Byron Shire Council

Climate Change Adaptation Plan

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Foreword

There are few places anywhere in the world as beautiful as Arakwal country. We are surrounded by outstanding natural beauty that countless generations have fought hard to protect. But the succession of severe weather events that have threatened the Byron Shire in recent years has been a confronting preview of the impacts expected as climate change continues. Our region has so much to lose.

In 2019, Australia experienced it's hottest and driest year on record – the first time both national records were broken in the same year. Rainfall was a 40 per cent below average across the continent, with temperatures running 1.5 degrees warmer than the historical mean. Prolonged heat influenced northern New South Wales, impacting farming, water resources, natural ecosystems, and outdoor work and recreation across the Shire.

Extreme temperatures and drought led to the catastrophic 2019–2020 Black Summer bushfires that burnt through the UNESCO World Heritage-listed Nightcap National Park. This region is part of the Gondwana Rainforests of Australia, a network that contains the largest remaining stands of subtropical rainforest in the world, and the most significant areas of warm temperate rainforest in the country. Blockades to protect these extraordinary forests from logging during the late 1970s helped birth the global environmental movement. These areas are of immense local and global significance, but their future is now threatened by a warming climate that is worsening bushfire risk even in rainforest areas.

The 2020–2021 La Niña event, which typically brings above average rainfall to the eastern seaboard, resulted in severe flooding in the Byron Shire, causing major damage to our roads and prolonged water quality issues in our waterways. Severe storms caused extensive beach erosion along the coastline, and the striking collapse of fragile dunes and infrastructure at Clarks and Main beaches in Byron Bay. Some of the most iconic beaches in the country are disintegrating before our eyes, as severe weather and sea level rise combine to batter our precious coast.

The occurrence of these types of weather and climate-related risks will increase in frequency and intensity as our world continues to warm. A future of compound extremes, like the simultaneous drought, heatwaves and bushfires experienced during Australia's Black Summer, or the subsequent heavy rainfall and storm surges caused by severe weather systems like east coast lows and tropical systems, pose very real and immediate threats to Byron Shire. It's now part of our lived experience.

This climate change adaptation plan is a direct acknowledgment of the threats we now face, and an important step towards actively facing an uncertain future. While the challenges are great, we must draw on the strong custodian spirit alive in our Shire, and provide an inspiring example of how a local community can build resilience and make clear-eyed plans to protect our collective future.

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Acknowledgements

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Acknowledgement of Country

Byron Shire Council acknowledges and pays respect to the Bundjalung of Byron Bay, the Arakwal People as the Traditional Custodians of the land within Byron Shire, that form part of the wider Aboriginal Nation known as Bundjalung.

Council also acknowledges and respects the Widjabul and Minjungbul people as Traditional Custodians within Byron Shire.

Council acknowledges the Aboriginal and Torres Strait Islander people who now reside within the area.

1.0 Introduction

Byron Shire Council recognises that responding to climate change involves decision-making for both mitigation and adaptation, with major implications for future generations, economies, and the environment.[1] Despite the continuously evolving research, current climate projections provide the best available evidence base to proactively assess and respond to future climate scenarios.[2] This process involves what is known as the precautionary principle.

> "A precautionary decision-making response evaluates whether risks can be minimized to an acceptable level based on the best available evidence, and adopts a prudent approach if risks of harm are considered too high" [2]

What does this mean for Byron Shire? These unprecedented circumstances require widespread action across all levels of government, businesses, and the community. Local governments have an important duty of care, and uncertainty surrounding climate change impacts should not stand in the way of action.

Byron Shire Council has been strategically addressing climate change since 2004, and in October 2018, became the first Council in NSW to declare a *climate emergency*. This Climate Change Adaptation Plan (The Plan) is a vital step forward in our climate emergency response.

> "Climate Adaptation is the process of adjustment to actual or expected climate and its effects, in order to moderate or avoid harm or exploit beneficial opportunities"[1]

First and foremost, the aim of the Plan is to:

- Reduce the risk of projected climate impacts by delivering specific actions and planning measures within Council's operational control
- Enhance community resilience and adaptive capacity before, during, and after climate events

The Plan will address four climate scenarios that have been identified as the most significant risks to Byron Shire:

1. Flooding due to extreme rainfall
2. Coastal storm surges due to severe storms and sea level rise
3. Extreme heat
4. Increased fire weather

These scenarios are the lens through which we have developed our 100 Adaptation Actions to be embedded across the organisation through our Operational Plan. In addition, Council acknowledges that climate change has the potential to impact our financial capacity to effectively respond to these scenarios. Recovering from the impacts of severe weather

events requires extensive financial and human resourcing, especially as the frequency of events increases. This presents a risk in itself.

