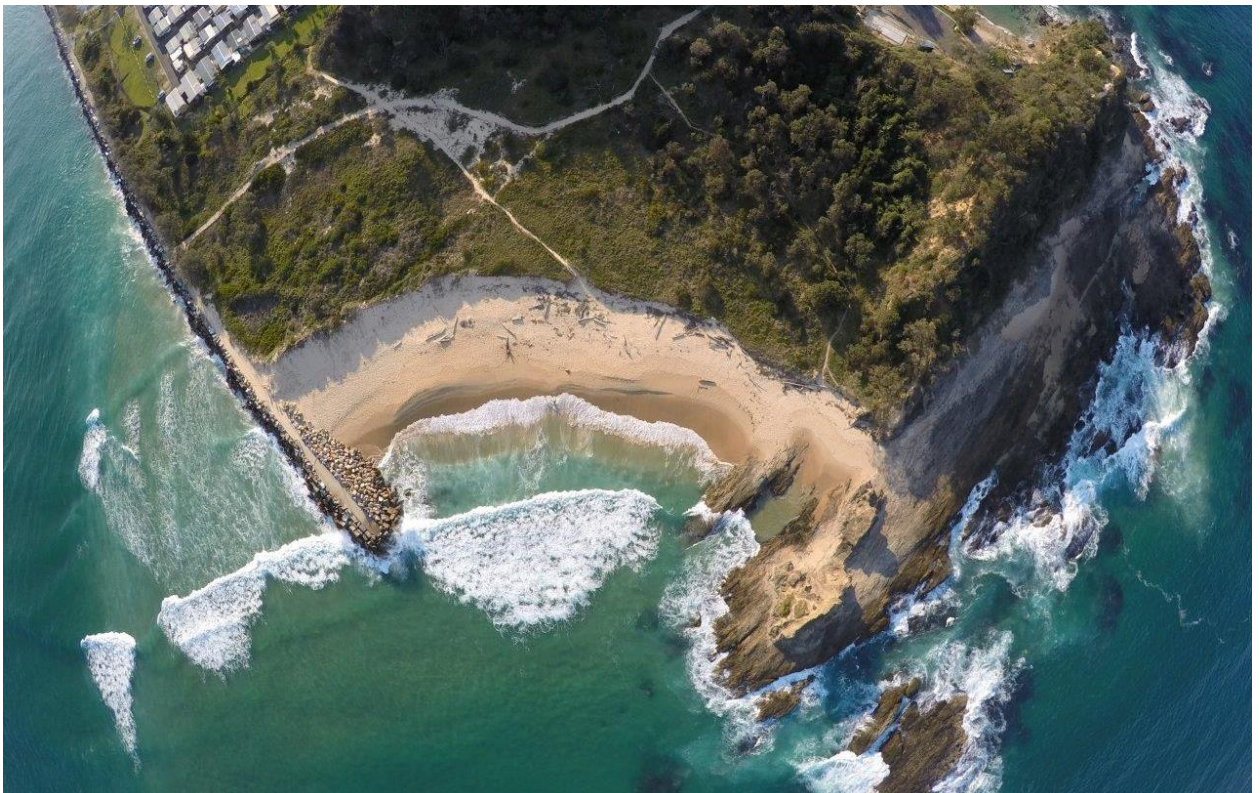


Nambucca Coastline and Estuaries Coastal Management Program

Stage 2: Vulnerabilities and Opportunities Study



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18-019 – NAMBUCCA COASTLINE AND ESTUARIES CMP – STAGE 2 VULNERABILITIES AND OPPORTUNITIES

REV	DESCRIPTION	AUTHORS	REVIEW	APPROVAL	DATE
0	Draft for Client Review	K.Menzies, K.Pratt	R.Campbell	M.Howland	7/10/2020
1	Final Report	K.Pratt	M.Howland	M.Howland	26/10/2020

EXECUTIVE SUMMARY

Nambucca Valley Council (NVC) has received funding through the NSW Government Coastal and Estuary Grants Program to prepare the Nambucca Coastal Management Program (CMP) which will document the integrated and sustainable management of the coastline and estuaries of the Nambucca Valley LGA. Stage 2 (this document) is a Vulnerabilities and Opportunities Study which provides information to support decision-making in later stages of the planning process. The additional information will assist the Nambucca community to better understand coastal management issues and to analyse and evaluate coastal risks and opportunities.

Stage 1 of the Nambucca CMP (Scoping Study - Hydrosphere Consulting, 2020) considered the current level of understanding of issues, the time and resources available, as well as community and stakeholder perceptions of risks and vulnerabilities. It was determined that the key knowledge gap requiring further assessment as part of Stage 2 studies was the lack of comprehensive, up-to-date bank stability and riparian condition mapping. This has now been resolved through the completion of the *Bank Condition Assessment – Nambucca River and Deep Creek* (Hydrosphere Consulting, 2019). This report provides a summary of the current extent of bank instability, bank protection measures in place and riparian condition of the estuaries up to the tidal limit. Priority sites are also identified to target management actions in subsequent stages of the CMP.

This Stage 2 report also provides a preliminary screening of potential management options to address the key issues and threats identified in Stage 1 of the CMP. The screening process identifies opportunities for reducing vulnerability, building resilience and strengthening the adaptive capacity of the study area and coastal communities. It incorporates a review of management solutions proposed and/or implemented as part of previous studies and plans of management. The report also includes additional actions to address identified pressures and threats affecting the study area now and projected into the future. Potential management options recommended for further consideration will be assessed in detail as part of Stage 3 of the CMP (Response Identification and Evaluation).

An updated risk assessment based on the results of Stage 2 studies is also included as Appendix 2. This updates the first-pass risk assessment completed during the Stage 1 Scoping Study considering all current information, including results of the bank condition assessment.

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1. INTRODUCTION

1.1 Nambucca Valley Coastal Management Program

Nambucca Valley Council (NVC) has received funding through the NSW Government Coastal and Estuary Grants Program to prepare the Nambucca Coastal Management Program (CMP) which will document the integrated and sustainable management of the coastline and estuaries of the Nambucca Valley LGA. The *NSW Coastal Management Manual* (OEH, 2018, the Manual) outlines the mandatory requirements and provides guidance on the preparation, development, adoption and content of a CMP. It includes a process for councils to follow when identifying and assessing the vulnerability of coastal environmental, social and economic values and evaluating management actions. The manual outlines a five-stage process for developing and implementing a CMP (Figure 1). The CMP Scoping Study (Hydrosphere Consulting, 2020) sets the scene for the coastal planning process for all areas of the open coast and all coastal creeks and estuaries in the Nambucca Valley LGA including Nambucca River, Deep Creek, Swimming Creek and Oyster Creek estuaries.

This report addresses Stage 2 of the CMP process for the Nambucca coastline and estuaries.

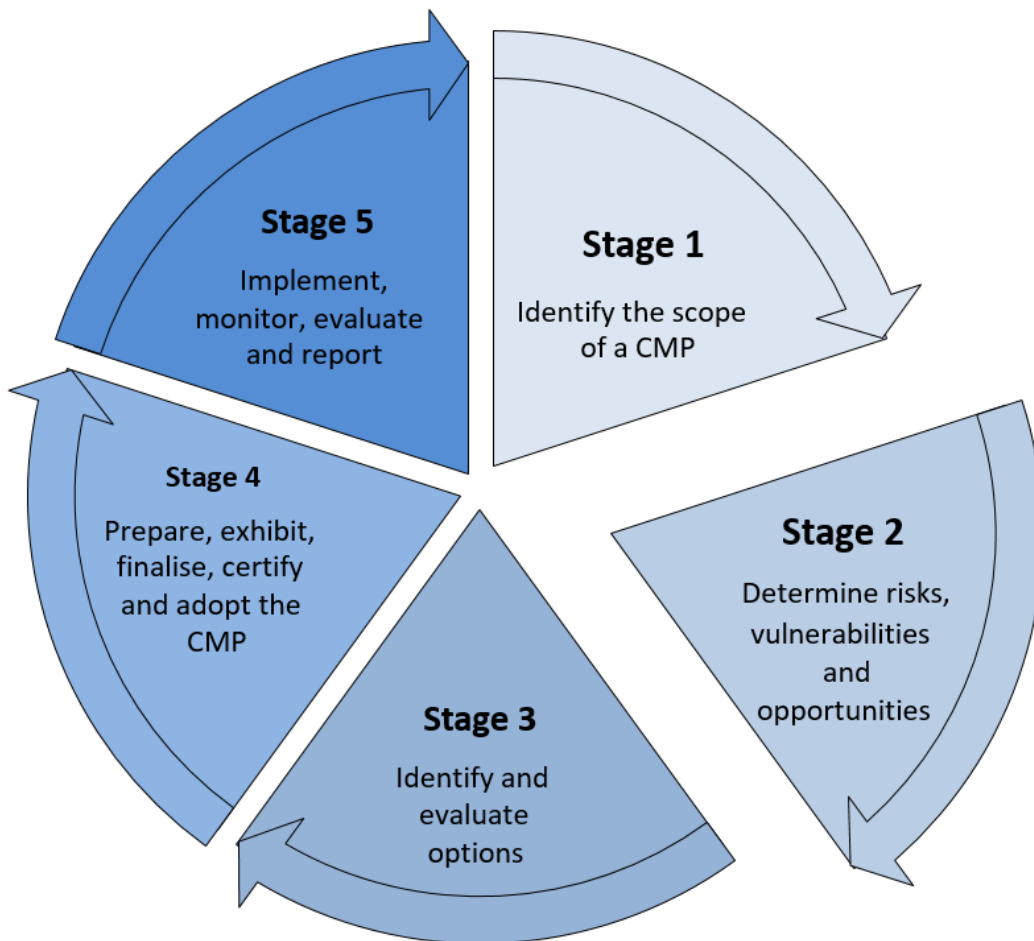


Figure 1: Five stage process for developing a coastal management program

Source: Adapted from OEH (2018b)

1.2 Risks, Vulnerabilities and Opportunities

Through the first-pass risk assessment and the gap analysis undertaken as part of the Scoping Study, it was identified that a critical knowledge gap existed regarding understanding of the condition of estuarine banks and riparian vegetation. Resolving this knowledge gap is necessary for effective, immediate and future management of the study area with improvements to bank stability and riparian condition likely to result in the single biggest improvement to estuary health within the study area (refer Table 1).

Table 1: Detailed studies and associated tasks to be completed during Stage 2

Issue	Knowledge gap	Study required and recommended tasks	Anticipated outcomes
Estuarine bank erosion	Lack of comprehensive, up to date bank stability and riparian condition mapping including for the previous unmapped areas of Deep Creek.	Estuarine bank and riparian vegetation condition assessment - desktop assessment, field survey and mapping of bank condition (erosion and riparian vegetation) of navigable reaches of Nambucca River estuary (including Taylors Arm, Newee Creek and Warrell Creek) and Deep Creek.	Detailed, comprehensive mapping and photography of current bank condition, current riparian vegetation condition and connectivity, causative factors and stressors, existing bank treatments, and priorities for management.

This report documents the outcomes of the estuarine bank erosion assessment.

A preliminary assessment of management opportunities arising from review of potential management solutions to address the risks and threats identified in the Scoping Study is also provided in this report.

2. BANK CONDITION ASSESSMENT

2.1 Introduction

The Scoping Study identified estuarine bank erosion and riparian condition as key issues to be addressed in the CMP for the Nambucca Valley coastal zone.

Foreshore erosion and degradation of bank condition is a common issue experienced in estuaries and is an issue that is not only highly visible, but also contributes to numerous factors affecting ecological health and public amenity. The processes leading to bank erosion can be attributed to a range of influences, some of which occur naturally, but are often exacerbated by factors such as land clearing, cattle access, boat wake or inappropriate foreshore structures. While significant works have and continue to be undertaken to restore the riverbanks in the Nambucca Valley, there had been no large-scale mapping or bank condition assessment undertaken for the Nambucca River since 2005 (GECO, 2005). As such, the effects of subsequent flooding, tidal inundation, storms and the success of rehabilitation projects have not been documented. In addition, mapping of bank condition within Deep Creek had not previously been undertaken.

The following sections provide a summary of the bank condition assessment undertaken as part of Stage 2 of the CMP development (refer Appendix 1 for full report).

2.2 Methodology

The *Bank Condition Assessment for Nambucca River and Deep Creek Estuary* (Hydrosphere Consulting, 2019) documents an assessment undertaken in April 2019 which consisted of a field survey and desktop assessment to identify and assess the extent of current bank instability and riparian condition. It is intended to provide an updated understanding of the issues within the study area to allow better informed scoping of future actions regarding these key issues.

2.2.1 Study Area

The field survey study area includes all navigable reaches of the Deep Creek and Nambucca River estuaries and associated major tributaries as shown in Figure 2. Upper catchment areas were not included in the assessment as rehabilitation of the upper catchment is being carried out by Nambucca Valley Landcare guided by a series of River Reach Plans.



Plate 1: Bank condition in the Nambucca River Estuary, April 2019

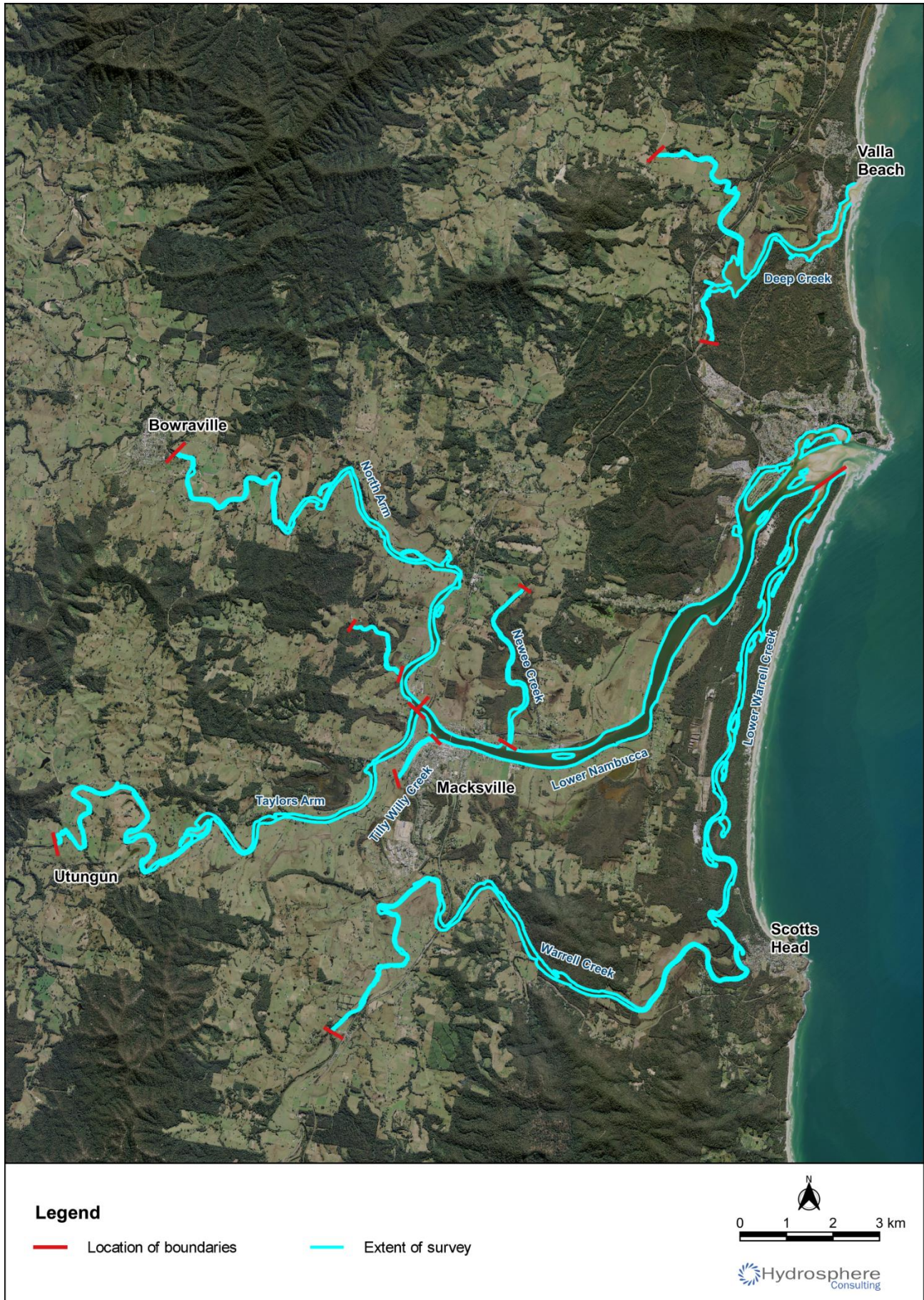


Figure 2: Bank condition assessment field survey study area

2.2.2 Field survey

The field survey was undertaken by boat over three days in April 2019. A total of 210 km of river bank was assessed during the study. Sections within the study area that were unnavigable were either traversed on foot (e.g. downstream of the footbridge on Deep Creek) or photos were taken and assessed in combination with aerial photographs (e.g. small inlets/backwaters).

Both left and right banks of the estuaries were divided into segments and assessed according to the following categories:

- Bank instability – classified as either insignificant, minor, moderate or high instability.
- Localised factors contributing to instability (e.g. natural meander, stock access, boat/wind wash, foreshore or instream structure, public access etc.).
- Assets at risk (e.g. roads, power and stormwater infrastructure, buildings, public access etc.).
- Protection works currently in place (e.g. rock, concrete, building rubble, gabions, tyres, fencing, revegetation, brush mulching, logs/timber, rock fillets, coir logs etc.).
- Effectiveness of protection works – classified as either effective, partially effective, effective in the future or ineffective.
- Riparian vegetation condition including level of weed infestation including vegetation type, cover (density and canopy cover), structure (trees, shrubs, grass etc.), diversity and weeds present.

2.3 Key Findings

2.3.1 Bank instability

The assessment measured the extent of bank instability in each of the estuary systems up to the tidal limit, recording both the length and severity of the instability as shown in Figure 3 and spatially in Figure 4 (Nambucca River estuary) and Figure 5 (Deep Creek estuary). North Arm was determined to be the most unstable reach with the highest overall levels of bank instability. Taylors Arm, Deep Creek, Lower Warrell Creek and the Lower Nambucca estuary also showed significant levels of bank instability.

