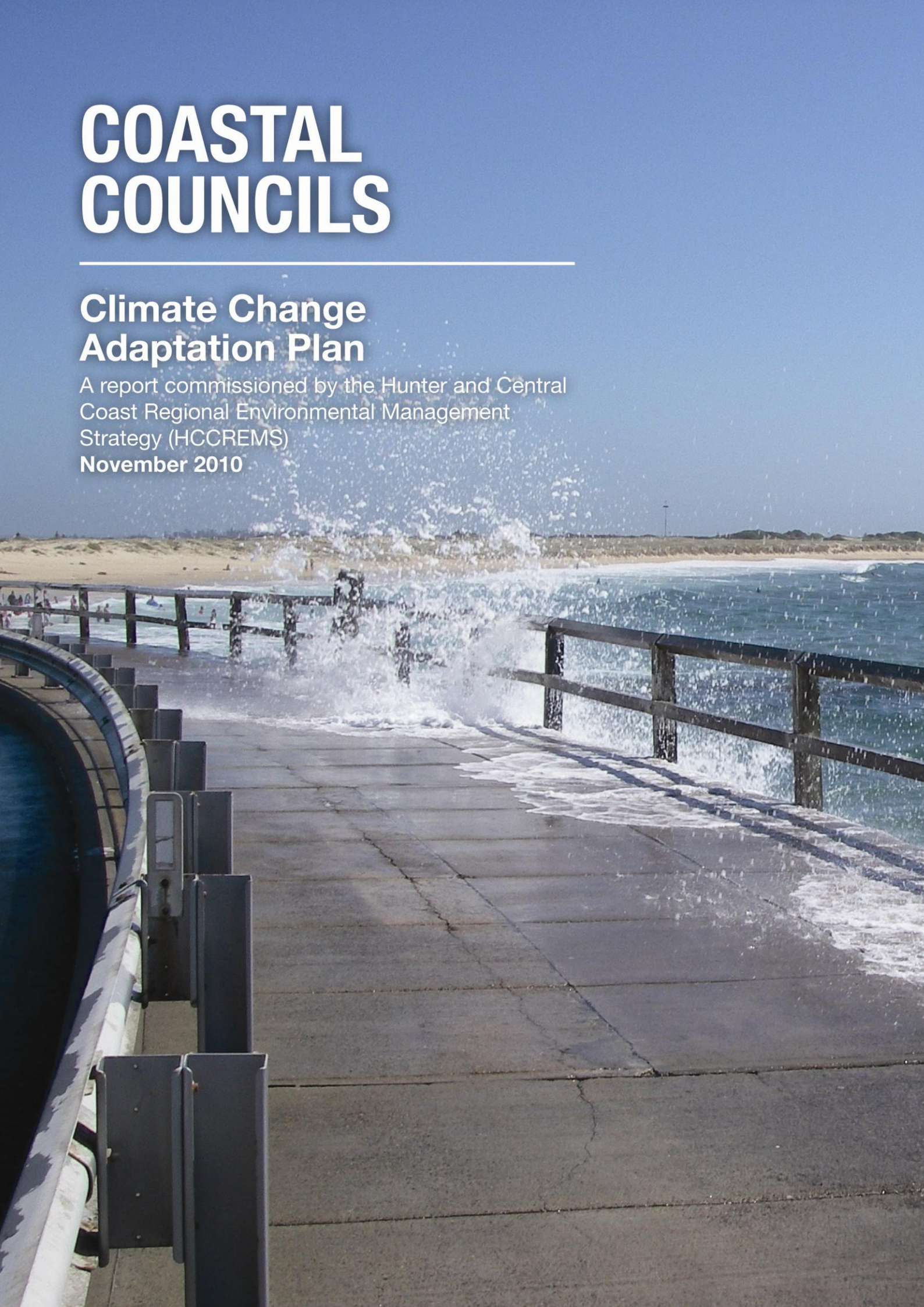
COASTAL COUNCILS

Climate Change Adaptation Plan

A report commissioned by the Hunter and Central Coast Regional Environmental Management Strategy (HCCREMS)

November 2010



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HCCREMS Coastal Councils

TABLE OF CONTENTS

Page

Executive Summary

INTRODUCTION

Climate change is emerging as a vital issue for Australian communities. Even with international action to reduce greenhouse gas emissions, the global climate is projected to undergo significant change in the 21st century, with the potential to create many risks as well as opportunities. It is important that the impacts of climate change are addressed at the local level, since local attributes including socio-economic characteristics and the physical environment will significantly determine the extent of the risks, as well as the nature of adaptation responses.

The need for local action on climate change has been recognised by Councils in the Hunter, Central and Lower North Coast region in partnership with the Hunter and Central Coast Regional Environmental Management Strategy (HCCREMS). Significant resources have been directed to improving Council and community understanding of climate change.

This is a report of actions that have been developed in response to the risks of climate change to HCCREMS member Coastal Councils (Gosford, Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Greater Taree). In particular, the report builds on the adaptation actions identified by individual councils through identification of regional opportunities for collaboration across these councils for responding to climate change.

RISK ASSESSMENT PROCESS

From late 2008 to mid 2010, climate change risk assessments were completed for each of the seven Coastal Councils. The purpose of each risk assessment was to explore the full range of potential risks posed by climate change to the relevant council and to prioritise those risks. The risk assessment process varied between Coastal Councils, but all assessments were carried out using the method described in the AGO publication, *Climate Change Impacts and Risk Management: A Guide for Business and Government*[1], based on the Australian standard for Risk Management AS/NZS4360 (2004).

All of the roles and responsibilities of councils that may be affected by climate change were addressed through the assessments. These risk assessments focused on council organisational assets, operations and liabilities. They did not focus on broader scale community risk arising from climate change.

PRIORITY CLIMATE CHANGE RISKS

In total, the seven risk assessments identified hundreds of climate change risks to Coastal Councils. The large number of risks, combined with some differences in the approach used to identify and rate risks between Councils, necessitated the use of a bridging step to obtain a regionally consistent and manageable list of risks for carrying forward to the adaptation planning process. This was done via a 'risk review and rationalisation' process that was centred on workshops held with staff from the Coastal Councils in June 2010.

From that process, a manageable list of 50 'priority risks' was developed. The priority risks form the basis of this adaptation plan (see Table 4, section 4.1). This synthesis provided a thorough integration of risks identified during the individual risk assessments into the adaptation planning stage. It also assisted Councils in gaining a greater whole of organisation perspective and understanding of risks identified through the previous risk assessment

[1] Available at: http://www.climatechange.gov.au/community/local-government/risk-management.aspx

process, as Councils were able to holistically review all high and extreme rated risks to their organisation.

REGIONAL CLIMATE CHANGE ADAPTATION

Climate change adaptation can be defined as 'actions taken in response to actual or anticipated climate change impacts that lead to a reduction in risks or realisation of benefits' Adaptation represents a planned, proactive response to climate change and, as such, can be distinguished from reactive adjustments to climate change impacts after they have occurred.

Actions considered for this Adaptation Plan are broadly based, including revised strategies and plans, changes to regulations and standards, revised internal procedures, research and data collection, training, on-ground works and education.

If Coastal Councils are to realise the potential benefits of climate change adaptation, it is important that their adaptation actions are well considered and designed prior to implementation. The following generic principles underpin adaptation actions proposed for the Council:

- focus on priority climate change issues;
- use an adaptive management approach (i.e. flexible, incremental changes);
- focus on cost effective actions;
- achieve balance between climate and non-climate risks; and
- avoid adaptation constraining decisions or maladaptation.

An additional, more specific principle, which underpins this Adaptation Plan, is a distinction between actions that Coastal Councils can implement internally and actions with the opportunity for region wide collaborative action by Councils and other key stakeholders (e.g. state and/or federal government). In this regard, this adaptation report specifically addresses risks that have been commonly identified by at least three of the Coastal Councils.

The adaptation planning process for the Adaptation Plan centred on cross council workshops attended by staff from across HCCREMS member Councils. The planning process entailed five major steps:

i. priority risk selection;
ii. grouping of priority risks into subsets to enable risks that have significant similarities to be considered collectively in the adaptation planning process;
iii. identifying and reviewing existing controls;
iv. identifying and assessing new and revised actions; and
v. follow up analysis.

ADAPTATION ACTIONS FOR PRIORITY RISKS

Infrastructure and assets

Eleven priority infrastructure and asset risks are addressed in the Adaptation Plan. The following table outlines the recommended actions for addressing those risks. The detailed adaptation actions are discussed in section 4.

Table ES.1 Infrastructure and Assets - Priority Risks and Recommended Actions

Priority Risks	Recommended Actions
Subset A – Council buildings and facilities	
▪ Increased damage to council buildings and structures due to inundation ▪ Increased damage to council buildings and structures due to wind and storm damage ▪ Increased damage to council assets due to increased frequency and intensity of bushfires	**Region wide actions** A1. HCCREMS Councils, in conjunction with the LGSA, should approach the state government to clarify and simplify natural disaster declarations and relief funding arrangements A2. HCCREMS Councils, in conjunction with the LGSA, should approach Statewide Mutual to provide consistent advice and application of insurance cover in relation to flooding A3. Guidelines establishing standard procedures for asset condition assessment and reporting by Councils should be developed **Council specific actions** A4. Councils should review their asset bases and level of service requirements to prioritise assets at risk, to evaluate a possible rationalisation of assets, and to inform development of risk management and investment plans A5. Councils should review their asset maintenance and planning schedules to prioritise asset maintenance works and to upgrade asset maintenance and design specification ***(Councils identifying risk - Wyong, Gosford, Newcastle, Port Stephens, Greater Taree)***
Subset B – Stormwater	
▪ Stormwater and drainage systems overwhelmed or damaged	**Region wide actions** B1. HCCREMS Councils, with other agencies, should model changes to extreme rainfall intensities B2. Guidelines should be developed for the design and management of new and upgraded drainage assets, and for the retrofitting of existing assets B3. A region wide stormwater and professional capacity building program should be developed B4. HCCREMS and Councils should seek funding from federal and state governments to implement stormwater adaptation priorities B5. HCCREMS and Councils should undertake a regional communications and information campaign on stormwater and flood management **Council specific actions** B6. Councils should revise local planning, stormwater and flood studies to integrate the outcomes of the regional rainfall and hydrological modelling B7. Councils should revise stormwater and drainage technical engineering standards and development controls

Priority Risks	Recommended Actions
	B8. Councils should prioritise upgrade of vulnerable stormwater assets or develop alternative strategies (e.g. decommissioning) at an LGA scale drawing on outputs of actions B1 and B7 ***(Councils identifying risk - all)***
Subset C – Transport infrastructure	
▪ Increased damage to roads (incl. gravel roads), causeways, bridges and footpaths due to increased rainfall intensity, flooding or coastal inundation leads to higher maintenance costs ▪ Increased damage to roads and bridges from landslips and landslides ▪ Increased capital costs for new coastal roads or bridges to accommodate sea level rise, storm surges and/or increased flood levels	**Region wide actions** C1. Guidelines should be developed for incorporating climate change adaptation into design criteria for new roads and bridges, and for the retrofitting of existing assets C2. HCCREMS and Councils should seek to commission region wide modelling of changes to extreme rainfall intensities and duration to inform a review of design criteria for new and upgraded roads and bridges based on the projections (see also B1) C3. See recommendation A1 (Clarified and simplified natural disaster declarations and relief funding arrangements) C4. HCCREMS should establish a panel of key experts on regional transport research and programs C5. A region wide professional training and capacity building program could be developed and implemented **Council specific actions** C6. Councils should revise their design and construction standards and forward works programs for transport infrastructure to incorporate outcomes from actions C1 and C2 C7. Councils should seek professional training on climate change and asset planning ***(Councils identifying risk - all)***
Subset D – Waste water treatment	
▪ Flooding/ inundation of low lying waste water facilities or pump stations ▪ Sewerage treatment system overloaded/fails due to intense rainfall / infiltration or loss of power and/or telecommunications	**Region wide actions** D1. HCCREMS Councils, with other agencies, should undertake regional modelling of changes to extreme rainfall intensities under climate change scenarios; use outputs of modelling to revise flood hazard mapping D2. Develop an analytical tool for prioritising key infrastructure treatments **Council specific actions** D3. Councils should identify and prioritise critical infrastructure exposed to flooding and sea level rise ***(Councils identifying risk - Wyong, Gosford and Great Lakes)***
Subset E – Water supply	
▪ Existing water supplies become unreliable or are unable to meet community demand or expectations	**Council specific actions** E1. Water authorities should consider funding modelling of down-scaled regional, climate change and associated hydrological projections E2. Gosford-Wyong Water, and other water authorities, should review their long term water supply plans taking account of climate change projections/scenarios E3. Water authorities should collaborate in strengthening and promoting consistency across jurisdictions in regard to water demand

Priority Risks	Recommended Actions
	management initiatives ***(Councils identifying risk - Wyong, Gosford)***

Coastal and flood management and planning

Eleven priority land use planning risks are addressed in the Adaptation Plan. The following table outlines the recommended actions for addressing those risks.

Table ES.3 Coastal and Flood Management and Planning - Priority Risks and Recommended Actions

Priority Risks	Recommended Actions
Subset F – Coastal area management	
▪ Increased erosion or permanent inundation and loss of beaches and public foreshore and lakeside areas ▪ Inundation and damage to coastal facilities and areas ▪ Inundation of coastal stormwater outfalls ▪ Inundation of sewerage outfalls ▪ Increased damage to or failure of coastal levees, sea walls, groynes and breakwaters	**Region wide actions** F1. HCCREMS and Councils should develop high resolution integrated elevation/bathymetry datasets F2. HCCREMS Councils and agencies should prepare Smartline Mapping for all estuarine foreshores in the region F3. HCCREMS Councils should work with the federal and state governments to develop a decision support tool for prioritising coastal areas, coastal protection works and other coastal management options F4. HCCREMS and Councils should prepare an information and education strategy aimed at building community awareness of coastal erosion processes F5. See action M1 (Review existing state, regional and local plans) F6. HCCREMS should develop and implement a region wide professional training and capacity building program to facilitate the integration of climate change impacts into Community Land Plans of Management **Council specific actions** F7. Councils should identify whether additional site specific modelling of coastal and estuarine erosion is required F8. Councils should prioritise beaches and foreshore areas for coastal management and protection works in their local area based on regional outcomes F9. Councils should ensure new research and tools generated through the above regional actions are integrated within Community Land Plans of Management in coastal areas ***(Councils identifying risk - all)***
Subset G – Land use planning in coastal and flood prone areas	
▪ Uncertainty in decision making around coastal planning and development ▪ Flood modelling, flood management plans and planning schemes fail to reflect the extent of flooding and land instability under	**Region wide actions** G1. See action F1 (High resolution integrated elevation/bathymetry datasets) G2. See action B1 (Model changes to extreme rainfall intensities) G3. HCCREMS Councils should approach and work with the State Government to develop protocols and a decision making framework for Councils to provide a consistent and transparent approach to land use planning in areas vulnerable to coastal erosion and inundation G4. HCCREMS should seek funding to develop and deliver a capacity building program on the land use planning and legal implications of

Priority Risks	Recommended Actions
climate change scenarios ▪ Development controls in coastal recession or flood risk areas are viewed as being too onerous ▪ Loss of development potential in coastal areas ▪ Permanent saturation of low lying residential and business districts in coastal areas ▪ Increased flooding of commercial areas reduces their long-term viability	climate change G5. HCCREMS and member Councils should produce a regional information package to advise the community on how they are addressing climate change in coastal and flood management processes **Council specific actions** G6. Councils should undertake site specific hydrological / flood modelling where the perceived risk is high and existing Flood Management Plans do not fully reflect the outcomes of region wide rainfall intensity projections and sea level rise planning benchmarks Coastal modelling work that combines concurrent storm surge, sea level rise and extreme rainfall projections should also be considered G7. See recommended action F7 (Site specific modelling of coastal and estuarine erosion and inundation risks) ***(Councils identifying risk - all)***

Emergency management and community wellbeing

Nine priority emergency management and community wellbeing risks are addressed in the Adaptation Plan. The following table outlines the recommended actions for addressing these risks.

Table ES.4 Emergency Management and Community Wellbeing - Priority Risks and Recommended Actions

Priority Risks	Recommended Actions
Subset H – Traffic management	
▪ Increased flooding of low lying roads and other transport corridors restricts traffic movement and access ▪ Increased flooding of bridges and causeways restricts traffic movement and access ▪ Bushfires restrict traffic movement and access ▪ Increased isolation / reduced access to communities due to storms, flooding or bushfires	**Region wide actions** H1. Councils, in conjunction with the RTA and regional emergency service agencies, should update local and regional traffic plans to identify alternative transport options during extreme events H2. Councils, with the support of the RTA, should identify and upgrade vulnerable roads and bridges (see also Subset C) H3. Councils, in partnership with Emergency Management Authorities, should undertake an education campaign to promote increased households' preparedness for floods and other emergencies **Council specific actions** H4. Drawing on outcomes from recommendation H2, Councils should identify adaptation strategies / works programs for key vulnerable local transport infrastructure ***(Councils identifying risk - all)***

Priority Risks	Recommended Actions
Subset I – Emergency response and recovery	
▪ Increased demand and associated costs and resources for localised emergency response ▪ Increased demand and associated costs and resources for recovery services	**Region wide actions** I1. HCCREMS member Councils and regional emergency service agencies should consider conducting emergency preparation exercises combining multiple events, multiple agencies and across zones I2. A review of existing emergency response frameworks and relationships should be conducted I3. A central access point for all regional information on emergency management procedures should be established I4. See recommended action A1 (Clarified and simplified natural disaster declarations and relief funding arrangements) I5. Councils should develop and implement a region wide professional training / capacity building program **Council specific actions** I6. Councils should consider training of staff to achieve a higher level of education and participation in emergency management procedures under DISPLAN I7. See recommended action A5 (Review asset management plan and maintenance program) ***(Councils identifying risk - Wyong, Gosford, Lake Macquarie, Port Stephens, Great Lakes, Greater Taree)***
Subset J – Community health and wellbeing	
▪ Community anxiety associated with extreme climate events / expectation of council engagement and direction ▪ Increase in heat stress in broader community especially amongst vulnerable groups ▪ Increased exposure of community to heat stress in council run facilities	**Region wide actions** J1. HCCREMS and Councils, in collaboration with relevant state agencies and non-government organisations, should develop a regional heat wave plan J2. HCCREMS Councils should work with the State Government to commission research to improve understanding of risk perceptions J3. Councils, in partnership with Emergency Management Authorities, should undertake an education campaign to promote increased households' preparedness for heatwaves J4. Councils should collaboratively review existing design standards for community facilities (e.g. Safer by Design) to facilitate enhanced retention of features that contribute to the cooling of these facilities (e.g. natural shading) **Council specific actions** J5. Councils should consider implementing a Community Neighbourhood Program ***(Councils identifying risk - all)***

Corporate services

Five priority corporate services risks are addressed in the Adaptation Plan. The following table outlines the recommended actions for addressing those risks.

Table ES.5 Corporate Services -
Priority Risks and Recommended Actions

Priority Risks	Recommended Actions
Subset K – Business continuity	
▪ Key council services (e.g. waste collection) significantly disrupted by storms, flooding or bushfires ▪ Council unable to ensure continuity of regular services due to resources (staff and/or financial) tied up in emergency response or recovery ▪ Loss of utility services (e.g. power outage, loss of telecommunications) due to storms, fires or extreme temperatures adversely impacts Council facilities and service delivery	**Region wide actions** K1. See recommended action A1 (Clarified and simplified natural disaster declarations and relief funding arrangements) K2. Deliver a regional training, capacity building and implementation program to promote implementation of business continuity plans by Councils. **Council specific actions** K3. Council should develop and implement a business continuity plan to provide strategies to follow in the event of business disruption of critical business processes and / or services. ***(Councils identifying risk - all)***
Subset L – Legal liability and insurance	
▪ Increased property damage or personal injury as a result of falling limbs and other damage caused by Council trees ▪ Increase in insurance costs and/or reduced insurance cover	**Region wide actions** L1. HCCREMS Councils, in conjunction with the LGSA, should approach Statewide Mutual to provide consistent advice and application of insurance cover in relation to property damage and personal injury claims due to falling limbs and trees **Council specific actions** L2. See recommended action A5 (Review asset management plan and maintenance program) L3. Councils should review and consider enhancing methods for recording tree inspections and maintenance work ***(Councils identifying risk - all)***

ENVIRONMENTAL management

Fourteen priority environmental management and protection risks are addressed in the Adaptation Plan. The following table outlines the recommended actions for addressing those risks.

Table ES.2 Environmental Management and Protection - Priority Risks and Recommended Actions

Priority Risks	Recommended Actions
Subset M – Pollution of waterways	
▪ Increased pollution of estuaries, waterways and groundwater ▪ Decline in viability of regional aquaculture and fisheries sector linked to changed climate ▪ Increased erosion and silting of waterways and estuaries due to increased rainfall intensity	**Region wide actions** M1. State, regional and local plans should be reviewed to reflect the potential impacts of climate change and to achieve greater consistency between state and local planning and environmental management objectives M2. A regional water quality monitoring strategy should be established M3. Regional modelling to identify water and nutrient runoff should be undertaken **Council specific actions** M4. Councils should prepare and implement management strategies for high risk septic systems ***(Councils identifying risk - all)***
Subset N – Stream flows	
▪ Loss or harm to wetlands, lakes and waterways due to reduced stream flows ▪ Increased incidence of algal blooms / reduced water quality in waterways, constructed and natural wetlands, and estuaries ▪ Reduced water levels and increases in algal blooms impact on potable water quality ▪ Increased incidence of pests and weeds in riparian zone due to altered climate regime	**Region wide actions** N1. See action E1 (Regional climate change projections on rainfall and runoff) N2. See action M1 (Review existing state, regional and local plans) N3. See action M2(Regional water quality monitoring) ***(Councils identifying risk - Wyong, Gosford, Lake Macquarie, Newcastle, Port Stephens, Great Lakes)***
Subset O – Coastal ecosystems	
▪ Loss or harm to coastal ecosystems (including dunes, estuaries, mangroves, saltmarsh, intertidal zones and wetlands) and associated ecological services due to sea	**Region wide actions** O1. See action M1 (Review existing state, regional and local plans) O2. See action F1 (High resolution integrated elevation/bathymetry datasets) O3. See action F2 (Smartline mapping of estuary foreshores) O4. HCCREMS should commission detailed, region wide high

Priority Risks	Recommended Actions
level rise	resolution mapping of littoral ecosystems and habitats including information on ecosystem and habitat types, status, connectivity and elevation O5. HCCREMS and Councils should commission site specific modelling of coastal and estuarine inundation and erosion in identified highly vulnerable littoral areas O6. HCCREMS should commission research to develop a landscape elevation and ecosystem model to identify littoral habitat responses (e.g. of wetlands, sea grasses, mangroves, rock platforms, beaches and dunes) to sea level rise and coastal erosion ***(Councils identifying risk - all)***
Subset P – Remnant vegetation	
▪ Loss of remnant vegetation as a result of water and heat stress ▪ Change in vegetation distribution and composition due to increased frequency and severity of bushfires or increased hazard reduction burning	**Region wide actions** P1. HCCREMS should commission research to identify potential impacts on endangered species and communities arising from climate change P2. HCCREMS Councils should develop regional planning tools and frameworks to facilitate long term conservation of species and communities identified as being at risk from climate change. **Council specific actions** P3. Councils should update planning tools and frameworks to improve conservation of regionally high conservation value ecosystems and target education and conservation incentive programs ***(Councils identifying risk - Wyong, Gosford, Lake Macquarie, Newcastle, Port Stephens, Great Lakes)***
Subset Q – Pests and weeds	
▪ Increased incidence of pests and weeds due to altered climate regime	**Region wide actions** Q1. HCCREMS and regional weed management groups should commission research to identify projected changes in climate on likely future terrestrial weed distribution Q2. Existing policies in the Hunter and Central Coast Regional Weed Management Strategy and Lower North Coast Weeds Strategy should be reviewed; a regional education strategy to raise community awareness of the issues / problems of climate change for regional weed distribution should also be implemented Q3. HCCREMS member Councils and the Hunter-Central Coast CMA should approach the NSW Livestock and Pest Authority to consider establishing a regionally coordinated approach to pest animal control ***(Councils identifying risk - Gosford, Lake Macquarie, Newcastle, Port Stephens)***
Subset R – Solid waste management	
▪ CPRS or other carbon pricing instrument affects the operations of solid waste	**Region wide actions** R1. Councils that are not currently members of MIDWASTE, should consider establishing a regional waste managers' network R2. MIDWASTE and the regional waste managers' network should undertake surveys to identify regional volumes of specific waste types as a basis for improving regional waste separation R3. MIDWASTE and the regional waste managers' should lobby the

Priority Risks	Recommended Actions
	Australian government to clarify local council reporting requirements under the NGER Act R4. MIDWASTE and the regional waste managers' should consider developing an education campaign to raise community awareness of the benefits of front end separation of waste going to waste stations, the purpose of landfill fees and the costs associated with illegal dumping. R5. MIDWASTE and the regional waste managers' should investigate options by member Councils to increase diversion of organic waste from landfills ***(Councils identifying risk – Great Lakes, Greater Taree)***
Subset S – Energy management	
▪ Increase in Council energy costs associated with carbon pricing and/ or climate change responses ▪ Reduced thermal comfort and/or increased air conditioning load in council buildings due to increased temperatures	**Region wide actions** S1. HCCREMS Councils should seek funding for a regional energy efficiency and emissions reduction strategy **Council specific actions** S2. Councils should establish an assessment and implementation framework for proposed energy efficiency and emissions reduction programs ***(Councils identifying risk - Wyong, Gosford, Lake Macquarie, Newcastle, Port Stephens, Great Lakes)***

CONCLUSION

Risk assessment and adaptation plan review

Climate change poses a number of challenges for Coastal Councils. Fifty priority climate change risks are addressed in this adaptation plan including 11 risks to infrastructure and assets, nine to coastal and flood planning and management, eight to emergency management and community wellbeing, five to corporate services and 14 to environmental management and protection.