Byron Shire Council has committed to actions that we can address as a regional Council to mitigate these risks, whilst also enhancing our adaptive capacity. This will enable us to continue to meet our Community Strategic Plan objectives, and provide essential services and opportunities for the local community to thrive in a changing environment.

2.0 A Changing Climate

The scientific evidence surrounding climate change and its impacts is stronger than ever. The Australian Government Bureau of Meteorology (BOM) and Commonwealth Scientific and Industrial Research Organisation (CSIRO) release a State of the Climate report biennially. Their latest publication (2020) states:

> "Australia's climate has warmed by 1.44 degrees Celsius since national records began in 1910".[3]

> "Concentrations of carbon dioxide (CO_2) are the highest levels seen on earth in at least two million years".[3]

As the climate warms we are seeing unprecedented severe weather events.[4] Many of these events often occur simultaneously or more frequently which can then reduce our recovery time and impact adaptive capacity.[4] The Intergovernmental Panel on Climate Change (IPCC) highlights this:

> "A changing climate leads to changes in the frequency, intensity, spatial extent, duration, and timing of extreme weather and climate events, and can result in unprecedented extreme weather and climate events."[4]

This is being felt in Australia, and Byron Shire has also experienced this first hand. Our Local Government Area (LGA) covers 566.7 square kilometers of the Far North Coast of NSW and shares its boundaries with Tweed, Lismore and Ballina LGAs.

Image - Map of Byron Shire

Byron Shire recorded a population of 35 081 in 2019.[5] The area is renowned for its rural beauty and beaches which attracts over two million visitors annually. However, this rapid growth in the area presents a unique challenge when it comes to managing climate change impacts and increasing resilience, particularly with regard to housing, infrastructure, water security, and coastal management. In recent years, Byron Shire has experienced several severe weather events:

2019 -

Following a prolonged and widespread period of drought in late 2019, many regions of Australia including Byron Shire witnessed bushfires of an unprecedented scale and intensity.[6] Our upper catchments saw rainforest of high ecological importance burn, with fires extending through several National Parks including nearly 5000 hectares of the World Heritage listed Nightcap Range.[7,8] This had major impacts on local residents and biodiversity within this important region.[7,8]

Image - Bushfire

2020 -

Just as the bushfires were coming to a halt, we then experienced major rainfall events in early February 2020. On 7 February the BOM recorded 275mm of rainfall in a 24 hour period in Byron Bay.[9] This lead to flash flooding throughout the Shire, damage to roads and other infrastructure, and implications for the management of flooding in our coastal estuaries at Tallow and Belongil Creeks.

Image - Byron Bay flooding

In December 2020, the impacts of severe storm weather and coastal storm surges saw large sections of Clarks and Main Beaches in Byron Bay heavily affected by coastal erosion. This is a key issue for the Byron Shire region, with many low-lying coastal areas and homes at high risk of exposure to similar weather events in the future.

Image - Main Beach erosion

2021 –

Most recently in March 2021, the East Coast of Australia including Byron Shire experienced heavy and prolonged downpours leading to another flash flooding event throughout the region.[10] Byron Shire is no stranger to inundation with the last flooding event occurring just months prior to the March floods.

Image - Mullumbimby flooding

These recent weather events are consistent with what is expected with climate change. Adverse impacts are expected to occur locally and worldwide, with vulnerable groups such as the elderly, children, outdoor workers, and isolated or coastal residents at most risk.

The 2019 North Coast Enabling Regional Adaptation (NERA) report identifies that regional drivers of vulnerability on the North Coast of NSW include lack of housing affordability, cultural change, population, demographic change, inadequate planning and decision-making, changing community risks, communities with transient lifestyles, and extreme event impacts.[11] These drivers, while not all climate-related, will likely be amplified by climate change.[11]

It is also broadly accepted that ongoing severe weather events have the potential to impact financial and economic stability, leading to a reduced capacity to respond and recover.[12,13] As the frequency of extreme weather events increases, our capacity to respond becomes further compromised.[14]

Resilient communities are diverse, healthy, inclusive, well prepared, and connected.[11] Byron Shire Council acknowledges that leadership is required to ensure we improve the ability for our community to achieve these markers of resilience, and our Community Strategic Plan objectives highlight this:

- We have infrastructure, transport and services that meet our expectations
- We cultivate and celebrate our diverse cultures, lifestyle and sense of community
- We protect and enhance our natural environment
- We manage growth and change responsibly
- We have community led decision making which is open and inclusive

This adaptation plan will focus on actions we can take in alignment with these objectives, minimising climate risk where possible, and building adaptive capacity in our communities.

