

A Climate Risk Report

A Climate Change
Adaptation Strategy for
Nambucca Bellingen and
Kempsey

Climate Risk Pty Ltd provide specialist professional services to business and government on risk, opportunity and adaptation to climate change.

www.climaterisk.net



Climate Risk

Climate Change Adaptation Strategy

December 2010

Current Draft Prepared by:

Dr Karl Mallon

Maria Mackiewicz-Turner

Janice Wormworth

This report was prepared by:

Karl Mallon (Climate Risk)

Maria Mackiewicz-Turner (Climate Risk)

Janice Wormworth (Climate Risk)

The authors would like to acknowledge the support and valuable input from Grant Nelson, Nathan Hegerty, Liz Thomas and the staff and community of Nambucca, Bellingen and Kempsey Shire Councils.



Australian Government
**Department of Climate Change
and Energy Efficiency**

Funded with the assistance of the Australian Government
Department of Climate Change and Energy Efficiency.

Climate Risk Pty Ltd provides professional services in relation to climate change risks and opportunities. Our technical and professional staff endeavour to work to international best practice standards using experienced scientists, sector specialists and associated experts. This document is intended to stimulate ideas and generate discussion for the Nambucca, Bellingen and Kempsey Shire Councils. While the information contained is drawn from reputable sources in the public domain, Climate Risk cannot take responsibility for errors or inaccuracies within original source material. This report does not consider individual investment requirements or the particular needs of individuals, corporations or others and as such the report should not be relied upon as the basis for specific commercial or other decisions. To the extent permitted by law, Climate Risk Pty Ltd accepts no liability for decisions made, losses, expenses, damages or costs associated direct and/or indirectly from this report.

Climate Risk supports a constructive dialogue about the ideas and concepts contained herein.

© Copyright Climate Risk Pty Ltd, 2010. This document is protected by copyright. Reproduction is authorised provided that Climate Risk Pty Ltd is appropriately cited and any diagrams used retain the CR logo if it is present.

TABLE OF CONTENTS

1	INTRODUCTION.....	5
1.1	ABOUT THIS PROJECT	5
1.2	ABOUT THIS DOCUMENT	5
2	OBJECTIVE.....	5
2.1	OVERALL OBJECTIVE	5
2.2	RATIONALE.....	5
3	METHODOLOGY	5
3.1	STRATEGIC BACK-CASTING FROM A RESILIENT SOCIETY	5
3.2	SYSTEMIC ADAPTATION	6
3.2.1	<i>Council and its component parts.....</i>	8
3.2.2	<i>Council's peer group.....</i>	8
3.2.3	<i>Upstream system elements.....</i>	8
3.2.4	<i>Downstream system elements.....</i>	8
3.3	SYSTEM-WIDE RESILIENCE.....	8
4	SUMMARY OF RISK ASSESSMENT RESULTS	9
5	STATE AND FEDERAL GOVERNMENT GUIDANCE	10
5.1	COUNCIL RESPONSIBILITY AND CLIMATE CHANGE	10
5.2	FEDERAL GOVERNMENT'S FIVE THEMES FOR ACTION	11
5.3	ANZS 4360 GUIDELINES.....	12
5.4	NSW SEA LEVEL RISE BENCHMARKS	12
5.5	LEGAL EXPOSURE.....	13
5.6	INCORPORATION IN THE ADAPTATION MATRIX	14
6	ADAPTATION STRATEGY: ACTIONS AND ALLOCATIONS.....	15
6.1	RESILIENCE REQUISITES	15
6.2	INTEGRATING OVERLAPPING ISSUES	16
6.3	CLIMATE RISK DIAMOND	16
6.4	RISK AND ADAPTATION TABLES	18
7	IMPLEMENTATION PRINCIPLES.....	38
7.1	A SYSTEMS APPROACH	38
7.2	DYNAMIC ADAPTATION.....	38
7.3	ASSUME A 20C TARGET	38
7.4	AFFORDABLE RISKS	38
7.5	CLIMATE REVISED QUANTITIES	38
7.6	NET-BENEFIT UNDER CLIMATE	38
7.7	EVIDENCE-BASED ITERATIONS	38
7.8	'DIVERSITY AND REDUNDANCY'.....	38
8	PERFORMANCE MEASUREMENT AND MONITORING.....	39
8.1	STRATEGIES FOR MEASUREMENT AND MONITORING.....	39
8.2	MEASUREMENT TOOLS OR METRICS	40
9	ADDITIONAL REFERENCES	51
10	APPENDIX 1: NAMBUCCA ALLOCATION OF STRATEGY ACTIONS	52
11	APPENDIX 2: BELLINGEN ADAPTATION STRATEGY.....	66
12	APPENDIX 3: KEMPSEY ADAPTATION STRATEGY.....	80

1 Introduction

1.1 ABOUT THIS PROJECT

This Adaptation Report is the second part of a project under an Australian Government initiative designed to support local government climate change risk assessment and adaptation planning - the Local Adaptation Pathway Program (LAPP). The report accompanies the Risk Report that provided an initial analysis of climate change risks in which regional specific climate change information was developed, including downscaled climate change projections, extreme event analysis, historical re-analysis, climate variability review, and newly developed regionally specific economic modelling.

In this Adaptation Plan the objective has been to develop a comprehensive strategy to develop climate change resilience and adaptive capacity for the mid-north coast councils of Nambucca, Bellingen and Kempsey.

1.2 ABOUT THIS DOCUMENT

This climate change project follows the AS/NZS 4360 standard (as directed by the Australian Government Department of Climate Change for the funding requirements of the Local Adaptation Pathway Program). The project contains a combination of qualitative and quantitative analysis and results from staff and community workshops.

For the adaptation phase, the process has been extended to consider 'system-wide' interdependencies and the roles risk mitigation, management and transfer. Options for risk reduction, resilience building and adaptive capacity have been developed by consultation with Council staff and community representatives and these have been refined

into a series of strategic frameworks, actions and responsibilities.

2 Objective

2.1 OVERALL OBJECTIVE

The objective is to develop an adaptation strategy that will develop the resilience to climate change of the evolving society, environment and economy in Nambucca Bellingen and Kempsey, and to develop the adaptive capacity to cope with effects that cannot be predicted.

2.2 RATIONALE

Within the Mid-North Coast of new South Wales, the region defined by Nambucca-Bellingen-Kempsey region (sometimes referred to as the N-B-K region) is evolving quickly. The aim is therefore not to try to adapt today's Nambucca-Bellingen-Kempsey region to tomorrow's climate and environment, but rather to ensure that tomorrow's N-B-K region is adapted to these future conditions.

It is therefore imperative to develop a strategy to align a rapidly-changing region with a fast-changing climate. The resulting adaptation strategy must also be dynamic.

3 Methodology

3.1 STRATEGIC BACK-CASTING FROM A RESILIENT SOCIETY

To deliver the stated objective there must be a clear sense of the core climate-ready elements that will underpin a climate resilient society across the Mid-North Coast. Once this core vision is defined, it is then possible to 'back-cast' the steps required delivering the resilience, and this defines the method used.

The following steps describe the process used over the course of this overall project.

1. Establish the scenarios for various points in time which will be 'the tomorrow' for which adaptation is intended.
2. Identify the 'Mid-North Coast System' of interdependencies which makes up the fabric of the society, economy and natural environment of which councils are a part.
3. Identify the 'resilience requisites' which define the future viability, resilience and adaptive capacity of that system.
4. Identify the climate change threats to the resilience requisites through a climate change risk assessment.
5. Identify the mitigation, management and transfer options which are available to address these threats; and
6. Identify the opportunities for economic, social and environmental development under climate and carbon constraints, and the capacities needed to capture them.
7. Develop a series of metrics and targets for each of the resilience requisites which are consistent with a climate adapted trajectory.
8. Develop an Adaptation Strategy which provides a critical pathway to deliver the adaptation targets, and a means to measure progress. This should be informed by an understanding of the cost-effectiveness of adaptation options.
9. Use the Adaptation Strategy as a basis for prioritising, resourcing and timing the adaptation options, and the iterative-loops needed to adjust those options based on measured performance.

10. Integrate the Adaptation Strategy into the governance structures of Council, by incorporating the strategy into the Corporate Plan and other strategic documents which guide ongoing decision making, as well as by assigning departmental responsibility and commensurate authority.

This report elaborates on the process from steps 4 through 10, that is, it focuses on the process that follows from risk identification onward.

3.2 SYSTEMIC ADAPTATION

In this project a "systems approach" has been adopted to develop adaptation strategies for the N-B-K councils. This approach requires a thorough understanding of the key actors and elements that affect the councils' ability to execute their responsibilities. It may be useful to think of the system elements in four groups:

1. Council and its component parts
2. Council's peer group
3. Upstream system elements
4. Downstream system elements



Figure 1: Schematic diagram of the System and its key elements which affect resilience.

For this project, the model of the system may be populated as follows:

3.2.1 Council and its component parts

This includes Council's governance structures as well as each of Councils departments.

For Nambucca these are:

- Corporate Services
- Department of Engineering Services
- Department of Environment and Planning
- General Manager and Senior Management
- Council

For Bellingen these are:

- Corporate Services
- Engineering and Operations
- Environmental Health and Planning
- General Manager and Senior Management
- Council

For Kempsey these are:

- Sustainable Environment
- Infrastructure Services
- Corporate Management
- Community Engagement
- General Manager and Senior Management
- Council

3.2.2 Council's peer group

This may include:

- Neighbouring councils
- Local Industry
- Local business
- Emergency services
- Health system providers
- Rate payers/Residents
- Conservation organisations
- Heritage and cultural organisations

3.2.3 Upstream system elements

This includes actors and elements upon which Council, and those it represents, may be dependant:

- Federal Government
- State Government
- Power utilities
- Regional water and catchment utilities/ authorities
- Communication utilities
- Fuel suppliers
- The Roads and Traffic Authority
- Railway transport providers
- Air transport authorities and providers
- Biodiversity/Ecosystems

3.2.4 Downstream system elements

This includes Council's clients and the aspects of the N-B-K region's economy, society and environment that are dependent on Council:

- Rate payers/Residents
- Users of council services (eg recreational areas)
- Users of council infrastructure (eg roads/ water)
- Biodiversity/Ecosystems

3.3 SYSTEM-WIDE RESILIENCE

The reason the system and its inter-dependencies are spelled out is to highlight the fact that a council cannot adapt unless the system as a whole adapts to climate change. It will be necessary for a council to recognise the risks coming from upstream, downstream and from its peers, and thereby work to facilitate whole-of-system adaptation. In this way, risks that may be beyond council's control can also be managed.

In this project, the non-council system elements will also form part of the adaptation analysis and strategy development.

4 Summary of Risk Assessment Results

This section sets out the higher level risks identified in each of the Councils. And it is useful to note that the risks identified for the three Councils significantly overlap with only a handful of issues which are not common to all.

The full range of risks that were identified in the risk analysis are presented in the following tables, however, the higher level risks which form the focus of this adaptation plan follow directly below, which are listed on a council-by-council basis.

For Nambucca the higher level risks were:

1. Aquifer salinity
2. Urban development zones under threat from sea level rise
3. Infrastructure and asset damage due to extreme weather events
4. Increased electrical use from higher temperatures: supply issues
5. Bushfire risk to property and life due to changes in temperature and rainfall patterns
6. Reduced tourism due to increased occurrence of extreme weather
7. Coastal erosion
8. Council liability from existing approvals - community seeking redress
9. Current & future development legal issues
10. The effect of carbon prices on Council operations costs for its fleet and plant.

11. Increased building and operational costs due to costs associated with greenhouse gas emissions
12. Changes to agricultural production (primary industry) regarding all CC hazards
13. Flooding from storm surges
14. Damage to infrastructure (eg playgrounds) from extreme temperatures
15. Population movements eg away from coast, or into to flood areas
16. Pressure on biodiversity and habitat due to Increases in mean temperature and sea level rise
17. Drainage failure from sea level rise
18. Mosquitoes
19. Landslides, riverine erosion, potholes
20. Damage to bridges from flooding
21. Damage to sewerage pump stations due to flooding
22. More homes flooded
23. Possibility of mal-adaptation from the new bypass which could create new flood risks to water supply
24. Oysters may become a less viable industry
25. Local food production under stress

For Kempsey the higher level risks were:

1. Impact on assets from extreme temperatures
2. Change in agricultural viability due to increase in extreme temperatures
3. Increased water consumption during extreme temperature events
4. Increased risk of bushfire (increased season and intensity)
5. Aged population - effect on health in extreme temperature events
6. Blackouts, brownouts in extreme temperatures

7. Rainfall change, Increased vegetation growth (esp weeds)
8. Increasing impacts placed on biodiversity due to rising temperatures and changes to precipitation
9. Impact on rural production due to drought
10. Impact on industries, businesses and tourism due to flooding
11. Loss of food security during extreme weather events
12. Increased incidence of flooding affecting rural lands
13. Loss of rural lands as a rates source for Council due to sea level rise
14. Increased incidence of wetting/drying of soil horizons, affecting soils
15. Dislocation of community - flooding isolating workers/school students
16. Waterborne disease incidence risk increased eg Ross River virus due to a rise in average temperatures
17. National impact as highway/transport corridors cut due to flooding eg heavy transport/milk etc.
18. Sea level rise: Confluence of sea level rise and sea surge/storm event – with low lying coastal villages
19. Increased (high) cost to public infrastructure – due to sea surge/ storm event and sea level rise
20. Impact on service provision - local govt eg garbage
21. Increase price of petrol - need for increased public transport network
4. Increase price of energy from a carbon constrained economy
5. Threats to the sewer and water system from sea level rise
6. Isolation of the community during flooding events
7. Flooding of the Urunga CBD
8. Threats to biodiversity from various climate change hazards
9. Increased service demands (and operational costs) from various climate change hazards
10. Food security issues due to exposure to extreme temperatures and changes in precipitation patterns
11. Detrimental effects of extreme weather events to the local tourism industry

For Bellingen the higher level risks were:

1. Damage to roads from storms and flooding
2. Damage to infrastructure from storms and flooding
3. Increased bushfire risks to life and property

5 State and Federal Government Guidance

This section outlines existing NSW State and Federal Government guidance for local government and climate change adaptation.

In this section, Climate Risk identifies several climate change adaptation actions which correspond well with the risks and responsibilities facing Councils. These have been added to the options developed during workshops.

5.1 COUNCIL RESPONSIBILITY AND CLIMATE CHANGE

A useful clarification of the responsibilities of Local Governments with regard to climate change has been made by the Local Government Association of Tasmania.

“Local government provides for the health, safety and welfare of its community and if a council cannot show that it has taken preventative action against any threat to the health, safety and welfare of its community,

it faces the possibility of liability costs - costs which can be reduced if a council identifies the threats to its community and implements appropriate strategies to prevent these threats” (Local Government Association of Tasmania, 2004).

5.2 FEDERAL GOVERNMENT’S FIVE THEMES FOR ACTION

An excellent guide to the climate change issues facing local government is provided by The Department of Climate Change and Energy Efficiency (DCCWEE 2010). It pointed out that due to the close connection between local governments and their communities, local governments are well situated to educate and promote awareness of climate change.

The report lays out five general areas of adaptation actions; Policy, New Buildings and Infrastructure, Existing Buildings and Infrastructure, Community Health and Recreation, and the Natural Environment. The impact of actions in these areas can extend beyond climate change and have benefits socially, economically and environmentally. The report sets out the following actions for addressing climate change at a local government level.

“POLICY

- *Undertake a risk assessment for the local government area to identify the most significant areas of risk and to establish priorities*
- *Incorporate potential climate change adaptation actions into strategic planning where appropriate.*

“NEW BUILDINGS AND INFRASTRUCTURE

- *Where practicable, adopt climate sensitive building design that considers local cooling and heating requirements eg inclusion of natural ventilation cooling, consideration of building orientation and low energy consumption*
- *Design buildings to allow for consideration of future climate change impacts and*

incorporation of future adaptation (noting that the Building Code of Australia sets minimum standards, and it can be difficult for local governments to justify setting more stringent requirements).

“EXISTING BUILDINGS AND INFRASTRUCTURE

- *Monitor any changes to the condition in structures so that any modifications/retrofitting occurs on time and prior to failure*
- *Identify alternative options should the existing buildings and infrastructure be impacted upon in order to maintain services and connections, eg to minimise isolation of communities during an adverse storm event that puts the infrastructure at higher risk*
- *Design retrofitting to a higher standard than the minimum set where possible and practical*
- *Progressively incorporate higher design standards into asset management plans and rolling capital works programmes.*

“COMMUNITY HEALTH AND RECREATION

- *Establish the level of risk to the community of climate change impacts to assist in prioritising potential adaptation actions*
- *Control planning and activities in areas of high risk*
- *Encourage building design and public spaces that provide improved levels of thermal comfort and security, eg protection during floods or extreme wind.*

“NATURAL ENVIRONMENT

- *Analyse the risks from the initial risk assessment, such as flood liability, storm surge, species extinction, security of water supply*
- *Reduce other external stresses eg pollution or development”*

(DECCWEE, 2010).

5.3 ANZS 4360 GUIDELINES

The Council has followed the risk management approach prepared by the Australian Greenhouse Office (AGO)¹ and used in the Local Adaptation Pathways Program (LAPP) processes, “Climate Change Impacts and Risk Management – A Guide for Business and Government” (AGO, 2006). This has been augmented by additional risk management approached developed for the insurance sector (Zurich 2008)

This process assists the incorporation of climate change impacts into risk management, as well as strategic planning activities in Australian public and private sector organisations. The guide is designed to support users in the:

- Enumeration of climate change impact-related risks
- Prioritisation of risks requiring further attention
- Establishment of processes to ensure higher priority risks are managed effectively (AGO, 2006)

This document has been used to develop the initial risk assessment for Council, and has guided the consideration of this Adaptation Plan.

5.4 NSW SEA LEVEL RISE BENCHMARKS

The NSW Department of Environment Climate Change and Water (DECCW) has established benchmarks for local governments at 0.4m by 2050 and 0.9m by 2100 relative to sea levels in its Sea Level Rise Policy Statement (DECCW 2009). The Statement requires that these benchmarks are taken into account under provisions of the EP&A Act by the following:

¹ The former government body presiding over the LAPP. The LAPP is now administered by The Department of Climate Change and Energy Efficiency.

- NSW Coastal Policy
- Coastal regional strategies
- All consent authorities in planning and development approval decisions
- Where relevant for the Standard Instrument for local Environmental Plans

These benchmarks are the strategies and policies affected are all of direct relevance to local governments in NSW as the following quote from the Statement confirms:

‘Provisions under the EP&A Act require consent authorities to consider coastal and flooding hazards in their planning and development approval decisions. The NSW Coastal Policy and coastal regional strategies also require consideration of sea level rise, as does the Standard Instrument for Local Environmental Plans where relevant.

The sea level rise planning benchmarks will support consistent consideration of the influence of sea level rise on any coastal hazards and flooding risks that may influence a development or redevelopment site. The benchmarks are not intended to be used to preclude development of land that is projected to be affected by sea level rise. The goal is to ensure that such development recognises and can appropriately accommodate the projected impacts of sea level rise on coastal hazards and flooding over time, through appropriate site planning, design and development control.’

DECCW 2009a

The correct application of the benchmarks also has important legal implications for Councils:

According to a letter issued by the Deputy Director General of DECCW (Smith 2010), to Michael Coulter General Manager of Nambucca Council, local governments are considered to be exempt from liability under section 733 of the NSW Local Government Act 1993 (Exemption from liability-flood liable land and land in coastal zone) if they adopt the outlined sea

level rise benchmarks in relevant planning and decision making procedures.

Follow up calls by Karl Mallon from Climate Risk to DECCW indicate that these benchmarks also represent upper limits to be applied by councils. This means that if a council applies a higher level of sea level rise accommodation in planning than the benchmarks that it is no longer exempted from liability under section 733 of the Local Government Act. This situation might arise where a party sought redress from a council because it had spent more on a building to cope with a sea level rise of say 1.1m rather than the state benchmark of 0.9m.

The NSW DECCW has also developed a Draft Flood Management Plan (DECCW 2009b) with guidelines for local councils and other stakeholders to assist in incorporating sea level rise benchmarks into floodplain risk management planning as well as flood risk assessments for new developments. Within these guidelines it is recommended that flood risk studies use the 2100 benchmark, 0.9 metres.

'Flood studies should use the 2100 sea level rise benchmark and may use the 2050 benchmark if information on the projected extent of flooding by 2050 is likely to be relevant for future decision-making' DECCW 2009b

The effects of sea level rise also affect flood frequency, storm surge inundation and coastal erosion. And these are considered in the NSW Draft Coastal Risk Management Guide (DECCW 2009c) which also provides guidance calculations on recession of unconsolidated shorelines due to sea level rise:

'the Coastline Management Manual (NSW Government 1990) identifies a range of coastal hazards, two of which will be directly exacerbated by sea level rise – shoreline recession and coastal inundation.' DECCW 2009c.

This report also acknowledges that impacts beyond 2100 may need to be considered and

therefore suggests that 'For consideration of sea level rise beyond 2100, an additional 0.1 m per decade allowance can be used above the 2100 benchmark level.' DECCW 2009c

5.5 LEGAL EXPOSURE

The Planning Institute of Australia has found that climate change may result in liability for local governments due to a breach of the duty of care (Planning Institute of Australia, 2004).

This issue of liability flowing from regulatory change – and lack thereof – as well as mal-adaptation (failure to avoid areas of high risk in new development) has been considered by Professor McDonald of Griffith University. Her concerns are summarised in a Climate Risk report (Climate Risk, 2009):

"On regulation, Professor McDonald emphasised that the continued use of industry standards without also considering climate change would not necessarily shield infrastructure developers from litigation. Such industry standards have generally not been updated to reflect emerging climate change science and may therefore be inadequate or obsolete. This may result in significant legal exposures through potential mal-adaptation in infrastructure development which is not climate resilient.

"Professor McDonald identified areas likely to be hardest hit: areas where no insurance exists or where cover would be denied. This dearth of coverage will further expose sectors such as lenders, leading to lender withdrawals, higher interest rates and/or shorter lending terms. Under such circumstances, legal recourse may be the only option for some stakeholders who seek to recover losses.

"Professor McDonald considered how increased litigation may further complicate the situation, and given a lack of historical experience to draw

on, the issues would be dealt with on a case-by-case basis. Her view was that this should be a major focus of all stakeholders, in order to explore ways to avoid and reduce climate change related litigation. Professor McDonald stressed that future development should aim to avoid risk and future damage, to prevent potential legal challenges”

Climate Change and Infrastructure Summit – Synthesis Report (Climate Risk, 2009)

5.6 INCORPORATION IN THE ADAPTATION MATRIX

Information and adaptive options from the key sources mentioned above, along with other documents and sources, have been reviewed with regard to their relevance for the Mid-North Coast.

In the following section these have been considered within the workshop process, and where relevant have then been added to the consolidated adaptation matrix in the next chapter.

6 Adaptation Strategy: Actions and Allocations

In April 2010 a series of adaptation workshops were held in Nambucca, Kempsey and Bellingen to review the risks and identify adaptive options and opportunities.

6.1 RESILIENCE REQUISITES

During the risk analysis and adaption workshops several risk themes resonated for the groups involved, arising repeatedly for different hazards and associated with consequences that would represent a material threat to the wellbeing of the community, the economy and the natural environment.

To draw out these themes and avoid repetition of response, the actions have been grouped under several themes referred to as the ‘resilience requisites’.

The intention of the resilience requisite

approach is to identify and properly address all of the components that make up properly functioning region. This starts with basic needs such as food, shelter and water which can be threatened under many extreme events. The next priority is essential services such as power, transportation and sanitation, and the proper functioning of government, the private sector/economy and the natural environment all provide the envelope to an functional society.

