

Figure A10: Tidal Inundation Extent Across Coastal Floodplain

0 0.5 1 1.5 km

APPROX SCALE

Bellingen Shire CMP

REV	DRAWN	CHECK
A	EN	DJW

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Salients

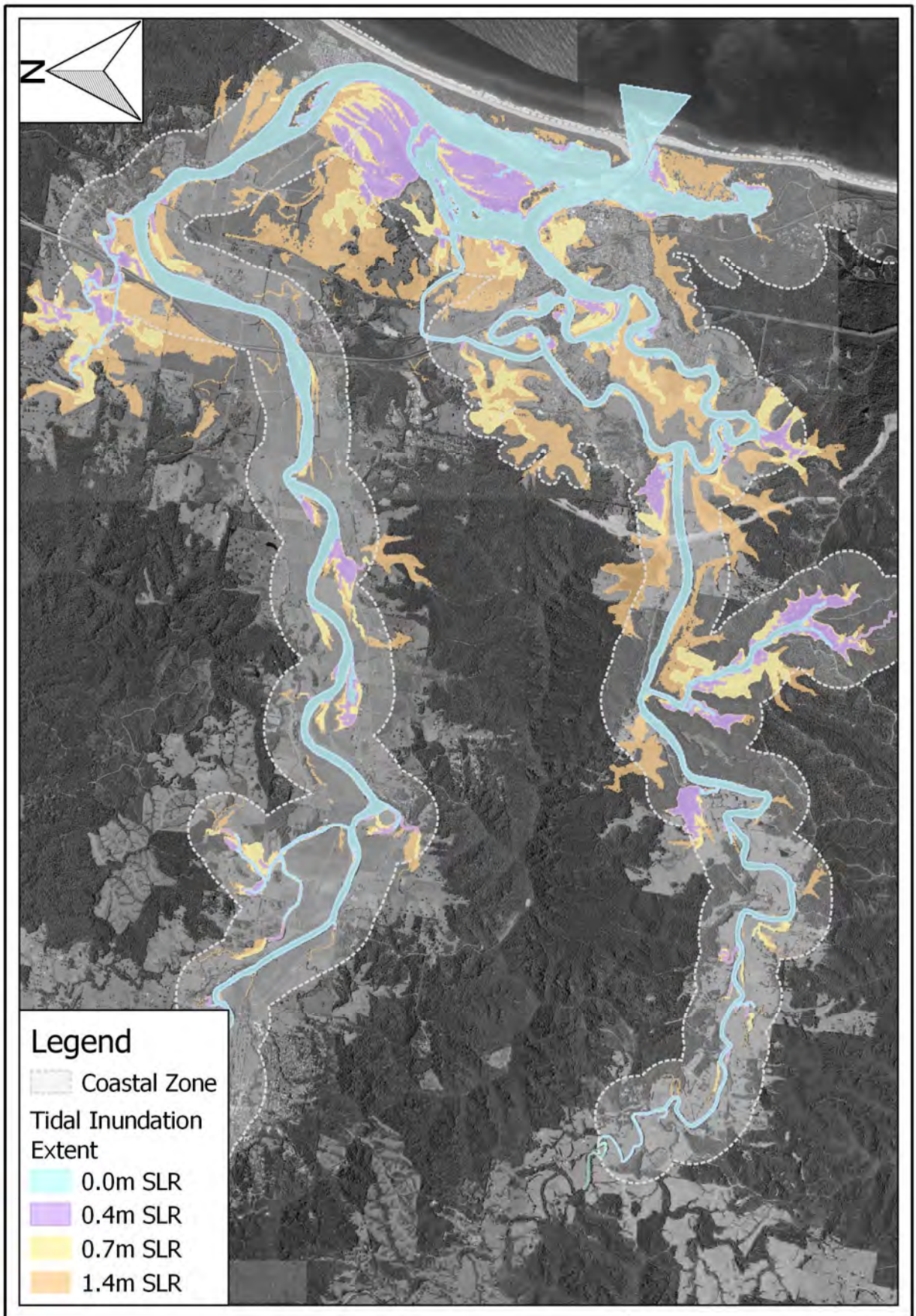

Figure A11: Coastal Zone Tidal Inundation Extent

0 1 2 3 km

APPROX SCALE

Bellingen Shire CMP	REV A	DRAWN EN	CHECK DJW	Salients

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The zero sea level rise scenario is similar to present day conditions, although we understand that the modelling undertaken for that scenario set mean sea level at 0.0m AHD. Present day (2022) mean sea level is closer to 0.1m above AHD. The zero scenario has been retained for comparison.

With mean sea level rise (SLR) of 0.4m (representative of a very unlikely 2040 scenario), the most notable impacts in the lower estuary are associated with the majority of Urunga Island now being inundated by king tides. Furthermore, inundation extends northwards into swales between successive alluvial ridge deposits to the south of Tuckers Island. Sections of Yellow Rock Road are inundated. It is these areas that should be the focus of any early management action related to increased tidal inundation.

With 0.4m of sea level rise, formally drained areas of the floodplain surrounding Manarm Creek, which flows from the north into the Bellinger River at Repton, begin to be inundated. Noting the low-lying nature of this part of the floodplain, acid sulfate soils may well be an issue here. Similarly, there are several low lying areas in and around Newry Island which will become inundated by King Tides.

Figure A-11 shows that 0.4m of SLR results in less pronounced inundation along the fluvially dominated reaches of the rivers, with additional inundation at the end of minor tributaries and within depressions remaining in the landscape from previously abandoned channel meanders. Most of this additional inundation is present on agricultural land. There is, however, notable additional inundation within Newry State Forest, around the fringes and upstream extents of Pickets Hill Creek and its tributaries.

In moving from 0.4m to 0.7m of SLR (from a representative 20 year to 50 year timeframe), Figure A-10 shows that the ridge lines associated with swales on Urunga Island and north of Back Creek towards Tuckers Island are now inundated by King Tides. Water also spreads more broadly onto the floodplain of Manarm Creek, and significant inundation begins to appear to the west of Back Creek, opposite Urunga Island. Around half of the fairway area of the Urunga Golf Course is inundated, and king tides also spread more across areas adjacent to and around Newry Island. A new area of inundation appears to the west of Boggy Creek, inundating forested land either side of South Arm Road.

There is notable additional inundation around Picket Hill Creek. However, additional inundation of tributaries leading off the fluvial reaches of the rivers is reasonably limited, most likely due to the steeper topography adjacent to these parts of the estuary.

In moving from 0.7m to 1.4m of SLR (from a representative 50 year to 100-year timeframe), Figure A-10 shows an extraordinary increase in the area inundated by

king tides. Close to 50% of the agricultural land between Back Creek and extending up to Mylestom, Repton and Raleigh (but mostly confined to the east of the railway line) is shown as inundated by king tides with possibly an even greater proportion of the floodplain associated with Manarm Creek now inundated. Inundation is extensive across the southern Parts of Newry Island, although the northern residential areas remain dry. Extensive inundation occurs within the hind dunes area between the ocean and Urunga Lagoon. Most of the golf course at Urunga is now inundated by king tides and there are several low-lying residential properties within Urunga itself that would be inundated by king tides.

There is substantial additional inundation to the west of Newry Island, both north and south of the Kalang River extending westward beyond the Pacific Motorway and apparently joining up relic drainage depressions from old meanders of the Kalang River. Additional inundation around Picket Hill Creek is comparatively constrained although several additional areas of inundation appear along the lower fluvial dominated reaches of the Kalang. The increase in inundation becomes less pronounced with distance upstream.

Along the fluvial reaches of the Bellingen, the increase in inundated area is similar in moving from 0.7 to 1.5m SLR, when compared to the additional inundation arising from an increase from 0.4 to 0.7m.

In summary, residential property only seems to become threatened between 0.7 to 1.5m and this need not be a substantial concern at the present time although planning measure may be warranted. However, there are medium term threats to agricultural land on Urunga Island and north of Back Creek that are of concern, and more extensive impacts on agriculture would begin to arise with SLR that could be expected over a 50-year time frame. Urunga Golf course begins to be threatened with SLR of more than 0.4m and this could be expected to occur within 30 years although this may take longer to eventuate.

The extents of tidal inundation extend well beyond the bounds of the coastal zone in many locations with higher levels, and in some locations with only moderate levels of SLR. Consideration should be given to adjusting the SEPP (Resilience and Hazards) 2021 maps to allow for those areas to at least be included in the *Coastal Environment Area*.

Overtopping

To the best of our knowledge, no studies have yet been undertaken of hazards associated with overtopping of beach barriers by ocean waves within the LGA. Again, this process is complicated and will interact significantly with a receding coastline, due to SLR, which may cause beach barriers to narrow and lower.

Beach barrier heights are governed by several processes including the height to which waves run up a beach, the presence of vegetation (which traps windblown sand) and sheltering of an area from winds (by adjacent headlands) and waves. For example, a beach to the north of a headland and/or reef is sheltered from the dominant south easterly wave climate of the NSW coast.

As a rule of thumb in NSW, it is considered that maximum 'design' runup levels for an exposed barrier (e.g., sandy nearshore zone facing towards East/Southeast) is around 7m above mean sea level (approximately 7m above Australian Height Datum). With, say, 1m of sea level rise, a maximum run up elevation of around 8m AHD could be expected.

A digital elevation model of the Bellingen coastline derived from data collected on behalf of the NSW state government in 2018 (Fugro, 2019) was examined to ascertain areas where the barrier was lower than 8m AHD and particularly areas lower than 6m AHD.

Areas identified as having a low barrier height were:

1 A length of the spit a few hundred metres south of Mylestom and extending southwards for some 1.5km, separating the Bellinger River and the Ocean. The narrowest parts of this spit are closer to Mylestom.

2 Isolated areas further south along this spit, but closer to the trained ocean entrance. These areas are backed by a wide expanse of vegetated dune and intertidal areas adjacent to the estuary and the threat of overtopping induced breakthrough is less than at location (1)

3 Isolated patches of low dunes with limited extent, between Urunga Lagoon and the Coast. Similar to the locations described under (2), these are backed by a wide expanse of elevated dune and intertidal area adjacent to Urunga Lagoon.

4 A low area immediately to the north of Wenonah Head, containing facilities understood to be informally managed by the Urunga Sport Fishing Club (BMT WBM, 2014). The low dune height here is expected to be, at least partially, due to the protection provided by the reef complex which exists offshore of Wenonah Head.

Other than these locations, other low points in the coastal barrier are in the immediate vicinity of coastal entrances (either intermittent or permanent).

Our assessment is that the primary risk associated with overtopping and low barriers is associated with potential breakthrough of the spit some 500m south of Mylestom. The others are minor in comparison.

2.3.5 Coastal Lake or Watercourse Instability

Coastal Lake or watercourse instability (Hazard 3) is not a major concern for the Bellingen Shire as:

- The entrance to the Bellinger/Kalang Estuary is trained and fixed in its location and remains open.
- The entrance to the Oyster Creek ICOLL is currently managed in its natural state and movement of that entrance alongshore does not impact any built infrastructure of significance.
- The entrance to Dalhousie Creek has an existing, recently adopted management strategy and the actions therein can be adopted to manage this entrance for the duration of the CMP.

One data gap which remains is that movement of the Dalhousie Creek entrance, possibly in conjunction with erosion from extreme coastal storms, could result in undermining of the access road to the Urunga SLSC and given even more severe conditions, undermining of the SLSC building itself. It seems possible that the building is founded on or above rock, which would be resistant to erosion. For this reason, a small geotechnical study to identify the extent and depth of rock has been recommended for this area in the past and such an action should be carried forwards to the CMP.

2.3.6 Erosion of Foreshores (From tidal waters, waves, and their interaction with catchment floodwaters)

As part of their study, Telfer and Cohen (2010) completed a riverbank condition assessment and identified sites of erosion concern. Their work is a suitable starting point on which to base related actions of the CMP.

There are some considerations of relevance to actions in the CMP:

- The CMP has limited scope to force actions on private land without the consent and cooperation of the landowner. Broader approaches such as the identification of priority sites, establishment of a funding mechanism to complete works and the development or adoption of suitable guidelines for any works could be considered as management actions in the CMP when addressing erosion on private land.
- Strict application of a "beneficiary pays" principle would result in the private landowner funding any works if the sole objective of the works were to protect their land from erosion.

- Public funding may be considered if there is a demonstrable environmental benefit from proposed works such as the establishment, fencing and revegetation of a riparian buffer, or if protective works curtail the delivery of sediment loads into the estuary.

Telfer and Cohen identified 28 sites and prioritised these into "Highest", "High" and "Moderate" priority sites. The locations are shown in Figure A-12. "Highest" and "High" sites should be prioritised for treatment, and any additional sites that have been identified over the past decade should also be considered for inclusion.

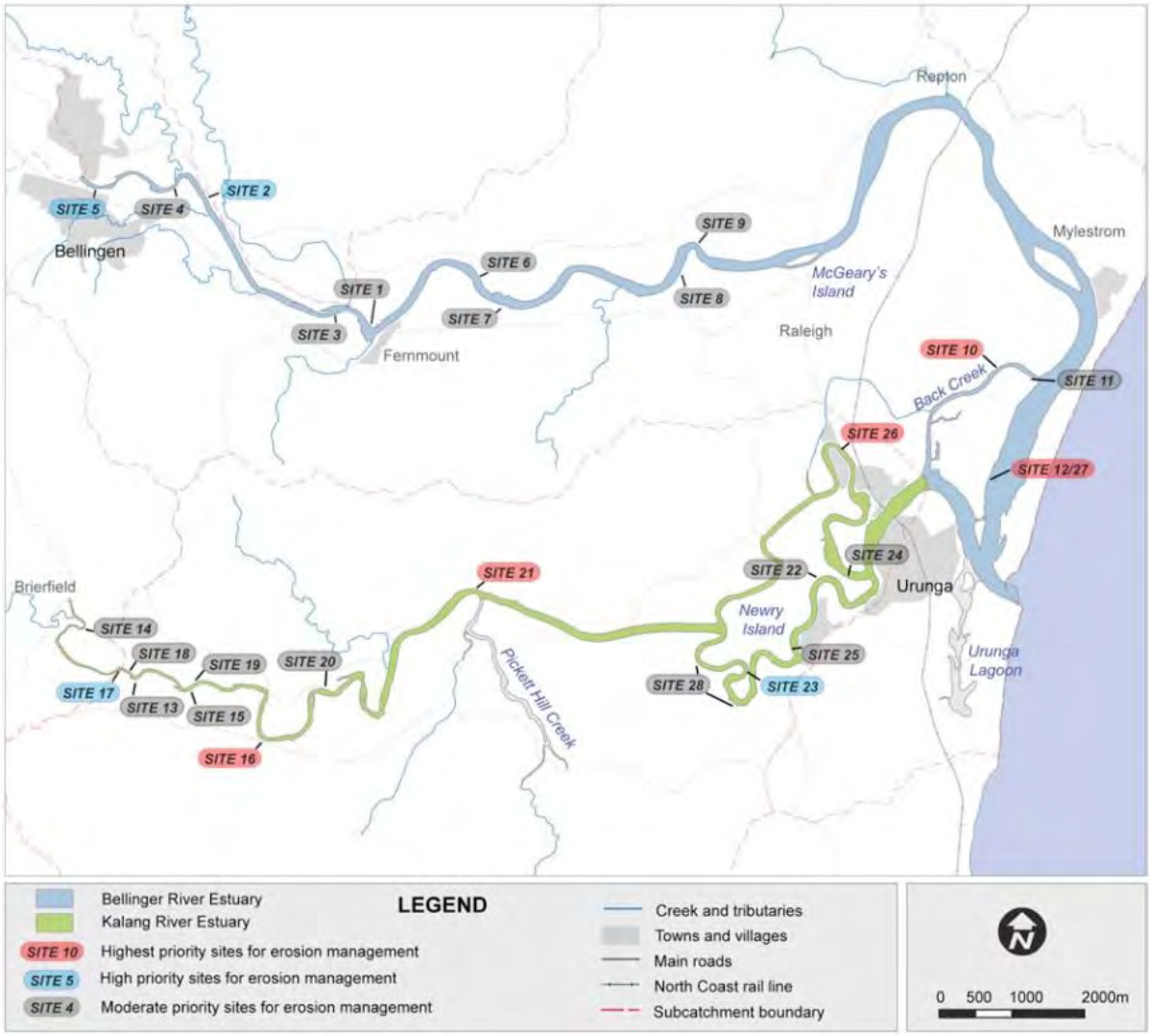

Figure A-12 Target Erosion Management Sites as Identified by Telfer and Cohen (2010)

The principles outlined in Telfer and Cohen are sound and should be used to guide CMP actions. They noted that, from a purely environmental standpoint, the highest priorities were:

1 Protection of reaches in good condition by removing threatening processes.

2 Action where reaches are of high value or can be easily restored.

However, they acknowledged the constraints associated with private land and the presence of human infrastructure and development. They listed the following general recommendations for consideration:

1 Protect existing public infrastructure.

2 Protect important conservation values.

3 Protect existing works.

4 Utilise best-practice erosion control techniques.

5 Improve riparian vegetation.

6 Manage recreational boat use.

In terms of coastal vulnerability (i.e., "Coastal Hazards"), sites are of particular importance where they threaten existing infrastructure (roads, bridges etc.).

In their draft plan for water quality management, Jeremy Benn Pacific (2022) recommended site specific erosion investigations at the following locations:

- Gordonville Road (some distance upstream of Bellingen, beyond the coastal zone) where the causeway was noted as requiring repair.
- Mylestom reserve bank stabilisation.
- Shoreline Stabilisation around Urunga.

Other actions recommended by Jeremy Benn Pacific included advocating for restoration of erosion on private land, minimising the impact of boating on bank erosion (particularly the southern branch of the Kalang around Newry Island, and Back Creek), and bank stabilisation and revegetation works on Council-managed land.

3 Ecological Context

3.1 Introduction

The Bellingen Shire contains a number of key ecological features that are documented within the Bellingen Shire Biodiversity Strategy (Ecological Australia, 2021). Those relevant to the coastal zone include:

- Approximately 190km of foreshore along the Bellinger and Kalang Rivers.
- Mangrove and saltmarsh habitats protected under the *Fisheries Management Act 1994*.
- 65 threatened fauna species in the coastal zone (of 87 shire wide) as listed under the NSW *Biodiversity Conservation Act 2016* (BCAct).
- 24 threatened fauna species as listed under the federal *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- 14 migratory birds protected under international agreements (JAMBA, CAMBA, ROKAMBA), all of which utilise the coastal zone as primary habitat.
- Nine threatened ecological communities as listed under the BC Act.
- 13 species of threatened flora in the coastal zone (of 27 shire wide) as listed under the BC Act.
- 7 threatened flora species under the EPBC Act.