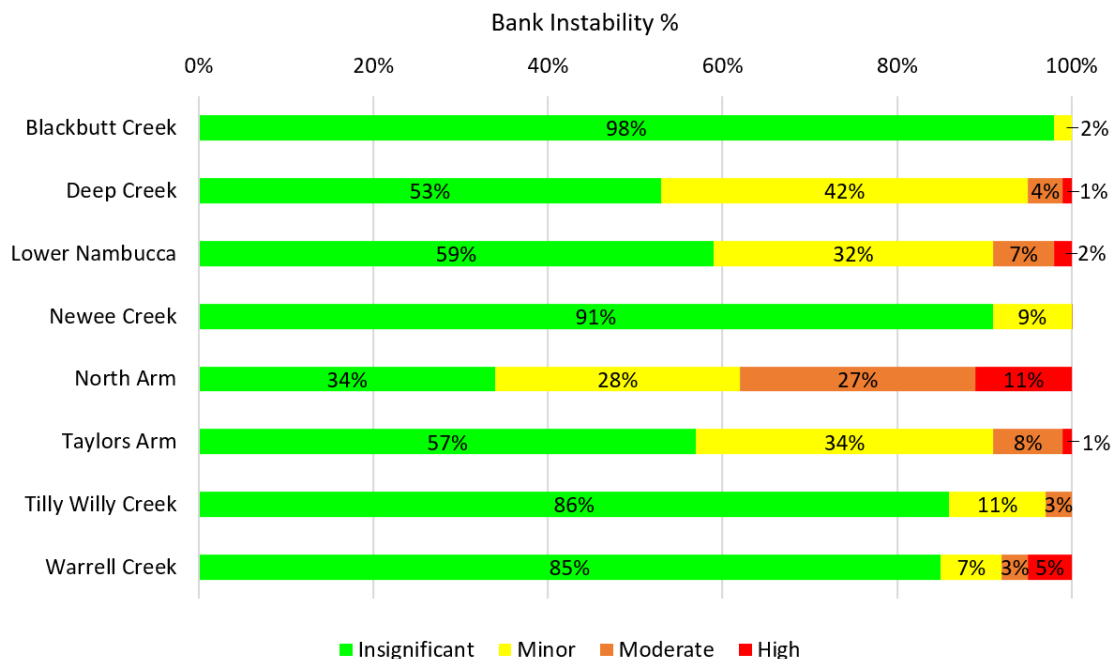


Figure 3: Bank instability extent across the study area

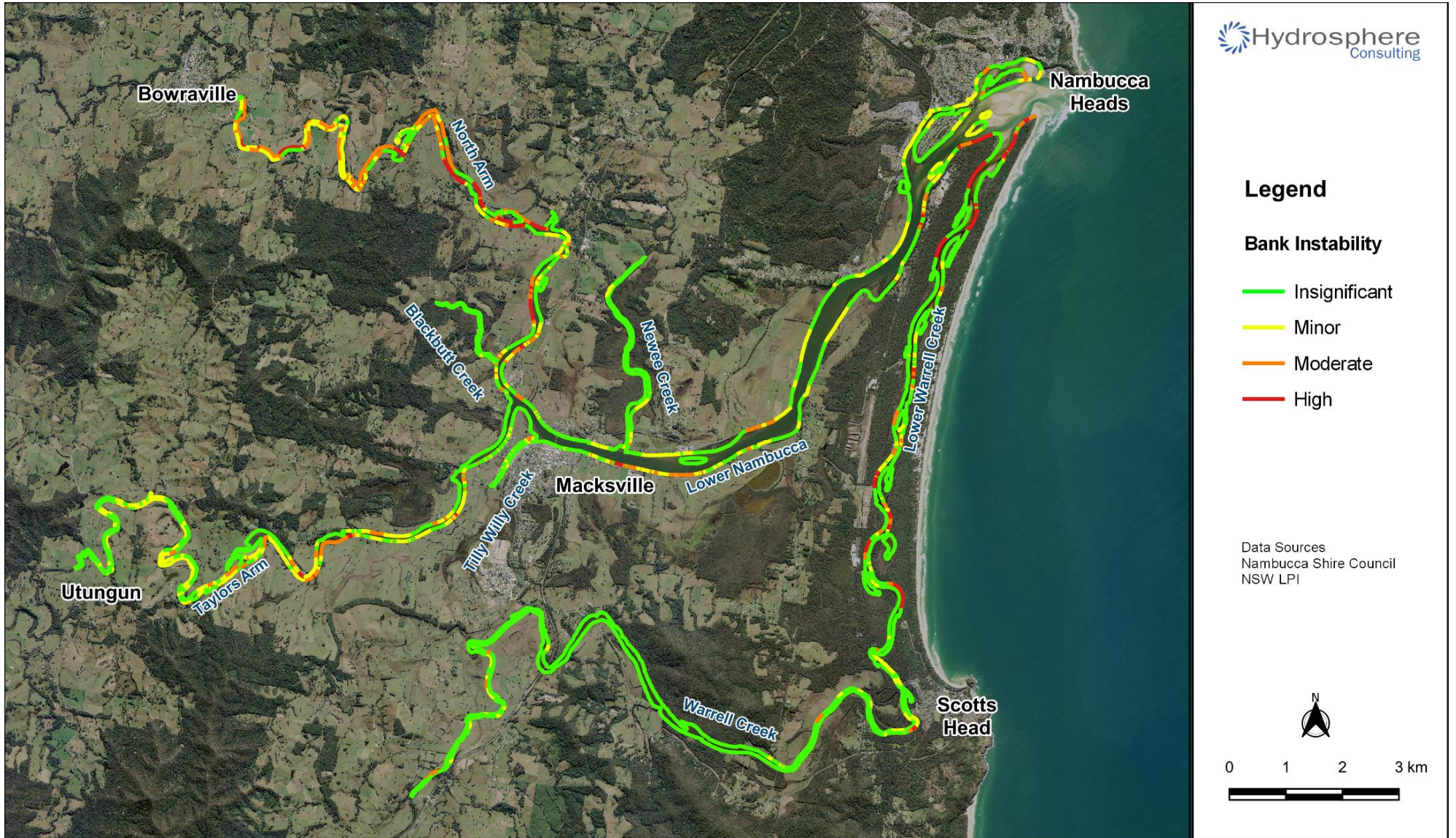


Figure 4: Bank instability - Nambucca River estuary



Figure 5: Bank instability – Deep Creek estuary

2.3.2 Bank protection works

In total, approximately 30 km of bank protection works were identified within the 210 km of estuary banks surveyed in this study. This was almost twice the amount recorded during the GECO (2005) survey and indicates a significant increase in bank protection works being undertaken in the last 14 years. Table 2 provides a summary of the extent and effectiveness of bank protection methods observed in the study area. Figure 6 shows the relative length of bank protection works within each system, Figure 7 shows the overall effectiveness of bank protection measures observed in each system and Figure 8 provides a breakdown of the different bank protection methods and materials used in each system.

Almost half of the protection works were recorded in the lower Nambucca River estuary concentrated around private land and built assets at Nambucca Heads. Rock revetment made up of 50% of the bank protection works followed by concrete (10%), building rubble (10%) and timber (10%). The majority of works (74%) were considered to be either effective, partially effective, or likely to be effective in the future. Building rubble, tyres and timber protection works were common examples of the largely ineffective bank erosion control measures observed.

Further considerable protection works were recorded on lower Taylors Arm and North Arm. Those on Taylors Arm were also predominantly concentrated around private land and built assets in Macksville and consisted of rock revetment (38%), fencing (22%) and building rubble (20%). Taylors Arm works had high overall effectiveness with 91% assessed as being either effective, partially effective, or likely to be effective in the future. Bank protection works on North Arm consisted primarily of cattle exclusion fencing (56%), small stretches of rock revetment (16%), revegetation works (11%) and also ad hoc works using building rubble (9%). The majority of these works (82%) were considered to be either effective, partially effective, or likely to be effective in the future. Tilly Willy Creek had a high proportion of bank protection works around private land and built assets along the western bank and consisted of concrete works (22%), building rubble (18%), tyres (12%) and fencing (12%).

Overall, considering all systems assessed, 23% of the bank protection works were considered to be ineffective. Building rubble, tyres and timber protection works were common examples of the largely ineffective bank erosion control measures observed.

Table 2: Summary of extent and effectiveness of bank protection works for each system

System	Total length surveyed (km)	Total length of bank protection works (km)	Effectiveness of bank protection works			
			Effective in Future	Effective	Partially Effective	Ineffective
Blackbutt Creek	3.90	0.02	0%	0%	100%	0%
Deep Creek	23.20	3.44	33%	29%	19%	20%
Lower Nambucca	36.10	12.71	28%	16%	30%	26%
Newee Creek	8.70	0.21	34%	45%	21%	0%
North Arm	32.10	7.21	4%	64%	14%	18%
Taylors Arm	34.70	3.84	10%	46%	35%	9%
Tilly Willy Creek	2.60	1.03	13%	57%	25%	5%
Warrell Creek	68.10	1.28	14%	9%	62%	15%
TOTAL	209.40	29.74				

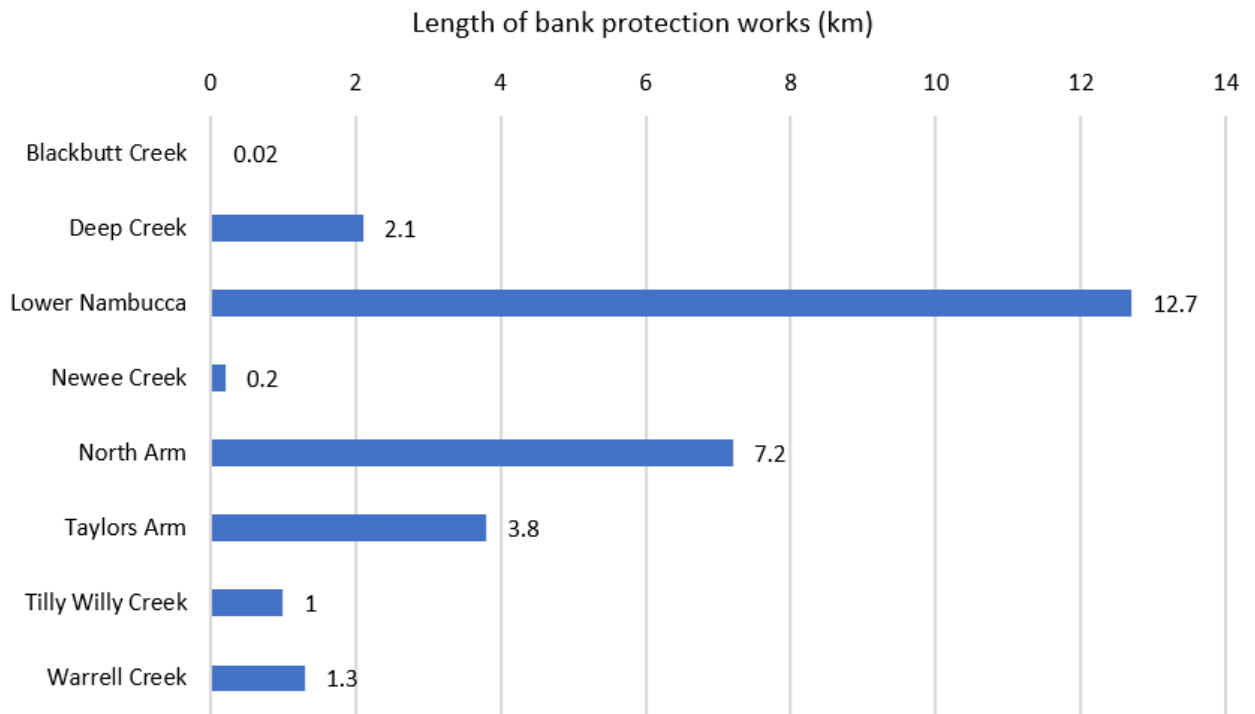


Figure 6: Length of bank protection works along each system

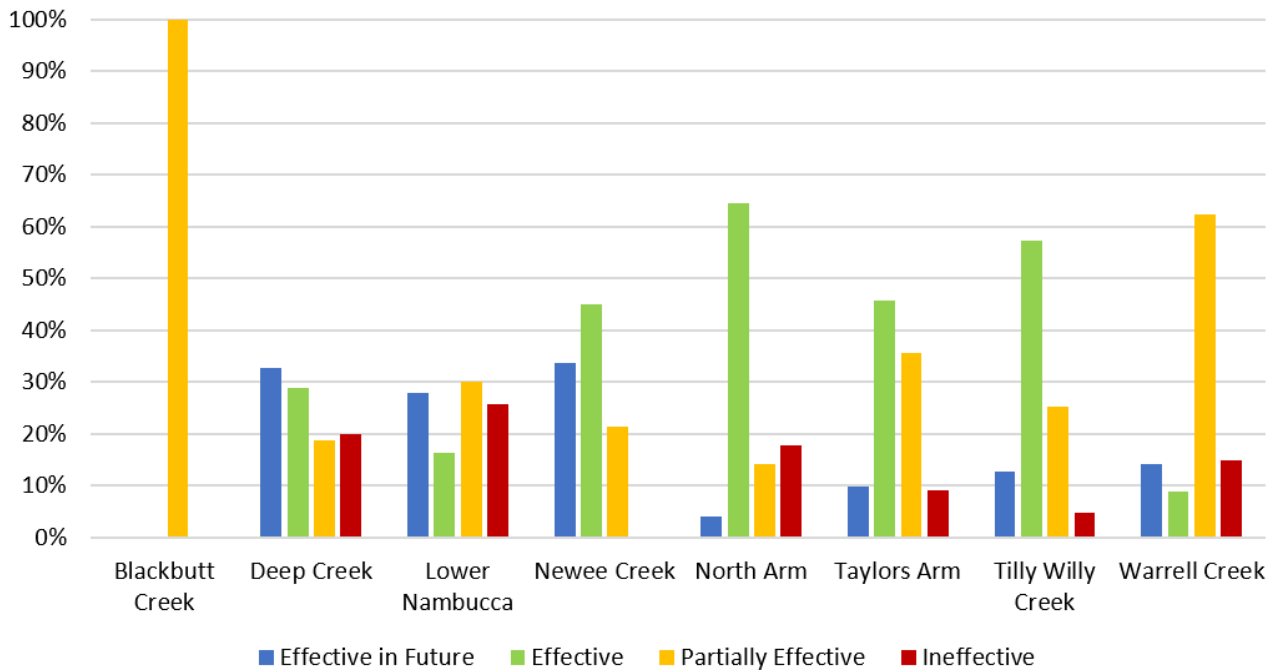


Figure 7: Effectiveness of bank protection measures observed in each system

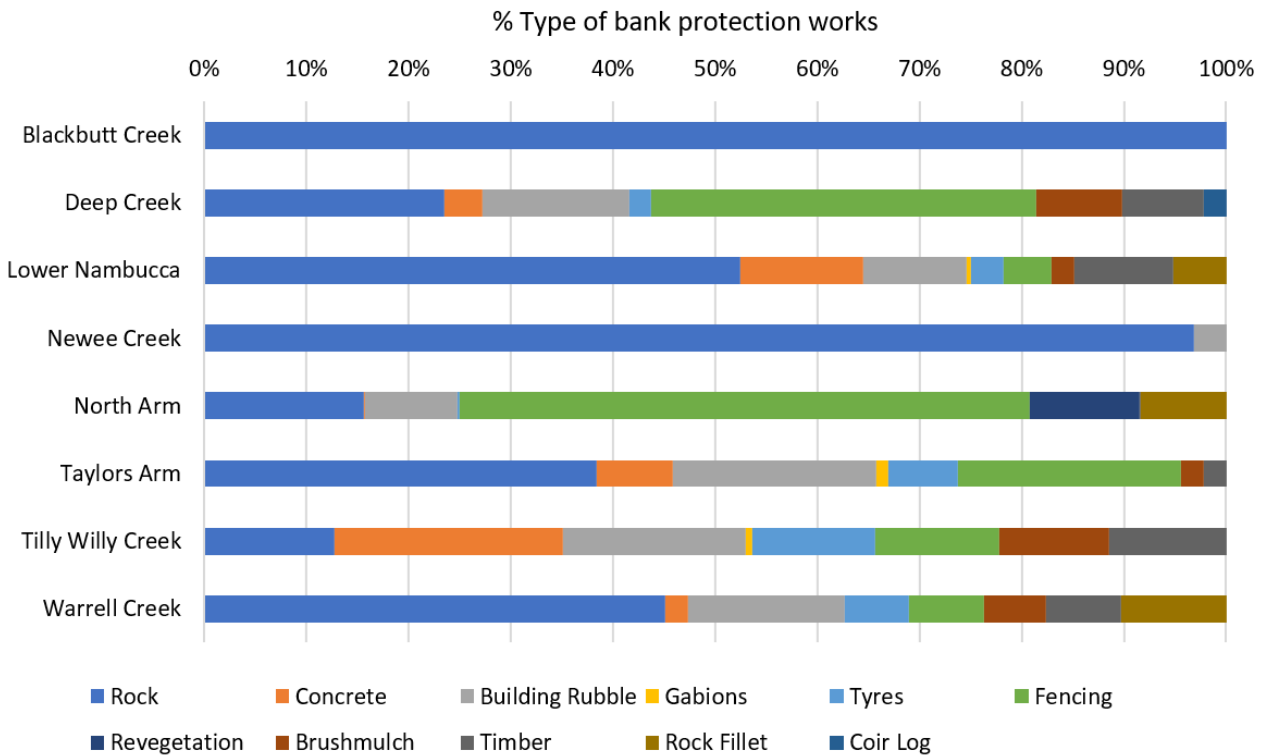


Figure 8: Percentage of bank protection methods observed along each system

2.3.3 Riparian vegetation condition

The riparian vegetation condition recorded for each system is summarised in Figure 2 and Figure 3 of the detailed report (Appendix 1).

Blackbutt Creek and Newee Creek were assessed as having the highest proportion of riparian vegetation in good condition while North Arm, Taylors Arm and Tilly Willy Creek had the highest proportions of poor riparian vegetation condition.

Significant weed coverage was mainly observed in the upper parts of the systems particularly in Taylors Arm and North Arm. A high occurrence of Camphor Laurel (*Cinnamomum camphora*) was observed in the upper estuaries, Cassia (*Senna spp.*) was prevalent in the mid to lower estuary and Lantana (*Lantana camara*) present throughout.

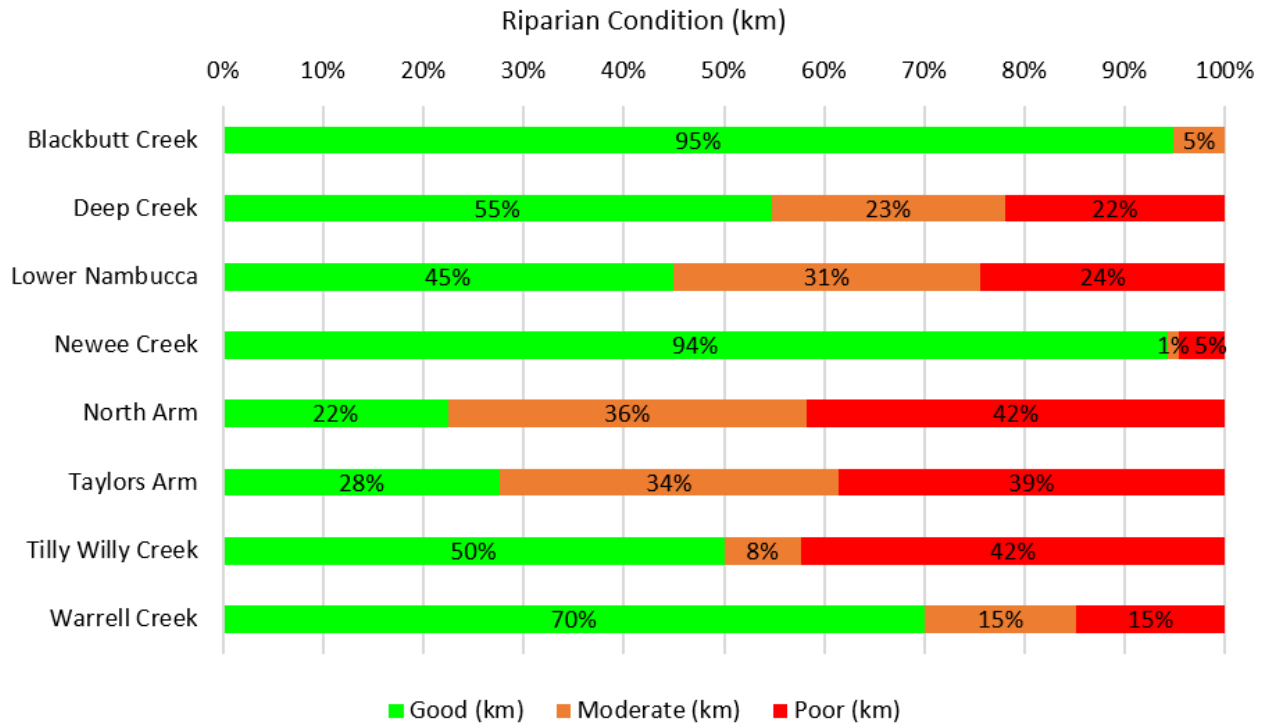


Figure 9: Riparian condition extent across the study area

2.4 Bank Management Opportunities

The bank condition assessment determined sites with both high bank instability and poor riparian condition as priority sites for management action. These sites represent areas of significant degradation with the greatest potential for improvement. The sites are located on North Arm, Taylor's Arm, Lower Nambucca River (near Macksville) and Warrell Creek. Generally, the sites lack riparian vegetation, and many are unfenced with cattle having uncontrolled access to banks down to the water's edge. Significant erosion was observed at these sites, often with a high active erosion scarp.

Further sites were selected as 'opportunity sites' which were considered to be logistically and technically feasible sites for bank stabilisation presenting significant opportunities for improvements in bank stability and riparian condition. Work at these 'quick fix' sites would also allow for erosion issues to be addressed promptly before further worsening of erosion to levels that would require a much higher degree of intervention. All opportunity sites generally have similar characteristics including:

- Generally minor bank instability with poor vegetation.
- Pasture to edge of bank with scattered trees.
- Stock access to water.
- Inside bend with low height and low relief banks.
- One landowner.
- Located in upper estuary.

The justification for selecting these sites as opportunity sites for bank management works is based on the following:

- The inside bend of the river is conducive to revegetation, rehabilitation and overall recovery.
- Fencing to exclude stock is generally easy to implement.

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- Stabilisation works are suitable where there is low height and relief of the river bank.
- The sites are easy to access.
- Significant benefits could be achieved in one location.
- There are downstream benefits of improving water quality and reducing sedimentation and shoaling.

Both priority and opportunity sites are shown on Figure 10 to Figure 12 and summarised by location in Table 3. Further details of individual sites, including photos are provided in Appendix 3.