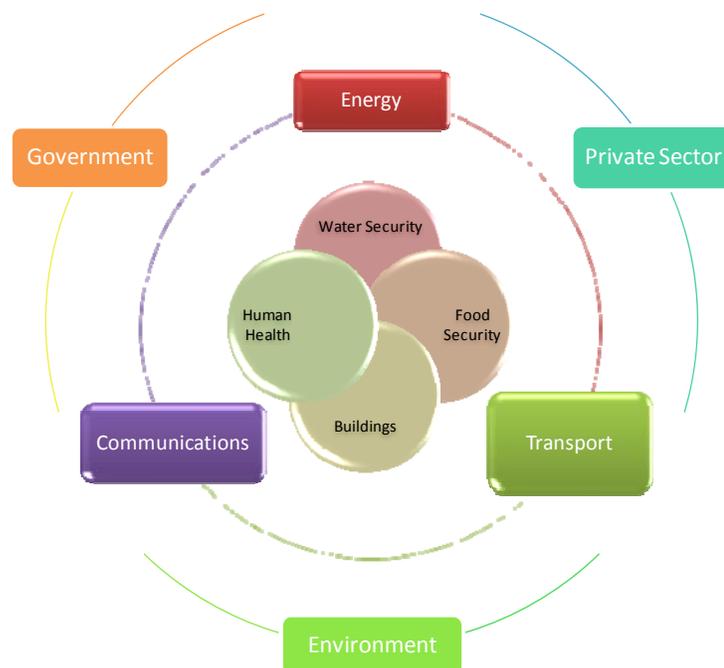


Figure 2: Schematic diagram of the Resilience Requisites for the N-B-K region.

Basic Needs:

1. Human Health Risk
2. Water Security (supply)
3. Food Security
4. Sanitation Risks
5. Built Environment Risks

Essential Services:

6. Energy Security (power and fuels)
7. Transport Security
8. Communications Security

Overarching Functions:

9. Economic Security
10. Governance (including legal and regulatory issues)
11. Natural Systems & Bio-security (agriculture and ecosystem)

For each of these security areas, a series of adaptation actions were identified (in the workshop and via desk-top research).

6.2 INTEGRATING OVERLAPPING ISSUES

The three councils have many features in common and consequently many similar risks. This implies an opportunity to share ideas across the councils, to build a more comprehensive suite of adaptation options.

In this section the original source of risks is noted on a council by council basis. The adaptation options, however, have been amalgamated and shared. These options have

also been structured according to the major resilience requisite themes developed in the 'systems analysis'.

6.3 CLIMATE RISK DIAMOND

Work for the Australian insurance sector (Climate Risk, 2008) has demonstrated the utility of describing climate change risks and adaptation options via five major elements: hazard, vulnerability, exposure, opportunity and capacity. Together, these are schematically represented by the Climate Risk Diamond. This conceptual framework may also serve Councils as they seek strategies to reduce climate change risks and capture advantages to the region through building adaptive capacity.

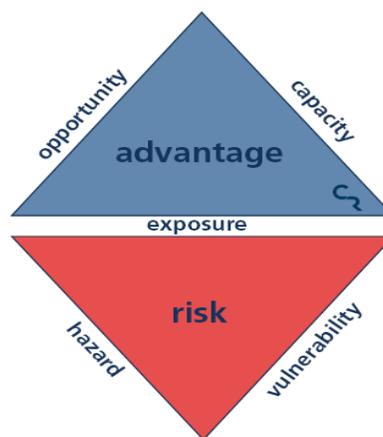


Figure 3: The Climate Risk Diamond (Climate Risk, 2008)

1. **Reduce Hazards** For example, to reduce risks, the N-B-K region will be required to achieve ongoing emission cuts to help reduce the greater hazards (such as more extreme weather) that would accompany more severe long-term warming associated with rapid emissions growth.
2. **Reduce Exposure** For example, risk reduction would also require that council avoid new development (exposures) in high risk locations.

3. **Reduce vulnerability** For example ensure new developments are designed for more severe and more frequent hazards. So that even if there is a hazard (such as severe hail) and an exposure (such as a structure in a hail prone area), the risk would be reduced.
4. **Identify Adaptive Opportunities** For example the possibility that the N-K-B region may attract industry relocating from higher risk areas, thereby allowing the region to capitalise on potential advantages.
5. **Develop Adaptive Capacity:** For example, allocate new low-risk industrial land for relocating businesses, to build the N-K-B region's capacity to realize potential advantages in the face of climate change.

The five levers outlined above also provide the basis for the risk indicators that can be used to measure progress toward resilience. However, of these, the ability of Council to reduce global emissions and thereby reduce climate change hazards is minimal. So the focus of attention for risk reduction will generally be minimising exposure and reducing vulnerability.

Where risks cannot be reduced, there remains the need to either manage these risks or transfer the risks:

6. **Manage Risks:** For example, developing emergency management plans for residents likely to be cut off for extended periods during flooding.
7. **Transfer Risk:** For example ensuring that adequate insurance is available to cover increased claims from damage due to Council trees during more frequent and severe weather.

6.4 RISK AND ADAPTATION TABLES

The following table provide a summary of the higher levels risks from the Risk Report and the set out the associated Adaptation Strategy Actions broken down according to the Resilience requisite and the type of action being applied to address the risks or build capacity.

The adaptation actions presented within this section have been placed within an Adaptation Plan for each Council. These adaptation plans are located in Appendix 1, 2 and 3. Each of these adaptation plans position the actions below within a relevant policy or strategy and departmental responsibility. The plans also identify gaps required to implement the actions and the current status of the action

Stated Human Health Risks	
Higher Level Risks Identified (by Council)	<p>B: Increased bushfire risks to life and property (note: due to increased temperature) N: Bushfire risk to property and life (note: due to increased temperature and changes in precipitation patterns) K: Increased risk of bushfire due to prolonged seasonal duration and increased intensity (note: extreme temperatures)</p> <p>K: Waterborne disease incidence risk increased eg Ross River Virus (note: increase in average temperatures)</p> <p>N: Flooding (note: due to storm surge)</p> <p>B: Isolation of the community during flooding events (note: intense precipitation) K: Dislocation of community - flooding isolating workers/school students (note: floods)</p> <p>N: Mosquitoes born disease (note: increased precipitation and mean temperature)</p> <p>K: Aged population - affect on health vulnerability (note: extreme temperatures)</p>

Human Health: Adaptation Strategy Actions	
Exposure Reduction	<p>HHER-1: Minimise the exposure of residents, businesses and visitors by using the Local Environment Plan (LEP) to limit development and access in areas at high risk from flooding and bushfire.</p> <p>HHER-2: Address climate change hazards, such as drought and heat, which may impact recreational/ open space areas and undermine their functionality; implement measures, such as shading or storm-water irrigation, to maintain functionality. Such measure would not only provide net benefits in terms of direct reduction to human health risk (such as heat-stress of injury), but also long term maintenance of human health (avoided obesity, diabetes etc).</p> <p>HHER-3: Increase availability and access to Council facilities and services that would be appropriate under a new climate regime. This may include, for example, increased access to swimming pools and beaches to provide relief from hotter summer temperatures, or indoor sports facilities for community members and tourists, increased night access to facilities.</p>

Human Health: Adaptation Strategy Actions continued	
Vulnerability Reduction	<p>HHVR-1: Use existing emergency management plans and relationships with emergency service providers to ensure that an adequate level of functionality can be developed for basic needs (food, water, sanitation and human health) and essential services (energy, transport and communications) during and post major extreme weather events which are expected to increase in frequency, severity and coincidence.</p> <p>HHVR-2: Ensure building controls adequately protect development from climate related hazards eg mandatory mosquito nets on openings, bushfire resilience.</p>
Risk Management	<p>HHRM-1: Educate residents and businesses to lower expectations of service levels, in light of the relevant climate hazards. Increase their individual resilience to cope with changes and disruptions affecting their long-term health, access to basic needs and essential services.</p>
Transfer or co-dependence	<p>HHRT – 1: Ensure that any human health strategies incorporate the climate change risks to other ‘basic needs’ and ‘essential services’.</p> <p>HHRT – 2: Ensure utility services outside of Council are aware of climate change risks in the region so they can incorporate into plans and services and seek quantification of vulnerability so that Council can plan for the events which will lead to failure of utility services. As an example forward flood mapping, seal level rise maps, Coastal Hazard Maps to Country Energy.</p>
Adaptive Capacity	

Stated Water Security Risks	
Higher Level Risks Identified (by Council)	<p>B: Damage to infrastructure from storms and flooding (note: intense precipitation) K: Impact on assets (note: extreme temperatures) N: Infrastructure and asset damage (note: storms)</p> <p>B: Threats to the sewer and water system from sea level rise (note: sea level rise and/or storm surge)</p> <p>N: Aquifer salinity (note: sea level rise)</p> <p>N: Flooding (note: storm surge)</p> <p>K: Waterborne disease incidence risk increased eg Ross River Virus (note: increase in average temperatures)</p> <p>N: Stress on water supply (note: reduced seasonal spread of precipitation rainfall and increased temperatures)</p> <p>K: Increased water consumption (note: extreme temperatures)</p> <p>K: Increased risk of bushfire due to prolonged seasonal duration and increased intensity (note: extreme temperatures – bushfires impact water quality of local catchments)</p>

Water Security: Adaptation Strategy Actions	
Exposure Reduction	<p>WSER-1: Implement planning controls and incentives which encourage/ maximise on-site water harvesting in all new development.</p> <p>WSER-2: Investigate and implement measures to mitigate the impacts of increased temperatures on water quality, such as through measures for aeration of storages.</p> <p>WSER-3: Implement or extend the Integrated Water Cycle Management System to provide additional water sources from harvesting, recycling, grey water use, and collection of storm water.</p>

Water Security: Adaptation Strategy Actions continued	
Vulnerability Reduction	<p>WSVR-1: Implement planning controls and incentives that decrease water use in all new development.</p> <p>WSVR-2: Ensure Council's Water Supply System is prepared for seasonal changes in water availability, more specifically a reduced mean monthly winter rainfall. This will include the provision of water storage and extraction licenses to capture the increased summer rainfall and maximize water security while limiting the winter extraction of water (when flows are reduced due to climate change) and minimizing impacts on environmental flows. Water storage capacities must be sufficient to capture increased precipitation in summer to meet needs through dry winters.</p> <p>WSVR-3: Update risk guidelines/specifications for Council infrastructure, to cope with weather-related events that may be affected by climate change (eg, flood risk), to reflect projected rather than historical risk levels. Since this risk is evolving, the coping capacity must correspond to that at the end of the asset life. (For example, a storm water drain designed to last 100 years and cope with a 1 in 100 year event, must be specified for the future 1 in 100 year flood levels which are likely to be considerably higher).</p>
Risk Management	<p>WSRM-1: Ensure inappropriate water extraction practices are not undertaken during periods of low flow. Extraction regimes should consider the projected reduction in mean monthly rainfall. (eg, bore fields, river extraction).</p> <p>WSRM-2: Consider measures to encourage changes in demand in keeping with seasonal water availability such as the projected reduction in winter rainfall and demand increases during the predicted hotter summer months.</p>
Transfer/ co-dependence	<p>WSRT-1: Seek cost sharing with State and Federal Governments for measures which do not provide short-term cost-benefit, but would increase water security.</p>
Adaptive Capacity	<p>WSAO-1: Develop strategies to capture economic and livability advantages for this region, which has comparatively high water security compared to other parts of the Eastern seaboard.</p>

Stated Food Security Risks	
Higher Level Risks Identified (by Council)	<p>B: food security (note: increased mean temperature and changes in precipitation patterns) K: Loss of food security (note: extreme weather)</p> <p>N: Local food production under stress (note: reduced rainfall and increased temperatures) K: Impact on rural production (note: drought)</p>

Food Security: Adaptation Strategy Actions	
Exposure Reduction	FSER-1: Implement controls to ensure regionally/nationally significant agricultural land remains available for farming. This is important because other parts of the State and Australia will experience reductions in water availability and temperature changes in areas which are currently suitable for agriculture.
Vulnerability Reduction	<p>FSVR-1: Provide controls that enhance the maintenance and development of local food production. These might take the form of flood management capacity for farms. Also, measures to identify and implement greater on-site or in-stream water storage will allow farmers to make use of elevated summer water levels during times of reduced water availability in winter.</p> <p>FSVR-2: Educate the agriculture sector on the regions potential climate risk, including provisions of climate change data available to Council, so Council can assist them in transitioning to crops and stock better suited to the changing climate.</p>
Risk Management	FSRM-1: Incorporate food security actions into existing emergency management plans. (eg DISPLAN). This must ensure that adequate food stocks are available for isolating incidents of increasing duration. It must include plans for shared refrigeration of perishable goods, with back-up power at pre-agreed locations (eg, a single supermarket in each location likely to be isolated). Contingency contracts should be established as required.
Transfer/ co-dependence	<p>FSRT-1: Seek a revision of water license conditions for water extraction from local rivers during summer high rain periods, which are more appropriate for the Mid-North Coast</p> <p>FSRT-2: Investigate expansion of Regionally Significant Farmland into lands not affected by climate change risks.</p>
Adaptive Capacity	FSAO-1: Identify Climate change resilient agricultural land for inward investment and an influx of new farmers who are investigating options. This should be based on harnessing agricultural lands which would be forecast to maintain current water levels under climate change scenarios; these lands would be at a relative advantage compared to lands in south-west and south-east Australia.

Stated Sanitation Risks (Waste and Storm Water)	
Higher Level Risks Identified (by Council)	<p>B: Threats to the sewer and water system from sea level rise (note: including storm surge) N: Damage to sewerage pump stations (note: extreme precipitation and sea level rise)</p> <p>B: Damage to infrastructure from storms and flooding (note: intense precipitation)</p> <p>N: Damage to infrastructure (note: extreme temperature)</p>

Sanitation Risk (Waste and Storm Water): Adaptation Strategy Actions	
Exposure Reduction	<p>SRER-1: Review water reticulation, waste water and storm water distributions systems and assets in the light of all identified climate hazards (including physical hazards and possible effects of carbon price on costs of operation). Use the results of this review as the basis for developing a management plan for a climate-proof waste water system with minimised exposure to climate change hazards.</p> <p>SRER-2: Undertake a review of sea level rise and flooding risks to 2300. Adopt planning controls that ensure new developments are limited to locations where infrastructure is viable into long term . (Note sea levels will continue to rise for 300 years even without the contribution of current greenhouse gas emissions to climate change). If development does occur in locations where viable infrastructure cannot be assured, require that developers make stand-alone arrangements for their wastewater treatment.</p> <p>SRER-3: Council will ensure that the level of service provided to communities in high risk locations is sustainable and that new development involving water and sewer infrastructure is technically viable and cost effective over the very long term (2200). Council will undertake process of review of existing assets and services which cannot be cost-effectively maintained by Council based on the current rates (eg to low lying coastal communities). Where communities wish to continue to live in the areas, Council will identify the measures for specific levies to cover the actual cost of providing the services or if regulation constrains the ability of Council to recover the costs, Council can investigate options to transfer ownership of the assets to the relevant communities.</p> <p>SRER-4: Undertake cost-benefit analysis of options to transfer coastal waste water assets to new dedicated utility or establish collaboration with neighbouring Councils if their systems may be better positioned to manage under climate change.</p> <p>SRER-5: Develop Thresholds for development requiring Council infrastructure to be constructed and maintained. An example would be to only allow development requiring a pump station where a predetermined number of lots are involved.</p>

Sanitation Risk (Waste and Storm Water): Adaptation Strategy Actions continued	
Vulnerability Reduction	<p>SRVR-1: Implement process to identify and remove storm water connections into waste water system combined with associated amnesty for disclosure of such connections.</p> <p>SRVR-2: As an extension to the management plan to minimise exposure, a resilience management plan is required to flood-proof sewerage and storm water systems. This would include the use of one-way valves and modification of release points within the system to cope with floods, and schemes to connect septic system in high risk locations to mains sewerage. The plan should address the costs by either subsidizing the work or issuing notices for the work to be undertaken. This management plan should encompass the issue of back-up power systems for all pumping stations, which will be needed to avert disruption in the face of anticipated increases in power outages caused by severe weather.</p>
Risk Management	<p>SRRM-1: Identify components of water, waste water and storm water systems that cannot be climate change -proofed, and which will require intervention if they are to remain functional. Develop strategies to address the vulnerability of these components which should consider the expected frequency and duration of disruptive events such as flooding and power outages.</p> <p>SRRM-2: Develop actions/strategies to manage loss of infrastructure during extreme weather events. These actions may include a component of community education in order to protect human health and the natural environment.</p>
Transfer/co-dependence	<p>SRRT-1: Review cost-benefit scenarios of options to transfer at-risk assets to other utilities or new utility, compared to loss of revenue.</p> <p>SRRT-2: Council can investigate options to transfer or privatise infrastructure that is not cost effective for Council to maintain, or make arrangements with affected customers to charge extra to cover additional costs, eg, for sewer systems in very low-lying communities.</p>
Adaptive Capacity	<p>SRAO-1: Review of on-site Sewerage Management Plan should consider use and management of systems under the projected climate regime</p>

Stated Built Environment Risks	
Higher Level Risks Identified (by Council)	<p>N: More homes flooded (note: rainfall)</p> <p>N: Increased building and operational costs (note: carbon price)</p> <p>K: Flooding of low lying coastal villages due to sea surges and storm events (note: sea level rise)</p> <p>N: Increased building and operational costs (note: carbon price)</p> <p>B: Increased bushfire risks to life and property (note: temperature)</p> <p>N: Bushfire risk to property and life (note: temperature/rainfall)</p> <p>K: Increased risk of bushfire due to prolonged seasonal duration and increased intensity (note: extreme temperatures)</p> <p>N: Flooding of urban development zones (note: sea level rise)</p> <p>N: Flooding (note: storm surge)</p> <p>N: More homes flooded (note: rainfall)</p> <p>B: Flooding of the Urunga CBD (note: intense precipitation)</p> <p>N: Liability from existing approvals - community seeking redress from council (note: legal)</p>

Built Environment: Adaptation Strategy Actions	
Exposure Reduction	<p>BEER-1: Implement controls to avoid new developments in at-risk locations, and investigate the opportunities, or scenarios that might allow a reduction in the existing number of properties in such locations through buy-back and/or relocation.</p> <p>BEER-2: Implement NSW state benchmarks of 0.4 and 0.9 metres of sea level rise by 2050 and 2100 respectively, to ensure indemnity under the Local Government Act. Disclose in the public domain that sea level rise of 2 metres is possible based on current science. Adopt this 2.0 m assumption for Council buildings.</p> <p>BEER-3: Ensure that development in green field areas considers sea level rise expectations over the expected life of the development. If this is indefinite, then sea level rise levels to 2300 may be the most appropriate time scale to use.</p> <p>BEER-4: Reduce uninformed development or capital investment by implementing market disclosure requirements for properties changing hands, or at development proceedings, by requiring Section 149 certificates to identify any known climate change related risks. This will ensure that property purchasers, valuers, insurers and mortgage holders are made aware of the climate change related risks associated with such at-risk properties.</p>

Built Environment: Adaptation Strategy Actions continued	
Vulnerability Reduction	<p>BEVR-1: Where the cost-benefit case is suitable, implement community-scale risk reduction works to reduce vulnerability to the hazard (eg, implement storm water up-grades, construction of sea walls or levies)</p> <p>BEVR-2: Use planning controls to require that new building and building changes are designed to cope with location-specific projected climate change hazards, in a manner that is consistent with their design lifetime. These designs must be mutually consistent so that addressing one hazard does not increase the vulnerability to another (eg, require passive cooling, rather than relying on air-conditioning which would increase exposure to carbon price and power disruption).</p> <p>BEVR-3: For exposed buildings, ensure that property management plans address the location specific climate change risk and require each property to maintain a current emergency risk management plan, to manage the impacts on people and property from climate change related events.</p> <p>BEVR-4: Update risk guidelines/specifications for Council infrastructure to cope with weather-related events that may be affected by climate change (eg, flood risk) to reflect projected rather than historical risk levels.</p>
Risk Management	<p>BERM-1: Educate the local business and industrial sectors to adjust existing or future emergency procedures for commercial and industrial buildings to include increased flooding and bushfire events, on the assumption that current rare and acute events may become frequent/chronic.</p> <p>BERM-2: Develop spatial information sets (Asset Risk Maps) within Council to identify assets that will be at-risk with climate change, and to identify alternative, low risk locations. Require that this information be included in asset management planning thereafter. Development and updating of Asset Risk Maps will be dependent upon the completion of modeled risks such as flood mapping.</p>
Transfer/co-dependence	<p>BERT-1: Work with insurance providers to ensure that all properties in the area are affordably insurable and where insurers have specific concerns about risks such as flooding and bushfire, review options within Council's control that can reduce these risks to levels acceptable to insurers. Promote full insurance cover within the community.</p> <p>BERT-2: In at-risk locations, transfer 'buyer-beware' risk and liability to the private sector by requiring Section 149 certificates to identify any known climate change related risks. This will ensure that at property purchasers, valuers, insurers and mortgage holders are made aware of the climate change related risks associated with such at-risk properties.</p> <p>BERT-3: Transfer sea level risk liability to the State Government under section 733 indemnities of the Local Government Act, while disclosing in the public domain that sea level rise of 2 metres is possible, based on current science.</p> <p>BERT-4: Negotiate for State and Federal funding for measures to reduce exposure and increase the resilience of all building stock. Alternatively, seek a mandate to increase the rates, to cover the additional capital and operational costs that may be associated with this exposure.</p>
Adaptive Capacity	

Stated Energy Security Risks	
Higher Level Risks Identified (by Council)	<p>N: Increased electrical use from higher temperatures - supply issues (note: temperature)</p> <p>K: Blackouts, brownouts (note: extreme temperatures)</p> <p>B: Increase price of energy from a carbon constrained economy (note: regulatory)</p> <p>N: Increased electrical use from higher temperatures - supply issues (note: temperature)</p> <p>B: Damage to infrastructure from storms and flooding (note: intense precipitation)</p> <p>N: Infrastructure and asset damage (note: storms)</p> <p>K: Impact on assets (note: extreme temperatures)</p> <p>N: Flooding (note: storm surge)</p> <p>N: Damage to infrastructure (eg playgrounds) (note: temperature)</p>

Energy Security: Adaptation Strategy Actions	
Exposure Reduction	<p>ESER-1: Develop planning controls that will facilitate reduction of climate-enhanced hazards to power distribution system (eg, toward undergrounding of cables, removal of hazards close to power lines). Investigate options to require large developments provide distributed power generation back in to the grid.</p> <p>ESER-2: Develop controls that allow for increases to embedded (local) generation of electricity, through gas turbines and renewable energy (eg, solar, wind, run-of-river hydroelectricity, biomass from agricultural waste).</p> <p>ESER-3: Facilitate the uptake of electric vehicles (which reduce the vulnerability to disruptions in the supply of fuels) through provision of charging stations and other incentives.</p>
Vulnerability Reduction	<p>ESVR-1: Install uninterruptible power supplies (UPS), back-up power storage, and back-up generation in Council facilities that provide critical systems for Council operations, and for essential services of water supply and waste water systems.</p> <p>ESVR-2: Ensure back-up systems exist for important private sector services including commercial-scale food refrigeration, telecommunications facilities, hospitals and aged care facilities.</p>