3.2 Littoral Rainforest

Littoral Rainforests occur on sheltered southerly and western slopes where average rainfall is high. The SEPP (Resilience and Hazards) 2021 includes a littoral rainforest map. For Bellingen Shire this mapping replicates the superseded SEPP 26 (Littoral Rainforests) mapping. The SEPP 26 mapping was based on 1:25000 aerial photography, analysed and field verified in 1986 and subsequently digitised in 2003[8]. It includes a 2.4 hectare area of Littoral Rainforest on the Urunga sandmass and two smaller patches north and west of the Surf Life Saving Club at Wenonah Head.

In 2011/2012 the NSW Office of Environment and Heritage completed fine-scale floristic vegetation mapping of the Bellingen LGA based on high resolution aerial photography and floristic field-based site data. Known as the 'Vegetation Map of Bellingen Local Government Area' (Office of Environment and Heritage, 2013), this mapping identifies an additional 18 patches of Littoral Rainforest from Oyster Creek

[8] https://data.gov.au/data/dataset/c6c20dcc-8f14-44b5-a018-b8865c4193e5

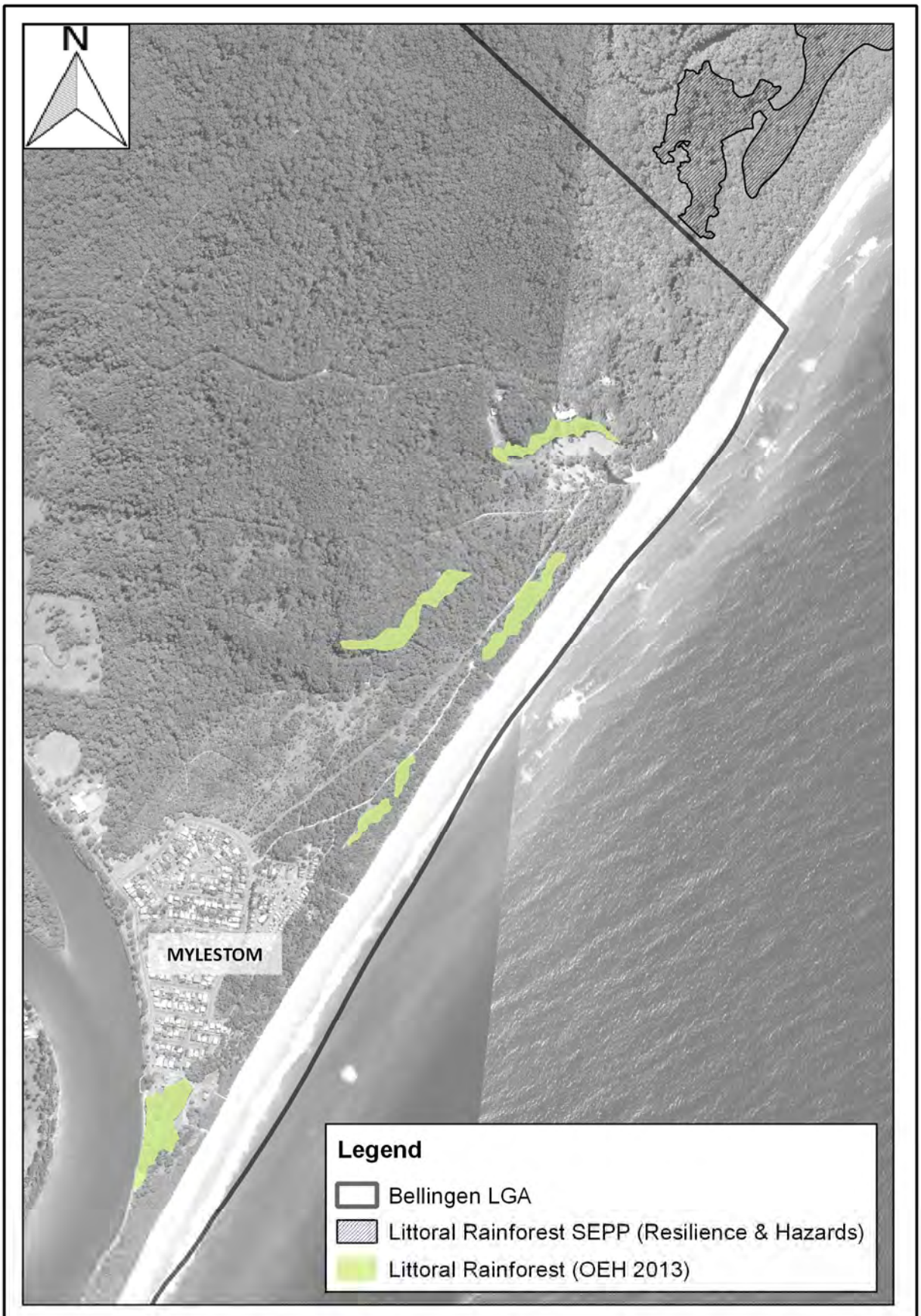

Figure A-13: Littoral Rainforest SEPP v OEH 2013 mapping (north of the entrance)

0 150 300 450 m

APPROX SCALE

Bellingen Shire CMP Stage 2 Report

REV	DRAWN	CHECK
A	ML	DJW

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Salients

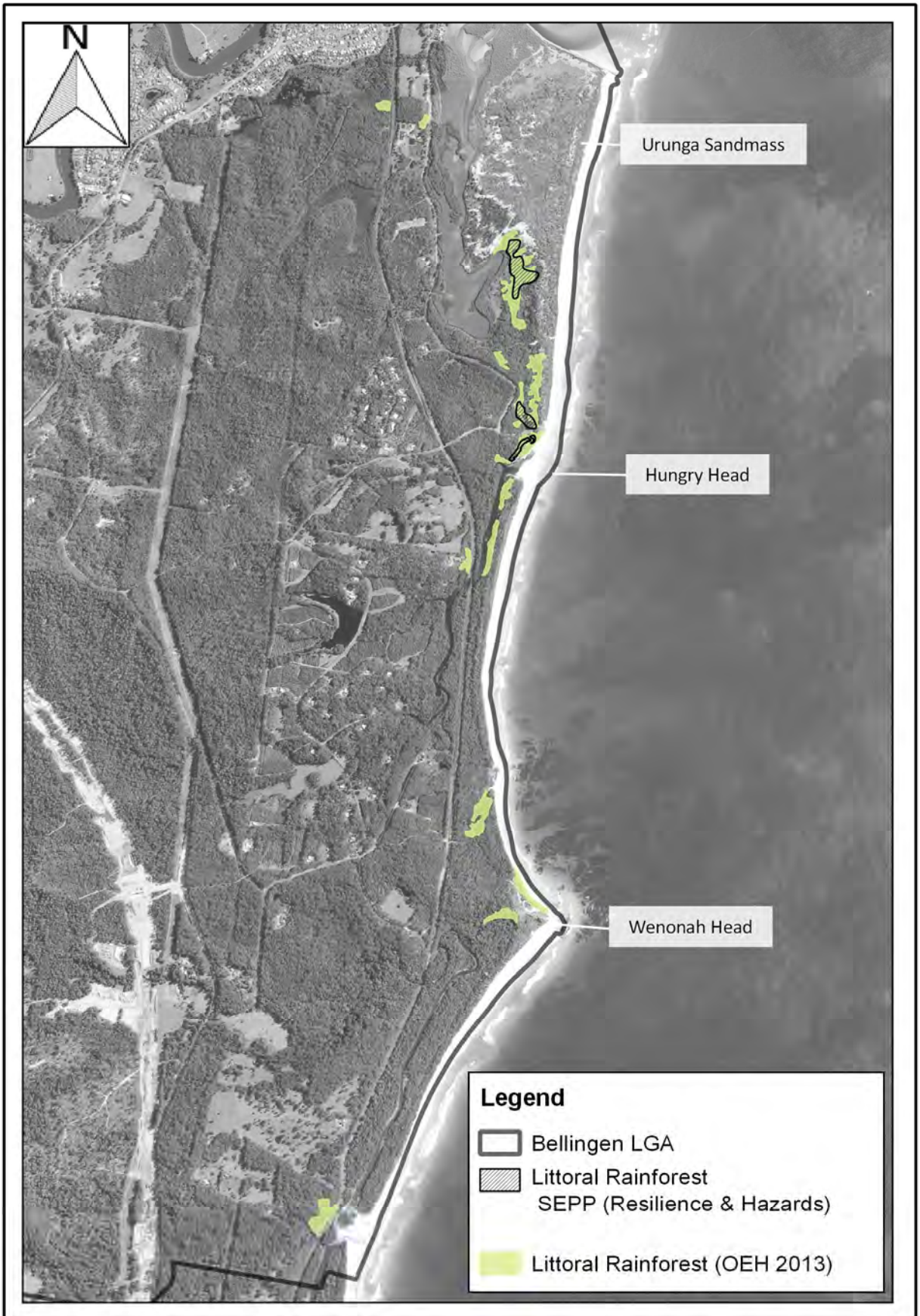

Figure A-14: Littoral Rainforest SEPP v OEH mapping (south of the entrance)

0 0.3 0.6 0.9 km

APPROX SCALE

Bellingen Shire CMP Stage 2 Report

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Salients

areas total 21.82 hectares. Comparatively, the SEPP (Resilience and Hazards) 2021 mapping of Littoral Rainforest has a total area of 3.95 hectares which represents only 18% of the area identified as Littoral Rainforest in the more recent mapping.

Of particular concern, are those patches of Littoral Rainforest that are not mapped in the SEPP (Resilience and Hazards) 2021 and have a land zoning that does not promote environmental protection of this. The patch of Littoral Rainforest at Oyster Creek is zoned RU2 (Rural Landscape). At Wenonah Head, most Littoral Rainforest falls within a conservation zone, however to the west and north of Dalhousie Creek, patches of Littoral Rainforest lie within RU4 (Primary Production Small Lots), R5 (large Lot Residential) and RE1 (Public Recreation) zones. To the west of Urunga Lagoon there is a small patch of Littoral Rainforest within an RE1 (Public Recreation) zone. Throughout the remaining local government area, all Littoral Rainforest is within a conservation zone.

As with much of the native vegetation in developed landscapes, the Littoral Rainforest has been subject to varying levels of disturbance. In the past this has included sand mining, understorey clearing and removal for agricultural and urban development. Ongoing threats to Littoral Rainforest include invasion by exotic weeds, fire, clearing on freehold land, edge effects from urban development and uncontrolled vehicle access. Bush regeneration of the Littoral Rainforest, on the former sand mining site at the Urunga sand-mass, has successfully improved both the extent and condition of the vegetation. However ongoing opportunities exist to further this work and prevent further disturbance associated with informal recreational access. The Littoral Rainforest at Wenonah Head was assessed as part of the 2019 Vegetation Management Plan (VMP) for Dalhousie Creek (Bellingen Bush Regenerators, 2019). The VMP states that the vegetation is generally in good condition but would benefit from bush regeneration to remove mid-story woody weeds and ground-layer invasive species that restrict native species recruitment. Except for the Urunga sandmass and the Littoral Rainforest adjoining Wenona Head SLSC, the condition of the remaining remnants is undocumented.

Littoral Rainforest is also at risk from coastal hazards, with the severity of the risk increasing over time due to sea level rise and erosion. The increasing severity would be largely driven by rising tide levels in future. The assumptions mad around sea level rise for different time frames are discussed in Section 2.3.2.

As Littoral Rainforest tends to occupy slopes it is largely safe from direct coastal inundation (see Figure A-15). Nevertheless, due to proximity of Littoral Rainforest to the coastline, it is threatened by coastal erosion. Figure A-16, Figure A-17 and Figure A-18 illustrate the projected coastal erosion lines in the immediate, 20-year, 50-year, and 100-year timeframes.

It is evident that areas of Littoral Rainforest on North Beach, Hungry Head and Wenonah Head are at immediate risk, with increasing areas of risk over time. The patch of Littoral Rainforest at Valla Beach remains unaffected by projected coastal erosion.

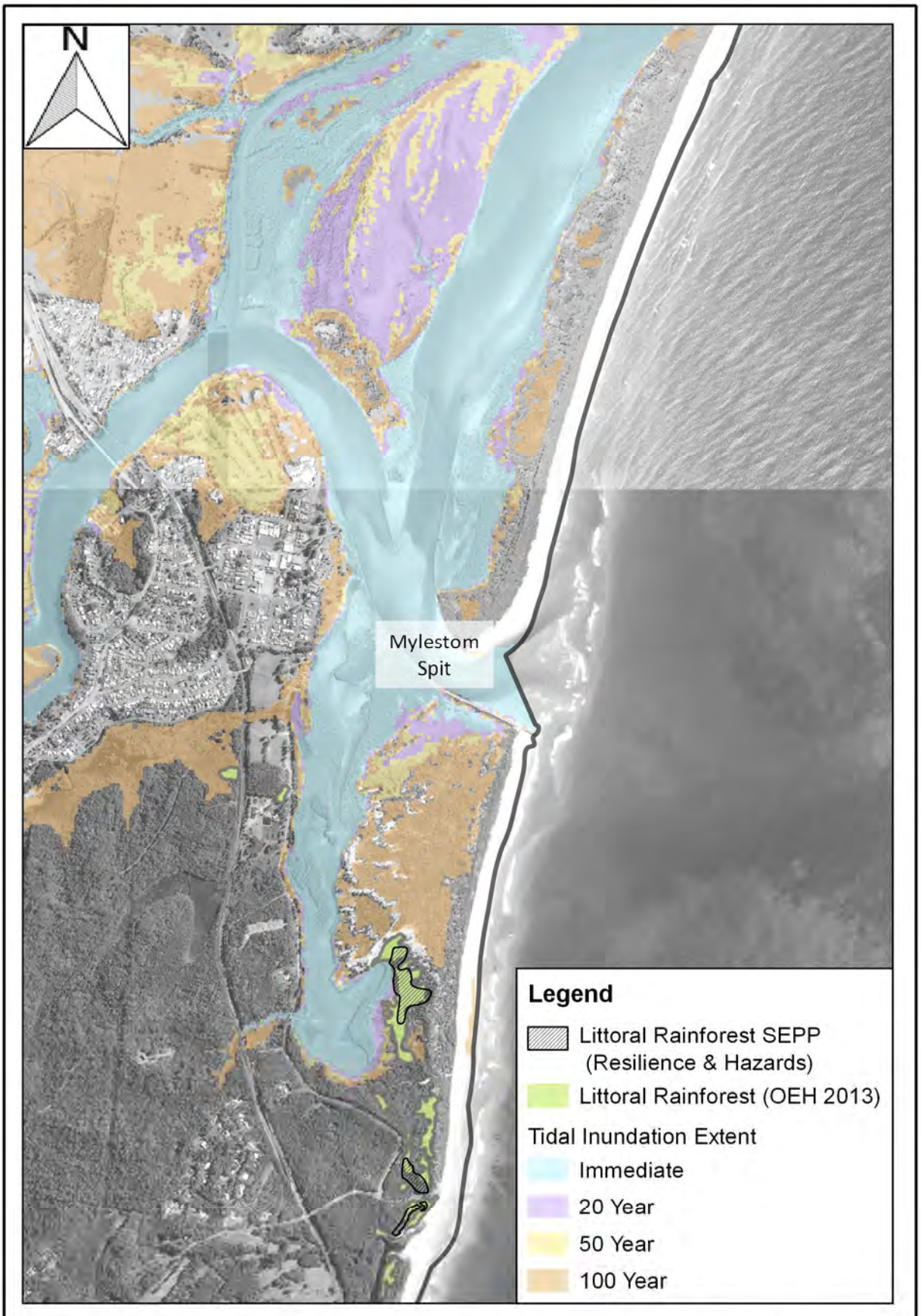

Figure A-15: Littoral Rainforest and Projected Tidal Inundation

0 250 500 750 m

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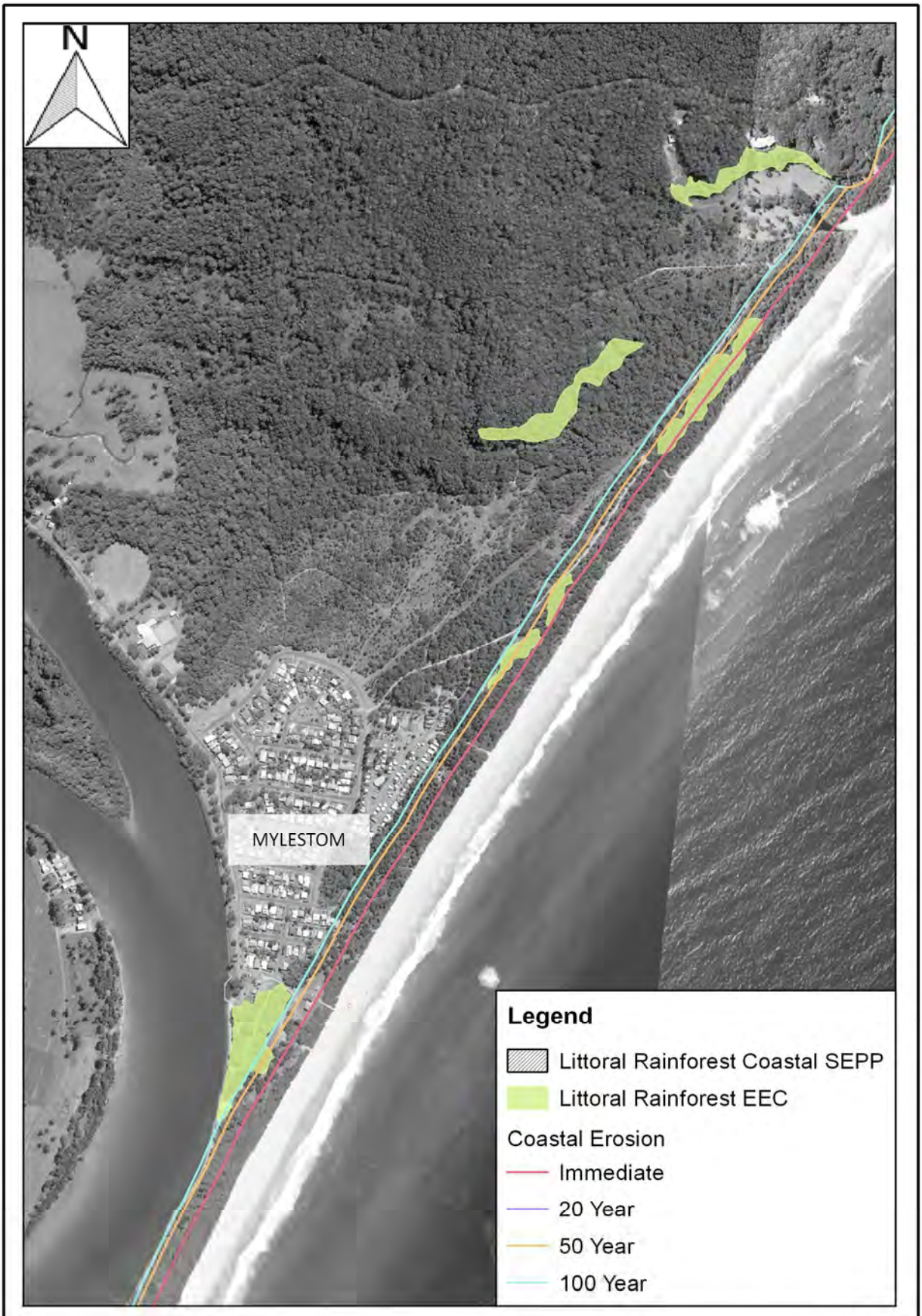