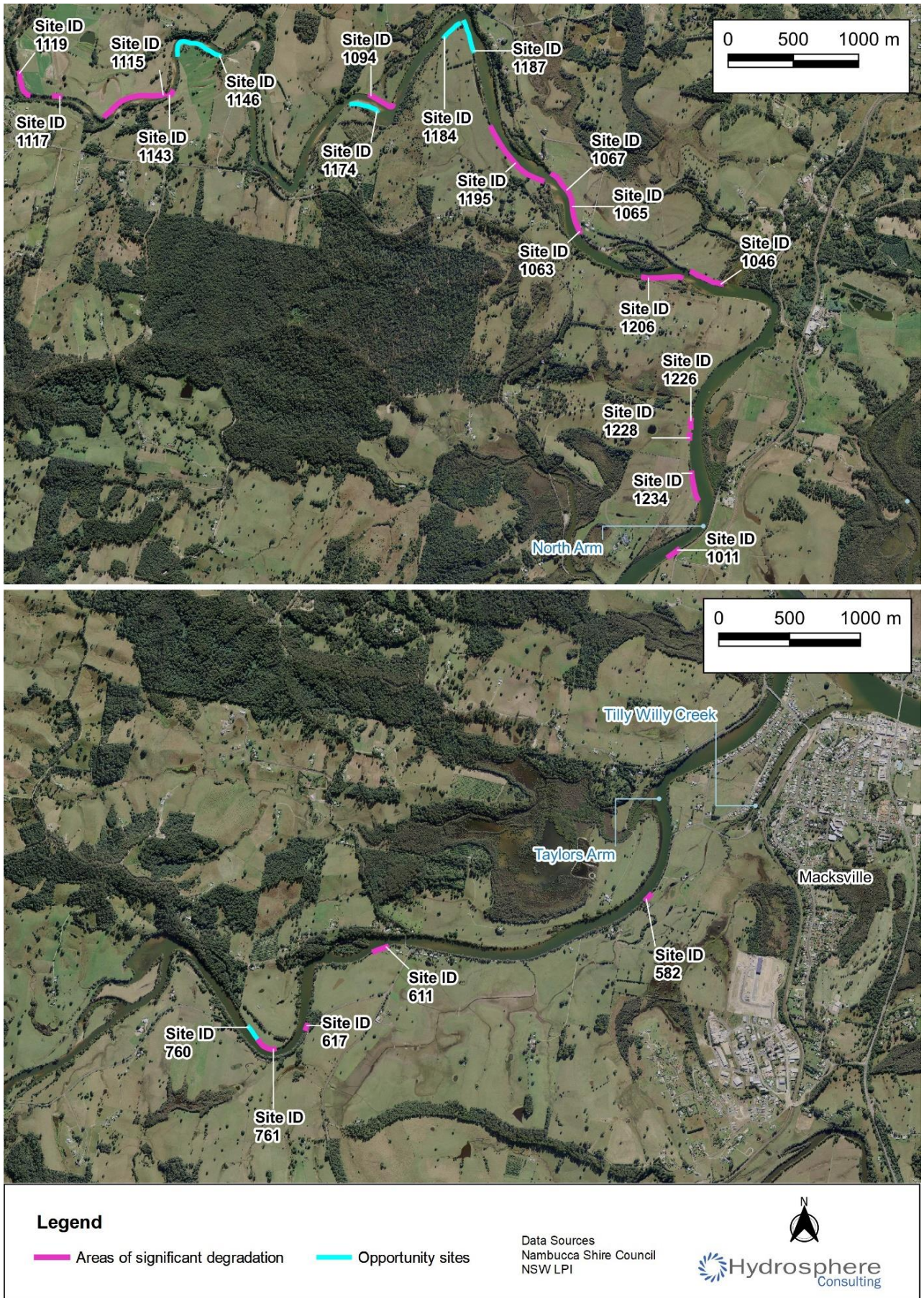


Figure 10: Recommended bank management sites on North Arm (top) and Taylors Arm (bottom)

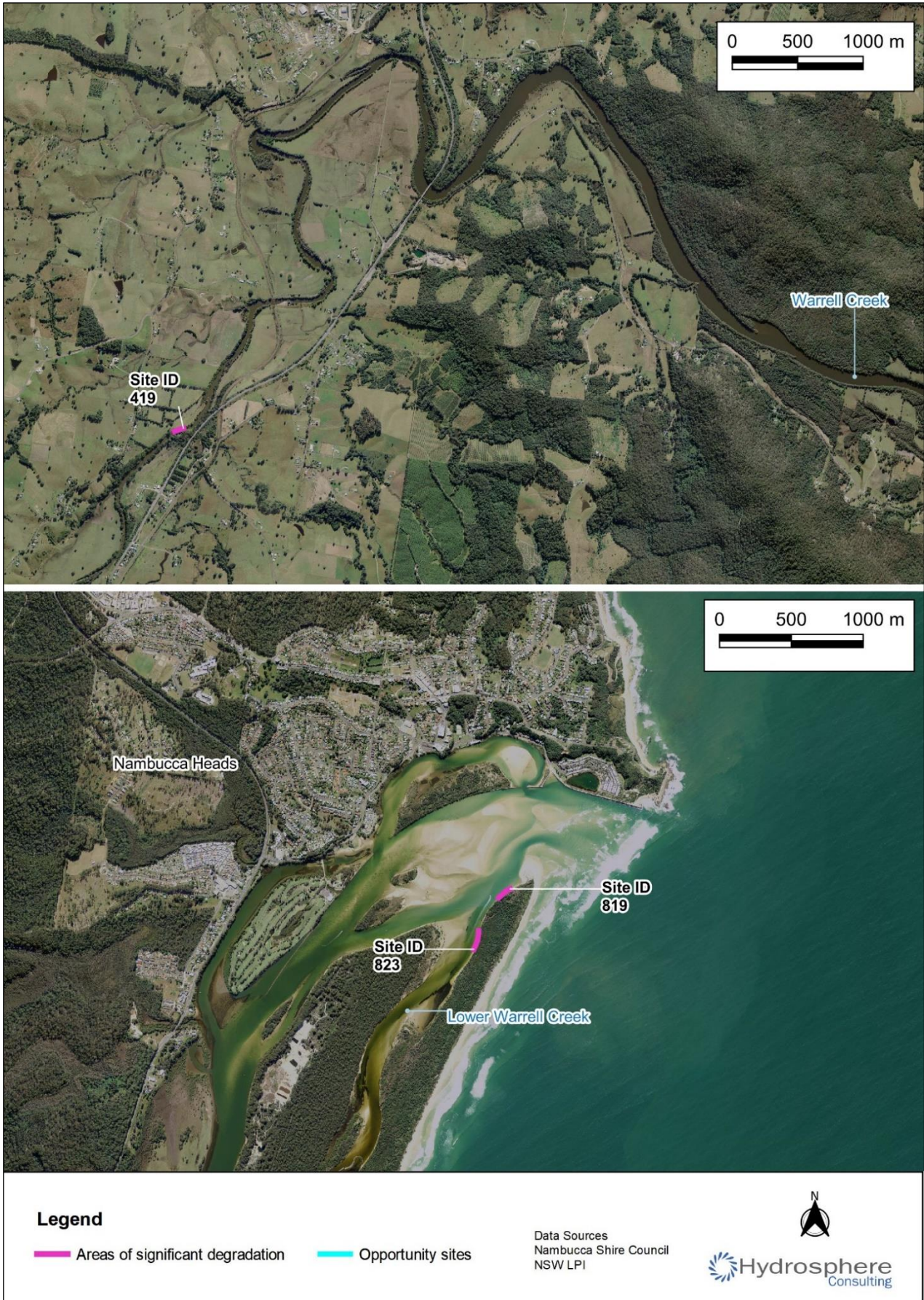






Figure 11: Recommended bank management sites on upper (top) and lower (bottom) Warrell Creek







Figure 12: Recommended bank management sites on the Nambucca River (top) and Deep Creek (bottom)

Table 3: Opportunities for bank stabilisation works

Location	Opportunity	Total Combined Length	Identified Causes of Instability	Site IDs	Representative Photos	
					Priority site	Opportunity site
North Arm	<u>Priority sites</u> Sites with high instability and riparian vegetation in poor condition.	2,670 m	Natural meander, cattle access, Boat/wind waves	1119, 1117, 1115, 1143, 1094, 1195, 1065, 1066, 1067, 1063, 1206, 1046, 1226, 1228, 1234, 1011		
	<u>Opportunity sites</u> Sites with easy access and potentially improved with stock exclusion fencing and revegetation. Sites present insignificant, minor and moderate instability. Stabilisation would prevent future erosion.	1,017 m	Cattle access, natural meander	1146, 1174, 1184, 1187		
Taylors Arm	<u>Priority sites</u> Sites with high instability and riparian vegetation in poor condition.	270 m	Natural meander, wind/boat waves, cattle access	761, 617, 611, 582,		
	<u>Opportunity site</u> Grassy section of bank devoid of riparian vegetation and showing minor instability. Easily accessible and would benefit from stock exclusion fencing and revegetation.	123 m	Cattle access and boat/wind waves	760		

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Location	Opportunity	Total Combined Length	Identified Causes of Instability	Site IDs	Representative Photos	
					Priority site	Opportunity site
Nambucca River	<u>Priority sites</u> Sites with high instability and riparian vegetation in poor condition.	90 m	Public access and structure causing erosion	243 and 251		
	<u>Opportunity site</u> Grassy section of bank devoid of riparian vegetation in an urban area would benefit from revegetation.	36 m	Boat/ wind waves and poor riparian vegetation.	905		
Warrell Creek	<u>Priority sites</u> Sites with high instability and riparian vegetation in poor condition.	309 m	Natural meander	419, 823, 819		N/A
Deep Creek	<u>Opportunity sites</u> Sites with poor riparian vegetation, generally with grass to the edge of the banks. Sites present insignificant and minor instability however are easily accessible and could be significantly improved with stock exclusion fencing and/or revegetation to prevent future erosion.	1,715 m	Natural meander, cattle access, boat/ wind waves	90, 169, 171, 172, 174,175, 176	N/A	

3. PRELIMINARY SCREENING OF CMP MANAGEMENT OPTIONS

The Scoping Study documents the threats to the CMP study area and corresponding risk levels as current and future risk (20-year, 50-year and 100-year). Threats were prioritised to assist in determining the importance of management action as part of subsequent stages of the CMP. High priority threats were identified as those presenting a high present-day risk to values and uses of the Nambucca coastline and estuaries.

Potential management options have been identified to address the identified risks and threats. A preliminary assessment of potential management options is provided in Table 4. This assessment incorporates management solutions proposed and/or implemented as part of previous studies and plans of management as well as additional actions to address key pressures and threats identified in the Scoping Study. The following plans and strategies were assessed:

- *Coastal Zone Management Plan for the Nambucca Shire Coastline* (Umwelt, 2012)
- *Nambucca River Estuary Management Plan* (BMT WBM, 2008)
- *Nambucca Master Plan and Compendium* (RDM et al.,2010)
- *Nambucca Ecohealth Project 2016-2017: Assessment of River and Estuarine Condition* (2016/17) (Mika et al., 2018)
- *Lower Nambucca Estuary Water Quality Study: Management Strategy* (GECO Environmental, 2009)
- *Gumma Swamp Restoration Management Plan* (NSC 2015)
- *Deep Creek Entrance Management Policy* (NSC, 2013)
- *Swimming Creek Catchment Management Plan* (Redman and Greenway, 1995)

A total of 285 individual actions from previous plans were assessed in terms of current status of actions, relevance to the study area and likelihood of success in addressing the key threats. A number of additional management options were also identified to address current and future threats.

A description of each management option is provided in Table 4 along with a summary of current status, benefits and limitations, details of any relevant past investigations to help inform decision making, likely funding mechanisms and the threats addressed by that action. Finally, a recommendation is made as to whether the option has merit and should be considered further. This preliminary assessment of management options identified 55 options for further consideration and assessment as part of Stage 3 of the CMP: Response Identification and Evaluation. Note that Stage 3 may incorporate additional options and is not limited to those listed in Table 4.

Table 4: Preliminary assessment of management options to address identified threats in the study area

ID	Management option	Description	Current status	Benefits	Limitations/risks	Reference	Likely funding mechanism	Further consideration required in Stage 3 of the CMP	Additional comments	Issue category	Threat ID	Threats (use, activity or stressor)	Current risk	20-year risk	50-year risk	100-year risk
O1	Coastal hazard planning and development controls as detailed in Nambucca DCP (2010).	Nambucca DCP (2010) incorporates a chapter on coastal hazards (e.g. development restrictions and planning controls for both new and existing buildings in line with coastal hazard risks etc.).	Ongoing implementation	Planning controls prevent inappropriate development in hazard areas and reduce future risk. The planning controls ensure that owners of properties that are affected by coastal risks are aware of those risks and the timeframes in which they are likely to occur. Comply with legislative requirements.	Relies on accuracy of coastal hazard mapping.	Umwelt (2012) Actions 1,2,5	F1 ¹	Yes - considered essential for effective management of coastal hazards. DCP to be updated as required by legislative changes. Update coastal erosion hazard assessment and mapping (see option O2). Review DCP as needed based on updated hazard assessment.	Update of coastal erosion hazard assessment and mapping now due (2019-2020)	Coastal hazards	T1	Storm surge and storm bite coastal erosion	Mod	Mod	High	High
											T2	Coastal long-term shoreline recession	High	High	High	High
											T3	Increased risk of slope instability/landslip	High	High	High	High
											T4	Coastal inundation including wave propagation into estuaries	Mod	Mod	High	High
											T5	Tidal inundation	High	High	High	High
											T6	Disrepair of, or inadequate design of coastal protection structures and infrastructure	High	High	High	High
											T7	Stormwater erosion in the coastal zone	Mod	Mod	Mod	High
O2	Updated coastal erosion hazard assessment and mapping	Update coastal erosion hazard assessment and mapping in SMEC (2009). Consider new knowledge about coastal processes, climate change, sea level rise, community aspirations and coastal ecosystems. Determine whether trigger points for changing coastal risk management approaches have been reached.	Incomplete	Assist NVC to analyse the current coastal hazard risks and evaluate management actions for areas exposed to coastal hazards.	High cost	SMEC (2009)	F1	Yes - up to date information considered essential for effective management of coastal hazards. Update of coastal erosion hazard assessment and mapping now due (2019-2020) as recommended in SMEC (2009). Update recommended every 10 years.	Once coastal hazard mapping is updated Council to consider coastal vulnerability areas for inclusion in the CM SEPP via a planning proposal.	Coastal hazards	T1	Storm surge and storm bite coastal erosion	Mod	Mod	High	High
											T2	Coastal long-term shoreline recession	High	High	High	High
											T3	Increased risk of slope instability/landslip	High	High	High	High
											T4	Coastal inundation including wave propagation into estuaries	Mod	Mod	High	High
											T5	Tidal inundation	High	High	High	High
											T6	Disrepair of, or inadequate design of coastal protection structures and infrastructure	High	High	High	High
											T7	Stormwater erosion in the coastal zone	Mod	Mod	Mod	High

ID	Management option	Description	Current status	Benefits	Limitations/risks	Reference	Likely funding mechanism	Further consideration required in Stage 3 of the CMP	Additional comments	Issue category	Threat ID	Threats (use, activity or stressor)	Current risk	20-year risk	50-year risk	100-year risk	
O3	Coastal hazard assessment and mapping for areas of Nambucca study area not currently covered by existing coastal hazard mapping (i.e. areas managed by stakeholders other than NVC)	Agencies/authorities other than Council to undertake coastal hazard mapping in areas under their control (present day, and relevant long-term planning scenarios) to fill in the gaps (DPIE - Crown Lands, DPIE - NPWS, State Rail in Oyster Creek etc.).	Incomplete	Would allow for more consistent governance. Addresses current knowledge gaps.	NVC has no control over whether other agencies take up the recommendation.	Stage 1 Scoping Study Risk Assessment	F1	Yes - Agencies/ authorities (other than NVC) to consider coastal hazard mapping to fill in the gaps where these agencies are land managers of the coastal zone (DPIE - Crown Lands, DPIE - NPWS, State Rail in Oyster Creek etc.).		Gov ern anc	T81	Insufficient/ ineffective/ inefficient governance	Mod	Mod	Mod	Mod	
											Coastal hazards	T1	Storm surge and storm bite coastal erosion	Mod	Mod	High	High
												T2	Coastal long-term shoreline recession	High	High	High	High
												T3	Increased risk of slope instability/ landslip	High	High	High	High
												T4	Coastal inundation including wave propagation into estuaries	Mod	Mod	High	High
												T5	Tidal inundation	High	High	High	High
												T6	Disrepair of, or inadequate design of coastal protection structures and infrastructure	High	High	High	High
T7	Stormwater erosion in the coastal zone	Mod	Mod	Mod	High												
O4	Section 149 certificates identify coastal hazard risk for affected properties (2050 and 2100 limits of the Stable Foundation Zone)	Note ongoing implementation. S149 certificates to be updated as required by legislative changes.	Ongoing implementation	Planning controls prevent inappropriate development in hazard areas. Complies with legislative requirements.	Landowners may perceive that the certificates reduce land value.	Umwelt (2012) Action 3	F10	Yes - considered a key element of planning controls providing communication of hazards to landholders and prospective property owners.	Also ensure S149 certificates include whether land is within a CMA.	Coastal hazards	T1	Storm surge and storm bite coastal erosion	Mod	Mod	High	High	
											T2	Coastal long-term shoreline recession	High	High	High	High	
											T3	Increased risk of slope instability/ landslip	High	High	High	High	
O5	Nambucca LEP 2010 incorporates open space zones along the coastline.	Open space zoning incorporated as appropriate in the LEP to reduce development in the coastal zones at risk of current or future coastal hazards.	Zoning complete, land management ongoing	Enhance ecological connectivity, maintain resilient coastal ecological communities and to avoid future development risks.	Appropriate management of open spaces still required to reduce coastal hazard risks	Umwelt (2012) Action 4	F10	Yes - considered to be a practical approach to reducing coastal hazard risks in the future and preserving public open space in the coastal zone. Further zoning may be considered in future as land use change opportunities arise. CMP to discuss appropriate management of open space areas affected by coastal hazard risks.		Coastal hazards	T1	Storm surge and storm bite coastal erosion	Mod	Mod	High	High	
											T2	Coastal long-term shoreline recession	High	High	High	High	
											T3	Increased risk of slope instability/ landslip	High	High	High	High	
O6	Coastal Hazard Monitoring Program	Design and implement a Coastal Hazard Monitoring Program to underpin Council's adaptive management of coastal risks. The strategy would incorporate assessment of condition and	Partial implementation	Allow for proactive management of coastal hazards. Inform council of effectiveness of risk management and protection of ecological values.	Requires resources (both staff time and funding)	Umwelt (2012) Action 6, 11	F1	Yes - considered a key part of effective management	A formal monitoring program has not been established at this time. Council regularly inspects seawalls particularly after coastal events and undertakes minor maintenance works as needed. An audit of beach access	Coastal hazards	T1	Storm surge and storm bite coastal erosion	Mod	Mod	High	High	
											T2	Coastal long-term shoreline recession	High	High	High	High	
											T3	Increased risk of slope instability/ landslip	High	High	High	High	
											T4	Coastal inundation including wave propagation into estuaries	Mod	Mod	High	High	

ID	Management option	Description	Current status	Benefits	Limitations/risks	Reference	Likely funding mechanism	Further consideration required in Stage 3 of the CMP	Additional comments	Issue category	Threat ID	Threats (use, activity or stressor)	Current risk	20-year risk	50-year risk	100-year risk
		effectiveness of coastal protection infrastructure, public access, coastal event response etc. and guide management action.							paths was completed in 2014/15. Other Council assets located in the coastal are managed in accordance with Councils Asset Management Plan (AMP).		T5	Tidal inundation	High	High	High	High
											T6	Disrepair of, or inadequate design of coastal protection structures and infrastructure	High	High	High	High
											T7	Stormwater erosion in the coastal zone	Mod	Mod	Mod	High
O7	Maintain and/or upgrade existing coastal protection infrastructure	Continue maintenance/replacement works for areas currently identified and either currently in progress or not yet addressed (refer status of actions Appendix D Scoping Study). CMP to identify where additional funds are required to carry out works. Undertake maintenance, redesign/reconstruction as informed by the Coastal Hazard Monitoring Strategy (Option O4) into the future.	Ongoing implementation	Protect important community assets. Improve safety, compliance and effectiveness of coastal protection infrastructure. May reduce the need for major works by undertaking timely maintenance when necessary.	Cost implications can be significant. Subject to ongoing coastal hazards and requiring continued maintenance and potentially redesign and reinforcement with changing coastal pressures.	Umwelt (2012) Action 13 NVC AMP	F1 (Upgrade or new works likely to be funded. However, maintenance of existing infrastructure not funded) F4	Yes - considered essential to maintain existing protection and provide future protection from coastal hazards.	Council infrastructure (including coastal infrastructure) is managed under the NVC AMP. recent works in accordance with Nambucca CZMP.	Coastal hazards	T1	Storm surge and storm bite coastal erosion	Mod	Mod	High	High
											T2	Coastal long-term shoreline recession	High	High	High	High
											T3	Increased risk of slope instability/landslip	High	High	High	High
											T4	Coastal inundation including wave propagation into estuaries	Mod	Mod	High	High
											T5	Tidal inundation	High	High	High	High
											T6	Disrepair of, or inadequate design of coastal protection structures and infrastructure	High	High	High	High
											T7	Stormwater erosion in the coastal zone	Mod	Mod	Mod	High