Energy Security: Adaptation Strategy Actions continued	
Risk Management	<p>ESRM-1: Educate the community to manage increased disruptions to their power supply. Identify high-risk people, groups and facilities to ensure they have continuity management plans that will allow them to cope with loss of power over extended periods.</p> <p>ESRM-2: Develop actions/ or non-emergency management plans to cope with more frequent and severe power outages so that Council and the community do not require repeated use of, or excessive dependence on, emergency services I,e, preparing for such disruption to become common place and therefore avoiding over stretching emergency services.</p> <p>ESRM-3: Develop actions to cover the high likelihood that there could be repeated confluence of extreme weather events and power outages.</p>
Transfer/co- dependence	<p>ESRT-1: Develop an energy security strategy and objectives in conjunction with energy utilities, regarding options for load shedding, priority supply locations, embedded generation, and undergrounding of cables, to reduce exposure to physical hazards.</p> <p>ESRT-2: Request and encourage utilities to introduce secondary power lines around high risk links, to introduce redundancy into the power supply chain.</p> <p>ESRT-3: Request and encourage utilities and neighbouring Councils to address neighbouring high-risk locations through which the power system passes and where it is prone to outage.</p>
Adaptive Capacity	

Stated Transportation Security Risks	
Higher Level Risks Identified (by Council)	<p>B: Damage to roads from storms and flooding (note: intense precipitation)</p> <p>N: Drainage failure (note: sea level rise)</p> <p>K: National impact as highway/transport corridors cut eg Heavy transport/milk etc (note: flood)</p> <p>B: Damage to infrastructure from storms and flooding (note: intense precipitation)</p> <p>N: Infrastructure and asset damage (note: storms)</p> <p>K: Impact on assets (note extreme temperatures)</p> <p>K: Increase price of petrol - need for increased public transport network (note: regulatory risk)</p> <p>N: New bypass creates a levee east of Macksville (note: mal-adaptation) (note: if it creates a levee that may put homes and human settlements at risk)</p> <p>N: Damage to bridges (note: rainfall)</p> <p>N: Flooding (note: storm surge)</p> <p>N: Damage to infrastructure (note: increased temperature)</p>

Transportation Security: Adaptation Strategy Actions	
Exposure Reduction	<p>TSER-1: Develop a strategy for climate-change-proof transport system and amend asset management plans as required. This would include the Identification of roads and bridges that are likely to be unviable to maintain in the long term due to repeated riverine and sea level rise flooding and natural processes which undermine roads such as erosion/ landslip. It will also be important to identify low-risk alternative routes (eg along ridge lines)</p> <p>TSER-2: Investigate options to close roads and buy back properties on roads which have a high remediation or operation cost, if this is cheaper than maintaining current services. Alternatively, transfer the asset to property holders.</p> <p>TSER-3: Ensure planning controls increase densities in and around urban centres to increase alternatives forms of transport such as walking, cycling and public transport</p>

Transportation Security: Adaptation Strategy Actions continued	
Vulnerability Reduction	<p>TSVR-1: Undertake a cost-benefit analysis for options to increase the resilience of roads and bridge materials, construction and management (compared to usual practice). This is important given expected increases in the frequency and severity of extreme flooding, land slip and temperature events.</p> <p>TSVR-2: Review hydrological engineering of water flows, retention, and street-scapes to minimise overtopping of roads during flooding events. This should include effects of new bypasses where relevant.</p> <p>TSVR-3: Ensure that ramps, wharfs and pontoons to cope with sea level rise and increased storm surge events and overland flooding.</p>
Risk Management	<p>TSRM-1: Identify and develop a strategy with actions for people and businesses affected by more frequent and lengthy road flooding and isolation which would include securing basic needs on-site, and management/response plans to ensure the well being of individuals and the continuity of affected businesses.</p> <p>TSRM-2: Develop strategies and interventions to minimize heavy freight traffic on council roads during very hot days, when roads are vulnerable to damage due to soft bitumen, (eg by requesting trucks keep to RTA roads only, or restricting access during periods of extreme midday heat).</p>
Transfer/co-dependence	<p>TSRT-1: Seek to transfer high-risk roads to the RTA if maintenance costs exceed Council's resources. Equally ensure that Council is aware if high-risk roads are being transferred to Council from the RTA. If so, ensure that appropriate funding is available to support operation of the roads under increased climate change hazards.</p> <p>TSRT-2: Seek State or Federal Government funding to cover costs of increased maintenance of the transport systems due to climate change, or increase rates to cover these costs.</p> <p>TSRT-3: Transfer ownership or maintenance of high-risk roads (eg, those subject to repeated sea water flooding) to the community serviced by the road. This may be particularly relevant for new development.</p>
Adaptive Capacity	<p>TSAO-1: Implement programs to enhance and extend walkable communities and cycling, all of which are also attractive to both tourists and residents, and also reduce fuel risks/dependency.</p>

Stated Communications Security Risks	
Higher Level Risks Identified (by Council)	<p>N: Flooding (note: storm surge)</p> <p>B: Damage to infrastructure from storms and flooding (note: intense precipitation)</p> <p>N: Damage to infrastructure (note: increased and extreme temperature)</p>

Communications Security: Adaptation Strategy Actions	
Exposure Reduction	<p>CSER-1: Develop controls to ensure communication systems are in locations at low risk of climate change enhanced natural hazards (eg, not on cables crossing rivers on vulnerable bridges). This could include undergrounding of cables, and relocation of systems out of areas prone to floods, bushfires and sea level rise.</p>
Vulnerability Reduction	<p>CSV-1: Investigate options to ensure developments and utilities servicing the developments in high risk locations install telecommunication equipment suitable for the projected risks.</p> <p>CSV-2: Educate the community to minimise pressures on mobile communications systems during extreme events (eg use texts to communicate to avoid overuse of bandwidth)</p>
Risk Management	<p>CSRM-1: Ensure diversified alternative communications avenues are in place that can be easily accessed by Council (eg radio stations, SMS,) to provide redundancy in the event of failure in the fixed line or mobile telecommunications systems, assuming expected increases in the severity and frequency of disruptive events.</p> <p>CSRM-2: Develop actions to ensure clear, reliable and consistent communications to tourists in the region, those anticipating travel to the region, especially if flooding or other events have been covered in the media. Local community sectors should also be clearly notified.</p>
Transfer/co-dependence	<p>CSRT-1: Consult with communication suppliers and neighbouring Councils to develop climate-proof communications systems for the area, including relocation of high-risk assets, and fit-for-purpose specification of equipment.</p>
Adaptive Capacity	<p>CSAO-1: Capture the opportunity to increase the quality and bandwidth of communications as a way to increase telecommuting, which would reduce emissions produced by Council, the community and the private sector. This would also provide an opportunity to expand the local economy through online or remote business development. Investigate opportunities to increase telecommuting for Council employees.</p>

Stated Economic Risks	
Higher Level Risks Identified (by Council)	<p>N: Changes to agricultural production (primary industry) (note: rainfall/temperature/sea level rise) K: Change in agricultural viability (note extreme temperatures)</p> <p>B: Increased bushfire risks to life and property (note: temperature) N: Bushfire risk to property and life (note: temperature/rainfall) K: Increased risk of bushfire due to prolonged seasonal duration and increased intensity (note: extreme temperature)</p> <p>B: Flooding of the Urunga CBD (note: intense precipitation)</p> <p>N: Local food production under stress (note: rainfall/temperature) K: Impact on rural production (note: drought)</p> <p>K: Increased incidence of flooding affecting rural lands (note: floods)</p> <p>K: Increased incidence of wetting/drying of soil horizons affecting acid sulphate soils (note: dry days)</p> <p>N: Oysters less viable industry (note: rainfall/ sea level rise)</p> <p>B: Tourism N: Reduced tourism (note: storms) K: Impact on industries, businesses and tourism (note: flood)</p> <p>N: Flooding (note: storm surge)</p> <p>K: Dislocation of community - flooding isolating workers, and school students etc.</p> <p>N: Population moves away from coast to flood liable land</p> <p>B: Increase price of energy from a carbon constrained economy (note: regulatory)</p>

Economic Risks: Adaptation Strategy Actions	
Exposure Reduction	<p>ERER-1: Identify opportunities to relocate highly-exposed agricultural farm activity to lower risk locations. These at-risk operations may include flooded lands on rivers, but also lands in coastal flood plains impacted by sea level rise.</p> <p>ERER-2: Identify suitable locations for the relocation of tourist assets (for example, caravan parks) away from highly-exposed locations.</p> <p>ERER-3: Identify options for re-timing tourist events such as festivals into months at lower risk of flooding, ie, non-summer months. This would also reduce the exposure of visitors to heat stress and tropical disease vectors.</p>

Economic Risks: Adaptation Strategy Actions continued	
Vulnerability Reduction	<p>ERVR-1: Investigate options to climate-proof key economic sectors in the region, especially agriculture and tourism. Investigations should address management of increased summer precipitations and flooding, and reduced winter rainfall. Options may entail embracing the new climate regimes, from wet pasture animals and crops, to higher-efficiency irrigation and niche agricultural activities on large lot residential land. It could also include diversification of tourism offerings that are compatible with increased rainfall in summer eg, indoor activities or safe viewing opportunities/tours of rivers in flood.</p> <p>ERVR-2: Develop an economic strategy that includes strategic opportunities that may be afforded to an area which has access to secure average water supplies and may therefore be a desirable place to live. This would also acknowledge limits to growth in order to maintain a sustainable resource base and the integrity of the natural environment (which underpins tourism).</p> <p>ERVR-3: Implement planning controls that provide protection of key economic assets, including agricultural lands and natural assets that attract tourists.</p> <p>ERVR-4: Identify measures that may reduce flooding and velocity of flows in commercial and industrial areas and develop implementation strategy if appropriate options exist</p>
Risk Management	<p>ERRM-1: Educate the local tourism industry on the projected risks associated with climate change. Encourage the development of industry partnerships to assist the area in maintaining itself as a desirable tourism destination.</p> <p>ERRM-2: Ensure clear and consistent communication to all economic actors in the community at risk from climate change hazards, to allow early action to avoid loss.</p> <p>ERRM-3: Identify options for live-stock management before during and after major flooding events. This is essential to prevent moving of live-stock in treacherous conditions at night, to prevent loss of life/stock. For example identify land unlikely to be impacted by flooding and consider use of flood mounds on flood prone agricultural land.</p>
Transfer/co-dependence	<p>ERRT-1: Develop 'state of emergency' triggers with State and Federal governments to avoid communication via media that can also have the effect of dissuading tourists from visiting the region.</p> <p>ERRT-2: Engage private-sector partners in arrangements with essential services providers, to ensure security of service provision where possible.</p>
Adaptive Capacity	<p>ERAO-1: Develop regional tourism strategy based on a low-carbon tourism paradigm, ie, travel from Sydney and Brisbane does not require a flight, and the region could be accessed by train. This should identify the cost advantages to be had at different levels of carbon price (whether it occurs through an emission trading scheme or a carbon tax).</p> <p>ERAO-2: Identify agriculture and forestry sector options for increased income under a low-carbon economy from bio-sequestration and renewable energy production.</p>

Stated Governance (Legal and Regulatory) Risks	
Higher Level Risks Identified (by Council)	<p>B: Increased service demands and operational costs (note: various)</p> <p>K: Impact on service provision - local govt eg Garbage (note: regulatory risk)</p> <p>N: Damage to infrastructure (eg playgrounds) (note: temperature)</p> <p>K: Increased cost to public infrastructure – due to sea surge, storm events and sea level rise</p> <p>N: Increased council fleet and plant costs (note: carbon price)</p> <p>N: Population moves away from coast to flood liable land</p> <p>B: Increased bushfire risks to life and property (note: temperature)</p> <p>N: Bushfire risk to property and life (note: temperature/rainfall)</p> <p>K: Increased risk of bushfire due to prolonged seasonal duration & increased intensity of extreme Temp</p> <p>K: Loss of rural lands as a rates source for Council (note: sea level rise)</p> <p>N: Liability from existing approvals - community seeking redress from council (note: legal)</p> <p>N: Current & future development (note: legal)</p> <p>N: Flooding (note: storm surge)</p>

Governance (Legal and Regulatory) Risks: Adaptation Strategy Actions	
Exposure Reduction	<p>GRER-1: Adopt controls to allow Council to minimise its exposure to future legal challenges, which may take the form of negligence-based torts or parties seeking compensation due to suffering material loss from climate change impacts. This can be done by minimising the number of properties at risk to future climate change impacts (see buildings strategy). These controls may require a whole-scale update of existing policies to include climate change management.</p> <p>GRER-2: Reduce the exposure of council to legal challenges through a strategy of disclosure and awareness by: (a) ensuring that all known climate change hazards are published in the public domain, (b) where possible, at minimum, adhering to State or Federal Government benchmarks, whilst also disclosing that risks may exceed these levels due to science known to Council, and (c) ensuring that parties that could suffer loss are made aware of possible risks at the earliest possible time (eg, through the 149 certificate), allowing them to make their own decisions on risk management.</p> <p>GRER-3: Ensure that Council complies with State benchmarks for indemnification under the Local Government Act (section 733) by implementing required benchmarks across all Council approvals, whilst also disclosing that actual risk may be higher.</p> <p>GRER-4: Reduce future legal and financial risks to Council by discouraging development in high risk locations by (a) disclosing the risks associated with these locations through maps and other tools, & (b) requiring that the known climate change hazards are adequately managed by those seeking to build in high-risk locations.</p> <p>GRER-5: Develop a legal transition strategy based upon legal opinion to minimise short-term litigation (eg, for cost increases in developments). This can be folded into the process of introducing measures that would address climate-related legal risks for Council in the long term.</p>

Governance (Legal and Regulatory) Risks: Adaptation Strategy Actions continued	
Vulnerability Reduction	<p>GRVR-1: Introduce controls that require buildings and other activities which require Council consent to show that climate change hazards have been adequately managed within their development.</p> <p>GRVR-2: Develop and implement an ongoing process to reduce Council’s economic exposure to measures which regulate carbon (ie measures which reduce greenhouse gas emissions). Could be accomplished by minimising energy & fuel use & high carbon materials (eg, in road construction) across Council operations.</p> <p>GRVR-3: Reduce Council’s financial exposure to increased extreme events which cause disruption to services and damage to assets. Act on a range of strategies to ensure resilience of Council’s services.</p> <p>GRVR-4: Reduce vulnerability of Council to community dissatisfaction, loss of goodwill and political instability by implementing consultative processes around climate change management strategies, changes in resource allocation, and possible increases in rates to maintain services and changes in service levels.</p> <p>GRVR-5: Update risk guidelines/specifications for Council infrastructure to cope with weather-related events that may be affected by climate change (eg, flood risk), to reflect projected rather than historical risk levels. For example, a storm water drain might be designed to last 100 years and cope with a 1 in 100 year event; with climate change, the suitable flood level should consider that an event with a return frequency of 1 in 100 years today may resemble the current 1 in 200 year event by 2100 (ie, more severe).</p> <p>GRVR-6: Implement a policy of ‘shadow pricing’ across decision-making to include Federal Treasury estimates for forward carbon prices under a two degree Celsius / sub-450 parts per million scenario.</p>
Risk Management	<p>GRRM-1: Improve the ability of Council to understand the implications of climate change hazards by commissioning research to quantify the impacts. This would include modelling of the effects of sea level rise and storm surge on the local coast, revised flood modelling in light of increased precipitation (3 day extreme precipitation currently predicted to increase by 10%. The Risk Report Accompanying this document predicts an increase by 13% to 2030), and the confluence of sea level rise and precipitation increases.</p> <p>GRRM-2: Review the ability of Council to provide core services and maintain assets under climate change. If this is not possible, develop plans to consolidate asset bases and service provisions. Also, review the ability of Council to respond to major events including the workforce required for timely recovery post-event. Overall, create a revised financial, asset and human resource strategy.</p> <p>GRRM-3: Develop and implement risk management plans for Council and residents, to manage not only changes in mean climate but also the increasing severity and frequency of extreme under climate change.</p> <p>GRRM-4: Integrate climate management strategies into all Council planning policies & guidelines.</p> <p>GRRM-5: Implement monitoring and measurement processes for key climate change indicators and metrics for exposed and vulnerable people, property and infrastructure.</p>

Governance (Legal and Regulatory) Risks: Adaptation Strategy Actions continued	
Transfer/co-dependence	GRRT-1: Introduce controls that transfer the requirement for climate change risk management (and therefore legal risks stemming from future loss) through to the market. This can be done by requiring building & activities needing Council consent to show that climate change hazards have been managed.
Adaptive Capacity	GRAO-1: Collaborate with all neighbouring Councils and State Government to 'climate-proof' the region which would increase relative value and also harness potential advantages: water and food security for agriculture and low-carbon tourism making the region attractive to inward investment and young families.

Stated Natural Systems and Bio-Security Risks	
Higher Level Risks Identified (by Council)	<p>N: Landslides, riverine erosion, potholes (note: storm/sea level rise)</p> <p>N: Coastal erosion (note: storm surge)</p> <p>B: Threats to biodiversity (note: various)</p> <p>N: Pressure on biodiversity and habitat (note: changes in temperature and sea level rise)</p> <p>K: Increased incidence of wetting and drying of soil horizons affecting acid sulphate soils (note: dry days)</p> <p>K: Increased risk of bushfire due to prolonged seasonal duration and increased intensity (note: extreme temperatures)</p> <p>K: Increased vegetation growth in particular weeds (note: rainfall change)</p> <p>K: Increased incidence of flooding affecting rural lands (note: floods)</p>

Natural Systems and Bio-Security: Adaptation Strategy Actions	
Exposure Reduction	<p>NSER-1: Minimise the exposure of conservation areas and agriculture by using the LEP to limit development in and access to areas at high risk from climate change hazards, including accelerated transfer of climate migrating weeds and pests.</p> <p>NSER-2: Develop controls to protect natural environments, including buffers and corridors. Revise conservation values to incorporate climate change driven constraints and identify options to re-optimize zoning for new climate regimes. Consider loss of habitat and coastal squeeze due to sea level rise, heat and drought stress and relocate farming out of coastal flood plains to allow natural coastal systems to realign.</p>
Vulnerability Reduction	NSVR-1: Maximise the health and resilience of natural environment through: (a) best-practice conservation, (b) limiting pressure from development/urban encroachment into high value areas, especially by noting that in the community there may be auto-adaptation pressures which may necessitate a development cap, and (c) incentives or regulations to develop and maintain biodiversity corridors on private land.

Natural Systems and Bio-Security: Adaptation Strategy Actions continued	
Risk Management	<p>NSRM-1: Monitor the migration of new species of flora and fauna entering the district and new or enhanced threats posed by new invaders and exacerbated pest outbreaks. Communicate these results to the agricultural sector to allow them to change pest control systems.</p> <p>NSRM-2: Revise environmental conservation and biodiversity management plans in light of climate change. Ensure they are realistic in the light of climate change, and do not escalate demands on resources to maintain systems which will be unavailable in the new climate change regime.</p> <p>NSRM-3: Develop management plans for increased risks from weed breakouts following more flooding, bushfires and higher temperatures.</p> <p>NSRM-4: Ensure Climate Change is comprehensively dealt with in any Estuary Management Plan.</p>
Transfer/co-dependence	<p>NSRT-1: Transfer costs to the State or Federal Governments, or consider raising land rates to cover costs of land-buy backs which will allow for re-zoning to promote more resilient conservation zones.</p> <p>NSRT -2: Develop a combined regional-scale strategy for cross cutting biodiversity and bio-security risks, to ensure that risks are managed overall.</p> <p>NSRT-3: Request State or Federal Government funding for adaptation measures for natural environments which may be of State or Federal significance.</p>
Adaptive Capacity	

7 Implementation Principles

In this section we set out the overarching Implementation Principles required to ensure an effective implementation of the Adaptation Strategy.

7.1 A SYSTEMS APPROACH

Pursue the adaptation strategy on the basis that all components of 'the System' which comprises its society, economy and natural environment, must adapt to climate change as a whole. This also necessitates that the effects of adaptation actions must not be considered singly or on piecemeal basis, but rather must be considered in terms of how the whole system will respond.

7.2 DYNAMIC ADAPTATION

Both the N-B-K region and climate change are evolving, undergoing a continuous process of change. Accordingly, the adaptation strategy must also be, and remain, dynamic. Therefore Councils' adaptation actions must allow for, monitoring, harnessing and steering change on an ongoing basis.

7.3 ASSUME A 20C TARGET

To avoid carbon price shocks and prepare for anticipated global efforts to avoid dangerous climate change, Councils must guide the region on a trajectory consistent with avoiding two degree Celsius (2 °C) of warming. This requires Council to facilitate regional emissions to levels below two tonnes per person per year by 2050 (Climate Risk 2009b).

7.4 AFFORDABLE RISKS

Climate change will increase risks. For the N-B-K region to remain economically viable under climate change, the risks to Councils must be contained and reduced to levels

which ensure that the residual risk can be transferred to insurers at affordable levels.

7.5 CLIMATE REVISED QUANTITIES

It is no longer sufficient to use the past climate as a guide to what can be expected in future. Instead the research from climate science must be used to supplement historical information, to quantify future hazards. This information must then be used for decision making. More specifically it is important that the climate change science is not compartmentalised to the Adaptation Strategy alone, but that all quantities used in decision making that are affected by the climate change use the most up-to-date climate change figures.

7.6 NET-BENEFIT UNDER CLIMATE

To avoid financial waste or stranded assets, cost-benefit decisions made on Council spending must be informed with a view to climate change impacts. This includes impacts of possible hazards, and the effect of carbon prices on capital costs, operational costs and residual value. In some cases – such as new subdivision or easements, potential impacts may require multi-century consideration.

7.7 EVIDENCE-BASED ITERATIONS

The decision to implement specific adaptation actions must be based on evidence that they will achieve the required outcomes. These decisions must also be based on ongoing measurement or monitoring, to test whether the required outcomes are being achieved.

7.8 'DIVERSITY AND REDUNDANCY'

Multiple adaptation and risk reduction options for the same problem must be sought and applied where possible to ensure required outcomes are met and new vulnerabilities are not created in the process.

8 Performance Measurement and Monitoring

8.1 STRATEGIES FOR MEASUREMENT AND MONITORING

keep the analysis and evaluation up to date

The metrics presented in section 8.2 have been developed as options for monitoring the ways in which climate change hazards may be increasing, the change in the level of exposure for people, property and the environment and the effectiveness of actions in reducing the vulnerability of the region's economy, society and biodiversity.

It is proposed that Council select those metrics which are most easily measurable and which best provide an insight into each of the important hazards and security themes, and then establish a process of regular monitoring and reporting. Some metrics will lend themselves to annual measurement and reporting, others for less frequent reporting intervals - perhaps based on the seven year IPCC climate change science data, or upon census updates.

It is further recommended that a standard reporting framework is established so that the trends over time can be discerned and reported. The State of the Environment may be a suitable carrier document.

Review the progress of actions

On the basis of the measurement, monitoring and reporting of climate change risk metrics it will be possible to see how Council and other stakeholders are progressing in reducing the overall risks and increasing resilience. There are two aspects to this process:

- (a) Progress in implementing the actions specified in the adaptation report.
- (b) The effectiveness of those actions in exposure and vulnerability reduction.

It is recommended that the progress in implementation be reported to senior management on a 6 monthly basis by each of the Council departments identified as responsible for implementation in this report. And that the effectiveness of those actions be monitored via the trends in the risk metrics being measured, monitored and reported. This may be best managed as part of the Council's State of the Environment process.

Ensure that the process is implemented in a timely and cost effective fashion

Overall, it may be appropriate for Council to adopt a 1.5 year implementation plan, to ensure that actions can be incorporated into the relevant process and procedures. This should be long enough to avoid undue disruption to current work loads, but short enough to ensure ongoing momentum and continuity of personnel.

The first six months of this process could be used to outline the budgetary implications of any actions which have a cost impact and to develop the business case for these actions in terms of avoided future losses. These can then be approved for implementation and funding in the

remaining year, or folded into ongoing budgets.

Councils may choose to formerly incorporate adaptation strategy in decision making framework

Councils may prepare a Climate Change Adaptation Policy to ensure that actions contained in the Climate Change Adaptation Strategy are given consideration in future decision making, policy implementation, strategy development by Council and Council staff.

This may be further considered in the preparation of the 20 year Community Strategic Plan, presently being developed by each of the Councils.