Figure A-16: Littoral Rainforest and projected coastal erosion Mylestom to Tuckers Rock

0 150 300 450 m

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Figure A-17: Littoral Rainforest and Projected Coastal Erosion at Hungry Head

0 100 200 300 m

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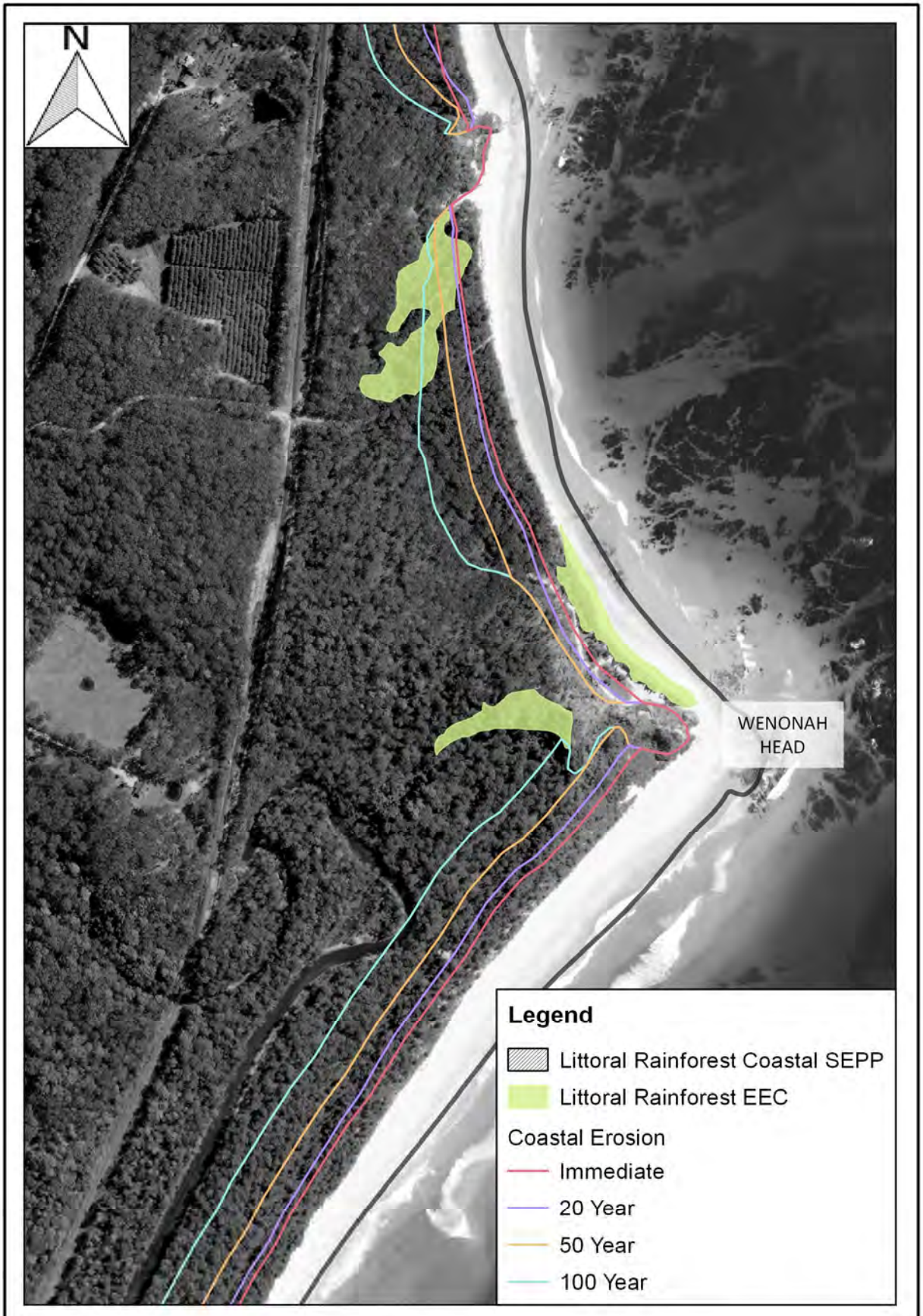

Figure A-18: Littoral Rainforest and Projected Coastal Erosion at Wenonah Head

0 100 200 300 m

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3.3 Coastal Wetlands

Coastal wetlands are defined as vegetation communities dominated by mangroves, saltmarsh, melaleuca forest, casuarina forest, sedgelands, brackish and freshwater swamps and wet meadows. The water source for coastal wetlands in the Bellingen Shire is either floodplain waters or estuary / tidal influence. The SEPP (Resilience and Hazards) 2021 coastal wetland mapping consists of:

- Coastal wetland mapping derived from refined SEPP 14 coastal wetlands mapping.
- Mangrove and saltmarsh stands in excess of 5000m^2 within the DPI Fisheries Estuarine Macrophytes dataset[9].

The SEPP (Resilience and Hazards) 2021 mapping identifies 314.2 hectares of coastal wetlands in the coastal zone. The largest areas of coastal wetland include Urunga Lagoon, Mylestom Spit, Urunga Island and on the floodplains north-west of Newry Island.

As with Littoral Rainforest, local high resolution vegetation mapping has not been incorporated into the SEPP (Resilience and Hazards) 2021 mapping. The 2013 high resolution vegetation mapping (Office of Environment and Heritage, 2013) identifies five coastal wetland communities within the coastal zone (see Table A-5). Coastal wetlands are defined as wetland communities dominated by mangroves, saltmarshes, melaleuca forests, casuarina forests, sedgelands, brackish and freshwater swamps or wet meadows (NSW Government Department of Planning and Environment, 2018).

Table A-5 Coastal wetland communities in the coastal zone (2013 Vegetation Map of the Bellingen LGA)

Coastal Wetland Community	Area (hectares)
Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions EEC	122.8
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC (floodplain only)	244.5
Subtropical Coastal Floodplain Forest of the NSW North Coast bioregion EEC (floodplain only)	62.6
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC	196.1
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions EEC (floodplain only)	312.0
TOTAL	**938.0**

The SEPP (Resilience and Hazards) 2021 mapping represents 33% of the total coastal wetlands identified in the 2013 vegetation mapping. Almost all coastal wetlands mapped under the SEPP (Resilience and Hazards) 2021 are on land zoned for Environmental Conservation (E2), Environmental Management (E3) or Natural

[9] https://datasets.seed.nsw.gov.au/dataset/estuaries-including-macrophyte-detail5ebff

Waterway (W1). For the coastal wetlands mapped in the 2013 vegetation mapping, 29% lie on land zoned for environmental conservation purposes and 43% on land zoned for primary production or rural landscape. This is important as allowable activities and planning controls can vary substantially between conservation and rural lands.

Clearing of native vegetation on rural land is governed by the Local Land Services Act 2013, The Native Vegetation Regulatory Map and the Land Management (Native Vegetation) Code 2018[10]. Together these planning tools assist in determining whether landholders require consent to clear native vegetation.

Should the SEPP (Resilience and Hazards) 2021 mapping be amended to include the coastal wetlands mapped in the 2013 vegetation mapping, this would provide greater consideration of the impacts of development in or near coastal wetlands on rural lands. The SEPP (Resilience and Hazards) 2021 requires development consent to clear land, even if that land does not require approval under the Land Management (Native Vegetation) Code 2018.

Some areas of coastal wetlands can be susceptible to edge effects due to their linear nature and large perimeter to area ratios. Many wetlands in the coastal zone are bordered by rural land, roads, the rail corridor, electricity easements and residential housing. South Arm Road Urunga cuts through one of the larger patches of Coastal Swamp Forest. Edge effects of concern for coastal wetlands in the Bellingen Shire include:

- Aquatic and terrestrial weeds.
- Boat wash.
- Stock access.
- Progressive edge clearing for development of rural and residential land.

Additional threats identified include filling of the wetland and floodplain, runoff from urban stormwater and septic systems, vehicular and pedestrian access.

Where coastal wetlands are bordered by hard structures such as roads, there is little room to migrate in response to coastal inundation. In many areas coastal wetlands are bordered by agricultural land and could be reasonably expected to migrate into these areas. Other sites such as the wetlands north-east of Burrawong Parade, Urunga will likely be squeezed out due to land filling south of the wetland.

[10] https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/native-vegetation-regulatory-map

Figure A-19: Coastal Wetlands SEPP v OEH 2013 mapping (north of the entrance)

0 0.3 0.6 0.9 km

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Figure A-20: Coastal Wetlands SEPP v OEH 2013 mapping (south of the entrance)

0 0.5 1 1.5 km

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Most coastal wetlands lie less than 800 metres from another wetland, thereby enhancing connectivity and potential for habitat corridors. However, information regarding the condition of the coastal wetlands is not readily available. Given the importance of wetlands and the valuable ecosystem services they provide, site specific condition assessments may be warranted as part of the CMP.

The Bellingen Shire Biodiversity Strategy (Ecological Australia, 2021) recommends:

- *Updated mapping of all coastal and wetland Threatened Ecological Communities.*
- *Identification of planning control opportunities to provide greater protection of wetlands, mangroves and saltmarsh.*
- *Preparation of a Council Policy to protect mangroves, mudflats, seagrass, coastal lagoons and shorebird habitat.*
- *Ensure that foreshore infrastructure is implemented in a way which protects wetlands, lagoons, saltmarsh and mangroves.*

3.4 Biodiversity Values Map

The Biodiversity Values (BV) Map[11] identifies land with high biodiversity value that is particularly sensitive to impacts from development and clearing. The Biodiversity Values Map is relevant for:

- *local developments (development under Part 4 of the Environmental Planning and Assessment Act 1979 which is not state significant development or complying development)*
- *clearing regulated by Chapter 2 of the State Environmental Planning Policy (Biodiversity and Conservation) 2021*
- *exempt and complying development (development regulated by the State Environmental Planning Policy (Exempt and Complying Development Codes) 2008 where clearing is regulated by the Vegetation SEPP.*

The BV map is prepared by the Department of Planning and Environment (DPE) under Part 7 of the BC Act. Table A-6 outlines the land types of biodiversity value and their representation in the Bellingen coastal zone (see Figure A-21, Figure A-22 and Figure A-23). Any changes to the coastal wetlands and Littoral Rainforests mapped under the SEPP (Resilience and Hazards) 2021, may result in changes to the BV map, as a contributing land type.

[11] https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BOSETMap

Table A-6 Land Types in the BV map represented in the Bellingen coastal zone

Land Type	Representation in coastal zone
Coastal wetlands and littoral rainforest mapped under the State Environmental Planning Policy (Coastal Management) 2018	See Figure A-14, Figure A-19 and Figure A-20 for extent of coastal wetlands and littoral rainforest as mapped in the SEPP (Resilience and Hazards) 2021.
Core koala habitat identified in a plan of management under State Environmental Planning Policy No 44 – Koala Habitat Protection (SEPP 44) (replaced by SEPP (Koala Habitat Protection) 2019 on 1 March 2020)	Core koala habitat north-east of Mylestom and patches north of Bellinger River.
Declared Ramsar wetlands defined by the Environment Protection and Biodiversity Conservation Act 1999	None
Land containing threatened species or threatened ecological communities identified as being at risk of serious and irreversible impacts (SAII) under section 6.5 of the BC Act	One area at the upstream extent of the coastal zone – likely to be for Bellingen Snapping Turtle as extends to upstream reaches.
Protected riparian land	An approximate 20m buffer in sections of Dalhousie Creek, McGraths Creek, Oyster Creek, Hogans Creek, Pine Creek, Spicketts Creek, Manarm Creek, Connels Creek, Burdett Park Creek, Frenchmans Creek.
High conservation value grasslands or groundcover	None
Rainforest identified in mapping developed under the National Forests Policy Statement	11 separate areas. Two between Tuckers Rock and Mylestom. Smaller areas adjoining Dalhousie and Oyster Creeks. Lowland rainforest in Forestry Management Zones adjoining Bellinger and Kalang Rivers.
Declared areas of outstanding biodiversity value	None
Old growth forest identified in mapping developed under the National Forests Policy Statement	None
Council nominated areas with connectivity or threatened species habitat that the Minister considers will conserve biodiversity at a bioregional or state scale	None

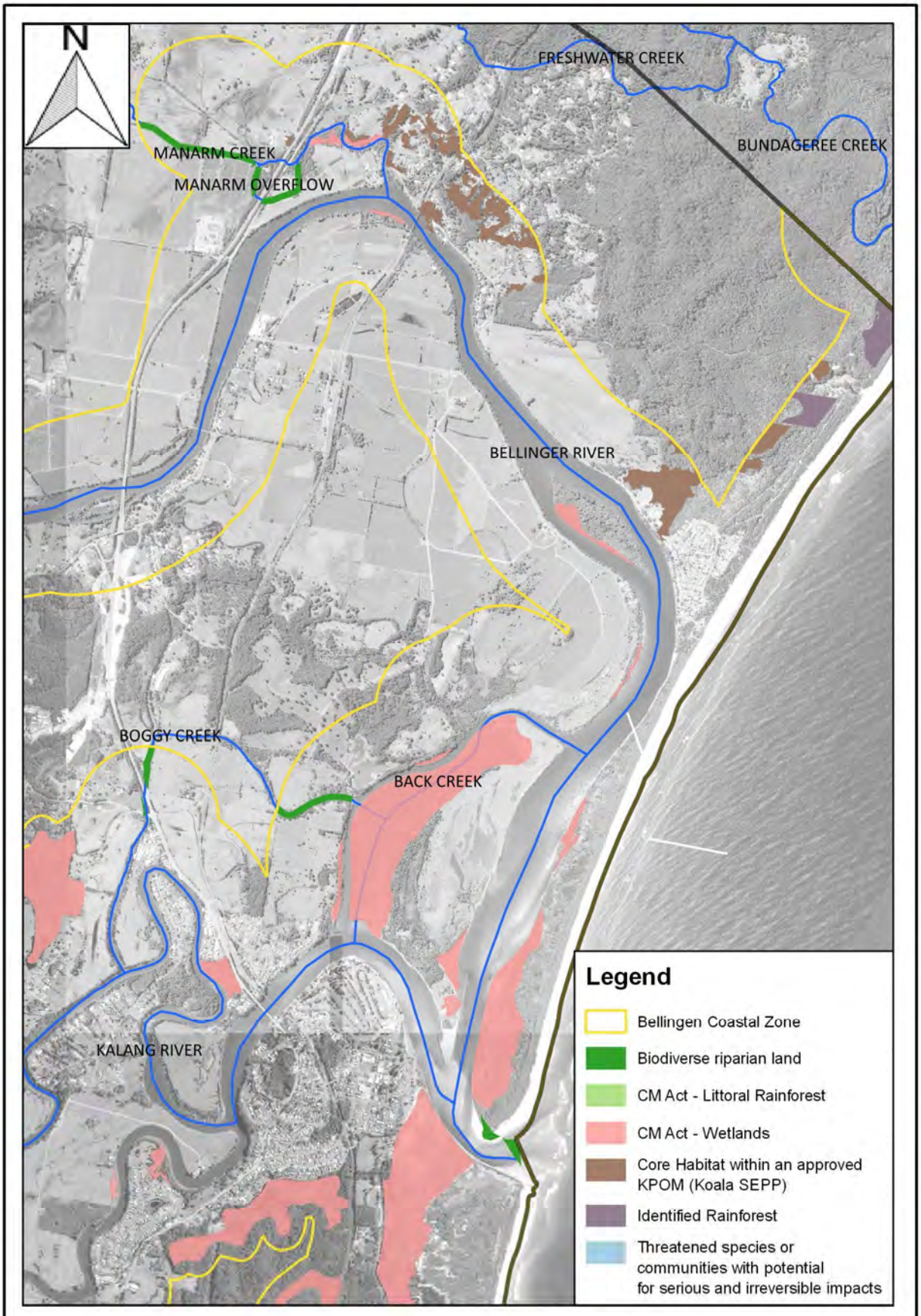

Figure A-21: Biodiversity Values in the coastal zone (north-east coastal zone)