Section 4 of this report contains some 80 actions for addressing the priority risks. When implemented together, the actions will provide Coastal Councils with an initial response to the challenges of climate change.

A review of proposed actions reveals:

- the wide spectrum of action types;
- the need to improve horizontal and vertical integration within Councils, between Councils, and between Councils and other stakeholder organisations in order to effectively adapt to climate change; and
- the substantial numbers of actions in the community education, research and training categories, highlighting the need to build knowledge and understanding of climate change in the region and to enhance the capacity of Councils, other agencies and the broader community to respond effectively to the risks posed by climate change.

Next steps

It is unlikely that any severe risks have been overlooked or that risks have been seriously misrated during the local and regional risk assessment processes. Nevertheless, it is important that the local and regional scale risks that have been identified are reviewed on a regular basis. This will ensure that the relative importance of these risks remains accurate so that adaptation responses are effectively and efficiently addressing those risks of most importance.

At an individual council level, it is important that the outcomes of the local and regional risk assessment processes are integrated with other aspects of council strategic risk management and planning. Senior management should remain engaged with this process and remain responsible for maintaining the risk assessment and implementing treatments (adaptation actions) flowing from it, including actions recommended in this report. To that end, the following recommendations are made in relation to the next steps of implementation for Coastal Councils:

1. Establishment of a regional technical reference group co-ordinated by HCCREMS to oversee prioritisation, implementation and evaluation of regional adaptation actions identified for Coastal Councils
2. Engagement of key external stakeholders identified in the regional plan to encourage their participation and support in implementing the regional adaptation actions that have been identified.
3. The regional adaptation plan should be reviewed on a regular basis (e.g. every 5 years), including a review of all risk ratings and consideration of new climate change risks in the light of new scientific information and changing circumstances in the region.
4. A regional approach to communicating the outcomes of climate change risk assessment should be developed to ensure that the community is properly informed in a timely manner and does not misinterpret, understate or overstate the risks of climate change to the region.

1. Introduction

> "*… adaptation is crucial to deal with the unavoidable impacts of climate change to which the world is already committed" (Stern, 2006).*
>
> *"… the benefits from mitigation occur on a global scale, whereas adaptation generally results in localised benefits" (Cimato & Mullan, 2010).*
>
> *"Adaptation to climate change is likely to benefit from experience gained in reaction to extreme climate events, by specifically implementing proactive climate change risk management adaptation plans" (IPCC, 2007).*

1.1. Climate Change Risk Assessment and Adaptation Planning by HCCREMS

Climate change is emerging as a vital issue for Australian communities. Even with international action to reduce greenhouse gas emissions, the global climate is projected to undergo significant change in the 21st century, with the potential to create many risks as well as opportunities. It is important that the impacts of climate change are addressed at the local level, since local attributes including socio-economic characteristics and the physical environment will significantly determine the extent of the risks, as well as the nature of adaptation responses.

The need for local action on climate change has been recognised by Councils in the Hunter, Central and Lower North Coast region in partnership with the Hunter and Central Coast Regional Environmental Management Strategy (HCCREMS). Significant resources have been directed to improving Councils' and communities' understanding of climate change.

This report is part of a region wide project that aims to assist HCCREMS member Councils to assess and manage climate risks both individually and collaboratively across the region. The project has comprised three major steps:

- The first step consisted of a region wide analysis of climate change impacts (presented in a region wide report);
- The second step consisted of climate change risk assessments conducted separately for each council; and
- The third step (detailed in part in this report), involved identifying high priority risks to 'rural' and 'coastal' Councils in the Hunter, Central and Lower North Coast region and developing, in turn, local and region wide adaptation actions for the two groups of Councils.

The project has been funded by the Commonwealth Government through the Local Adaptation Pathways Program (LAPP) and through the NSW Environmental Trust. It builds upon individual council risk assessments that were undertaken through LAPP or had previously been completed through Statewide Mutual.

1.2. Regional Analysis of Climate Change Impacts

As a preceding step to the risk assessments and adaption planning, the report '*Impacts of Climate Change on the Hunter, Central and Lower North Coast of NSW'* has been prepared. This report provides background information on potential climate change impacts in the region that can be used to help HCCREMS and Councils to identify and understand likely impacts of climate change and resulting risk, and to assist them in the adaptation planning process.

Exposure and sensitivity information is presented in relation to five major climate change variables or hazards:

- coastal inundation and recession associated with sea level rise and storm surges;
- extreme rainfall, flooding and storms;
- changes to fire weather conditions;
- changes to average rainfall and water availability; and
- changes to average and extreme temperatures.

The report then provides an overview of potential impacts that exposed and sensitive communities and systems could face as a consequence of the relevant climate change variable.

1.3. Coastal Councils' Climate Change Risk Assessments and Adaptation Plan

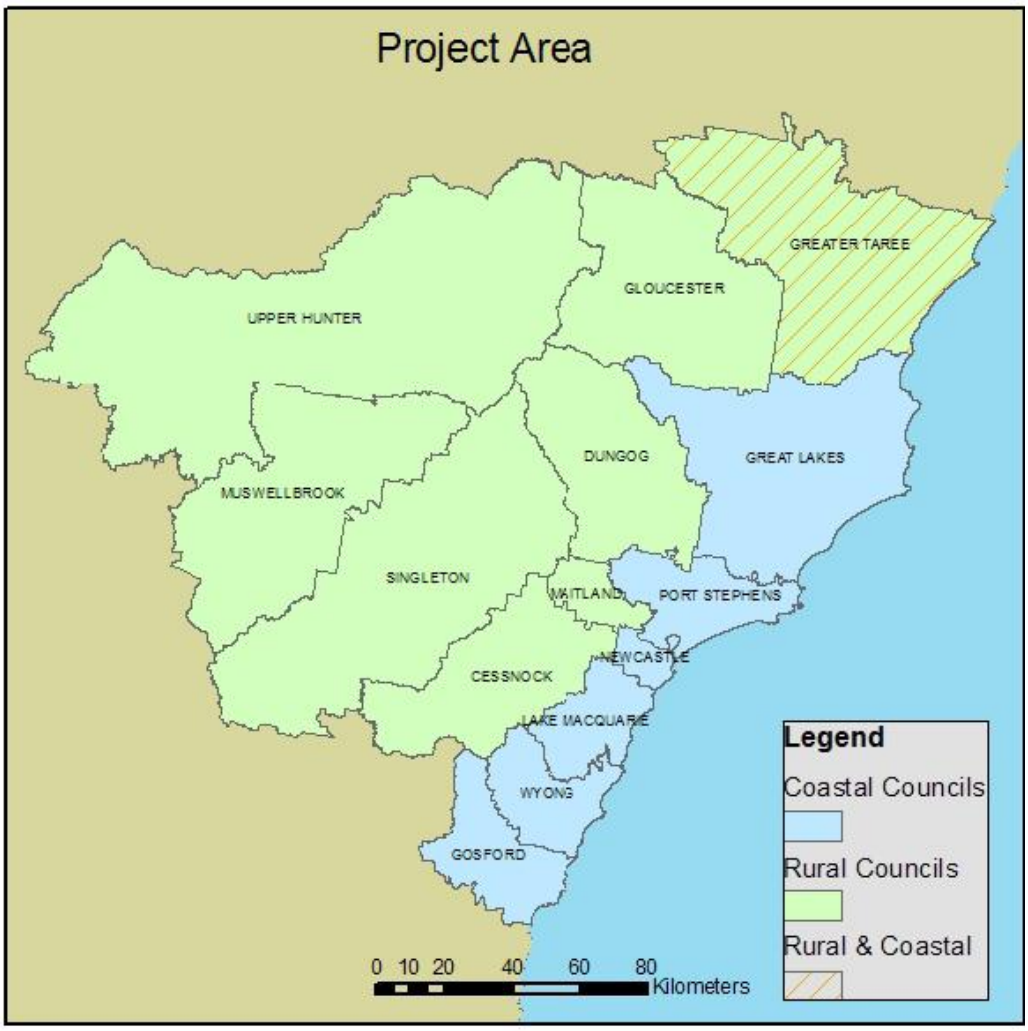
This report details actions that have been developed in response to high priority climate change risks to HCCREMS member Coastal Councils. In particular, it focuses on regional scale risks and opportunities for collaborative action by councils and other stakeholders to manage these risks. The report should also be read in conjunction with risk assessment reports produced for individual councils in the region and an '*Adaptation Plan for Rural Councils*' report. Councils covered in this plan include the Coastal Councils of Gosford, Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Greater Taree[2] (referred to hereafter as 'Coastal Councils' - see Figure 1).

The selection of priority risks addressed in this report was based on a number of criteria, notably their initial risk rating and also the regional significance of the risks. The rationale for this focus is that, given resource constraints, Councils' climate change response efforts are best targeted in the short term at issues that matter most to them. Nevertheless, risks that are not addressed in the adaptation plan should not be ignored by Coastal Councils or other agencies, a point discussed later in this report. Also underpinning this rationale is recognition that the capacity of each Coastal Council will be enhanced through collaborative action. Particular benefits arising to councils include:

1. Sharing of costs and resources to deliver identified adaptation responses.
2. Greater consistency in adaptation responses being implemented by councils. This provides greater certainty to the community, and can assist in reducing legal and liability risks to individual councils.
3. Greater capacity to attract external stakeholders and funding to assist with the implementation of adaptation responses.

[2] Greater Taree has been classified as both a 'coastal' and 'rural' council.

Figure 1: Project Area Indicating 'Coastal' and 'Rural' Councils



Notwithstanding the collaborative regional basis for actions proposed in the Adaptation Plan, it is acknowledged that implementing all of the actions in the plan will be likely to require significant resources by individual Coastal Councils. For this reason, a process to prioritise adaptation actions is strongly recommended (see section 5.2.2).Response actions proposed in this plan are broad ranging and include research and evaluation, communication and education, changes to councils' assessment and decision making practices, as well as numerous actions benefiting from or requiring a coordinated regional response with other agencies. Nevertheless, the actions should only be viewed as initial steps in Coastal Councils' climate change response program. Thus the plan should be reviewed on a regular basis (e.g. every five years – see section 5.2).

1.4. Report Outline

The remaining sections of the Climate Change Adaptation Plan are as follows:

Section 2 details the framework and approach that was applied to identify high priority risks for Coastal Councils.

Section 3 discusses the concept of climate change adaptation, outlines principles underpinning adaptation actions proposed in the report and the process that was used to identify them.

Section 4 reviews current policies, programs and measures relevant to the Council's priority risks and recommends new adaptation planning measures for Council and other regional agencies.

Finally, section 5 provides general conclusions and recommendations on next steps.

2. Risk Assessment and Review

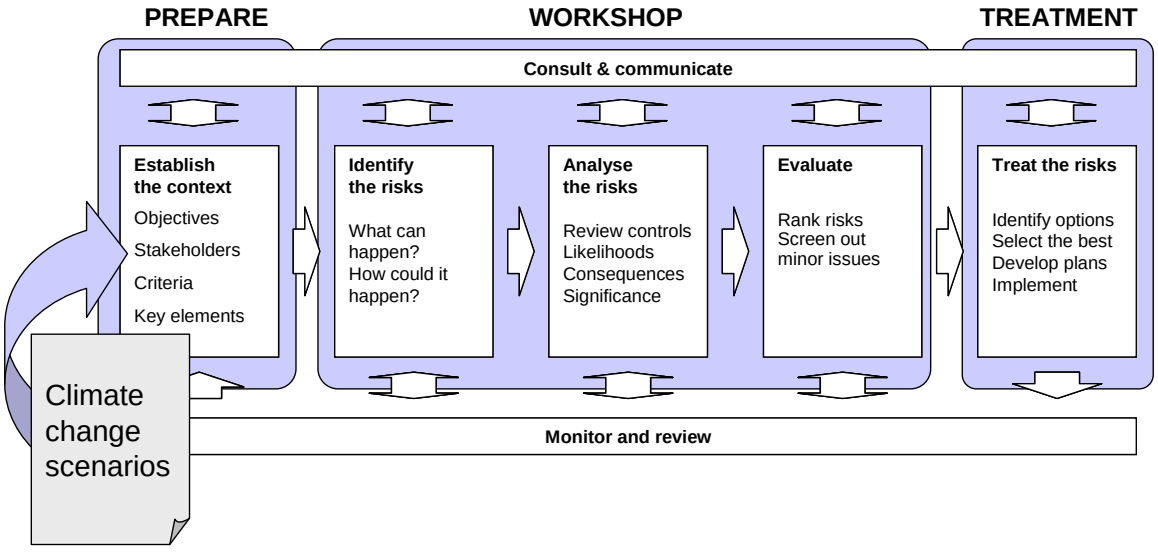
2.1. Risk Assessment Process

From late 2008 to mid 2010, climate change risk assessments were completed for each of the seven Coastal Councils. The purpose of each risk assessment was to explore the potential risks posed by climate change to the relevant council and to prioritise those risks. The scope of each risk assessment addressed the full range of a council's operations and service delivery including:

- infrastructure and assets;
- land use planning;
- emergency management;
- community services;
- environmental protection;
- economic development; and
- corporate services.

The risk assessment process varied between Coastal Councils but all risk assessments were undertaken using a qualitative risk evaluation framework that closely follows the Australian and International Standard AS/NZS ISO 31000:2009 and a process established in the report *Climate Change Impacts and Risk Management: A Guide for Business and Government*[3] (Figure 2).

Figure 2: Risk assessment process steps



The rating scales that were used to evaluate risks are substantially the same for all seven Coastal Councils, that is:

- a scale to describe the likelihood of experiencing that level of consequence;
- a scale to describe the level of consequence of a risk, if it should happen[4]; and

[3] Available at: http://www.climatechange.gov.au/community/local-government/risk-management.aspx

[4] There were some small differences in criteria and weightings of the consequences scales between councils, reflecting differences in councils' operations and budgets.

- a scale to assign a priority rating to each risk, given its consequences and likelihood (Table 1 and Table 2).

Table 1. Priority Rating

Likelihood	Consequences				
	Insignificant (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Almost certain (A)	Medium	High	High	Extreme	Extreme
Likely (B)	Medium	Medium	High	High	Extreme
Possible (C)	Low	Medium	High	High	High
Unlikely (D)	Low	Low	Medium	Medium	High
Rare (E)	Low	Low	Medium	Medium	High

Table 2. Priority Interpretation

Priority	*Interpretation*
Extreme	Immediate action required and formal risk management plans will be prepared
High	Senior management attention needed and formal risk management plans will be prepared
Medium	Management responsibility must be specified and risk management tasks integrated with general plans
Low	Manage by routine procedures with no additional tasks or changes to routine procedures

The climate change scenarios that were used to inform the risk assessments were also broadly similar between the Councils, although scenarios used for the Greater Taree and Port Stephens risk assessments covered more than one time period, whereas the scenarios used for the other Councils covered just one time period (2030).

Overall therefore, the approach that was used to assess the risks of climate change was broadly consistent between the seven Coastal Councils, although there were some differences in detail.

2.2. Risk Review Process

In total, the seven risk assessments identified hundreds of climate change risks to Coastal Councils. The large number of risks, combined with some differences in the approach used to identify and rate risks between Councils, necessitated the use of a bridging step to obtain a regionally consistent and manageable list of regional 'priority risks' for carrying forward to the adaptation planning process. This was done via a review and rationalisation process that was centred on workshops held with staff from the Coastal Councils in June 2010.

The review and rationalisation process involved six main steps. Steps 1 to 3 were undertaken prior to the risk review workshops. Step 4 was undertaken at the review workshops with Coastal Councils. Step 5 was undertaken both at and following the review workshops:

1. **Select risks rated 'High' or 'Extreme'**. Risks that are rated 'High' or 'Extreme' in each of the individual Coastal Councils' risk assessments were identified from each of the individual

Coastal Councils' risk registers[5]. An initial list comprising many hundreds of risks (across the seven Council risk registers) was reduced to approximately 200 risks through this step.

2. **Aggregate and standardise.** The 'High' and 'Extreme' risks were aggregated and standardised so as to:
   - remove duplications (many of the risks listed in the risk registers of Councils are essentially the same as each other but have multiple listings, reflecting different climate drivers and/or consequences – see Figure 3)
   - remove 'risks' that are more appropriately described as 'adaptation responses';
   - remove risks that were rated as 'High' or 'Extreme' by only one or two Coastal Councils[6]; and
   - standardise the text description of the risks rated 'High' and Extreme' by multiple Councils.
3. **Group risks**. The aggregated and standardised list of risks were grouped into broad council functions and categories of interest, namely:
   - infrastructure and assets (buildings, transport infrastructure, stormwater and wastewater, water supply);
   - land use planning (coastal planning, statutory planning);
   - emergency management;
   - corporate services (business continuity, legal liability, insurance);
   - community services (public health, community engagement); and
   - environmental management and protection (waterways, coastal ecosystems, terrestrial ecosystems, greenhouse gas mitigation).

   The outcome of Steps 1 to 3 was a preliminary list of 'priority risks' that was taken to the risk review workshops for review by Coastal Councils.
4. **Review preliminary list of priority risks**. The preliminary list of priority risks was reviewed by Coastal Councils as a group during a workshop to ensure that important risks had not been lost as a consequence of the aggregation and standardisation process.
5. **Review of priority risks by individual Councils.** Each Council reviewed the priority risks to ensure that it fully captures all of their 'High' and 'Extreme' rated risks and that the initial ratings they applied to those risks were accurate.

This synthesis provided a thorough integration of risks identified during the individual risk assessments into the adaptation planning stage. It also assisted Councils in gaining a greater whole of organisation perspective and understanding of risks identified through the previous risk assessment process, as Councils were able to holistically review all high and extreme rated risks to their organisation.

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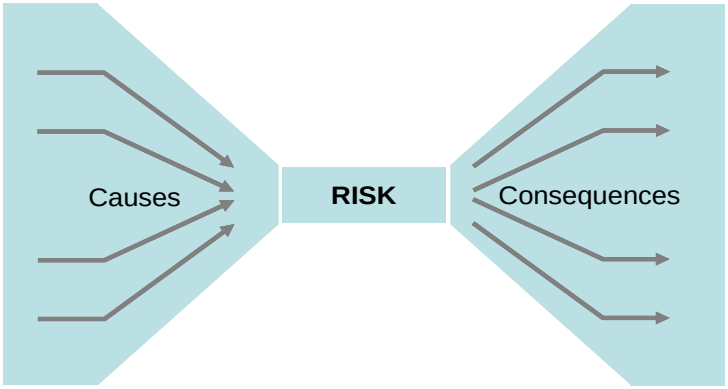
[5] Note, climate change risks were only rated for a single time period (2030) by most of the Coastal Councils. Risks were rated for three time periods - 'current period', 'medium term' (2010 to 2050) and 'long term' (2050-2100) - by Greater Taree. On that basis, a risk has only been identified as a priority risk for Greater Taree if it has been rated 'High' or 'Extreme' in the current period or medium term.

[6] Water supply related risks were an exception to this rule. Because only a small number of Coastal Councils have direct responsibility for water supply, water-related risks were treated as priority risks if two or more Councils rated them as 'High' or 'Extreme'.

Figure 3. Many Climate Change Risks have Multiple Causes and Consequences



Drawing on feedback from Coastal Councils during and following the workshops, a manageable list of 50 priority risks was developed. They form the basis of this adaptation plan (see Table 4, section 4.1).

3. Climate Change Adaptation

3.1. Climate Change Adaptation Defined

There is no universally agreed definition of climate change adaptation. For the purpose of this Action Plan however, climate change adaptation can be defined as 'actions taken in response to actual or anticipated climate change impacts that lead to a reduction in risks or realisation of benefits'[7]. Adaptation represents a planned, proactive response to climate change and, as such, can be distinguished from reactive adjustments to climate change impacts after they have occurred.

Actions in this Adaptation Plan have been defined to include any policy, program or measure that, once implemented, will work to reduce the financial, social or environmental costs stemming from a climate change impact, either:

- directly, by reducing the magnitude or likelihood of an impact occurring - i.e. by reducing the risk; or
- indirectly, by increasing the capacity of vulnerable communities and systems to respond to an impact should it occur - i.e. by enhancing adaptive capacity.

As outlined in Table 3, actions considered for this Adaptation Plan are broadly based, including changes to institutional and management frameworks, revised strategies and plans, changes to regulations and standards, revised internal procedures, research and data collection, on the ground works and education. Actions have been tailored to specifically address the risks that were rated 'High' or 'Extreme' by Coastal Councils in their climate change risk assessments (see previous chapter).

[7] This is an abridged version of a definition provided by the IPCC (Parry et al. 2007).

Table 3: Types of Adaptation Measures Considered for the Adaptation Plan

Control category	Description and examples
Coordinated, regional approach	Coordinated, regional approaches to managing an issue: - Regional institution or organisation - Regional alliance or network - Shared regional framework or approach
Strategies and plans	Local strategies and plans: - Strategic plans - Management plans
Regulations / standards	Regulations, standards and statutory planning frameworks: - Local planning schemes - Building design standards - Planning provisions that prevent new infrastructure from being built in high risk areas - Council by-laws
Internal procedures	Practices and procedures at an organisational level: - Improve decision making processes - HR management practices - OH&S practices
Data collection / information / research	Information / data collection or research that improves understanding of relationship between climate change and risk: - Research on relationship between past and potential future variations in climate and performance of economic, social and environmental systems - Research on relationship between changes to frequency and magnitude of extreme events and critical thresholds - Assessment of adaptation options
Structural or 'on-ground' works	Engineering solutions and practices: - Infrastructure protection measures - Inherent design of infrastructure maximising resilience - Environmental protection or remediation works - Energy / water efficient design
Education, behavioural	Educate and inform community about climate change risks and adaptation measures Educate community about approaches to and benefits of changing behaviour
Spread or displace risk	Insurance and diversification strategies: - Use of insurance products to off-lay the risk - Risks shared between different agencies / entities - Geographical diversification (e.g. of raw materials)

3.2. Principles and criteria underpinning recommended adaptation actions

3.2.1. Generic principles

If Coastal Councils are to realise the potential benefits of climate change adaptation, it is important that their adaptation actions are well considered and designed prior to implementation. This means that actions should be consistent with relevant government legislation, policies and guidelines.

As well, generic principles of good practice climate adaptation have been established in the climate change literature over recent years. In the process of producing this Adaptation Plan, efforts have been made to ensure those principles are adhered to. Principles include:

1. **Focus on priority climate change issues.** Coastal Councils' climate change risk assessments have provided them with a process for identifying and prioritising climate change issues. As discussed in section 2.2, the Action Plan focuses on a defined list of priority risks, ensuring that it is targeted at the issues most important to Coastal Councils.

2. **Use an adaptive management approach.** Adaptive management is an important strategy for dealing with climate change uncertainties. It is the process of putting into place small, flexible, incremental changes based on regular monitoring and revision of plans using information available at the time rather than relying on new, large-scale measures. At a general level, this Coastal Councils' Adaptation Plan incorporates the principle of adaptive management, since it largely builds on existing measures and has a strong focus on improving information and decision making processes.

3. **Focus on cost effective actions.** It is important that Coastal Councils have a clear understanding of the costs and benefits and likely effectiveness of alternative adaptation options. To that end, an initial qualitative assessment has been undertaken of the effectiveness and costs of current and proposed new adaptation actions (see section 3.3). As discussed further in section 5.2 though, more detailed assessment of many of the measures in this Action Plan is likely to be required.

4. **Achieve balance between climate and non-climate risks.** Implementing a climate change adaptation Action Plan is not itself risk free. Coastal Councils need to take a balanced approach to managing climate and non-climate risks. This is best achieved by each Council integrating its climate change risk assessment with its broader risk management processes. Priority should also be given to actions that have 'win-win' outcomes, i.e. they will have additional benefits to Coastal Councils or the local community beyond climate change adaptation.

5. **Avoid adaptation constraining decisions or maladaptation.** Actions in this Adaptation Plan should not lead to the perverse outcome of constraining the ability of the Councils and local communities to adapt to climate change in the future. Other decisions of the Councils should also follow this principle.

3.2.2. Distinguish between 'Internal' and 'Region Wide' Actions

An additional, more specific principle, which underpins this Action Plan, is a distinction between actions that Coastal Councils can implement internally and actions that will require or benefit from a region wide approach. In distinguishing between the two classes of action, it is important to note that Coastal Councils, where feasible, should move to expedite implementation of internal actions (subject to meeting the generic principles discussed above), whereas region wide actions will require extensive dialogue and coordination with other councils and agencies. It is noted however, that for a number of actions, local council responses will require preceding regional actions to be completed.

3.3. Adaptation Planning Process

The adaptation planning process centred on workshops with staff of HCCREMS member Coastal Councils. The process entailed five major steps, with steps 1 and 2 being undertaken prior to the workshops, steps 3 and 4 being completed at the workshops and step 5 following the workshops:

1. **Priority risk selection**. As discussed in section 2.2, the principal basis for selecting priority risks was their overall risk rating. Generally, a risk has been classified as a priority risk if it has been rated as 'High' or 'Extreme' by a number of Coastal Councils. Using this approach, a

total of 50 priority risks were selected for assessment by Coastal Councils at the adaptation workshops. Those 50 priority risks are addressed in this Adaptation Plan (Table 4).

2. **Priority risk categories and subsets**. Priority risks were grouped into categories and subsets (see Table 4). The purpose of the grouping was to enable risks that have significant similarities (and are therefore likely to require common adaptation responses) to be considered collectively in the adaptation planning process.