8.2 MEASUREMENT TOOLS OR METRICS

The following table summarises the exposure and vulnerability measurement criteria that can be used to inform progress in risk reduction and resilience building.

0. Hazards to be measured (historical, current and projected)
<p style="text-align: center;">Temperature Means and Extremes</p> <p style="text-align: center;">Mean Temperature Projections (2030, 2050, 2100) (degrees) Days over 35 degrees (number days per year) Heat waves - 5 days above 35 degrees (number per year)</p>
<p style="text-align: center;">Fire Risk</p> <p style="text-align: center;">Increase in number of days of fire risk (Number days per year)</p>
<p style="text-align: center;">Intense Precipitation</p> <p style="text-align: center;">Total mean rainfall</p> <p>Increase in precipitation for 1 day extreme rainfall with future return periods of 5,10, 20,50, 100, 200 and 500 years (% change)</p> <p>Increase in precipitation for 3 day extreme rainfall with future return periods of 5,10, 20,50, 100, 200 and 500 years (% change)</p>
<p style="text-align: center;">Drought</p> <p style="text-align: center;">Total mean rainfall</p> <p style="text-align: center;">Increase in classified drought frequency (% change in annual risk)</p>
<p style="text-align: center;">Extreme Weather</p> <p style="text-align: center;">Changes in projection for barometric level consistent with damaging storm (% change in annual risk) Changes in hail risk frequency (number of events per year) Changes in hail stone size (max hail size per year)</p>
<p style="text-align: center;">Sea Level Rise and Storm Surge</p> <p style="text-align: center;">Increase in sea level (mm sea level rise per year) Increase in storm surge frequency (number events exceeding damaging storm surge level in SEQ) Increase in storm surge severity (height of max annual storm surge in metres)</p>
<p style="text-align: center;">Regulatory Impacts</p> <p style="text-align: center;">Emission trading (carbon price dollars per tonne) Implementation targets for renewable energy (percentage of total power generation from renewables)</p>

1. Human Health	
Temp Exposure	~Human Population (number)
Temp Vulnerability	~Over 60 years (%) ~Vulnerable health conditions (%)
Fire Exposure	~Human Population in bushfire exposed areas (number)
Fire Vulnerability	~ Number and percentage of people in non-bushfire resilient dwellings ~ Number and percentage of people in high risk communities (eg without local fire service or with poor access)
Precip. Exposure	~Number of people living in food prone areas
Precip. Vulnerability	~Number of people in home or offices which are not built to with stand levels of flooding for each return period.
Drought Exposure	~Human population ~Number of significant industrial water users Residential (number) Commercial (sq m) and Industrial Property (m Sq) in active soils ~Water use per person
Drought Vulnerability	~Cost of water as percentage of household spending ~Cost of water a percentage of business costs for key industries
Extreme Weather Exposure	~Human Population (number)
Extreme Weather Vulnerability	~Human Population (number)
SLR Exposure	Human population living in areas projected to be subject to flooding or erosion due to sea level rise and erosion, number of exposed homes
SLR Vulnerability	Fraction of properties that have not been designed to cope with inundation and erosion
Regulatory Exposure	~energy consumption per capita for cooling and heating
Regulatory Vulnerability	~Over 60 years (%) ~Vulnerable health conditions (%)

2. Water Security (supply - not including infrastructure)	
Temp Exposure	~Evaporation rates (ML/yr)
Temp Vulnerability	~Value of replacement water
Fire Exposure	~Amount of catchment in area
Fire Vulnerability	~Percentage of catchment vulnerable to bushfire ~percentage of water sourced for area which is vulnerable to bush fire damage (can be outside area)
Precip. Exposure	~Amount and percentage of water supply which is exposed to contamination or disruption due to flooding
Precip. Vulnerability	~Amount and percentage of water supply which is vulnerable to contamination or disruption due to flooding
Drought Exposure	~Historical water use (ML/yr) ~Historical water storage/reservoir amounts (ML)
Drought Vulnerability	Current and Projected total requirement
Extreme Weather Exposure	~km of water pipeline at risk from high winds
Extreme Weather Vulnerability	~km of water pipeline
SLR Exposure	~exposed water supply which is subject to being undermined by SLR eg into water table
SLR Vulnerability	~Amount of water which would be removed form regional supply due to corruption by SLR
Regulatory Exposure	~energy use in water treatment and pumping
Regulatory Vulnerability	~cost of energy use in water treatment and pumping ~percentage of total cost ~percentage currently sources from non-renewable sources

3. Food Security	
Temp Exposure	Hectares of Crops, Head of livestock, ~volume of perishable food in non-refrigerated storage
Temp Vulnerability	Hectares of Crops vulnerable to heat damage, ~hectares of crops in temperature hot-spots, head of cattle in hot-spots, ~head of cattle of type poorly adapted to high temperatures, ~volume of perishable food in non-refrigerated storage
Fire Exposure	Hectares of Crops potentially exposed to bushfire damage, ~Head of livestock in bushfire exposed areas which do not have ready access to safer pastures.
Fire Vulnerability	Hectares of Crops potentially exposed to bushfire damage , ~Head of livestock in bushfire exposed areas
Precip. Exposure	Hectares of Crops at risk of flooding damage, ~ head of livestock at risk of flooding
Precip. Vulnerability	Hectares of Crops vulnerable to flooding, ~head of cattle in hot-spots, ~head of cattle of type poorly adapted to flooded fields
Drought Exposure	Hectares of Crops, ~Head of livestock
Drought Vulnerability	Hectares of Crops vulnerable to seasonal drought, ~hectares without irrigation, ~ head of cattle with poor on-site water storage
Extreme Weather Exposure	Hectares of Crops , ~head of cattle, ~days of food reserves in shops
Extreme Weather Vulnerability	Hectares of Crops vulnerable to hail or severe wind damage, ~head of cattle without ready access to shelter, ~number of days for perishable food reserves in shops which is non-refrigerated
SLR Exposure	Hectares of Crops , ~head of cattle
SLR Vulnerability	Hectares of Crops vulnerable to hail or severe wind damage, ~head of cattle without ready access to shelter
Regulatory Exposure	Carbon intensity of local food production (tonnes per kilogram for major food types), ~carbon intensity of imported food (tonnes per kilogram for major food types)
Regulatory Vulnerability	Fractional cost increase for prices of carbon from \$20/tCO _{2e} to \$160/tCO _{2e}

4. Sanitation Risk (Waste and Storm Water)	
Temp Exposure	Amount infrastructure and value exposed to heat damage or inefficiency, total population, tourist population
Temp Vulnerability	Number, value and percentage of assets exposed to heat damage, percentage of assets that do not have stand alone power
Fire Exposure	Amount infrastructure (and value exposed to possible bush-fire impact
Fire Vulnerability	Number, value and percentage non-bushfire resilient infrastructure, percentage of assets which do not have stand alone power if needed
Precip. Exposure	~number and percentage of infrastructure which is exposed to contamination or disruption due to flooding
Precip. Vulnerability	Number and percentage of infrastructure which is exposed and vulnerable to contamination or disruption due to flooding
Drought Exposure	~Infrastructure which is exposed to drought impacts on soil stability to foundations. ~Total length of water pipes exposed to reduce flows in drought conditions and therefore increased corrosion
Drought Vulnerability	Percentage of exposed assets built to standards below standards that would withstand soil movement ~ meters of pipe not designed to cope with low water flows
Extreme Weather Exposure	~Infrastructure which is exposed to extreme weather impacts
Extreme Weather Vulnerability	Percentage built to standards below the CC projected weather extremes
SLR Exposure	~Infrastructure which is exposed to SLR and SS - up or downstream (eg drainage to sea and tidal lock)
SLR Vulnerability	Percentage dependent on systems built to standards below the CC projected weather extreme
Regulatory Exposure	~carbon emission related to infrastructure operation and maintenance
Regulatory Vulnerability	~projected cost of carbon on operational costs ~projected cost of emissions as a fractional increase in O&M costs for infrastructure

5. Built Environment	
Temp Exposure	~Amount of residential (number), commercial (sq m) and industrial property (sq m)
Temp Vulnerability	~Number and percentage built with (to be defined) low thermal performance
Fire Exposure	Amount of residential (number), commercial (sq m) and industrial property (sq m) exposed to possible bushfire impact
Fire Vulnerability	Number and percentage non-bushfire resilient residential, commercial and industrial property
Precip. Exposure	Flood prone area residential dwellings (number), commercial office space (square meters), industrial space (square meters)
Precip. Vulnerability	Number of dwellings which would be flooded for at each return frequency (5-200yr)
Drought Exposure	Number of residential properties (number), commercial office space (m sq) and industrial area (m Sq)
Drought Vulnerability	Percentage with foundations vulnerable to drought induced soil movement., percentage of agriculture activity which is vulnerable to drought
Extreme Weather Exposure	Number of residential properties (number), commercial office space (m sq) and industrial area (m Sq)
Extreme Weather Vulnerability	~Percentage build below project wind speed standards ~ Percentage which have non-hail resistant roof and guttering
SLR Exposure	Number of properties in SEQ exposed to SLR + SS (who may wish to locate into area)
SLR Vulnerability	Number of properties exposed to SLR and SS which are not flood resilient
Regulatory Exposure	~average energy consumption per person, house, commercial area and industrial area (sq m) ~average personal car commute length per person per yr
Regulatory Vulnerability	~ percentage sourced from non zero-emission sources ~ average emission intensity of supply ~average commute length is person car KM/yr ~ public transport use per person km/yr

7. Transport Security	
Temp Exposure	Number of people in shire. Number of vehicles in the shire. Number of kms of road network in shire. Km of rail network in shire. Number of people regularly using rail and public transport, km of cycle tracks with no shading
Temp Vulnerability	Number of km and value of roads exposed to heat damage (eg bitumen road surface), number of KM of rail track, number of heavy vehicles using at risk roads (increasing damage) number of people using bus stops without shade /shelter
Fire Exposure	Km of roads running through bushfire areas. Km of rail running through bushfire areas. Km of pedestrian or cycle paths running through bushfire areas.
Fire Vulnerability	Km of roads running through bushfire areas. Km of rail running through bushfire areas. Km of pedestrian or cycle paths running through bushfire areas.
Precip. Exposure	Km of unsealed roads subject to runoff and flooding damage, K of sealed roads exposed to land slip, Km of rail subject to flooding, km of road or pathways subject to flooding.
Precip. Vulnerability	Percentage of exposed transport lines following creek lines, crossing creeks or flood plains, crossing land slip risk locations
Drought Exposure	Percentage of unsealed roads passing across land at risk on contraction and cracking in drought
Drought Vulnerability	km of exposed road and pathways not deigned to cope with cracking and contraction.
Extreme Weather Exposure	Number of people in shire. Number of vehicles in the shire. Number of kms of road network in shire. Km of rail network in shire. Number of people regularly using rail and public transport,
Extreme Weather Vulnerability	Percentage of roads and pedestrian/pushbike pathways vulnerable to closure due to tree falls, km of roads that have to close in high wind conditions, percentage of bus stops without shelters, value of vehicle fleets
SLR Exposure	km of roads, rail and pathways subject running through areas potentially impacted by sea level rise, storm surge flooding, and coastal erosion. - coastal and floodplain networks
SLR Vulnerability	Km of roads, rail and pathways subject exposed to Sea level rise and storm surge projections but not designed to cope.
Regulatory Exposure	Emissions intensity of average road, rail and other transport use in shire.
Regulatory Vulnerability	Impact of carbon prices on average cost of transportation for people, business and industry.

8. Communications Security	
Temp Exposure	~Number of communication assets and meters of distribution cable going through council area
Temp Vulnerability	~Amount of transmission and distribution vulnerable to overloading in high heat conditions
Fire Exposure	~Number of communication assets and meters of distribution cable going through council area
Fire Vulnerability	Amount infrastructure exposed to possible bush-fire impact
Precip. Exposure	Amount of communication infrastructure in flood prone areas
Precip. Vulnerability	Percentage of communication infrastructure in flood prone areas which is not designed to be flood proof, percentage at risk and not designed for land slip
Drought Exposure	~Number of communication assets and meters of distribution cable going through council area in soil subject to contraction due to drought
Drought Vulnerability	~Number of communication assets and meters of distribution cable which is in soils subject to contraction and has foundations of pipes not designed to cope with the contraction/movement
Extreme Weather Exposure	Number of above ground assets, metres and percentage of lines above ground
Extreme Weather Vulnerability	Number of above ground assets, metres and percentage of lines above ground
SLR Exposure	Percentage of communication infrastructure easements within flooding zones from combined sea level rise and storm surge
SLR Vulnerability	Percentage of exposed communication facilities and lines which are not inundation proofed (meters. Number)
Regulatory Exposure	~energy demand of communications infrastructure
Regulatory Vulnerability	~fractional costs of energy in communications and cost vulnerability to increased carbon prices

9. Economic Security	
Temp Exposure	~Gross regional product ~Per capital GRP ~Major economic activities ~
Temp Vulnerability	~Industries which are vulnerable to heat disruption ~scale of economic vulnerability
Fire Exposure	~Gross regional product ~Per capital GRP ~Major economic activities ~
Fire Vulnerability	~Industries which are vulnerable to bushfire disruption ~scale of economic vulnerability top bushfire
Precip. Exposure	~Gross regional product ~Per capital GRP ~Major economic activities ~
Precip. Vulnerability	~Percentage of business/industry that do not have business continuity plans (by number and also weighted by turnover)
Drought Exposure	~Gross regional product ~Per capital GRP ~Major economic activities ~
Drought Vulnerability	~Percentage of business/industry that are exposed to drought related impacts and price increases (eg for energy)
Extreme Weather Exposure	~Gross regional product ~Per capital GRP ~Major economic activities ~
Extreme Weather Vulnerability	~Percentage of business/industry that are exposed to extreme weather impacts and disruptions ~ percentage of businesses that do not have business continuity plans which include extreme weather disruption
SLR Exposure	~Gross regional product ~Per capital GRP ~Major economic activities ~
SLR Vulnerability	~Industries which are vulnerable to upstream or downstream SLR and SS disruption ~scale of economic vulnerability top bushfire
Regulatory Exposure	~Percentage non-renewable energy generation
Regulatory Vulnerability	~cost of carbon as a percentage of total GRP ~Trends in renewable energy generation compared to national average.

10. Governance (Legal and Regulatory)	
Temp Exposure	~Number of outside staff ~Number of people using heat exposed council facilities
Temp Vulnerability	~Policies regarding staff working conditions and heat ~Policies regarding staff and clients in council buildings or facilities
Fire Exposure	~Number of staff at risk from bushfire ~Number of people using bushfire exposed council facilities
Fire Vulnerability	~People affected by inadequate policies regarding staff /volunteer working conditions and bushfire risk ~Policies regarding staff and clients in council buildings or facilities
Precip. Exposure	~Number of staff at risk from flooding ~Number of people using flood exposed council facilities
Precip. Vulnerability	~People affected by inadequate policies regarding staff /volunteer working conditions and bushfire risk ~Policies regarding staff and clients in council buildings or facilities
Drought Exposure	~Number of properties at risk of Council tree damage. ~People exposed to injury on council facilities that may be hazardous during drought
Drought Vulnerability	~Fraction of Council trees which have drought proof water supplies ~Number of facilities that have drought management plans
Extreme Weather Exposure	Fraction of council spending on extreme weather incidents (eg tree damage)
Extreme Weather Vulnerability	Projected increase in spending with no adaptation
SLR Exposure	Properties and number of businesses in areas at risk of coastal inundation and erosion with Sea level rise included
SLR Vulnerability	Number and value of properties which have been approved by council in high risk areas since 2007.
Regulatory Exposure	~energy consumption by council
Regulatory Vulnerability	~Tonnes of Carbon emitted by council. ~Tonnes of c emitted per person in area, ~tonnes per square metre commercial space, ~emissions per square metre industrial space, ~emissions per hectare agricultural space.

11. Natural Systems and Bio-Security	
Temp Exposure	<p>~ Known weeds in area ~Head of Cattle (Number)</p>
Temp Vulnerability	<p>~Non-heat-resilient cattle (%) ~Invasive species ~Percentage change in existing weed prevalence, ~Number of new weeds entering the area, ~Number of new Australian flora and fauna species entering area, ~Percentage reduction in flora and fauna native to area</p>
Fire Exposure	<p>~ Agricultural land exposed to bushfire ~Natural and heritage areas exposed to bushfire</p>
Fire Vulnerability	<p>~Crops and stock vulnerable to bushfire during likely seasons of increase (ie post dry winter) ~Natural assets which may be vulnerable to more extreme or frequent bushfire than historical norm</p>
Precip. Exposure	<p>~ Agricultural land exposed to various flood levels (hectares) ~Natural and heritage areas exposed to various flood levels (hectares) and sites of high value</p>
Precip. Vulnerability	<p>~Crops and stock vulnerable to increased flooding ~Natural assets which may be vulnerable to more extreme or frequent flooding than historical norm</p>
Drought Exposure	<p>~agricultural land (hectares), ~average water use per dollar yield ~historical norms for environmental flows</p>
Drought Vulnerability	<p>~Vulnerability of yield (dollars) to water reductions ~percentage of non-on-site water storage ~Impact on eco-systems from reductions in environmental flows ~Percentage of environmental flows redirected</p>
Extreme Weather Exposure	<p>~ Agricultural land ~Natural and heritage areas</p>
Extreme Weather Vulnerability	<p>~crops vulnerable to damage by extreme weather eg hail or severe wind ~Conservation areas vulnerable to extreme storm damage eg tree fall</p>
SLR Exposure	<p>sq km of natural habitat in areas projected to be inundated or eroded by flood waters due to sea level rise and storm surge</p>
SLR Vulnerability	<p>Number of species of flora and fauna which are vulnerable, amount of biodiversity contraction projected.</p>
Regulatory Exposure	<p>NA</p>
Regulatory Vulnerability	<p>NA</p>

9 Additional References

The following references are additional to those set out in the Risk Report.

Climate Risk 2008, *From Risk to Advantage: General Insurers as Key Agents for Climate Change Adaptation*. A report to Zurich Financial Services Australia.
www.climaterisk.com.au/climate%20changex%20and%20general%20insurance%20v.20.pdf

Climate Risk 2009a Synthesis Report: Climate Change and Infrastructure Expert Summit. Published by Climate Risk Pty Ltd

Climate Risk 2009b Climate Solutions 2: Low-Carbon Re-Industrialisation. A Report to WWF International. Released London, November 2009

DECCW, 2009. NSW Sea Level Rise Policy Statement. Department of Environment Climate Change and Water NSW. ISBN 978-1-74232-464-7, DECCW 2009/708, October 2009. Accessed via www.environment.nsw.gov.au/climateChange/sealevel.htm

Draft Flood Risk Management Guide: Incorporating sea level rise benchmarks in flood risk assessments. Department of Environment Climate Change and Water, NSW. ISBN 978 1 74232 467 8 DECCW 2009/711, October 2009. Accessed via <http://www.environment.nsw.gov.au/resources/climatechange/09711draftfloodrisk.pdf>

Draft Coastal Risk Management Guide: Incorporating sea level rise benchmarks in coastal risk assessments. Department of Environment, Climate Change and Water, NSW. ISBN 978 1 74232 466 1, DECCW 2009/710, October 2009. Accessed via <http://www.environment.nsw.gov.au/resources/climatechange/09710draftcoastrisk.pdf>

DECCWEE 2010, Climate Change Adaptation Actions for Local Governments. Published by The Department of Climate Change and Energy Efficiency.

AGO 2006, Climate Change Impacts and Risk Management – A Guide for Business and Government. Published by the Australian Greenhouse Office.

Planning Institute of Australia (2004), Sustainable Regional and Urban Communities Adapting to Climate Change. Issues Paper. www.greenhouse.sa.gov.au

RFS 2004 (Rural Fire Service of Queensland) Don't Welcome Bushfire into your House. Published by the Rural Fire Service of Queensland.

www.ruralfire.qld.gov.au/images/RFS_HO_Brochure_Bushfire_Prep_Communities.pdf

DES 2006 (Department of Emergency Services, Queensland). Watch Out: Staying Safe in the Neighbourhood.

www.emergency.qld.gov.au/publications/pdf/Watch_Out_Information_Booklet.pdf

Smith, S. (2010), Letter of clarification sent to by the Deputy Director General of DECCW NSW to Michael Coulter, General Manager of Nambucca Council.

10 Appendix 1: Nambucca Allocation of Strategy Actions

Local Environmental Plan (LEP) and Development Control Plan (DCP)				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
HHER-1	Limit Development and Access in areas at high risk of flooding	Department of Environment and Planning	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies; In some instances individual studies which address hazards may be provided by developers.	Department of Lands are acquiring LIDAR which will be available to Council; Stage 1 Flood Study at Lower Nambucca in Draft Form. Deep Ck Flood Study Commenced. Stage 1 of a 3 Stage Coastal Hazard Assessment has been completed.
HHVR-2 & BERM-1	Ensure Development Controls adequately protect development from Climatic Change Risk			
BEER-1	Investigate opportunities, or scenarios to reduce the number of existing properties and developments in at-risk locations through buy back or relocation			
BEER-1	Avoid new development in high-risk locations			
BEER-3	Ensure development in green field locations adequately considers sea level rise expectations over the life of the development.			
BEVR-2	Investigate opportunities to apply development controls which address location specific climate change hazards			
BERT-3	To maintain indemnity under section 733 of the Local Government Act 1993, ensure Development complies with state government policies on sea level rise.			
ERER-2	Identify suitable locations for the relocation or development of tourist assets (Caravan Parks) away from highly exposed locations.			
ERVR-3	Implement planning controls that provide protection of key economic assets including agriculture and natural environment which attracts tourism.			
GRER-1	Develop controls to minimise Councils exposure to future legal challenges			
FSER-1	Ensure Regionally Significant Farmland is retained for Agriculture	Department of Environment and Planning/ State Government	The Regionally Significant Farmland Mapping Project (2009) has been prepared by the NSW Department of Planning, there is no scheduled review planned. Council may initiate a review through a local growth management strategy should it be deemed necessary.	Nambucca LEP 2010 has incorporated Regionally Significant Farmland Mapping into the RU1 Primary Production Zone.
FSVR-1	Ensure Development Controls enhance the potential for local food production on rural land	Department of Environment and Planning	Local Growth Management Strategy - Rural Lands Component	Nambucca DCP 2010 has been prepared this would be subject to review upon completion of the Rural Lands Strategy
HHER-1	Limit Development and access in areas at high risk of bushfire	Department of Environment and Planning	New Bushfire Prone Lands Map	The Rural Fires Act require each local government area to have a Bushfire Prone Lands Map, which is expected to be reviewed every 5 years. Council's updated Bushfire Prone Lands Map is awaiting the NSW RFS Commissioners approval. Planning for Bushfire Protection (NSW RFS, 2007) provides Guidelines for Bushfire Hazard Assessment.
WSER-1	Provide Development Controls incentives which encourage/ maximise on-site water harvesting in all new development. Consider using development incentives.	Department of Environment and Planning		Nambucca DCP 2010 has been prepared this would be subject to investigation at the next review

Local Environmental Plan (LEP) and Development Control Plan (DCP)				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
WSVR-1	Provide Development Controls and/or incentives which decrease water use in all development.			
SRER-2	Should development occur in locations where viable infrastructure cannot be assured, require that developers make stand alone arrangements for wastewater treatment.			
SRER-5	Develop thresholds for development requiring Council infrastructure to be constructed and maintained. An example would be to only allow development requiring a pump station where a predetermined number of lots are involved.			
ESER-1	Develop planning controls that will facilitate reduction of climate-enhanced hazards to power distribution system (eg toward undergrounding of cables, removal of hazards close to power lines).			
ESER-2	Develop controls that allow for increases to embedded (local) generation of electricity, through gas turbines and renewable energy (eg, solar, wind, run-of-river hydroelectricity, biomass from agricultural waste).			
ESVR-2	Ensure back-up systems exist for important private sector services including commercial-scale food refrigeration, telecommunications facilities, aged care facilities.			
GRVR-1 & GRRT-1	Introduce controls that transfer the requirement for climate change risk management (and therefore legal risks stemming from future loss) to the developer. This can be done by requiring buildings and other activities that need Council consent to show that climate change hazards have been adequately managed.			
TSER-3	Ensure planning controls increase densities in and around urban centres to increase alternative forms of transport such as walking, cycling and public transport.	Department of Environment and Planning		Nambucca LEP 2010 has incorporated height and density increases in Macksville and Nambucca CBD to try and encourage urban consolidation.
BEVR-3	For exposed buildings, ensure that property management plans address the location specific climate change risk and require each property to maintain a current emergency risk management plan, to manage the impacts on people and property from climate change related events.	Department of Environment and Planning	Funding; Resources	New buildings can be requested to provide management plans through consent conditions. Property owners of existing buildings could be encouraged to prepare plans through education programs. The SES is responsible for education regarding flooding and storm emergencies; the NSW RFS is responsible for education relating to Bushfire Emergencies.
CSER-1	Develop controls to ensure communication systems are located in low risk environments.	Department of Environment and Planning	Telecommunications Act and SEPP Infrastructure provide exemptions	Typically not subject to Council approval. Communication service providers can be advised of climate risks as Council is made aware of them.
CSVR-1	Investigate options to ensure developments in high risk locations install suitable telecommunication equipment.	Department of Environment and Planning	Telecommunications Act and SEPP Infrastructure provide exemptions	Typically not subject to Council approval. Communication service providers can be advised of climate risks as Council is made aware of them.
NSER-1	Minimise the exposure of conservation areas and agriculture by using the LEP to limit development in and access to areas at high risk from climate change hazards, including accelerated transfer of climate migrating weeds and pests.	Department of Environment and Planning	Biodiversity Management Plan; Funding; Resources	Council does not have a Biodiversity Management Plan or similar conservation policy. Should Council resolve to prepare such a strategy a key component would be the consideration of Climate Change Risks.
NSER-2	Develop controls to protect natural environments, including buffers and corridors.	Department of Environment and Planning	Biodiversity Management Plan; Funding; Resources	Council does not have a Biodiversity Management Plan or similar conservation policy. Should Council resolve to prepare such a strategy a key component would be the consideration of Climate Change Risks.