ID	Management option	Description	Current status	Benefits	Limitations/risks	Reference	Likely funding mechanism	Further consideration required in Stage 3 of the CMP	Additional comments	Issue category	Threat ID	Threats (use, activity or stressor)	Current risk	20-year risk	50-year risk	100-year risk
O8	Periodic beach scraping	Review previous beach scraping works and determine achievements/ outcomes. Design beach scraping works. Gain pre-emptive approval and funding for beach scraping. Carry out beach scraping works as needed to assist beach recovery after erosion events and informed by the Coastal Hazard Monitoring Strategy (coastal event response).	Ongoing implementation	Increase recovery of beach following coastal erosion events. Relatively low-cost option (e.g. Lower cost than nourishment options). An emergency response option that can be implemented quickly. This may be particularly beneficial where public assets or access to coastal environments is compromised due to short-term erosion events.	May scrape more sand than natural recovery rates and may over steepen beaches and cause additional erosion. Approvals/licences required from land managers (e.g. Crown Lands licence) to carry out work. Time delays. Potential for environmental impacts	Umwelt (2012) Action 14, and NVC Emergency Action Subplan	F1 - but only if not eligible for funding under natural disaster relief	Yes - considered to be an effective management option at suitable locations and where environmental impacts are minimal. Requires design and environmental assessment as part of Emergency Action Subplan/ Entrance management plan for Deep Creek.	In the past minor beach scraping has been undertaken at Scotts Head after major coastal events and prior to school holiday periods.	Coastal hazards	T1	Storm surge and storm bite coastal erosion	Mod	Mod	High	High
O9	Dredging of marine sands at identified hotspots	Dredging at key locations to improve navigation, boating safety. Hotspot areas were identified and prioritised in the Shoaling Investigation and Dredging Strategy (GHD, 2016).	Not commenced	Improve navigation and boating safety.	Costs of dredging reported in Shoaling Investigation (GHD, 2016) significant and no guarantee of long-term benefits. Environmental impacts (e.g. marine vegetation, marine fauna/ macrofauna etc.), short-term water quality impacts, construction stage noise etc. Many stakeholders responsible for river and foreshores, complex management and approvals process.	GHD (2016), BMT WBM (2008), RDM <i>et al.</i> , (2010)	F5 (navigation dredging), F1 (dredging for env benefit).	Yes - preliminary instigations and planning completed (GHD, 2016). Funding may also be available under the DPIE Rescuing our Waterways Program.	The Master Plan concluded (after community consultation) that the Nambucca River need only support the existing style of boats not deep hulled boats. EMP (2008) indicated minor dredging only for key navigation and boat ramps. Shoaling Investigation completed in 2016 identified priorities and potential costs. Many stakeholders responsible for management of the riverbed. If for navigation purposes dredging would generally be implemented by MIDO under Rescuing our Waterways Program.	Entrance management, shoaling and estuary hydraulics	T41	Shoaling of marine sands affecting navigation and marine safety	High	High	High	High
											T42	Artificial entrance management (risk of unintended impacts on water quality, salinity regimes, vegetation etc.)	Mod	Mod	Mod	Mod
											T43	Closure of ICOLLs	Mod	Mod	Low	Min
O10	Review of Deep Creek ICOLL entrance management policy		Not commenced		Nil	Recommended by the Stage 1 risk assessment.	F1			Entrance management, shoaling and	T40	Siltation affecting navigation, water quality (reduced flushing) and aesthetics	High	High	High	High
											T41	Shoaling of marine sands affecting navigation and marine safety	High	High	High	High

ID	Management option	Description	Current status	Benefits	Limitations/risks	Reference	Likely funding mechanism	Further consideration required in Stage 3 of the CMP	Additional comments	Issue category	Threat ID	Threats (use, activity or stressor)	Current risk	20-year risk	50-year risk	100-year risk
		Review efficacy of the existing Deep Creek Entrance Management Strategy since its implementation in 2012 (e.g. effect on flooding, water quality, inundation of EECs such as Swamp Oak forest etc.). Update as appropriate based on review.		Ensure ICOLL management remains appropriate. Improve knowledge and understanding of the hydrological regime of Deep Creek.				Yes - Stage 3 of CMP to review the Deep Creek ICOLL entrance management policy and based on review recommend update as required. Consider DPIE EES Best Practice Guidelines for ICOLL Management.	Agency support and resources should be made available to support a review by Councils (e.g. DPI Fisheries, DPIE-Crown lands and DPIE – EES)		T43	Closure of ICOLLs	Mod	Mod	Low	Min
O11	Consider alternative location for Marine Rescue facilities or purchase of alternative (shallow-hulled) boating equipment	Undertake an assessment of the suitability of alternative marine rescue equipment and the possibility of relocation of marine rescue assets and infrastructure	Not commenced	Enhance marine safety. Ensure rescue assets/ infrastructure are in the most strategic location. Equipment suitable for conditions.	Waterfront land at a premium and in short supply. Cost could be significant. Purchase of new equipment costly.	Recommended by the Stage 1 risk assessment.	F12	Yes - Stage 3 of CMP to assess option further	CMP could include actions for communication of risks to Marine Rescue NSW. Consideration of alternative locations for infrastructure/ purchase of alternative boats is responsibility of land manager.	Entrance management, shoaling and estuary hydraulics	T41	Shoaling of marine sands affecting navigation and marine safety	High	High	High	High
O12	Tidal Inundation Assessment	Detailed local tidal inundation assessment of the estuaries for a variety of future sea level rise scenarios, with a risk assessment to estuary assets and infrastructure.	Partial implementation	Allow for climate change and sea level rise preparedness. Mandatory requirement under CM Act.	Does not address any immediate risks.	Recommended by the Stage 1 risk assessment.	F1	Yes- Mandatory requirement under CM Act.	Council has acquired LIDAR information for the Shire, which provides accurate information on landform and height. Council is yet to undertake inundation mapping; however Coastal Risk Australia does have mapping available (refer Scoping Study). This mapping may be suitable for the interim.	Climate change impacts	T4	Coastal inundation including wave propagation into estuaries	Mod	Mod	High	High
											T5	Tidal inundation	High	High	High	High
											T6	Disrepair of, or inadequate design of coastal protection structures and infrastructure	High	High	High	High
											T7	Stormwater erosion in the coastal zone	Mod	Mod	Mod	High
O13	Estuarine Vegetation Response Assessment	Assessment of potential for estuarine vegetation migration with sea level rise (2050 and 2100) based on vegetation types, topography, land use and possible future tidal range. Include mapping and assign management priority classification.	Not commenced	Improve understanding of future tidal inundation extent. Improve preparedness for sea level rise impacts.	Difficult to forecast with priorities with accuracy.	None	F1	Yes - considered a moderate current and 20-year risk and therefore could be scheduled at later stages of CMP as funding permits		Climate change impacts	T11	Anthropogenic barriers to migration of vegetation communities with sea level rise	Mod	Mod	High	High
O14	Nambucca Bank Management Strategy	Develop an estuary-wide Bank Management Strategy	Partial implementation	Provide a strategic approach to direct funding and effort to	Potentially expensive considering the	Hydrosphere Consulting (2020), BMT	F1, F4	Yes - considered essential to address significant areas of bank erosion in a	Council has undertaken several bank management projects in	Estuarine bank	T13	Powered vessels and towing	Mod	Mod	Mod	High

ID	Management option	Description	Current status	Benefits	Limitations/ risks	Reference	Likely funding mechanism	Further consideration required in Stage 3 of the CMP	Additional comments	Issue category	Threat ID	Threats (use, activity or stressor)	Current risk	20-year risk	50-year risk	100-year risk
		consistent with Initiative 2 of the Marine Estate Management Strategy and any tool/ guidance provided. Bank Condition Assessment - Nambucca River and Deep Creek (Hydrosphere Consulting, 2020) maps current areas of concern and priority sites for rehabilitation works.		priority sites. Mitigate and protect riverbanks from erosion, improves riparian and subtidal habitat, with flow on effects for water quality.	vast stretches where improvement is required. Licensing with Crown Land often presents a significant project hold point for Council projects.	WBM (2008), RDM <i>et al.</i> , (2010), Mika <i>et al.</i> (2018) Recommended by the Stage 1 risk assessment.		comprehensive and strategic manner. Utilise recent Bank Condition Assessment and the recently developed DPI Fisheries Bank Erosion Decision Support Tool to assist in determining appropriate methods for erosion protection. Include education and awareness raising around bank erosion impacts either as part of this strategy or delivered as part of overall education program.	the past and seeks to expand and enhance past work. To be eligible for F1 funding work must be for public benefit/ public asset protection (no private asset protection). For seawall Council must demonstrate environmental benefit and alignment with Environmentally Friendly Seawalls Guide (OEH, 2009).		T14	Wind waves	Mod	Mod	Mod	High
											T15	Historic clearing of riparian vegetation and adjacent habitat	High	High	High	High
											T16	Uncontrolled stock access to and grazing within the riparian zone	High	High	High	High
											T17	Past gravel extraction contributing to ongoing poor geomorphic condition	Mod	Mod	Mod	Mod
											T12	Flooding	High	High	High	High
											T18	Accumulation of flood debris impacting bank stability	Mod	Mod	Mod	High
O15	Review and Update the Nambucca River Estuary River Bank Restoration Guide (2010)	A guideline on riverbank protection works has been prepared by Council and other Agencies. It requires updating to reflect current/ new legislation. Infrastructure SEPP, Coastal SEPP, and Fisheries Management Act control riverbank works through various processes. Also review and ensure alignment with Environmentally Friendly Seawalls Guide (OEH, 2009)	Not commenced	Update existing guideline to reflect current legislation, information and status of banks. Low cost	Potential overlap with DPI Bank Condition Decision Support Tool currently under development.	NSC (2010), Hydrosphere Consulting (2020), BMT WBM (2008), RDM <i>et al.</i> , (2010), Recommended by the Stage 1 risk assessment.	F1	Yes - considered essential to help guide works to address bank erosion. Refer to/ incorporate the recently developed DPI Fisheries Bank Erosion Decision Support Tool to assist in determining appropriate methods for erosion protection.	Council's Riverbank protection works have developed overtime and Council with the assistance of other agencies is now undertaking bank stabilisation using contemporary methods that often incorporate fish habitat and riparian improvements	Estuarine bank erosion	T13	Powered vessels and towing	Mod	Mod	Mod	High
											T14	Wind waves	Mod	Mod	Mod	High
											T15	Historic clearing of riparian vegetation and adjacent habitat	High	High	High	High
											T16	Uncontrolled stock access to and grazing within the riparian zone	High	High	High	High
											T17	Past gravel extraction contributing to ongoing poor geomorphic condition	Mod	Mod	Mod	Mod
											T12	Flooding	High	High	High	High
											T18	Accumulation of flood debris impacting bank stability	Mod	Mod	Mod	High
O16	Weed Management /Bushland Regeneration Activities	Coastal weed management in co-operation with North Coast Weeds Advisory Committee, Landcare groups and other stakeholders. Weed management may include weed removal,	Ongoing implementation	Integrated management of weeds for biodiversity outcomes	Continued and constant weed sources make this an ongoing management issue particularly adjacent to populated areas and along edges	Umwelt (2012) Action 16. Mika <i>et al.</i> (2018) NSC (2010), Hydrosphere Consulting (2020), BMT WBM (2008).	F1, F14	Yes - ongoing weed management and vegetation enhancement are considered a key part of effective management for both coastal and riverine environments. Actions could be implemented as part of	Several successful grants under various programs in past. Target areas identified etc. The North Coast Weeds Advisory committee has developed a number of policies and programs to support weed	Riparian vegetation and weed management	T19	Dominance of invasive weeds	High	High	High	High
											T16	Uncontrolled stock access to the riparian zone	High	High	High	High
											T15	Historic clearing of riparian vegetation and adjacent habitat	High	High	High	High

ID	Management option	Description	Current status	Benefits	Limitations/risks	Reference	Likely funding mechanism	Further consideration required in Stage 3 of the CMP	Additional comments	Issue category	Threat ID	Threats (use, activity or stressor)	Current risk	20-year risk	50-year risk	100-year risk
		assisted bushland regeneration, planting, fencing out stock or human access etc. May also be combined with other works including dune management/ coastal protection/ bank protection works.			(e.g. road verges, reserve boundaries etc.)			site-specific plans (e.g. River Reach Plan model)	management in the region.	Threats to biodiversity	T45	Removal, fragmentation and degradation of riparian and adjacent habitat	High	High	High	High
									T47		Predation and invasion by introduced animals and exotic plants	High	High	High	High	High
									T33		Trampling and unfenced access to coastal vegetation	Low	Low	Mod	Mod	Mod
									T48		Soil disturbance through uncontrolled stock access/ erosion/ nutrient and pathogen introduction	High	High	High	High	High
									T49		Overgrazing by stock resulting in reduction in groundcover, enabling erosion and compaction of soil	High	High	High	High	High
									T51		Unrestricted pedestrian access in sensitive vegetation communities (e.g. dunes)	Mod	Mod	Mod	Mod	Mod
O17	Riparian Restoration/ River Reach Plans	Provide funding for greater roll out of River Reach Plans in the study area. Plan would cover aspects based on site-specific assessments which may include bank erosion controls, weed management, riparian fencing instalment/ improvement to exclude stock and allow for protection of estuarine macrophytes, recovery of native riparian vegetation, and reduced faecal matter in waterways.	Partial implementation	Builds on the existing successful program and expanding into new areas s (e.g. River Reach Plans Supports improved coordination between governing bodies. Actions directly address key threats to estuary health.	Relies on landholder willingness and continued support of Landcare/LLS	BMT WBM (2008), Mika <i>et al.</i> (2018) GECO Environmental (2009)	F1, F7, F8	Yes- could potentially form part an integrated governance strategy to improve catchment and waterways management	The Nambucca River Oyster Growers have developed their own Environmental Management System. Horticultural industries are preparing best practice guides. River Reach Plans have been successfully implemented in North Arm by NV Landcare and LLS involving erosion control, fencing, weed removal, riparian vegetation enhancement etc.	Governance, education and compliance	T82	Lack of awareness, education and engagement	Low	Low	Low	Low
											T83	Poor community compliance with rules and regulations to protect coastal and estuary environments, public health and safety and amenity.	Low	Low	Low	Low
										Water Quality	T65	Agricultural diffuse source runoff (runoff from large areas of agricultural land with no specific point source)	High	High	High	High
										Riparian vegetation and weed	T19	Dominance of invasive weeds	High	High	High	High
									T16		Uncontrolled stock access to the riparian zone	High	High	High	High	
									T15		Historic clearing of riparian vegetation and adjacent habitat	High	High	High	High	
										Estuarine bank erosion	T15	Historic clearing of riparian vegetation and adjacent habitat	High	High	High	High
									T16		Uncontrolled stock access to and grazing within the riparian zone	High	High	High	High	
									T17		Past gravel extraction contributing to ongoing poor geomorphic condition	Mod	Mod	Mod	Mod	
O18	Support improvements in	Programs focussed on improving agricultural	Partial implementation	Supports water quality improvements	Relies on landholder	BMT WBM (2008), Mika <i>et</i>	F15, F1 (only supported	Yes- could form part of an integrated strategy to	River Reach Plans have been successfully	Gove rnananc e,	T82	Lack of awareness, education and engagement	Low	Low	Low	Low

ID	Management option	Description	Current status	Benefits	Limitations/risks	Reference	Likely funding mechanism	Further consideration required in Stage 3 of the CMP	Additional comments	Issue category	Threat ID	Threats (use, activity or stressor)	Current risk	20-year risk	50-year risk	100-year risk
	agricultural management	land management to reduce export of pollutants (e.g. sediment, nutrients/fertilisers, bacteria, pesticides etc.). Potential examples include: on-farm property scale plans and actions to improve drainage, fertiliser management, seal dirt roads, maintain grass cover and buffer zones etc.); Target areas identified by DPIE EES Estuary Health Risk Dataset, Ecohealth Monitoring and local strategies (e.g. sub catchments of Deep Creek, North Arm, Buckra Bendinni Creek, Gumma Gumma Swamp, Newee Creek etc.).		and enhancement of important local industry. Could build on existing successful programs (e.g. River Reach Plans). Supports improved coordination between governing bodies. Direct links to MEMS with potential funding/resourcing opportunities.	willingness and support of Landcare and state government (e.g. MEMA, LLS, DPI Agriculture etc.)	al. (2018), GECO Environmental (2009), Dela-Cruz <i>et al.</i> , 2017); Newcastle Innovation (2009).	where improved estuary health can be clearly demonstrated) Industry bodies would be expected to prepare/update their own best practice guidelines etc.	improve agricultural land management and create water quality benefits downstream. Potential scope for MEMS projects/funding. Also, an educational component to be incorporated in Education Program. Some actions could be implemented through extension of existing programs (e.g. River Reach)	implemented in North Arm by Landcare and LLS involving erosion control, fencing, weed removal, riparian vegetation enhancement etc. Horticultural industries are preparing best practice guides. The Nambucca River Oyster Growers have developed their own Environmental Management System		T83	Poor community compliance with rules and regulations to protect coastal and estuary environments, public health and safety and amenity.	Low	Low	Low	Low
										Water Quality	T65	Agricultural diffuse source runoff (runoff from large areas of agricultural land with no specific point source)	High	High	High	High
										Riparian vegetation and weed management	T19	Dominance of invasive weeds	High	High	High	High
											T16	Uncontrolled stock access to the riparian zone	High	High	High	High
											T15	Historic clearing of riparian vegetation and adjacent habitat	High	High	High	High
										Estuarine bank erosion	T14	Historic clearing of riparian vegetation and adjacent habitat	High	High	High	High
										O19	Monitor condition of habitats of high ecological and/or conservation value e.g. saltmarsh, littoral rainforests, riparian zone and floodplain wetlands.	Monitoring program to track the health and condition of key habitats. Targeted to areas of previous works (e.g. Stuart Island, Watt Creek, Deep Creek, Macksville, Sand Island, Lower Nambucca, Wirrimbi, and various coastal wetlands and Riparian areas). Mapping of condition required.	Partial implementation	Track condition and success of previous and ongoing management work. Results can dictate future works requirements for maintenance etc.	Cost depending on scale and level of detail required.	Recommended by the Stage 1 Scoping Study Status of Actions.
Riparian vegetation and weed management	T19	Dominance of invasive weeds	High	High	High	High										
	T16	Uncontrolled stock access to the riparian zone	High	High	High	High										
	T15	Historic clearing of riparian vegetation and adjacent habitat	High	High	High	High										
Threats to biodiversity	T45	Removal, fragmentation and degradation of riparian and adjacent habitat	High	High	High	High										
	T47	Predation and invasion by introduced animals and exotic plants	High	High	High	High										

ID	Management option	Description	Current status	Benefits	Limitations/risks	Reference	Likely funding mechanism	Further consideration required in Stage 3 of the CMP	Additional comments	Issue category	Threat ID	Threats (use, activity or stressor)	Current risk	20-year risk	50-year risk	100-year risk	
O20	Targeted restoration in high value habitats identified as degraded.	Based on the results of monitoring program, target priority areas for works. Management priorities should be based on the area and condition of remnant vegetation and adjacent land uses, restoration potential and overall values.	Partial implementation	Restore priority sites to enhance high value habitat	Cost depending on scale and level of detail required.	BMT WBM (2008) GECCO Environmental (2009)	F1, F3	Yes - considered important to overall ecological health goals.	Currently, site specific management areas are target by NVC staff as issues are identified. A major wetland restoration project was completed in the Watt Creek catchment in 2016 by LLS and NSW recreational fishers with the assistance of the landholders. This included 4.4km of stock exclusion fencing of a major wetland and re-instatement of full tidal flows by removal of failing floodgate system. The area is expected to self-rehabilitate. Also completed Gumma Gumma Swamp Rehabilitation project.	Riparian vegetation and weed management	T19	Dominance of invasive weeds	High	High	High	High	
											T16	Uncontrolled stock access to the riparian zone	High	High	High	High	
											T15	Historic clearing of riparian vegetation and adjacent habitat	High	High	High	High	
										Threats to biodiversity	T45	Removal, fragmentation and degradation of riparian and adjacent habitat	High	High	High	High	
											T47	Predation and invasion by introduced animals and exotic plants	High	High	High	High	
O21	Improve protection of high value habitats particularly riparian vegetation	A potential future project may be shire-wide stewardship site feasibility assessment, highlighting properties in the shire that may have significant natural resource value if protected into perpetuity. Potential to provide funding for Land for Wildlife conservation agreements in cooperation with NV Landcare	Partial implementation	Protect significant existing habitat on private land. Enhance riparian zone health and condition, with flow on positive benefit to water quality and estuarine health.	Relies on landholder willingness	BMT WBM (2008), Mika <i>et al.</i> (2018)	F1	Yes - consider feasibility assessment to identify target areas for preservation. Allocation of funding to Land for Wildlife through CMP.	Council has offered funding for Land for Wildlife program in the past.	Threats to biodiversity	T50	Development including catchment, foreshore, reducing land for habitat	Mod	High	High	High	
											T45	Removal, fragmentation and degradation of riparian and adjacent habitat	High	High	High	High	
											T47	Predation and invasion by introduced animals and exotic plants	High	High	High	High	
											Estuarine bank erosion	T15	Historic clearing of riparian vegetation and adjacent habitat	High	High	High	High
												T16	Uncontrolled stock access to and grazing within the riparian zone	High	High	High	High
											Water quality	T65	Agricultural diffuse source runoff (runoff from large areas of agricultural land with no specific point source)	High	High	High	High