3. **Identification and review of existing controls**. Existing controls (policies, programs and measures) relevant to each priority risk subset were identified and then reviewed against a range of criteria, such as effectiveness, resourcing and flexibility, with the purpose of establishing where there are significant gaps or deficiencies with current controls.

4. **New and revised actions**. For each priority risk subset, actions necessary to overcoming gaps or deficiencies were identified. Both region wide actions and Council specific actions were identified. Noting the adaptation principles discussed in section 3.2, an initial assessment of the actions was undertaken against a range of criteria such as timeframe for implementation, budgetary implications, Councils' roles vis-à-vis other agencies and barriers to implementation.

5. **Follow up analysis**. The outputs have been refined and consolidated into climate change adaptation actions that are presented in the next section.

4. Adaptation Actions for Priority Risks

4.1. Overview

This section presents a review of existing controls and outlines recommended actions to deal with priority climate change risks to Coastal Councils. As discussed in section 3.3, the full suite of risks identified through the risk assessment has been prioritised for adaptation planning. Risks rated 'High' or 'Extreme' by at least three Coastal Councils (at least two Councils in the case of water supply related risks) have been taken forward for adaptation planning. Priority risks addressed include:

- risks to infrastructure and associated services;
- risks to land use planning and management;
- risks to emergency management and community wellbeing;
- risks to corporate services; and
- risks to environmental management and protection.

Table 10 details all priority risks considered for Coastal Councils. In order to undertake efficient adaptation planning for the priority risks, the risks have also been grouped into alphabetically-numbered subsets. The purpose of the grouping was to enable risks that are closely related and likely therefore to require common adaptation responses to be considered collectively in the adaptation planning process.

Adaptation actions proposed for the priority risk subsets are detailed in sections 4.2 to 4.6.

In summary, 80 recommendations have been made for actions to address the risks of climate change to Coastal Councils. Many of the actions (38) focus on research and information collection, community education or training, reflecting a need to improve understanding of the risks or potential adaptation responses. Other significant areas of proposed action include revised or new strategies and plans, improved decision making processes and increased funding (principally for on-ground works).

Approximately two thirds of all recommended actions (55) focus on region wide initiatives, an approach that will increase prospects for efficient and cost effective outcomes. The other third of actions are directed specifically at individual Coastal Councils, although each council will also benefit from engaging with other councils and agencies to ensure effective implementation of these actions.

Indicative timeframes for implementation of recommended actions in the Adaptation Plan are:

- short term: 1-2 years;
- medium term: 2-5 years; and
- long term: more than 5 years.

Table 4. Priority risks addressed in the Adaptation Plan (clustered into categories and subsets)

Category/ subset	*Risk #*	*Generic Risk*	*Councils that rated risk as 'High' or 'Extreme'*						
			Wyong	*Gosford*	*Lake Macquarie*	*Newcastle*	*Port Stephens*	*Great Lakes*	*Greater Taree*
Infrastructure and assets									
Subset A *Buildings*	**1.**	Increased damage to council buildings and structures due to wind and storm damage			✓		✓		✓
	2.	Increased damage to or destruction of council buildings and structures due to flooding	✓	✓	✓	✓	✓		✓
	3.	Increased damage to council assets due to increased frequency and intensity of bushfires		✓	✓	✓			
Subset B *Stormwater and drainage*	**4.**	Stormwater and drainage systems overwhelmed or damaged	✓	✓	✓	✓	✓	✓	✓
Subset C *Transport infrastructure*	**5.**	Increased damage to roads (incl. gravel roads), causeways, bridges and footpaths due to increased rainfall intensity, flooding or coastal inundation leads to higher maintenance costs	✓	✓	✓	✓	✓	✓	✓
	6.	Increased damage to roads and bridges from landslips and landslides		✓	✓	✓			✓
	7.	Increased capital costs for new coastal roads or bridges to accommodate sea level rise, storm surges and/or increased flood levels	✓						✓
Subset D *Wastewater treatment*	**8.**	Flooding and/or inundation of low lying waste water facilities or pump stations	✓	✓			✓		
	9.	Sewerage treatment system overloaded/fails due to intense rainfall/infiltration or loss of power and/or telecommunications	✓	✓			✓	✓	
Subset E *Water supply*	**10**	Existing water supplies become unreliable, or are unable to meet community demand or expectations	✓	✓					
	11.	Fires adversely impact on catchment yields	✓	✓					

Category/ subset	***Risk #***	***Generic Risk***	*Councils that rated risk as 'High' or 'Extreme'*						
			Wyong	*Gosford*	*Lake Macquarie*	*Newcastle*	*Port Stephens*	*Great Lakes*	*Greater Taree*
Coastal and flood management and planning									
Subset F *Management of coastal areas*	**12.**	Increased erosion or permanent inundation and loss of beaches and public foreshore and lakeside areas and community open space	✓	✓	✓	✓	✓	✓	✓
	13.	Inundation and damage to coastal facilities and areas (jetties, boat ramps, playgrounds, access infrastructure, such as roads and walkways, etc.)	✓	✓	✓	✓	✓	✓	
	14.	Inundation of coastal stormwater outfalls	✓	✓	✓	✓	✓	✓	
	15.	Inundation of sewerage outfalls			✓	✓		✓	
	16.	Increased damage to or failure of coastal levees, sea walls, groynes and breakwaters	✓	✓	✓	✓	✓		
Subset G *Land use planning*	**17.**	Uncertainty in decision making around coastal planning and development results in legal liability or loss of reputation	✓	✓	✓	✓	✓	✓	✓
	18.	Groundwater modelling, flood modelling, flood management plans and planning schemes fail to reflect the extent of flooding and land instability under climate change scenarios	✓	✓	✓	✓		✓	✓
	19.	Development controls in flood risk areas are viewed as being too onerous and/or lead to challenges to planning decisions		✓		✓	✓		✓
	20.	Loss of development potential in coastal areas	✓	✓	✓		✓	✓	
	21.	Rising water table and/or permanent inundation of existing residential and business districts in coastal areas	✓	✓	✓	✓	✓	✓	✓
	22.	Increased flooding of commercial areas reduces their long-term viability		✓	✓	✓		✓	

Category/ subset	Risk #	Generic Risk	Councils that rated risk as 'High' or 'Extreme'						
			Wyong	*Gosford*	*Lake Macquarie*	*Newcastle*	*Port Stephens*	*Great Lakes*	*Greater Taree*
Emergency management and community wellbeing									
Subset H *Traffic management and access*	**23.**	Increased flooding and/or inundation of low lying roads and other transport corridors restricts traffic movement and access (including for emergency services and evacuation)	✓	✓	✓	✓	✓	✓	✓
	24.	Increased flooding and/or inundation of bridges and causeways restricts traffic movement and access	✓	✓		✓		✓	✓
	25.	Bushfires restrict traffic movement and access		✓			✓	✓	
	26.	Increased isolation and/or reduced access to communities due to storms, flooding or bushfires		✓	✓	✓	✓	✓	✓
Subset I Emergency response and recovery	**27.**	Increased demand and associated costs and resources for localised emergency response (including requirements under the DISPLAN) associated with increased frequency or intensity of floods, bushfires and storms		✓			✓		✓
	28.	Increased demand and associated costs and resources for recovery services	✓	✓	✓			✓	✓
Subset J *Community health& wellbeing*	**29.**	Community anxiety associated with extreme climate events and/or expectation of council engagement and direction	✓	✓	✓	✓		✓	✓
	30.	Increase in heat stress in broader community especially amongst vulnerable groups (elderly, infants)	✓	✓	✓		✓		
	31.	Increased exposure of community to heat stress in council run facilities (aged and child care facilities, pools, parks, caravan parks etc)	✓	✓		✓			
Corporate services									
Subset K	**32.**	Key council services (e.g. waste collection) significantly disrupted by storms, flooding or bushfires	✓	✓	✓			✓	✓

Category/ subset	Risk #	Generic Risk	Councils that rated risk as 'High' or 'Extreme'						
			Wyong	*Gosford*	*Lake Macquarie*	*Newcastle*	*Port Stephens*	*Great Lakes*	*Greater Taree*
Business continuity	**33.**	Council unable to ensure continuity of regular services due to resources (staff and/or financial) tied up in emergency response or recovery		✓		✓			✓
	34.	Loss of utility services (e.g. power outage, loss of telecommunications) due to storms, fires or extreme temperatures adversely impacts Council facilities and service delivery	✓	✓	✓	✓	✓	✓	
Subset L *Legal liability and insurance*	**35.**	Increased property damage or personal injury claims as a result of falling limbs and trees caused by droughts, fire and storms	✓	✓	✓		✓	✓	✓
	36.	Increase in insurance costs and/or reduced availability of appropriate insurance cover		✓	✓	✓	✓	✓	✓
Environmental management and protection									
Subset M *Water quality*	**37.**	Increased pollution of estuaries, waterways and groundwater, (caused by leachate and pollution from waste facilities, septic tanks and sewage systems) due to increased rainfall intensity and flooding	✓	✓		✓	✓	✓	✓
	38.	Decline in viability of regional aquaculture and fisheries sector linked to changed climate	✓	✓			✓	✓	
	39.	Increased erosion and silting of waterways and estuaries due to increased rainfall intensity	✓	✓	✓	✓		✓	✓
Subset N *Steam flows*	**40.**	Loss or harm to wetlands, lakes and waterways due to reduced stream flows	✓	✓		✓		✓	
	41.	Increased incidence of algal blooms and/or reduced water quality in waterways, constructed and natural wetlands, and estuaries due to higher water temperatures and reduced flows	✓	✓	✓	✓		✓	
	42.	Reduced water levels and increases in algal blooms impact on potable water quality	✓	✓					
	43.	Increased incidence of pests and weeds in riparian zone due to altered climate regime (e.g. reduced flows)		✓	✓	✓	✓		

Category/ subset	Risk #	Generic Risk	Councils that rated risk as 'High' or 'Extreme'						
			Wyong	Gosford	Lake Macquarie	Newcastle	Port Stephens	Great Lakes	Greater Taree
Subset O *Coastal ecosystems*	**44.**	Loss or harm to coastal ecosystems (including dunes, estuaries, mangroves, saltmarsh, intertidal zones and wetlands) and associated ecological services due to sea level rise	✓	✓	✓	✓	✓	✓	✓
Subset P *Terrestrial ecosystems*	**45.**	Loss of remnant vegetation and habitat as a result of water and heat stress	✓	✓	✓	✓	✓	✓	
	46.	Change in vegetation distribution and composition due to increased frequency and severity of bushfires or increased hazard reduction burning	✓	✓	✓	✓	✓		
Subset Q *Pests and weeds*	**47.**	Increased incidence of pests and weeds due to altered climate regime		✓	✓	✓	✓		
Subset R *Waste management*	**48.**	CPRS or other carbon pricing instrument affects the operations of solid waste facilities						✓	✓
Subset S *Energy management*	**49.**	Increase in Council energy costs associated with carbon pricing and/or climate change responses (e.g. cooling demand)		✓	✓	✓	✓		
	50.	Reduced thermal comfort and/or increased air conditioning load in council buildings due to increased temperatures	✓	✓	✓			✓	

4.2. Protecting Infrastructure, Assets and Associated Services

This section provides an overview of existing controls, gaps and deficiencies, and proposed actions for high-priority infrastructure risks. Priority risks addressed in this section are:

Subset A: Increased damage or destruction of council buildings and structures due to inundation (risk 1); Increased damage to council buildings and structures due to wind and storm damage (risk 2); and Increased damage to council assets due to increased frequency and intensity of bushfires (risk 3).

Subset B: Stormwater and drainage systems overwhelmed or damaged (risk 4).

Subset C: Increased damage to roads (incl. gravel roads), causeways, bridges and footpaths due to increased rainfall intensity, flooding or coastal inundation leads to higher maintenance costs (risk 5); Increased damage to roads and bridges from landslips and landslides (risk 6); and Increased capital costs for new coastal roads or bridges to accommodate sea level rise, storm surges and/or increased flood levels (risk 7).

Subset D: Flooding/ inundation of low lying waste water facilities or pump stations (risk 8); and Sewerage treatment system overloaded/fails due to intense rainfall and/or infiltration or loss of power and/or telecommunications (risk 9).

Subset E: Existing water supplies become unreliable, or are unable to meet community demand or expectations (risk 10); and Fires adversely impact on catchment yields (risk 11).

4.2.1. Damage to council buildings and structures due to inundation and storms

Subset A Buildings	**Increased damage or destruction of council buildings and structures due to inundation (risk 1)** **Increased damage to council buildings and structures due to wind and storm damage (risk 2)** **Increased damage to council assets due to increased frequency and intensity of bushfires (risk 3)**
Focus	All council owned and operated buildings and facilities, particularly assets located in flood prone areas and older buildings and structures.
Councils identifying risk	Wyong, Gosford, Newcastle, Port Stephens, Greater Taree
Context	To varying degrees, Coastal Councils have major assets located in flood prone areas including recreation and entertainment centres, administration centres and community halls. These have been affected by floods as recently as 2007, resulting in substantial costs to Councils. A few Councils also have assets located in bushfire prone areas, although these tend to be less substantial. Older buildings owned by Councils, such as community halls, are also frequently affected by wind and storm events. Projections of an increase in the frequency and magnitude of extreme rainfall events and storms point to greater exposure of these facilities to

flooding and storm damage in the future.

Existing controls

Asset management

A number of Councils have implemented a range of measures aimed at maintaining or improving the condition and structural integrity of assets in the face of storms, floods and other climate related impacts. Measures include:

- condition assessment reports and an assets maintenance program to prioritise maintenance work and ensure that established buildings and other assets are kept serviceable and safe over the long term;
- structural integrity certification to ensure the structural integrity of buildings in flood prone land and from storms and hail; and
- Asset Management Plans to assess risks to council assets and plan for new, improved or upgraded community facilities when existing facilities have passed their useful life and/or to improve service levels – new buildings generally are required to meet the Australian Building Code (Building Council of Australia), which establishes minimum design requirements including for the protection from wind, storm and flood damage.

Flood planning management

Councils have in place Development Control Plans that generally include Floodplain development provisions, applied through Floodplain Management Plans. The provisions generally (although not always) apply to areas subject to a 100 ARI flood, since the Manual defines flood-prone land as all land up to the largest conceivable flood (Probable Maximum flood (PMF)). Most Coastal Councils have undertaken flood hazard mapping as part of their Floodplain Management Plans in accordance with the NSW Floodplain Development Manual. The mapping identifies Council buildings and facilities that are located in flood prone land. New buildings and facilities in flood prone land are subject to the same principles and codes as private developments.

In some cases, flood mitigation works have also been implemented to protect infrastructure.

Minimising the costs of impacts

Councils also have access to measures that can have the effect of reducing costs of storm and flood damage to its infrastructure. They include:

- insurance (covers storm, hail and fire damage, but not flooding); and
- the Natural Disaster Relief Fund (NDRF), funded through the NSW Department of Commerce, which assists with emergency response costs and with cost recovery for uninsured items.

Regional responses and networking

Extreme storms and floods experienced in the region during 2007 have provided coastal Councils with a clearer understanding of the potential nature and extent of damage caused by such events. Considerable

reflection of these events and their impact on council facilities, and networking to share this knowledge has been completed by Councils across the region. This networking should assist with future regional responses to the issue.

Gaps and deficiencies

Asset management

Existing asset management programs generally provide a sound basis for asset planning and prioritising maintenance. Nevertheless, Councils often confront significant shortfalls in funding and staff resources for asset maintenance and replacement – meaning that there is generally a gap between what needs to be done and what can be done. The gap has worsened in recent years due to an ageing asset base, increasing community expectations on service delivery and cost shifting – Councils taking on responsibility of managing assets previously managed by the community or crown land assets that had been the responsibility of other agencies. Rate capping restricts the capacity of some Councils to respond to the shortfalls. In other words, Councils are becoming increasingly 'asset rich' but 'income poor'. As asset management programs in place usually do not consider climate change impacts, increased frequency and intensity or storm and/or flood damage will likely exacerbate this situation.

Minimising the costs of impacts

There are significant anomalies with administration of the NDRF as it is currently structured. Anomalies include:

- administrators of the fund being reluctant to fund response and recovery works by council staff work during normal working hours (but prepared to fund similar work by contractors); and
- a lag of a year or more between Councils' expenditure on response and recovery works (potentially millions of dollars) and reimbursement through the Fund.

As previously noted insurance does not cover damage from flooding or damage due to shifting foundations. Confusion over what constitutes 'storm damage' and what constitutes 'flood damage' exacerbates this problem.

Recommended region wide actions

Action A1 **Clarified and simplified natural disaster declarations and relief funding**

HCCREMS member Councils, in conjunction with LGSA, should collectively approach / lobby the state government to ensure:

- clarified and simplified natural disaster declarations and relief funding arrangements from a central body;
- a more consistent and prompt payment schedule for natural disaster relief funding;
- council works (undertaken by council staff) are included in natural

disaster relief funding; and

- definitions of natural disasters and eligibility are clarified and take account of the changing climate.

This action can be implemented in the short term[8] and should have only minor budgetary implications[9] for Councils.

(This action is also relevant to Risk Subsets C, I and K)

Action A2 **Consistent application of insurance cover**

HCCREMS member Councils, in conjunction with the LGSA, should approach / lobby Statewide Mutual to:

- clarify (for the purpose of insurance cover) the distinction between over flood and storm damage; and
- seek consistent application of insurance cover in relation to flooding.

This action can also be implemented in the short term and should have only minor budgetary implications for Councils.

Action A3 **Asset planning guidelines**

HCCREMS member Councils should approach and work with the Department of Local Government to develop guidelines that establish standard procedures for asset condition assessment and reporting by Councils, specifically taking account of future climate change scenarios. The guidelines would build on existing work undertaken by the National Asset Management Strategy Committee (NAMS.AU). The guidelines would cover:

- an assets register;
- asset condition standards;
- an audit process and hierarchy; and
- decision making on maintenance, upgrades and rationalisation, taking into account level of service requirements.

The guidelines would need to take account of regional differences. The guidelines could be undertaken in the short to medium term, with adoption by Councils being a long term prospect (see Actions A4 and A5). Costs of developing the guidelines would be moderate.

Recommended actions for individual Coastal Councils

Action A4 **Review asset base and level of service requirements**

To resolve the current gap between required asset management works and available resources, Coastal Councils should review their asset bases and levels of service requirements with a view to a possible rationalisation of assets, particularly with regard to the future impacts of

[8] Indicative timeframes in the Adaptation Plan are: short term, 1-2 years; medium term, 2-5 years; long term > 5 years.

[9] Indicative costs in the Adaptation Plan are: low, <$50,000 p.a.; moderate $100,000 – 250,000 p.a.; major >$250,000 p.a.

climate change and the potential need to retreat in high risk areas, and to inform development of risk management and investment plans. If available, Councils would draw on guidelines discussed in Action A3.

Feasibly, this action can only be implemented over the medium to long term, given likely strong community resistance to asset or service rationalisation and the need therefore for effective consultation processes. However, budgetary impacts should be relatively minor. Indeed, effective implementation of the measure should increase resources available to the Councils in the longer term.

Action A5	**Review asset management plan and maintenance program** Councils should review their asset management plans, maintenance programs and funding allocations with a view to: i. prioritising asset maintenance works in the event of a major natural disaster; and ii. upgrading asset maintenance and design specifications for some categories of asset (with reference to the Building Code of Australia and tools and guides developed by relevant professional bodies). When undertaking the review, particular attention should be given to adequate protection and maintenance of buildings that have been identified as Emergency Evacuation Centres or Neighbourhood Safe Places. Part i) of this action can probably be implemented over the short to medium term and will involve minor budgetary impacts. Part ii) however, is a long term action and has the potential to have major budgetary impacts. Councils would draw on guidelines established under Action A3, if available.

4.2.2. Stormwater and drainage systems overwhelmed

Subset B Stormwater	**Stormwater and drainage systems overwhelmed or damaged (risk 4)**
Focus	All stormwater drains and other drainage systems managed by Coastal Councils, especially older parts of the system. Low lying areas subject to flash flooding, sea level rise, storm surge and coastal erosion.
Councils identifying risk	All Coastal Councils
Context	Many parts of the stormwater system are aging. In most LGAs only relatively new underground components of the drainage system are designed for a 1:5 year peak flow ARI. Although a 1-in-5 year event does not generally cause major problems, low lying areas are often affected, as

are many roads. Furthermore, rainfall projections for the region indicate that the intensity of extreme rainfall events could increase significantly over the coming decades. This will lead to increased peak flows and runoff, reduced drainage system performance and greater frequency and severity of flash flooding. Stormwater drainage systems in low lying areas will also be significantly affected by sea level rise. As inundation due to sea level rise occurs, there is the probability that Councils will be forced to decommission certain drainage assets.

An increased frequency or intensity of extreme rainfall events could also lead to an increase in environmental impacts from overwhelmed stormwater treatment systems. Many systems discharging to tidal waters will be affected over time due to submergence of stormwater system outlets. This will further exacerbate the issue in combination with increased rain intensities. The performance of some systems is already influenced by tidal action.

Existing controls

Stormwater and flood planning and management (new developments)

Flood planning and stormwater management processes currently in place are set out in Local Environmental Plans (LEP) and Development Control Plans (DCP). Floodplain development provisions are applied through Floodplain Management Plans (produced in accordance with the *NSW Flood Plain Development Manual*). These are aimed at reducing the impact of flooding and flood liability to property occupiers and to public and private infrastructure by establishing siting and design controls for flood prone lands (areas subject to a 100 year ARI flood). Coastline development provisions are also applied through Coastline Management Plans

Stormwater and on-site detention guidelines, implemented through the DCPs and Stormwater Plans, aim to ensure stormwater is controlled and managed in a way that is consistent with the principles of integrated water cycle management (IWCM) and water sensitive urban design (WSUD) including by:

- reducing flood risk in urban areas;
- reducing soil erosion and sedimentation; and
- minimising urban run-off pollutants to watercourses.

Relevant modelling and design guidelines available to Councils include:

- *Australian Rainfall & Runoff*, which provides the basis for flood modelling;
- *Engineering Guidelines for Subdivision & Development*, which establish minimum design requirements for stormwater drains in new developments and system capacity for stormwater treatment systems; and
- Water Sensitive Urban Design (WSUD) Guidelines, which provide guidance on reducing runoff from buildings/impervious surfaces in new developments.

Asset management (existing system)

Councils also have in place measures that have the objectives of maintaining and (where resources allow) upgrading the stormwater system. These include:

- a stormwater service charge, which Councils levy in accordance with 1995 amendments to the Local Government Act (1993) implemented by Division of Local Government (DLG), Department of Premier & Cabinet – the levy helps to fund upgrades to stormwater and drainage infrastructure over the longer term (e.g. 30 years); and
- an assets management plan, which provides for a review of the existing capacity of system and guides the works program and procedures for infrastructure maintenance.

Community feedback/complaints also help to inform prioritisation and budget allocations for works, particularly in areas prone to flooding.

Capacity building, regional partnerships and networking

Over the past 10 years, Councils and agencies in the Hunter, Central and Lower North Coast region have been engaged in capacity building, data collation and partnerships promoting the implementation of IWCM and WSUD approaches. Due to this work there is considerable understanding and buy in by council and agency staff to such approaches that can be capitalised on.

In addition, Hunter Councils is a core member of an existing National Water Sensitive Urban Design (WSUD) Practitioners Network, which includes the University of Southern Queensland, Melbourne Water and WSUD in Sydney. This network has the potential to provide expert input into future responses by Councils.

Gaps and deficiencies

Flood management and development control planning

Generally, planning and development controls in place are adequate for the current situation. Emerging information though, suggests that controls may need to be strengthened to take account of likely increases in rainfall intensity. There are significant barriers to this though, which add to existing systemic 'weaknesses' relating to Councils' capacities to ensure that controls in place are effectively applied. Barriers include:

- Lack of State Government direction on development controls relating to flood and stormwater management in the context of climate change.
- The need for improved hydrological data and technical guidance from credible professional groups (e.g. revised Australian Rainfall & Runoff (AR&R) guidelines from Engineers Australia).
- The time required to get new policies and strategies approved by Council.
- Lack of resources and in house expertise to:
  - plan works and check Development Approvals (DAs);
  - enforce conditions of consent - at construction, development

hand-over stage; and
- ground truth works against design specifications.

- Section 94 requirements in the *Environment Planning & Assessment Act* 1979 (with respect to developer contributions) are unlikely to be adequate to support increases in stormwater capacity (built system) or to fund acquisition of urban riparian land.
- Ineffective sediment and erosion control (particularly post construction and pre landscaping) - this sediment can enter built stormwater drains and reduce capacity (e.g. by up to 25%).

Asset management

Notwithstanding, the stormwater service charge, there is an ongoing shortage of funds for infrastructure evaluation, retrofits, enhancements and maintenance works. Additionally, Councils face issues surrounding the management and maintenance of drainage areas on privately owned land.

There is also an ongoing need for improved assessment and information collation on stormwater asset condition.

Recommended region wide actions

Action B1 **Model changes to extreme rainfall intensities**

HCCREMS member councils, in conjunction with water utilities and relevant government agencies, should seek to commission region wide modelling of changes to extreme rainfall intensities and duration under climate change scenarios. This information, in conjunction with Australian Rainfall & Runoff (AR&R) Guidelines, can then be used in hydrological modelling to assess local and regional impacts of climate change to flood hazard and to stormwater and drainage systems. It would complement AR&R Guidelines that are currently being updated. [10]

This action can be implemented over the medium term and is likely to have quite moderate budgetary implications (if shared between Councils and other agencies).

(See also actions in risk Subsets C, D and H)

(Refer to subset G (in particular action G8) in relation to concurrent flood and storm surge modelling).