3.0 Aboriginal Culture and Perspectives on Climate Change Adaptation

Image - Arakwal Traditional Owners at Tallow Creek

Byron Shire lies on Arakwal (Country) within the Bundjalung Nation. It is home to the Traditional Owners and Custodians of the land – the Arakwal People. Arakwal boundaries begin from South of the Brunswick River, and go West to Mullumbimby, Bangalow and Newrybar, down to Broken Head in the South.[15]

The local land, seas, and waterways have been supporting the Bundjalung People for over 20, 000 years.[15] Aboriginal People hold distinct and specialised knowledge of place, local history, species, and land management, and have been observing ongoing changes to Country for thousands of years.[16]

Climate events that take place on Bundjalung Country not only have biophysical impacts on plants and animals, but will also impact traditional sites, knowledge and cultural heritage.[16] For example, sea level rise, storm surges and associated inundation and erosion are having impacts on culturally significant Aboriginal coastal middens along the coast of Byron Bay (Cavanbah).

"Sacred sites can link us to our ancestors and they connect us to the land. They help a person feel strong about where they came from. We can live elsewhere but this is where we belong and so it's important to know and understand these significant sites so that you can walk around with pride."[15]

To Aboriginal People, adaptation is not a new idea connected to climate change, it is something that has always happened.[16] Changes in landscapes, sea level, rainfall, and new plant and animal species have always been a normal part of life.[16] Adaptation is part of the history of Indigenous survival over millennia and is rooted in traditional knowledge, respect for, and time connected to Country.[16]

The Australian Government Royal Commission into National Natural Disaster Arrangements released in 2020, highlighted the importance of incorporating the views of Aboriginal People into disaster risk management. The report states that sharing the traditional land (and fire) management practices of Aboriginal People could improve Australia's resilience to natural disasters.[17]

Byron Shire Council hopes to continue to engage and consult with the Traditional Owners and Custodians of the land within the Shire and surrounds on climate adaptation. The Memorandum of Understanding ensures that Council will work in partnership with the Bundjalung of Byron Bay Arakwal People to ensure preservation of cultural practices, traditional sites, significant places and expressions of connection and cultural identity.

Case Study 1 – Community Resilience and Caring for Country

In the 2021/22 financial year, Byron Shire Council will host a series of community workshops aimed at improving our resilience against natural disasters and severe weather events. These projects are funded through the Commonwealth and State Government resilience and economic recovery grant funding:

Community Resilience Workshops and Street Meets (Adaptation Action 18)

Facilitated by Red Cross, the delivery of these workshops will ensure that the community are prepared for more extreme weather events and emergencies in the future. They will focus on disaster resilience, local level neighbourhood networks, partnerships with local emergency services and ensure the community can make informed decisions during an emergency.

Aboriginal Custodianship and Caring for Country Workshops (Adaptation Action 31)

Byron Shire Council acknowledges the importance of Aboriginal cultural heritage and traditional land management practices to improve disaster resilience. These workshops will engage the Byron Shire community and local emergency services to come together in a way that supports our local community to better understand, value, and work together to protect local Aboriginal cultural heritage and mitigate negative impacts during disaster events.

4.0 Global, National and State Policy Context

4.1 Global:

- The IPCC assesses climate change and its impacts via expert scientific analysis from scientists around the world. Released in 2013/14, the latest IPCC Fifth Assessment Report (AR5) asserts '*that anthropogenic emissions of greenhouse gases are the highest in history*'.[18] These findings resulted in the 2015 Paris Agreement where 197 countries committed to limit global warming to below 2°C.[19]

- The 2030 Agenda for Sustainable Development was adopted by all United Nations Member States in 2015, highlighting 17 Sustainable Development Goals (SDGs) for a more sustainable and equitable future.[20] There are 12 of the 17 SDGs that take action on climate change, in addition to climate change having its own goal, *Climate Action* (Goal 13).[20]

- In November 2019, 11, 000 scientists from 153 nations declared that earth is facing a climate emergency.[21] As of December 2020, a climate emergency has been declared by 1856 jurisdictions around the world.[21]

4.2 National:

- In Australia, a climate emergency has been declared across 97 jurisdictions (December 2020).[21] However, the only Federal emission reduction targets are those set under the *Paris Agreement 2015,* which are much less ambitious than other developed nations around the world.[22]

- On 9 November 2020 the *Climate Change (National Framework for Adaptation and Mitigation) Bill 2020* was presented to the Senate by Independent Member of Parliament, Zali Steggall.[23] Based on the United Kingdom's *Climate Change Act* it includes a requirement for a national risk assessment, net zero 2050 target, national climate adaptation program and an independent Climate Change Commission for accountability.