Local Environmental Plan (LEP) and Development Control Plan (DCP)				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
NSER-2	Revise conservation values to incorporate climate change driven constraints and identify options to re-optimize zoning for new climate regimes. Consider loss of habitat and coastal squeeze due to sea level rise, heat and drought stress and relocate farming out of coastal flood plains to allow natural coastal systems to realign.	Department of Environment and Planning	Biodiversity Management Plan; Funding; Resources	Council does not have a Biodiversity Management Plan or similar conservation policy. Should Council resolve to prepare such a strategy a key component would be the consideration of Climate Change Risks.
NSVR-1	Maximise the health and resilience of natural environment through: (a) best-practice conservation, (b) limiting pressure from development/urban encroachment into high value areas, especially by noting that in the community there may be auto-adaptation pressures which may necessitate a development cap, and (c) incentives or regulations to develop and maintain biodiversity corridors on private land.	Department of Environment and Planning	Funding; Resources	Best practice conservation principles and protection measure can be developed through LEP and DCP controls should Council choose to pursue them. The State Government provides incentives to conserve biodiversity on private land through Biobanking Schemes and other similar arrangements such as conservation agreements.

Local Growth Management Strategy - Rural Lands Component				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
FSRT-2	Investigate expansion of Regionally Significant Farmland into lands not effected climate risks	Department of Environment and Planning	Rural Lands Component of Local Growth Management Strategy; LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Funding/Resources	The Local Growth Management Strategy - Rural Lands Component will require State Government Approval. Before Council examines this Rural Component it is expected that the Residential Component will need to be completed.
FSAO-1	Identify climate proof agricultural land			
ERER-1	Identify opportunities to relocate high-risk agricultural activities to low risk locations			
ERV-1	Investigate agricultural activities that would be suitable to the projected climate regime			
ERRM-3	Identify options for stock management before during and after major flooding events. For example identify land unlikely to be impacted by flooding.			
ERAO-2	Identify agriculture and forest options for increased income under a low-carbon economy from bio-sequestration and renewable Energy Production.			
ERV-1	Investigate opportunities for niche agricultural activities on large lot residential land			

Local Growth Management Strategy - Tourism Component				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
ERER-2	Identify suitable locations for the relocation or development of tourist assets (Caravan Parks) away from highly exposed locations.	Department of Environment and Planning	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	Council has not scheduled the preparation of the local growth management strategy - tourism component. Such a strategy could identify alternative lands for tourism activities which could be implemented through zoning changes in the LEP.
ERRM-1	Educate the local tourism industry on the projected risks associated with Climate Change. Encourage the development of industry partnerships to assist the area in maintaining it self as a desirable tourism destination.			Council has not scheduled the preparation of the local growth management strategy - tourism component. Such a strategy could identify alternative lands for tourism activities which could be implemented through zoning changes in the LEP. Although a Council prepared tourism strategy may examine these actions, their implementation is largely dependent on the on tourism industry embracing and implementing them.
ERER-3	Identify options for re-timing tourist events in months with lower risk of flooding, heat stress and tropical disease vectors.	Department of Environment and Planning		
ERV-1	Investigate Tourism activities that would be suitable in the projected climate regime	Department of Environment and Planning		
ERAO-1	Identify tourism opportunities related to a low carbon tourism paradigm	Corporate Services/ Department of Environment and Planning		

On-site Sewerage Management Plan				
SRA0-1	Review of On-site Sewerage Management Plan should consider use and management of systems under the projected climate regime	Department of Environment and Planning	Council on-site Sewerage Management Plan was adopted in 2009, changes may not be made until next review.	Reviewed every eight (8) years, the next review is in 2017.
Flood Risk and Estuary Management Planning				
GRRM-1	Improve the ability of Council to understand the implications of climate change hazards by commissioning research to quantify the impacts. This would include modelling of the effects of sea level rise and storm surge on the local coast, revised flood modelling in light of increased precipitation (3 day extreme precipitation currently predicted to increase by 10%. The risk report accompanying this document predicts an increase by 13% to 2030), and the confluence of sea level rise and precipitation increases.	Department of Environment and Planning; State Government	LIDAR; Funding; Resources	Council has commenced a review of its flood mapping taking into consideration State Policies on Sea Level Rise. Stage 1 Flood Mapping for Lower Nambucca has been drafted . Stage 2 will address the Macksville Floodplain and Stage 3 upper catchment areas including Bowraville. A flood study has also commenced in the Deep Ck Catchment. Council has recieved State Government Funding to pursue these actions.
SRER-2	Reviewing flooding and sea level rise to 2300.	Department of Environment and Planning		
SRER-2	Adopt planning controls that ensure developments are limited to locations where infrastructure is viable for the long term			
BERT-3 & BEER-2	To maintain indemnity under section 733 of the Local Government Act 1993, ensure Development complies with state government policies on sea level rise.			
ERV-4	Identify measures which may reduce flooding and velocity of flows in commercial and industrial areas			

Integrated Water Cycle Management Strategy				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
FSRT-1	Seek a revision of water license conditions to allow a higher level of extraction during periods of increased rainfall.	Department of Engineering Services	Water extraction license requirements will be dependant on Council's Water Supply System and whether or not Council proceeds with the off River Storage Facility or an alternative option to secure Council's Water Supply.	Water extraction licenses are issued by the State Government under the Water Management Act 2000
WSER-2	Investigate and implement measures to mitigate the impacts that increased temperatures may have on water quality.	Department of Engineering Services	Funding	It is standard practice for the design of Water supply systems to ensure water quality is maintained. The studies completed to support development of an off river storage facility have considered various treatment options such as aerators.
WSER-3	Investigate options to extend the Integrated Water Cycle Management System to provide additional sources from harvesting, recycling and grey water use.	Department of Engineering Services	Funding	The Integrated Water Cycle Management Plan developed 3 options to for consideration through a triple bottom line assessment process. The recommended option allows for the greatest level of system integration as the integration becomes feasible.
WSVR-2	Ensure Council's Water Supply System is prepared for seasonal changes in water availability, more specifically a reduced mean monthly winter rainfall.	Department of Engineering Services	Funding	Investigations have commenced into a proposed off River Storage Facility and expansion of the borefields (watersource) at Bowraville.
WSRM-1	Ensure inappropriate water extraction practices are not undertaken during periods of low flow. Extraction regimes should consider the projected reduction in mean monthly rainfall.	Department of Engineering Services		Water extraction licenses are issued by the State Government under the Water Management Act 2000
WSRM-2	Consider seasonal water pricing and regulation to accommodate the projected reduction in winter rainfall and demand increases during the predicted hotter summer months.	Department of Engineering Services		
WSRT-1	Seek cost sharing with State and Federal Governments for measures which do not provide short term cost-benefit but would increase water security.	Department of Engineering Services		

Asset Management Plan				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
BERM-2	Develop spatial information sets (Asset Risk Maps) to identify assets that will be at-risk with climate change, and identify alternative, low risk locations. Require that this information be considered in asset management planning.	Department of Environment and Planning	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies	
HHER-2	Maintain Functionality of Open Space Areas	Department of Engineering Services	Asset Risk Maps; Funding; Resources	
HHER-2	Ensure Adequate shading is provided in open space areas	Department of Engineering Services; SES	Funding; Resources	
HHER-2	Ensure Stormwater in open space areas does not effect functionality	Department of Engineering Services	Asset Risk Maps; Funding; Resources	
HHER-3	Increase availability and access to Council facilities/ services	All of Council	Resources	
WSVR-3; BEVR-4 & GRVR-5	Ensure Risk guidelines and specifications for Council infrastructure give consideration to projected climate change risks such as flooding that considers sea level rise and predicted rainfall patterns.	Department of Engineering Services	Asset Risk Maps; Funding; Resources	
SRER-1 & SRVR-2	Review water reticulation, waste water and storm water systems and associated infrastructure in respect to identified climate hazards (including physical hazards and possible effects of carbon price on costs of operation). Use the results of this review as the basis for developing a management plan for climate-proof systems with minimised exposure to climate change hazards.	Department of Engineering Services	Asset Risk Maps; Funding; Resources	This action may need to be undertaken in a staged process, commencing in areas identified as high risk areas through the Asset Risk Maps.
SRVR-2	Actions which may assist in creating a climate-proof system include: the use of one way valves and modification of release points to accommodate floods; connect septic systems in high risk locations to mains sewerage; ensure backup power systems to pumping stations (due to anticipated increases in power outages).	Department of Engineering Services	Asset Risk Maps; Funding; Resources	Retrofitting one way valves would be of benefit in existing low lying areas subject to surface water ingress. However only likely to occur if Council subsidised work or issued notices on properties.
SRRM-1	Identify components of water, waste water and storm water systems that cannot be climate-proofed, and which will require intervention if they are to remain functional. Develop strategies to address these components which should consider the expected frequency and duration of disruptive events such as flooding and power outages.	Department of Engineering Services	Asset Risk Maps; Funding; Resources	
SRRM-2	Develop actions/strategies to manage loss of infrastructure during climatic events	Department of Engineering Services	Asset Risk Maps; Funding; Resources	
SRER-2	Should development occur in locations where viable infrastructure cannot be assured, require that developers make stand alone arrangements for wastewater treatment.	Department of Environment and Planning	Asset Risk Maps;	Nambucca DCP 2010 has been prepared this would be subject to investigation at the next review
SRER-3 & SRRT-2	Investigate options privatise to infrastructure that is not cost effective to maintain, or make arrangements with affected community to charge for additional costs.	Department of Engineering Services	Asset Risk Maps;	This action would be location specific as issues with specific infrastructure are raised.
SRER-4 & SSRT-1	Investigate options to transfer at-risk assets to other utilities or a new utility.	Department of Engineering Services	Asset Risk Maps;	This action would be location specific as issues with specific infrastructure are raised.

Asset Management Plan				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
SRVR-1	identify stormwater connections into the waste water system.	Department of Engineering Services	Resources	
SRVR-1	Investigate options to remove stormwater connections into the waste water system.	Department of Engineering Services	Funding; Resources	
BEVR-1	Subject to cost benefit analysis consider community scale risk reduction works to reduce vulnerability to an identified hazard. For example stormwater upgrades, construction of sea walls or levies.	Department of Engineering Services	Asset Risk Maps; Funding; Resources	This action would be location specific as risks specific to certain locations are identified.
ESVR-1	Install uninterruptible power supplies (UPS), back-up power storage, and back-up generation in Council facilities that provide critical systems for Council operations, and for essential services of water supply and waste water systems.	Department of Engineering Services	Funding	
TSER-1	Identify roads and bridges that are likely to be unviable to maintain in the long term due to repeated riverine and sea level rise flooding. It will also be important to identify low-risk alternative routes (eg, along ridge lines).	Department of Engineering Services	Asset Risk Maps;	
TSER-2	Investigate options to close roads and buy back properties on roads which have a high remediation or operation cost, if this is cheaper than maintaining current services.	Department of Engineering Services		This action would be location specific as issues with specific infrastructure are raised.
TSRT-3	Investigate options to transfer ownership of high risk roads to the community serviced by the road.	Department of Engineering Services	Asset Risk Maps;	This action would be location specific as issues with specific infrastructure are raised.
TSVR-1	Investigate options to increase the resilience of road and bridge materials, construction and management.	Department of Engineering Services		
TSRT-2	Seek State or Federal Government funding to cover costs of increased maintenance of the transport systems due to climate change, or seek rate increases to cover these costs.	Department of Engineering Services/ Corporate Services	Asset Risk Maps;	
TSVR-2	Investigate options to minimise overtopping of roads during flooding events	Department of Engineering Services	Asset Risk Maps;	This action will require the Asset Risk Maps to identify existing overtopping problems areas or areas likely to be inundated at a later date;
TSVR-3	Ensure that boat ramps, wharfs and pontoons can accommodate sea level rise, increased storm surge and overland flooding.	Department of Engineering Services	Asset Risk Maps;	
TSRM-2	Develop strategies to divert heavy traffic off council roads during very hot days, when roads are vulnerable to damage.	Department of Engineering Services	Resources	

Asset Management Plan				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
TSRT-1	Seek to transfer high-risk roads to the RTA if maintenance costs exceed Council's resources.	Department of Engineering Services	Asset Risk Maps;	
TSRT-1	Ensure that Council is aware if high-risk roads are being transferred to Council from the RTA and If so, ensure that appropriate funding is available to support operation of the roads under increased climate change hazards.	Department of Environment and Planning	Asset Risk Maps	The Asset Risk Maps should specifically target section of the existing Pacific Highway likely to be transferred to Council when the Highway Upgrade is completed.
TSAO-1	Implement programs to enhance walkable communities	Department of Engineering Services	Funding;	Council has prepared a Draft Cycleway Plan, the focus of the plan is to provide a cycleway link between Nambucca and Macksville. Funding has been made available through the federal Government, Council and various State Government authorities to construct the cycleway. Additional funding is required to complete stage 2.
GRVR-2	Develop and implement an ongoing process to reduce Council's economic exposure to measures which regulate carbon (ie, measures which reduce greenhouse gas emissions). This could be accomplished by minimising energy use, fuel use and high carbon materials (eg, in road construction) across Council operations.	Department of Engineering Services		Continue to review Councils Sustainable Fleet and Plant Policy
ESER-3	Facilitate the uptake of electric vehicles (which reduce the vulnerability to disruptions in the supply of fuels) through provision of charging stations and other incentives.	Department of Engineering Services	Funding; Demand Analysis	Subject to funding opportunities and a demand analysis this may be something that Council could consider for public parking areas.

Nambucca Disaster Management Plan (2007) (DISPLAN)				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
HHVR-1	Use existing emergency management plans and relationships with emergency service providers to ensure that an adequate level of functionality can be developed for basic needs (food, water, sanitation and human health) and essential services (energy, transport and communications) during and post major extreme weather events which are expected to increase in frequency, severity and coincidence	Department of Engineering Services/ Department of Engineering Services/ SES	Nambucca DISPLAN was adopted in 2009. Consideration of these matters should be included in the next review. At which time more accurate flood mapping and coastal hazard mapping will be available.	The Nambucca DISPLAN is reviewed every five (5) years or after an Emergency Event. The Nambucca DISPLAN is not due for review until 2014. Should the revised Flood Risk Mapping become available prior to the scheduled review period, it is recommended the DISPLAN review be moved forward.
FSRM-1	Incorporate food security considerations for isolating climate incidents. Eg shared refrigeration in pre-agreed location (eg a single supermarket in each location likely to be isolated).			
ESRM-2	Develop actions to cope with more frequent and severe power outages that do not require repeated use of, or excessive dependence on, emergency services.			
ESRM-3	Develop actions to cover the high likelihood that there could be a confluence of extreme weather events and power outage.			
TSRM-1	Identify and develop actions for people and businesses affected by more frequent and lengthy road flooding and isolation.			
CSVR-2	Educate the community to minimise the pressures on mobile communications systems during extreme events.			
CSRM-1	Ensure alternative communication avenues are available to provide redundancy in the event of telecommunications failure during extreme events.			
CSRM-2 & ERRM-2	Develop actions to ensure clear, reliable and consistent communications to tourists, travellers and residents in region during extreme events. Ensure the community is made aware of current threats and risks as well as when the risk/threats are withdrawn			
ERRT-1	Develop 'state of emergency triggers' to avoid communication via media that can also have the effect of dissuading tourists from the visiting the area.			
Council Property Plans of Management				
BEVR-3	For exposed buildings, ensure that property management plans address the location specific climate change risk and require each property to maintain a current emergency risk management plan, to manage the impacts on people and property from climate change related events.	Corporate Services/ Department of Engineering Services	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	All property management plans should address climate change risk in their preparation. It is noted that this can only be considered as the information becomes available.
Human Resources Strategic Plan				
CSAO-1	Investigate options to increase telecommuting for Council Employees	Corporate Services		The human resources strategic plan currently in draft form identifies options to investigate work from home and E-recruitment. These are scheduled for investigation by 2012.

Economic Development Plan				
WSAO-1 & ERVR-2	Investigate options to capture economic and livability advantages for this region, which has comparatively high water security compared to other parts of the eastern seaboard.	Corporate Services		Council's Economic Development Plan 2006, identifies opportunities to maintain, expand and diversify economic growth in the Shire. When the Economic Development Plan 2006 is reviewed it should examine the opportunities Climate Change may present for the shire.
State of the Environment Report				
NSRM-1	Monitor the migration of new species of flora and fauna entering the district and new or enhanced threats posed by new invaders and exacerbated pest outbreaks. Communicate these results to the agricultural sector to allow them to change pest control systems.	Department of Environment and Planning /State Government		The State of the Environment Report can continue to monitor and communicate species presence in the shire. The state government monitors, regulates and educates on threatened species, and communities, threatening processes and other immediate threats

Environmental Education				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
HHRM-1	Educate Residents and Businesses to lower expectation of service levels in light of climate hazards. Encourage the community to develop individual resilience to cope with changes and disruptions affecting health, access to basic needs and services.	Department of Environment and Planning	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	Seek Funding Opportunities for a climate Change Education Program
SRRM-2	Educate communities which are located in areas at risk from infrastructure failure during climatic events.			
BERM-1	Educate local business and industrial sectors of projected climate risks and options to improve their resilience to these risks.			
ERRM-1	Educate the local tourism industry on the projected risks associated with Climate Change. Encourage the development of industry partnerships to assist the area in maintaining it self as a desirable tourism destination.			
ESRM-1	Educate the community to manage increased disruptions to their power supply. Identify high-risk people, groups and facilities to ensure they have continuity management plans that will allow them to cope with loss of power over extended periods.	Department of Environment and Planning	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program
FSVR-2	Educate the regions agriculture sector on the regions potential climate risk so it can assist them in transitioning crops and stock better suited to the changing climate.	Department of Environment and Planning	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program
	Encourage the private sector to make arrangements with essential service providers, to ensure security of service provision where possible.	Department of Environment and Planning	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program
HHRT-1	Ensure that Community Health Plans and Strategies address climate change risks in relation to basic needs and essential services.	Department of Environment and Planning/ NSW Department of Health	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program
HHRT-2	Ensure utility services outside of Council are aware of climate change risks in the region so they can incorporate into plans and services. As an example forward flood mapping, seal level rise maps, Coastal Hazard Maps to Country Energy.	Department of Environment and Planning	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	Seek Funding Opportunities for a climate Change Education Program
BEER-4, BERT-2 & GRER-2	Section 149 Certificate should identify an known climate change risks and state government policies or requirements and also disclose the predictions of current science	Department of Environment and Planning	Legal Advice	Council presently identifies the State Governments sea level rise predictions on all S149 Certificates. We need to consider disclosing the predictions of current science. This may be subject to legal advice.
ESRM-2	Develop non-emergency management plans to cope with more frequent and severe power outages that do not require repeated use of, or excessive dependence on, emergency services.	Department of Environment and Planning	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program

Natural Resource Management				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
NSRM-1	Integrate new practices to manage the protection of native species which are in process of dispersing to track climate change	State Government		The state government monitors, regulates and educates on threatened species, and communities, threatening processes and other immediate threats
NSRM-2	Revise environmental conservation and biodiversity management plans in light of climate change. Ensure they are realistic in the light of climate change, and do not escalate demands on resources to maintain systems which will be unavailable in the new climate change regime.	Department of Environment and Planning	Funding; Resources	Council does not have a Biodiversity Management Plan or similar conservation policy. Should Council resolve to prepare such a strategy a key component would be the consideration of Climate Change Risks.
NSRM-3	Develop management plans for increased risks from weed breakouts following more flooding, bushfires and higher temperatures.	Department of Engineering Services	Funding; Resources	The NSW North Coast Weeds Advisory Committee documents management plans and other policies which assist local governments and other authorities to implement weed management. Representatives of this committee should ensure climate change is appropriately considered during the preparation of plans and policies.
NSRM-4	Ensure Climate Change is comprehensively dealt with in any Estuary Management Plan	Department of Environment and Planning	Funding; Resources	Council has recently completed an estuary management plan for the Nambucca River. This plan gave some consideration to Climate Change
NSRT-1	Transfer costs to the State or Federal Governments, or consider raising land rates to cover costs of land-buy backs which will allow for re-zoning to promote more resilient conservation zones.	Department of Environment and Planning	Funding; Resources; Biodiversity Management Plan	Council does not have a Biodiversity Management Plan or similar conservation policy. Should Council resolve to prepare such a strategy a key component would be the consideration of Climate Change Risks.
NSRT-2	Develop a combined regional-scale strategy for cross cutting biodiversity and bio-security risks, to ensure that risks are managed overall.	State Government		The State Government has prepared a Draft Northern Rivers Biodiversity Management Plan. This plan identify a range of actions help maintain and conserve biodiversity.
NSRT-3	Request State or Federal Government funding for adaptation measures for natural environments which may be of State or Federal significance.	Department of Environment and Planning		Should Council resolve to prepare a biodiversity management plan it should seek funding assistance from the State Government to prepare it.