Action B2 **Guidelines for the design and management of new and upgraded drainage assets, and for the retrofitting of existing assets**

Drawing on modelling outputs, revised AR&R guidelines, and WSUD technical design guidelines, HCCREMS member Councils, in conjunction with other agencies, should consider developing:

- regional guidelines for the design and management of new and

[10] Note AR&R is currently being revised. Part of the revision process will include development of rainfall 'intensity duration frequency' information for different regions in Australia based on updated historical data records for those regions and improved statistical techniques. The intensity duration frequency information will not incorporate regionally specific climate change projections however.

upgraded stormwater and drainage assets and for the retrofitting of existing assets - the proposed guidelines would be adapted to local circumstances by individual Councils; and

- regionally consistent condition assessment tools for natural and built stormwater infrastructure.

Coastal Councils could consider establishing a regional 'technical/engineering' job-share position to assist with technical engineering manual revision and to provide some consistency between Councils especially for development controls.

This action can be also implemented over the medium term and is likely to have only minor budgetary implications (if shared between Councils).

Action B3 **Stormwater professional capacity building program**

A region wide stormwater professional capacity building program should be developed drawing on IWCM and WSUD approaches to managing stormwater and flooding. The focus of the program would include:

- managing projected changes in rainfall intensity and duration; and
- design / upgrade of new and existing stormwater and drainage systems to encompass IWCM / WSUD principles in the context of climate change.

This action can be implemented over the medium term and is likely to have minor budgetary implications (if shared between Councils and other agencies).

Action B4 **Funding for stormwater adaptation priorities**

HCCREMS and Councils, in conjunction with regional water management authorities, should lobby federal and state governments to provide funding to implement stormwater adaptation priorities.

This action can be implemented over the short term and is likely to have only minor budgetary implications.

Action B5 **Stormwater communications and information campaign**

HCCREMS and Councils should undertake a regional communications and information campaign targeting community expectations on levels of service and Councils' ability to deliver with regards to stormwater and flood management.

This action can be implemented over the short to medium term and is likely to have minor budgetary implications (if shared between Councils).

Recommended actions for individual Coastal Councils

Action B6 **Revise local planning, stormwater and flood studies to integrate the outcomes of the regional rainfall and hydrological modelling**

Councils should revise / update local planning, stormwater and flood studies to integrate the outcomes of the regional rainfall and hydrological modelling outputs.

	This is likely to be a long term action, requiring implementation of action B1 before it can proceed and support of the Department of Planning.
Action B7	**Revise stormwater and drainage technical engineering standards** Drawing on outputs of action B2, Coastal Councils should revise stormwater and drainage technical engineering standards and development controls (e.g. through a policy template / planning provisions / development consent conditions) to integrate WSUD and IWCM technical standards and to account for projected climate change impacts. This is also likely to be a long term action, requiring implementation of action B2 before it can proceed.
Action B8	**Prioritise upgrades of vulnerable stormwater assets** Drawing on outputs of actions B1 and B7, Coastal Councils should prioritise management / upgrade of vulnerable stormwater assets or develop alternative strategies (e.g. rationalisation / decommissioning) at an LGA scale. This is also a long term action and is likely to have major budgetary implications.

4.2.3. Increased maintenance costs associated with intense rainfall and flooding of low lying transport infrastructure

Note, there is considerable overlap between risks in this subset and the traffic management risks (subset H) discussed in the section 4.4.

Subset C **Transport infrastructure**	**Increased damage to roads (incl. gravel roads), causeways, bridges and footpaths due to increased rainfall intensity, flooding or coastal inundation leads to higher maintenance costs (risk 5)** **Increased damage to roads and bridges from landslips and landslides (risk 6)** **Increased capital costs for new coastal roads or bridges to accommodate sea level rise, storm surges and/or increased flood levels (risk 7)**
Focus	All Coastal Council roads, bridges and causeways, especially those subject to frequent flooding, landslides and/or degradation due to extreme rainfall.
Council identifying risk	All Coastal Councils
Context	Repairs to roads, bridges and causeways damaged as a result of flooding or extreme rainfall are a major budget item for Coastal Councils, with many having backlogs of road repairs. Most Coastal Councils also manage older timber bridges that are at significant risk

of being washed out by flooding. Even when damage costs are covered by natural disaster relief funding, Councils often experience delays and other difficulties in accessing funding.

Increases in the frequency and/or magnitude of extreme rainfall events and associated flooding in the future suggests that the difficulty Councils currently faces in maintaining roads and other transport infrastructure to the required service level could worsen in the future.

Sea level rise could also necessitate changes in design standards of roads and bridges, such as an increase in the elevation of roads and bridges. It may also necessitate the need for alternative access routes where redesign and reconstruction is not cost effective. This would also result in additional capital costs for Coastal Councils.

Existing controls

Asset maintenance and upgrades

Councils undertake ongoing roads and other transport infrastructure maintenance works to their rural, main and urban roads. Works are generally programmed through an assets management plan and forward works program and maintenance schedule that has been developed from inspections by council officers. Additionally, community requests and/or complaints with the relevant council often trigger repairs. Works include upgrading of sealed and unsealed roads, pothole patching, sign replacement, maintenance of culverts, drains and road shoulders. Although much of the maintenance is reactive (i.e. after an extreme event), it can also help to prevent further deterioration of road surfaces and other assets.

Subject to funding, more substantial road and bridge upgrades are also undertaken from time to time on main roads and other state significant infrastructure through grants and regional strategies. Works are generally undertaken by the NSW Roads and Traffic Authority on shared funding basis between the Australian and State Governments and the relevant council. Upgrades are undertaken in accordance with various Australian Standards and Guidelines for road design and planning.

Planning and development controls

Established planning and development controls and Section 94 requirements in the *Environment Planning & Assessment Act* (1979) provide design specifications and require developer contributions for road improvements relating to new developments.

Gaps and deficiencies

Resourcing for asset maintenance and upgrades

A shortfall in funds linked to ‘rate pegging’ and anomalies in natural disaster relief funding means that Coastal Councils often face significant backlogs in their road maintenance and upgrade schedules. This problem is widespread amongst Councils in the Hunter, Central and Lower North Coast region and is likely to be exacerbated by an increase in the frequency and/or magnitude of extreme rainfall events, sea level rise, coastal erosion and associated impacts to transport

infrastructure.

An initial step therefore, towards developing an effective funding model for roads, incorporating climate related impacts, would be to remove existing anomalies in Natural Disaster Relief funding arrangements.

At present, councils do not have available to them effective decision making frameworks or tools to identify and assess management options for existing assets in the context of projected climate change impacts. The availability of tools of this nature would assist councils in determining the most appropriate management strategies for vulnerable assets, ranging from decommissioning and rationalisation through to extensive upgrading to promote resilience.

Design criteria for new infrastructure

Design standards and guidelines for the construction of new and upgraded roads and bridges do not currently incorporate projected climate changes or provide any guidance on how asset managers should incorporate climate change adaptation requirements when designing and building new or upgrading existing roads and bridges. Guidelines are probably best developed at the national and state levels but will need to incorporate flexibility to provide for regional and local applications.

Recommended region wide actions

Action C1 **Guidelines for incorporating climate change adaptation into design criteria for new roads and bridges, and for retrofitting existing transport assets**

Councils, in conjunction with the RTA (and with support from the LGSA and Infrastructure Australia) should commission research from a suitable professional body (e.g. Institute of Public Works Engineers) to develop decision making frameworks and guidelines to assist asset managers incorporate climate change adaptation requirements when designing and building new, or maintaining or upgrading existing roads and bridges. These would include elements such as calculating impacts of rainfall intensity on asset lifespan and maintenance costs and options for adapting assets over time versus total replacement. The decision making framework should include the range of management strategies available to councils, ranging from rationalisation and decommissioning through to extensive upgrading of assets.

This action can be implemented over the medium term.

Action C2 **Review design criteria for new and upgraded roads and bridges based on extreme rainfall projections**

HCCREMS and Councils, in conjunction with water utilities and catchment management authorities, should seek to commission region wide modelling of changes to extreme rainfall intensities and duration.

Refer to Subset F (in particular actions F1 and F7) in regard to sea

level rise.

This information should then be used to review design criteria for new and upgraded roads and bridges.

This action can also be implemented over the medium term.

(See also Actions B1 and H2)

Action C3 **Clarified and simplified natural disaster declarations and relief funding**

See recommendation A1.

Action C4 **Panel of key experts on regional transport research and programs**

HCCREMS, in conjunction with regional transport planning agencies, should consider establishing a regional panel of key experts and stakeholders. This panel would strategically review and direct regional transport research and program implementation, including region wide actions for risk Subsets C and H and development of a regional transport infrastructure plan.

This action can feasibly be implemented in the short term and should have relatively minor budgetary implications.

Action C5 **Professional training on climate change and asset planning**

A region wide professional training and capacity building program and resources could be developed and provided to council staff to promote understanding and application of available research and tools to assist with integrating climate change considerations into asset planning, construction and maintenance processes.

This action can commence in the short term but is likely to be ongoing.

(This action is also relevant to Risk Subsets A and B)

Recommended actions for individual Coastal Councils

Action C6 **Revision of forward works programs for transport infrastructure**

Drawing on outcomes from actions C1 and C2, Coastal Councils should seek to:

- apply the decision making frameworks to the development and revision of forward works programs for transport infrastructure. This will ensure that the full range of management options available (e.g. decommissioning through to asset upgrades), are considered during project planning and prioritisation processes; and
- integrate new design criteria into the planning and construction / upgrade of council roads and bridges.

This is a long term action, requiring implementation of actions C1 and C2 before it can proceed.

Action C7	**Professional training on climate change and asset planning** Councils should seek professional training courses for relevant staff to promote understanding and application of available research and tools to assist with integrating climate change considerations into asset planning, construction and maintenance processes. This action can commence in the short term but is likely to be ongoing. (This action is also relevant to Risk Subsets A and B)

4.2.4. Flooding and overload of waste water treatment facilities

Subset D **Waste water treatment**	**Flooding and/or inundation of low lying waste water facilities or pump stations (risk 8)** **Sewerage treatment system overloaded/fails due to intense rainfall/infiltration or loss of power and/or telecommunications (risk 9)**
Focus	Waste water treatment facilities, especially in low lying areas
Councils identifying risk	Wyong, Gosford and Great Lakes (Port Stephens has also given a high rating to these risks)
Context	Some Coastal Councils provide sewerage reticulation and treatment services for residents through their water and waste water authorities (Gosford-Wyong Water, MidCoast Water). Sewerage services consist of sewer main networks, pump stations and treatment facilities. Some of these are in flood hazard areas. If pumps are out of order due to power outages, effluent will flow back into the sewer system, causing a loss of service and leading to community outcry. Sludge can also flow into and cause pollution of waterways. Back-up power systems are designed to prevent the disruption of pumping when there is power loss. However, if a back-up system is also unable to work due to inundation, the problems will be significantly exacerbated. Projections of increased rainfall intensity and associated flooding increase the risk of flooding of treatment facilities, pump stations and/or the reticulation system.
Existing controls	Back-up power is generally provided at main pump stations and treatment plants. Live monitoring systems provide warning of pump failure. Some treatment plants in flood prone areas are protected by levees. In-system storages are designed to cope with power outages of varying durations.

Gaps and deficiencies	It is not clear whether all relevant plants are safe from very intense rainfall and associated flood events. These could cause major damage (e.g. shut down of plant), as well as environmental damage and back-flow into the sewage system. Problems tend to be magnified during major storm events. This points to a need for improved hydrological data - how climate change will impact on extreme rainfall intensities in the region and how changes to rainfall intensity will in turn, affect flood hazard areas and exposure of critical infrastructure including treatment facilities and waste water pump stations. This information could then be used to prioritise possible future asset protection works, including levees and back-up power generation.

Recommended region wide actions

Action D1	**Model changes to extreme rainfall intensities; flood hazard mapping** HCCREMS Councils, in conjunction with regional water authorities (Hunter Water Corporation, MidCoast Water) and other government agencies, should seek to commission region wide modelling of changes to extreme rainfall intensities and duration under climate change scenarios. This information should then be used in hydrological modelling to inform regional and local flood hazard mapping. This action can be implemented over the medium term and is likely to have moderate budgetary implications (if shared between Councils and other agencies). (See also action B1)
Action D2	**Analytical tool for prioritising key infrastructure treatments** HCCREMS Councils, in conjunction with water and other utilities, and state government infrastructure agencies, should consider funding the development of a tool for assessing and prioritising treatments on key public infrastructure in the context of climate change and other drivers of risk. The tool should include a cost benefit analysis component and combine 'importance of service' hierarchies with 'at risk communities' and cost of treatment. This action can be implemented over the medium term and is likely to have minor to moderate budgetary implications (if shared between Councils and other agencies). It may be feasible to integrate this action with action F3.

Recommended actions for individual Coastal Councils

Action D3	**Identify and prioritise critical infrastructure exposed to flooding** Relevant Councils should integrate rainfall and hydrological modelling outputs (from D1) into revised flood hazard mapping and

identification of critical infrastructure (including waste water infrastructure) exposed to flooding. Results of the assessment should be integrated into Floodplain Risk Management Plans.

Outputs from the assessment should then be used to prioritise potential protection works / treatments for waste water treatment and other critical assets (drawing on outputs of action D2 if available).

This is a medium to long term action.

(Refer to Subset G, in particular action G8, with regards to concurrent flood and storm surge modelling).

4.2.5. Water supply reliability

Subset E **Water supply**	**Existing water supplies become unreliable, or are unable to meet community demand or expectations (risk 10)** **Fires adversely impact on catchment yields (risk 11)**

Focus	Gosford-Wyong Councils' Water Authority water supply district
Councils identifying risk	Gosford, Wyong (also potentially relevant to Hunter Water Corporation and MidCoast Water)
Context	Gosford-Wyong Water provides water and waste services to approximately 123,000 residential customers. Water is supplied principally from Mangrove Creek, Mooney Mooney Creek, Ourimbah Creek and Wyong River through a network of three dams (Mangrove, Mardi, Mooney), 40 reservoirs, two water treatment plants and 1,900 km of pipelines. The system currently provides a reliable source of water to the region. Nevertheless, due to extended drought, storage levels fell to as low as 10% in early 2007, since then storage levels have increased to about 30%. Gosford-Wyong Water has had water restrictions in place for several years, with restrictions currently being at Level 3. Hunter Water is a state-owned Corporation providing water and wastewater services in the lower Hunter region, i.e. to Port Stephens, Lake Macquarie and Newcastle Councils. MidCoast Water is a county council and is responsible for reticulated water and waste water services in the Greater Taree and Great Lakes local government areas. Climate change projections of increased rainfall variability and potentially increased frequency or severity of droughts mean that water supplies may become less secure in the future.
Existing controls	**Water resource management** Gosford Wyong Water has introduced a number of measures in recent

years in response to the drought including:

- a two-way pipeline connection with Hunter Water;
- a stormwater harvesting program, providing more than 50 ML of water for public reserves and gardens; and
- recycled water schemes for use on golf courses, ovals and other facilities.

In addition, its WaterPlan 2050 sets out a long-term water supply strategy for the Central Coast, covering both system upgrades and supply augmentations including groundwater bore field development and a link between Mardi Dam and Mangrove Creek Dam.

Demand management

Gosford Wyong Water has a range of demand management strategies in place including:

- water restrictions (various levels);
- a voluntary target for maximum household water consumption of 150 litres / person / day;
- water savings information and education campaigns aimed at achieving the target; and
- rebates for water efficiency and demand management measures including rainwater tanks and grey water systems.

Gaps and deficiencies

WaterPlan 2050 provides a comprehensive strategy response to future water demand and supply. Nevertheless, the Plan relies on historical drought and rainfall experience and, as such, does not appear to take account of climate change projections including the potential for an increase in rainfall variability and increase in drought frequency.

There is also some potential to ramp up demand management strategies including through further education and water pricing.

Recommended region wide actions

Action E1 **Regional climate change projections on rainfall and runoff**

Gosford-Wyong Water, in conjunction with other water authorities (Hunter Water Corporation, MidCoast Water) and HCCREMS should consider funding modelling of down-scaled regional, climate change and associated hydrological projections considering relevant climate variables including:

- average annual and seasonal rainfall;
- runoff;
- potential evaporation;
- rainfall variability; and
- drought frequency and severity.

The modelling could build on the work completed for HCCREMS by the University of Newcastle and would complement rainfall intensity

	modelling proposed in action B1. This action can be undertaken in the short to medium term. Budgetary implications of the review should be moderate to major.
Action E2	**Review Water Plan** Gosford-Wyong Water, as well as Hunter Water and MidCoast Water, should review their long term water supply plans, e.g. WaterPlan 2050, taking account of climate change projections/scenarios developed through action E1. This action can be undertaken in the short to medium term. Budgetary implications of the review should be minimal.
Action E3	**Strengthen water demand management initiatives** Gosford-Wyong Water, Hunter Water and Mid Coast Water should consider collaborating and strengthening water demand management initiatives and promoting consistency across the region through: ▪ water pricing (e.g. inclining block tariffs); ▪ community information and education on the potential implications of climate change for water availability; ▪ further community education on alternative water supply options (potable and non-potable).

4.3. Coastal and Flood Management and Planning

This section provides an overview of existing controls, gaps and deficiencies, and proposed actions for high-priority land use management and planning risks. Priority risks addressed in this section are:

Subset F: Increased erosion or permanent inundation and loss of beaches and public foreshore and lakeside areas and community open space (risk 12); Inundation and damage to coastal facilities and areas (jetties, boat ramps, playgrounds, access infrastructure, such as roads and walkways, etc.) (risk 13); Inundation of coastal stormwater outfalls (risk 14); Inundation of sewerage outfalls (risk 15); and Increased damage to or failure of coastal levees, sea walls, groynes and breakwaters (risk 16)

Subset G: Uncertainty in decision making around coastal planning and development results in legal liability or loss of reputation (risk 17); Groundwater modelling, flood modelling, flood management plans and planning schemes fail to reflect the extent of flooding and land instability under climate change scenarios (risk 18); Development controls in coastal recession, flood risk areas are viewed as being too onerous/lead to challenges to planning decisions (risk 19); Loss of development potential in coastal areas (risk 20); Rising water table/ permanent inundation of existing residential and business districts in coastal areas (risk 21); and Increased flooding of commercial areas reduces their long-term viability (risk 22).

4.3.1. Coastal area management

Subset F **Coastal area management**	**Increased erosion or permanent inundation and loss of beaches and public foreshore and lakeside areas and community open space (risk 12)** **Inundation and damage to coastal facilities and areas (jetties, boat ramps, playgrounds, and access infrastructure, such as roads and walkways) (risk 13)** **Inundation of coastal stormwater outfalls (risk 14)** **Inundation of sewerage outfalls (risk 15)** **Increased damage to or failure of coastal levees, sea walls, groynes and breakwaters (risk 16)**
Focus	All beaches, foreshore areas and coastal infrastructure in the Central Coast region, including along the open coast and estuaries
Councils identifying risk	All Coastal Councils
Context	Many if not most beaches and estuarine foreshore areas in the Hunter, Central and Lower North Coast region are vulnerable to sea level rise and increased frequency and intensity of storm surges (see Box 1). Analysis undertaken through a number of site specific Coastline Hazard Definition or Coastal Processes studies for example, indicate the

potential for long term recession due to a combination of natural sand loss and sea level rise. Some dune systems and beaches are already being impacted by erosion, although it is not clear if this is the result of natural factors or is linked to sea level rise.

Dunes and foreshore areas could be lost and substantial numbers of coastal infrastructure including seawalls, jetties, piers and boat ramps, as well as important service infrastructure such as stormwater and sewerage outfalls, roads and bridges.

Sea level rise and higher water levels in creeks, rivers and receiving waters will also increase groundwater levels. Higher water tables may reduce the integrity of building foundations and increase the need for building maintenance.

Councils have limited direct control over most of these areas but face significant community expectations to provide remediation measures.

Existing controls

Research and information

Many Coastal Councils now have LIDAR (ALS) data covering some or all coastal areas in their LGA. In addition, LIDAR data for the entire length of coast has been made available for this project through the NSW Department of Lands and is held by HCCREMS. As noted, a number of site specific Coastline Hazard Definition and Coastal processes studies have been completed including Black Head to Crowdy Head (Greater Taree), Stockton Beach (Newcastle) and the Wyong coastline. The studies generally aim to assess hazard lines for beaches based on short term fluctuations due to storm erosion, long-term recession due to net sand loss and long-term recession due to sea level rise.

Coastal management

Most of the planning and controls relevant to coastal management are detailed in the existing controls for Subset G (see below). In addition:

- A number of Coastal Councils have prepared or are preparing Coastline Management Studies (often based on the outcomes of their Coastline Hazard Definition studies) – the studies consider management options for beaches including protective works, development controls and dune management.
- Environmental or Coastal Management Plans establish programs and actions to enhance protection of the coast including, for example, mapping of unstable dunes.
- Estuary Management Plans have been prepared for most of the major coastal lakes and estuaries in the region including Tuggerah Lakes, Hunter Estuary, Manning River, Port Stephens - Myall Lakes, Smiths Lakes and Wallis Lake.

In accordance with the Local Government (General) Amendment (Community Land Management) Regulation 1999, Councils are required to prepare generic and site specific plans of management and Master Plans for areas of Council managed community open space. These plans provide an important mechanism through which coastal adaptation strategies can be incorporated and prioritised for implementation.

Local Coastcare programs are being implemented with the support of Coastal Councils and state agencies.

Gaps and deficiencies

Coastal management

Overall environmental planning and management frameworks for the region are generally sound. However, a review process is needed to ensure that the potential impacts of climate change on the coastal zone are being fully considered.

There is also a lack of clear, transparent and consistent decision making frameworks to assist council decision making. Councils and other coastal managers would also benefit from having access to tools to assist them with coastal management decision making, particularly in the context of climate change.

(Note, land use planning issues are discussed in Subset G)

Research, information and education - coastal vulnerability

Through their Coastline Hazard Definition Studies, Coastal Councils have initiated important work to assist understanding of the potential impacts of climate change on key sections of the LGAs' coastline. However, there are still gaps in information and understanding of coastal vulnerability across the region and the potential for an integrated response by Councils and other agencies.

Information on coastal vulnerability also needs to be more consistently and effectively communicated to the community.

Recommended region wide actions

Action F1

High resolution integrated elevation/bathymetry datasets

HCCREMS currently holds high resolution, LIDAR digital elevation datasets for the Hunter, Central and Lower North Coast region. HCCREMS and Councils should seek to process these datasets and integrate them with bathymetry datasets to enable region wide hydrological and coastal flood modelling to be undertaken. Processed datasets should be provided to member Councils.

This action should be implemented in the short term.

(See also recommended action G1)

Action F2

Smartline mapping of estuary foreshores

HCCREMS and Councils should seek funding from the federal or state government to prepare Smartline Mapping for all estuarine foreshores in the region to improve understanding of the vulnerability of coastal and estuarine foreshores to erosion. The mapping would integrate location specific coastal hazard assessments undertaken by individual Councils in the region and build on Smartline information (principally open coastline) accessed for this project. Subject to funding, this action could be implemented in the short to medium term.

Action F3 **Decision support framework / tool for prioritising coastal areas and assets and for prioritising coastal protection measures**

HCCREMS member Councils, in conjunction with other regional agencies responsible for coastal management, should work with the federal and/or state government to develop a decision support framework/tool (including case studies) for prioritising coastal areas and assets and for prioritising coastal protection works and other coastal management options. The tool would have three main components:

1. A framework that assists coastal managers to rate and prioritise beaches, foreshore areas and coastal assets based on their vulnerability and environmental, social and economic values.
2. A framework that assists coastal asset managers to identify and assess management and protection options for highly rated coastal areas and assets or when upgrading or maintaining coastal infrastructure and assets. The framework would include both technical and financial elements such as calculating impacts of climate change on asset lifespan and costs and benefits of adapting assets gradually over time versus total replacement.
3. A Condition Assessment Tool for established coastal infrastructure and assets. This will ensure a consistent approach to the ongoing assessment of the condition and performance of such infrastructure in the context of their ability to meet changing climate conditions.

This action could be implemented in the short to medium term. It may be feasible to integrate the action with action D2.

Action F4 **Community information on coastal erosion and vulnerability**

Drawing on outputs of some of the above actions, HCCREMS and Councils should prepare and deliver an information and education strategy aimed at building community awareness of coastal erosion processes and contributors to these processes.

This action could be integrated with action G6. It would be implemented over the medium term and is likely to have minor to moderate budgetary implications.

Action F5 **Review existing state, regional and local plans**

See action M1

Action F6 **Regional training and capacity building a program**

HCCREMS should consider development of a regional training and capacity building program for Councils to facilitate the integration of climate change impacts into Community Land Plans of Management.

Recommended actions for individual Coastal Councils

Action F7 **Site specific modelling of coastal and estuarine erosion and inundation risks**

Drawing on outputs of actions F1 to F4, Coastal Councils should identify whether additional site specific modelling of coastal and estuarine erosion and inundation hazards is required in addition to the work undertaken for existing Coastline Hazard Definition studies. It is important that the modelling considers storm tide heights (e.g. 1:100) and return intervals under different sea level rise scenarios. The modelling should also consider concurrent storm surge, sea level rise and extreme rainfall events.

(See also recommended action G8).

This is a medium to long term action.

Action F8 **Prioritise beaches and foreshore areas for protection**

Drawing on outputs of action F2 and outcomes of the Coastal Management Study, Coastal Councils should prioritise beaches and foreshore areas for coastal management and protection works.

This is also a medium to long term action.

Action F9 **Revise and update Community Land Plans Of Management**

Councils should ensure new research and tools generated through the above regional actions are integrated within Community Land Plans Of Management in coastal areas.