4.3 State:

- Net zero emissions and renewable energy targets have been declared in Victoria, Tasmania, the Australian Capital Territory, South Australia, Queensland, and the Northern Territory.[22] Western Australia and New South Wales do not have renewable energy targets, but do have similar net zero targets to other states.[22]

- While NSW has not formally declared a renewable energy target, the newly adopted NSW *Electricity Infrastructure Investment Act 2020* supports a $32 billion investment into renewable energy infrastructure and the establishment of several Renewable Energy Zones.[24]

- The NSW Government also recently released the Net Zero Plan Stage 1: 2020–2030, outlining four priorities to reduce emissions in NSW by 35%, (compared to 2005 levels) by 2030.[25]

- A 2021 assessment by the NSW Government Treasury formally acknowledged climate risk with regard to the impact on NSW's long-term economic and fiscal outlook.[13]

5.0 Byron Shire Council Climate Emergency Response

How did we get here? A timeline of climate action

The following information (Table 1) is a summary of key actions taken by Byron Shire Council since 2004.

Table 1 - Key dates and actions taken regarding climate change

Year	Key Actions
2004	Greenhouse Action Strategy adopted Joined International Council for Local Environmental Initiatives (ICLEI) and Cities for Climate Protection
2009	Climate Change Strategic Planning Policy adopted Byron and Tweed Shires Climate Change Comprehensive Risk Assessment and Adaptation Plan completed
2014	Climate Change Strategic Planning Policy update adopted Development Control Plan 2014 Chapter C2 Areas affected by Flood adopted Byron Shire Low Carbon Strategy adopted
2015	Formed partnership with Zero Emissions Byron (ZEB) Joined Global Covenant of Mayors for Climate & Energy (GCoM)
2017	Convened an Energy Action Tank resulting in feasibility studies for bioenergy, solar farms, solar carpark and electric vehicle charging stations Commitment to Net Zero Emissions for Council operations by 2025 and 100% renewable energy by 2027 Established a Sustainability Officer role Joined Cities Power Partnership
2018	Declared a climate emergency Established the Sustainability and Emissions Reduction Advisory Committee (SERAC)
2019	Net Zero Emissions Strategy for Council Operations 2025 adopted Convened facilitated workshops re: AdaptNSW for Councillors, staff & community Convened a Climate Action Tank for the development of a Climate Change Adaptation Plan (developed but not delivered due to COVID-19)
2020	Net Zero Emissions Action Plan 2025 adopted Climate resilience framework for internal staff explored and presented to Council – *Our Resilience Approach* Statewide Mutual Climate Change Risk Assessment completed

5.1 Climate Change Mitigation

While this Plan focusses primarily on adaptation, Byron Shire Council also acknowledges its own contribution to anthropogenic climate change and the importance of mitigation. Mitigation seeks to limit the human-induced changes in the global climate by reducing and offsetting greenhouse gas emissions, whereas adaptation is focused on building adaptive capacity to reduce harm from climatic impacts.[20, 21] The two are inextricably linked.

Mitigation	Crossover	Adaptation
Energy efficiency	Ecologically sustainable development	Resilient building & infrastructure design
Renewable energy	Resilient energy systems	Community understanding of climate impacts & risks
Improvements in industrial processes	Water & energy conservation	Business continuity
Sustainable transport	Urban greening	Emergency planning
Enhanced carbon sinks	Education	Change in land use

To Zero Together

In March 2017, Council resolved to –

- Achieve 100% net zero emissions by 2025
- Source 100% of its energy through renewable sources by 2027

These targets will be formally certified in the 2025/26 financial year under the Federal Government Climate Active certification. To date, Council has made considerable progress towards their goals in alignment with the Net Zero Emissions Strategy and Action Plan for Council Operations 2025.