ID	Management option	Description	Current status	Benefits	Limitations/risks	Reference	Likely funding mechanism	Further consideration required in Stage 3 of the CMP	Additional comments	Issue category	Threat ID	Threats (use, activity or stressor)	Current risk	20-year risk	50-year risk	100-year risk
O22	Review environmental mapping and ensure consistency with NLEP and DCP	Desktop GIS assessment: Review environmental mapping (e.g. CMAs, EECs, marine vegetation). Overlay with NLEP zoning. Consider future likely areas for migration of estuarine vegetation with sea level rise (refer Tidal Inundation Assessment). Consider provisions of NLEP and DCP to ensure it reflects appropriate protection of these sensitive environments, aid community awareness and assist in ease of the development application processes.	Not commenced	Improve consistency in planning framework at state, regional and local levels and across legislation. Identify areas for action to better protect significant and sensitive habitat.	Nil	Recommended by the Stage 1 risk assessment.	F2	Yes - considered appropriate and is a discrete project that can be implemented quickly. Risk level is low and may be deferred to later stages of CMP is desired.		Threats to biodiversity	T56	Inconsistencies in planning framework	Low	Low	Low	Low
O23	Water Quality Monitoring Program	Development of a targeted and integrated water quality monitoring program consistent with other CMP actions as relevant and existing monitoring (e.g. Ecohealth program). Design of program will involve determination of aims and objectives, selecting key sites, appropriate monitoring methods, frequencies and reporting of results. Establish an integrated water quality database as central storage location for data. Include consideration of runoff from intensive horticultural uses, faecal coliforms in recreational areas and aquaculture industries.	Not commenced	Allow better collation and interpretation of water quality data. Improve identification of sources of water quality issues and target management action.	Costs can be significant depending on scale	Mika <i>et al.</i> (2018) BMT WBM (2008), GECO Environmental (2009), Recommended by the Stage 1 risk assessment.	F1	Yes - considered a key part of effective management. Integrate with other CMP actions (e.g. stormwater management, EPA licence monitoring, Ecohealth etc.). Communicate results as part of education strategy. Could be achieved through extension of Ecohealth Program currently in planning stages.	Two water monitoring projects completed (Newee Creek and Nambucca River). Water quality improvement project completed at Gumma Swamp, ongoing monitoring being undertaken. Oyster industry completes its own water quality testing Ecohealth Monitoring Program recently completed 2018). Data Loggers installed in Gumma Gumma Creek and Watt Creek currently sampling water flows and a range of other matters. Water quality monitoring undertaken at Deep Creek during closed periods. Urban Stormwater Management Project presently underway at Dawkins Park in Macksville (2018).	Water quality	T65	Agricultural diffuse source runoff (runoff from large areas of agricultural land with no specific point source)	High	High	High	High
											T66	Urban stormwater pollution and lack of maintenance of existing controls	High	High	High	High
											T67	Sewer surcharge and STP overflows	High	High	High	High
											T68	On-site wastewater management (e.g. failing septic systems)	Mod	Mod	Mod	Mod
											T69	Pet and wild fauna faeces	Low	Low	Low	Low
											T70	Logging on steep, highly erodible soils (i.e. of the Nambucca Beds)	Mod	Mod	Mod	Mod
											T71	Urban development	Mod	Mod	High	High
											T72	Construction industries	Mod	Mod	High	High
											T73	Other licensed industrial sources	Mod	Mod	High	High
											T74	Pesticide and fertilizer runoff	Mod	Mod	High	High
											T75	Poor geomorphic condition (i.e. bed instability)	Mod	Mod	Mod	Mod
											T76	Poor flushing of ICOLLs	Mod	Mod	Low	Min

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										Climate change impacts	T9	Increased salinity in the upper estuary	Low	Mod	High	High
										Riparian vegetation and weed	T20	Community concern about pesticide and herbicide use in the catchments as well in Council roadside weed spraying.	Low	Low	Low	Low
										Public use and access	T34	Public safety risks from faecal contamination of waterways	Mod	Mod	Mod	High
O24	Stormwater management	Develop catchment-based stormwater plan to investigate issues and determine management actions required. Key locations identified previously include Scotts Head Main Beach, Beilby's Beach, Shelly Beach and Main Beach northern carpark, Swimming Creek catchment. Implement stormwater management actions to address issues.	Ongoing	Improve knowledge on stormwater issues and allow for strategic and prioritised stormwater management to reduce peak flows, reduce erosion scour and improve water quality.	May not be worth the investment at Beilby's Beach due to its isolated location and other impacts from coastal hazards	Umwelt (2012) Action 28, 29. Recommended by the Stage 1 risk assessment. GECO Environmental (2009)	F1 - but only if shown to have direct impact on estuary water quality or coastal hazard risk	Yes - considered a key part of effective management	Some minor stormwater management activities have occurred however other opportunities may be available. Council implemented a water tank rebate scheme in 2013/14 originally funded through the environmental levy now the water fund. Stormwater Turtle Our Living Coast rehabilitation initiative 2013/14 (GPT installed at Bellwood park). DCP has controls for new development with respect to water quality treatment and outputs.	Coastal hazards	T7	Stormwater erosion in the coastal zone	Mod	Mod	Mod	High
										Water quality	T66	Urban stormwater pollution and lack of maintenance of existing controls	High	High	High	High
O25	Wastewater Management	Continue to work with EPA to develop Pollution Reduction Programs. Identify risk and impact of sewage spill from existing pump stations/pipes with a view to upgrading priority systems. Investigate upgrade of Macksville STP including assessment of feasibility of removing effluent discharge to river.	Ongoing implementation	Minimise the risk of sewage overflow to estuary waterways. Reduce impact from wastewater systems on estuary water quality.	Costs can be significant depending on scale	BMT WBM (2008), Mika <i>et al.</i> (2018) Recommended by the Stage 1 risk assessment.	F2, F1 (monitoring env. health only)	Yes - considered a key part of effective management. Consider incorporating monitoring downstream on discharge points into estuary water quality monitoring program.	Council has improved telemetry at pump stations and increased overflow storage at priority stations, targeted awareness campaigns such as media releases to discourage non-biodegradable wipes from being flushed and is presently investigating resourcing to support more improvements to monitoring. New smart technology/ telemetry for reticulation networks).	Water quality	T66	Urban stormwater pollution and lack of maintenance of existing controls	High	High	High	High
											T67	Sewer surcharge and STP overflows	High	High	High	High
											T68	On-site wastewater management (e.g. failing septic systems)	Mod	Mod	Mod	Mod
										Public use and access	T34	Public safety risks from faecal contamination of waterways	Mod	Mod	Mod	High
O26	Buy back of Gumma Swamp ASS areas and remediation	Investigate the purchase of land identified previously and feasibility of	Incomplete	Opportunity to address ASS hotspot and improve water quality and habitat	Potentially high cost to acquire land and carry out restoration	NSC (2015), GECO Environmental (2009)	F1- if it can be directly related to env benefit to	Yes - investigate further as option to address ASS	Opportunities to acquire a significant portion of Gumma swamp was reported to Council.	Threats to biodiversity	T45	Removal, fragmentation and degradation of riparian and adjacent habitat	High	High	High	High

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		restoration works to remediate ASS. Engagement with landholders required.		values in the estuary.	works. Requires landholder willingness.		estuary		However, Council resolved not to receive the land dedication, largely due to the potential resources required. Engagement with landholders required and resources to support initiatives	Water Quality	T65	Agricultural diffuse source runoff (runoff from large areas of agricultural land with no specific point source)	High	High	High	High
											T77	Acid Sulfate Soils	High	High	High	High
O27	OSSM Strategy implementation	Continue implementation of NVC's OSSM Plan. Incorporate sites downstream of known OSSM problem areas into WQ monitoring program.	Ongoing implementation	Directly address source of water quality decline	Requires high level of staff resourcing.	GECO Environmental (2009)	F2	Yes - Incorporate sites downstream of known OSSM problem areas into WQ monitoring program.	NVC implements its OSSM Plan which requires all OSSMs to be inspected on a regular basis to ensure system performance is satisfactory and is not leading to env problems.	Water Quality	T68	On-site wastewater management (e.g. failing septic systems)	Mod	Mod	Mod	Mod
O28	Lower Nambucca Estuary Water Quality Study: Management Strategy and Newee Creek Study remaining site-specific works	Incorporates all remaining actions from the strategy considered to be relevant and suitable today, and addresses current issues affecting the study area. Action to include review and rationalisation of proposed works to determine those of most benefit.	Not commenced	Improvements in water quality, bank erosion, wetland and riparian habitats, hydrological connectivity, fish passage etc.	Many actions will need to be prioritised for implementation	GECO Environmental (2009)	F1 if it can be directly related to env benefit to estuary	Yes - specific actions will need to be assessed as part of Stage 3 Options Assessment to rank importance. Requires prioritisation and assessment of actions eligible for funding under the CMP Program.	Several actions undertaken by NVC and other agency/community partners. Other opportunities identified in plan that may still be of benefit.	Water Quality	T65	Agricultural diffuse source runoff (runoff from large areas of agricultural land with no specific point source)	High	High	High	High
											T77	Acid Sulfate Soils	High	High	High	High
										Riparian vegetation and weed management	T19	Dominance of invasive weeds	High	High	High	High
											T16	Uncontrolled stock access to the riparian zone	High	High	High	High
											T15	Historic clearing of riparian vegetation and adjacent habitat	High	High	High	High
										Estuarine bank erosion	T14	Historic clearing of riparian vegetation and adjacent habitat	High	High	High	High
											T16	Uncontrolled stock access to and grazing within the riparian zone	High	High	High	High
											T12	Flooding	High	High	High	High
										Hydrology, connectivity and water extraction	T79	Hydrological modifications of wetlands and floodplain drainage works	Mod	Mod	High	High
											T80	Floodgate design, operation and maintenance	Mod	Mod	High	High

ID	Management option	Description	Current status	Benefits	Limitations/risks	Reference	Likely funding mechanism	Further consideration required in Stage 3 of the CMP	Additional comments	Issue category	Threat ID	Threats (use, activity or stressor)	Current risk	20-year risk	50-year risk	100-year risk	
O29	Fish passage and wetland connectivity review	Review current status of wetland connectivity and fish passage barriers including the discussions between DPI Fisheries, Council, landholders (and any drainage boards) RE location of structures and management practices; and mapping of impediments to connectivity; and prioritisation of barriers for removal/modification (DPI Fisheries as responsible agency).	Not commenced	Improve knowledge of hydrologic connectivity and barriers. Strategic approach to management	Action required by external agency, no control over execution.	GECO Environmental (2009) Stage 1 Scoping Study Risk Assessment	F1, F3	Yes - DPI Fisheries would be responsible agency and therefore will need to agree and provide support.	A major wetland restoration project was completed in the Watt Creek catchment in 2016 by LLS and NSW recreational fishers with the assistance of the landholders. This included 4.4 km of stock exclusion fencing of a major wetland and re-instatement of full tidal flows by removal of failing floodgate system. The area is expected to self-rehabilitate.	Hydrology, connectivity and water extraction	T79	Hydrological modifications of wetlands and floodplain drainage works	Mod	Mod	High	High	
											T80	Floodgate design, operation and maintenance	Mod	Mod	High	High	
O30	Consult with NRAR and DPIE-Water regarding management of water extraction under the Nambucca Water Sharing Plan (2016).	Consultation will aim to highlight the threat and implications of increased water extraction on estuary health and seek to ensure adequate oversight and enforcement of water sharing plan rules and regulations.	Not commenced	Open communication of issues with responsible regulatory body to encourage enforcement of rules and protection of water resources for over extraction	WSP rules are difficult to monitor and enforce on a broad-scale particularly in catchments with a high number of extraction points. Currently, no monitoring of individual extraction is conducted and NRAR relies largely on public complaints to identify unlawful extraction.	Stage 1 Scoping Study recommendations	F10	Yes - considered important in overall health of catchments		Hydrology, connectivity and water extraction	T78	Water extraction	Mod	High	High	High	
											Governance, education and compliance	T82	Lack of awareness, education and engagement	Low	Low	Low	Low
												T83	Poor community compliance with rules and regulations to protect coastal and estuary environments, public health and safety and amenity.	Low	Low	Low	Low
O31	Floodplain drainage mapping	Accurately map the drainage system on the floodplain.	Not commenced	Accurately determining the drain catchment area may assist in locating potential sources of contamination or pollutant generation in both the Lumsden Lane and Wrights Corner drain systems.	Relies on accurate LIDAR data.	GECO Environmental (2009)	F1	Yes	Council has acquired LIDAR for the shire, but a detailed analysis of this catchment has not been undertaken, other than for flooding behaviour. Consider use of method developed for MEMS Coastal Floodplain Project.	Hydrology, connectivity and water extraction	T79	Hydrological modifications of wetlands and floodplain drainage works	Mod	Mod	High	High	
											T80	Floodgate design, operation and maintenance	Mod	Mod	High	High	
										Water Quality	T77	Acid Sulfate Soils	High	High	High	High	

ID	Management option	Description	Current status	Benefits	Limitations/ risks	Reference	Likely funding mechanism	Further consideration required in Stage 3 of the CMP	Additional comments	Issue category	Threat ID	Threats (use, activity or stressor)	Current risk	20-year risk	50-year risk	100-year risk
O32	Public Recreational Use Strategy	Prepare a strategy that builds on previously successful plans. The strategy would include assessment of suitability of current infrastructure, consideration of growth potential, disability needs, identification of public land that could be used for public recreation, and a suggested allocation of funds for facility improvements, provision of coastal pathways etc. The aim will be to provide strategic master planning for additional areas that support placemaking, facility improvement and open space/ environmental management.	Ongoing implementation	Drive future public recreational infrastructure needs for the study area. Identify priorities for public infrastructure. Provide strategic master plan for additional areas that support placemaking, facility improvement, public access requirements and open space/ environmental management. Monitor and maintain existing facilities, access ways and public infrastructure. Give strategic direction to allocation of public recreational infrastructure funding.	Difficult to gain agreement from all sectors of the community as to the most appropriate facilities, locations etc. and could draw criticism.	BMT WBM (2008), <i>RDM et al.</i> , (2010), Dawkins Park Plans, Nambucca Lookouts Plans Recommended by the Stage 1 risk assessment.	F6, F2, F1- but only for actions that have env. benefit or direct linkage to reduction of risk associated with coastal processes; improve public access to the coastal zone or are educational opportunities for the public.	Yes - considered a key part of effective management. Important to consult with local community regarding proposed changes to deliver on community expectations and aspirations as much as possible.	Various components to incorporate including monitoring and maintenance of existing infrastructure and access points, and actions to increase connectivity and enhance amenity and public use.	Public use and access	T21	Not enough public recreational access and facilities	Mod	Mod	Mod	Mod
											T22	Poor condition and inadequate foreshore access and parking during summer peak use	Low	Mod	Mod	High
											T23	No linkage of coastal pathways	Low	Low	Low	Low
											T24	Not enough mobility infrastructure	Low	Mod	Mod	Mod
											T25	Insufficient maintenance of access infrastructure to minimise safety risks	Low	Mod	Mod	Mod
											T26	Insufficient, or inappropriate public education and signage	Mod	Mod	Mod	Mod
											T27	Litter and marine debris	Mod	Mod	Mod	High
											T28	Conflict of use between off-leash dogs (at both on-leash and off-leash areas)	Low	Low	Mod	Mod
											T29	4WD/ motorbikes on beaches (ambiguity of permitted areas; lack of enforcement)	Mod	Mod	Mod	High
											T30	Illegal camping in coastal and foreshore areas	Mod	Mod	Mod	High
											T31	Conflicts of use between cyclists and other users of footpaths and boardwalks	Low	Low	Mod	Mod
											T32	Use of recreational drones disturbing amenity and birdlife	Min	Min	Low	Mod
											T33	Trampling and unfenced access to coastal vegetation	Low	Low	Mod	Mod
											T35	Public safety risks from marine life (e.g. shark bite, stingers)	Mod	Mod	Mod	Mod

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O33	Improve safety at V-Wall and along break wall	Improve the quantity and accessibility of safety and rescue equipment near the v-wall and along the break wall.	Incomplete	Enhanced safety	Theft and vandalism of equipment.	BMT WBM (2008) RDM <i>et al.</i> , (2010)	F12, F13	Yes - incorporate into Recreational Use Strategy	The Nambucca River Masterplan concluded that the hole in the v-wall is to remain open. No further action has been taken in respect to this item.	Public use and access	T44	Dangerous currents at V-wall opening and recreational back beach	High	High	High	High
O34	Alternative safe swimming areas	Consider the creation of alternative safe swimming locations in the lower estuary; including enclosing a swimming area and protect from sharks and/or other shark management options (e.g. monitoring, tagging, smart drum lines etc.)	Not commenced	Enhanced safety	Use of shark nets has had mixed results and often has unintended impacts (e.g. by-catch, high maintenance costs etc.)	BMT WBM (2008)	F2, DPI Fisheries, DPIE Crown Lands	Yes - likely to have mixed level of support.		Public use and access	T35	Public safety risks from marine life (e.g. shark bite, stingers)	Mod	Mod	Mod	Mod
O35	Monitor success of current/ previous companion animal management actions	Monitor performance of existing actions and management relating to the use of off-leash and on-leash areas by the public and their pets.	Partial implementation	Allow for management actions to be revised and updated as appropriate.	Identified as an ongoing contentious issue among the community and may be difficult to manage/ resolve.	Recommended by the Stage 1 risk assessment.	F2	Yes - could be incorporated into overall recreational use strategy.	Existing signage needs renewing. Dog control off-leash/ on-leash signage is present. Dog bags provided at appropriate locations	Public use and access	T28	Conflict of use between off-leash dogs (at both on-leash and off-leash areas)	Low	Low	Mod	Mod
O36	Traffic Study at key locations	Traffic study of: Beach parking areas at Scotts Head to identify opportunities for improved layout. (options to be considered include changed turn around areas for the boat ramp; limiting parking beyond the surf club) Main Beach Nambucca Heads - consider alternative access arrangements.	Not commenced	Improved traffic management. Improve access to coastal facilities (e.g. boat ramps, beaches, surf clubs, walking paths etc.) Consideration of and planning for long-term coastal recession.		Umwelt (2012) Action 32,33	F2	Yes - considered a key part of effective management	Council is presently preparing designs for improvements to the Nambucca main beach seawall, carpark and pedestrian access. Any potential changes should be discussed with the local community and would be included in reviews of the Master Plan for the Crown Reserve.	Public use and access	T22	Poor condition and inadequate foreshore access and parking during summer peak use	Mod	Mod	Mod	Mod
O37	Monitor success of current/ previous 4WD management actions	Monitor performance of existing actions and management relating to the use of 4WDs and motorbikes on beaches.	Ongoing implementation	Allow for management actions to be revised and updated as appropriate.	Identified as an ongoing contentious issue among the community and may be difficult to manage/ resolve.	Recommended by the Stage 1 risk assessment.	F1 monitoring must be linked to actions to improve ecosystem health.	Yes - could be incorporated into overall recreational use strategy or as part of Traffic Study	Council monitors 4WD access at beaches with CCTV	Public use and access	T29	4WD/ motorbikes on beaches (ambiguity of permitted areas; lack of enforcement)	Mod	Mod	Mod	High

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O38	Boating and Waterway Usage Strategy	To maintain and enhance safe, responsible and ecologically sustainable recreational boating and water sports activities. The strategy would incorporate a number of elements including rationalise and improve access points, boat ramps and associated facilities; signage and education etc.	Ongoing implementation	Improve recreational value, public access and safety. Protect estuarine vegetation. Protect areas exposed to waves caused by vessel wake. Reduce erosion caused by vessels.	Potential for opposition from stakeholders with any changes to current boating conditions/regulations.	BMT WBM (2008)	F1	Yes - CMP to identify remaining sites for improvement of facilities/access etc.	Council has undertaken improvement works at various locations in the Nambucca River and other areas through access to both the Better Boating and Boating Now programs.	Public use and access	T36	Lack of exclusion areas and regulatory restrictions (speed and usage controls)	Mod	Mod	High	High
											T37	Irresponsible usage (e.g. speeding) and lack of enforcement	Mod	Mod	High	High
											T38	Lack of understanding habitat sensitivities and locations; impacts to sensitive habitats	Mod	Mod	High	High
											T39	Marine noise pollution	Low	Low	Low	Low
O39	Investigate need for additional boat ramps at key locations for boats and passive recreational craft	Investigate the need for future boat ramps and associated recreational activities at Tewinga or Wirrimibi, Henstock Reserve (Warrell Creek), Welshes Park (Talarm)	Ongoing implementation	Improve recreational value, public access and safety.	Cost	BMT WBM (2008)	F2, F6	Yes - incorporate into overall boating strategy	Council has investigated formalising facilities at Tewinga and the proposed informal ramp used at present does not present safe sight lines/distances to Rodeo Drive particularly if towing a boat trailer. Henstock reserve has not been investigated further; Council has a draft budget in the 19/20 period to examine improvements to Welshes Park	Public use and access	T37	Irresponsible usage (e.g. speeding) and lack of enforcement	Mod	Mod	High	High
O40	Nambucca River Master Plan remaining site-specific works	Incorporates all remaining actions from the River Master Plan considered to be relevant and suitable today, and addresses current issues affecting the study area. Action to include review and rationalisation of proposed works to determine those of most benefit. Also consider recommendations of the Nambucca Aboriginal and Cultural Heritage Study McIntyre-Tamwoy (2003) and any other	Ongoing implementation or Not Complete	Detailed plans that have been through community consultation and are ready for implementation. Many proposed actions in the plan are consistent with the objects of the CM Act (e.g. public access and education, cultural heritage protection and education)	Costs could be significant based on large number of actions. The Plan is now 10 years old and some aspects may no longer be relevant (e.g. includes references and mapping of the Pacific Highway going through Nambucca Heads). Requires prioritisation and assessment of actions including identifying those	RDM <i>et al.</i> , (2010)	F1, F2 Streams 2-5 if it can be directly related to env benefit to estuary, improving access to coastal zone or public education about estuary health.	Yes - specific actions will need to be assessed as part of Stage 3 Options Assessment to rank importance.	Many actions in the Plan have been implemented to date by Council in collaboration with Crown Lands, DPI Fisheries, Landcare and other agencies and community groups.	Public use and access	T21	Not enough public recreational access and facilities	Mod	Mod	Mod	Mod
											T22	Poor condition and inadequate foreshore access and parking during summer peak use	Low	Mod	Mod	High
											T23	No linkage of coastal pathways	Low	Low	Low	Low
											T24	Not enough mobility infrastructure	Low	Mod	Mod	Mod
											T25	Insufficient maintenance of access infrastructure to minimise safety risks	Low	Mod	Mod	Mod
											T26	Insufficient, or inappropriate public education and signage	Mod	Mod	Mod	Mod
											T27	Litter and marine debris	Mod	Mod	Mod	High
											T28	Conflict of use between off-leash dogs (at both on-leash and off-leash areas)	Low	Low	Mod	Mod