Box 1: Improving Understanding of Vulnerable Coastal Areas

Data relating to the physical characteristics of the Hunter, Central and Lower North Coast region's coastline (sourced from the Australian Coastal Smartline Geomorphic and Stability Map Version 1) indicates that there are more than 400 kilometres of open coastline in the region. Half of this length is comprised of sandy shores backed by soft sediment or muddy shores backed by soft sediments, two categories of shoreline considered particularly susceptible to instability in the context of sea level rise.

Smartline data for the region does not cover estuaries though, an important gap when seeking to understand the vulnerability of the region to coastal erosion in the context of climate change and sea level rise. There are also other significant gaps in information required to ensure a reasonably complete understanding of the potential for coastal erosion and inundation in the region under climate change and priorities for decision makers . Gaps include:

- high resolution integrated elevation/bathymetry datasets across the region;
- storm tide heights (e.g. 1:100) and return intervals under different sea level rise scenarios (noting that the current State planning level of 0.9 metres is consistent with IPCC AR4 projections, but that the IPCC is likely to produce substantially revised projections in its next assessment;
- understanding of the relative significance of different coastal areas and assets that are potentially vulnerable to coastal erosion and inundation.

Table 5. Coastal Landforms (Open Coast), Hunter, Central & Lower North Coast Region

Landform (general classification intertidal zone)	*Gosford*	*Great Lakes*	*Greater Taree*	*Lake Macquarie*	*Newcastle*	*Port Stephens*	*Wyong*	***Total Region***
Hard rock shores, cliffed	17.4	15.0	0.2	3.2	0.2	5.7	4.1	**45.9**
Hard rock shores, gently to moderately sloped	10.0	32.3	5.5	8.8	2.3	26.1	6.7	**91.8**
Muddy shores backed by bedrock								**0.0**
Muddy shores backed by soft sediments		7.3				0.7		**8.1**
Sandy shores backed by bedrock	5.6	7.4	2.0	5.7	3.6	1.9	7.6	**33.9**
Sandy shores backed by soft sediment	13.5	74.5	45.5	13.7	6.4	33.9	21.8	**209.2**
Sandy shores undifferentiated		9.1	0.0		1.7	12.7		**23.5**
Structures	1.6	0.2	0.6	0.6	2.3	0.9	0.9	**7.1**
Total open coastline (kms)	**48.1**	**145.8**	**53.8**	**32.0**	**16.5**	**81.9**	**41.2**	**419.4**

(Source: Sharple, Mount & Pederson, 2009)

4.3.2. Land use planning in coastal and flood prone areas

Subset G **Planning in coastal and flood prone areas**	**Uncertainty in decision making around coastal planning and development results in legal liability or loss of reputation (risk 17)** **Groundwater modelling, flood modelling, flood management plans and planning schemes fail to reflect the extent of flooding and land instability under climate change scenarios (risk 18)** **Development controls in coastal recession or flood risk areas are viewed as being too onerous/lead to challenges to planning decisions (risk 19)** **Loss of development potential in coastal areas (risk 20)** **Rising water table/ permanent inundation of existing residential and business districts in coastal areas (risk 21)** **Increased flooding of commercial areas reduces their long-term viability (risk 22)**
Focus	Coastal developments and developments adjacent to waterways or other flood prone areas
Councils identifying risk	All Coastal Councils
Context	Available information indicates that established residences and associated infrastructure are located in areas that are already exposed to coastal erosion and/or flooding. Sea level rise projections indicate that some coastal areas are likely to be subject to more frequent and intense storm surges, increased erosion and (in the long term) permanent inundation. Rainfall projections for the region also indicate that the intensity of extreme rainfall events could increase significantly over the coming decades. The impact of new developments on catchment hydrology together with an increase in frequency and severity of extreme rainfalls could lead to increased extent of flood hazard areas and/or frequency and severity of flooding within established flood hazard areas (see Box 2). Future population growth, necessitating additional housing and infrastructure, places pressure on Coastal Councils to allow further development in some of these areas but Councils also faces community backlash and liability, if it fails to ensure that appropriate development controls are in place in these areas.
Existing controls	**Coastal zone management, flood management and development control planning** A comprehensive legislative and planning framework is currently in place at the state, regional and LGA levels that is designed to control development coastal and flood prone areas.

State and regional levels

At the state and regional levels, the framework includes the following.

- NSW Coastal Policy (1997), which establishes statewide directions on protecting the coastline and coastal values from excessive development.
- Sea Level Rise Policy Statement (2009), which provides guidance on adaptation to projected sea level rise impacts. The Policy Statement includes sea level rise planning benchmarks for use in assessing the potential impacts of projected sea level rise in coastal areas, including flood risk and coastal hazard assessment and is supported by a *Draft Flood Risk Management Guide* and a *Coastal Risk Management Guide*.
- *Coastal Planning Guideline: Adapting to Sea Level Rise* (2010) prepared by NSW Department of Planning
- *Draft Coastal Protection and Other Legislation Amendment Bill 2010* and associated policies and guidelines, including:
  - Coastal Risk Management Guide: Incorporating sea level rise benchmarks in coastal risk assessments
  - Minister's Requirements under the Coastal Protection Act 1979 A Guide to the Statutory Requirements for Temporary Coastal Protection Works
  - A guide for authorised officers under the Coastal Protection Act Guidelines for preparing coastal erosion emergency sub plans
  - Guidelines for assessing and managing the impacts of seawalls
- Guidelines for preparing coastal zone management plans A suite of State Environmental Planning Policies (SEPPs), including Regional Environmental Plans. SEPP 71, for example, provides guidance on coastal protection.
- Supporting legislation, including the *Environmental and Planning and Assessment Act* 1979.

LGA level

State and regional policies and legislation are implemented at the LGA level through the Local Environmental Plan, Development Control Plans, and Local Area Plans and Floodplain and Coastal Management Plans, which provide guidance and establish controls on development in a LGA, including specific controls for coastal and flood prone areas. The Plans are aimed at protecting coastal areas, estuaries and waterways, reducing the potential of flooding to occupiers and infrastructure, informing decision making in flood prone areas and ensuring future development in those areas is carefully controlled through siting and design criteria.

Section 149 Planning Certificates are issued on individual properties to inform planning applicants of the development potential of a parcel of land including the planning restrictions that apply to the land (e.g. in relation to a flood hazard).

Flood modelling and flood hazard mapping inform the above planning processes.

Gaps and deficiencies

Research and information

There are significant gaps in the data and information required for Councils to make informed planning decisions that reflect climate change projections and uncertainties. Data gaps include:

- integrated high resolution elevation data and bathymetry for use in hydrological and coastal flood modelling;
- high resolution, regional rainfall intensity data incorporating best available climate change projections; and
- a detailed understanding of areas that are at risk from coastal inundation and/or flooding taking into account best available climate change projections.

Flood management and development control planning

Generally, planning and development controls in place are adequate for the current situation in relation to flood prone land. Emerging information though, suggests that controls will need to be strengthened to take account of sea level rise and likely increases in rainfall intensity, and resulting changes to floods levels and ARIs.

There are barriers to this though, which add to existing systemic 'weaknesses' relating to each council's capacity to ensure that controls in place are effectively applied (discussed in Subset B). Perhaps the most significant barrier is the lack of a detailed decision making framework that Councils (regionally and state wide) can apply to making consistent decisions on land use in areas affected by coastal inundation and/or flooding. Additionally, there is no clear planning framework to address future climate change impacts on existing urban developments.

Community education

Based on stakeholder engagement, it seems that more community education is required to overcome a lack of understanding within the community, and clarify and make clear the risks of flooding and extreme rainfall in particular in the face of climate change.

Legal liability

Another important barrier is an understanding of the liability of local government arising from decisions in relation to coastal planning and flooding. There is currently a high degree of uncertainty regarding the legal position and liability of Councils with regard to coastal planning decision in the context of climate change, a point noted by the House of Representatives Standing Committee on Climate Change, Water, Environment and the Arts, which has recommended an urgent review of legal issues and climate change impacts on the coastal zone (HRSCECCW, 2009).

Recommended region wide actions	
Action G1	**High resolution integrated elevation/bathymetry datasets** See recommended action F1
Action G2	**Model changes to extreme rainfall intensities** See recommended action B1
Action G3	**Guidelines for integrating climate change into coastal and flood modelling** HCCREMS member Councils, in conjunction with LGSA NSW, should approach and/or lobby the State Government (through DECCW and Department of Planning) to develop comprehensive and detailed guidelines for integrating climate change projections into new and existing coastal and flood hazard models, maps and management plans applied by Councils. The Guidelines will facilitate a consistent understanding and approach by Councils to the integration of climate change scenarios and impacts into coastal and flood modelling and management processes. It should be noted that implementation of this action will need to take into consideration the suite of coastal management protection legislation and guidelines currently under development by the NSW State Government. This action should be implemented in the short term.
Action G4	**Review liability of local government to coastal planning decisions** HCCREMS member Councils should work with the LGSA to commission a complete legal review of the liability of local government associated with coastal planning decisions in the context of climate change. The review should be completed in the short term. It is likely to have minor to moderate budgetary implications.
Action G5	**Decision making framework and tools for local government planning in coastal areas** HCCREMS member Councils, in conjunction with LGSA NSW, should approach and work with the State Government to develop protocols and a decision making framework for Councils to provide a consistent and transparent approach to land use planning, and to the long term management of infrastructure and services provided to existing urban areas, in locations vulnerable to coastal erosion and inundation. The framework would provide Councils, agencies and the community with greater certainty when making decisions regarding whether to permit development in potentially affected areas, both through long term strategic processes (e.g. LEPs) or through day to day development application processes. In regard to existing urban development, the framework and/or guidelines would assist councils in determining the most appropriate adaptation

management options available in light of both short and long term costs and benefits. The framework / guidelines would consider and assist in evaluating the broad spectrum of potential strategies available to councils, from planned retreat through to protection options.

The framework should draw on outputs of Actions G3 and G4 and include:

- guidelines;
- model planning provisions;
- practice notes; and
- development consent conditions.

This action should be implemented in the short to medium term.

Action G6 **Capacity building on planning issues**

Drawing on outputs of actions G3 to G5, HCCREMS, should seek funding from the state or federal governments (e.g. DECCW) to develop and deliver a capacity building program for senior management, planning staff, elected councillors and other relevant agencies on the land use planning and legal implications of climate change and approaches for managing these. The program would address a range of climate-related land use planning issues including bushfires, flooding and sea level rise and associated coastal issues.

Subject to funding, this action could be implemented in the medium term.

Action G7 **Community information package**

Drawing on outputs of actions above, HCCREMS and Councils should produce a regional information package to advise the community on how Councils are addressing climate change in coastal and flood modelling, management and planning processes.

This action can be implemented over the medium term and is likely to have quite moderate budgetary implications.

Recommended actions for individual Coastal Councils

Action G8 **Hydrological / flood / coastal modelling**

Drawing on outputs from Actions G1 to G3, Councils should undertake site specific hydrological / flood modelling of local priority areas, particularly ***where the perceived risk is high and existing Flood Management Plans do not fully reflect the outcomes of region wide rainfall intensity projections and sea level rise planning benchmarks.***

Councils should also consider updating coastal modelling work that combines concurrent storm surge, sea level rise and extreme rainfall projections in local priority areas, noting the potential compounding effects of storm surge and extreme rainfall events.

This action can be implemented in the medium term. It is likely to entail

moderate costs for Councils.

Action G9 **Prioritise beaches and foreshore areas for protection**

See recommended action F6

Box 2: A regionally consistent approach to flood modelling

Approximately 125,000 people are exposed to flooding[11] in the coastal zone of the Hunter, Central and Lower Coast region (see Table 6).[12] This data however, does not reveal the extent or frequency of exposure in the future given climate change. Although comprehensive hydrological modelling and flood hazard mapping has been undertaken by all Coastal Councils, data compiled for this project suggests there are some inconsistencies in methods applied to the mapping, most particularly in relation to whether and how climate change projections have been integrated into flood hazard modelling.

Thus it would be desirable to develop a regionally consistent approach to flood hazard modelling and mapping incorporating climate change projections. An initial step towards that end will be to undertake region wide modelling of changes to extreme rainfall intensities and duration under climate change scenarios. This regionally specific information would complement and build on Australian Rainfall & Runoff (AR&R) Guidelines for hydrological modelling that are currently being updated nationally by Engineers Australia.

A regionally consistent approach to flood hazard assessment and mapping will be important to informing decision making on key infrastructure issues such as stormwater and drainage, waste water management and transport, as well as emergency management and business continuity.

Table 6. People and Residential Areas Exposed to Flooding, Hunter, Central and Lower North Coast Region

Category	*Gosford*	*Great Lakes*	*Greater Taree*	*Lake Macquarie*	*Newcastle*	*Port Stephens*	*Wyong*	***Total Region***
Exposed People	18,554	1,600	14,442	4,389	54,617	8,230	22,691	124,523
Exposed Residential Dwellings	7,133	610	5,715	1,656	22,386	2,924	8,330	48,754
Exposed Low Income Households	1,604	197	1,906	471	5,770	630	1,978	12,556
Exposed People > 65 years	3,897	378	3,275	845	8,855	1,074	3,945	22,269

[11] Flood risk areas were identified from geographic flood model data provided by councils. Generally, but not always, the models were 1:100 year flood layers.

[12] HCCREMS, 2010. Potential Impacts of Climate Change on the Hunter, Central and Lower North Coast of NSW, Hunter Councils NSW.

4.4. Emergency Management and Community Services

This section provides an overview of existing controls, gaps and deficiencies, and proposed actions for high-priority risks relating to emergency management and community services. Priority risks addressed in this section are:

Subset H: Increased flooding and/or inundation of low lying roads and other transport corridors restricts traffic movement and access (including for emergency services and evacuation) (risk 23); Increased flooding and/or inundation of bridges and causeways restricts traffic movement and access (risk 24); Bushfires restrict traffic movement and access (risk 25); and Increased isolation and/or reduced access to communities due to storms, flooding or bushfires (risk 26).

Subset I: Increased demand and associated costs and resources for localised emergency response (including requirements under the DISPLAN) associated with increased frequency or intensity of floods, bushfires and storms (risk 27); and Increased demand and associated costs and resources for recovery services (risk 28).

Subset J: Community anxiety associated with extreme climate events and/or expectation of council engagement and direction (risk 29); Increase in heat stress in broader community especially amongst vulnerable groups (elderly, infants) (risk 30); and Increased exposure of community to heat stress in council run facilities (aged and child care facilities, pools, parks, caravan parks etc) (risk 31).

4.4.1. Increased flooding of low lying roads and other transport corridors (leads to disruption to traffic)

Subset H Traffic management	**Increased flooding and/or inundation of low lying roads and other transport corridors restricts traffic movement and access (including for emergency services and evacuation) (risk 23)** **Increased flooding and/or inundation of bridges and causeways restricts traffic movement and access (risk 24)** **Bushfires restrict traffic movement and access (risk 25)** **Increased isolation and/or reduced access to communities due to storms, flooding or bushfires (risk 26)**
Focus	All highways, main roads, rural roads, causeways and bridges in the region subject to flooding, especially those providing sole or principal access route for communities.
Councils identifying risk	All Coastal Councils
Context	Flooding of roads, causeways and other transport corridors in the region can isolate significant sections of the community for extended periods, disrupt traffic movement, including emergency management and commercial vehicles, and create major safety hazards. Projections for an increase in the frequency and/or magnitude of extreme rainfall events and associated flooding indicate that the impacts of

flooding on traffic movement could become more severe in the future.

This issue has important emergency management implications.

Existing controls

Flood management planning and information

Councils' flood hazard mapping and flood plans provide them with a good understanding of the roads and other transport corridors most at risk from flooding. This information, in turn, informs decisions on priorities for road upgrades and decisions on road, bridge and causeway closures and alternative transport routes in the event of a flood.

Website and other information services provided by Coastal Councils, roadside signage and flood markers provide the community with information on road closures and flood levels.

Local emergency management

Local Emergency Management Committees (LEMC) link Coastal Councils with emergency management agencies (SES, RFS, NSW Police, Ambulance Service), as well as relevant State government agencies. Each LEMC oversees implementation of the local DISPLAN, which sets out local emergency response to floods including in relation to road closures, emergency evacuation, flood gauges and reporting systems.

Regional partnerships

In some areas, Regional Emergency Management Risk Studies link a council's DISPLAN with other local DISPLANs.

Significant regional partnerships also exist between Councils, the Department of Transport, the RTA and other relevant agencies to effectively manage traffic in the event of a major flood having regional implications. In particular, the Mid North Coast and Hunter Central Coast Emergency Management Districts provide hubs for coordinated responses to regional emergencies. Agencies are able to draw on shared experiences and knowledge gained from previous major floods in the region, such as the 2007 floods.

Gaps and deficiencies

Information on traffic routes

The local DISPLAN, implemented through the LEMC, provides a sound platform for emergency response in the LGA, including in relation to traffic management. Similarly effective regional coordination is provided through the Emergency Management District. Nevertheless, key transport information often resides with a few individuals at council level and within other agencies, suggesting the need for better documentation of roads likely to be affected by floods and of alternative transport routes.

Community information

Similarly, based on stakeholder discussions, it is apparent that the broader community may not be fully and effectively informed and engaged in local and regional emergency response efforts particularly in relation to:

- alternative transport routes in the event of a flood (or other

emergencies, such as a bushfires); and

- household preparedness in the event of being cut off from day to day services for prolonged periods due to road closures.

Resourcing

As discussed in relation to Subset C, sufficient and timely funding for transport route upgrades is an ongoing issue, likely to be exacerbated under a future climate regime.

Recommended region wide actions

Action H1 **Update local and regional traffic plans**

HCCREMS member Councils, in conjunction with the RTA and local and regional emergency service agencies should:

- identify and document key local and regional traffic routes likely to be affected by flooding and also other extreme events such as bushfires, and identify alternative options during these events;
- update local and regional traffic plans to encompass alternative transport options during these events; and
- provide information to the community on alternative transport and evacuation routes in the event of a flood or other extreme events.

This action can be implemented in the medium term. With cost sharing, costs to Council are likely to be minor to moderate.

Action H2 **Identify and upgrade vulnerable roads and bridges**

Drawing on research and guidelines of established professional bodies, Coastal Councils, with the support of the RTA should:

- develop consistent criteria for quantitatively identifying vulnerability of major roads, bridges and other transport infrastructure to flooding and other climate extremes;
- identify and rank vulnerability of roads and bridges to flooding at a regional scale;
- research and provide recommendations for the development of new design standards to account for changed climate parameters in construction of new or upgrade works for roads and bridges; and
- actively seek funding from state and federal Governments for a program to upgrade vulnerable infrastructure.

This is a medium term action, requiring collaboration between Councils, the RTA and other agencies.

(See also Action C2).

Action H3 **Promote increased household preparedness for floods**

Councils, in conjunction with regional emergency service agencies, should undertake an education campaign to promote increased household preparedness for floods (including, for example, decentralisation of

power and water supplies) to reduce their short term dependence on mainstream services and the need for evacuation.

This action can be implemented in the short term. With cost sharing, costs to Council are likely to be minor.

Recommended actions for individual Coastal Councils	
Action H4	**Adaptation strategies for key local transport infrastructure** Drawing on outcomes from action H1 and H2, Coastal Councils should identify adaptation strategies and/or works programs for key vulnerable local transport infrastructure. This is a long term action. Its implementation is dependent on Councils being able to access substantial new resources.

4.4.2. Emergency response and recovery

Subset I Emergency response & recovery	**Increased demand and associated costs and resources for localised emergency response (including requirements under the DISPLAN) associated with increased frequency or intensity of floods, bushfires and storms (risk 27)** **Increased demand and associated costs and resources for recovery services (risk 28)**
Focus	Councils' response and recovery obligations, as set out in the local DISPLAN, including emergency accommodation and clean up. Coordination of Councils' response in case of an emergency with other members of the Local Emergency Management Committee (LEMC).
Councils identifying risk	Wyong, Gosford, Lake Macquarie, Port Stephens, Great Lakes, Greater Taree
Context	The *State Emergency and Rescue Management Act* 1989 recognises that involvement of local government in all stages of an emergency is critical (including prevention, preparedness, response and recovery). Emergency management structures and arrangements at the local level are therefore based on local government boundaries. There is also strong community expectation regarding response and (especially) recovery services provided by Councils. The State Emergency and Rescue Management Act (SERM Act) mandates several council obligations, including financial (funding for RFS and SES) and in-kind support (e.g. staff and equipment). This can place a strain on the resources of Coastal Councils. Similarly, there is strong community expectation regarding the provision of recovery services through Councils (such as emergency accommodation, social services and welfare provision). Recovery operations can often be resource intensive and this limits resources available for regular council

services.

An increase in the frequency and/or severity of climate related emergencies over time could increase demand on emergency response and recovery resources including those provided by Coastal Councils.

Existing controls

Local planning and emergency management

Local flood and bushfire management plans set out procedures to assist Councils to mitigate, prepare for and respond to flood and bushfire risks.

As previously noted, coordinated local emergency response and recovery is implemented through the local DISPLAN. The DISPLAN is implemented through the Local Emergency Management Committee (LEMC), which comprises council, emergency management agencies (SES, RFS, NSW Police, Ambulance Service NSW) and other agencies.

Regional partnerships

As also noted in the discussion in Subset H, strong partnerships currently exist between Councils, between Councils and emergency services organisations and at the regional level. Thus there is already significant experience of coordinated regional emergency responses and `buy in' to programs that can enhance a regional approach.

Internal procedures

Internal procedures and insurance are designed to mitigate risks to Councils that could arise from their emergency response and recovery commitments. Measures include:

- internal emergency management procedures; and
- internal procedures designed to ensure that requests to Council for recovery services are prioritised or referred to other agencies.

Natural Disaster Relief Funding

As noted previously noted, the Natural Disaster Relief Fund (NDRF), funded through the NSW Department of Commerce, assists Councils with emergency response costs and with cost recovery for uninsured items.

Gaps and deficiencies

Local emergency management

DISPLAN has proven to provide an effective and strong platform for local emergency response. It should be noted however, that although plans have proven to be effective in multi-agency events they have not really been tested under multiple or frequent 'event' situations, especially given that key organisations are heavily reliant on availability of volunteers. Planning documentation and procedures also need to be more readily available to relevant agencies and the broader community.

Furthermore, local DISPLANs tend to deal less well with 'recovery' aspects of emergency management and are often not so well resourced, placing strains on Councils and other agencies response for recovery operations (see below).

Council resources and facilities

Ultimately, Councils are highly dependent upon adequate and timely state or federal funding to assist with disaster recovery and clean up. In that respect the NDRF assists Councils with recovery in the case of State declared disasters. As noted previously however, there are anomalies with current funding arrangements.

Although resources are made available to Councils for preparatory planning, contingency funding is not available for disasters that are not state declared, meaning that Councils' responses to local emergencies have a direct impact on their capacity to meet day to day (essential and non essential) service requirements. Ultimately, the lack of contingency funding could also impact on Councils' capacity to provide funding to emergency service agencies such as the RFS and SES.

Although Councils and other emergency agencies' roles and responsibilities are set out in the DISPLAN, roles and responsibilities within each council could be further clarified. In particular, there is scope through training to broaden the knowledge base within each council on its responsibilities regarding emergency management.

Councils need to ensure that its emergency and recovery facilities and equipment (e.g. Neighbourhood Safe Places) are well maintained and located.

Community information and responsibilities

Finally, as noted in the discussion on Subset H, community education on emergency response needs to be improved. On the one, hand the community expectations are high as to the role of Councils and other agencies in responding to emergency situations. On the other hand, there needs to be improved community awareness and understanding of the importance of self preparedness, self responsibility and the ramifications of personal decisions (e.g. private land management).

Recommended region wide actions

Action I1 **Emergency preparation exercises combining multiple events**

HCCREMS member Councils and regional emergency service agencies should consider conducting emergency preparation exercises combining multiple events, multiple agencies and zones to test effectiveness of the DISPLAN. This will improve preparedness and efficiency of Councils, agencies and emergency management authorities when responding to extreme or multi-event natural disasters.

This action could be implemented in the short term. Costs to individual Councils and agencies are likely to be minor.

Action I2 **Review of emergency response frameworks and relationships**

Councils, regional emergency service agencies and the state government should conduct a review of emergency services response frameworks and relationships. This would identify existing limitations and provide

recommendations and tools to improve capacity to manage projected increases in extreme events from an emergency response perspective, particularly projected increases in the coincident occurrence of extreme events. It would also include a focus on the ability of key service providers to continue to deliver community services during and after extreme events.

This action could be implemented in the short term to medium term.

Action I3 **Central access point for information on emergency management procedures**

HCCREMS member Councils and regional emergency service agencies should establish a central access point – including physical location and website - for all regional information on emergency management procedures, including response and recovery. They should also conduct an awareness campaign for community on their rights, roles and responsibilities in the event of a natural disaster such as a flood.

This action could be implemented in the short term. Costs to individual Councils and agencies are likely to be minor.

(See also recommended action H3)

Action I4 **Clarified and simplified natural disaster declarations and relief funding**

See recommended action A1.

Action I5 **Development and delivery of training program**

Councils should consider development and delivery of a regional program for staff to achieve a higher level of education and participation in emergency management procedures under DISPLAN (including response and recovery).

This action could commence in the short term, although it is likely to be ongoing. Costs to the Councils are likely to be minor.

Recommended actions for individual Coastal Councils

Action I6 **Council staff training**

Council should consider training of staff to achieve a higher level of education and participation in emergency management procedures under the DISPLAN (including response and recovery).

This action could commence in the short term, although it is likely to be ongoing. Costs to the Councils are likely to be minor.

Action I7 **Review asset management plan and maintenance program**

See recommended action A5.