General Governance				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
BERT-4	Negotiate for State and Federal funding for measures to reduce exposure and increase the resilience of building stock. Alternatively, seek a mandate to increase the rates, to cover the additional capital and operational costs that may be associated with this exposure.	Corporate Services	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	
ESRT-1	Consult with energy utilities, regarding options for load shedding, priority supply locations, embedded generation, and undergrounding of cables, to reduce exposure to physical hazards.	Department of Environment and Planning	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	As Climate Change Hazards become known to Council the information should be forwarded to service providers, neighbouring Councils and other relevant authorities
ESRT-2	Consult with utilities to introduce secondary power lines around high risk links, to introduce redundancy into the power supply chain.	Department of Environment and Planning	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	As Climate Change Hazards become known to Council the information should be forwarded to service providers, neighbouring Councils and other relevant authorities
ESRT-3	Consult with utilities and neighbouring Councils to address neighbouring high-risk locations through which the power system passes and where it is prone to outage.	Department of Environment and Planning	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies; Risk identification in neighbouring Councils	As Climate Change Hazards become known to Council the information should be forwarded to service providers, neighbouring Councils and other relevant authorities
CSRM-2 & ERRM-2	Develop actions to ensure clear, reliable and consistent communications to tourists, travelers and residents in region during extreme events. Ensure the community is made aware of current threats and risks as well as when the risk/threats are withdrawn	Department of Engineering Services/ Department of Engineering Services/ SES		Subject to the DISPLAN review
CSRT-1	Consult with communication suppliers and neighbouring Councils to develop climate-proof communications systems for the area, including relocation of high-risk assets, and fit-for-purpose specification of equipment.	Department of Environment and Planning	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	As Climate Change Hazards become known to Council the information should be forwarded to service providers, neighbouring Councils and other relevant authorities
GRER-2, GRER-4 & BEER-2	Reduce the exposure of council to legal and financial risks through a strategy of disclosure and awareness by: (a) ensuring that all known climate change hazards are published in the public domain, (via maps and other tools) (b) where possible, at minimum, adhering to State or Federal Government benchmarks, whilst also disclosing that risks may exceed these levels due to science known to Council; (c) ensuring that parties that could suffer loss are made aware of possible risks at the earliest possible time (eg, through the 149 certificate), allowing them to make their own decisions on risk management; and (d) requiring that the known climate change hazards are adequately managed by those seeking to build or redevelop in high-risk locations	Department of Environment and Planning	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	Will require amendments to Nambucca LEP 2010 and DCP 2010 when climate change risks are appropriately identified
GRER-3, BERT-3 & BEER-2	Ensure that Council complies with State benchmarks for indemnification under the Local Government Act (section 733) by implementing required benchmarks across all Council approvals, whilst also disclosing that actual risk may be higher.	Department of Environment and Planning	Legal Advice	

General Governance				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
GRER-5	Develop a legal transition strategy based upon legal opinion to minimise short-term litigation (eg, for cost increases in developments). This can be folded into the process of introducing measures that would address climate-related legal risks for Council in the long term.	Corporate Services		May be required when new development standards are implemented. If standards are based on professional investigations, legal opinions may only be necessary when proponents challenge those standards.
GRVR-4	Reduce vulnerability of Council to community dissatisfaction, loss of goodwill and political instability by implementing consultative processes around climate change management strategies, changes in resource allocation, and possible increases in rates to maintain services and changes in service levels.	Department of Environment and Planning	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program
GRVR-5	Update risk guidelines/specifications for Council infrastructure to cope with weather-related events that may be affected by climate change (eg, flood risk), to reflect projected rather than historical risk levels. For example, a storm water drain might be designed to last 100 years and cope with a 1 in 100 year event; with climate change, the suitable flood level should consider that an event with a return frequency of 1 in 100 years today may look more like the current 1 in 200 year event by 2100 (ie, much more severe).	Department of Engineering Services	Asset Risk Maps; Funding; Resources	
GRVR-6	Implement a policy of 'shadow pricing' across decision-making to include Federal Treasury estimates for forward carbon prices under a two degree Celsius / sub-450 parts per million scenario.	All of Council	Will require a standard methodology to be provided to staff so estimates of the carbon price can be simply calculated.	Implement into Council Reporting process for projects likely to be actioned in the next 5 years.
GRRM-2	Review the ability of Council to provide core services and maintain assets under climate change. If this is not possible, develop plans to consolidate asset bases and service provisions. Also, review the ability of Council to respond to major events including the workforce required for timely recovery post-event. Overall, create a revised financial, asset and human resource strategy.	All of Council	Funding; Resources	This action would require a supporting study prepared by a specialist in economic and planning.
BERT-1	Work with insurance providers to ensure that all properties in the area are affordably insurable and where insurers have specific concerns about risks such as flooding and bushfire, review options within Council's control that can reduce these risks to levels acceptable to insurers Promote full insurance cover within the community.	Corporate Services	Funding; Resources	Council can continue to communicate with insurance companies and develop and implement actions within this strategy to promote more insurable communities, however it is idealistic to achieve full insurance cover within the community.
GRRM-4	Integrate climate change management strategies into all Council planning documents, policies and guidelines.	Department of Environment and Planning/ Corporate Services		This action is best placed in Council 20 year Community Strategic Plan as an overriding objective.

General Governance				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
GRRM-5	Implement monitoring and measurement processes for key climate change indicators and metrics for exposed and vulnerable people, property and infrastructure.	Department of Environment and Planning		May be incorporated in existing monitoring activities such as the State of the Environment Report; Land and Housing monitors; development statistics etc
GRAO-1	Collaborate with all neighbouring Councils and State Government to 'climate-proof' the region which would increase relative value and also harness potential advantages: water and food security for agriculture and low-carbon tourism making the region attractive to inward investment and young families.	Department of Environment and Planning		As Climate Change Hazards become known to Council the information should be forwarded to service providers, neighbouring Councils and other relevant authorities. Initiatives for joint actions or programs should be identified and joint funding opportunities investigated.
GRVR-3	Reduce Council's financial exposure to increased extreme events which cause disruption to services and damage to assets. Act on a range of strategies to ensure resilience of Council's services - eg implement this adaptation plan	All of Council		

11 Appendix 2: Bellingen Adaptation Strategy

Local Environmental Plan (LEP) and Development Control Plan (DCP)				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
HHER-1	Limit Development and Access in areas at high risk of flooding	Environmental Health and Planning Division	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies; In some instances individual studies which address hazards may be provided by developers.	Department of Lands are acquiring LIDAR which will be available to Council;
HHVR-2 & BERM-1	Ensure Development Controls adequately protect development from Climatic Change Risk			
BEER-1	Investigate opportunities, or scenarios to reduce the number of existing properties and developments in at-risk locations through buy back or relocation			
BEER-1	Avoid new development in high-risk locations			
BEER-3	Ensure development in green field locations adequately considers sea level rise expectations over the life of the development.			
BEVR-2	Investigate opportunities to apply development controls which address location specific climate change hazards			
BERT-3	To maintain indemnity under section 733 of the Local Government Act 1993, ensure Development complies with state government policies on sea level rise.			
ERER-2	Identify suitable locations for the relocation or development of tourist assets (Caravan Parks) away from highly exposed locations.			
ERVR-3	Implement planning controls that provide protection of key economic assets including agriculture and natural environment which attracts tourism.			
GRER-1	Develop controls to minimise Councils exposure to future legal challenges			

FSER-1	Ensure Regionally Significant Farmland is retained for Agriculture	Environmental Health and Planning Division/ State Government	The Regionally Significant Farmland Mapping Project (2009) has been prepared by the NSW Department of Planning, there is no scheduled review planned. Council may initiate a review through a local growth management strategy should it be deemed necessary.	Bellingen LEP 2010 has incorporated Regionally Significant Farmland Mapping into the RU1 Primary Production Zone.
FSVR-1	Ensure Development Controls enhance the potential for local food production on rural land	Environmental Health and Planning Division	Local Growth Management Strategy - Rural Lands Component	Bellingen DCP 2010 has been prepared this would be subject to review upon completion of the Rural Lands Strategy
HHER-1	Limit Development and access in areas at high risk of bushfire	Environmental Health and Planning Division	New Bushfire Prone Lands Map	The Rural Fires Act requires each local government area to have a Bushfire Prone Lands Map, which is expected to be reviewed every 5 years. Planning for Bushfire Protection (NSW RFS, 2007) provides Guidelines for Bushfire Hazard Assessment.
WSER-1	Provide Development Controls incentives which encourage/ maximise on-site water harvesting in all new development. Consider using development incentives.	Environmental Health and Planning Division		Bellingen DCP 2010 has been prepared this would be subject to investigation at the next review
WSVR-1	Provide Development Controls and/or incentives which decrease water use in all development.			

Local Environmental Plan (LEP) and Development Control Plan (DCP)				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
SRER-2	Should development occur in locations where viable infrastructure cannot be assured, require that developers make stand alone arrangements for wastewater treatment.			
SRER-5	Develop thresholds for development requiring Council infrastructure to be constructed and maintained. An example would be to only allow development requiring a pump station where a predetermined number of lots are involved.			
ESER-1	Develop planning controls that will facilitate reduction of climate-enhanced hazards to power distribution system (eg toward undergrounding of cables, removal of hazards close to power lines).			
ESER-2	Develop controls that allow for increases to embedded (local) generation of electricity, through gas turbines and renewable energy (eg, solar, wind, run-of-river hydroelectricity, biomass from agricultural waste).			
ESVR-2	Ensure back-up systems exist for important private sector services including commercial-scale food refrigeration, telecommunications facilities, and aged care facilities.			
GRVR-1 & GRRT-1	Introduce controls that transfer the requirement for climate change risk management (and therefore legal risks stemming from future loss) to the developer. This can be done by requiring buildings and other activities that need Council consent to show that climate change hazards have been adequately managed.			
TSER-3	Ensure planning controls increase densities in and around urban centres to increase alternative forms of transport such as walking, cycling and public transport.	Environmental Health and Planning Division		
BEVR-3	For exposed buildings, ensure that property management plans address the location specific climate change risk and require each property to maintain a current emergency risk management plan, to manage the impacts on people and property from climate change related events.	Environmental Health and Planning Division	Funding; Resources	New buildings can be requested to provide management plans through consent conditions. Property owners of existing buildings could be encouraged to prepare plans through education programs. The SES is responsible for education regarding flooding and storm emergencies; the NSW RFS is responsible for education relating to Bushfire Emergencies.
CSER-1	Develop controls to ensure communication systems are located in low risk environments.	Environmental Health and Planning Division	Telecommunications Act and SEPP Infrastructure provide exemptions	Typically not subject to Council approval. Communication service providers can be advised of climate risks as Council is made aware of them.
CSV-1	Investigate options to ensure developments in high risk locations install suitable telecommunication equipment.	Environmental Health and Planning Division	Telecommunications Act and SEPP Infrastructure provide exemptions	Typically not subject to Council approval. Communication service providers can be advised of climate risks as Council is made aware of them.
NSER-1	Minimise the exposure of conservation areas and agriculture by using the LEP to limit development in and access to areas at high risk from climate change hazards, including accelerated transfer of climate migrating weeds and pests.	Environmental Health and Planning Division	Biodiversity Management Plan; Funding; Resources	

Local Environmental Plan (LEP) and Development Control Plan (DCP)				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
NSER-2	Develop controls to protect natural environments, including buffers and corridors.	Environmental Health and Planning Division	Biodiversity Management Plan; Funding; Resources	The Bellingen LEP 2010 has incorporated provisions to protect environmentally sensitive land (water and vegetation) which has associated mapping. Council does not have Biodiversity Management Plan or similar conservation policy at present. Should Council resolve to prepare such a strategy a key component would be the consideration of Climate Change Risks, and amendments to the LEP or DCP.
NSER-2	Revise conservation values to incorporate climate change driven constraints and identify options to re-optimize zoning for new climate regimes. Consider loss of habitat and coastal squeeze due to sea level rise, heat and drought stress and relocate farming out of coastal flood plains to allow natural coastal systems to realign.	Environmental Health and Planning Division	Biodiversity Management Plan; Funding; Resources	Council does not have a Biodiversity Management Plan or similar conservation policy. Should Council resolve to prepare such a strategy a key component would be the consideration of Climate Change Risks.
NSVR-1	Maximise the health and resilience of natural environment through: (a) best-practice conservation, (b) limiting pressure from development/urban encroachment into high value areas, especially by noting that in the community there may be auto-adaptation pressures which may necessitate a development cap, and (c) incentives or regulations to develop and maintain biodiversity corridors on private land.	Environmental Health and Planning Division	Funding; Resources	The Bellingen LEP 2010 has incorporated provisions to protect environmentally sensitive land (water and vegetation) which has associated mapping. Other best practice conservation principles and protection measure can be developed through LEP and DCP controls should Council choose to pursue them. The State Government provides incentives to conserve biodiversity on private land through Biobanking Schemes and other similar arrangements such as conservation agreements.

Local Growth Management Strategy - Rural Lands Component				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
FSRT-2	Investigate expansion of Regionally Significant Farmland into lands not effected climate risks	Environmental Health and Planning Division	Rural Lands Component of Local Growth Management Strategy; LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Funding/Resources	Bellingen Shire has prepared its local growth Management Strategy. Further review this strategy may incorporate considerations presented in this plan. Alternatively individual studies may be required to address these rural matters.
FSAO-1	Identify climate proof agricultural land			
ERER-1	Identify opportunities to relocate high-risk agricultural activities to low risk locations			
ERVR-1	Investigate agricultural activities that would be suitable to the projected climate regime			
ERRM-3	Identify options for stock management before during and after major flooding events. For example identify land unlikely to be impacted by flooding.			
ERAO-2	Identify agriculture and forest options for increased income under a low-carbon economy from bio-sequestration and renewable Energy Production.			
ERVR-1	Investigate opportunities for niche agricultural activities on large lot residential land			

Local Growth Management Strategy - Tourism Component				
ERER-2	Identify suitable locations for the relocation or development of tourist assets (Caravan Parks) away from highly exposed locations.	Environmental Health and Planning Division	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	Council has not scheduled the preparation of the local growth management strategy to address tourism. Such a strategy could identify alternative lands for tourism activities which could be implemented through zoning changes in the LEP.
ERRM-1	Educate the local tourism industry on the projected risks associated with Climate Change. Encourage the development of industry partnerships to assist the area in maintaining it self as a desirable tourism destination.			Council has not scheduled the preparation of the local growth management strategy to address tourism. Such a strategy could identify alternative lands for tourism activities which could be implemented through zoning changes in the LEP. Although a Council prepared tourism strategy may examine these actions, their implementation is largely dependent on the on tourism industry embracing and implementing them.
ERER-3	Identify options for re-timing tourist events in months with lower risk of flooding, heat stress and tropical disease vectors.	Environmental Health and Planning Division		
ERV-1	Investigate Tourism activities that would be suitable in the projected climate regime	Environmental Health and Planning Division		
ERAO-1	Identify tourism opportunities related to a low carbon tourism paradigm	Corporate Services Division/ Environmental Health and Planning Division		

On-site Sewerage Management Plan				
SRAO-1	Review of On-site Sewerage Management Plan should consider use and management of systems under the projected climate regime	Environmental Health and Planning Division	Council on-site Sewerage Management Plan was adopted in 2007, changes may not be made until next review.	Reviewed every eight (8) years, the next review is in 2015.

Flood Risk and Estuary Management Planning				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
GRRM-1	Improve the ability of Council to understand the implications of climate change hazards by commissioning research to quantify the impacts. This would include modelling of the effects of sea level rise and storm surge on the local coast, revised flood modelling in light of increased precipitation (3 day extreme precipitation currently predicted to increase by 10%. The risk report accompanying this document predicts an increase by 13% to 2030), and the confluence of sea level rise and precipitation increases.	Environmental Health and Planning Division; State Government	LIDAR; Funding; Resources	Council has commenced Climate change impacts and identification of at risk areas (capacity building and educational strategies) which is to be integrated with this LAPP Adaptation Strategy.
SRER-2	Reviewing flooding and sea level rise to 2300.	Environmental Health and Planning Division		
SRER-2	Adopt planning controls that ensure developments are limited to locations where infrastructure is viable for the long term			
BERT-3 & BEER-2	To maintain indemnity under section 733 of the Local Government Act 1993, ensure Development complies with state government policies on sea level rise.			
ERV-4	Identify measures which may reduce flooding and velocity of flows in commercial and industrial areas			
Integrated Water Cycle Management Strategy				
FSRT-1	Seek a revision of water license conditions to allow a higher level of extraction during periods of increased rainfall.	Engineering and Operations Division	Water extraction license requirements will be dependant on Council's Water Supply System and whether or not Council proceeds with the off River Storage Facility or an alternative option to secure Council's Water Supply.	Water extraction licenses are issued by the State Government under the Water Management Act 2000
WSER-2	Investigate and implement measures to mitigate the impacts that increased temperatures may have on water quality.	Engineering and Operations Division	Funding	It is standard practice for the design of Water supply systems to ensure water quality is maintained. The studies completed to support development of an off river storage facility have considered various treatment options such as aerators.
WSER-3	Investigate options to extend the Integrated Water Cycle Management System to provide additional sources from harvesting, recycling and grey water use.	Engineering and Operations Division	Funding	
WSVR-2	Ensure Council's Water Supply System is prepared for seasonal changes in water availability, more specifically a reduced mean monthly winter rainfall.	Engineering and Operations Division	Funding	Consider in the preparation/ review of the Integrated Water Cycle Management Plan.
WSRM-1	Ensure inappropriate water extraction practices are not undertaken during periods of low flow. Extraction regimes should consider the projected reduction in mean monthly rainfall.	Engineering and Operations Division		Water extraction licenses are issued by the State Government under the Water Management Act 2000
WSRM-2	Consider seasonal water pricing and regulation to accommodate the projected reduction in winter rainfall and demand increases during the predicted hotter summer months.	Engineering and Operations Division		Consider in the preparation/ review of the Integrated Water Cycle Management Plan.
WSRT-1	Seek cost sharing with State and Federal Governments for measures which do not provide short term cost-benefit but would increase water security.	Engineering and Operations Division		Consider in the preparation/ review of the Integrated Water Cycle Management Plan.

Asset Management Plan				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
BERM-2	Develop spatial information sets (Asset Risk Maps) to identify assets that will be at-risk with climate change, and identify alternative, low risk locations. Require that this information be considered in asset management planning.	Environmental Health and Planning Division	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies	Council has commenced Climate change impacts and identification of at risk areas (capacity building and educational strategies) which is to be integrated with this LAPP Adaptation Strategy.
HHER-2	Maintain Functionality of Open Space Areas	Engineering and Operations Division	Asset Risk Maps; Funding; Resources	
HHER-2	Ensure Adequate shading is provided in open space areas	Engineering and Operations Division; SES	Funding; Resources	
HHER-2	Ensure Storm water in open space areas does not effect functionality	Engineering and Operations Division	Asset Risk Maps; Funding; Resources	
HHER-3	Increase availability and access to Council facilities/ services	All of Council	Resources	
WSVR-3; BEVR-4 & GRVR-5	Ensure Risk guidelines and specifications for Council infrastructure give consideration to projected climate change risks such as flooding that considers sea level rise and predicted rainfall patterns.	Engineering and Operations Division	Asset Risk Maps; Funding; Resources	
SRER-1 & SRVR-2	Review water reticulation, waste water and storm water systems and associated infrastructure in respect to identified climate hazards (including physical hazards and possible effects of carbon price on costs of operation). Use the results of this review as the basis for developing a management plan for climate-proof systems with minimised exposure to climate change hazards.	Engineering and Operations Division	Asset Risk Maps; Funding; Resources	This action may need to be undertaken in a staged process, commencing in areas identified as high risk areas through the Asset Risk Maps.
SRVR-2	Actions which may assist in creating a climate-proof system include: the use of one way valves and modification of release points to accommodate floods; connect septic systems in high risk locations to mains sewerage; ensure backup power systems to pumping stations (due to anticipated increases in power outages).	Engineering and Operations Division	Asset Risk Maps; Funding; Resources	Retrofitting one way valves would be of benefit in existing low lying areas subject to surface water ingress. However only likely to occur if Council subsidised work or issued notices on properties.
SRRM-1	Identify components of water, waste water and storm water systems that cannot be climate-proofed, and which will require intervention if they are to remain functional. Develop strategies to address these components which should consider the expected frequency and duration of disruptive events such as flooding and power outages.	Engineering and Operations Division	Asset Risk Maps; Funding; Resources	
SRRM-2	Develop actions/strategies to manage loss of infrastructure during climatic events	Engineering and Operations Division	Asset Risk Maps; Funding; Resources	
SRER-2	Should development occur in locations where viable infrastructure cannot be assured, require that developers make stand alone arrangements for wastewater treatment.	Environmental Health and Planning Division	Asset Risk Maps;	Bellingen DCP 2010 has been prepared this would be subject to investigation at the next review
SRER-3 & SRRT-2	Investigate options privatise to infrastructure that is not cost effective to maintain, or make arrangements with affected community to charge for additional costs.	Engineering and Operations Division	Asset Risk Maps;	This action would be location specific as issues with specific infrastructure are raised.
SRER-4 & SSRT-1	Investigate options to transfer at-risk assets to other utilities or a new utility.	Engineering and Operations Division	Asset Risk Maps;	This action would be location specific as issues with specific infrastructure are raised.
SRVR-1	Identify stormwater connections into the waste water system.	Engineering and Operations Division	Resources	

Asset Management Plan				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
SRVR-1	Investigate options to remove stormwater connections into the waste water system.	Engineering and Operations Division	Funding; Resources	
BEVR-1	Subject to cost benefit analysis consider community scale risk reduction works to reduce vulnerability to an identified hazard. For example stormwater upgrades, construction of sea walls or levies.	Engineering and Operations Division	Asset Risk Maps; Funding; Resources	This action would be location specific as risks specific to certain locations are identified.
ESVR-1	Install uninterruptible power supplies (UPS), back-up power storage, and back-up generation in Council facilities that provide critical systems for Council operations, and for essential services of water supply and waste water systems.	Engineering and Operations Division	Funding	
TSER-1	Identify roads and bridges that are likely to be unviable to maintain in the long term due to repeated riverine and sea level rise flooding. It will also be important to identify low-risk alternative routes (eg, along ridge lines).	Engineering and Operations Division	Asset Risk Maps;	
TSER-2	Investigate options to close roads and buy back properties on roads which have a high remediation or operation cost, if this is cheaper than maintaining current services.	Engineering and Operations Division		This action would be location specific as issues with specific infrastructure are raised.
TSRT-3	Investigate options to transfer ownership of high risk roads to the community serviced by the road.	Engineering and Operations Division	Asset Risk Maps;	This action would be location specific as issues with specific infrastructure are raised.
TSVR-1	Investigate options to increase the resilience of road and bridge materials, construction and management.	Engineering and Operations Division		
TSRT-2	Seek State or Federal Government funding to cover costs of increased maintenance of the transport systems due to climate change, or seek rate increases to cover these costs.	Engineering and Operations Division/ Corporate Services Division	Asset Risk Maps;	
TSVR-2	Investigate options to minimise overtopping of roads during flooding events	Engineering and Operations Division	Asset Risk Maps;	This action will require the Asset Risk Maps to identify existing overtopping problems areas or areas likely to be inundated at a later date;
TSVR-3	Ensure that boat ramps, wharfs and pontoons can accommodate sea level rise, increased storm surge and overland flooding.	Engineering and Operations Division	Asset Risk Maps;	
TSRM-2	Develop strategies to divert heavy traffic off council roads during very hot days, when roads are vulnerable to damage.	Engineering and Operations Division	Resources	
TSRT-1	Seek to transfer high-risk roads to the RTA if maintenance costs exceed Council's resources.	Engineering and Operations Division	Asset Risk Maps;	
TSRT-1	Ensure that Council is aware if high-risk roads are being transferred to Council from the RTA and If so, ensure that appropriate funding is available to support operation of the roads under increased climate change hazards.	Environmental Health and Planning Division	Asset Risk Maps	The Asset Risk Maps should specifically target sections of the existing Pacific Highway likely to be transferred to Council when the Highway Upgrade is completed.