0 0.5 1 1.5 km

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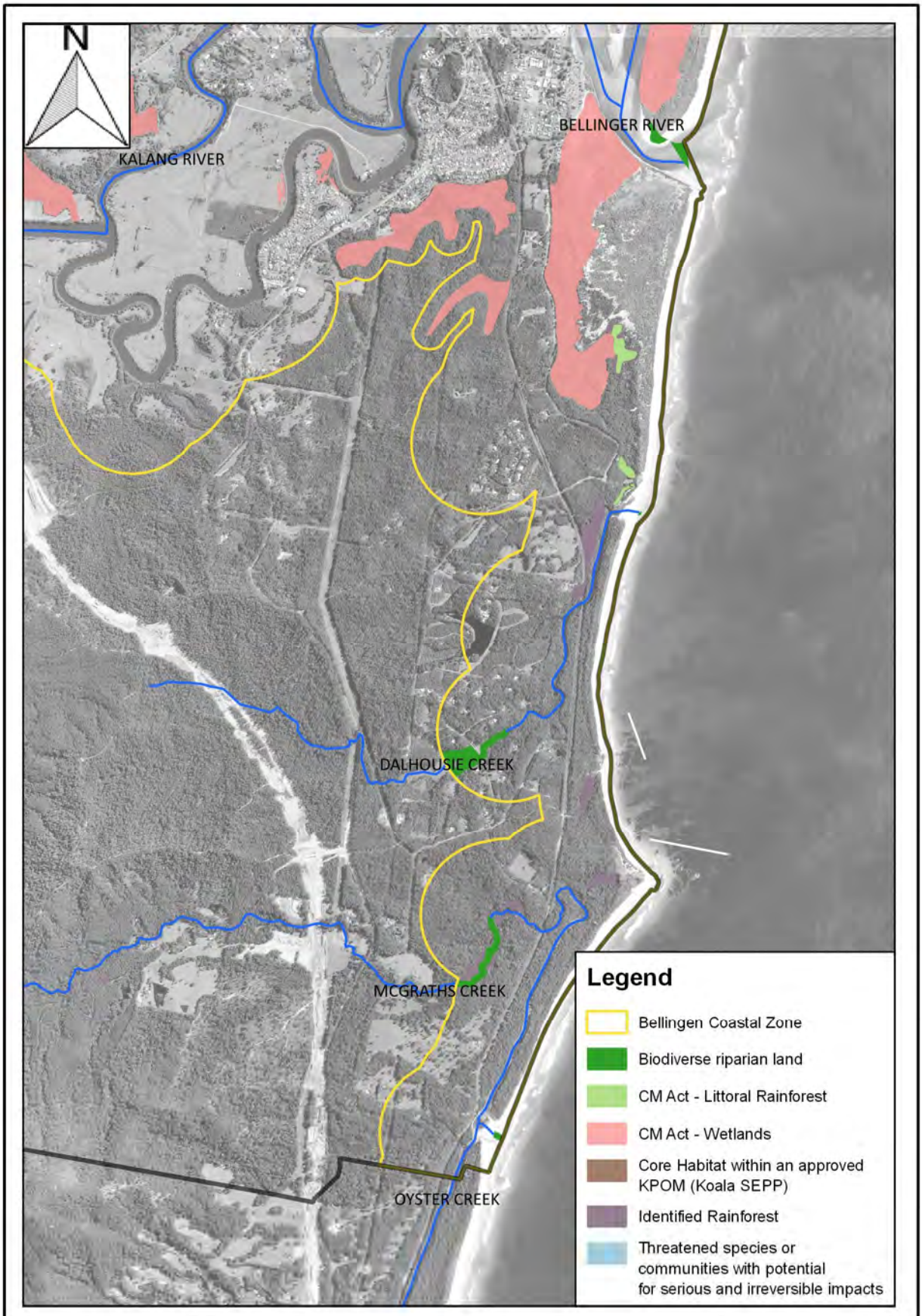

Figure A-22: Biodiversity Values in the coastal zone (south-east coastal zone)

0 0.5 1 1.5 km

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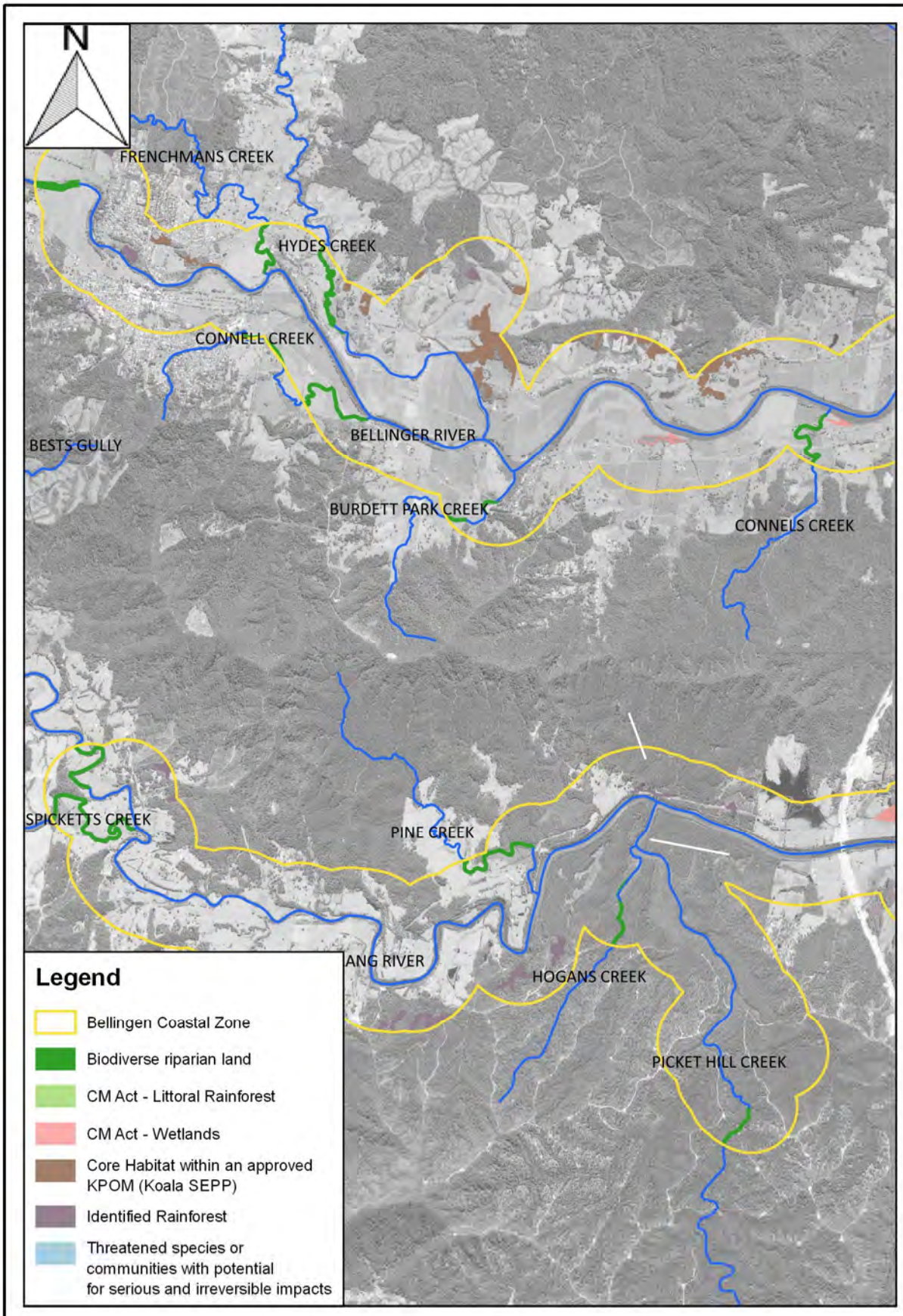

Figure A-23: Biodiversity Values in the coastal zone (western coastal zone)

0 0.5 1 1.5 2 km

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3.5 Other vegetation communities

3.5.1 *Themeda* grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South-East Corner Bioregions

Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South-East Corner Bioregions is an Endangered Ecological Community in NSW. It has a large geographic distribution often comprising of small but widely scattered patches. There is a 1700 square metre patch of *Themeda* grassland on the cliff top at Hungry Head, the only mapped area of this vegetation type in the Bellingen coastal zone. Bellingen Bush Regenerators (2019) report that the *Themeda* grassland is heavily impacted by recreational use of the area and is under threat from informal access tracks, cliff erosion, coastal recession and weed invasion. (Bellingen Bush Regenerators, 2019) state that *Themeda* grassland is at high risk of extinction at this site without active management.

3.5.2 Riparian and floodplain vegetation

There has been substantial clearing of floodplain and riparian vegetation in the past for agricultural purposes. Native subtropical rainforest and grasslands confined to poorly drained low-lying alluvial soils, have been largely replaced by mixed pastures and legumes. Ongoing pressures to floodplain and riparian vegetation include grazing, cattle access to riverbanks and loss of riparian vegetation due to bank erosion. Weeds are also a significant issue in the riparian zone. Vine weeds, such as Morning Glory, Glory Lily and Madeira Vine, are particular evident along both the Kalang and Bellinger Rivers, altering the structure of riparian vegetation and preventing natural regeneration of native species.

A number of riparian rehabilitation sites were identified in the Bellinger River Action Plan (Bellingen Shire Council, 2010). Council staff state, that of the sixty action sites downstream of Lavender's Bridge to Mylestom, approximately half of the recommended actions have been completed under grant funding.

In 2015/2016, BSC received a $100,000 grant to rehabilitate priority erosion sites in the Kalang River Estuary and improve adjacent riparian habitats. The project, focused on the Newry Island foreshore, provides an example of successful rehabilitation works. In addition to riverbank stabilisation, a riparian zone of up to 10 metres was re-established including fencing and revegetation with a mix of native species. Ongoing riparian rehabilitation will likely require a similar approach that integrates bank stabilisation, weed control, stock access control and revegetation given the strong inter-relationship of these issues. Change in landholders, with different objectives for rural land management, may provide new opportunities for

engagement and partnerships to further establish riparian and floodplain rehabilitation projects.

3.5.3 Estuarine Macrophytes

An estuarine macrophyte dataset was developed under the NSW Government Monitoring, Evaluation and Reporting (MER) Program by DPI Fisheries in 2009 and field verified for the Bellingen area in 2011[12]. It provides mapping of seagrass, saltmarsh and mangrove communities. As stated earlier, areas of estuarine macrophyte mapping (saltmarsh and mangroves) greater than 5000 square metres have been incorporated into the SEPP (Resilience and Hazards) 2021 coastal wetlands mapping. MEMA KPI 4

Seagrass distribution is patchy and limited to the tidal flats close to the entrance. *Zostera capricorni* is the dominant species and although less sensitive to disturbance than other seagrasses, its range can be strongly limited by water clarity. Threats to seagrass include direct disturbance from boats, turbidity due to sediment, increased nutrient runoff and sea level rise.

The majority of mangrove and saltmarsh stands occur at Urunga Lagoon, Back Creek, Urunga Island, the southwestern end of Mylestom Spit, Newry Island and Tuckers Island. Fringing patches of mangroves can be observed from the entrance to approximately 1.5km downstream of Spicketts Creek on the Kalang River. Likewise, mangroves intermittently fringe the Bellinger River from the entrance to midway between Connells Creek and Hydes Creek. Construction of rock fillets at Newry Island has allowed an intertidal bench to form where mangroves are self-propagating (see Figure A-24 and

[12] https://datasets.seed.nsw.gov.au/dataset/estuaries-including-macrophyte-detail5ebff

Figure A-25). Beyond the ecological benefit, the mangroves also provide bank protection through wave and flow attenuation.

Distribution of estuarine macrophytes along the smaller southern estuaries, Dalhousie and Oyster Creeks, is limited. Oyster Creek has small, discontinuous patches of both mangrove and saltmarsh. Dalhousie Creek has mangroves and saltmarsh in narrow bands fringing the creek line. Some smaller embayments containing areas of saltmarsh and mangrove are also present.

Figure A-24 Mangrove re-establishment following stabilisation of drainage line, Newry Island

Figure A-25 Mangrove re-establishment behind rock fillets, Newry Island

3.5.4 Dune vegetation

The native vegetation along the open coast dunes includes Spinifex, Coastal Headland Heaths and Wallum Sand Heaths. There are substantial areas of bitou bush that form a monoculture on Mylestom Spit and south of Dalhousie Creek to just north of Wenonah Head. Threats to dune vegetation include uncontrolled vehicle access and further invasion of bitou bush, which outcompetes native species.

Previous sand mining has also involved the clearing of native dune vegetation. Replanting of these sites has occurred, although the dunes would benefit from more complete rehabilitation. Dunecare groups operate at Wenonah Head and Tuckers Rock.

3.5.5 Rocky shores

There is very little information available in relation to rocky shores in the Bellingen coastal zone. The only notable rocky shore is at Wenonah Head where a rocky platform is accessible at low tide seaward of a sandy beach. During Stage 2 community consultation, community members reported four-wheel drive vehicles parking on the platform causing damage to the intertidal area. No site assessment has been conducted to quantify this impact.

3.6 Fauna

The largest threat to terrestrial fauna in the coastal zone is habitat loss and fragmentation. Much of the low-lying coastal floodplain has been cleared for agriculture. Habitat has also been lost or fragmented through urban development and associated infrastructure, such as roads and railway. Other threats to terrestrial fauna include invasive weed species, predation and disturbance from feral and domestic animals and altered bushfire regimes. Community consultation as part of Stage 2 of the CMP identified predation of Little Terns and migratory birds as a particular concern in areas such as Tuckers Rock, where off-leash dog walking occurs.

Beach Stone-curlews are found exclusively in coastal habitats and have a known range along the entire NSW coastline. Local sightings have been recorded at Urunga wetlands and Urunga Island[13]. A key contributor to their conservation status is their slow reproduction rate, producing just one egg per year. Threats include predation of eggs and chicks by foxes and disturbance of nesting birds by four-wheel drive vehicles, domestic dogs and tidal inundation. The Bellingen Biodiversity Strategy (Ecological Australia, 2021) recommends a community program to educate dog owners about protection of the Beach Stone-curlew and nesting sites.

[13] https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10280 accessed 1/04/2022

The coastal zone coincides with the Bellingen Shire Coastal Area Koala Planning Area (KPA) and contains areas of core koala habitat north of the Bellinger River. The koala population is in decline largely due to habitat loss, domestic dog attacks and vehicle strike. The BSC Koala Management Strategy (Bellingen Shire Council, 2017) guides development and planning within the KPA. The Koala Management Strategy and Chapter 3 & 4 of the Biodiversity and Conservation SEPP, provides an appropriate mechanism to address this issue.

Similarly, the Grey Headed Flying Fox (GHFF) is identified as a threatened species with a roost site at Bellingen Island. Council has developed a GHFF Camp Management Plan (Ecosure, 2017) for the site and therefore the issue does not need to be addressed in the CMP. However, there may be the opportunity to consider supporting actions such as riparian rehabilitation at Bellingen Island as part of the CMP process.

The entire length of both the Kalang and Bellinger Rivers and many of their tributaries are Key Fish Habitat[14] under the Fisheries Management Act (FMA) 1994. An objective of the FMA is to 'conserve key fish habitats'. Fishing using a trap (other than a bait trap) is prohibited in the Kalang and Bellinger Rivers for all fish (includes invertebrates) at all times of year. Consultation with representatives of NSW DPI Fisheries during Stage 2 consultation indicated that there are no current issues of concern relating to fish stocks or fish health.

There are several Oyster leases in the Kalang and Bellinger Rivers. As filter feeders, oysters are sensitive to pollutants and faecal coliform levels have resulted in closure of oyster harvesting in the past. Oyster harvesting in the Bellingen Shire remains under a restricted area classification meaning shellfish may be harvested only with the approval of the NSW Food Authority and then subjected to an effective purification process such as relaying or depuration[15]. Sewering of coastal villages is an ongoing major project of BSC that will benefit the oyster industry and result in an overall improvement in water quality for all aquatic fauna species. The project will connect the sewer to Mylestom, parts of Raleigh and Repton and the Raleigh Industrial Estate.

[14] https://webmap.industry.nsw.gov.au/Html5Viewer/index.html?viewer=Fisheries_Data_Portal
[15] https://www.foodauthority.nsw.gov.au/industry/shellfish

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Appendix B - Strategic Context

APPENDIX B STRATEGIC CONTEXT FOR MANAGEMENT OF THE BELLINGEN COASTAL ZONE

BELLINGEN SHIRE COASTAL MANAGEMENT PROGRAM – STAGE 2

Authors:	Emma Graham (Salients Pty Ltd)
Prepared For	Bellingen Shire Council
Version	FINAL
Date	17/06/2022

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1 Introduction

1.1 Background

This report forms an appendix to the Stage 2 summary report prepared during development of the Bellingen Shire Coastal Management Program (CMP). The key outcome of Stage 2 is a set of prioritised risks that should be managed by the CMP, where possible, within budgetary and other constraints.

As an initial step of the risk management process, a 'context' needs to be identified, with that context setting appropriate boundaries and informing the risk assessment completed during Stage 2.

The present appendix addresses the strategic context through a review of legislation and planning (Section 2), governance (Section 3) and links to other management programs (Section 4). Due to its overarching nature, the strategic context is of relevance to the consideration of risks within all coastal zone areas (*Coastal Vulnerability Area*, *Coastal Wetland and Littoral Rainforest Areas, Coastal Environment Area and Coastal Use Area)*. Section 2 of the Bellingen Shire Coastal Management Program – Stage 1 Scoping Study (Alluvium, 2020) detailed the Coastal Management Framework and relevant state, regional and local planning documents. This report describes changes to the strategic context post finalisation of the scoping study.

Parallel appendices address the physical and biological context (Appendix A) and the social context (Appendix C).

2 Legislative Context

2.1 NSW Coastal Management Framework

Since completion of the Scoping Study there has been one amendment to the Coastal Management Act 2021. The amendment (NSW Government, 2021) relates to 'Schedule 3 - Savings, transitional and other provisions'. Schedule 3, Clause 4 now states:

1 *A coastal zone management plan (including any emergency action subplan in that plan) in force under the former Act before the repeal date continues to have effect in respect of the local council to which it applied immediately before the repeal date until replaced by a coastal management program prepared and adopted under this Act.*

2 *This clause ceases to have effect at the end of 31 December 2023.*

The amendment changed the repeal date for existing coastal zone management plans from 31 December 2021 to 31 December 2023. Therefore, the Bellingen Coastal Zone Management Plan (BMT WBM, 2017), gazetted 20 October 2017, will remain in effect until replaced by the certified CMP which is currently under development.

2.2 SEPP

On 21 December 2021 the NSW Government consolidated 45 State Environmental Planning Policies (SEPPs) into 11 SEPPs. The provisions of the previous Coastal Management SEPP now sit within the SEPP (Resilience and Hazard) 2021. All provisions from the previous CM SEPP have been maintained and therefore the change is administrative in nature with no impact on the current CMP development process. The SEPP (Resilience and Hazard) 2021, as with all other consolidated SEPPS, came into effect on 1 March 2022.

3 Regional and Local Strategic Plans

Since completion of the Scoping Study, Regional Plans relevant to development of the CMP remain unchanged. However, at a Council level, there are several new strategic documents with links to the CMP. These are detailed in sections 3.1 to 3.5. Importantly the CMP is referenced in key documents within Council's Integrated Planning and Reporting Framework including the Operational Plan.