4.4.3. Community health and wellbeing

Subset J **Community health and wellbeing**	**Community anxiety associated with extreme climate events / expectation of council engagement and direction (risk 29)** **Increase in heat stress in broader community especially amongst vulnerable groups (elderly, infants) (risk 30)** **Increased exposure of community to heat stress in council run facilities (aged and child care facilities, pools, parks, caravan parks etc) (risk 31)**
Focus	Local communities, especially vulnerable groups such as elderly residents, infants and residents with disabilities or limited access to information and local networks
Councils identifying risk	All Coastal Councils
Context	Heat waves place vulnerable sections of the community at risk from dehydration and heat stress. A key determinant of heat stress is the rate of change between temperature extremes. The elderly (>65 years) are especially vulnerable. They comprise a significant proportion of the community of the Central Coast region at present (17%), a proportion that is expected to grow substantially over the coming 20 years (25% by 2027) (see Box 3). Other climate extremes such as storms and floods can also have a significant impact on the wellbeing of community members. Even if they are not directly affected, vulnerable and isolated groups previously mentioned, can suffer from anxiety and stress. Councils are often the first point of contact for the community in relation these issues, with an expectation that they will provide information and/or referral and advocacy services.
Existing controls	**Vulnerable communities** A range of relevant measures are in place at the regional and state levels that are designed to identify vulnerable sections of the community and assist them with targeted programs. These include: ▪ the Home and Community Care (HACC) program administered by the Department of Ageing, Disability and Home Care; ▪ Telecross, a program run by Red Cross that provides the elderly and housebound with a daily phone call to ensure that they are safe and well; ▪ meals on wheels; and ▪ health registers (e.g. of people at home requiring oxygen or home dialysis). **Community information** State and regional emergency information programs include health alerts issued by NSW Health and DECCW on days of high pollution. Extreme

weather alerts are also issued by local and state emergency managers (e.g. SES) on preparedness for extreme weather.

Emergency management

The local DISPLAN, implemented through the LEMC, provides a sound platform for emergency response in the LGAs, including in relation to storms and floods.

Infrastructure

Infrastructure design and management can help to mitigate the affects of extreme weather events such as heatwaves. Artificial cooling is used by a significant and growing proportion of households to regulate thermal comfort. Public buildings, such as the library, can provide informal refuges during extreme heat events. Electricity Networks and backup power systems are designed to minimise power losses, especially to major public buildings and infrastructure.

Gaps and deficiencies

High risk groups

Programs are effective for known high risk groups, but people who are not included in those existing networks are difficult to reach. In part, this reflects incompleteness or lack of integration of registers of high-risk groups and responsibility for ensuring that the registers are maintained and kept up-to-date. Thus, there is a need for better linkages between different agencies and services to improve and integrate existing registers of high risk groups (aged care services, infants and early years, as well as disability services).

Communication

Communication at times of extreme heat also appears to be ad hoc.

There needs to be a better understanding of when (i.e. trigger points) to issue warnings, media releases and other communications on heat events and how best to get the message out.

Improved information is also needed on preparing people for extreme events – building their awareness about what they can and should do in specific circumstances.

Recommended region wide actions

Action J1

Regional heatwave plan

HCCREMS and Councils, in collaboration with relevant state agencies (NSW Health and Department of Ageing, Disability and Home Care) and non-government organisations, should develop a regional heat wave plan. The strategy would build on the NSW framework/plan and incorporate local data and circumstances. Important aspects of the plan would include:

- a coordinated approach to heat waves response between Councils, state agencies and non-government organisations;
- a communications strategy to ensure effective communications by Councils and other agencies, before and during periods of extreme

heat (informed by outcomes of action J2);

- an integrated register of high risk groups/people;
- community facilities identified as 'cool places' (and if necessary, upgrades to ensure that they meet requirements); and
- other targeted intervention strategies to assist high risk groups in the event of a heat wave.

The plan should be integrated with local DISPLANs.

The timeframe for implementation is the short term, e.g. within two years. The budgetary implications of the development of the plan would be minor if shared between Councils and agencies. Some of individual actions in the plan may have more substantial budgetary implications.

Action J2 **Improve understanding of risk perceptions**

HCCREMS and Councils should work with the State Government (through Emergency Management NSW) to commission research to improve understanding of community risk perceptions and behaviour in the event of heat waves and other extreme weather events. The research should be evidence based as well as surveys of community perceptions of risks.

The timeframe for implementation is the short to medium term. The budgetary implications would be minor to moderate.

Action J3 **Promote increased household preparedness for heat waves**

Councils, in conjunction with regional emergency service agencies, should undertake an education campaign to promote increased household preparedness for heatwaves (including, for example, decentralisation of power and information on community 'cool places'), to reduce their short term dependence on mainstream and/or emergency services.

This action can be implemented in the short term. With cost sharing, costs to Council are likely to be minor.

Action J4 **Councils should review existing design standards for community facilities**

Councils should collaboratively review existing design standards for community facilities (e.g. Safer by Design) to facilitate enhanced retention of features that contribute to the cooling of these facilities during extreme heat events (e.g. natural shading)

Some requirements associated with existing design standards for council community facilities (e.g. Safer by Design) at present conflict with design principles that would reduce heat impacts on community facilities. For example, Safer by Design may require the removal of shade trees to improve sight lines. Improved integration of existing design standards has the potential to ensure features conducive to reducing the impacts of extreme heat on the community are retained and promoted in community facilities.

Recommended actions for individual Coastal Councils

Action J5

Community Neighbourhood Program

Where they have not already done so, Coastal Councils should consider implementing a local Community Neighbourhood Program, drawing on experience of similar programs that have been implemented in other parts of the region and state. The program aims to build a sense of community and raise awareness of the local community by encouraging people to get to know their neighbours, supporting local networks and participating in local community activities and organisations. Programs of this nature are instrumental in contributing to the monitoring and assistance of vulnerable groups and individuals.

The timeframe for implementation of this action is the medium term. Budgetary implications would be minor to moderate.

Box 3: Sections of the Community Vulnerable to Climate Change

The potential impacts of climate change on communities can also be significantly influenced by the sensitivity of those communities to a particular climate change or hazard. There are a number of social and economic characteristics and trends that provide a general indication of the overall sensitivity of communities to climate change. Two important social characteristics are demography and income. Australian and international studies indicate that groups especially vulnerable to extreme climate events such as flooding, storms, bushfires and heat waves include:

- low income earners;
- the elderly; and
- people with existing health conditions (including physical and mental health).

The vulnerability of these groups stems from:

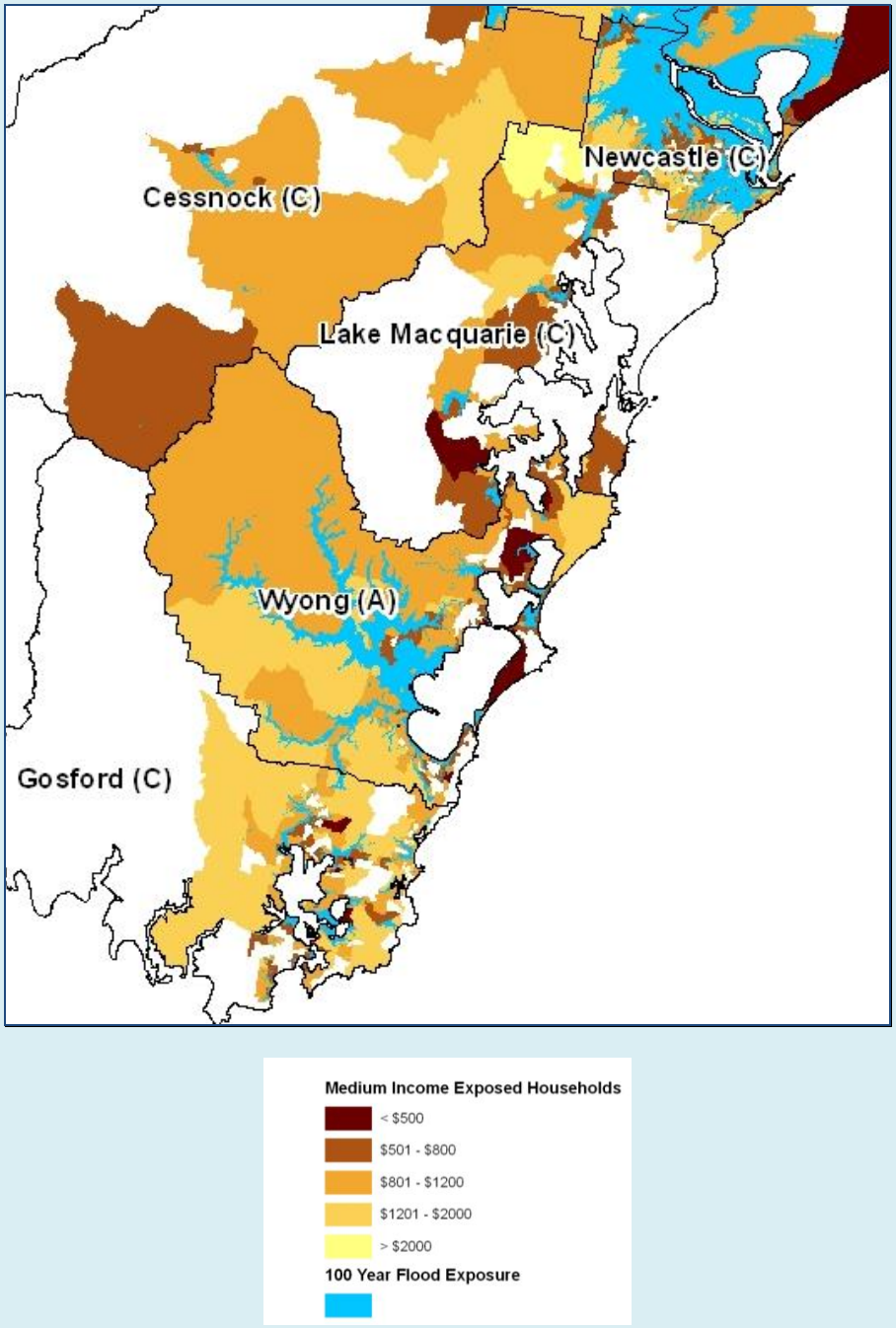
- limited capacity to prepare for impacts due to lack of resources or an inability to access or effectively utilise relevant information;
- difficulty in responding to particular impacts, due to physical incapacity, lack of mobility or lack of resources; and/or
- problems with recovering from impacts, again due to lack of resources or to the absence of strong social networks.

Data for the Coastal Councils indicates that the region has a relatively high proportion of people at least in the first two groups, certainly above the NSW State average (see Table 7). Spatial information suggests that there can be concentrations of these groups in particular localities, some of which overlap with significant climate-related hazards such as flooding (see Figure 4). Responding to the needs of these groups will be an important aspect of climate change adaptation planning.

Table 7. Breakdown of Weekly Household Incomes, Hunter, Central and Lower North Coast Region and NSW, 2006

Gross Weekly Household Income	Hunter Valley Region		Central Coast Region		NSW	
	No. of Households	% of Households	No. of Households	% of Households	No. of Households	% of Households
<$500	52,425	26.7	25,651	27.1	467,382	22.6
$800-$1199	76,116	38.8	38,143	40.4	755,991	36.6
$1200-$1999	39,660	20.2	18,721	19.8	422,933	20.5
>$2000	27,829	14.2	11,989	12.7	420,736	20.4
Total	196,030	100.0	94,504	100.0	2,067,042	100.0

Figure 4. Median Weekly Income of Households in Flood Prone Areas, Hunter, Central and Lower North Coast



4.5. Corporate Services

This section provides an overview of existing controls, gaps and deficiencies, and proposed actions for high-priority corporate services risks. Priority risks addressed in this section are:

Subset K: Key council services (e.g. waste collection) significantly disrupted by storms, flooding or bushfires (risk 32); Council unable to ensure continuity of regular services due to resources (staff and/or financial) tied up in emergency response or recovery (risk 33); and Loss of utility services (e.g. power outage, loss of telecommunications) due to storms, fires or extreme temperatures adversely impacts Council facilities and service delivery (risk 34).

Subset L: Increased property damage or personal injury and claims as a result of falling limbs and trees caused by droughts, fire and storms (risk 35); and Increase in insurance costs and/or reduced availability of appropriate insurance cover (risk 36).

4.5.1. Business continuity

Subset K **Business continuity**	**Key council services (e.g. waste collection) significantly disrupted by storms, flooding or bushfires (risk 32)** **Council unable to ensure continuity of regular services due to resources (staff and/or financial) tied up in emergency response or recovery (risk 33)** **Loss of utility services (e.g. power outage, loss of tele-communications) due to storms, fires or extreme temperatures adversely impacts Council facilities and service delivery (risk 34)**
Focus	Coastal Councils' service delivery
Councils identifying risk	All Coastal Councils
Context	Most day to day Council operations and services require ongoing and consistent involvement of staff and contractors, if they are to be effectively delivered. When a major natural disaster occurs, delivery of key Council services (e.g. waste management) could be directly affected. As well, many Council staff and resources are needed to respond to the disaster and to undertake recovery works. This can also affect delivery of routine services. Greater frequency and severity of extreme events (floods, storms) has the potential to increase service disruptions.
Existing controls	**Work prioritisation process** Councils' maintain work schedules within different departments to ensure works and services are prioritised. **Coordination with emergency services and other agencies** Through their Local Emergency Management Committees, Councils are able to coordinate and share emergency response actions with other agencies and, potentially, reduce the emergency response workload on

council staff.

Use of contractors can also help to diminish work load on Council staff.

Natural Disaster Relief Funding

Councils are reimbursed for (some) costs associated with responding to state declared natural disasters or for direct impacts of the disaster.

Gaps and deficiencies

Policies and procedures currently in place in most Coastal Councils appear to provide an effective approach to dealing with short term staff shortages in relation to emergency responses. However, if extreme events occur more frequently and for longer time periods, the strain on Council resources is likely to increase, potentially affecting long term service delivery. Furthermore, a majority of Councils do not appear to have a plan to deal with longer term disruptions to its services (e.g. lack of access to waste transfer station/landfill due to flooding). A business continuity plan needs to be developed and implemented to prepare for these eventualities.

As previously noted, Councils often experience delays and other difficulties in accessing natural disaster relief funding.

Recommended region wide actions

Action K1 **Clarified and simplified natural disaster declarations and relief funding**

See recommended action A1

Action K2 **Regional training, capacity building and implementation program**

Councils should consider delivery of a regional training, capacity building and implementation program for Councils on the importance and process of Business Continuity Planning.

This would address staff and financial barriers to developing Continuity Plans individually by Councils and promote consistency in approach and standards across Councils.

Recommended actions for individual Coastal Councils

Action K3 **Business Continuity Plan**

Councils should develop and implement a business continuity plan consistent with Australian Standards and best practice on business continuity management as set out in:

- AS/NZS 5050:2010 - Business Continuity - Managing Disruption Related Risk;
- HB 221-2004 – *Business Continuity Management Handbook*;
- HB 292-2006 – *A practitioner's guide to business continuity management*; and
- HB 293-2006 – *Executive guide to business continuity management*

The business continuity plan would aim to provide procedures to ensure

continuity of key Council services in the event of business disruption, including weather-related emergencies such as heat waves, floods, storms and fires, and power and telecommunications outages. Issues associated with risks to staff and resourcing in the event of emergencies should also be addressed in the plan.

This action can be implemented in the short to medium term. It is likely to entail moderate costs.

4.5.2. Legal liability and insurance

Subset L **Legal liability & insurance**	**Increased property damage or personal injury claims as a result of falling limbs and trees caused by droughts, fire and storms (risk 35)** **Increase in insurance costs and/or reduced availability of appropriate insurance cover (risk 36)**
Focus	Council parks, gardens, buildings and other assets
Councils identifying risk	All Coastal Councils
Context	Falling limbs from trees in public parks, gardens and nature strips is already a major issue, with most Coastal Councils receiving complaints each year for property damage or injury. While Council liability associated with these damages is generally covered by legislation (Civil Liability Act 2002), some claims incur costs and involve insurance. An increase in frequency of extreme weather events (drought, rainfall variability, storms) could result in a greater number of claims and ultimately higher insurance costs. Similarly, greater frequency of extreme weather events and associated damage to Council infrastructure will not only increase the cost of insurance premiums but also the maintenance work required to comply with conditions of insurance and sound asset management.
Existing controls	**Tree inspection and maintenance** As part of their parks and gardens works programs Coastal Councils have ongoing tree inspection and maintenance programs for high risk trees in high use areas. **Asset management** As previously noted, Councils also have general asset management programs which include ongoing inspection and maintenance of council buildings, roads and other infrastructure. Some of the maintenance work is proactive, designed to reduce the potential for damage from storms and other extreme weather events. **Insurance** Councils hold public liability insurance policies.

	Councils also have property insurance cover on their buildings and various other assets.
Gaps and deficiencies	Although Councils have active inspection and works programs in place, in light of the potential for increased claims, they may need to improve monitoring and record keeping.

Recommended region wide actions

Action L1 **Consistent application of insurance cover**

HCCREMS member Councils, in conjunction with the LGSA, should approach and lobby Statewide Mutual to seek consistent application of insurance cover in relation to damage and personal injury as a result of falling limbs and trees caused by extreme events.

This action can also be implemented in the short term and should have only minor budgetary implications for Councils.

Recommended actions for individual Coastal Councils

Action L2 **Review asset base and level of service requirements**

See recommended action A5

Action L3 **Record keeping**

Councils should review and consider enhancing their methods for recording tree inspections and maintenance work, e.g. how and what documentation is maintained. This would enhance each Council's ability to react to inquiries, to prove its due diligence and to defend potential claims.

One means of improving record keeping would be to map the location and frequency of problems associated with trees, as well as the causes. This would allow each Council to identify emerging trends and enable a more targeted remedy and proactive response.

It is expected that this action could be implemented in the short to medium term with minor to moderate budgetary implications.

4.6. Environmental Management and Protection

This section provides an overview of existing controls, gaps and deficiencies, and proposed actions for high-priority risks relating to environmental management and protection. Priority risks addressed in this section are:

Subset M: Increased pollution of estuaries, waterways and groundwater (due to leachate and pollution from waste facilities, septic tanks and sewage systems) caused by increased rainfall intensity and flooding (risk 37); Decline in viability of regional aquaculture and fisheries sector linked to changed climate (risk 38); Increased erosion and silting of waterways and estuaries due to increased rainfall intensity (risk 39).

Subset N: Loss or harm to wetlands, lakes and waterways due to reduced stream flows (risk 40); Increased incidence of algal blooms and/or reduced water quality in waterways, constructed and natural wetlands, and estuaries due to higher water temperatures and reduced flows (risk 41); Reduced water levels and increases in algal blooms impact on potable water quality (risk 42); and Increased incidence of pests and weeds in riparian zone due to altered climate regime (risk 41).

Subset O: Loss or harm to coastal ecosystems (including dunes, estuaries, mangroves, saltmarsh, intertidal zones and wetlands) and associated ecological services due to sea level rise (risk 44).

Subset P: Loss of remnant vegetation and habitat as a result of water and heat stress (risk 45); and Change in vegetation distribution and composition due to increased frequency and severity of bushfires or increased hazard reduction burning (risk 46).

Subset Q: Increased incidence of pests and weeds due to altered climate regime (risk 47).

Subset R: CPRS or other carbon pricing instrument affects the operations of solid waste facilities (risk 48).

Subset S: Increase in Council energy costs associated with carbon pricing and/or climate change responses (e.g. cooling demand) (risk 49); and Reduced thermal comfort and/or increased air conditioning load in council buildings due to increased temperatures (risk 50).

4.6.1. Pollution of waterways

Subset M **Pollution of waterways**	**Increased pollution of estuaries, waterways and groundwater (due to leachate and pollution from waste facilities, septic tanks and sewage systems) due to increased rainfall intensity and flooding (risk 37)** **Decline in viability of regional aquaculture and fisheries sector linked to changed climate (risk 38)** **Increased erosion and silting of waterways and estuaries due to increased rainfall intensity (risk 39)**
Focus	All waterways in the region impacted by stormwater, siltation from roads and other development sites or leachate from sewerage and septic systems

Councils identifying risk	All Coastal Councils
Context	Councils and other agencies are under increasing community pressure to monitor and improve the quality of water in the region's waterways and estuaries. Community concerns stem from both public health and ecological impacts. Water quality is extremely significant to the health and wellbeing of the local community, with rivers, aquifers and estuaries being utilised for a wide range of purposes including swimming, diving, boating and fishing, aquaculture and other commercial production. The ecological viability of regional estuaries and waterways is also critically dependent on maintenance of water quality. Many estuaries and wetlands in the region have national and international significance, being listed under the Ramsar Convention and/or State Environmental Planning Policy 14 for coastal wetlands (SEPP 14). Water quality of waterways and estuaries in the region is variable with some (e.g. Port Stephens, Smiths and Wallis Lake), especially in the north, being in relatively good condition compared with many other developed estuaries along the NSW coast. However, increased rainfall intensity that is projected for the region has the potential to worsen water quality stressors through increased runoff, erosion and flooding of wastewater systems.
Existing controls	**Council level controls – planning and development** Council planning, development and environmental management controls implemented through the Coastal Councils' Local Environmental Plans, Development Control Plans, Stormwater Plans and Environmental Management Plans are designed (in part) to limit impacts of developments on waterways and estuaries by: ▪ establishing water quality objectives for maintenance of ecosystem health and local waterway sensitivities. ▪ requiring Water Sensitive Urban Design; ▪ restricting the location of developments, especially in close proximity to waterways so as to maintain riparian corridors; ▪ minimising site impacts and associated runoff; and ▪ controlling septic system siting, design and maintenance. As noted in discussion under risk Subset F, Estuary Management Plans have also been prepared for most of the major coastal lakes and estuaries in the region including Hunter Estuary, Manning River, Myall Lakes, Smiths Lakes, Wallis Lake, Lake Macquarie, Brisbane Water and Tuggerah Lakes. The Commonwealth Government has also funded the Great Lakes Water Quality Improvement Plan covering Wallis Lake, Myall Lake and Smiths Lake. The plan establishes water quality objectives and actions for protecting and improving receiving (lake) water quality through improved catchment management strategies. These Plans set out additional programs and strategies designed to protect water

quality and other estuary values including:

- prevention of diffuse catchment and point source pollution (e.g. through promotion of sustainable agricultural practices);
- riparian revegetation along waterways and estuaries;
- other restoration works;
- water quality monitoring; and
- community education and awareness.

Regional level controls – monitoring, waste water treatment and landholder practices

Effluent reuse schemes have been developed by Hunter Water Corporation and Gosford Wyong Water for many of the wastewater treatment plants located in the region. These divert effluent from discharging into waterways, with the effluent being used for other purposes such as watering of agricultural pastures and golf courses.

Catchment management strategies, developed and implemented through the Hunter-Central Rivers CMA (including *Lower North Coast Catchment Blueprint* and Wallis Lake Catchment Management Plan), have objectives and a range of strategies aimed at enhancing water quality through improved landholder practices (e.g. fertilizer application and nutrient runoff).

State level controls

Controls falling under state government jurisdiction include:

- a range of state legislation that are designed (in part) to achieve protection of waterways and aquatic ecosystems from pollution and other threats (e.g. *Water Management Act*, *Protection of Environment Operations (POEO) Act*, *Environmental Planning & Assessment (EP&A) Act*, 1979, *Threatened Species Conservation Act*, 1995, *Native Vegetation (NV) Act*, 2003);
- Environmental Protection Licences issued under the POEO Act, which control point source pollution from industrial premises to waterways, including wastewater treatment facilities;
- the NSW Monitoring, Evaluation and Reporting (MER) Strategy which coordinates monitoring, evaluation and reporting on natural resource condition (including water quality and flows) by CMAs, Councils, water agencies and landholders;;
- the NSW diffuse Source Water pollution Strategy (2009);
- the NSW Oyster Industry Sustainable Aquaculture Strategy; and
- State Environmental Planning Policy SEPP 62 Sustainable Aquaculture.

Gaps and deficiencies

Planning and management

Overall environmental planning and management frameworks appear to

be sound in principle.

A review process is needed however, to ensure that the potential impacts of climate change on waterways, estuaries and water supply catchments are reflected in plans. Moreover, there appears to be some inconsistencies in the treatment of development planning and environmental management objectives between state / regional level plans (e.g. Lower Hunter Regional Strategy) and local level plans (e.g. LEPs and Estuary and Environmental Management Plans), with the result that objectives established in Councils' plans in relation to protection of waterways, estuaries and catchments are not always being met. This outcome could be exacerbated under climate change.

Water quality monitoring

Notwithstanding current monitoring programs, there are still significant information gaps in understanding of water quality in the region (partly reflecting inconsistent approaches to water quality monitoring between different agencies and groups) and understanding of factors affecting water quality.

For example, relatively little data currently exists on groundwater quality and on the impact of septic systems and other sources of pollution on groundwater quality.

Recommended region wide actions

Action M1 **Review existing state, regional and local plans**

State, regional and local strategies and plans should be reviewed to ensure that they reflect the potential impacts of climate change on the condition of waterways, estuaries and coastal wetlands.

The review should also aim to achieve greater consistency between state and local planning and environmental management objectives (especially in relation to management of waterways, estuaries, coastal wetlands and coastal foreshore areas).

The review will require the coordinated involvement of state government (through the Department of Planning, Department of Local Government, DECCW and Hunter Central Rivers CMA) and Councils. It should be feasible to undertake the review in the medium term.

Action z **Regional water quality monitoring strategy**

A region wide water quality monitoring strategy should be established to overcome existing knowledge gaps on water quality in the region. The strategy would aim to establish a central database on regional water quality to support planning and management decision making.

The strategy should be implemented at the regional level, with financial support provided by the state government (e.g. DECCW, Hunter-Central Rivers CMA, Industry and Investment NSW) and regional water agencies.