Asset Management Plan				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
TSAO-1	Implement programs to enhance walkable communities	Engineering and Operations Division	Funding;	Council adopted the Pedestrian Access and Mobility plan and Bicycle Plan in 2006. As funding becomes available proposed improvements under the plan are continuing to be implemented.
GRVR-2	Develop and implement an ongoing process to reduce Council's economic exposure to measures which regulate carbon (ie, measures which reduce greenhouse gas emissions). This could be accomplished by minimising energy use, fuel use and high carbon materials (eg, in road construction) across Council operations.	Engineering and Operations Division		Ensure Councils Council's Sustainability Policy is implemented through Councils decision making and operations
ESER-3	Facilitate the uptake of electric vehicles (which reduce the vulnerability to disruptions in the supply of fuels) through provision of charging stations and other incentives.	Engineering and Operations Division	Funding; Demand Analysis	Subject to funding opportunities and a demand analysis this may be something that Council could consider for public parking areas.

Nambucca Disaster Management Plan (2007) (DISPLAN)				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
HHVR-1	Use existing emergency management plans and relationships with emergency service providers to ensure that an adequate level of functionality can be developed for basic needs (food, water, sanitation and human health) and essential services (energy, transport and communications) during and post major extreme weather events which are expected to increase in frequency, severity and coincidence	Engineering and Operations Division/ Engineering and Operations Division/ SES	Nambucca DISPLAN was adopted in 2009. Consideration of these matters should be included in the next review. At which time more accurate flood mapping and coastal hazard mapping will be available.	The Nambucca Bellingen is reviewed every five (5) years or after an Emergency Event. Should any revised Flood Risk Mapping become available prior to the scheduled review period, it is recommended the DISPLAN review be moved forward.
FSRM-1	Incorporate food security considerations for isolating climate incidents. Eg shared refrigeration in pre-agreed location (eg a single supermarket in each location likely to be isolated).			
ESRM-2	Develop actions to cope with more frequent and severe power outages that do not require repeated use of, or excessive dependence on, emergency services.			
ESRM-3	Develop actions to cover the high likelihood that there could be a confluence of extreme weather events and power outage.			
TSRM-1	Identify and develop actions for people and businesses affected by more frequent and lengthy road flooding and isolation.			
CSV-2	Educate the community to minimise the pressures on mobile communications systems during extreme events.			
CSR-1	Ensure alternative communication avenues are available to provide redundancy in the event of telecommunications failure during extreme events.			
CSR-2 & ERR-2	Develop actions to ensure clear, reliable and consistent communications to tourists, travellers and residents in region during extreme events. Ensure the community is made aware of current threats and risks as well as when the risk/threats are withdrawn			
ERR-1	Develop 'state of emergency triggers' to avoid communication via media that can also have the effect of dissuading tourists from the visiting the area.			
Council Property Plans of Management				
BEVR-3	For exposed buildings, ensure that property management plans address the location specific climate change risk and require each property to maintain a current emergency risk management plan, to manage the impacts on people and property from climate change related events.	Corporate Services Division/ Engineering and Operations Division	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	All property management plans should address climate change risk in their preparation. It is noted that this can only be considered as the information becomes available.

Human Resources Strategic Plan				
CSAO-1	Investigate options to increase telecommuting for Council Employees	Corporate Services Division		
Economic Development Plan				
WSAO-1 & ERVR-2	Investigate options to capture economic and livability advantages for this region, which has comparatively high water security compared to other parts of the eastern seaboard.	Corporate Services		The chamber of commerce is preparing an economic development and tourism plan. This plan should address issues and opportunities raised in this climate change adaptation plan.
State of the Environment Report				
NSRM-1	Monitor the migration of new species of flora and fauna entering the district and new or enhanced threats posed by new invaders and exacerbated pest outbreaks. Communicate these results to the agricultural sector to allow them to change pest control systems.	Environmental Health and Planning Division /State Government		The State of the Environment Report can continue to monitor and communicate species presence in the shire. The state government monitors, regulates and educates on threatened species, and communities, threatening processes and other immediate threats

Environmental Education				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
HHRM-1	Educate Residents and Businesses to lower expectation of service levels in light of climate hazards. Encourage the community to develop individual resilience to cope with changes and disruptions affecting health, access to basic needs and services.	Environmental Health and Planning Division	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	Seek Funding Opportunities for a climate Change Education Program
SRRM-2	Educate communities which are located in areas at risk from infrastructure failure during climatic events.			
BERM-1	Educate local business and industrial sectors of projected climate risks and options to improve their resilience to these risks.			
ERRM-1	Educate the local tourism industry on the projected risks associated with Climate Change. Encourage the development of industry partnerships to assist the area in maintaining it self as a desirable tourism destination.			
ESRM-1	Educate the community to manage increased disruptions to their power supply. Identify high-risk people, groups and facilities to ensure they have continuity management plans that will allow them to cope with loss of power over extended periods.	Environmental Health and Planning Division	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program
FSVR-2	Educate the regions agriculture sector on the regions potential climate risk so it can assist them in transitioning crops and stock better suited to the changing climate.	Environmental Health and Planning Division	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program
	Encourage the private sector to make arrangements with essential service providers, to ensure security of service provision where possible.	Environmental Health and Planning Division	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program
HHRT-1	Ensure that Community Health Plans and Strategies address climate change risks in relation to basic needs and essential services.	Environmental Health and Planning Division/ NSW Department of Health	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program

Environmental Education				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
HHRT-2	Ensure utility services outside of Council are aware of climate change risks in the region so they can incorporate into plans and services. As an example forward flood mapping, seal level rise maps, Coastal Hazard Maps to Country Energy	Environmental Health and Planning Division	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	Seek Funding Opportunities for a climate Change Education Program
BEER-4, BERT-2 & GRER-2	Section 149 Certificate should identify an known climate change risks and state government policies or requirements and also disclose the predictions of current science	Environmental Health and Planning Division	Legal Advice	
ESRM-2	Develop non-emergency management plans to cope with more frequent and severe power outages that do not require repeated use of, or excessive dependence on, emergency services.	Environmental Health and Planning Division	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program

Natural Resource Management				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
NSRM-1	Integrate new practices to manage the protection of native species which are in process of dispersing to track climate change	State Government		The state government monitors, regulates and educates on threatened species, and communities, threatening processes and other immediate threats
NSRM-2	Revise environmental conservation and biodiversity management plans in light of climate change. Ensure they are realistic in the light of climate change, and do not escalate demands on resources to maintain systems which will be unavailable in the new climate change regime.	Environmental Health and Planning Division	Funding; Resources	Council does not have a Biodiversity Management Plan or similar conservation policy. Should Council resolve to prepare such a strategy a key component would be the consideration of Climate Change Risks.
NSRM-3	Develop management plans for increased risks from weed breakouts following more flooding, bushfires and higher temperatures.	Engineering and Operations Division	Funding; Resources	The NSW North Coast Weeds Advisory Committee documents management plans and other policies which assist local governments and other authorities to implement weed management. Representatives of this committee should ensure climate change is appropriately considered during the preparation of plans and policies.
NSRM-4	Ensure Climate Change is comprehensively dealt with in any Estuary Management Plan	Environmental Health and Planning Division	Funding; Resources	Council has completed an estuary management plan for the Kalang and Bellinger Rivers, this plan has given consideration to Climate Change and associated Actions. Specifically the plan states, 'Ensure climate change and sea level rise implications are incorporated into Council's planning horizon'.
NSRT-1	Transfer costs to the State or Federal Governments, or consider raising land rates to cover costs of land-buy backs which will allow for re-zoning to promote more resilient conservation zones.	Environmental Health and Planning Division	Funding; Resources; Biodiversity Management Plan	Council does not have a Biodiversity Management Plan or similar conservation policy. Should Council resolve to prepare such a strategy a key component would be the consideration of Climate Change Risks.
NSRT-2	Develop a combined regional-scale strategy for cross cutting biodiversity and bio-security risks, to ensure that risks are managed overall.	State Government		The State Government has prepared a Draft Northern Rivers Biodiversity Management Plan. This plan identify a range of actions help maintain and conserve biodiversity.
NSRT-3	Request State or Federal Government funding for adaptation measures for natural environments which may be of State or Federal significance.	Environmental Health and Planning Division		Should Council resolve to prepare a biodiversity management plan it should seek funding assistance from the State Government to prepare it.

General Governance				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
BERT-4	Negotiate for State and Federal funding for measures to reduce exposure and increase the resilience of building stock. Alternatively, seek a mandate to increase the rates, to cover the additional capital and operational costs that may be associated with this exposure.	Corporate Services Division	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	
ESRT-1	Consult with energy utilities, regarding options for load shedding, priority supply locations, embedded generation, and undergrounding of cables, to reduce exposure to physical hazards.	Environmental Health and Planning Division	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	As Climate Change Hazards become known to Council the information should be forwarded to service providers, neighbouring Councils and other relevant authorities
ESRT-2	Consult with utilities to introduce secondary power lines around high risk links, to introduce redundancy into the power supply chain.	Environmental Health and Planning Division	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	As Climate Change Hazards become known to Council the information should be forwarded to service providers, neighbouring Councils and other relevant authorities
ESRT-3	Consult with utilities and neighbouring Councils to address neighbouring high-risk locations through which the power system passes and where it is prone to outage.	Environmental Health and Planning Division	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies; Risk identification in neighbouring Councils	As Climate Change Hazards become known to Council the information should be forwarded to service providers, neighbouring Councils and other relevant authorities
CSRM-2 & ERRM-2	Develop actions to ensure clear, reliable and consistent communications to tourists, travellers and residents in region during extreme events. Ensure the community is made aware of current threats and risks as well as when the risk/threats are withdrawn	Engineering and Operations Division/ Engineering and Operations Division/ SES		Subject to the DISPLAN review
CSRT-1	Consult with communication suppliers and neighbouring Councils to develop climate-proof communications systems for the area, including relocation of high-risk assets, and fit-for-purpose specification of equipment.	Environmental Health and Planning Division	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	As Climate Change Hazards become known to Council the information should be forwarded to service providers, neighbouring Councils and other relevant authorities
GRER-2, GRER-4 & BEER-2	Reduce the exposure of council to legal and financial risks through a strategy of disclosure and awareness by: (a) ensuring that all known climate change hazards are published in the public domain, (via maps and other tools) (b) where possible, at minimum, adhering to State or Federal Government benchmarks, whilst also disclosing that risks may exceed these levels due to science known to Council; (c) ensuring that parties that could suffer loss are made aware of possible risks at the earliest possible time (eg, through the 149 certificate), allowing them to make their own decisions on risk management; and (d) requiring that the known climate change hazards are adequately managed by those seeking to build or redevelop in high-risk locations	Environmental Health and Planning Division	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	May require amendments to Bellingen LEP 2010 and DCP 2010 when climate change risks are appropriately identified.
GRER-3, BERT-3 & BEER-2	Ensure that Council complies with State benchmarks for indemnification under the Local Government Act (section 733) by implementing required benchmarks across all Council approvals, whilst also disclosing that actual risk may be higher.	Environmental Health and Planning Division	Legal Advice	
GRER-5	Develop a legal transition strategy based upon legal opinion to minimise short-term litigation (eg, for cost increases in developments). This can be folded into the process of introducing measures that would address climate-related legal risks for Council in the long term.	Corporate Services Division		May be required when new development standards are implemented. If standards are based on professional investigations, legal opinions may only be necessary when proponents challenge those standards.

General Governance				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
GRVR-4	Reduce vulnerability of Council to community dissatisfaction, loss of goodwill and political instability by implementing consultative processes around climate change management strategies, changes in resource allocation, and possible increases in rates to maintain services and changes in service levels.	Environmental Health and Planning Division	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program
GRVR-5	Update risk guidelines/specifications for Council infrastructure to cope with weather-related events that may be affected by climate change (eg, flood risk), to reflect projected rather than historical risk levels. For example, a storm water drain might be designed to last 100 years and cope with a 1 in 100 year event; with climate change, the suitable flood level should consider that an event with a return frequency of 1 in 100 years today may look more like the current 1 in 200 year event by 2100 (ie, much more severe).	Engineering and Operations Division	Asset Risk Maps; Funding; Resources	
GRVR-6	Implement a policy of 'shadow pricing' across decision-making to include Federal Treasury estimates for forward carbon prices under a two degree Celsius / sub-450 parts per million scenario.	All of Council	Will require a standard methodology to be provided to staff so estimates of the carbon price can be simply calculated.	Implement into Council Reporting process for projects likely to be actioned in the next 5 years.
GRRM-2	Review the ability of Council to provide core services and maintain assets under climate change. If this is not possible, develop plans to consolidate asset bases and service provisions. Also, review the ability of Council to respond to major events including the workforce required for timely recovery post-event. Overall, create a revised financial, asset and human resource strategy.	All of Council	Funding; Resources	This action would require a supporting study prepared by a specialist in economic and planning.
BERT-1	Work with insurance providers to ensure that all properties in the area are affordably insurable and where insurers have specific concerns about risks such as flooding and bushfire, review options within Council's control that can reduce these risks to levels acceptable to insurers Promote full insurance cover within the community.	Corporate Services Division	Funding; Resources	Council can continue to communicate with insurance companies and develop and implement actions within this strategy to promote more insurable communities, however it is idealistic to achieve full insurance cover within the community.
GRRM-4	Integrate climate change management strategies into all Council planning documents, policies and guidelines.	Environmental Health and Planning Division/ Corporate Services Division		This action is best placed in Council 20 year Community Strategic Plan as an overriding objective.
GRRM-5	Implement monitoring and measurement processes for key climate change indicators and metrics for exposed and vulnerable people, property and infrastructure.	Environmental Health and Planning Division		May be incorporated in existing monitoring activities such as the State of the Environment Report; Land and Housing monitors; development statistics etc
GRAO-1	Collaborate with all neighbouring Councils and State Government to 'climate-proof' the region which would increase relative value and also harness potential advantages: water and food security for agriculture and low-carbon tourism making the region attractive to inward investment and young families.	Environmental Health and Planning Division		As Climate Change Hazards become known to Council the information should be forwarded to service providers, neighbouring Councils and other relevant authorities. Initiatives for joint actions or programs should be identified and joint funding opportunities investigated.
GRVR-3	Reduce Council's financial exposure to increased extreme events which cause disruption to services and damage to assets. Act on a range of strategies to ensure resilience of Council's services - eg implement this adaptation plan	All of Council		

12 Appendix 3: Kempsey Adaptation Strategy

Local Environmental Plan (LEP) and Comprehensive Development Control Plan (DCP)				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
HHER-1	Limit Development and Access in areas at high risk of flooding	Department of Sustainable Environment	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Assessment and Management Plan; Funding required to undertake / complete studies; In some instances individual studies which address hazards may be provided by developers.	Department of Lands are acquiring LIDAR which will be available to Council; Kempsey Flood Study Hydraulic Modelling Report completed Aug 2009 - will need to include climate change figures upon next review; Coastal Hazard Assessment yet to commence - currently seeking funding.
HHVR-2 & BERM-1	Ensure Development Controls adequately protect development from Climatic Changes			
BEER-1	Investigate opportunities, or scenarios to reduce the number of existing properties and developments in at-risk locations through buy back or relocation			
BEER-1	Avoid new development in high-risk locations			
BEER-3	Ensure development in green field locations adequately considers sea level rise expectations over the life of the development.			
BEVR-2	Investigate opportunities to apply development controls which address location specific climate change hazards			
BERT-3	To maintain indemnity under section 733 of the Local Government Act 1993, ensure Development complies with state government policies on sea level rise.			
ERER-2	Identify suitable locations for the relocation or development of tourist assets (Caravan Parks) away from highly exposed locations.			
ERV-3	Implement planning controls that provide protection of key economic assets including agriculture and natural environment which attracts tourism.			
GRER-1	Develop controls to minimise Councils exposure to future legal challenges			
FSER-1	Ensure Regionally Significant Farmland is retained for Agriculture	Department of Sustainable Environment/ State Government	The Regionally Significant Farmland Mapping Project (2009) has been prepared by the NSW Department of Planning, there is no scheduled review planned. Council may initiate a review through a local growth management strategy should it be deemed necessary.	Preliminary Draft LEP has incorporated Regionally Significant Farmland Mapping into the RU1 Primary Production Zone.
FSVR-1	Ensure Development Controls enhance the potential for local food production on rural land	Department of Sustainable Environment, State Government	Local Growth Management Strategy - Rural Lands Component, Comprehensive DCP yet to be developed	Comprehensive DCP yet to be prepared. Would aim to incorporate be Rural Lands Strategy into DCP.
HHER-1	Limit Development and access in areas at high risk of bushfire	Department of Sustainable Environment	New Bushfire Prone Lands Map	The Rural Fires Act requires each local government area to have a Bushfire Prone Lands Map, which is expected to be reviewed every 5 years. Council is currently reviewing its Bushfire Prone Lands Map. Planning for Bushfire Protection (NSW RFS, 2007) provides Guidelines for Bushfire Hazard Assessment.

Local Environmental Plan (LEP) and Comprehensive Development Control Plan (DCP)				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
WSER-1	Provide Development Controls and/or incentives which encourage/ maximise on-site water Harvesting in all new development. Consider using development incentives.	Department of Sustainable Environment	Need to review all DCPs and develop comprehensive DCP	Comprehensive DCP yet to be prepared. Would aim to incorporate these issues into preparation of comprehensive DCP
WSVR-1	Provide Development Controls and/or incentives which decrease water use in all development.			
SRER-2	Should development occur in locations where viable infrastructure cannot be assured, require that developers make stand alone arrangements for wastewater treatment.			
SRER-5	Develop thresholds for development requiring Council infrastructure to be constructed and maintained. An example would be to only allow development requiring a pump station where a predetermined number of lots are involved.			
ESER-1	Develop planning controls that will facilitate reduction of climate-enhanced hazards to power distribution system (eg toward undergrounding of cables, removal of hazards close to power lines).			
ESER-2	Develop controls that allow for increases to embedded (local) generation of electricity, through gas turbines and renewable energy (eg, solar, wind, run-of-river hydroelectricity, biomass from agricultural waste).			
ESVR-2	Ensure back-up systems exist for important private sector services including commercial-scale food refrigeration, telecommunications facilities, and aged care facilities.			
GRVR-1 & GRRT-1	Introduce controls that transfer the requirement for climate change risk management (and therefore legal risks stemming from future loss) to the developer. This can be done by requiring buildings and other activities that need Council consent to show that climate change hazards have been adequately managed.			
TSER-3	Ensure planning controls increase densities in and around urban centres to increase alternative forms of transport such as walking, cycling and public transport.	Department of Sustainable Environment	Comprehensive DCP, further consultation	Preliminary Draft LEP has maintained areas for med-high density development in Kempsey CBD to try and encourage urban consolidation.
BEVR-3	For exposed buildings, ensure that property management plans address the location specific climate change risk and require each property to maintain a current emergency risk management plan, to manage the impacts on people and property from climate change related events.	Department of Sustainable Environment	Funding; Resources	New buildings can be requested to provide management plans through consent conditions. Property owners of existing buildings could be encouraged to prepare plans through education programs. The SES is responsible for education regarding flooding and storm emergencies; the NSW RFS is responsible for education relating to Bushfire Emergencies.
CSER-1	Develop controls to ensure communication systems are located in low risk environments.	Department of Sustainable Environment	Telecommunications Act and SEPP Infrastructure provide exemptions	Typically not subject to Council approval. Communication service providers can be advised of climate risks as Council is made aware of them.

Local Environmental Plan (LEP) and Comprehensive Development Control Plan (DCP)				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
CSVR-1	Investigate options to ensure developments in high risk locations install suitable telecommunication equipment.	Department of Sustainable Environment	Telecommunications Act and SEPP Infrastructure provide exemptions	Typically not subject to Council approval. Communication service providers can be advised of climate risks as Council is made aware of them.
NSER-1	Minimise the exposure of conservation areas and agriculture by using the LEP to limit development in and access to areas at high risk from climate change hazards, including accelerated transfer of climate migrating weeds and pests.	Department of Sustainable Environment	Biodiversity Management Plan; Funding; Resources	Council does not have a Biodiversity Management Plan or similar conservation policy. Should Council resolve to prepare such a strategy a key component would be the consideration of Climate Change Risks. The Comprehensive Koala Plan of Management is close to finalisation. Some consideration of climate change impacts had been considered, however further detailed consideration will need to be given upon next review if 5 yrs.
NSER-2	Develop controls to protect natural environments, including buffers and corridors.	Department of Sustainable Environment	Biodiversity Management Plan; Funding; Resources	Council does not have a Biodiversity Management Plan or similar conservation policy. Should Council resolve to prepare such a strategy a key component would be the consideration of Climate Change Risks. The Comprehensive Koala Plan of Management is close to finalisation. Some consideration of climate change impacts had been considered, however further detailed consideration will need to be given upon next review if 5 yrs.
NSER-2	Revise conservation values to incorporate climate change driven constraints and identify options to re-optimize zoning for new climate regimes. Consider loss of habitat and coastal squeeze due to sea level rise, heat and drought stress and relocate farming out of coastal flood plains to allow natural coastal systems to realign.	Department of Sustainable Environment	Biodiversity Management Plan; Funding; Resources	Council does not have a Biodiversity Management Plan or similar conservation policy. Should Council resolve to prepare such a strategy a key component would be the consideration of Climate Change Risks. The Comprehensive Koala Plan of Management is close to finalisation. Some consideration of climate change impacts had been considered, however further detailed consideration will need to be given upon next review if 5 yrs.
NSVR-1	Maximise the health and resilience of natural environment through: (a) best-practice conservation, (b) limiting pressure from development/urban encroachment into high value areas, especially by noting that in the community there may be auto-adaptation pressures which may necessitate a development cap, and (c) incentives or regulations to develop and maintain biodiversity corridors on private land.	Department of Sustainable Environment	Funding; Resources	Best practice conservation principles and protection measure can be developed through LEP and DCP controls should Council choose to pursue them. The State Government provides incentives to conserve biodiversity on private land through Biobanking Schemes and other similar arrangements such as conservation agreements.

Local Growth Management Strategy - Rural Lands Component				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
FSRT-2	Investigate expansion of Regionally Significant Farmland into lands not effected climate risks	Department of Sustainable Environment, State Government, NSW Farmers Association?	Rural Lands Component of Local Growth Management Strategy; LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Funding/Resources	The Local Growth Management Strategy - Rural Lands Component will require State Government Approval. Before Council examines this Rural Component it is expected that the Residential Component will need to be completed.
FSAO-1	Identify climate proof agricultural land			
ERER-1	Identify opportunities to relocate high-risk agricultural activities to low risk locations			
ERVR-1	Investigate agricultural activities that would be suitable to the projected climate regime			
ERRM-3	Identify options for stock management before during and after major flooding events. For example identify land unlikely to be impacted by flooding.			
ERAO-2	Identify agriculture and forest options for increased income under a low-carbon economy from bio-sequestration and renewable Energy Production.			
Tourism / Economic Development Plan				
ERER-2	Identify suitable locations for the relocation or development of tourist assets (Caravan Parks) away from highly exposed locations.	Department of Sustainable Environment	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	Council has not scheduled the preparation of the local growth management strategy - tourism component. Such a strategy could identify alternative lands for tourism activities which could be implemented through zoning changes in the LEP.
ERRM-1	Educate the local tourism industry on the projected risks associated with Climate Change. Encourage the development of industry partnerships to assist the area in maintaining itself as a desirable tourism destination.	Department of Sustainable Environment, Department of Community Engagement	Need to review Tourism Strategy and Economic Development Plan	Council is due to review both the Tourism Strategy and Economic Development Plan following finalisation of Council's restructuring process. Although a Council prepared tourism strategy / economic development plan may examine these actions, their implementation is largely dependent on the on tourism industry embracing and implementing them.
ERER-3	Identify options for re-timing tourist events in months with lower risk of flooding, heat stress and tropical disease vectors.	Department of Sustainable Environment		
ERVR-1	Investigate Tourism activities that would be suitable in the projected climate regime.	Department of Sustainable Environment		
ERAO-1	Identify tourism opportunities related to a low carbon tourism paradigm.	Department of Sustainable Environment		
WSAO-1 & ERVR-2	Investigate options to capture economic and livability advantages for this region, which has comparatively high water security compared to other parts of the eastern seaboard.	Department of Corporate Services		
				Council's Economic Development Plan 2006, identifies opportunities to maintain, expand and diversify economic growth in the Shire. When the Economic Development Plan 2006 is reviewed it should examine the opportunities Climate Change may present for the shire.
On-site Sewerage Management Plan				
SRAO-1	Review of Onsite Sewerage Management Plan should consider use and management of systems under the projected climate regime	Department of Sustainable Environment	Need to up date On-site Sewage Management Strategy	On-site Sewage Management Strategy proposed to be updated in 2011.