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		relevant information when reviewing proposed actions.			eligible for funding under the CMP Program and other funding mechanisms.						T29	4WD/ motorbikes on beaches (ambiguity of permitted areas; lack of enforcement)	Mod	Mod	Mod	High
											T30	Illegal camping in coastal and foreshore areas	Mod	Mod	Mod	High
											T31	Conflicts of use between cyclists and other users of footpaths and boardwalks	Low	Low	Mod	Mod
											T32	Use of recreational drones disturbing amenity and birdlife	Min	Min	Low	Mod
											T33	Trampling and unfenced access to coastal vegetation	Low	Low	Mod	Mod
											T35	Public safety risks from marine life (e.g. shark bite, stingers)	Mod	Mod	Mod	Mod
O41	Swimming Creek debris removal	Remove debris from swimming Creek (e.g. concrete, bricks, tyres, timber).	Unknown	Improve amenity and habitat values. Low cost. Quick fix.	Nil	Redman and Greenway (1995)	N/A	Yes	Debris is still evident.	Public use and access	T27	Litter and marine debris	Mod	Mod	Mod	High
O42	DPI Fisheries to undertake education program targeted to Nambucca LGA.	DPI Fisheries undertake community educational program on current threats and impacts to fish/fish habitat and current fish management practices.	Not commenced	Improve public understanding of fishery health, key impacts and management of fish stocks.	Action delegated to external agency and hence outside of Council's direct control.	Recommended by the Stage 1 risk assessment.	F3, F1 with focus on importance of coastal and estuarine areas and reducing exacerbating issues.	Yes - could be incorporated into overall education strategy.		Recreational and commercial fishing and aquaculture	T57	Commercial ocean trawl and ocean haul	Mod	Mod	Mod	Mod
											T58	Commercial trap and line	Mod	Mod	Mod	Mod
											T59	Estuary general fishing	Mod	Mod	Mod	Mod
											T60	Estuary prawn trawl	Mod	Mod	Mod	Mod
											T61	Recreational boat and shore-based line and trap fishing	Mod	Mod	Mod	Mod
											T62	Recreational hand gathering	Low	Low	Low	Low
											T63	Oyster aquaculture	Low	Low	Low	Low
											T64	Marine debris, including monofilament fishing line, bait bags and microplastics	Mod	Mod	Mod	High
O43	Support sustainable aquaculture industries within the Nambucca River estuary	Application of the highest levels of catchment and waterway management to ensure that the estuary's water quality is sufficient to maintain this industry, in clearly identified areas	Partial implementation	Supports water quality improvements and enhancement of important local industry. Supports improved coordination between governing bodies.		BMT WBM (2008)	F1 But only indirectly. Actions to improve water quality are eligible for funding only when linked to environmental benefit (not to support industry).	Yes - in effect this would be delivered through several link actions in the CMP directed at improving water quality (e.g. Bank Erosion Management, Riparian restoration, River Reach Plans, Stormwater management, WQ monitoring etc.)		Recreational and commercial fishing and aquaculture	T63	Oyster aquaculture	Low	Low	Low	Low

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O44	Conduct recreational fishing catch surveys	Initiate recreational fishing catch surveys on the Nambucca River estuary, which identify key fishing locations, fishing effort, catch quantities, target species and species caught	Not commenced	Provides information on status of recreational fishing. Can help assess fishery stocks and impact of rec fishing.	Not Council responsibility. DPI Fisheries role to carry out this type of assessment. Surveys specific to Nambucca would overlap existing state-wide survey work and not likely to be cost-effective.	BMT WBM (2008), Survey of Recreational Fishing in NSW (DPI, 2014, 2020)	F3	No - DPI Fisheries conducts state-wide recreational fishing surveys based on random survey of recreational fishing licence holders. the survey improves understanding of the status of recreational fishing in NSW and is used in fishery stock assessments to ensure that our fisheries are managed on an ecologically, economically and socially sustainable basis.		Recreational and commercial fishing and aquaculture	T61	Recreational boat and shore-based line and trap fishing	Mod	Mod	Mod	Mod
											T62	Recreational hand gathering	Low	Low	Low	Low
O45	Fish Surveys	Conduct fish surveys to assess current fish stocks, habitat values and determine extent of threats and pressures affecting fisheries health.	Not commenced	Obtain better understanding of fisheries habitat values and trends in fish communities over time in different parts of estuary	Not Council responsibility. DPI Fisheries role to carry out this type of assessment. Surveys specific to Nambucca would overlap existing state-wide survey work and not likely to be cost-effective.	BMT WBM (2008)	F3, F1	No - DPI Fisheries conducts fishing surveys and fishery stock assessments. CMP action may be developed in conjunction with DPI Fisheries regarding a community educational program on current threats and impacts to fish/fish habitat and current fish management practices.	Include in educational program action	Recreational and commercial fishing and aquaculture	T57	Commercial ocean trawl and ocean haul	Mod	Mod	Mod	Mod
											T58	Commercial trap and line	Mod	Mod	Mod	Mod
											T59	Estuary general fishing	Mod	Mod	Mod	Mod
											T60	Estuary prawn trawl	Mod	Mod	Mod	Mod
											T61	Recreational boat and shore-based line and trap fishing	Mod	Mod	Mod	Mod
											T62	Recreational hand gathering	Low	Low	Low	Low
											T63	Oyster aquaculture	Low	Low	Low	Low
											T64	Marine debris, including monofilament fishing line, bait bags and microplastics	Mod	Mod	Mod	High
O46	Protect Aboriginal and European cultural heritage items and places	Council to undertake appropriate consultation with relevant bodies when designing work/projects in the lower estuary. Recommendations of the Nambucca Aboriginal and Cultural Heritage Study to be addressed in any future works or projects in areas of significance	Ongoing implementation	Ensure protection of Aboriginal and European heritage	Nil	BMT WBM (2008), <i>RDM et al.</i> , (2010), McIntyre-Tamwoy (2003).	F1	Yes - ongoing protection required		Cultural Heritage	T85	Threats to Aboriginal cultural practices and heritage	High	High	High	High
											T86	Threats to European cultural heritage	Mod	Mod	Mod	Mod

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O47	Cultural heritage education and Awareness	Education regarding cultural heritage significance of study area (e.g. Signposting to identify and explain areas that have cultural significance, school programs etc.)	Ongoing implementation	Increase understanding of Aboriginal and European heritage	Nil	BMT WBM (2008), RDM <i>et al.</i> , (2010), McIntyre-Tamwoy (2003).	F1	Yes - incorporate as part of Educational Program and as part of the Nambucca Foreshore Walk (cultural way) as identified in the Nambucca River Masterplan (signage, sculpture etc.).		Cultural Heritage	T85	Threats to Aboriginal cultural practices and heritage	High	High	High	High	
											T86	Threats to European cultural heritage	Mod	Mod	Mod	Mod	
O48	Consultation with local Indigenous Community	Ongoing consultation with the local indigenous community on a long-term basis regarding coastline and estuary values/ indigenous knowledge of ecology, seasonal cycles etc. / identifying threats and issues to be addressed and greater involvement of indigenous community in coastline and estuary management.	Partial implementation	Increase understanding of Indigenous knowledge and management practices. Increase collaboration and enhance relationships. Identify risks and opportunities.	Nil	BMT WBM (2008), RDM <i>et al.</i> , (2010), McIntyre-Tamwoy (2003).	F1	Yes – include as a specific action in the CMP		Cultural Heritage	T85	Threats to Aboriginal cultural practices and heritage	High	High	High	High	
											Governance, education and compliance	T82	Lack of awareness, education and engagement	Low	Low	Low	Low
												T82	Poor community compliance with rules and regulations to protect coastal and estuary environments, public health and safety and amenity.	Low	Low	Low	Low
												T26	Insufficient, or inappropriate public education and signage	Mod	Mod	Mod	Mod
O49	Nambucca Rivers Creeks Estuaries and Coastline Management Committee to oversee CMP implementation	Continue oversight of CMP by Committee. Ensure adequate representation of all key local stakeholder groups in management of study area. Consider formalising a regular meeting frequency (e.g. quarterly) during CMP implementation and more regularly as needed to discuss implementation milestones, funding and emerging issues etc.	Ongoing Implementation	Coordinated and cooperative management between land managers, agencies and the community. The existing Committee has proved to be an effective and committed group and based on this, the risk of ineffective management is considered low.	Risk that membership on management committees will wax and wane over the years. Participation is dependent on the motivation and willingness of individuals to attend meetings and contribute positively to discussions and decision-making processes.	Umwelt (2012) Action 9,10 BMT WBM (2008). RDM <i>et al.</i> , (2010)	F9	Yes – Continue oversight of CMP by Committee. Consider formalising a regular meeting frequency (e.g. quarterly) during CMP implementation and more regularly as needed to discuss implementation milestones, funding and emerging issues etc.		Governance, education and compliance	T81	Insufficient/ ineffective/ inefficient governance	Mod	Mod	Mod	Mod	

ID	Management option	Description	Current status	Benefits	Limitations/ risks	Reference	Likely funding mechanism	Further consideration required in Stage 3 of the CMP	Additional comments	Issue category	Threat ID	Threats (use, activity or stressor)	Current risk	20-year risk	50-year risk	100-year risk
O50	Plan of Management for Crown Land Coastal Reserves	Prepare a Plan of Management for Crown Land Coastal Reserves under NVC management. PoM to be consistent with CMP.	Ongoing	Comply with legislative requirements under the Crown Land Management Act 2016 and the Local Government Act 1993	May unnecessarily overlap CMP	Umwelt (2012) Action 15	F4	No – considered a separate process under the Crown Lands Act 2016. is presently progressing with the preparation of Crown Reserves as appropriate.	NVC is land manager for Coastal Crown Reserves from the southern end of Jagun Nature Reserve to Nambucca Heads	Governance, education and compliance	T81	Insufficient/ ineffective/ inefficient governance	Mod	Mod	Mod	Mod
O51	MoU between NVC and NPWS	Develop a memorandum of understanding (MoU) between NSC and NPWS to document and agree on roles and responsibilities in areas where this overlap	Incomplete	Consistent requirements for compliance across various land tenures		Umwelt (2012) Action 17	F10, F11	Yes – further consideration/ assessment required as part of Stage 3	Beach Access Committee developed to manage issues with access to beaches. Council undertakes regular inspections of vehicle activities on beaches using various methods.	Governance, education and compliance	T81	Insufficient/ ineffective/ inefficient governance	Mod	Mod	Mod	Mod
O52	NVC Coastline and Estuary Educational Program	Design and implement an integrated Coastline and Estuary Educational Program to educate and promote understanding of the natural attributes of the coastline and estuaries, sensitivities and key issues and	Partial implementation	Maintain the community's awareness and access to information regarding coastal management, coastal processes and community activities. Improve understanding of	May not be effective/ may not engage majority of users. Can only provide information to improve knowledge. Success relies on community	Umwelt (2012) Action 9,10 BMT WBM (2008) RDM <i>et al.</i> , (2010)	F1	Yes – considered a key part of effective management, related to every aspect of the CMP.	Educational activities currently implemented by NVC include: Coast and Estuary section of NVC website, signage at key locations to inform residents and visitors about coastal process hazards/ environmental attributes etc.;	Governance, education and compliance	T82	Lack of awareness, education and engagement	Low	Low	Low	Low
											T82	Poor community compliance with rules and regulations to protect coastal and estuary environments, public health and safety and amenity.	Low	Low	Low	Low
											T26	Insufficient, or inappropriate public education and signage	Mod	Mod	Mod	Mod

ID	Management option	Description	Current status	Benefits	Limitations/risks	Reference	Likely funding mechanism	Further consideration required in Stage 3 of the CMP	Additional comments	Issue category	Threat ID	Threats (use, activity or stressor)	Current risk	20-year risk	50-year risk	100-year risk
		encouraging low-impact use/practices to protect key sites. May involve installation/ replacement of attractive and engaging signage at key locations; leaflets/flyers, webpage; posters; information days/activities; school programs; educational videos etc. Target groups could include: local construction industry (erosion and sediment controls); boating users; agricultural industry; oyster industry, tourists/tourism sector; foreshore Crown land managers (e.g. caravan parks), school groups; general public, residents close to sensitive systems (e.g. swimming creek) etc.		issues and the individual role in managing these environments. May increase rates of compliance with environmental regulation. Relatively low cost.	willingness to engage.				workshops with local construction industry; Water User and Good Boating pamphlets; Nambucca Tourism Strategy.	Several issues addressed through education	T26-39 T45-49 T53-55 T61-74 T84-85	Several issues addressed both directly and indirectly through education (issues range from High to Low risk level)				
O53	Estuary Shoaling Education	Raise community awareness of coastal/estuary processes to increase the level of understanding of shoaling mechanisms and associated implications as well as the consequences of intervention measures.	Partial implementation	Low cost. Improves community awareness	Can only provide information to improve knowledge. Success relies on community willingness to engage. May not reach all stakeholders.	BMT WBM (2008)	F1	Yes – combine into overall Education Program	Shoaling investigation prepared by GHD in 2016 included a community forum and community consultation which included an education component. Sign to be placed at Rotary Lookout with historical information regarding shoaling and other matters. Next phase would be a river sediment size investigation, to determine source of lower estuary sediments, particle size and composition.	Governance, education and compliance	T82	Lack of awareness, education and engagement	Low	Low	Low	Low
O54	Improve recognition of Crown Land	Improve recognition of Crown Land areas in the lower estuary, particularly those	Ongoing implementation	Low cost Improve community awareness	Can only provide information to improve knowledge.	BMT WBM (2008)	F1	Yes – combine into Education Program		Governance, education	T82	Lack of awareness, education and engagement	Low	Low	Low	Low

ID	Management option	Description	Current status	Benefits	Limitations/risks	Reference	Likely funding mechanism	Further consideration required in Stage 3 of the CMP	Additional comments	Issue category	Threat ID	Threats (use, activity or stressor)	Current risk	20-year risk	50-year risk	100-year risk
	areas	around existing facilities that may promote greater connectivity and tourist related usage of the area			Success relies on community willingness to engage. May not reach all stakeholders.						T83	Poor community compliance with rules and regulations to protect coastal and estuary environments, public health and safety and amenity.	Low	Low	Low	Low
											T26	Insufficient, or inappropriate public education and signage	Mod	Mod	Mod	Mod
O55	Specific allocation from NVC's Environmental Levy provides funds for implementing the coast and estuary program	Continue as key funding source. Review adequacy of funding amounts and recommend changes as appropriate.	Ongoing implementation	Allow for priority actions and projects to be funded and undertaken. Typically used to match grant funding opportunities.	Funding is limited to allocation amount. Larger infrastructure projects are often funded through general funds	Umwelt (2012) Action 8	F2	Yes - Continue as key funding source. Review adequacy of funding amounts and recommend changes as appropriate.		All issues	T1 – T83	All threats				
O56	Sustainable Tourism	Promote the natural values of the estuary and sustainable use and also support the valuable tourism industry of the Nambucca Shire.	Ongoing implementation	Benefits to the economy through support to the tourism industry. Encourage sustainable uses of the estuary.		BMT WBM (2008),	F1	Yes – incorporate as part of Educational Program		Governance, education and compliance	T82	Lack of awareness, education and engagement	Low	Low	Low	Low
											T83	Poor community compliance with rules and regulations to protect coastal and estuary environments, public health and safety and amenity.	Low	Low	Low	Low
O57	Foreshore Structure Approvals Review	Review approval process for foreshore structures to ensure that all proposed structures go through an appropriate process	Ongoing implementation	Regulation and compliance of foreshore structures to ensure safety, effectiveness and suitability of structures.	Not Council responsibility. DPI Fisheries role to carry out. Licensing with Crown Land often presents a significant project hold point for Council projects.	BMT WBM (2008)	DPI Fisheries	No – However, NVC to participate in the process managed by DPI-Fisheries. Can include as part of a governance action	DPI Fisheries are reviewing the approval process for private and public foreshore works. NVC has been invited to participate in the process. The project is being funded by NSW DPI under the Marine Estate Management Strategy process.	Governance, education and compliance	T82	Lack of awareness, education and engagement	Low	Low	Low	Low
											T83	Poor community compliance with rules and regulations to protect coastal and estuary environments, public health and safety and amenity.	Low	Low	Low	Low
										Cultural Heritage	T85	Threats to Aboriginal cultural practices and heritage	High	High	High	High
											T86	Threats to European cultural heritage	Mod	Mod	Mod	Mod
O58	Education, promotion and compliance with best practice erosion and sediment control guidelines for construction sites	More effective sediment controls where soil disturbance occurs, for example, during early phases of land development or construction.	Ongoing implementation	Reduce sediment (and associated pollutant) export to the estuary	Require individuals to implement guidelines effectively. Staff resourcing required to oversee construction can be significant.	GECO Environmental (2009)	F1	Yes- incorporate into overall education strategy	Erosion and sediment control component added to Councils DCP in 2012/13.	Governance, education and compliance	T82	Lack of awareness, education and engagement	Low	Low	Low	Low
											T83	Poor community compliance with rules and regulations to protect coastal and estuary environments, public health and safety and amenity.	Low	Low	Low	Low

ID	Management option	Description	Current status	Benefits	Limitations/risks	Reference	Likely funding mechanism	Further consideration required in Stage 3 of the CMP	Additional comments	Issue category	Threat ID	Threats (use, activity or stressor)	Current risk	20-year risk	50-year risk	100-year risk
O59	Investigate and remove illegal connections of stormwater to sewer	Assess urban residential areas to identify properties with illegal stormwater to sewer connections. Smoke testing can be used to quickly identify illegal connections.	Not commenced	This may assist in reducing the potential for overflows from sewer infrastructure to heavy rainfall events.		GECO Environmental (2009)	F2	Yes		Governance, education and compliance	T82	Lack of awareness, education and engagement	Low	Low	Low	Low
											T83	Poor community compliance with rules and regulations to protect coastal and estuary environments, public health and safety and amenity.	Low	Low	Low	Low

NOTES:

1. Funding ID Key:

F1 – 2:1 NSW Coastal and Estuary Grants Program: Council funded

F2 – Nambucca Valley Council

F3- DPI Fisheries Recreational Fishing Trust (Fish Habitat Action Grants).

F4 – Crown Reserves Improvement Fund Program for development and maintenance projects on Crown land

F5 – DPIE Crown Lands Rescuing Our Waterways Program (dredging for navigation).

F6 – NSW Boating Now Program

F7 – Landcare grants

F8 – Landholder in-kind contributions.