Implementation of this action should happen over the medium term.

Action M3 **Regional modelling to identify water and nutrient runoff**

HCCREMS, in partnership with relevant government agencies (e.g. Hunter-Central Rivers CMA, DECCW and Industry and Investment NSW (Fisheries Conservation Branch)), should implement regional modelling to identify water and nutrient runoff in basins and catchments under different rainfall scenarios. The modelling would build on work previously undertaken by Great Lakes Council and Hunter Water Corporation.

Research would then be undertaken to assess impacts of modelled outputs on wetlands, lakes and waterways.

This is a long term action, having moderate budgetary implications.

Recommended actions for individual Coastal Councils

Action M4 **Management strategies for high risk septic systems**

Drawing on outputs from actions B1 and M1, Councils should identify the number, location and nature of vulnerable septic systems with high potential to contribute to water pollution under regional climate change scenarios. It should apply a risk management approach, to allow for re-prioritising of vulnerable areas as more detailed information on climate change impacts become available. Council should then prepare management strategies for these systems and implement them through its asset planning and management and on-site sewage management programs. This could include GIS/GPS management systems to identify and monitor on-site sewage management systems that are located in sensitive and vulnerable locations.

This is a long term action that will have minor to moderate budgetary implications.

4.6.2. Stream flows

Subset N Stream flows	**Loss or harm to wetlands, lakes and waterways due to reduced stream flows (risk 40)** **Increased incidence of algal blooms and/or reduced water quality in waterways, constructed and natural wetlands, and estuaries due to higher water temperatures and reduced flows (risk 41)** **Reduced water levels and increases in algal blooms impact on potable water quality (risk 42)** **Increased incidence of pests and weeds in riparian zone due to altered climate regime (risk 43)**
Focus	Waterways and estuaries, especially standing, warm water bodies with elevated nutrient levels

Councils identifying risk	Wyong, Gosford, Lake Macquarie, Newcastle, Port Stephens, Great Lakes
Context	In recent years, the region has experienced significant outbreaks of blue-green algae (Lyngbya majuscule). As well as posing risks to human health and to water-based recreational activities, algal blooms can result in significant impacts to the aquatic ecology of estuaries and waterways. The potential for elevated water temperatures and increased rainfall variability associated with climate change, combined with an ongoing problem with nutrient run-off into waterways, poses the risk of an increase in the frequency or severity of algal blooms in the future.
Existing controls	Most of the controls discussed in relation to risk Subset M are also relevant to this risk subset. Additional relevant controls include: ▪ Water Sharing Plans, implemented under the *Water Management Act 2000*, which have been developed to establish rules for sharing water between the environmental needs of a waterway and other water users such as town water, industrial use and irrigation; ▪ NSW Algal Management Strategy, which is administered by the NSW Office of Water, State Algal Advisory Group and nine regional algal coordinating committees including the Hunter Regional Algal Coordinating Committee; ▪ Algal Watch, a program designed to encourage community members to report sitings of algae blooms ▪ Protocols between Councils and the Department of Health, for dealing with algal bloom outbreaks including community information, media liaison and event control.
Gaps and deficiencies	Improved information on the potential impacts of climate change on rainfall, runoff and water availability is required. Gaps and deficiencies relevant to Subset M are also relevant to this subset.

Recommended region wide actions	
Action N1	**Regional climate change projections on rainfall and runoff** See action E1
Action N2	**Review existing state, regional and local plans** See action M1
Action N3	**Regional water quality monitoring** See action M2

4.6.3. Coastal ecosystems

Subset O **Coastal ecosystems**	**Loss or harm to coastal ecosystems (including dunes, estuaries, mangroves, saltmarsh, intertidal zones and wetlands) and associated ecological services due to sea level rise (risk 44)**
Focus	Estuaries, coastal wetlands, dunes, mangroves and saltmarshes in the Central Coast region
Councils identifying risk	All Coastal Councils
Context	The littoral zone of the Central Coast region contains many high conservation value coastal ecosystems and communities (of state, national and international significance) including estuaries, coastal wetlands, dunes, mangroves, saltmarshes, rock platforms and beaches. In recent decades population growth and development pressures have placed significant stress on many of these areas. In response, Councils and state government agencies have implemented coastal and estuary management plans that include objectives of protecting remaining high conservation values. By their nature and position though, many of these areas are exposed and vulnerable to sea level rise and associated impacts (see Box 4).
Existing controls	**Research and information** As discussed in risk Subset F, many Coastal Councils now have LIDAR (ALS) data covering some or all coastal areas in their LGAs. Drawing on this data, a number of site specific Coastline Hazard Definition and Coastal processes studies have been completed. The studies generally aim to assess hazard lines for beaches based on short term fluctuations due to storm erosion, long-term recession due to net sand loss and long-term recession due to sea level rise. **Coastal planning and environmental protection** A range of local, regional and state level environmental and planning controls have been implemented with the objective (in part) of protecting environmental values (in coastal and other areas). These controls are detailed in risk Subset M. They include: ▪ State Environmental Planning Policies (implemented through the *Environmental Planning and Assessment Act*, 1979), including SEPP 14 aimed at ensuring protection of coastal wetlands and SEPP 26 which aims to protect littoral rainforest; ▪ Local Environmental Plans (also implemented through the EP&A Act), which guide planning decisions for local government areas including in the coastal zone; and ▪ the *Threatened Species Conservation Act*, 1995, which (in

conjunction with the Commonwealth *Environment Protection and Biodiversity Conservation Act*, 1999) aims to protect threatened species, populations and ecological communities in NSW, including in coastal species and communities.

Coastal management

Most Coastal Councils have prepared or are preparing Coastline Management Studies. The studies consider management options for beaches including protective works, development controls and dune management.

Environmental or Coastal Management Plans establish programs and actions to enhance protection of the coast including, for example, mapping of unstable dunes.

Estuary Management Plans have been prepared for most of the major coastal lakes and estuaries in the region including Hunter Estuary, Manning River, Myall Lakes, Smiths Lakes, Wallis Lake, Lake Macquarie, Tuggerah lakes and Brisbane Water.

Local Coastcare programs are being implemented with the support of Coastal Councils and state agencies.

Gaps and deficiencies

Planning and management

A number of the gaps and deficiencies discussed in relation to risk Subsets M and N are also relevant to this risk subset. In particular, a review of environmental planning and management frameworks is needed to ensure that the potential impacts of climate change on estuaries and other coastal areas are reflected in plans and to remove any inconsistencies in the treatment of development planning and environmental management objectives between state / regional level plans and local level plans.

Research and information

Gaps in understanding of coastal vulnerability across the region (discussed in Subset F) are accentuated in the context of ecological values, since there is currently limited knowledge of ecosystems, and most of the coastal hazard studies completed to date tend to be focussed on the vulnerability and protection of built coastal assets. Thus there is limited information at present, locally or regionally, on the exposure and vulnerability of estuaries and coastal ecosystems to coastal erosion and inundation or (in the worst case scenario) opportunities for retreat.

Recommended region wide actions

Action O1	**Review existing state, regional and local plans** See action M1
Action O2	**High resolution integrated elevation/bathymetry datasets** See action F1

Action O3 **Smartline mapping of estuary foreshores**

See action F2

Action O4 **High resolution mapping of littoral ecosystems and habitats**

Detailed, region wide high resolution mapping of littoral ecosystems and habitats is required, including information on ecosystem and habitat types, status, connectivity and elevation. The mapping would build on existing datasets held by state government agencies (e.g. Department of Lands and DECCW) and by Coastal Councils.

The mapping could be undertaken or commissioned by HCCREMS with support of DECCW and the Land and Property Management Authority. It could be completed in the short to medium term. It would have minor to moderate budgetary implications and would directly inform strategies to facilitate the protection and retreat of high conservation value ecosystems.

Action O5 **Model coastal and estuarine inundation and erosion**

Drawing on outputs of Actions O2 to O4, HCCREMS and Councils, with the support of DECCW and the Land & Property Management Authority, should commission site specific modelling of coastal and estuarine inundation and erosion in identified highly vulnerable littoral areas. The modelling would seek to incorporate the full range of 'best available' sea level rise projections and associated storm tide heights and recurrence intervals.

The modelling could be completed in the medium term. It would have moderate budgetary implications.

Action O6 **Model habitat responses to coastal inundation and erosion**

HCCREMS, with the support of DECCW and the Department of Lands, should commission research to develop a landscape elevation and ecosystem model:

- to identify littoral habitat responses (e.g. of wetlands, sea grasses, mangroves, rock platforms, beaches and dunes) to sea level rise and coastal erosion;
- to identify high conservation value habitat areas,
- to predict habitat shifts and to identify potential opportunities for retreat.

The model would then be applied to high priority, regionally high conservation value ecosystems and habitats identified through Action O5.

Drawing on outcomes of the modelling, HCCREMS member Councils could seek to identify and protect potential retreat corridors for key high conservation value ecosystems and habitats through LEPs and Coastal Management Plans.

The modelling could be completed in the medium to long term. It would

have moderate to major budgetary implications.

Recommended actions for individual Coastal Councils

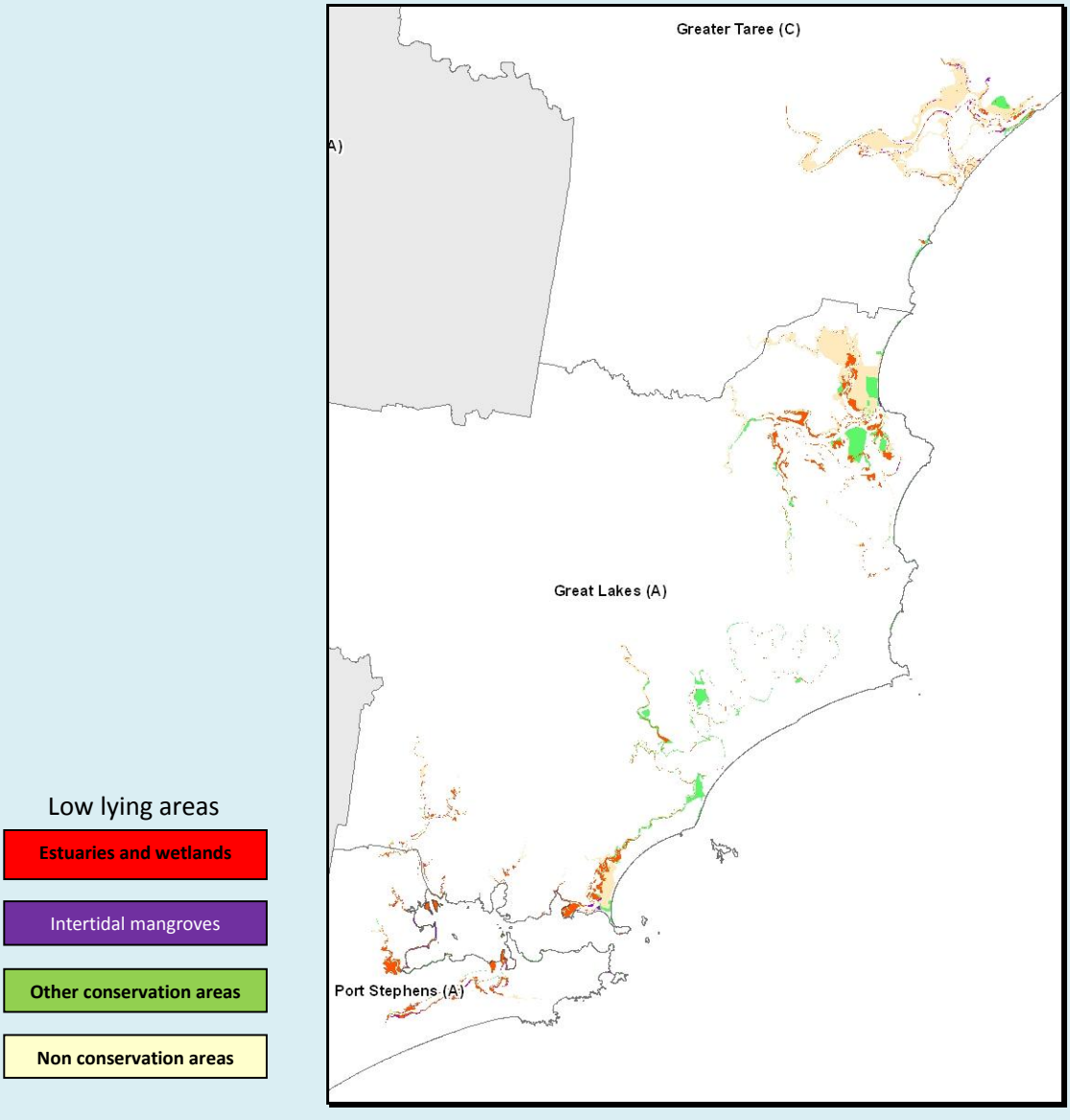
Action O7 **Review and update local planning strategies and plans of management**

Utilising the outputs of the regional actions outlined above, Councils should update local planning strategies and plans of management to facilitate conservation and retreat options for high conservation value ecosystems.

Box 4: Sea Level Rise and High Value Coastal Conservation Areas

The littoral zone of the Hunter, Central and Lower North Coast region contains many high conservation value coastal ecosystems and communities including estuaries, coastal wetlands, dunes, mangroves and saltmarshes. By their nature and position, most of these ecosystems are potentially exposed to sea level rise and associated hazards such as coastal inundation and recession. For example, an estimated 12,000 hectares, or one third of all low lying areas in the region (nominally defined as areas below 2.5 metres above mean sea level) are reserves containing high conservation value coastal ecosystems (see Figure 5). Many of these reserves are sensitive to sea level rise due to fragmentation associated with urban encroachment and other development. This is particularly true of those areas that are bounded by roads or other land uses that will prevent inland migration of ecosystems. Especially high conservation value ecosystems and locations are beaches and dune systems with soft, erodible substrates backing onto endangered ecological communities (EECs) and high conservation value wetlands (Ramsar and SEPP 14 – coastal wetlands of state significance). All Coastal Councils have exposed wetlands in the latter category.

Figure 5. Low Lying, High Value Conservation Areas on the Lower North Coast



4.6.4. Loss of remnant vegetation

Subset P **Remnant vegetation**	**Loss of remnant vegetation and habitat as a result of water and heat stress (risk 45)** **Change in vegetation distribution and composition due to increased frequency and severity of bushfires or increased hazard reduction burning (risk 46)**
Focus	High conservation value ecological communities throughout the Central Coast region
Councils identifying risk	Wyong, Gosford, Lake Macquarie, Newcastle, Port Stephens, Great Lakes
Context	The biome of the Hunter, Central and Lower North Coast region generally is classified as being 'subtropical moist' (Dunlop &Brown, 2008). Nevertheless, the region is recognised as being at the intersection of a number of bioregions, where vegetation communities from the coast, the inland and the north and south all meet. Increased temperatures and water stress associated with increased rainfall variability and more persistent and severe droughts may further reduce viability of these communities, adding to existing stresses associated with population growth and resulting urban development, land clearing, fragmentation and pests and weeds. Shared management responsibilities between Coastal Councils and other jurisdictions (e.g. DECCW) complicate potential approaches to protecting these communities, with Councils having direct responsibility for protection of communities only on roadside verges and through land use planning strategies and processes.
Existing controls	**Legislative and planning frameworks** A cascading suite of legislation, strategies and plans, designed to protect high conservation value and endangered ecological communities, are currently in place at the state, regional and local levels. State government legislation and plans include the following: ▪ The *Threatened Species Conservation Act* 1995 (administered by DECCW) is designed to identify and protect native plants and animals in danger of becoming extinct. ▪ 'Threatened Species Priority Action Statements' are required for all threatened species listed under the Act. ▪ The NSW Government has adopted targets to maintain or improve the condition and trend of the State's natural resources including biodiversity. Local and regional plans and strategies include: ▪ Councils' Local Environmental Plans and Development Control

Plans. These establish conservation zones in respective LGAs and set requirements for the protection of native vegetation in relation to developments.

- A 'Catchment Action Plan' (Hunter-Central Rivers CMA) that sets management targets and investment priorities, including in relation to high conservation value ecological communities, in the Hunter-Central Rivers catchment.

Management and restoration programs

Regional and local management and restoration programs are implemented to give effect to the objective set out in the plans and strategies. These include:

- Land use planning processes and conservation plans;
- collaborative roadside vegetation protection initiatives, between HCCREMS member Councils, implemented through the 'Regional Roadside Environmental Management Program' (consistent with Catchment Action Plan priorities);
- Landcare initiatives; and
- Incentive programs for biodiversity protection on private land (e.g. voluntary partnership agreements).

Research / data collection / monitoring

The Hunter Regional Biodiversity Conservation Strategy (HRBCS) commenced in 1998 to collect baseline data on the biodiversity of the Hunter, Central and Lower North Coast region. Data collected through the plan is intended to guide land use and planning decisions in the region. Initiatives implemented through the plan include:

- Region wide mapping of vegetation communities;
- flora and fauna surveys; and
- habitat modelling.

More recently, a natural resources Monitoring, Evaluation and Reporting (MER) Strategy has been initiated at the state level to collect data on the condition of assets covered by 13 natural resources target areas and the pressures on those assets (including native vegetation, native fauna, threatened species and invasive species). State of the catchment reports are to be produced through the MER, with a Hunter-Central Rivers State of the Catchment report due for release in 2010.

Gaps and deficiencies

Key deficiencies with existing frameworks and programs include:

- insufficient resources (financial and staff), with the result that strategies and plans are often not fully and effectively implemented at the local level;
- notwithstanding initiatives implemented through the HRBCS, there is insufficient data and other information on existing status and threats to endangered species and ecological communities and on changes arising from climate change;

- (at times) lack of integration between State, regional and local planning frameworks, a crucial issue given shared management responsibilities for protection of threatened species and communities; and
- the need for more effective community education and engagement on the impacts land use decisions on the viability of regionally and locally significant ecological communities.

Deficiencies are magnified by the potential impacts of climate change.

Recommended region wide actions

Action P1 **Research into endangered species and communities risk factors and impacts of climate change**

HCCREMS, in partnership with member Councils and relevant state and federal government agencies (e.g. Hunter-Central Rivers CMA, DECCW and Department of the Environment, Water & Heritage and the Arts (DEWHA)) should implement a research program aimed at:

- identifying key risk factors likely to impact on the long term conservation of Commonwealth and State threatened species and ecological communities located in the region arising from climate change;
- identifying projected changes to these communities and species arising from regional climate change scenarios;
- identifying projected spatial change to the location and extent of high conservation value communities (utilising region wide vegetation mapping); and
- developing a `threat ranking' to assess the overall risk to threatened and high conservation value species and communities arising from climate change and other degrading / threatening processes to inform conservation planning priorities.

This action could be implemented in the short to medium term and would directly inform conservation planning priorities. Subject to funding, it is likely to have moderate budgetary implications.

Action P2 **Planning tools, education and conservation incentives programs**

Building on the outcomes of P1, HCCREMS Councils should:

- develop regional planning tools and frameworks to facilitate long term conservation of species and communities identified as being at risk from climate change;
- facilitate enhanced education and engagement programs by Councils with their local communities, highlighting the increasing importance of wildlife corridors / refugia for the long term viability of regionally significant ecological communities and the implications of land use decisions; and
- actively assist Councils to target conservation incentive programs to

high conservation value locations.

This action could be implemented in the medium to long term. It is likely to have minor to moderate budgetary implications.

Recommended actions for individual Coastal Councils	
Action P3	**Planning tools , education and conservation incentives programs** Drawing on outputs of action P1 and P2, Coastal Councils and state government agencies (e.g. Hunter-Central Coast CMA and Department of Planning) should: ▪ update planning tools and frameworks to improve conservation of regionally high conservation value ecosystems (e.g. through land use zonings and development controls); ▪ enhance education and engagement programs with local communities, highlighting the increasing importance of wildlife corridors / refugia for the long term viability of regionally significant ecological communities and the implications of land use decisions; and ▪ actively target conservation incentive and council works programs to high conservation value locations. This action could be implemented in the medium term. It is likely to have minor budgetary implications.

4.6.5. Pests and weeds

Subset Q **Pests & weeds**	**Increased incidence of pests and weeds due to altered climate regime (risk 47)**
Focus	Roadside verges, reserves and agricultural land
Councils identifying risk	Gosford, Lake Macquarie, Newcastle, Port Stephens
Context	Invasive weeds (both noxious and environmental) can be a serious threat to the natural environment, as they displace native species and reduce water quality, farm and forest productivity. Noxious weeds are a particular concern. The *Noxious Weeds Act 1993* requires control of noxious weeds by landholders and councils to reduce the threat they pose to human and animal health (e.g. allergies) and to control the potential for increased distribution and density. Pests and weeds are usually opportunistic breeders with wide climatic tolerance. They have the potential to dominate ecological niches if native species are placed under stress as a result of climate change.

Existing controls

Legislative and planning frameworks

The Noxious Weeds Act, 1993 defines the roles of governments, councils and private landholders in the management of noxious weeds and sets up control actions for the various noxious weeds, based on their potential to cause harm to the community and/or environment.

As noted in the discussion under risk Subset P, a MER has been implemented at the state level to collect data on the condition of natural assets and the pressures on those assets including from invasive species. A State of the Catchment report, to be produced through the MER, should contain updated information on threats to the Hunter-Central Rivers catchment from pests and weeds.

Regional management

Wyong, Gosford, Lake Macquarie, Newcastle and Port Stephens Councils are all members of the Hunter and Central Coast Regional Weed Management Professional Team that comprises representatives from each of the Lower Hunter and Central Coast Councils and the Upper Hunter Weeds Authority. A regional weed management strategy has been developed that aims to provide the overriding framework to manage weeds on a strategic landscape scale through coordination in planning, investment and operational activities on a regional basis across landscapes, land management boundaries (irrespective of tenure) and local control authority jurisdictions.

Greater Taree and Gloucester Councils are members of the Mid North Coast Weeds Advisory Committee which also has a regional weeds management strategy.

Most Coastal Councils also have noxious weed officers, who are actively involved in locating and eradication of declared noxious weeds on roadsides and other council land. The noxious weed officers are also responsible for inspections of private property for declared weeds under the *Noxious Weed Act*.

Gaps and deficiencies

Planning and management

Notwithstanding development and implementation of Regional Weed Management Strategies, there are still significant gaps in pest and weed planning and management in the region. In particular, there is a need for improved regional coordination in the planning and management of pest animal threats to natural assets.

Furthermore, a review process is probably needed to ensure that the potential impacts of climate change on pests and weeds are reflected in plans and strategies. Moreover, extreme events, such as heavy rain and storms, prevent works in relation to pest and weed control and can contribute to the spread of weeds, particularly aquatic weed species. This needs to be reflected in plans and strategies.

Roles and responsibilities

It appears that there is a lack of communication and integration between agencies and councils, and roles and responsibilities at the state level and

the regional/local level are not clearly defined. As a result, objectives established in Councils' and regional pest and weed control plans might not always being met. This outcome could be exacerbated under climate change.

Community awareness and education

Based on stakeholder discussions, it seems that the broader community is not being effectively informed and engaged in local and regional pest and weed management efforts. The success of Councils' weed management largely depends on the effective management of pests and weeds on private land, to control the spreading of weeds within the region.

Resources / funding

Sufficient (and timely) funding for pest and weed management is an ongoing issue and likely to be exacerbated, if climate regime impacts increase the occurrence of pest and weeds.

Recommended region wide actions

Action Q1 **Research and ecological niche modelling**

HCCREMS, in partnership with Councils, weed management authorities and relevant state government agencies (e.g. Hunter Central Rivers CMA and Industry and Investment NSW), should commission research that applies ecological niche modelling approaches to identify projected changes in climate on likely future terrestrial weed distribution and impact scenarios at regional and sub-regional scales. Funding should be sought from Industry and Investment NSW and other relevant State and Commonwealth Government agencies.

This is a medium term action, requiring collaboration between Councils and other agencies. Costs to Councils are likely to be minor.

Action Q2 **Review existing policies and implement an education strategy**

Once completed, outputs from Q1 should be used to:

- review relevant policies and programs in existing regional weed management strategies;
- inform relevant staff in Councils and other stakeholder organisations; and
- develop and implement a regional education strategy to raise community awareness of the issues and problems of climate change for regional weed distribution.

This action can be implemented in the medium term. With cost sharing and/or funding, costs to Councils are likely to be minor.

Action Q3 **Regional coordination of pest animal management**

Drawing on experiences of the regional approach to noxious weed control, HCCREMS member Councils and the Hunter-Central Coast CMA should consider approaching the NSW Livestock and Pest

Authority to establish a regionally coordinated approach to pest animal control.

This action can be implemented in the short to medium term. With cost sharing, costs to individual Councils are likely to be minor.

4.6.6. CPRS or other carbon pricing instrument increases cost of council waste services

Subset R Waste management	**CPRS or other carbon pricing instrument affects the operations of solid waste facilities (risk 48)**
Focus	Council operated landfill facilities
Councils identifying risk	Greater Taree, Great Lakes
Context	Costs associated with managing landfills have been increasing in response to community expectations and government policies requiring changes to waste disposal and waste management practices. These changes have been driven by general 'sustainability' objectives including the need to reduce greenhouse gas (GHG) emissions. In the medium to long term it is likely that a mechanism will be introduced that has the effect of pricing GHG emissions including emissions from landfills, a move that will accelerate the ongoing trend of increasing landfill management costs. Although Councils can pass on cost increases to users of landfill facilities, its capacity to do so can be constrained by social and political factors.
Existing controls	**Landfill levy** Landfill levies applied and administered in NSW by the Department of Environment, Climate Change and Water encourage diversion of waste from landfills. **Waste management strategy** Greater Taree and Great Lakes are members of MIDWASTE, a regional forum made up of eight member Councils located on the Mid North Coast, whose focus is regional co-operation in waste management and waste minimisation. A major objective of MIDWASTE is to provide measurable diversion of waste from landfill. To that end, MIDWASTE has a three year 'Regional Resource Recovery Strategy', which establishes a range of measures to be implemented by Councils to reduce waste going to landfill including through: ▪ a waste education strategy; ▪ monitoring of waste volumes and types diverted from landfill; ▪ regular reporting of waste diversion to DECCW.