3.1 Lower Bellingen and Kalang Rivers Floodplain Risk Management Plan (WMA Water, 2021)

Issues associated with catchment flooding are managed under the Floodplain Risk Management process in NSW, as governed by the gazetted Floodplain Development Manual (NSW Government, 2005). The Lower Bellingen and Kalang Rivers Floodplain Risk Management Plan details the nature and extent of flooding and evaluates and prioritises potential management options. Catchment flooding is of diminished relevance to this CMP given the existence of this separate floodplain management process. However, the interaction of that management plan and the CMP will need to be considered when addressing coastal hazards associated with inundation.

3.2 Climate Change Risk Assessment Report for Bellingen Shire Council (Statewide Mutual, 2021)

This report outlines the findings and results of the climate change risk assessment that involved development of localised climate change scenarios and a risk assessment workshop. All risks were assigned a priority rating based on likelihood and consequence. Risks identified as extreme or high will be considered further for action by Council. Of most relevance to the CMP, was the Sea Level Rise (SLR) Scenario which used a SLR projection range of .13m (RCP6.) to .14m (RCP8.5) by 2030 and .34m (RCP6.0) and .45m (RCP8.5) by 2070.

Under the SLR scenario, one risk was rated extreme.

- *An increase in sea level rise will lead to increased erosion and inundation, impacting on council's ability to manage biodiversity and infrastructure along coastline (Ref SLDE1).*

Three risks were rated high.

- *An increase in sea level rise could cause loss/damage to coastal nature reserves, beaches, public recreational sites and public recreational facilities (Ref SLDE2).*
- *An increase in sea level rise could negatively impact on the region's development opportunities and tourism, resulting in a decline in the regions economic viability and sustainability (Ref SLBC3).*

- *An increase in sea level rise will result in higher groundwater salinity impacting bore dependant industry and reducing available potable water for town supply (Ref SLBL4).*

CMP implementation was identified as the current control mechanism for the extreme risk (SLDE1) and for one high risk (SLDE2) with the adequacy of control rated as 'highly beneficial' and 'some benefit (reduces likelihood)' accordingly. The adequacy of the control rating will require review following development of the CMP, as it has not yet been determined what management options will be selected for the final program.

3.3 Bellingen Shire Biodiversity Strategy (Ecological Australia, 2021)

The Bellingen Shire Biodiversity Strategy provides a 10-year framework to guide management, enhancement and protection of natural areas and biodiversity. The strategy details seven key focus areas. Of direct relevance to the CMP is *'Key focus area 3: Waterways: managing and conserving river systems, wetlands, riparian land, coastal and estuarine health'*. The high priority programs under this theme are:

- Measurable improvement in water quality
- Protect foreshores, coastal lagoons, significant wetlands and coastal saltmarsh. (An action under this program is the preparation, implementation and review of the CMP)
- Restore the ecological function of high priority waterways and wetlands with a focus on Key Fish Habitat and migratory wader habitat.
- Develop education workshops, programs and to engage schools, community groups and residents to establish a sense of ownership and participation and restoring the biodiversity along rivers and coastal foreshores.

Bellingen Shire Council relies heavily on grant funding opportunities and an environmental levy for implementation of environmental restoration works. As a framework document, the Biodiversity Strategy does not specify funding sources for the actions identified or provide a schedule of implementation. The CMP management options may align and provide a funding mechanism for actions identified in the Biodiversity Strategy.

3.4 Bellingen Shire Operational Plan 2021-2022 (Bellingen Shire Council, 2021)

The Operational Plan forms a component of Council's Integrated Planning and Reporting (IP&R) framework. It is an annual plan of actions that support a longer-term Delivery Program (Bellingen Shire Council, 2017) and includes budget allocations to

support the activities to be completed. The Bellingen Shire Operational Plan 2021-2022 identifies development of the CMP as an action. Other Operational Plan actions that may address some of the risks identified in Stages 1 and 2 of the CMP process include completion of:

- Aboriginal Cultural Heritage Study.
- Beach Access and Driving Policy.
- Beach Access Signage.
- Coastal Towns Sewer Scheme.

3.5 Bellingen Shire Council Local Strategic Planning Statement 2020-2040 (Bellingen Shire Council, 2020)

A Local Strategic Planning Statement (LSPS) sets out the 20-year vision for land-use in the local area including the values that are to be preserved and changes to be managed in future. The CMP is referenced both directly and indirectly on two occasions within the Planning Statement:

- *Priority 8 – Biodiversity Conservation occurs at a landscape scale using a variety of mechanisms across different land tenures.* The primary and only action under this priority is to implement the Biodiversity Strategy. Implementation of the Biodiversity Strategy also actions preparation, implementation and review of the CMP.
- *Planning Priority 9 – That Councils policy framework for dealing with natural hazards recognises risks associated with climate change and avoids additional exposure of development to hazards.* The action under this priority is to finalise and implement the CMP. An action to review coastal hazard mapping within the CMP, would likely be required to meet this objective.

4 Governance

Governance in the coastal zone is complex due to the multiple agencies responsible for land management. Along the coastline, land is largely within the Crown Lands tenure and care, apart from North Beach and an area around Hungry Head Surf Club where Council is the responsible land manager (see Figure B1 and Figure B-2). Consultation with Crown Land representatives[1] indicates that future changes to the lawful tenure of Crown Lands may occur under the NSW Aboriginal Land Claims process:

> *"…there are numerous unresolved Aboriginal Land Claims (ALCs) within the CMP study scope area. Further, there are a number of granted claims and/ or lands which are pending transfer to Coffs Harbour District Local Aboriginal Land Council (CHDLALC), particularly in the area of Wenonah Head. Please note, a subdivision is being lodged for easements for public access to the beach and coastal protection. The easements will be the responsibility of the Minister for Lands. The Gumbaynggirr Wenonah Head Aboriginal Corporation continue to have native title rights and interests in the CHDLALC lands and the easements as determined by the Federal Court."*

Crown Lands recommends that Council request details of any unresolved ALC's in the coastal zone and engagement with the CHDLALC and Gumbaynggirr Wenonah Head Aboriginal Corporation throughout the development of the CMP.

Further inland along the Bellinger and Kalang Rivers, the coastal zone consists of largely freehold agricultural land, however south of the Kalang River there is an area of NSW Forestry land around Picket Hill and Hogans Creeks (see Figure B-3).

[1] Email correspondence from David Tritton (Senior Policy Officer, Native Title and Coastal Unit) on 10 March 2022

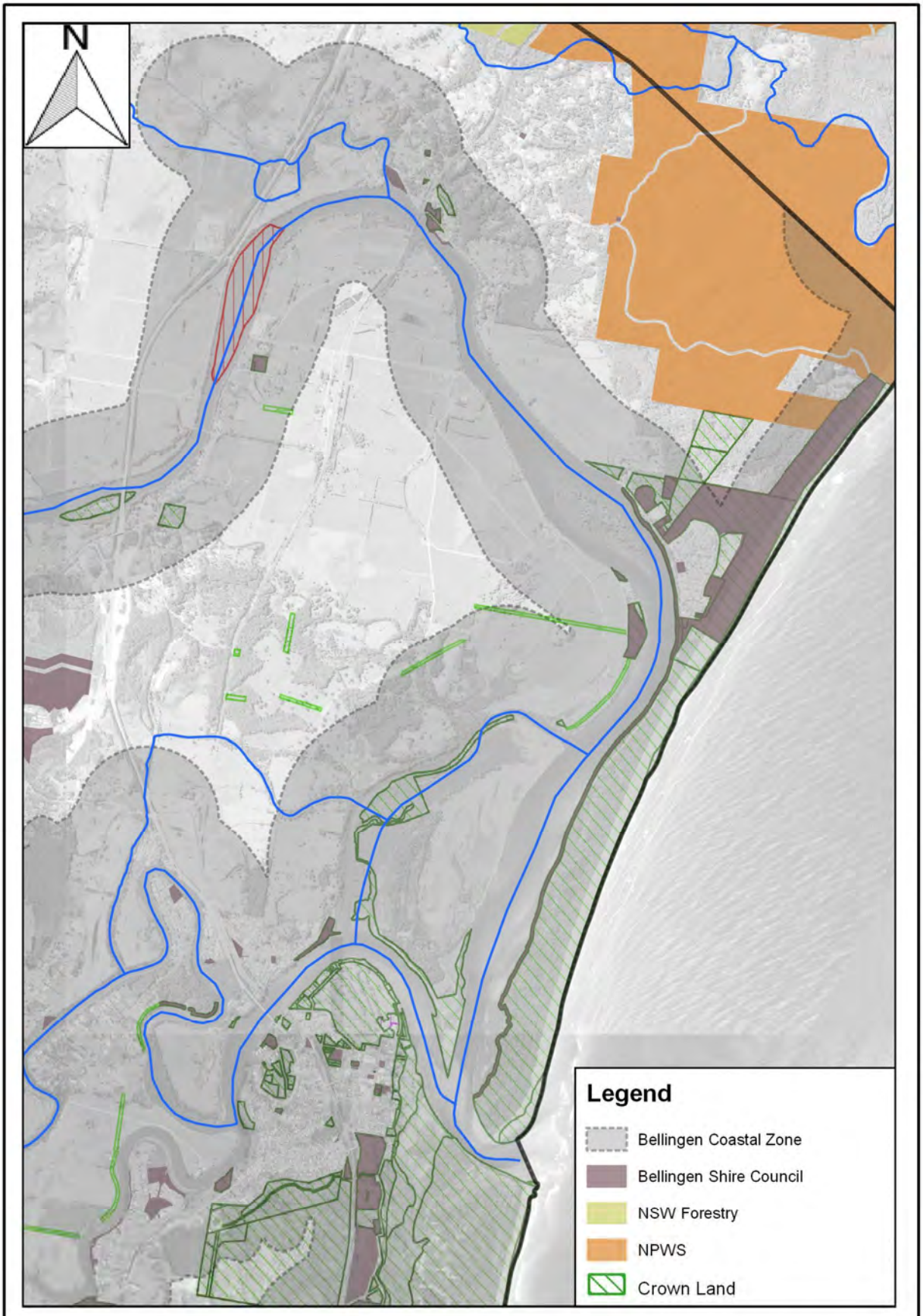

Figure B-1: Land tenure in the coastal zone (north-east coastal zone)

0 0.5 1 1.5 km

APPROX SCALE

Bellingen Shire CMP Stage 2 Report	REV A	DRAWN EG	CHECK DJW

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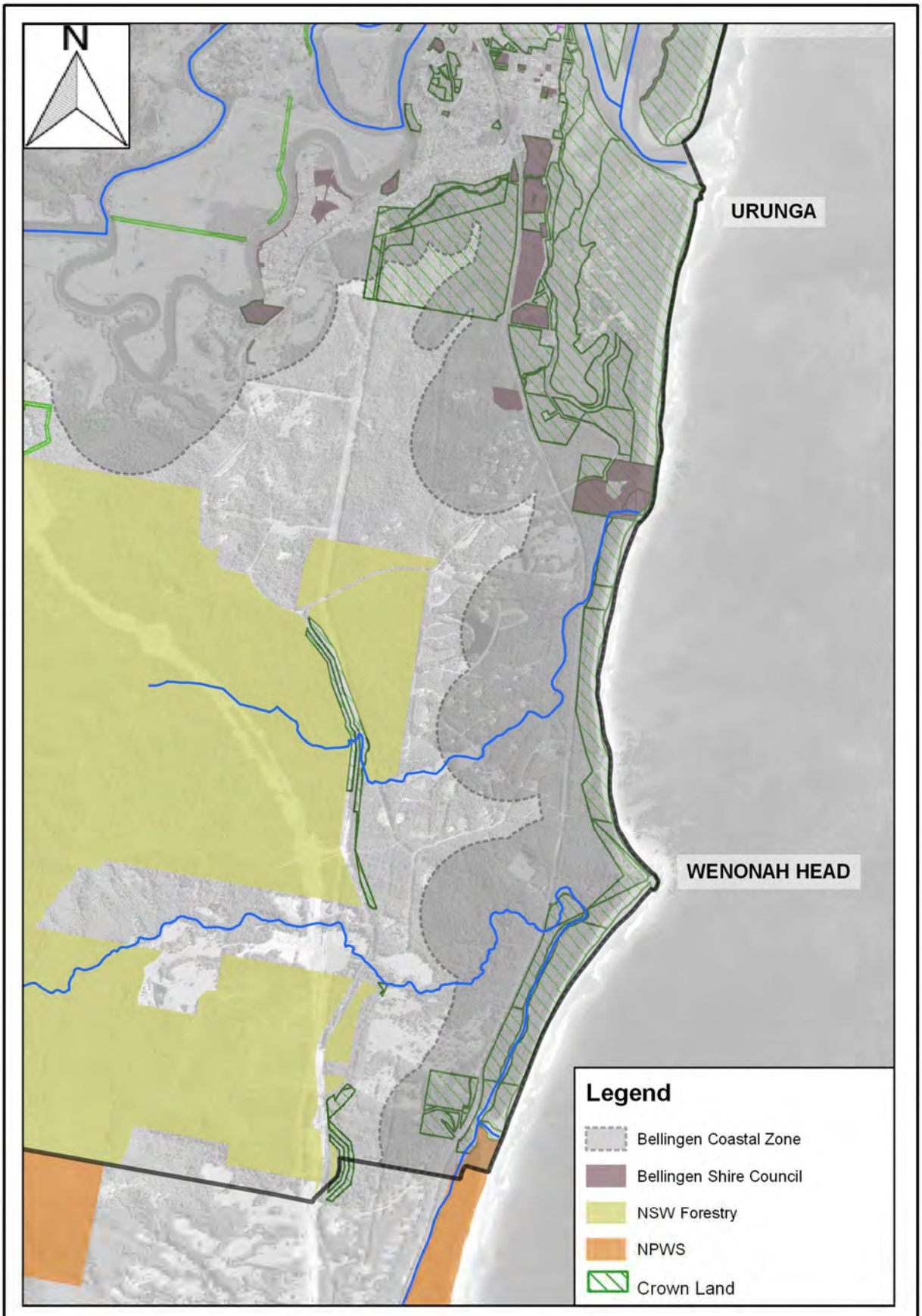

Figure B-2: Land tenure in the coastal zone (south-east coastal zone)

0 0.5 1 1.5 km

APPROX SCALE

Bellingen Shire CMP Stage 2 Report

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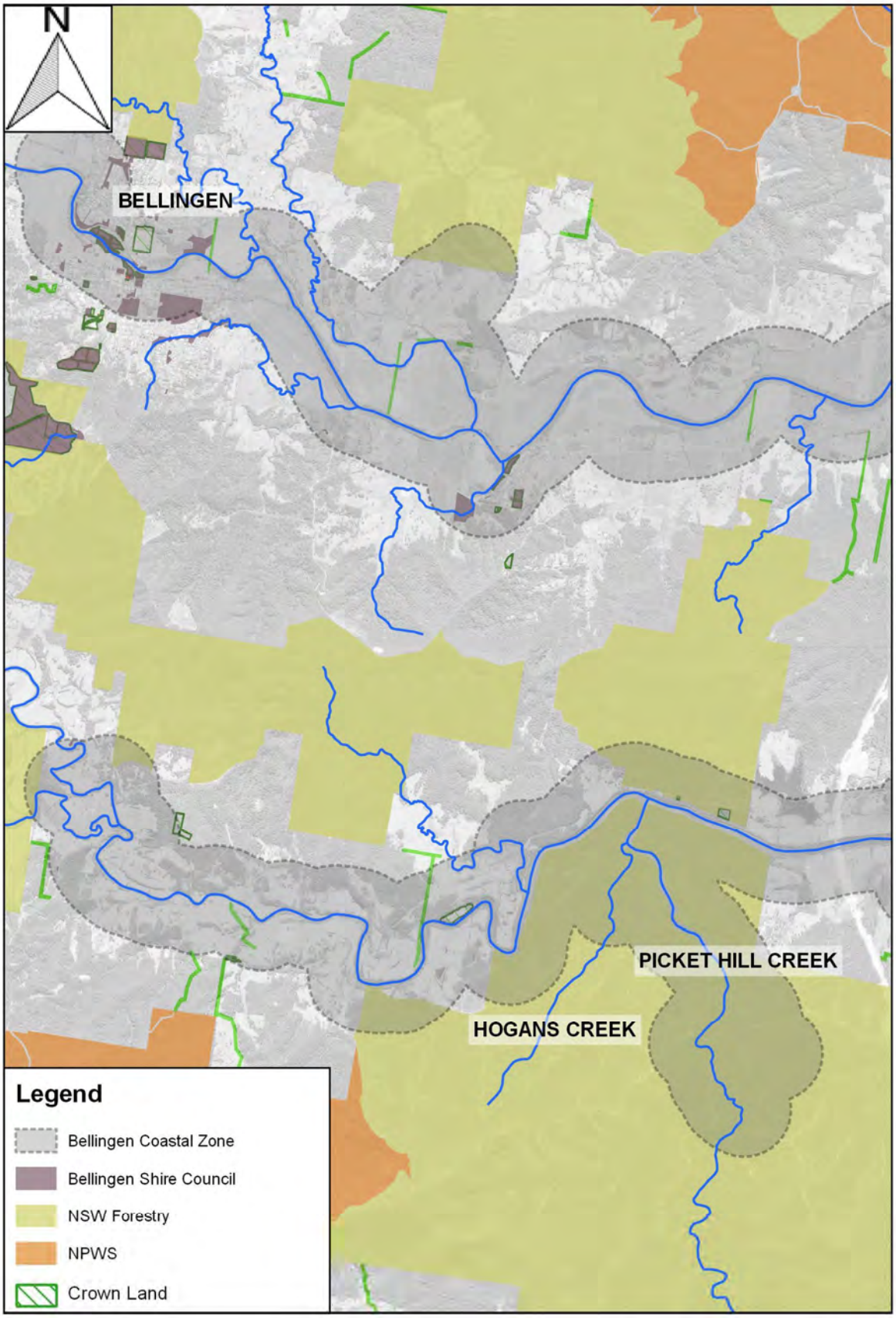

Figure B-3: Land tenure in the coastal zone (western coastal zone)

0 0.5 1 1.5 2 km

APPROX SCALE

Bellingen Shire CMP Stage 2 Report

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Salients

5 Links to other programs

5.1 NSW Marine Estate Management Strategy

The NSW Marine Estate Management Strategy is in the fourth year of a ten-year program. Whilst there are no specific actions assigned to the Bellingen Shire, there are several state-wide actions that may align with priority CMP issues. As the CMP development progresses into Stage 3, awareness of these actions is beneficial, to avoid duplication of effort and capitalise on complementary actions. Table 1 documents state-wide actions within the Strategy Implementation Plan 2021-2022 that may help manage risks relevant to the Bellingen coastal zone. The actions are at various stages of completion.