Flood Risk and Estuary Management Planning				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
GRRM-1	Improve the ability of Council to understand the implications of climate change hazards by commissioning research to quantify the impacts. This would include modelling of the effects of sea level rise and storm surge on the local coast, revised flood modelling in light of increased precipitation (3 day extreme precipitation currently predicted to increase by 10%. The risk report accompanying this document predicts an increase by 13% to 2030), and the confluence of sea level rise and precipitation increases.	Department of Sustainable Environment; State Government	LIDAR; Funding; Resources, Completion of Macleay River Estuary Management Study and Plan	Kempsey Flood Study Hydraulic Modelling Report completed Aug 2009 - will need to include climate change figures upon next review. Need to ensure all Estuary Management Plans include, or are updated to incorporate climate change.
SRER-2	Reviewing flooding and sea level rise to 2300.	Department of Sustainable Environment		
SRER-2	Adopt planning controls that ensure developments are limited to locations where infrastructure is viable for the long term			
BERT-3 & BEER-2	To maintain indemnity under section 733 of the Local Government Act 1993, ensure Development complies with state government policies on sea level rise.			
ERV-4	Identify measures which may reduce flooding and velocity of flows in commercial and industrial areas			
NSRM-4	Ensure Climate Change is comprehensively dealt with in any Estuary Management Plan.			
Integrated Water Cycle Management Strategy				
FSRT-1	Seek a revision of water license conditions to allow a higher level of extraction during periods of increased rainfall.	Department of Infrastructure Services	Water extraction license requirements will be dependant on Council's Water Supply System and whether or not Council proceeds with the off River Storage Facility or an alternative option to secure Council's Water Supply.	Water extraction licenses are issued by the State Government under the Water Management Act 2000
WSER-2	Investigate and implement measures to mitigate the impacts that increased temperatures may have on water quality.	Department of Infrastructure Services	Funding	
WSER-3	Investigate options to extend the Integrated Water Cycle Management System to provide additional sources from harvesting, recycling and grey water use.	Department of Infrastructure Services	Funding	
WSVR-2	Ensure Council's Water Supply System is prepared for seasonal changes in water availability, more specifically a reduced mean monthly winter rainfall.	Department of Infrastructure Services	Funding	
WSRM-1	Ensure inappropriate water extraction practices are not undertaken during periods of low flow. Extraction regimes should consider the projected reduction in mean monthly rainfall.	Department of Infrastructure Services		Water extraction licenses are issued by the State Government under the Water Management Act 2000
WSRM-2	Consider seasonal water pricing and regulation to accommodate the projected reduction in winter rainfall and demand increases during the predicted hotter summer months.	Department of Infrastructure Services		
WSRT-1	Seek cost sharing with State and Federal Governments for measures which do not provide short term cost-benefit but would increase water security.	Department of Infrastructure Services, State & Federal Government		
WSAO-1	Investigate options to capture economic and livability advantages for this region, which has comparatively high water security compared to other parts of the eastern seaboard.	Sustainable Environment, Corporate Management, Local Businesses, Macleay Valley Tourism Association		

Asset Management Plan				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
BERM-2	Develop spatial information sets (Asset Risk Maps) to identify assets that will be at-risk with climate change, and identify alternative, low risk locations. Require that this information be considered in asset management planning.	Department of Sustainable Environment	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to commence and complete studies	
HHER-2	Maintain Functionality of Open Space Areas	Department of Infrastructure Services	Asset Risk Maps; Funding; Resources	
HHER-2	Ensure Adequate shading is provided in open space areas	Department of Infrastructure Services; SES	Funding; Resources	
HHER-2	Ensure Stormwater in open space areas does not effect functionality	Department of Infrastructure Services	Asset Risk Maps; Funding; Resources	
HHER-3	Increase availability and access to Council facilities/ services	All of Council	Resources	
WSVR-3; BEVR-4 & GRVR-5	Ensure Risk guidelines and specifications for Council infrastructure give consideration to projected climate change risks such as flooding that considers sea level rise and predicted rainfall patterns.	Department of Infrastructure Services	Asset Risk Maps; Funding; Resources	
SRER-1 & SRVR-2	Review water reticulation, waste water and storm water systems and associated infrastructure in respect to identified climate hazards (including physical hazards and possible effects of carbon price on costs of operation). Use the results of this review as the basis for developing a management plan for climate-proof systems with minimised exposure to climate change hazards.	Department of Infrastructure Services	Asset Risk Maps; Funding; Resources	This action may need to be undertaken in a staged process, commencing in areas identified as high risk areas through the Asset Risk Maps.
SRVR-2	Actions which may assist in creating a climate-proof system include: the use of one way valves and modification of release points to accommodate floods; connect septic systems in high risk locations to mains sewerage; ensure backup power systems to pumping stations (due to anticipated increases in power outages).	Department of Infrastructure Services	Asset Risk Maps; Funding; Resources	Retrofitting one way valves would be of benefit in existing low lying areas subject to surface water ingress. However only likely to occur if Council subsidised work or issued notices on properties.
SRRM-1	Identify components of water, waste water and storm water systems that cannot be climate-proofed, and which will require intervention if they are to remain functional. Develop strategies to address these components which should consider the expected frequency and duration of disruptive events such as flooding and power outages.	Department of Infrastructure Services	Asset Risk Maps; Funding; Resources	
SRRM-2	Develop actions/strategies to manage loss of infrastructure during climatic events	Department of Infrastructure Services	Asset Risk Maps; Funding; Resources	
SRER-2	Should development occur in locations where viable infrastructure cannot be assured, require that developers make stand alone arrangements for wastewater treatment.	Department of Sustainable Environment	Asset Risk Maps;	
SRER-3 & SRRT-2	Investigate options privatise to infrastructure that is not cost effective to maintain, or make arrangements with affected community to charge for additional costs.	Department of Infrastructure Services	Asset Risk Maps;	This action would be location specific as issues with specific infrastructure are raised.
SRER-4 & SRRT-1	Investigate options to transfer at-risk assets to other utilities or a new utility.	Department of Infrastructure Services	Asset Risk Maps;	This action would be location specific as issues with specific infrastructure are raised.
SRVR-1	Identify stormwater connections into the waste water system.	Department of Infrastructure Services	Resources	

Asset Management Plan				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
SRVR-1	Investigate options to remove stormwater connections into the waste water system.	Department of Infrastructure Services	Funding; Resources	
BEVR-1	Subject to cost benefit analysis consider community scale risk reduction works to reduce vulnerability to an identified hazard. For example stormwater upgrades construction of sea walls or levies.	Department of Infrastructure Services	Asset Risk Maps; Funding; Resources	This action would be location specific as risks specific to certain locations are identified.
ESVR-1	Install uninterruptible power supplies (UPS), back-up power storage, and back-up generation in Council facilities that provide critical systems for Council operations, and for essential services of water supply and waste water systems.	Department of Infrastructure Services	Funding	
TSER-1	Identify roads and bridges that are likely to be unviable to maintain in the long term due to repeated riverine and sea level rise flooding. It will also be important to identify low-risk alternative routes (eg, along ridge lines).	Department of Infrastructure Services	Asset Risk Maps;	
TSER-2	Investigate options to close roads and buy back properties on roads which have a high remediation or operation cost, if this is cheaper than maintaining current services.	Department of Infrastructure Services		This action would be location specific as issues with specific infrastructure are raised.
TSRT-3	Investigate options to transfer ownership of high risk roads to the community serviced by the road.	Department of Infrastructure Services	Asset Risk Maps;	This action would be location specific as issues with specific infrastructure are raised.
TSVR-1	Investigate options to increase the resilience of road and bridge materials, construction and management.	Department of Infrastructure Services		
TSRT-2	Seek State or Federal Government funding to cover costs of increased maintenance of the transport systems due to climate change, or seek rate increases to cover these costs.	Department of Infrastructure Services/ Corporate Management	Asset Risk Maps;	
TSVR-2	Investigate options to minimise overtopping of roads during flooding events	Department of Infrastructure Services	Asset Risk Maps;	This action will require the Asset Risk Maps to identify existing overtopping problems areas or areas likely to be inundated at a later date;
TSVR-3	Ensure that boat ramps, wharfs and pontoons can accommodate sea level rise, increased storm surge and overland flooding.	Department of Infrastructure Services	Asset Risk Maps;	
TSRM-2	Develop strategies to divert heavy traffic off council roads during very hot days, when roads are vulnerable to damage.	Department of Infrastructure Services	Resources	
TSRT-1	Seek to transfer high-risk roads to the RTA if maintenance costs exceed Council's resources.	Department of Infrastructure Services	Asset Risk Maps;	
TSRT-1	Ensure that Council is aware if high-risk roads are being transferred to Council from the RTA and If so, ensure that appropriate funding is available to support operation of the roads under increased climate change hazards.	Department of Sustainable Environment	Asset Risk Maps	The Asset Risk Maps should specifically target section of the existing Pacific Highway likely to be transferred to Council when the Highway Upgrade is completed.
ESER-3	Facilitate the uptake of electric vehicles (which reduce the vulnerability to disruptions in the supply of fuels) through provision of charging stations and other incentives.	Department of Infrastructure Services	Funding; Demand Analysis	Subject to funding opportunities and a demand analysis this may be something that Council could consider for public parking areas.

Asset Management Plan				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
TSAO-1	Implement programs to enhance walkable communities	Department of Infrastructure Services	Funding;	
GRVR-2	Develop and implement an ongoing process to reduce Council's economic exposure to measures which regulate carbon (ie, measures which reduce greenhouse gas emissions). This could be accomplished by minimising energy use, fuel use and high carbon materials (eg, in road construction) across Council operations.	Department of Corporate Management		Continue to review Councils Sustainable Fleet and Plant Policy

Kempsey Shire Local Disaster Plan (2007) (DISPLAN)				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
HHVR-1	Use existing emergency management plans and relationships with emergency service providers to ensure that an adequate level of functionality can be developed for basic needs (food, water, sanitation and human health) and essential services (energy, transport and communications) during and post major extreme weather events which are expected to increase in frequency, severity and coincidence	Department of Infrastructure Services / SES	Kempsey DISPLAN was adopted in 2007. Consideration of these matters should be included in the next review. At which time more accurate flood mapping and coastal hazard mapping will be available.	The Kempsey DISPLAN is reviewed every five (5) years or after an Emergency Event. The Kempsey DISPLAN is not due for review until 2011. Should the revised Flood Risk Mapping become available prior to the scheduled review period, it is recommended the DISPLAN review be moved forward.
FSRM-1	Incorporate food security considerations for isolating climate incidents. Eg shared refrigeration in pre-agreed location (eg a single supermarket in each location likely to be isolated).			
ESRM-2	Develop actions to cope with more frequent and severe power outages that do not require repeated use of, or excessive dependence on, emergency services.			
ESRM-3	Develop actions to cover the high likelihood that there could be a confluence of extreme weather events and power outage.			
TSRM-1	Identify and develop actions for people and businesses affected by more frequent and lengthy road flooding and isolation.			
CSV-2	Educate the community to minimise the pressures on mobile communications systems during extreme events.			
CSRM-1	Ensure alternative communication avenues are available to provide redundancy in the event of telecommunications failure during extreme events.			
CSRM-2 & ERRM-2	Develop actions to ensure clear, reliable and consistent communications to tourists, travellers and residents in region during extreme events. Ensure the community is made aware of current threats and risks as well as when the risk/threats are withdrawn			
ERRT-1	Develop 'state of emergency triggers' to avoid communication via media that can also have the effect of dissuading tourists from the visiting the area.			
Council Property Plans of Management				
BEVR-3	For exposed buildings, ensure that property management plans address the location specific climate change risk and require each property to maintain a current emergency risk management plan, to manage the impacts on people and property from climate change related events.	Department of Corporate Management/ Department of Infrastructure Services	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	All property management plans should address climate change risk in their preparation. It is noted that this can only be considered as the information becomes available.
Human Resources Strategic Plan				
CSAO-1	Investigate options to increase telecommuting for Council Employees	Department of Corporate Management		The human resources strategic plan currently in draft form identifies options to investigate work from home and E-recruitment. These are scheduled for investigation by 2012.
State of the Environment Report				
NSRM-1	Monitor the migration of new species of flora and fauna entering the district and new or enhanced threats posed by new invaders and exacerbated pest outbreaks. Communicate these results to the agricultural sector to allow them to change pest control systems.	Department of Sustainable Environment /State Government		The State of the Environment Report can continue to monitor and communicate species presence in the shire. The state government monitors, regulates and educates on threatened species, and communities, threatening processes and other immediate threats

Community / Environmental Education				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
HHRM-1	Educate Residents and Businesses to lower expectation of service levels in light of climate hazards. Encourage the community to develop individual resilience to cope with changes and disruptions affecting health, access to basic needs and services.	Department of Community Engagement, Department of Sustainable Environment	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	Seek Funding Opportunities for a climate Change Education Program
SRRM-2	Educate communities which are located in areas at risk from infrastructure failure during climatic events.			
BERM-1	Educate local business and industrial sectors of projected climate risks and options to improve their resilience to these risks.			
ERRM-1	Educate the local tourism industry on the projected risks associated with Climate Change. Encourage the development of industry partnerships to assist the area in maintaining itself as a desirable tourism destination.			
ESRM-1	Educate the community to manage increased disruptions to their power supply. Identify high-risk people, groups and facilities to ensure they have continuity management plans that will allow them to cope with loss of power over extended periods.	Department of Community Engagement, Department of Sustainable Environment	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program
FSVR-2	Educate the regions agriculture sector on the regions potential climate risk so it can assist them in transitioning crops and stock better suited to the changing climate.	Department of Community Engagement, Department of Sustainable Environment	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program
ERRT-2	Encourage the private sector to make arrangements with essential service providers, to ensure security of service provision where possible.	Department of Community Engagement, Department of Sustainable Environment	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program
HHRT-1	Ensure that Community Health Plans and Strategies address climate change risks in relation to basic needs and essential services.	Department of Sustainable Environment/ NSW Department of Health	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program
HHRT-2	Ensure utility services outside of Council are aware of climate change risks in the region so they can incorporate into plans and services. As an example forward flood mapping, seal level rise maps, Coastal Hazard Maps to Country Energy.	Department of Community Engagement, Department of Sustainable Environment, Country Energy	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	Seek Funding Opportunities for a climate Change Education Program
BEER-4, BERT-2 & GRER-2	Section 149 Certificate should identify an known climate change risks and state government policies or requirements and also disclose the predictions of current science	Department of Community Engagement, Department of Sustainable Environment	Legal Advice	Council presently identifies the State Governments sea level rise predictions on all S149 Certificates. We need to consider disclosing the predictions of current science. This may be subject to legal advice.
ESRM-2	Develop non-emergency management plans to cope with more frequent and severe power outages that do not require repeated use of, or excessive dependence on, emergency services.	Department of Community Engagement, Department of Sustainable Environment	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program

Natural Resource Management Plans				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
NSRM-1	Integrate new practices to manage the protection of native species which are in process of dispersing to track climate change	State Government		The state government monitors, regulates and educates on threatened species, and communities, threatening processes and other immediate threats
NSRM-2	Revise environmental conservation and biodiversity management plans in light of climate change. Ensure they are realistic in the light of climate change, and do not escalate demands on resources to maintain systems which will be unavailable in the new climate change regime.	Department of Sustainable Environment	Funding; Resources	Council does not have a Biodiversity Management Plan or similar conservation policy. Should Council resolve to prepare such a strategy a key component would be the consideration of Climate Change Risks. The Comprehensive Koala Plan of Management is close to finalisation. Some consideration of climate change impacts had been considered, however further detailed consideration will need to be given upon next review if 5 yrs.
NSRM-3	Develop management plans for increased risks from weed breakouts following more flooding, bushfires and higher temperatures.	Department of Infrastructure Services	Funding; Resources	The NSW North Coast Weeds Advisory Committee documents management plans and other policies which assist local governments and other authorities to implement weed management. Representatives of this committee should ensure climate change is appropriately considered during the preparation of plans and policies.
NSRT-1	Transfer costs to the State or Federal Governments, or consider raising land rates to cover costs of land-buy backs which will allow for re-zoning to promote more resilient conservation zones.	Department of Sustainable Environment	Funding; Resources; Biodiversity Management Plan	Council does not have a Biodiversity Management Plan or similar conservation policy. Should Council resolve to prepare such a strategy a key component would be the consideration of Climate Change Risks. The Comprehensive Koala Plan of Management is close to finalisation. Some consideration of climate change impacts had been considered, however further detailed consideration will need to be given upon next review if 5 yrs.
NSRT-2	Develop a combined regional-scale strategy for cross cutting biodiversity and bio-security risks, to ensure that risks are managed overall.	State Government		The State Government has prepared a Draft Northern Rivers Biodiversity Management Plan. This plan identify a range of actions help maintain and conserve biodiversity.
NSRT-3	Request State or Federal Government funding for adaptation measures for natural environments which may be of State or Federal significance.	Department of Sustainable Environment		Should Council resolve to prepare a biodiversity management plan it should seek funding assistance from the State Government to prepare it.

General Governance				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
BERT-4	Negotiate for State and Federal funding for measures to reduce exposure and increase the resilience of building stock. Alternatively, seek a mandate to increase the rates, to cover the additional capital and operational costs that may be associated with this exposure.	Department of Corporate Management	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	
ESRT-1	Consult with energy utilities, regarding options for load shedding, priority supply locations, embedded generation, and undergrounding of cables, to reduce exposure to physical hazards.	Department of Sustainable Environment, Country Energy	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	As Climate Change Hazards become known to Council the information should be forwarded to service providers, neighbouring Councils and other relevant authorities
ESRT-2	Consult with utilities to introduce secondary power lines around high risk links, to introduce redundancy into the power supply chain.	Department of Sustainable Environment, Country Energy	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	As Climate Change Hazards become known to Council the information should be forwarded to service providers, neighbouring Councils and other relevant authorities
ESRT-3	Consult with utilities and neighbouring Councils to address neighbouring high-risk locations through which the power system passes and where it is prone to outage.	Department of Sustainable Environment	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies; Risk identification in neighbouring Councils	As Climate Change Hazards become known to Council the information should be forwarded to service providers, neighbouring Councils and other relevant authorities
CSRM-2 & ERRM-2	Develop actions to ensure clear, reliable and consistent communications to tourists, travellers and residents in region during extreme events. Ensure the community is made aware of current threats and risks as well as when the risk/threats are withdrawn	Department of Infrastructure Services, SES		Subject to the DISPLAN review
CSRT-1	Consult with communication suppliers and neighbouring Councils to develop climate-proof communications systems for the area, including relocation of high-risk assets, and fit-for-purpose specification of equipment.	Department of Sustainable Environment	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	As Climate Change Hazards become known to Council the information should be forwarded to service providers, neighbouring Councils and other relevant authorities
GRER-2, GRER-4 & BEER-2	Reduce the exposure of council to legal and financial risks through a strategy of disclosure and awareness by: (a) ensuring that all known climate change hazards are published in the public domain, (via maps and other tools) (b) where possible, at minimum, adhering to State or Federal Government benchmarks, whilst also disclosing that risks may exceed these levels due to science known to Council; (c) ensuring that parties that could suffer loss are made aware of possible risks at the earliest possible time (eg, through the 149 certificate), allowing them to make their own decisions on risk management; and (d) requiring that the known climate change hazards are adequately managed by those seeking to build or redevelop in high-risk locations	Department of Sustainable Environment	LIDAR; Flood Risk Mapping which considers the implications of Climate Change; Coastal Hazard Mapping; Funding required to complete studies;	Will require amendments to Kempsey LEP and DCP when climate change risks are appropriately identified
BEER-2, GRER-3 & BERT-3	Ensure that Council complies with State benchmarks for indemnification under the Local Government Act (section 733) by implementing required benchmarks across all Council approvals, whilst also disclosing that actual risk may be higher.	Department of Sustainable Environment	Legal Advice	
GRER-5	Develop a legal transition strategy based upon legal opinion to minimise short-term litigation (eg, for cost increases in developments). This can be folded into the process of introducing measures that would address climate-related legal risks for Council in the long term.	Department of Corporate Management		May be required when new development standards are implemented. If standards are based on professional investigations, legal opinions may only be necessary when proponents challenge those standards.

General Governance				
Action Code	Action Summary	Responsibility	GAPs	Notes/Status
GRVR-4	Reduce vulnerability of Council to community dissatisfaction, loss of goodwill and political instability by implementing consultative processes around climate change management strategies, changes in resource allocation, and possible increases in rates to maintain services and changes in service levels.	Department of Sustainable Environment	Funding; Resources	Seek Funding Opportunities for a climate Change Education Program
GRVR-5	Update risk guidelines/specifications for Council infrastructure to cope with weather-related events that may be affected by climate change (eg, flood risk), to reflect projected rather than historical risk levels. For example, a storm water drain might be designed to last 100 years and cope with a 1 in 100 year event; with climate change, the suitable flood level should consider that an event with a return frequency of 1 in 100 years today may look more like the current 1 in 200 year event by 2100 (ie, much more severe).	Department of Infrastructure Services	Asset Risk Maps; Funding; Resources	
GRVR-6	Implement a policy of 'shadow pricing' across decision-making to include Federal Treasury estimates for forward carbon prices under a two degree Celsius / sub-450 parts per million scenario.	All of Council	Will require a standard methodology to be provided to staff so estimates of the carbon price can be simply calculated.	Implement into Council Reporting process for projects likely to be actioned in the next 5 years.
GRRM-2	Review the ability of Council to provide core services and maintain assets under climate change. If this is not possible, develop plans to consolidate asset bases and service provisions. Also, review the ability of Council to respond to major events including the workforce required for timely recovery post-event. Overall, create a revised financial, asset and human resource strategy.	All of Council	Funding; Resources	This action would require a supporting study prepared by a specialist in economic and planning.
GRRM-4	Integrate climate change management strategies into all Council planning documents, policies and guidelines.	Department of Sustainable Environment/ Corporate Management		This action is best placed in Council 20 year Community Strategic Plan as an overriding objective.
GRRM-5	Implement monitoring and measurement processes for key climate change indicators and metrics for exposed and vulnerable people, property and infrastructure.	Department of Sustainable Environment		May be incorporated in existing monitoring activities such as the State of the Environment Report; Land and Housing monitors; development statistics etc
GRAO-1	Collaborate with all neighbouring Councils and State Government to 'climate-proof' the region which would increase relative value and also harness potential advantages: water and food security for agriculture and low-carbon tourism making the region attractive to inward investment and young families.	Department of Sustainable Environment		As Climate Change Hazards become known to Council the information should be forwarded to service providers, neighbouring Councils and other relevant authorities. Initiatives for joint actions or programs should be identified and joint funding opportunities investigated.
GRVR-3	Reduce Council's financial exposure to increased extreme events which cause disruption to services and damage to assets. Act on a range of strategies to ensure resilience of Council's services - eg implement this adaptation plan	All of Council		



Climate Risk Pty Ltd
2/50 York Street
Sydney NSW 2000

T: +61 2 8243 5767
F: +61 2 8243 1122

[www.climate**risk**.net](http://www.climaterisk.net)