The two Councils have also established a partnership with Gloucester to deliver more cost-efficient waste disposal services.

Emissions monitoring

Calculation of emissions using the Solid Waste Emissions Calculator provided by the Department of Climate Change and Energy Efficiency suggests that the emissions from Councils' landfills are currently below the annual statutory threshold of 25,000 tonnes that requires reporting. However, this may change in the future, either due to a lowered threshold or increased waste levels.

Gaps and deficiencies

NGER reporting

Currently, there remains some uncertainty as to whether The National Greenhouse and Energy Reporting (NGER) Act applies to "unincorporated entities" including local Councils. Although, the Australian Government has stated that it intends to amend the NGER Act so that it will apply to unincorporated entities in the future, when these changes will take place and how they will affect local council reporting of landfill waste emissions, is unclear.

Community education

Waste education strategies pursued through MIDWASTE and other coastal council have provided significant information to the community on the benefits of recycling. Nevertheless, it is apparent from waste monitoring data that considerable unseparated waste is still going to landfills in the region. It is also apparent from illegal dumping and other community practices that sections of the community still do not understand the purpose and benefits of landfill levies or the environmental costs associated with illegal dumping.

Green waste

Green waste separation and diversion is currently limited in the municipalities to garden waste and then only to townships/urban areas.

Recommended region wide actions

Action R1

Regional waste management network

Coastal Councils that are not currently members of MIDWASTE, should consider establishing a regional waste managers' network (with support from the NSW Waste Association and DECCW). The purpose of the network would be to:

- share information and knowledge;
- develop a regionally consistent approach to waste policy and management; and
- actively identify and pursue regional and sub-regional opportunities for reducing carbon emissions from waste (e.g. improved waste separation, composting, energy recapture etc).

The network could potentially build on the functions of the established

Regional Illegal Dumping Working Group.

This action can feasibly be implemented in the short term and would have only minor budgetary implications for each council.

Action R2 **Surveys to identify regional volumes of specific waste types**

Proposed initial research by the MIDWASTE and regional waste managers' network would include surveys to identify regional volumes of specific waste types (organics, general waste, construction and demolition, and dry recyclables), as a basis for improving regional waste separation and capturing opportunities to reduce carbon emissions from waste.

This action can be implemented in the short term and is likely to involve only minor costs to individual Councils.

Action R3 **Clarify NGER reporting requirements**

MIDWASTE and the regional waste managers' network, with support from the LGSA, should lobby the Australian government to clarify as soon as possible local council reporting requirements under the NGER Act, particularly with respect to emissions from landfills.

This action can be implemented in the short term and will involve only minor costs.

Action R4 **Community education on front end separation of waste, landfill fees and illegal dumping**

MIDWASTE and the regional waste managers' network, with support from the NSW Waste Association, should consider regional education campaigns to improve community awareness of the benefits of front end separation of waste going to waste stations, the purpose of landfill fees (as a user pays mechanism, including for potential future carbon costs) and the costs associated with illegal dumping.

This action can be implemented in the short term and is likely to involve only minor costs to individual Councils.

Action R5 **Options to increase diversion of organic waste**

MIDWASTE and the regional waste managers' network should investigate options to collaboratively increase diversion of organic waste from landfills. Options include but are not limited to:

- investment in and provision of technology by operators on site or at centralised facilities to divert and treat organic waste from landfill; and
- adjustments by Councils to their waste collection regime to enable households to put organic food waste into 'green bins' along with garden waste, for regular collection.

Investigation of options can be undertaken in the short to medium term. Implementation of option(s) is a long term action and is likely to involve major costs.

4.6.7. Energy management

Subset S Energy management	**Increase in Council energy costs associated with carbon pricing and/ or climate change responses (e.g. cooling demand) (risk 49)** **Reduced thermal comfort and/or increased air conditioning load in council buildings due to increased temperatures (risk 50)**
Focus	Energy consumption by Coastal Councils including in their buildings, transport fleet and for street lighting
Councils identifying risk	Wyong, Gosford, Lake Macquarie, Newcastle, Port Stephens, Great Lakes
Context	Although energy costs account for a relatively small proportion of Councils' budgets, a significant increase in energy prices (e.g. due to the Carbon Pollution Reduction Scheme or other carbon pricing initiative) could have a significant financial impact on its budget bottom line.
Existing controls	**Emissions assessment and strategies** Coastal Councils were members of the Cities for Climate Protection Program through the 2000s[13]. Under the program, Councils undertook a baseline assessment of their greenhouse gas (GHG) emissions and initiated a range energy savings and emission reduction initiatives. Most Coastal Councils have also developed an Energy Savings Action Plan, as required under the *Energy Administration Amendment (Water and Energy Savings) Act* 2005. **Community energy efficiency programs** Councils participate in a number of programs promoting energy efficiency and GHG emissions reduction in the community.
Gaps and deficiencies	**Monitoring and benchmarking** At present, there is not a clear and consistent approach to monitoring and benchmarking of energy consumption and GHG emissions at either an individual council, regional or national level. Thus, although Councils are currently tracking their energy consumption, it is not clear how this information will be used to assess the effectiveness of current and future energy efficiency programs. **Council energy efficiency programs** Other than the HCCREMS FOCUS on Facilities Program, there is not currently a coordinated program targeting energy efficiency and emission reductions across all Coastal Councils. Lack of such a program can in part be attributed to a dearth of resources for program implementation but also could reflect the absence of clear lines of responsibility, from senior management down, for implementing energy efficiency measures in

[13] Cities for Climate Protection ceased providing support to councils after 2008/2009.

Councils.

Recommended region wide actions

Action S1 **Funding for a regional energy efficiency and emissions reduction strategy**

HCCREMS Councils should seek funding for a regional energy and water efficiency and emissions reduction strategy. The strategy would target council facilities across the region and involve:

- audits of energy consumption in facilities;
- energy efficiency measures for identified high priority facilities;
- an accurate and consistent approach to benchmarking energy consumption and emissions to ensure accurate monitoring and assessment of energy and emission reductions pursued through energy efficiency measures; and
- guidelines and design specifications for new (or upgraded) council buildings to ensure high levels of thermal comfort and energy efficiency.

Funding should be sought in the short term. Once funding has been obtained, program implementation would proceed over the medium to long term.

Recommended actions for individual Coastal Councils

Action S2 **Assessment and implementation framework for energy efficiency and emission reduction programs**

Councils should establish an assessment and implementation framework for proposed energy efficiency and emission reduction programs. The framework should include:

- cost effectiveness assessment of programs;
- priority setting;
- clear lines of responsibility for implementation;
- a timeframe for implementation; and
- program monitoring.

This action would be implemented in the medium term consistent with outcomes of Action S1.

5. Conclusion

5.1. Risk Assessment and Adaptation Plan Review

Climate change poses a number of challenges for Coastal Councils. The climate change risk assessments undertaken for the councils identified hundreds of risks to their objectives and areas of operation. Fifty of those risks were rated 'High' or 'Extreme' by a number of Coastal Councils and, as such, have been identified as 'priority risks' for the purpose of adaptation planning by the councils. Of the 50 priority risks, 11 relate to infrastructure and assets, nine to coastal and flood planning and management, eight to emergency management and community wellbeing, five to corporate services and 14 to environmental management and protection.

Treatment of risks is an essential next step in the risk management process. In climate change parlance, the treatment of risks is generally referred to as 'adaptation'. It is apparent from engaging with staff at workshops and subsequent analysis that Coastal Councils already have in place many policies, programs and measures that are relevant to the priority risks. This is unsurprising given that many of the climate change risks to the Councils add to or intersect with pre-existing risks. It is equally apparent, both from the risk assessment and adaptation planning processes that the Councils will need to implement additional measures, if the risks of climate change to the organisation and to its objectives are to be effectively addressed.

Section 4 of this report contains some 80 actions for addressing the priority risks. In particular, these actions identify collaborative opportunities for Councils to respond to climate change. When implemented together, the actions will provide Coastal Councils with an initial response to the challenges of climate change.

Table 8 provides an overview of the different types of actions proposed in the Action Plan.

Table 8. Categories of recommended adaptation actions

Category of action	Number of actions	
	Region wide	Council
Changes to legislation / regulations/ standards	1	1
New / amended strategies and plans	11	7
Improved decision-making processes	6	8
Research and information collection	16	3
Community education, engagement and capacity building	7	1
Training and information sharing	9	2
On-ground works (or associated funding)	4	3
Risk diversification /insurance	1	-

Information in the table reveals:

- the wide spectrum of action types; and
- the substantial numbers of actions in the community education, research and training categories, highlighting the need to improve and build knowledge and understanding of climate change in the region and to enhance the capacity of Coastal Councils, other agencies

and the broader community to respond effectively to the risks posed by climate change (see Box 5).

Box 5: Knowledge and Capacity Building on Climate Change

A number of research and information collection requirements are identified in the Adaptation Plan, highlighting the need for building knowledge on climate change. In addition, numerous educations and training programs are recommended, emphasising that good information, while important, is not a sufficient condition for effective local and regional responses to the issue; capacity building - amongst Councils, other agency staff and the broader community - is also crucial to ensure that available information on the impacts of climate change is well utilised.

The Adaptation Plan points to a need to improve our understanding of the impacts of climate change at the local and regional levels, especially in relation to coastal impacts, the frequency and magnitude of flooding and ecosystem impacts. Education and training programs are especially pertinent to stormwater management and emergency management.

Research, education and training programs will tend to be more effective and efficient if they are implemented and coordinated at the regional level – hence actions in the Adaptation Plan tend to be listed as region wide actions. Actions are as follows.

Research, monitoring and data collection

- Develop guidelines that establish standard procedures for asset condition assessment and reporting by councils (Action A3)
- Model changes to extreme rainfall intensities (Action B1)
- Model down-scaled regional, climate change and associated hydrological projections (Action E1)
- Develop high resolution integrated elevation/bathymetry datasets (Action F1)
- Prepare Smartline Mapping for all estuarine foreshores in the region (Action F2)
- Identify whether additional site specific modelling of coastal and estuarine erosion is required (Action F6)
- Develop guidelines for integrating climate change projections into coastal and flood hazard models, maps and management (Action G3)
- Undertake site specific hydrological / flood modelling where the perceived risk is high and existing Flood Management Plans do not fully reflect the outcomes of region wide rainfall intensity projections and sea level rise planning benchmarks (Action G8)
- Research to improve understanding of risk perceptions (Action J2)
- Develop regional water quality monitoring strategy (Action M2)
- Regional modelling to identify water and nutrient runoff (Action M3)
- Commission detailed, region wide high resolution mapping of littoral ecosystems and habitats (Action O4)
- Commission site specific modelling of coastal and estuarine inundation (Action O5)
- Commission research to develop a landscape elevation and ecosystem model to identify littoral habitat responses to sea level rise and coastal erosion (Action O6)
- Commission research into endangered species and communities (Action P1)
- Commission research to identify projected changes in climate on likely future terrestrial weed distribution (Action Q1)
- Investigate options by member Councils to increase diversion of organic waste from landfills (Action R3)

Education and engagement, training, information sharing

- Develop regional guidelines for the design and management of new and upgraded stormwater and drainage assets (Action B2)
- Implement a region wide stormwater and professional capacity building program (Action B3)
- Undertake a regional communications and information campaign on stormwater and flood management (Actions B5)
- Develop guidelines for incorporating climate change adaptation into design criteria for new roads and bridges (Action C1)
- Establish a panel of key experts on regional transport research and programs (Action C4)
- Professional training on climate change and asset planning (Action C6)
- Prepare an information and education strategy aimed at building community awareness of coastal erosion processes (Action F4)
- Develop and deliver a capacity building program on the land use planning and legal implications of climate change (Action G6)
- Produce a regional information package to advise the community on how councils are addressing climate change in coastal and flood management processes (Action G7)
- Undertake an education campaign to promote increased households' preparedness for floods (Action H3)
- Conduct emergency preparation exercises combining multiple events, multiple agencies and across zones (Action I1)
- Establish a central access point for all regional information on emergency management procedures (Action I3)
- Training of staff to achieve a higher level of education and participation in emergency management procedures under DISPLAN (Action I5)
- Establish Community Neighbourhood Program (Action J4)
- Develop an education campaign to raise community awareness of the benefits of front end separation of waste going to waste stations, the purpose of landfill fees and the costs associated with illegal dumping (Action R2)

Another noteworthy aspect of the proposed actions is that some intersect different risk areas and subsets. Three intersecting actions worth noting are:

1. Natural Disaster Declarations and Relief Funding

The need for clarified and simplified Natural Disaster Declarations and Relief Funding arrangements is an important action in response to a number of risk Subsets in the infrastructure, emergency management and business continuity areas.

2. Coastal modelling

Modelling of coastal erosion processes and inundation under climate change scenarios will be crucial for a better understanding of risks and adaptation responses in a number of infrastructure, land use planning and environmental management areas.

3. Modelling of extreme rainfall intensity

Modelling of extreme rainfall intensity is crucial for a better understanding of risks and adaptation responses in a number of infrastructure and emergency management areas including stormwater management, transport infrastructure, traffic management and coastal management and planning.

5.2. Next Steps

5.2.1. Risk Assessment Process

It is unlikely that any severe risks have been overlooked or that risks have been seriously misrated during the local and regional risk assessment processes. Nevertheless, it is important that the local and regional scale risks that have been identified are reviewed on a regular basis. This will ensure that the relative importance of these risks remains accurate so that adaptation responses are effectively and efficiently addressing those risks of most importance.

At an individual council level, it is important that the outcomes of the local and regional risk assessment processes are integrated with other aspects of council strategic risk management and planning. Senior management should remain engaged with this process and remain responsible for maintaining the risk assessment and implementing treatments (adaptation actions) flowing from it, including actions recommended in this report. To that end, the following recommendations are made in relation to the next steps of implementation for coastal councils.

5.2.2. Adaptation Planning Process

Prioritising adaptation actions

Consistent with the good practice principles of adaptation outlined in section 3.2 of this report, it is important that the process of adapting to climate change is not a resource intensive exercise for Coastal Councils. This is why the actions identified in this report focus on regional opportunities for collaboration across councils and other stakeholders. As identified previously, a collaborative approach of this nature will significantly enhance the capacity of individual Coastal Councils to effectively respond to climate change in a timely manner.

Additionally, many of the recommended actions in this report are intended to build on existing measures. Many others aim to improve understanding of the potential impacts of climate change and potential adaptation responses and designed therefore to prevent pre-emptive actions that lead to 'maladaptation' or 'over adaptation'[14]. This approach is consistent with the concept of 'adaptive management', which is about small-scale, incremental responses, rather than major, resource intensive new programs or investments.

Prioritisation of actions is another aspect of the adaptive management approach. Before implementing recommended measures therefore, it is essential that the measures are prioritised, both within each risk subset and between risk subsets. Thus precedence would normally be given to measures that:

- have low budgetary implications;
- can be implemented in the short to medium terms;
- are not likely to be administratively burdensome;
- are not likely to face other significant barriers to implementation such as institutional or political constraints; and
- are likely to have benefits beyond addressing the direct impacts of climate change (i.e. 'win-win' outcomes).

[14] Maladaptation is an action that leads to perverse outcomes (e.g. reduce the community's ability to adapt in the long term). Over adaptation is an action that is inefficient or proves to be unnecessary.

In some instances, recommended measures may meet most of the above criteria, except the first listed. In those instances, HCCREMS and Coastal Councils should consider undertaking more detailed analysis of the measures, using cost benefit analysis or cost effectiveness for example.

Coordinated implementation

Most actions identified in the Adaptation Plan will require a coordinated approach across councils and other agencies to achieve effective implementation (see Table 8). Other actions, directed at individual councils, will require effective internal coordination.

As well as undertaking direct dialogue with relevant stakeholder agencies in the region, HCCREMS and its member Coastal Councils should be mindful of climate change adaptation priorities identified by federal and state governments. Three documents in particular have relevance in this regard:

- **National Climate Change Adaptation Framework**. The Council of Australian Governments (COAG) has developed the framework as part of its Plan of Collaborative Action on Climate Change. The framework outlines the future agenda of collaboration between governments to address climate change impacts. A key focus of the framework is to "…. support decision-makers understand and incorporate climate change into policy and operational decisions at all scales and across all vulnerable sectors". Priorities identified in the framework that are of particular relevance to Coastal Councils' priority climate change risks include infrastructure & planning; natural disaster management and tourism.
- **Adapting to Climate Change in Australia**. In 2010, the Australian government released a position paper on Adapting to Climate Change in Australia. The position paper identifies six national priority areas for action, two of which – infrastructure and natural disaster management – are very relevant to Coastal Councils' Adaptation Plan.
- **NSW Climate Change Action Plan**. This is currently under development through the NSW Department of Environment, Climate Change and Water.

Response to non-priority risks

As previously noted, the adaptation plan addresses 50 'priority risks'. Nevertheless, risks that are not addressed in this adaptation plan should not be ignored. Coastal Councils should maintain a 'watching brief' on non-priority risks as a part of the review process outlined above. This means:

- reviewing the ratings of non-priority risks as new information comes to light;
- upgrading a risk to 'priority' should new information indicate a 'high' or 'extreme' risk rating in the short to medium term and an 'extreme' rating in the longer term;
- identifying adaptation actions for the upgraded risks.

5.2.3. Look for Opportunities

The focus of the Adaptation Plan is on addressing risks of climate change. Climate change however, is likely to create opportunities for Coastal Council and the communities they represent. Certain opportunities could stem from favourable climate changes while others could stem from international, national and local responses to the impacts of climate change (e.g. improved building design). Coastal Councils should investigate these opportunities and incorporate measures aimed at realising them into their climate change response.

5.2.4. Recommendations for Implementing the Action Plan

A key means through which the outcomes of this report can be progressed at the individual Council level is through integration of its recommendations within Council's strategic planning processes. As stipulated in the Planning and Reporting Guidelines for local government in NSW (NSW Division of Local Government, 2010), the Community Strategic Plan is now the highest level plan that councils are required to prepare.

1. On that basis, it is recommended that in the process of formulating their Community Strategic Plan Coastal Councils should consider integrating the outcomes of this Climate Change Adaptation Plan (including proposed actions and other recommendations).

Additionally, the following recommendations are made for implementing this Action Plan at the regional level:

1. Establish a regional technical reference group, co-ordinated by HCCREMS, to oversee prioritisation, implementation and evaluation of regional adaptation actions identified for Coastal Councils
2. Engage key external stakeholders identified in the regional plan to encourage their participation and support in implementing the regional adaptation actions that have been identified.
3. The regional adaptation plan should be reviewed on a regular basis (e.g. every 5 years), including a review of all risk ratings and consideration of new climate change risks in the light of new scientific information and changing circumstances in the region.
4. A regional approach to communicating the outcomes of climate change risk assessment should be developed to ensure that the community is properly informed in a timely manner and does not misinterpret, understate or overstate the risks of climate change to the region.

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Glossary

ARI	Average Recurrence Interval
AR&R	Australian Rainfall and Runoff
DCCEE	Department of Climate Change and Energy Efficiency (Australia)
DCP	Development Control Plan
DECCW	NSW Department of Environment, Climate Change and Water
DISPLAN	Disaster Plan
DLG	Division of Local Government, NSW Department of Premier & Cabinet
HCCREMS	Hunter and Central Coast Regional Environmental Management Strategy
IWCM	Integrated Water Cycle Management
IPCC	Intergovernmental Panel on Climate Change
LAPP	Local Adaptation Pathways Program
LEMC	Local Emergency Management Committee
LEP	Local Environmental Plan
LGA	Local Government Area
LGSA	Local Government and Shires Association, NSW
LIDAR	Light Detection and Ranging
MER	(natural resources) Monitoring Evaluation and Reporting
NDRF	Natural Disaster Relief Fund
RFS	Rural Fire Service
RTA	Roads and Traffic Authority, NSW
SEPP	State Environmental Planning Policy
SES	State Emergency Service
WSUD	Water Sensitive Urban Design

Appendix I: Climate Change Scenarios for Coastal Councils

The climate change scenarios that were used to inform the risk assessment were broadly similar between the Councils, although scenarios used for the Greater Taree and Port Stephens risk assessments covered more than one time period, whereas the scenarios used for the other councils covered just one time period (2030).

Table 9. Climate change scenarios Coastal zone

Climate Variable	Current[1] (indicative)	Indicative change[2] (relative to current)		Comments
		2050	2100	
1. Sea level rise and storm surge				
Sea level		↑ 0.4m	↑ 0.9m	Latest projections indicate SLR of up to 1.4m by 2100
Storm tide – max height, 1:100 ARI (average recurrence interval)	1.4m	1.8m	2.3m	Based on NSW design still water levels - excludes wave setup
Storm tide – ARI (1.4 m)	1:100	1:1	na	Limited regional modelling of recurrence intervals has been undertaken to date
2. Extreme rainfall, flooding and storms				
24 hr rainfall intensity (max)	250mm	↑ up to 20%	↑↑	Based on NSW models - Hunter region not well represented. Greatest intensity increases likely in Summer
Extreme rainfall frequency (95th %ile)		↑	↑↑	Increases in Summer and Autumn, decrease in Winter.
Flooding – Annual Exceedance Probability (AEP)		↑ flash ↑ riverine	↑↑ flash ↑↑ riverine	Specific projections not available
Maximum wind gust intensity	155 km/hr	↑↓	na	Possible increase in Spring and decrease in Winter
Frequency of high wind gusts (95th %ile)		↑↓	na	Possible increase in Summer, and Autumn, decrease in Winter
3. Fire weather				
Number of very high and extreme fire danger days	16	↑ up to 24	na	Based on CSIRO projections for one site (Williamtown). Regionally specific projections are not as conclusive, although increased fire danger for Autumn is indicated

Climate Variable	Current[1] (indicative)	Indicative change[2] (relative to current)		Comments
		2050	2100	
Length of fire season		↑	na	Fire season extends further into Autumn
4. Average and extreme temperatures				
Average annual maximum temperature	23	↑ up to 1.5 °C	↑ up to 3.5 °C	Greatest increases in autumn and winter
Days per year > 37 °C	3	↑	↑↑	Specific projections not available
Days per year < 0 °C	1	no change	na	Possible decrease in winter, increases in autumn and spring
5. Average rainfall and water availability				
Average annual	1200 mm	↑ 9%	na	Increases in Summer, Winter and Spring, decrease in Autumn
Summer	350 mm	↑ 22%	na	
Autumn	390 mm	↓ 14%	na	
Winter	200 mm	↑ 19%	na	
Spring	260 mm	↑ 18%	na	
Number of rainy days per year	130	↓	↓	Specific projections not available
Average water balance (rainfall less evaporation)		slight ↓	na	No change in summer, drier in autumn, moister in winter and spring
Annual stream flows		↓ 5-10 %	na	Based on 'mid' scenario for Namoi catchment
Drought frequency	10-20% of months	↑ to 24-28% of months	na	Based on projections for NSW central-north coast

Table 10. Climate change scenarios Central zone

Climate Variable	Current[1] (indicative)	Indicative change[2] (relative to current)		Comments
		2050	2100	
1. Sea level rise and storm surge				
Not applicable				
2. Extreme rainfall, flooding and storms				

Climate Variable	Current[1] (indicative)	Indicative change[2] (relative to current)		Comments
		2050	2100	
24 hr rainfall intensity (max)	190mm	↑ up to 20%	↑↑	Based on NSW models - Hunter region not well represented. Greatest intensity increases likely in Summer
Extreme rainfall frequency (95th %ile)		↑	↑↑	Increases in Summer and Autumn
Flooding – Annual Exceedance Probability (AEP)		↑ flash	↑↑ flash	Specific projections not available
		↑ riverine	↑↑ riverine	
Maximum wind gust intensity	122 km/hr	↑↓	na	Possible increase in Spring and decrease in Winter
Frequency of high wind gusts (95th %ile)		↑↓	na	Possible increase in Summer, and decrease in Winter
3. Fire weather				
Number of very high and extreme fire danger days	16	↑ up to 24	na	Based on CSIRO projections for one site (Williamtown). Regionally specific projections are not as conclusive, although they do indicate an increase in fire danger for autumn
Length of fire season		↑	na	Fire season extends further into Autumn
4. Average and extreme temperatures				
Average annual maximum temperature	25	↑ up to 2.0 °C	↑ up to 4.0 °C	Greatest increases in autumn and winter
Days per year > 37 °C	7	↑	↑↑	Specific projections not available
Days per year < 0 °C	6	no change	na	Decrease in winter, increases in autumn and spring
5. Average rainfall and water availability				
Average annual	810 mm	↑ 7%	na	Increases in Summer, Winter and Spring, decrease in Autumn
Summer	220 mm	↑ 20%	na	
Autumn	250 mm	↓ 12%	na	
Winter	150 mm	↑ 24%	na	
Spring	190 mm	↑ 5%	na	
Number of rainy days per year	120	↓	↓	Specific projections not available
Average water balance (rainfall less evaporation)		no change	na	Moister in spring and summer, drier in autumn

Climate Variable	Current[1] (indicative)	Indicative change[2] (relative to current)		Comments
		2050	2100	
Annual stream flows		↓ 5-10 %	na	Regional projections not available - based on 'mid' scenario for Namoi catchment modelled for the MDB Sustainable Yields project
Drought frequency	10-20% of months	↑ to 24-28% of months	na	Regional projections not available - based on projections for NSW central-north coast