Table 1 – Relevant Initiative and Actions within the Marine Estate Management Strategy Implementation Plan 2021-2022

Relevant Initiatives	Actions
Initiative 1 – Improving water quality and reducing litter	NSW Water quality objectives reviewed for all coastal catchments. Marine Litter Campaign. NSW Litter Prevention Strategy.
Initiative 2 – Delivering healthy coastal habitats with sustainable use and development	Commercial dredging audit. Breakwater audit – complete (see https://www.marine.nsw.gov.au/projects/fish-friendly-breakwater-maintenance). Audit report of ICOLL Entrance management works approvals. Blue-carbon prioritisation report.
Initiative 3 – Planning for Climate Change: Risk Assessment	Model Mangrove and saltmarsh vulnerability to sea level rise. Map marine species re-distribution due to climate change.
Initiative 5 – Reducing impacts on threatened and protected species.	Guidelines for the management of beach nesting shorebirds. Community engagement materials for use at events.
Initiative 6 – Ensuring sustainable fishing and aquaculture	Social and economic assessment of recreational fishing (saltwater) on other users. Environmental assessment of recreational fishing. Update the Oyster Industry Sustainable Aquaculture Strategy.
Initiative 7 – Enabling safe and sustainable boating.	Boating Now grants program to deliver improved access to the marine estate through updated infrastructure such as public boat ramps, pontoons.
Initiative 8 – Enhancing social, cultural and economic benefits.	Implementation of the Marine Estate Education Strategy school-based curriculum. Finalisation of the coastal residents, visitors, Sea Country and Youth surveys. High level scoping of a Blue Growth Strategy (sustainable and equitable economic growth for the marine estate)

6 References

Alluvium, 2020. Bellingen Shire Coastal Management Program - Stage 1 Scoping Study.
Bellingen Shire Council, 2021. Bellingen Shire Operational Plan 2021-2022.
Bellingen Shire Council, 2020. Bellingen Shire Council Local Strategic Planning Statement 2020-2040.
Bellingen Shire Council, 2017. Bellingen Shire Council Delivery Program 2017-2021.
BMT WBM, 2017. Bellingen Coastal Zone Management Plan Final Report.
Ecological Australia, 2021. Bellingen Shire Biodiversity Strategy.
NSW Government, 2021. Coastal Management Amendment Act 2021 No 27.
NSW Government, 2005. Floodplain Development Manual.
Statewide Mutual, 2021. Climate Change Risk Assessment Report Bellingen Shire Council.
WMA Water, 2021. Lower Bellinger and Kalang Rivers Floodplain Risk Management Plan. Draft Report for Public Exhibition.

Appendix C - Social Context

APPENDIX C SOCIAL CONTEXT OF THE BELLINGEN COASTAL ZONE

BELLINGEN SHIRE COASTAL MANAGEMENT PROGRAM – STAGE 2

Authors:	Emma Graham
Prepared For	Bellingen Shire Council
Version	FINAL
Date	17/06/2022

Document Control

Version	Date	CHECKED BY	ISSUED BY	Distribution					
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1 Introduction

1.1 Background

This report forms an appendix to the Stage 2 summary report prepared during development of the Bellingen Shire Coastal Management Program (CMP). The key outcome of Stage 2 is a set of prioritised risks that should be managed by the CMP, where possible, within budgetary and other constraints.

As an initial step of the risk management process, a 'context' needs to be identified, with that context setting appropriate boundaries and informing the risk assessment.

The present appendix addresses the social context through a review of demographics (Section 2), economics (Section 3) and stakeholder and community values (Section 4). Due to its overarching nature, the social context is of relevance to the consideration of risks within all coastal zone areas (*Coastal Vulnerability Area*, *Coastal Wetland and Littoral Rainforest, Coastal Environment Areas)* but of particular relevance to the *Coastal Use Areas*. The Bellingen Shire Coastal Management Program – Stage 1 Scoping Study (Alluvium, 2020) provided a description of the social context. This report includes new information regarding social context which has become available post finalisation of the scoping study.

Parallel appendices address the physical and biological context (Appendix A) and the strategic context (Appendix B).

2 Demographics

The Bellingen Shire Coastal Management Program – Stage 1 Scoping Study (Alluvium, 2020) described the demographic profile of Bellingen based on the 2016 census. A new census was completed in August 2021. However, the key demographic, cultural diversity and health data results will not be released until June 2022. More complex data analysis will not be available until mid-2023[1]. The NSW Government did release population projections for Bellingen in 2019 (NSW Government, 2019). The population is predicted to remain stable between 2016 and 2041.A small shift towards an older population is predicted with the number of children under the age of 16 decreasing and adults over the age of 65 increasing. An increase of an additional 250 dwellings is projected over the next 10 years largely due to decreased average persons per dwelling.

[1] https://www.abs.gov.au/census/planning-2021-census/overview. Accessed online 8/04/2022.

3 Economics

The Scoping Study utilised 2017/2018 financial year data from the National Institute of Economy and Industry Research (NIEIR) to describe the Bellingen Shire economic context. The economic value-added (a measure of the value generated by business activity) has reduced from $62 million (FY2017-2018) to $55 million (FY2020-2021) across a three-year time period[2]. However, the total economic value when broken down by sector (Figure 1), shows a relatively similar distribution with a minor increase in the economic value-add percentage for construction and healthcare. Conversely, accommodation and food services, as well as mining and transport show a decreased economic value-add percentage from 2017/18 to 2020/21. These changes may represent the impacts of COVID-19 on regional industries, rather than a more long term shift in industry development trends.

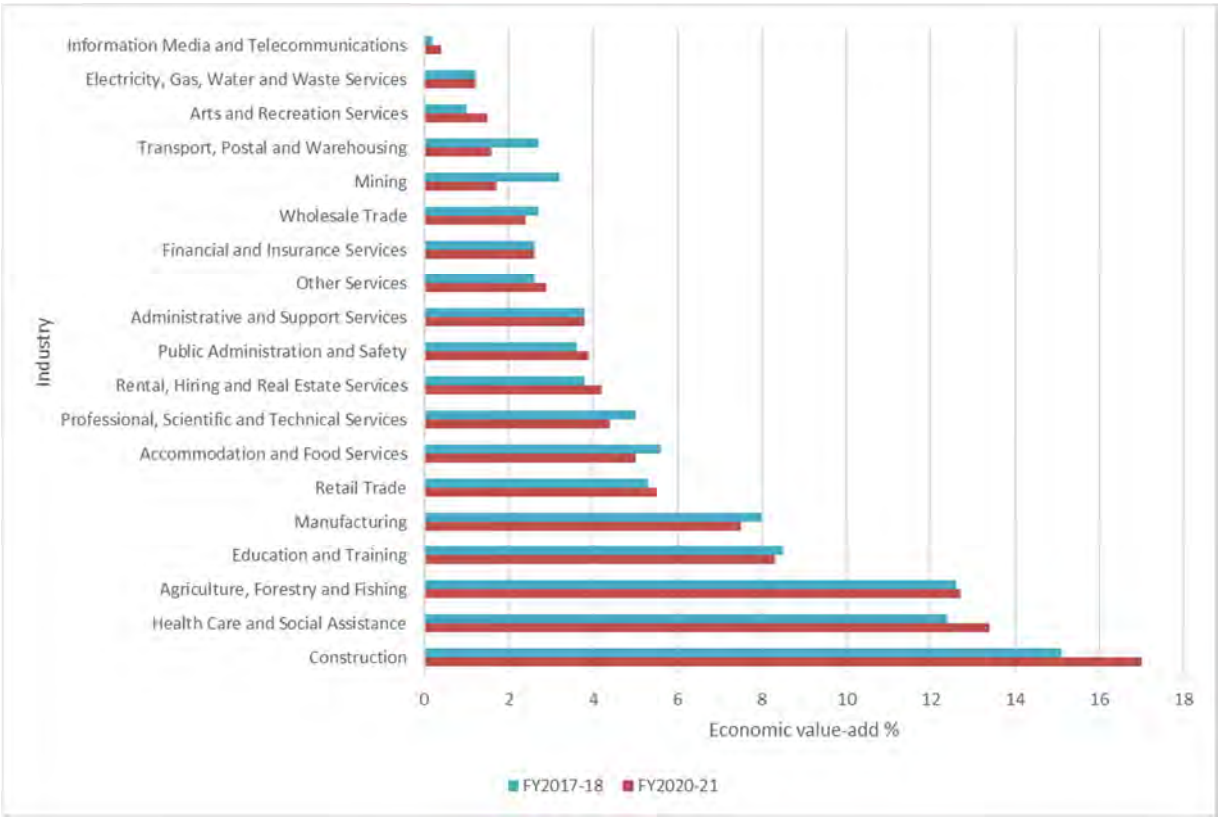

Figure 1- Comparison of total economic value-added by sector, FY2017-18 v FY2020/21

[2] https://economy.id.com.au/bellingen. Accessed online 8/04/2022.

4 Stakeholder and community values

Since completion of the Scoping Study (Alluvium, 2020), there have been several opportunities for community consultation through Stage 2 of the CMP process and development of other Council strategies (see section 4.1 to 4.5). The consultation consistently demonstrates that the community values the natural environment particularly for the recreational amenity it provides. Threats commonly identified in the coastal zone include riverbank erosion, litter, weeds, loss of riverbank vegetation, recreational user conflicts and recreational user impacts.

4.1 Stage 1 CMP Scoping Study Consultation

The Bellingen Shire Coastal Management Program – Stage 1 Scoping Study (Alluvium, 2020) involved community and stakeholder engagement to identify values and threats in the coastal zone. Community members had the opportunity to participate in an online survey, with stakeholder interviews undertaken with coastal community groups such as the Surf Life Saving Clubs. The following key threats were identified in priority order:

1 Riverbank erosion.

2 Pests (animals and weeds).

3 Loss of vegetation along waterways.

4 Pollution.

5 Climate change.

4.2 Stage 2 CMP Consultation

Due to COVID restrictions, consultation in Stage 2 was limited to the use of an online interactive map where stakeholders could share comments and photos to identify issues, concerns and ideas for improvement in the coastal zone. The online forum was open for a period of 6 weeks over November and December 2021. There were more than 140 comments and more than 250 reactions recorded on the map. Key issues of concern included riverbank erosion; management and loss of riparian vegetation; speed, noise and use of boats and jet-skis; 4WD access to beaches; impact of camping visitors; litter and pollution, as well as noxious weeds, old signage that needs replacement and identification of passive recreation areas. See Figure 2 and Figure 3 for the consultation summary.

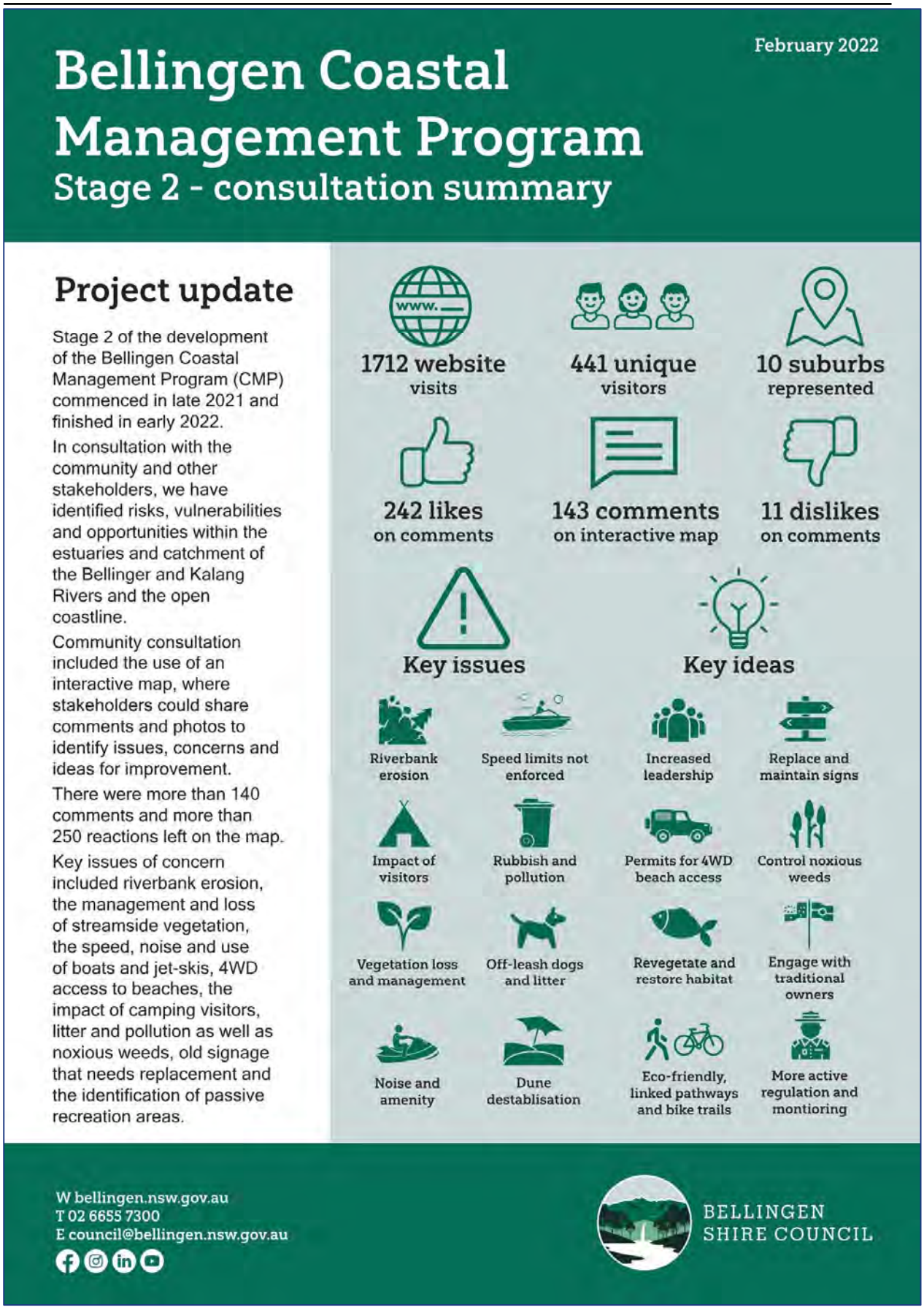

Figure 2 – Stage 2 Community Consultation Summary (p1)

In the field

We completed two days of boat field work in December 2021 to inspect the entire navigable reach of the Bellinger and Kalang rivers and record the condition of the riverbank and riparian vegetation quality.

A geo-referenced photographic record was taken of sites of concern and contributing factors such as cattle access and vegetation removal were also noted.

Sites where rehabilitation has occurred were also documented and the outcomes recorded.

Land-based fieldwork involved on foot inspection of the entrances of estuaries and lagoons along the coastline.

Assets likely to be subject to coastal hazards were recorded, as well as contributing threats to coastal condition (weeds, 4WDs etc).

Salients also met with a range of staff from Council across both operational works and strategic planning to discuss funding and resources for the draft CMP actions which will be developed in Stage 3.

For more about development of the CMP and to view the interactive map, use your phone to scan the QR code below or head to Council's website.

Scan me

Two days of boat and land-based fieldwork was undertaken along the Bellinger and Kalang rivers in December 2021.

The project team inspected the entrances to estuaries and lagoons along the coastline on foot.

Aerial and drone photography allowed the project team to inspect the extent of issues such as riverbank erosion.

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Figure 3 – Stage 2 Community Consultation Summary (p2)

4.3 Water Quality Management Plan Consultation

In conjunction with development of the Bellingen Water Quality Management Plan (Jeremy Benn Pacific, 2022) a water quality survey was distributed to stakeholders and public forums over a two-week period from 23 November to 7 December 2021. The survey received 53 responses with the following key issues identified:

- User conflicts (boating, swimming).
- Visual amenity – pollution.
- Limited access or parking.
- Lack of amenities. Recreation infrastructure.
- Sensitive area/ cultural heritage.

4.4 Biodiversity Strategy

During development of the Bellingen Shire Biodiversity Strategy (Ecological Australia, 2021), Ecological Australia completed surveys with the community and key stakeholders as well as holding workshops with Councillors and stakeholders. Whilst pertaining to the whole Shire, vegetation clearing, weeds and pest animals were considered the largest threats to biodiversity. Respondents reported Bellinger River Foreshore (Lavenders Bridge), Urunga Beach foreshore, Hungry Head beach foreshore as the most visited places, all of which lie with the coastal zone.

4.5 Local Strategic Planning Statement 2020-2040

The Bellingen Shire Local Strategic Planning Statement 2020-2040 (Bellingen Shire Council, 2020) included the word cloud reproduced in Figure 4 to illustrate the values and attributes expressed to Council during public consultation in 2018-2019.

Figure 4 Word Cloud representing Values and Attributes (derived from public consultation during preparation of Bellingen LSPS)

5 References

Alluvium, 2020. Bellingen Shire Coastal Management Program - Stage 1 Scoping Study.
Bellingen Shire Council, 2020. Bellingen Shire Council Local Strategic Planning Statement 2020-2040.
Ecological Australia, 2021. Bellingen Shire Biodiversity Strategy.
Jeremy Benn Pacific, 2022. Bellingen Water Quality Management Plan - Draft Report.
NSW Government, 2019. Bellingen Shire Council 2019 NSW Population Projections.