F9 – Committee resources (member time)

F10 – Council staff time

F11 – NPWS staff time

F12 – Marine Rescue NSW

F13 – NSW Surf Lifesaving

F14 – North Coast Weeds Advisory

F15 – Marine Estate Management Strategy (MEMS)

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GLOSSARY AND ABBREVIATIONS

4WD	Four Wheel Drive/ing
Acid sulfate soils (ASS)	Acid sulfate soils are the common name given to soils containing iron sulfides. In Australia, the acid sulfate soils of most concern are those which formed within the past 10,000 years, after the last major sea level rise. When the iron sulfides are exposed to air and produce sulfuric acid, they are known as actual acid sulfate soils. The soil itself can neutralise some of the sulfuric acid. The remaining acid moves through the soil, acidifying soil water, groundwater and, eventually, surface waters.
Amenity	A desirable or useful feature or facility of a building or place
CMA	Coastal Management Area
CM Act	Coastal Management Act 2016 – the legislation under which this Scoping Study has been prepared.
CMP	Coastal Management Program
CZMP	Coastal Zone Management Plan
DCP	Development Controls Plans
DPI	(NSW) Department of Primary Industries
DPIE	Department of Planning, Industry & Environment
DPI Fisheries	NSW Department of Primary Industries – Fisheries
Ecosystem	Refers to all the biological and physical parts of a biological unit (e.g. an estuary, forest, or planet) and their interconnections.
Estuarine	Part of the river channel with a mix of fresh water and salt (tidal) water
FM Act	<i>Fisheries Management Act 1994</i>
Foreshore	That part of the shore that lies between the mean high tide mark and the mean low tide mark
GIS	Geographic Information System
Hydrology	The study of water and its properties, including precipitation onto land and returning to oceans
ICOLL	Intermittently Closed and Open Lakes and Lagoons
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan
LGA	Local Government Area
MEMA	Marine Estate Management Authority
MEMS	Marine Estate Management Strategy
NPWS	National Parks and Wildlife Service
NSC	Nambucca Shire Council (now known as Nambucca Valley Council)
NVC	Nambucca Valley Council (previously Nambucca Shire Council)
NSW	New South Wales
PoM	Plan of Management
Riparian	Of, on or relating to the banks of a watercourse

Nambucca Coastline and Estuaries CMP: Stage 2 –Vulnerabilities and Opportunities

Salinity	The level of salt dissolved in the water
Sedimentation	The deposition or accumulation of sediment
SEPP	State Environmental Planning Policy
SLSC	Surf Life Saving Club
STP	Sewerage Treatment Plant
TARA	Threat And Risk Assessment
Terrestrial	Living or growing on land (not aquatic)

**Appendix 1. BANK CONDITION ASSESSMENT- NAMBUCCA RIVER
AND DEEP CREEK**

Appendix 2. UPDATED RISK ASSESSMENT

Issue	ID	Threats (use, activity or stressor)	Key locations	Key impacts	Preliminary Risk Assessment (present day risk)			Future Risk			Assessment of Knowledge Gaps			Recommendation for additional studies
					Consequence	Likelihood	Current Risk	20 yr Risk	50yr Risk	100 yr Risk	Knowledge Gap	Importance for Resolution	Priority for Resolution	
Coastal hazards	T1	Storm surge and storm bite coastal erosion	Shelly Beach, Beilbys Beach, Nambucca Main Beach, Scotts Head Main Beach, South Valla Beach, North Valla Beach, Swimming Beach Potentially other locations.	Degradation to or of loss of assets and infrastructure including increased frequency of flooding and inundation; loss of dune vegetation; extent of, and migration of estuarine and riparian vegetation communities; loss of amenity; public safety risks; tourism impacts; Council liability and legality issues; other social, cultural and economic factors	C-Moderate	1-Almost Certain	Moderate	Moderate	High	High	Coastal hazards within NVC's area of responsibility have been sufficiently mapped. Unmapped areas include Oyster Creek/ North Valla Beach, South Valla Beach, Forster/ South Beach, Little Beach and Wakki Beach.	Low	Short term	Stage 5 (CMP Action) – - Mapping of storm surge and storm bite erosion hazards. - Recommendation to other agencies/authorities to consider coastal hazard mapping (present day, and relevant long term planning scenarios) to fill in the gaps where these agencies are land managers of the coastal zone (DPIE – Crown Lands, DPIE – NPWS, State Rail in Oyster Creek etc.). Stage 5 (CMP Action) – Digitise information from SMEC (2011) Coastal Slope Instability Hazard Study and any amendments made through reassessment of priority sites. Stage 5 (CMP Action) – Detailed local tidal inundation assessment of the estuaries for a variety of future sea level rise scenarios, with a risk assessment to estuary assets and infrastructure. Stage 5 (CMP Action) – -Monitor performance of existing coastal protection infrastructure. - Detailed design of coastal infrastructure and approval for maintenance and improvement (e.g. South Valla Beach carpark) - Ensure coastal infrastructure is adequately addressed in Council's AMP and where necessary investigations are undertaken to support contemporary inventory of coastal assets
	T2	Coastal long-term shoreline recession	Main beach, Shelly Beach, Swimming Creek, Beilby's Beach, Scotts Head.		D-Major	1-Almost Certain	High	High	High	High		These areas are the responsibility of other agencies/authorities (e.g. DPIE – Crown Lands, DPIE – NPWS, and State Rail in Oyster Creek etc.). Understanding of potential for breakthrough of frontal dunes (e.g. at Deep Creek and Warrell Creek).	Moderate	
	T3	Increased risk of slope instability/ landslip	10 sites at North Valla, Main Beach, Scotts Head and the lower Nambucca River estuary as per SMEC (2009).		D-Major	1-Almost Certain	High	High	High	High	Lack of GIS information on coastal cliff instability. Hard copy data available only.	Moderate	Medium term	
	T4	Coastal inundation including wave propagation into estuaries	Estuarine waterways and waterbodies		C-Moderate	1-Almost Certain	Moderate	Moderate	High	High	None – sufficient high-level information provided in SMEC (2009 & 2010) and WMAwater (2017a).	N/A	N/A	
	T5	Tidal inundation	Wellington Drive; Bellwood Park; Rural Lands		D-Major	1-Almost Certain	High	High	High	High	Inadequate understanding of tidal inundation extent and frequency (separate to catchment flooding) with climate change, and the associated impacts (e.g. to assets & infrastructure, ecological habitats, access to built areas, and to recreational opportunities and infrastructure).	Moderate	Medium term	
	T6	Disrepair of, or inadequate design of coastal protection structures and infrastructure	Shelly Beach, South Valla Beach, Swimming Beach, Main beach, V-wall, Scotts Head; and others as identified through investigations		D-Major	1-Almost Certain	High	High	High	High	On-going monitoring of infrastructure condition and performance especially. after coastal hazard events. Lack of detailed design of coastal infrastructure and approval for maintenance and improvement.	Moderate	Short term	
	T7	Stormwater erosion in the coastal zone	Scotts Head (Forster Beach), Main Beach, Beilbys Beach		C-Moderate	1-Almost Certain	Moderate	Moderate	Moderate	High	None - sufficient high-level information provided in Umwelt (2012).	N/A	N/A	

Issue	ID	Threats (use, activity or stressor)	Key locations	Key impacts	Preliminary Risk Assessment (present day risk)			Future Risk			Assessment of Knowledge Gaps			Recommendation for additional studies
					Consequence	Likelihood	Current Risk	20 yr Risk	50yr Risk	100 yr Risk	Knowledge Gap	Importance for Resolution	Priority for Resolution	
Climate change impacts	T8	Increased storminess	Catchment and estuarine waterways/water bodies. North Valla, Swimming Creek	Water quality impacts associated with increased runoff events (e.g. high turbidity levels/ suspended solid concentrations; increased erosion and sedimentation; low DO; high nutrient concentrations elevated acidity and heavy metal loadings etc.) Impacts to seagrass health and distribution; risk from elevated bacterial concentrations to oyster aquaculture and human health.	D-Major	3-Possible	Moderate	Moderate	High	High	None -	N/A	N/A	Stage 5 (CMP Action) - Development of catchment plans for key urban areas with a focus on water quality improvements (e.g. East Street/Hughes Creek, Nambucca Heads, Bellwood, Scotts Head all urban areas and growth areas).
	T9	Increased salinity in the upper estuary	Upper estuary	Decline in potable/stock water quality	C-Moderate	3-Possible	Low	Moderate	High	High	None -	N/A	N/A	N/A
	T10	Average warming and extreme temperatures	Whole study area	Estuarine ecological impacts; increased bushfire risk; extended dry periods.	C-Moderate	3-Possible	Low	Moderate	High	High	None -	N/A	N/A	N/A
	T11	Anthropogenic barriers (i.e. physical barriers, land use and planning constraints) to migration of vegetation communities with sea level rise (e.g. saltmarsh)	Estuarine waterways/water bodies.	Coastal squeeze; loss of estuarine, dune and riparian vegetation.	C-Moderate	1-Almost Certain	Moderate	Moderate	High	High	Lack of mapping of barriers and land use constraints to estuarine vegetation migration with sea level rise	High	Medium term	Stage 5 (CMP Action) - Assessment of potential for estuarine vegetation migration with sea level rise (2050 and 2100) based on vegetation types, topography, land use and possible future tidal range and including: - mapping of anthropogenic barriers and land use constraints to migration (e.g. training walls and rock revetments, footpaths, roads, land uses); - allocation of a management priority classification indicating the level of intervention required to minimise the potential impact of sea level rise on migration.
Estuarine bank erosion	T12	Flooding	Current areas of concern: Significantly degraded sites on North Arm, Taylors Arm, Nambucca River (near Macksville) and Lower Warrell Creek as detailed and mapped in <i>Bank Condition Assessment - Nambucca River and Deep Creek</i> (Hydrosphere Consulting, 2020)	Bank instability; loss of land; erosion to and loss of riparian and estuarine vegetation and habitat; siltation; water quality issues; navigational impacts; impacts to oyster growers; impacts to general amenity; tourism impacts; Council liability and legality issues	D-Major	2-Likely	High	High	High	High	Lack of robust, repeatable, evidence-based approach to selection of best practice management bank treatments (Priority = Medium term).	High	Short-term	Stage 5 (CMP Action) – Develop an estuary-wide Bank Management Strategy (BMS) commensurate with Initiative 2 of the Marine Estate Management Strategy and any tool/ guidance provided.
	T13	Powered vessels and towing			D-Major	3-Possible	Moderate	Moderate	Moderate	High				
	T14	Wind waves			C-Moderate	1-Almost Certain	Moderate	Moderate	Moderate	High				
	T15	Historic clearing of riparian vegetation and adjacent habitat			D-Major	1-Almost Certain	High	High	High	High				
	T16	Uncontrolled stock access to and grazing within the riparian zone			D-Major	1-Almost Certain	High	High	High	High				
	T17	Past gravel extraction contributing to ongoing poor geomorphic condition			C-Moderate	1-Almost Certain	Moderate	Moderate	Moderate	Moderate				
	T18	Accumulation of flood debris (e.g. fallen trees resulting in scour eddies of adjacent banks)			D-Major	3-Possible	Moderate	Moderate	Moderate	High				

Issue	ID	Threats (use, activity or stressor)	Key locations	Key impacts	Preliminary Risk Assessment (present day risk)			Future Risk			Assessment of Knowledge Gaps			Recommendation for additional studies
					Consequence	Likelihood	Current Risk	20 yr Risk	50yr Risk	100 yr Risk	Knowledge Gap	Importance for Resolution	Priority for Resolution	
Riparian vegetation and weed management	T19	Dominance of invasive weeds (e.g. Camphor Laurel and Small-leaved Privet in the upper reaches and bitou bush in the lower reaches)	Buckra Bendinni Creek; South Creek; tributaries to Taylors Arm; upper catchment of Deep Creek; Nambucca River estuary entrance; North Arm (upstream of Macksville); Taylors Arm.	Bank instability; sedimentation; displacement of native species; alteration of fauna habitats; reduced recruitment of native riparian vegetation; poor water quality; other social and economic factors.	D-Major	1-Almost Certain	High	High	High	High	-	N/A	N/A	N/A
	T16	Uncontrolled stock access to and grazing within the riparian zone									-	N/A	N/A	N/A
	T15	Historic clearing of riparian vegetation and adjacent habitat									-	N/A	N/A	N/A
	T20	Community concern about pesticide and herbicide use in the catchments as well in Council roadside weed spraying.	Catchment wide but primarily for roadside weeds	Public perception	C-Moderate	3-Possible	Low	Low	Low	Low	N/A- Use of glyphosate as a weed management technique is supported by the Australian Government at present provided it is used as recommended including with appropriate PPE.	N/A	N/A	N/A
Public use and access	Public access													
	T21	Not enough public recreational access and facilities throughout the estuaries (e.g. bike storage; canoe trail facilities; fish cleaning facilities; boardwalks; parking; amenities; rubbish bins; waterway access for boating and non-motorised water sports)	Whole study area other than the lower Nambucca River estuary (covered by the Nambucca River Master Plan)	Public access, public safety, public amenity; tourism impacts	C-Moderate	2-Likely	Moderate	Moderate	Moderate	Moderate	Whilst the Nambucca Estuary Management Plan and the Nambucca River Master Plan (RDM <i>et al.</i> , 2010) provides detailed strategy for the Nambucca River, there is a lack of understanding of recreational access and infrastructure needs in other parts of the study area (coastal beaches and Deep Creek).	Moderate	Medium term	Stage 5 (CMP Action). -Prepare a strategy that builds on previously successful plans (e.g. Nambucca River Masterplan, Dawkins Park Plans, Nambucca Lookouts Plans) to drive future public recreational infrastructure needs for the study area. The strategy would include assessment of suitability of current infrastructure, consideration of growth potential, disability needs, identification of public land that could be used for public recreation, and a suggested allocation of funds for facility improvements, provision of coastal pathways etc. The aim will be to provide strategic master planning for additional areas that support placemaking, facility improvement and open space/ environmental management.
	T22	Poor condition and inadequate foreshore access and parking during summer peak use. Likely to increase with population growth.	e.g. Parking at Valla Beach Road, foreshore areas in the lower estuary Nambucca Heads; Scotts Head;	Public access, public safety, public amenity; tourism impacts	C-Moderate	3-Possible	Low	Moderate	Moderate	High				
	T23	No linkage of coastal pathways	e.g. narrow Inner Harbour Boardwalk, failing boardwalks, pedestrian trails and footpaths requiring maintenance	Level of tourism; economic activity; recreational enjoyment; commuting ability	C-Moderate	3-Possible	Low	Low	Low	Low				
	T24	Not enough mobility infrastructure (e.g. lookouts, easily traversable access ways, design of seats etc.)	Whole study area other than the lower Nambucca River estuary (covered by the Nambucca River Master Plan)	Public safety risk, lack of public access, social impacts	C-Moderate	3-Possible	Low	Moderate	Moderate	Moderate				
	T25	Insufficient maintenance of access infrastructure to minimise safety risks	e.g. bridge at North Valla Beach access track; Deep Creek footbridge, Nambucca Foreshore Boardwalks; Hyland Park Footbridge.	Public safety risk	C-Moderate	3-Possible	Low	Moderate	Moderate	Moderate				
										Lack of detailed design of coastal infrastructure and approval for maintenance and improvement.	N/A	N/A	Stage 5 (CMP Action). Detailed design of coastal infrastructure and approval for maintenance and improvement.	

Issue	ID	Threats (use, activity or stressor)	Key locations	Key impacts	Preliminary Risk Assessment (present day risk)			Future Risk			Assessment of Knowledge Gaps			Recommendation for additional studies
					Consequence	Likelihood	Current Risk	20 yr Risk	50yr Risk	100 yr Risk	Knowledge Gap	Importance for Resolution	Priority for Resolution	
	T26	Insufficient, or inappropriate public education and signage (e.g. outdated or too much information)		Un-informed community; confusion; information fatigue; tourism impacts	C-Moderate	1-Almost Certain	Moderate	Moderate	Moderate	Moderate	Current delivery methods, locations of and types of information being provided; and effectiveness of delivery/ engagement with the community.	Moderate	Medium term	Stage 5 (CMP Action). Assessment of public education and signage including: consideration of key issues requiring education; review of previous/ current educational techniques being implemented (e.g. web-based, signage), their status and appropriateness; consideration of s successful education program(s) that has produced a favourable outcome and its applicability to the coastal zone.
	T27	Litter and marine debris	Nambucca Estuary esp. at Pacific Hwy service station, open coastline.	Reduced amenity; micro-plastics; ingestion, smothering and entanglement of seabirds and marine fauna	C-Moderate	2-Likely	Moderate	Moderate	Moderate	High	-	N/A	N/A	Stage 5 (CMP Action) - Development of catchment plans for key urban areas incorporating management of litter (e.g. GPTs at key locations, education campaign etc.)
Usage conflicts and public safety (other than boating - see below)														
	T28	Conflict of use between off-leash dogs (at both on-leash and off-leash areas)	Several locations within study area	Public health and safety; recreational enjoyment; amenity; habitat disturbance; reduction in abundance and health of fauna;	B-Minor	1-Almost Certain	Low	Low	Moderate	Moderate	N/A. Council has been through several iterations of management options and associated community consultations regarding companion animals. It is anticipated that this will be a continual and ongoing issue. Increased regulation of the existing policy is an option however this is subject to resource availability.	N/A	N/A	This is a continual and ongoing issue that is being addressed through existing Council programs outside of this CMP. Stage 5 (CMP Action) to monitor the performance of existing actions and ensure effective management.
	T29	4WD/ motorbikes on beaches (ambiguity of permitted areas; lack of enforcement)	4WD areas at North Valla, Swimming Creek to Deep Creek, and Forster Beach and prohibited areas adjacent to these beaches (e.g. entrances to Deep Creek, Oyster Creek, Scotts Head beaches)	Public safety; public amenity; +ve and -ve tourism impacts; noise disturbance/ physical disturbance to nesting shorebirds; vegetation disturbance; erosion risk.	C-Moderate	1-Almost Certain	Moderate	Moderate	Moderate	High	N/A. Council has a beach access committee which manages policy decision in respect to 4WD on beaches. Council is presently trialling improved regulation of 4WD access to beaches.	N/A	N/A	This is a continual and ongoing issue that is being addressed through existing Council programs outside of this CMP. Stage 5 (CMP Action) to monitor the performance of existing actions and ensure effective management.
	T30	Illegal camping in coastal and foreshore areas	South Valla	Fire risk; habitat disturbance; litter; public amenity; faecal contamination	C-Moderate	2-Likely	Moderate	Moderate	Moderate	High	-	N/A	N/A	N/A
	T31	Conflicts of use between cyclists and other users of footpaths and boardwalks	Lower Nambucca River estuary	Public safety; public amenity	B-Minor	1-Almost Certain	Low	Low	Moderate	Moderate	-	N/A	N/A	N/A
	T32	Use of recreational drones disturbing amenity and birdlife	Lower Nambucca River estuary and other coastal locations	Public amenity; habitat disturbance	B-Minor	3-Possible	Minimal	Minimal	Low	Moderate	-	N/A	N/A	N/A
	T33	Trampling and unfenced access to coastal vegetation	Coastal dunes	Damage to and loss of habitat; reduction in abundance and health of fauna and flora	B-Minor	1-Almost Certain	Low	Low	Moderate	Moderate	-	N/A	N/A	N/A
	T34	Public safety risks from faecal contamination of waterways	Estuary waterways	Public safety, public amenity; tourism impacts	C-Moderate	2-Likely	Moderate	Moderate	Moderate	High	-	N/A	N/A	N/A
	T35	Public safety risks from marine life (e.g. shark bite, stingers)	Marine and estuary waterways	Public safety, public amenity; tourism impacts	D-Major	3-Possible	Moderate	Moderate	Moderate	Moderate	-	N/A	N/A	N/A
Boating and waterway usage (including fishing, leisure boating, commercial uses, and transportation); jet-skiing; motorised towing sports (e.g. water skiing, wakeboarding, wake surfing, wake foiling and tubing)														
	T36	Lack of exclusion areas and regulatory restrictions (speed and usage controls)	Estuary waterways	Wave impacts on unprotected banks, estuarine vegetation and oyster growers (particularly during high usage periods); trampling of	C-Moderate	1-Almost Certain	Moderate	Moderate	High	High	-	N/A	N/A	N/A

Issue	ID	Threats (use, activity or stressor)	Key locations	Key impacts	Preliminary Risk Assessment (present day risk)			Future Risk			Assessment of Knowledge Gaps			Recommendation for additional studies
					Consequence	Likelihood	Current Risk	20 yr Risk	50yr Risk	100 yr Risk	Knowledge Gap	Importance for Resolution	Priority for Resolution	
	T37	Irresponsible usage (e.g. speeding) and lack of enforcement		estuarine vegetation and bed sediments; anchor dragging; conflict of use and safety risks to other waterway users; noise and amenity disturbances; vessel strike of marine mammals							-	N/A	N/A	N/A
	T38	Lack of understanding habitat sensitivities and locations; impacts to sensitive habitats (see "Public access - education and signage" above)									-	N/A	N/A	N/A
	T39	Marine noise pollution									Marine environments	Reduced habitat usage and health of marine mammals	B-Minor	1-Almost Certain
Entrance management, shoaling and estuary hydraulics	T40	Siltation affecting navigation, water quality (reduced flushing) and aesthetics	Upper reaches of the estuaries, e.g. Deep Creek tidal limit and East Bowraville; lower Deep Creek near Hyland Park	Navigational impacts, reduced flushing, aesthetics/ amenity; poor water quality, biodiversity impacts	D-Major	2-Likely	High	High	High	High	-	N/A	N/A	N/A
	T41	Shoaling of marine sands affecting navigation and marine safety	Lower reaches of Deep Creek and of the Nambucca River estuary (priority locations include Marine Rescue, Gordon Park and Golf Course Shoal)	Navigational impacts; marine safety; community perception/ satisfaction; tourism	D-Major	1-Almost Certain	High	High	High	High	Suitability of alternative marine rescue equipment, or alternatives for relocation of marine rescue assets and infrastructure (as recommended in GHD, 2016).	Moderate	Short term	Stage 5 (CMP Action). In conjunction with Nambucca Marine Rescue, consider undertaking an assessment of the suitability of alternative marine rescue equipment and the possibility of relocation of marine rescue assets and infrastructure.
	T42	Artificial entrance management	Deep Creek, Swimming Creek	Potential for unintended impacts (e.g. changing salinity regimes and impact on marine vegetation (i.e. mangrove die-off), water quality issues, fish kills, ASS impacts etc.)	D-Major	3-Possible	Moderate	Moderate	Moderate	Moderate	Efficacy of the existing Deep Creek Entrance Management Strategy since its implementation in 2012 (e.g. effect on flooding, water quality, inundation of EECs such as Swamp Oak forest etc.).	High	Short term	Stage 4 . Review of the Deep Creek Entrance Management Policy
	T43	Closure of ICOLLs (likely to decrease in frequency with SLR)	Deep Creek; Swimming Creek	Detrimental: Inundation of private property (Deep Creek); decreased recreational and environmental water quality (DO, nutrients, temperature, faecal coliforms etc.); inundation of estuarine wetland vegetation; reduced fish health and potential fish stress; aesthetics/ amenity; odour; community perception/ satisfaction; tourism; potential contribution to mangrove die-off Beneficial: Natural inundation and changed salinity regimes for fringing and swamp vegetation	C-Moderate	2-Likely	Moderate	Moderate	Low	Minimal				
	T44	Dangerous currents	V-wall opening and recreational back beach	Safety of passive waterway users (e.g. swimmers, snorkelers); navigational difficulties; tourism	D-Major	2-Likely	High	High	High	High	-	N/A	N/A	N/A
Threats to biodiversity	T45	Removal, fragmentation and degradation of riparian and adjacent habitat	Catchment and estuarine waterways	Reduced habitat availability; reduced abundance; loss of biodiversity; water quality impacts, reduced amenity.	D-Major	1-Almost Certain	High	High	High	High	An understanding of current riparian condition and connectivity.	Moderate	Immediate	Incorporated into the bank condition assessment study under "Estuarine Bank Condition" above
	T46	Removal of instream (e.g. dead wood) and reef habitat	Catchment and estuarine waterways		D-Major	1-Almost Certain	High	High	High	High	-	N/A	N/A	N/A
	T47	Predation and invasion by introduced animals and exotic plants	Whole study area		D-Major	1-Almost Certain	High	High	High	High	-	N/A	N/A	N/A
	T48	Soil disturbance through uncontrolled stock access/ erosion/ nutrient and pathogen introduction	Whole study area		D-Major	1-Almost Certain	High	High	High	High	-	N/A	N/A	N/A
	T49	Overgrazing by stock resulting in reduction in groundcover, enabling erosion and compaction of soil	Grazing areas		D-Major	1-Almost Certain	High	High	High	High	-	N/A	N/A	N/A