Appendix D - Risk Assessment Tables

WETLANDS AND LITTORAL RAINFOREST						
Risk	**Location**	**Cause**	**Event**	**Outcome/Consequences/Impact**	**Management Objective(s) Affected**	**Final Risk Rating**
W1	Valla Beach through to Hungry Head	Coastal Recession 100yr	1.4m of Sea Level Rise + Rare Erosion Event	A - As for 50 yr B - As for 50 yr, plus additional 0.38 ha loss C - Complete loss of 0.6ha patch of Littoral Rainforest D - Same as for 50yr E - Complete loss of 0.8 ha patch of Littoral Rainforest Minor additional Patches of saltmarsh ~ 400 sq.m fringing McGraths Creek also impacted, however, should this recession occur, the tidal dynamics will have changed markedly and saltmarsh areas will change dramatically.	CM6, CM7, CM8, CM9, CE1, CE5, CM12, CV2, CV3, CV6, MEMA1, MEMA7	***High***
W2	Coastal wetland between Newry Island and Ginnagay Way	Coastal Inundation 100yrs	Normal tides raised by 1.4m	Area inundated by mean ocean tide level changes from to 3.4 ha	CM5, CM6, CM8, CM9, CM12, CW1, CW3, CW5, CE1,CE3, CE5, CU3	***Medium***
W3	Coastal wetland fringing yellow rock road	Coastal Inundation 100yrs	Normal tides raised by 1.4m	Broad scale king tide inundation of the area between Yellow Rock Road, and Boggy Creek. Also broad scale inundation of Areas east of railway line, north of Boggy/Back Creek and west of Bellinger River. It could be expected that wetland species will end up colonising much of this area, which is largely used for agriculture at present. Unless actively supressed, coastal wetlands will migrate into these areas. - The land affected is largely zoned RU1.	CM5, CM6, CM8, CM9, CM12, CW1, CW3, CW5, CE1, CE3, CE5, CU3	***High***
W4	Coastal wetland north-east of Burrawong Parade	Coastal Inundation 100yrs	Normal tides raised by 1.4m	The point north of the residential area is completely inundated by King Tides. This will affect much of the parcel at 40 Burrawong Parade.	CM5, CM6, CM8, CM9, CM12, CW1, CW3, CW5, CE1, CE3, CE5, CU3	***High***
W5	Coastal wetlands Urunga Lagoon	Coastal Inundation 100 yrs	Normal tides raised by 1.4m	Expansion of the area inundated by King tides into areas largely protected for conservation and as either Coastal Wetlands under the SEPP, or otherwise mapped as EEC's by Bellingen Shire Council.	O5, O6, O8, O9, O12, W1, W3, W5, E1, E3, E5, U1	***Medium***

Risk	Location	Cause	Event	Outcome/Consequences/Impact	Management Objective(s) Affected	Final Risk Rating
W6	North Beach	Coastal Recession 100yr	1.4m of Sea Level Rise + Rare Erosion Event	As for 50 year, Plus Area A: an additional 0.1 ha (Around 15% total loss of this patch) Area B: the remaining 1/3 of the mapped littoral rainforest patches is affected (Some Swamp Oak & Swamp Sclerophyll Forest also impacted totalling around 400 sq.m) Area C: The remaining 500sq. m of this patch is lost.	CM6, CM7, CM8, CM9, CE1, C5, CM12, CV2, CV3, CV6, MEMA1, MEMA6	***High***
W7	Urunga Island	Yellow Rock Island is in private ownership	Management practices of this important ecological and cultural land are not consistent with coastal zone objectives.	Reduction in extent and condition of coastal wetlands No ability to require remediation of ecologically and culturally significant land	CM1, CM3, CM8, CM12, CW1, CW2, CW4, CE1, CE4, MEMA3, MEMA4	***High***
W8	Urunga Island	Grazing by goats and horses	Decreased extent and condition of endangered ecological communities. .	Destruction of habitat, riparian zone degradation (bank erosion), loss of genetic diversity, fragmentation of populations, disturbed habitat leading to spread of exotic species, habitat loss for fauna	CM1, CM5, CW2, CE1, MEMA1, MEMA4	***High***
W9	Urunga sandmass	Bitou infestation	Outcompetes native species	Serious threat to littoral rainforest. Listed as a Key Threatening Process under Threatened Species Conservation Act 1995. Reduces vegetation diversity and consequently habitat.	CM1, CE1, CW1, CW2, MEMA1, MEMA4	***High***
W10	Valla Beach through to Hungry Head	Coastal Recession Immediate	"Present Day" Rare Erosion Event	A - Loss of entire 0.82 ha patch of Littoral Rainforest mapped in 2013, to north of Wenonah Head (but not included in SEPP) B - 0.1 ha of 1.6 ha patch of Littoral Rainforest at northern end of Snapper Beach. (Not Included in SEPP)	CM6, CM7, CM8, CM9, CE1, CE5, CM12, CV2, CV3, CV6, MEMA1, MEMA4	***Medium***
W11	Valla Beach through to Hungry Head	Coastal Recession 20 yr	0.4m of Sea Level Rise + Rare Erosion Event	A - Same as Present Day B - Present day plus loss of an extra 250sq.m C - Loss of around 200 sq.m of 0.6ha patch of Littoral Rainforest to south of Dalhousie Ck Entrance (Not Included in SEPP)	CM6, CM7, CM8, CM9, CE1, CE5, CM12, CV2, CV3, CV6, MEMA1, MEMA5	***Medium***

Risk	Location	Cause	Event	Outcome/Consequences/Impact	Management Objective(s) Affected	Final Risk Rating
W12	Valla Beach through to Hungry Head	Coastal Recession 50yr	0.7m of Sea Level Rise + Rare Erosion Event	A - As for 20yr D - of 7.5ha patch of Subtropical Coastal Floodplain Forest B - As for 20yr, plus an additional 0.27 ha loss C - As for 20yr, plus an additional 0.38 ha loss E - 0.5 ha loss of Littoral Rainforest mapped in 2013, some 300 to 600 m south of Dalhousie Ck Entrance. Total size of patch is 0.8ha	CM6, CM7, CM8, CM9, CE1, CE5, CM12, CV2, CV3, CV6, MEMA1, MEMA6	***Medium***
W13	Coastal wetland between Newry Island and Ginnagay Way	Coastal Inundation 20yrs	Normal tides raised by 0.4m	Area inundated by mean ocean tide level changes to 1.8ha, compared to current inundation of 0.2ha. Total area of mapped SEPP is around 4ha. (i.e. inundation at msl)	CM5, CM6, CM8, CM9, CM12, CW1, CW3, CW5, CE1,CE3, CE5, CU1	***Low***
W14	Coastal wetland between Newry Island and Ginnagay Way	Coastal Inundation 50yrs	Normal tides raised by 0.7m	Area inundated by mean ocean tide level changes to 2.55ha	CM5, CM6, CM8, CM9, CM12, CW1, CW3, CW5, CE1,CE3, CE5, CU2	***Medium***
W15	Coastal wetland fringing yellow rock road	Coastal Inundation 20yrs	Normal tides raised by 0.4m	King tide inundation extends into areas which are already largely protected (EECs and Coastal Wetlands). Of particular note are large expansions with the king tide now inundating most of Yellow Rock Island and northwards from Back Creek.	CM5, CM6, CM8, CM9, CM12, CW1, CW3, CW5, CE1, CE3, CE5, CU1	***Medium***
W16	Coastal wetland fringing yellow rock road	Coastal Inundation 50yrs	Normal tides raised by 0.7m	King tide now begins to spill out of previously EEC areas, but additional extent is marginal.	CM5, CM6, CM8, CM9, CM12, CW1, CW3, CW5, CE1, CE3, CE5, CU2	***Medium***
W17	Coastal wetland north-east of Burrawong Parade	Coastal Inundation 20yrs	Normal tides raised by 0.4m	Areas fringing wetlands are presently protected as part of EECs (as per Bellingen EEC mapping). Mangroves will tend towards moving into areas of saltmarsh and Swamp Oak Floodplain Forest. These will tend to be squeezed out due to fille land to the south (Burrawong Parade, Melaleuca Pl, & Lake Ct.)	CM5, CM6, CM8, CM9, CM12, CW1, CW3, CW5, CE1, CE3, CE5, CU1	***Medium***
W18	Coastal wetland north-east of Burrawong Parade	Coastal Inundation 50yrs	Normal tides raised by 0.7m	More of the area immediately north of the end of Burrawong Parade is inundated by King Tides.	CM5, CM6, CM8, CM9, CM12, CW1, CW3, CW5, CE1, CE3, CE5, CU2	***Medium***

Risk	Location	Cause	Event	Outcome/Consequences/Impact	Management Objective(s) Affected	Final Risk Rating
W19	North Beach	Coastal Recession 20 yr	0.4m of Sea Level Rise + Rare Erosion Event	Impacts on EECs From Mylestom North as follows: Area A: Littoral Rainforest immediately South of Mylestom: Not Affected Area B: Littoral Rainforest around 700m North of Mylestom: Only marginally Affected Area C: Remaining Littoral Rainforest between Area B and ICOLL to south of Tuckers Rocks: Around 0.25ha of 1.25 ha patch lost Note there are also patches of saltmarsh and swamp oak forest wetland associated near private property to the south of Tuckers Rocks at the entrance to a small ICOLL, The crown land components of these relativley small patches could be progressively lost over a 100 year time frame.	CM6, CM7, CM8, CM9, CE1, C5, CM12, CV2, CV3, CV6, MEMA1, MEMA4	***Medium***
W20	North Beach	Coastal Recession 50yr	0.7m of Sea Level Rise + Rare Erosion Event	As for 20 year, Plus Area A: an additional 0.06 ha (Around 5% total loss) Area B: an additional 0.42ha (of around 0.6ha total, i.e. 2/3) loss in total Area C: The majority of the remaining patch 0.95ha, resulting in 1.20 of 1.25ha being lost.	CM6, CM7, CM8, CM9, CE1, C5, CM12, CV2, CV3, CV6, MEMA1, MEMA5	***Medium***
W21	Mylestom Drive, Repton	The drainage area and wetland contains land zoned R1 and RU2	Decreased protection from development	Potential loss of floodplain and floodplain vegetation.	CM1, CM5, CM8, CM12, CW1, CE1, CU1, MEMA1	***Medium***
W22	Urunga Lagoon	Clearing of native vegetation for sand mining and opprotunity for further rehabiltation	Decreased condition and extent of native vegetation including littoral rainforest.	Destruction of habitat, loss of genetic diversity, fragmentation of populations, disturbed habitat leading to spread of exotic species, habitat loss for fauna	CM1, CW2, CE1, MEMA1, MEMA4	***Medium***

COASTAL VULNERABILITY						
Risk	**Location**	**Cause**	**Event**	**Outcome/Consequences/Impact**	**Management Objective(s) Affected**	**Final Risk Rating**
V1	Numerous Sites on the Bellinger River (private rural riparian land) where bank erosion is currently occurring.	Lack of Riparian Vegetation	High Flows during catchment flood and livestock access down riverbanks.	Poor ecological function of riparian areas combined with the delivery of eroded sediment to river resulting in turbidity/siltation/impacts on water quality.	CM4, CM5, CM11, CM12, CE1, CE2, CE3, CE5, CV5, CV6, CV7, CV9, MEMA1, MEMA4	***Extreme***
V2	Numerous Sites on the Kalang River (private rural riparian land) where bank erosion is currently occurring.	Lack of Riparian Vegetation	High Flows during catchment flood and livestock access down riverbanks.	Poor ecological function of riparian areas combined with the delivery of eroded sediment to river resulting in turbidity/siltation/impacts on water quality.	CM4, CM5, CM11, CM12, CE1, CE2, CE3, CE5, CV5, CV6, CV7, CV9, MEMA1, MEMA4	***High***
V3	Sections of north coast railway line	Coastal Recession 100yr.	1.4m of Sea Level Rise + Rare Erosion Event	Loss of up to 600m of North Coast rail line.	CM2, CM4, CM6, CM7, CM8, CM9, CM10, CU2, CU6, CV1, CV2, CV6, CV8, CV9	***High***
V4	Riverbank north of tidal pool and also from southern boat ramp to opposite toilet block Mylestom Park	Natural northward/eastward migration of the foreshore and ongoing failure of seawall (now at least 40 years old) - failure of some structural elements causing sink holes to rear and temporary fencing of areas from public access.	Ongoing waves cause additional failures and collapese, potential for injury to members of the public.	Loss of amenity, potential legal liability.	CM2, CM6, CM7, CM9, CM12, CE4, CE6, CU3, CU4, CU6, CV1, CV2, CV4, CV5, CV6, CV9, MEMA3	***High***
V5	Urban residential properties all clustered around Newry Island	Naturally variable state of channel, particularly in meanders around Newry Island.	Erosion of residential property, followed by ad-hoc & uncoordinated foreshore protection works which are subsequently undermined	Highly variable and unsightly foreshore with poorly designed and ineffective protection works in many locations.	CM4, CM5, CM11, CM12, CE6, CV5, CV6, CV7, CV9, MEMA3	***High***
V6	North Beach	Coastal Inundation 20yrs	Recession and Erosion	SLSC building is undermined, resulting in collapse, damage and safety issues.	CM1, CM2, CM4, CM6, CM7, CM8, CM9, CM11, CE5, CE6, CU2, CU5, CV1, CV2, CV4, CV5,CV6, CV8, CV9, MEMA3.	***Low***
V7	North Beach	Coastal Erosion & Recession (Immediate)	Formation of an erosion scarp and narrowing of the beach berm	Public access affected with steep drop to beach and resultant pedestrian safety issue.	CM1, CM2, CM4, CM5, CM6, CM7, CM10, CE4, CE5, CE6, CV1, CV2, CV3, CV4, CV6, MEMA3, MEMA4	***High***
V8	North Beach	Coastal Erosion & Recession (Immediate)	Formation of an erosion scarp and narrowing of the beach berm	Dangerous conditions for 4WD, safety impacts, more likelihood that 4WD will encroach upon foredunes/dunes, exacerbating erosion.	CM1, CM2, CM4, CM5, CM6, CM7, CM10, CE1, CE4, CE5, CE6, CV1, CV2, CV3, CV4, CV6, MEMA1, MEMA3, MEMA4	***High***

Risk	Location	Cause	Event	Outcome/Consequences/Impact	Management Objective(s) Affected	Final Risk Rating
V9	North Hungry Head Beach	Recession and Coastal Erosion (Immediate)	Formation of an erosion scarp and narrowing of the beach berm	Steep drop off to beach results in safety issue for 4WD.	CM1, CM2, CM4, CM5, CM6, CM7, CM10, CE4, CE5, CE6, CV1, CV2, CV3, CV4, CV6, MEMA1, MEMA3, MEMA4	***Medium***
V10	Left bank (Pacific Highway side) upstream of the Newry Island bridge	High flows	Turbulent eddies cause erosion adjacent to bridge abutment.	Eventual Erosion and undermining of Bridge abutment, failure of bridge	CM2, CM4, CM5, CM6, CM9, CM12, CV2,CV4,CV6, CV8, CV9	***High***
V11	Bridge Street Bellingen	High discharges from river, natural meandering of the river and constraint posed by bridge, particularly as it is prone to partial blockage by dead trees and debris.	Catchment discharges are directed towards southern side of river.	Progressive erosion downstream of the southern abutment caused by expansion turbulence. Potential eventual undermining of the bridge abutment.	CM2, CM4, CM5, CM6, CM9, CM12, CV1, CV2, CV4, CV6, CV8, CV9	***Medium***
V12	Ford Street	High discharges from river, natural meandering of the river and constraint posed by bridge, particularly as it is prone to partial blockage by dead trees and debris.	Catchment discharges are directed towards southern side of river.	Progressive erosion by fast flowing currents may be causing failure of foreshore access structure.	CM2, CM6, CM9, CE1, CE4, CE6, CU3, CU4, CV1, CV2, CV4, CV6, CV9, MEMA3	***Medium***
V13	Lavender Bridge Park	Natural morphological processes acting on an artificially grassed and mown area at Lavender Bridge Park	Artificial edge to park is gradually eroded by river flows.	Loss of amenity, which will increase with time.	CM2, CM4, CM6, CM9, CM12, CE6, CU1, CU4, CV1, CV2, CV4, CV6, MEMA3.	***Medium***

COASTAL ENVIRONMENT AREA						
Risk	**Location**	**Cause**	**Event**	**Outcome/Consequences/Impact**	**Management Objective(s) Affected**	**Final Risk Rating**
E1	Bellinger and Kalang Rivers	Lack of consistent water health monitoring.	Difficulty interpreting results	Lack of confidence in water quality monitoring makes it difficult to have confidence in proposed management actions.	CM8, CE2, MEMA5	***Medium***
E2	Coastal vegetation corridor between Mylestom and Tuckers Rock	Morning Glory	Strangling Banksia, Tuckeroo, Beech Birdseye trees and Acacia rehabilitation areas.	Impact ecosystem structure and function, reduce native species richness, alter hydrological and fire regimes, change soil nutrient status and alter habitat.	CM1, CE1, MEMA1, MEMA4	***High***
E3	Urunga sandmass	Bitou infestation	Outcompetes native species	Serious threat to littoral rainforest. Listed as a Key Threatening Process under Threatened Species Conservation Act 1995. Reduces vegetation diversity and consequently habitat.	CM1, CE1, CW1, CW2, MEMA1, MEMA4	***High***
E4	Inland from Wenonah Head	Loss of canopy trees in fire, garden escapees, bitou.	Outcompetes native species	Serious threat to Littoral Rainforest & Themeda Grasslands on Sea Cliffs and Coastal Headlands (Both EECS). Listed as a Key Threatening Process under Threatened Species Conservation Act 1995	CM1, CE1, MEMA1, MEMA4	***High***
E5	Hungry Head to Oyster Creek	Bitou infestation	Outcompetes native species	Serious threat to Littoral Rainforest & Themeda Grasslands on Sea Cliffs and Coastal Headlands (Both EECS). Listed as a Key Threatening Process under Threatened Species Conservation Act 1995	CM1, CE1, MEMA1, MEMA4	***High***
E6	Lowland Rainforest EEC, Subtropical Coastal Floodplain EEC, Lowland Rainforest on Floodplain	Broadleaf paspalum, lantana, giant parramatta grass, molasses grass, bitou, morning glory, rhodes grass, mistflower, privet, madeira vine, balloon vine, tradescantia, castor oil.	Outcompetes native species	Impacts ecosystem structure and function, reduce native species richness, alter hydrological and fire regimes, change soil nutrient status and alter habitat. Alteration of the condition of the riverbank.	CM1, CE1, MEMA1, MEMA4	***High***
E7	Bongil Bongil National Park coast	Foxes, cats, covid species	Preying on Little Terns and their eggs	Decrease in an already threatened population. Potential local extinction.	CM1, CM10, CE1, MEMA1, MEMA4	***High***
E8	Bellinger and Kalang River riparian area	Clearing of native vegetation for agriculture	Decreased extent and condition of native vegetation on the alluvial plain including several endangered ecological communities.	Destruction of habitat, riparian zone degradation (bank erosion and water quality impacts) loss of genetic diversity, fragmentation of populations, disturbed habitat leading to spread of exotic species, habitat loss for fauna	CM1, CM5, CW2, CE1, MEMA1, MEMA4	***Extreme***

Risk	Location	Cause	Event	Outcome/Consequences/Impact	Management Objective(s) Affected	Final Risk Rating
E9	Urunga Island	Grazing by goats and horses	Decreased extent and condition of endangered ecological communities. .	Destruction of habitat, riparian zone degradation (bank erosion), loss of genetic diversity, fragmentation of populations, disturbed habitat leading to spread of exotic species, habitat loss for fauna	CM1, CM5, CW2, CE1, MEMA1, MEMA4	***Extreme***
E10	Ginagay Way Urunga	Lack of governance or ineffective governance of rural land clearing.	Rural landholders degrading or clearing native vegetation.	Destruction of habitat, riparian zone degradation (bank erosion), loss of genetic diversity, fragmentation of populations, disturbed habitat leading to spread of exotic species, habitat loss for fauna	CM1, CM5, CM10, CW2, CE1, MEMA1, MEMA4, MEMA6	***High***
E11	Mylestom Spit	Uncontrolled vehicle access	Vehicles driving on the foreshore and dunes	Loss of dune vegetation including EEC's (Coastal saltmarsh & Swamp Oak Forested Wetland of Hind-dunes) May alter beach/dune morphology	CE1 , CM1, MEMA 1, MEMA4	***Extreme***
E12	Back Creek	Wave wash from boats	Undermining and subsequent bank collapse	Loss of mangroves and fish habitat.	CE1 , CM1, MEMA 1, MEMA4	***Medium***
E13	Hungry Head	Uncontrolled vehicle access	Vehicles driving on the foredune	Loss of dune vegetation including EEC's (Littoral Rainforest) May alter beach/dune morphology	CE5, CM1, MEMA1, MEMA4	***High***
E14	Raleigh	Off leash dogs	Chasing endangered shorebirds	Physical injury to birds, abandonment of nesting sites, trampling of eggs	CE1, CM1, MEMA1	***High***
E15	Bellinger Island	Dumping of garden waste and garden escapees	Outcompetes native species	Decrease in condition and loss of subtropical vegetation.	CM1, CE1, MEMA1, MEMA4	***Medium***
E16	Crown Reserve near residential areas of Mylestom and Urunga	Dumping of garden waste and garden escapees.	Outcompetes native species	Impact ecosystem structure and function, reduce native species richness, alter hydrological and fire regimes, change soil nutrient status and alter habitat. Alteration of the condition of the riverbank.	CM1, CE1, MEMA1, MEMA4	***Medium***
E17	South of Alma Doepel Reserve	Introduced plants	Outcompetes native species	Impact ecosystem structure and function, reduce native species richness, alter hydrological and fire regimes, change soil nutrient status and alter habitat. Alteration of the condition of the riverbank.	CM1, CE1, MEMA1, MEMA4	***Medium***
E18	Urunga Lagoon	Clearing of native vegetation for sand mining and opprotunity for further rehabiltation	Decreased condition and extent of native vegetation including littoral rainforest.	Destruction of habitat, loss of genetic diversity, fragmentation of populations, disturbed habitat leading to spread of exotic species, habitat loss for fauna	CM1, CW2, CE1, MEMA1, MEMA4	***Medium***

Risk	Location	Cause	Event	Outcome/Consequences/Impact	Management Objective(s) Affected	Final Risk Rating
E19	Urunga Island	Fire	Decreased extent and condition of native vegetation including several endangered ecological communities.	Destruction of habitat, riparian zone degradation (bank erosion), loss of genetic diversity, fragmentation of populations, disturbed habitat leading to spread of exotic species, habitat loss for fauna	CM1, CM5, CW2, CE1, MEMA1, MEMA4	***Medium***
E20	Habitats of high ecological and conservation value	Clearing of native vegetation for agriculture	Decreased extent and condition of native vegetation on the alluvial plain including several endangered ecological communities.	Destruction of habitat, riparian zone degradation (bank erosion and water quality impacts) loss of genetic diversity, fragmentation of populations, disturbed habitat leading to spread of exotic species, habitat loss for fauna	CM1, CM5, CW2, CE1, MEMA1, MEMA4	***High***
E21	Alluvial Plain	Clearing of native vegetation for agriculture	Decreased extent and condition of native vegetation on the alluvial plain including several endangered ecological communities.	Destruction of habitat, riparian zone degradation (bank erosion and water quality impacts) loss of genetic diversity, fragmentation of populations, disturbed habitat leading to spread of exotic species, habitat loss for fauna	CM1, CM5, CW2, CE1, MEMA1, MEMA4	***High***
E22	Crown Land Reserve R13646	Uncontrolled vehicle access	Vehicles driving on the foreshore and dunes	Deterioration of beaches, dunes and natural features of foreshores.	CE1 , CM1, MEMA 1, MEMA4	***Medium***
E23	Bellinger and Kalang Rivers	Prop scour and boat wash	Damage to seagrass	Reduces seagrass extent and condition.	CE1 , CM1, MEMA 1, MEMA4	***Medium***
E24	North Beach	Unclear signage	Dog owners entering the national park	Threats and harm to natural character, biological diversity and ecosystem integrity	CE1, CM1, MEMA1, MEMA4	***Medium***
E25	Near Beach Parade Mylestom	Insufficient signage and bins	Litter, dog poo bags left	Decreased enjoyment of the natural environment.	CE1, CE4, CE6, CM1, CM2, MEMA3	***Medium***
E26	Picket Hill Creek near Martells Road	Long-term campers without toilet facilities	Leaving waste	Decreased water quality and potential contamination of oyster farms	CE3, CE4, CM4, MEMA1, MEMA2	***Medium***
E27	Picket Hill Creek	Long-term campers without toilet facilities	Leaving waste	Decreased water quality and potential contamination of oyster farms	CE3, CE4, CM4, MEMA1, MEMA3	***Medium***
E28	Trail off Martell's Road adjoining Kalang River Foreshore	Long-term campers without toilet facilities	Leaving waste	Decreased water quality and potential contamination of oyster farms	CE3, CE4, CM4, MEMA1, MEMA4	***Medium***
E29	Wenonah Head	Uncontrolled vehicle access	Parking on rock shelf	Erosion and damage to the rock shelf including intertidal fauna and flora	CE5, CM1, MEMA1, MEMA4	***Medium***
E30	Wenonah Head	Camping from June to November	Disturbing the the mating/breeding season of native animals	Potential decrease in local native fauna populations.	CE1, CM1, MEMA1	***Medium***
E31	Urunga boardwalk	Lack of long term weed control.	Contributing to fire hazard fuel load	Risk to the boardwalk from fire	CM1, CM10, CE1, MEMA1, MEMA4	***Medium***

COASTAL USE AREA						
Risk	**Location**	**Cause**	**Event**	**Outcome/Consequences/Impact**	**Management Objective(s) Affected**	**Final Risk Rating**
U1	Myelstom	Boat ramp is too close to the road	Dangerous traffic conditions	Decreased public safety	CE4, CM2, MEMA4	***High***
U2	Atherton Drive Precinct Urunga	Insufficient facilities for demand	Bins overflowing and user conflicts	Decreased public amenity of the foreshore	CE4, CE6, CM2, MEMA3	***Medium***
U3	Dalhousie Creek Entrance	After floods the entrance to Dalhousie Creek is altered	Prevents access to the beach and surf club	Decreased amenity and use of the beach and surf club.	CE4, CE6, CV4, CM2, CM9, MEMA3	***Medium***
U4	Mylestom Spit foreshore on the river side	Wash from high speed boats and jet skis	Shoreline recession	Increased public safety risk due to steep embankments and scarps.	CE6, CM2, MEMA3	***High***
U5	Bellinger River	Damaged concrete steps	Trip / slip hazard for users	Decreased public safety and reduced accessibility.	CE6, CM2, MEMA3	***Extreme***
U6	Kalang River past bridge	Shoals	Decreasing navigability for boats	Reduced safety for boat users.	CE4, CM2, MEMA3	***Medium***
U7	Estuary Entrance	Shoals	Decreasing navigability for boats	Reduced safety for boat users.	CE4, CM2, MEMA3	***High***
U8	Tuckers Island to Raleigh (Bellinger)	High numbers of waterskiers	Crowding of the waterway	Reduced safety for waterskiers and decreased enjoyment of the recreational experience.	CE4, CM2, MEMA3	***Medium***
U9	Newry Island to Pacific Highway (Kalang)	High numbers of waterskiers	Crowding of the waterway	Reduced safety for waterskiers and decreased enjoyment of the recreational experience.	CE4, CM2, MEMA3	***Medium***
U10	Urunga Lagoon	Urunga Lagoon boardwalk does not extend to the beach	Reducing accessibility	Inequitable beach access	CE6, CM2, MEMA3	***Medium***
U11	Oyster Creek Reserve	No basic facilities are available	Visitation experience is dimished	Litter and decreased visitation time	CE1, CM2, CM4, MEMA3	***Low***
U12	Atherton Drive Precinct Urunga	Unauthorised camping	Litter, pollution and loss of public space	Loss of public access and amenity.	CE4, CM2, MEMA3	***Medium***
U13	Kalang River Foreshores	Insufficient bike and walking tracks/paths linking the reserves and foreshore areas	Prevents safe egress for locals and tourists	Decreased public access, amenity and use of the foreshore and beach	CE6, CM2, MEMA3	***Medium***
U14	Kalang River foreshore Urunga	Boats exceeding speed limits	Erosion of the foreshore in front of properties along Newry Island Drive	Loss of amenity and use of the foreshore.	CE6, CM1, CM9, CM11, MEMA3	***Medium***
U15	North Beach Mylestom Spit	Insufficient signage or vehicles not complying with signage	Vehicles driving on the foreshore and dunes	Conflicts between vehicles and passive recreation.	CE5, CM2, MEMA3	***High***
U16	The Lido Urunga	Irresponsible dog owners	Dogs defecating and urinating at the Lido and on the boardwalk	Decreased amenity of the beach, swimming area and boardwalk .	CE6, CM2, MEMA3	***Medium***

Risk	Location	Cause	Event	Outcome/Consequences/Impact	Management Objective(s) Affected	Final Risk Rating
U17	North Beach near caravan park	Insufficient signage and bins for high visitation area	Litter	Decreased enjoyment of the natural environment.	CE1, CE4, CE6, CM1, CM2, MEMA3	***Medium***
U18	Bellinger River - the northern side of the southern set of stairs	The horizontal handrail recently added to connect the concrete stairs with the fence	Prevents people carrying kayaks or paddle boards from the park to the river on the northern side of the southern set of stairs	Forces users to traverse less safe, steeper foreshore embankments to launch passive watercraft.	CE6, CM2, MEMA3	***Medium***
U19	Myleston Spit river foreshore	Insufficient facilities for high visitation area	Bins overflowing and litter in natural areas (toilet paper and dog poo bags)	Decreased enjoyment of the natural environment.	CE4, CM2, MEMA3	***Medium***
U20	Wenonah Head	Littering in bushland areas	Litter	Decreased enjoyment of the natural environment.	CE1, CE4, CE6, CM1, CM2, MEMA3	***Medium***
U21	Near Beach Parade Mylestom	Insufficient signage and bins	Litter, dog poo bags left	Decreased enjoyment of the natural environment.	CE1, CE4, CE6, CM1, CM2, MEMA3	***Medium***
U22	Urunga Island	Littering and rubbish being washed downstream during floods	Pollution	Decreased enjoyment of the natural environment.	CE1, CE4, CE6, CM1, CM2, MEMA3	***Medium***
U23	Alma Doepel Reserve foreshore	River access is steep and dangerous	Prevents safe access for boats , paddleboards and kayaks	Increased safety risk for recreational users launching passive watercraft.	CE6, CM2, MEMA3	***Medium***
U24	Kalang River near Back Creek	Speeding boats and jetskis	Conflict with passive recreation (swimming, kayaking)	Loss of recreational amenity .	CE6, CM2, MEMA3	***Medium***
U25	Bellinger River	Unclear / disrepaired signage	8 knot speed limit exceeded	User conflicts and decreased recreational enjoyment.	CE6, CM2, MEMA3	***Medium***
U26	Bellinger River near Alma Doepel Reserve	Speeding boats and jetskis	Conflict with passive recreation (swimming, kayaking)	User conflicts and decreased recreational enjoyment.	CE6, CM2, MEMA3	***Medium***
U27	Hungry Head	Poor signage at entrance to four wheel drive beach access	Motorists travelling south from track and endangering beachgoers	Conflicts between recreational user groups. Increased risks to public safety.	CE6, CM2, MEMA3	***Medium***
U28	Near Tuckers Island	Oyster leases in disrepair	Hazard for paddlers and will detach in floods	Increased safety risk for passive watercraft users.	CE6, CM2, MEMA3	***Medium***
U29	Wenonah Head	Long term campers in areas with very limited facilities	Leaving rubbish and eroding the site	Loss of public amenity on beaches. Litter entering coastal waters.	CE6, CM2, MEMA3	***Medium***
U30	Urunga	Vehicles driving on the beach	Killing pipis	Loss of a cultural food source.	CE4, CM3, MEMA3	***Medium***
U31	Kalang River	Overhanging vegetation and log jams	Increased chance of hitting submerged or aerial objects when boating.	Increased safety risk for boat users.	CE6, CM2, MEMA3	***Medium***
U32	Bellinger River near Alma Doepel Reserve	Jetskis and powerboats	Are noisy and intrusive	Incompatible with councils ambition of attracting ecotourism.	CE4, CU1, CM2, CM4, MEMA2, MEMA3	***Medium***

Risk	Location	Cause	Event	Outcome/Consequences/Impact	Management Objective(s) Affected	Final Risk Rating
U33	Bellinger and Kalang River Entrance	Loss of the northern training wall	Prevents safe passage for boats	Boats unable to safely traverse the entrance limiting accessibility.	CE6, CM2, MEMA3	***Low***
U34	Urunga Island	CM1, CM3, CM8, CM12, CW1, CW2, CW4, CE1, CE4, MEMA3, MEMA4	Yellow Rock Island is in private ownership	Management practices of this important ecological and cultural land are not consistent with coastal zone objectives.	Reduction in extent and condition of coastal wetlands No ability to require remediation of ecologically and culturally significant land Private ownership prevents cultural access and First Nations management.	***Low***

GOVERNANCE						
Risk	**Location**	**Cause**	**Event**	**Outcome/Consequences/Impact**	**Management Objective(s) Affected**	**Final Risk Rating**
G1	Alma Doepel Reserve and Mylestom Tidal Baths	Inaction on bank erosion	Seawall failing at multiple locations	Reduced available public land. Potential safety risks to users of the public recreation area. Reputational risk to Council.	CE6, CV1, CV4, CM2, CM10, CM11, MEMA3, MEMA6	***High***
G2	Kalang River Boathouses	Boathouses in disrepair	Public perception of unclear forward planning for Kalang River boathouses	Lack of confidence in governance processes.	CM2, CM8, CM10, CM11, CE4, MEMA3, MEMA6	***Medium***
G3	Bongil Bongil National Park	Tuckers Head Road is not maintained or regulated.	Poor road surface	Risk of damage to vehicles and increased safety risks.	CM2, CM10, CE6, MEMA6	***Low***
G4	Public foreshore land	Unclear responsibilities of public agencies	Inconsistent management	Reputational impacts. Public reserves of varying environmental and recreational quality.	CM8, CM10, CM11, CU4, MEMA6	***Medium***
G5	Shire wide	Small rates base in Bellingen Shire Council	Small budget to complete management actions in the coastal zone or match funds for government grants	Limitation to management actions that Council can reasonably undertake with current resourcing.	CM10, CE1, MEMA6	***Extreme***
G6	Urunga Island	Yellow Rock Island is in private ownership	Management practices of this important ecological and cultural land are not consistent with coastal zone objectives.	Reduction in extent and condition of coastal wetlands No ability to require remediation of ecologically and culturally significant land Private ownership prevents cultural access and First Nations management.	CM1, CM3, CM8, CM12, CW1, CW2, CW4, CE1, CE4, MEMA3, MEMA4	***High***
G7	Shire wide	Technical data and local knowledge of established residents is not alway used	Uninformed management decisions	Perception that leadership is not knowledgeable	CM10, CM11, MEMA5	***Medium***
G8	Atherton Drive precinct	Lack of consultation with Gumbaynggir people	Plan of management developed without First Nations input or review.	Loss of cultural knowledge and significance of the site.	CM2, CM8, CM11, CE4, MEMA3	***High***
G9	Mylestom North Beach	There is no permit system for 4WDs	No regulation or monitoring of 4WD activity	User conflicts No revenue source for enforcement activities Unauthorised access to dunes and dune vegetation	CM1, CM2, CM8, CE1, CU4, MEMA6	***High***
G10	Coastal zone	Unmanaged Council and Government owned reserves that are not incorporated into Bellinger State Park or similar	Less restoration and protection when compared to managed reserves	Inconsistent management of public land Biodiversity impacts Decreased rehabilitation potential	CM1, CM10, CM12, CE1, MEMA1, MEMA4, MEMA6	***High***

Risk	Location	Cause	Event	Outcome/Consequences/Impact	Management Objective(s) Affected	Final Risk Rating
G11	Bellinger River	Inability to access information regarding dredging of the Bellinger River Who pays? How much is taken? Who monitors? How long since an EIS has been done? What effect does this dredging pose to our wildlife?	Decreased public knowledge of dredging impacts	Decreased public confidence that impacts of dredging are adequately monitored.	CM11, CE1, MEMA2, MEMA6	***High***
G12	Mylestom Drive, Repton	The drainage area and wetland contains land zoned R1 and RU2	Decreased protection from development	Potential loss of floodplain and floodplain vegetation.	CM1, CM5, CM8, CM12, CW1, CE1, CU1, MEMA1	***Low***
G13	Kalang River, railway bridge	Broken water pipe leaking on railway pylon since 2020	Complaints to Council	Public frustration as council has advised that they cannot fix a pipe on a railway pylon.	CM10, CU2, MEMA6	***High***
G14	Bellinger and Kalang near entrance	Inadequate policing of boating speeds by NSW Maritime	Boats speeding	Safety risks to passive water users Increased boat wash impactings riverbanks	CM2, CM11, CE4, MEMA6	***Medium***
G15	Mylestom North Beach	Inadequate protection of littoral rainforest regenerated by Landcare between the beach and houses.	Perception that Landcare work is not adequately supported.	Reputational risks to responsible public authorities. Potential decrease in willingness of volunteers to work on land that is not pro-actively managed by the land owner/manager.	CM10, CM11,CM12,CW2, MEMA6	***Medium***
G16	Coastal Zone	Insufficient support for Gumbaynggirr community in terms of coastal management	Decreased collaboration and support between coastal land managers.	Loss of cultural knowledge and significance of the sites.	CM2, CM8, CM11, CE4, MEMA3	***High***