Issue	ID	Threats (use, activity or stressor)	Key locations	Key impacts	Preliminary Risk Assessment (present day risk)			Future Risk			Assessment of Knowledge Gaps			Recommendation for additional studies
					Consequence	Likelihood	Current Risk	20 yr Risk	50yr Risk	100 yr Risk	Knowledge Gap	Importance for Resolution	Priority for Resolution	
	T50	Development including catchment, foreshore, urban and industrial development reducing land for habitat	Urban development at Hyland Park, Macksville, Pearl at Valla, Scotts Head		D-Major	3-Possible	Moderate	High	High	High	-	N/A	N/A	N/A
	T51	Unrestricted pedestrian access in sensitive vegetation communities (e.g. dunes and riparian areas)	Deep Creek.		C-Moderate	1-Almost Certain	Moderate	Moderate	Moderate	Moderate	-	N/A	N/A	N/A
	T52	Pesticide spray drift	Deep Creek catchment in particular		C-Moderate	3-Possible	Low	Low	Low	Low	-	N/A	N/A	N/A
	T53	Dumping of rubbish and green waste	Hughes Creek/ Macksville drain and areas on the urban fringe		C-Moderate	2-Likely	Moderate	Moderate	Moderate	Moderate	-	N/A	N/A	N/A
	T54	Illegal plant collection			B-Minor	2-Likely	Low	Low	Low	Low	-	N/A	N/A	N/A
	T55	Fire/ altered and inappropriate fire regimes/ frequent burning			D-Major	2-Likely	High	High	High	High	-	N/A	N/A	N/A
	T56	Inconsistencies between Council's planning framework and mapping of protected habitats (e.g. SEPP Coastal Wetlands and EECs)	Particularly: Saltmarsh on the west side of the Newee Creek complex, towards the outlet of Gumma Swamp, and upstream of Scotts Head on Warrell Creek. Swamp Oak Forest, Swamp Sclerophyll Forest and Freshwater Wetlands adjacent to Warrell Creek (upstream of Scotts Head) and on significant areas of the Nambucca River floodplain upstream of Watts Creek.	Whilst SEPP Coastal Wetlands and other EECs are protected under the overarching planning framework, it is desirable that the Nambucca LEP and DCP fully reflect the conservation status of these protected communities to aid community awareness and assist in ease of the development application process.	B-Minor	1-Almost Certain	Low	Low	Low	Low	Whilst the NLEP2010 was amended to zone estuarine macrophytes mapped by DPI Fisheries as either Waterway as (W1/ W2) or Environmental Conservation (E2) (where not already appropriately zoned as E1 National Parks/ Nature Reserves), it is not understood whether these zonings sufficiently protect other areas of significant habitat such as: - extent of SEPP CM mapped wetlands and littoral rainforests (and their proximity areas); - other EECs such as swamp oak forest, swamp sclerophyll and freshwater wetlands; and - future likely areas for migration of estuarine vegetation with sea level rise (refer "Climate change 2050 & 2100 - tidal inundation").	Moderate	Medium term	Stage 5 (CMP Action) - GIS desktop assessment involving: - mapping of NLEP environmental protection/ W1, W2 and E2 zones overlaid with vegetation mapping of other sensitive habitats in the study area. - assessment of suitability of existing zones to protect current significant habitat; - assessment of suitability of zones to protect and conserve areas, and to prevent land use constraints from impeding future migration of habitat with sea level rise (based on associated estuarine vegetation migration mapping); and - discussion of potential management actions (such as discussions with landholders RE placing protective covenants on the land under the Biodiversity Conservation Act 2016 etc.)
Recreational and commercial fishing and aquaculture	T57	Commercial ocean trawl and ocean haul	Nambucca River estuary and Warrell Creek	Reduced abundance of species and trophic levels; marine debris; bycatch, physical disturbances; wildlife disturbances; lack of community support for local fishing industry	D-Major	1-Possible	Moderate	Moderate	Moderate	Moderate	Commercial and recreational fishing are considered priority regional threats in the MEMA TARA (BMT WBM, 2017) contributing to reduced abundance of species and trophic levels, marine debris, bycatch, physical disturbance and wildlife disturbance. Data specific to the Nambucca study area is currently lacking.	Moderate	Medium term	N/A
	T58	Commercial trap and line					Moderate	Moderate	Moderate	Moderate				
	T59	Estuary general fishing					Moderate	Moderate	Moderate	Moderate				
	T60	Estuary prawn trawl					Moderate	Moderate	Moderate	Moderate				
	T61	Recreational boat and shore-based line and trap fishing	All study area	D-Major	1-Possible	Moderate	Moderate	Moderate	Moderate					
	T62	Recreational hand gathering	All study area	B-Minor	1-Almost Certain	Low	Low	Low	Low					
	T63	Oyster aquaculture	Lower Nambucca River estuary	B-Minor	1-Almost Certain	Low	Low	Low	Low	-	N/A	N/A	N/A	
T64	Marine debris, including monofilament fishing line, bait bags and microplastics	All study area	C-Moderate	1-Almost Certain	Moderate	Moderate	Moderate	High	-	N/A	N/A	N/A		
Water quality	T65	Agricultural diffuse source runoff (runoff from large areas of agricultural land with no specific point source)	Agricultural land use catchments	TSS and sedimentation; nutrient export	D-Major	1-Almost Certain	High	High	High	High	Comprehensive, catchment wide: - long-term monitoring programs and records of water quality monitoring results to assess trends and issues	High	Medium term	Stage 5 (CMP Action) - Development of a long-term and frequent monitoring program and record of water quality monitoring results as a component of a frequent Ecohealth reporting




Issue	ID	Threats (use, activity or stressor)	Key locations	Key impacts	Preliminary Risk Assessment (present day risk)			Future Risk			Assessment of Knowledge Gaps			Recommendation for additional studies
					Consequence	Likelihood	Current Risk	20 yr Risk	50yr Risk	100 yr Risk	Knowledge Gap	Importance for Resolution	Priority for Resolution	
	T66	Urban stormwater pollution and lack of management of existing GPTs; gutter and gully erosion	Discharge from urban areas, e.g. Bay St Nambucca Heads	TSS and sedimentation; nutrient export	D-Major	1-Almost Certain	High	High	High	High	including data for Oyster Creek, Scotts Head and Swimming Creek. - catchment plans for stormwater management, focused on water quality improvements.			program. Stage 5 (CMP Action) - Development of catchment plans for key urban areas with a focus on water quality improvements such as undertaken for Dawkins Park catchment. Seek opportunity for pollutant reduction such as GPTs.
	T67	Sewer surcharge and STP overflows	Licensed discharges and overflows from the four STPs; sewer surcharges (e.g. Bellwood Creek, Swimming Creek)	Export of nutrients, high TSS, high BOD, and faecal contamination; oyster industry closures	D-Major	2-Likely	High	High	High	High				
	T68	On-site wastewater management (e.g. failing septic systems)	LGA wide - rural areas		C-Moderate	1-Almost Certain	Moderate	Moderate	Moderate	Moderate				
	T69	Pet and wild fauna faeces	e.g. Beer Creek/ Dawkins Park	Water quality impacts; public safety and public amenity	B-Minor	1-Almost Certain	Low	Low	Low	Low				
	T70	Logging on steep, highly erodible soils (i.e. of the Nambucca Beds)	Steep, upper catchment forestry areas	Mass movements; high TSS; sedimentation	D-Major	3-Possible	Moderate	Moderate	Moderate	Moderate				
	T71	Urban development	Hyland Park, Macksville, Pearl at Valla, Scotts Head	Urban stormwater impacts e.g. increased TSS and TN, potentially low pH	C-Moderate	2-Likely	Moderate	Moderate	High	High				
	T72	Construction industries	LGA wide		C-Moderate	2-Likely	Moderate	Moderate	High	High				
	T73	Other licensed industrial sources	e.g. extraction, processing associated with the construction of the Pacific Highway Upgrade and of Macksville Hospital; abattoir, Wirrimbi; resource extraction, Missabotti; waste management facility, Nambucca Heads; quarrying, Macksville and Valla	Export of various physical and chemical stressors	C-Moderate	1-Almost Certain	Moderate	Moderate	High	High				
	T74	Pesticide and fertilizer runoff	Roadside weed management (LGA wide); horticultural pesticide use (e.g. Deep Creek); pasture improvement (e.g. Watts Creek catchment)	Potential pesticide contamination of waterways and impacts on biodiversity; legality issue for Council; export of nutrients	C-Moderate	1-Almost Certain	Moderate	Moderate	High	High				
	T75	Poor geomorphic condition (i.e. bed instability)	Upper catchments	Mobilisation of sediment and organic matter; smothering of aquatic habitat; reduced channel capacity	C-Moderate	1-Almost Certain	Moderate	Moderate	Moderate	Moderate				
	T76	Poor flushing of ICOLLs	Deep Creek; Swimming Creek	Amplification of existing water quality impacts leading to eutrophication	C-Moderate	1-Almost Certain	Moderate	Moderate	Low	Minimal				
	T77	Acid Sulfate Soils	Gumma Gumma Creek; Gumma Swamp; Watt Creek	High levels of acidity and associated heavy metal export due to exposure of ASS through management actions that lower the water table (i.e. Floodplain drainage, operation of floodgates etc.)	D-Major	1-Almost Certain	High	High	High	High				



Issue	ID	Threats (use, activity or stressor)	Key locations	Key impacts	Preliminary Risk Assessment (present day risk)			Future Risk			Assessment of Knowledge Gaps			Recommendation for additional studies
					Consequence	Likelihood	Current Risk	20 yr Risk	50yr Risk	100 yr Risk	Knowledge Gap	Importance for Resolution	Priority for Resolution	
Hydrology, connectivity and water extraction	T78	Water extraction	Primarily Deep Creek (e.g. for horticulture farming) and Oyster Creek	Hydrological stress; reduced aquifer recharge; impacts to groundwater dependent ecosystems and threatened species (e.g. frogs, birds and floodplain and riparian vegetation such as Swamp oak forest), reduce flow, stagnation, stratification, increased temperatures and other water quality impacts. Likely to increase in future with expansion of the horticulture industry.	C-Moderate	1-Almost Certain	Moderate	High	High	High	Understanding of the hydrological regime and requirements of Deep Creek estuary, the volumes of water extraction in the catchment and the impacts on ecohealth.	Moderate	Medium term	Management of water extraction is addressed in the Water Sharing Plan administered by NRAR and DPIE-Water. CMP to document this threat and implications for estuary health and seek to coordinate and consult with agencies responsible for managing extraction. Also incorporated for consideration of the review of ICOLL entrance management strategy and hydrological review/ flushing regime under "Entrance Management" above.
	T79	Hydrological modifications of wetlands and floodplain drainage works	e.g. historical modifications to Gumma Swamp; rural drainage works	Reduced hydraulic connectivity and fish passage; soil acidity and salinity changes; native vegetation changes; agricultural viability and commerciality; export of acidity, metals (including iron and aluminium), nutrients and bacterial contamination either by groundwater flow or surface runoff; modified inundation regimes; habitat and biodiversity implications	D-Major	3-Possible	Moderate	Moderate	High	High	Understanding of any current impediments to connectivity (e.g. floodgates, weirs, roads, levees), floodgate design and operation (management plans, memorandums of understanding etc.) within the study area.	Moderate	Medium term	Stage 5 (CMP Action) - Review current status of wetland connectivity and fish passage barriers including the discussions between DPI Fisheries, Council, landholders (and any drainage boards) RE location of structures and management practices; and mapping of impediments to connectivity; and prioritisation of barriers for removal/ modification (DPI Fisheries as responsible agency).
	80	Floodgate design, operation and maintenance			D-Major	3-Possible	Moderate	Moderate	High	High				
Governance, education and compliance	T81	Insufficient governance	Whole study area	Complex mix of landowners/managers, lack of alignment of plans/policies, lack of collaboration, cooperation and resource support	C-Moderate	2-Likely	Moderate	Moderate	Moderate	Moderate	-	N/A	N/A – To be addressed through development and implementation of the CMP	N/A
	T82	Lack of awareness, education and engagement		Tourism, insufficient governance, limited availability of resources	B-Minor	1-Almost Certain	Low	Low	Low	Low	-	N/A		N/A
	T83	Compliance		Limited availability of resources, competing compliance issues within the study area	B-Minor	1-Almost Certain	Low	Low	Low	Low	-	N/A		N/A
Political risk	T84	Political risk	Whole study area	Election promises, media profiles, political support for climate change mitigation/adaptation, political support which limit actions involved with certain activities, ad hoc release of state and federal funding associated with political cycles, ideological beliefs, and differing community priorities and expectations	C-Moderate	2-Likely	Moderate	Moderate	Moderate	Moderate	-	N/A	N/A	N/A
Cultural Heritage	T85	Threats to Aboriginal cultural practices and heritage	Whole study area, and specific significant sites/places identified within the study area	The estuaries, beaches and headlands of the Nambucca Valley are of great significance to the local Aboriginal people. Threats to Aboriginal cultural practices, places and heritage include development or works that may impact significant sites or heritage items, environmental degradation of natural areas and flow on affects to fish stocks, birdlife and biodiversity values. The CMP needs to consider these aspects, in liaison with the Aboriginal community to ensure the appropriate balance in management options is achieved.	C-Major	2-Likely	High	High	High	High	-	N/A	N/A	N/A



Issue	ID	Threats (use, activity or stressor)	Key locations	Key impacts	Preliminary Risk Assessment (present day risk)			Future Risk			Assessment of Knowledge Gaps			Recommendation for additional studies
					Consequence	Likelihood	Current Risk	20 yr Risk	50yr Risk	100 yr Risk	Knowledge Gap	Importance for Resolution	Priority for Resolution	
	T86	Threats to European cultural heritage	Whole study area, and specific significant sites/places identified within the study area	There are several items and places of European heritage value within the study area that require ongoing protection and conservation for future generations.	D-Major	3-Possible	Moderate	Moderate	Moderate	Moderate	-	N/A	N/A	N/A

Appendix 3. PRIORITY BANK MANAGEMENT SITE DETAILS




Table 5: North Arm priority bank management site details




Site ID	Length (m)	Riparian Vegetation Condition	Bank Instability	Causes of Instability	Justification	Photo
1119	188	Poor	High	Natural meander, Cattle access	Significant degradation	
1117	39	Poor	High	Cattle Access	Significant degradation	
1115	493	Poor	High	Natural meander, Cattle access	Significant degradation	




Site ID	Length (m)	Riparian Vegetation Condition	Bank Instability	Causes of Instability	Justification	Photo
1143	34	Poor	High	Natural meander	Significant degradation	
1146	432	Poor	Minor	Cattle access	Opportunity-easily accessible site which would benefit from low-cost works (stock exclusion fencing, revegetation and off stream water troughs).	




Site ID	Length (m)	Riparian Vegetation Condition	Bank Instability	Causes of Instability	Justification	Photo
1174	207	Poor	Insignificant	Cattle access	Opportunity- stock exclusion fencing, and riparian vegetation planting would significantly improve the site.	
1094	193	Poor	High	Natural meander	Significant degradation	

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Site ID	Length (m)	Riparian Vegetation Condition	Bank Instability	Causes of Instability	Justification	Photo
1184	147	Poor	Moderate	Natural meander Cattle access	Opportunity- stock exclusion fencing and revegetation at this site would arrest erosion before it worsens.	
1187	231	Moderate	Moderate	Natural meander Cattle access	Opportunity- site would benefit from fencing and revegetating riparian zone and rubbish removal.	
1194	34	Poor	High	Natural meander Cattle access	Significant degradation	

Site ID	Length (m)	Riparian Vegetation Condition	Bank Instability	Causes of Instability	Justification	Photo
1195	541	Poor	High	Natural meander Cattle access	Significant degradation	
1065	118	Poor	High	Natural meander Cattle access	Significant degradation	
1066 & 1067	161 + 180	Poor	High	Not identified	Significant degradation	

Site ID	Length (m)	Riparian Vegetation Condition	Bank Instability	Causes of Instability	Justification	Photo
1063	163	Poor	High	Natural meander Cattle access	Significant degradation	
1206	285	Poor	High	Not recorded	Significant degradation	
1046	241	Poor	High	Natural meander	Significant degradation	

Site ID	Length (m)	Riparian Vegetation Condition	Bank Instability	Causes of Instability	Justification	Photo
1226	52	Poor	High	Natural meander	Significant degradation	
1228	25	Poor	High	Not recorded	Significant degradation	
1234	201	Poor	High	Natural Meander Boat/wind waves	Significant degradation	




Site ID	Length (m)	Riparian Vegetation Condition	Bank Instability	Causes of Instability	Justification	Photo
1011	81	Poor	High	Natural meander	Significant degradation	

Table 6: Taylors Arm priority bank management site details

Site ID	Length (m)	Riparian Vegetation Condition	Bank Instability	Causes of Instability	Justification	Photo
760	123	Poor	Minor	Cattle access Boat/wind waves	Opportunity- grassy section of bank with cattle. Would benefit from stock exclusion fencing and revegetation.	
761	124	Poor	High	Natural meander Cattle access Wind/boat waves	Significant degradation	




Site ID	Length (m)	Riparian Vegetation Condition	Bank Instability	Causes of Instability	Justification	Photo
617	20	Poor	High	Natural meander	Significant degradation	
611	87	Poor	High	Natural meander	Significant degradation	
582	39	Poor	High	Natural meander Boat/wind waves	Significant degradation	

Table 7: Nambucca River priority bank management site details




Site ID	Length (m)	Riparian Vegetation Condition	Bank Instability	Causes of Instability	Justification	Photo
905	36	Poor	Minor	Boat/wind waves	Opportunity- Grassy riparian zone in urban area would benefit from revegetation.	
243	84	Poor	High	Not identified	Significant degradation	
251	6	Poor	High	Structure Public access	Significant degradation	

Table 8: Upper Warrell Creek priority bank management site details



Site ID	Length (m)	Riparian Vegetation Condition	Bank Instability	Causes of Instability	Justification	Photo
419	70	Poor	High	Natural meander	Significant degradation	
823	136	Poor	High	Natural meander	Significant degradation	

Table 9: Lower Warrell Creek priority bank management site details








Site ID	Length (m)	Riparian Vegetation Condition	Bank Instability	Causes of Instability	Justification	Photo
819	103	Poor	High	Natural meander	Significant degradation	

Table 10: Deep Creek priority bank management site details

Site ID	Length (m)	Riparian Vegetation Condition	Bank Instability	Causes of Instability	Justification	Photo
90	489	Poor	Minor	Cattle access	Opportunity- Grassy banks with cattle. Site could be significantly improved with stock exclusion fencing and revegetation of banks.	

Site ID	Length (m)	Riparian Vegetation Condition	Bank Instability	Causes of Instability	Justification	Photo
169	462	Poor	Minor	Natural meander Cattle access	Opportunity- lack of vegetation on the banks, site could be significantly improved by revegetating the riparian zone.	
171	70	Poor	Insignificant	Cattle access	Opportunity- lack of vegetation on the banks and cattle access to water, site could be significantly improved by fencing and revegetating the riparian zone.	
172	149	Poor	Minor	Natural meander Boat/ wind waves	Opportunity- site could be significantly improved by revegetating the riparian zone.	

Nambucca Coastline and Estuaries CMP: Stage 2 –Vulnerabilities and Opportunities

Site ID	Length (m)	Riparian Vegetation Condition	Bank Instability	Causes of Instability	Justification	Photo
174	103	Poor	Minor	Natural meander Boat/ wind waves	Opportunity- site could be significantly improved by revegetating the riparian zone.	
175	250	Poor	Minor	Natural meander Cattle access Boat/ wind waves	Opportunity- - site could be significantly improved by fencing and revegetating the riparian zone.	
176	192	Poor	Minor	Natural meander Boat/ wind waves	Opportunity- - site could be significantly improved by revegetating the riparian zone.	