Key achievements as of 2019/20 financial year –

- A net reduction in emissions of 26% (9,776 tC02-e) since monitoring began in 2016
- Over 600 kilowatts (kW) of solar installed across Council assets
- Multiple energy efficiency audits and upgrades of Council assets
- 100% carbon neutral electricity contract
- Shire-wide LED street lighting upgrade (in progress)
- Feasibility studies into a potential 5 megawatt solar farm and bioenergy facility

Image - 99kW solar carpark at Mullumbimby Administration Building

5.2 Climate Change Adaptation

Image - Negative climate change impacts

Climate change is expected to affect a range of services provided by local governments including infrastructure and utilities, emergency services, public health, safety and wellbeing, and environmental management. It is therefore essential that Councils' make operational adjustments to limit disruption to these areas, and manage the risk to the local community and environment.

Adaptation Plan methodology –

Currently, each State in Australia projects their specific climate change impacts based upon the modelling used by the State. In NSW, that modelling is the NSW and ACT Regional Climate Modelling (NARCliM), with the resulting parameters utilised within State plans and local government risk assessments by Council insurers. NARCliM bases their modelling on the IPCC A2 high emissions scenario.[28]

In 2020, Byron Shire Council partnered with its insurer, *Statewide Mutual*, to undertake a comprehensive climate change risk assessment using this data, involving extensive input from a range of Council staff across the organisation. The resulting Risk Assessment underpins our Climate Change Adaptation Actions, which focus on risk management and reduction within the context of Council operations. Additional Actions have also evolved and been included in The Plan following further consultation.

Other key projections have been sourced from comprehensive projection reports prepared by the CSIRO, BOM and the Australian Government Department of Environment.[29,30] These technical reports utilise data from the Coupled Model Intercomparison Project phase 5 (CMIP5) which also underpins the science of the IPCC's AR5 report.[29,30]

Implementation –

Many of our Adaptation Actions are already in progress as part of our day-to-day operations and in alignment with our Operational Plan. This means that in many cases, funding has already been allocated to implement all or part of these actions. One of the barriers that Council will face is ongoing funding to continue these actions into the future and in some cases expand their scope. Where new controls are identified, future funding will also be required.

A combination of grant funding (e.g State and Federal Government), external resourcing (such as collaborative partnerships), staff time, and future Council budget allocation will be required into the future. This Adaptation Plan will sit within the Integrated Planning and Reporting framework that Council uses to identify resourcing needs and allocate funds accordingly into the annual Operational Plan. Each year, Council staff will be required to factor in their Adaptation Actions into their annual resourcing requirements. A complete list of our 100 Adaptation Actions and their resourcing considerations can be found in Appendix 1.

Image - IP&R framework

Review –

In alignment with the NSW Government *Guide to Climate Change Risk Assessment for NSW Local Government*, this Adaptation Plan will be reviewed every five years to capture updated science and incorporate best practice in adaptation planning.[31] Actions that are within our Operational Plan will be reported on annually as per regular Council reporting requirements.

Diagram - Review process

Important note –

It is important to note that Council has prioritised risks identified in our Risk Assessment as High or Extreme to be included in this Adaptation Plan. Risks identified as Medium to Low have not been included in this Plan, however were still addressed within the Risk Assessment undertaken by Council staff and will be reviewed every 5 years.

Many of our Adaptation Actions are also repeated throughout. We acknowledge that by conserving environmental and ecosystem services, we are in turn strengthening the physical barriers that protect us from the impacts of climate change. For example, Action 7 - *Develop and implement Coastal Management Program in accordance with Coastal Management Manual,* applies to the risk of flooding impacts on both ecosystems and infrastructure.

Many actions will also respond to multiple climate scenarios. For example, the risk to public safety and wellbeing is applicable to flooding, storm surges, extreme heat and bushfires. *Action 17 – Promote usage of Climate Wise Communities and Emergency Dashboard to encourage residents to develop their own emergency plan and stay informed of emergency services during extreme weather events*, will therefore carryover across each of these severe weather events.

For accessibility, a list of our 100 Adaptation Actions without duplicates can be found in Appendix 1.

5.3 Climate Change Adaptation Actions

Climate Change impacts can be either acute or chronic. Acute risks such as severe storms, floods, fire and drought have an immediate and apparent impact, whereas chronic risks such as sea-level rise, are longer-term. There are four scenarios identified as high risk to Byron Shire that are being addressed within this Plan:

1. Flooding due to extreme rainfall
2. Coastal storm surges due to severe storms and sea level rise
3. Extreme heat
4. Increased fire weather

Flooding due to extreme rainfall –

Key projections -

- Extreme rain periods (wettest day of the year and wettest day in 20 years) are projected to become more intense on the east coast of Australia.[33]
- Tropical cyclones may occur less often, become more intense, and reach further south into Northern NSW, bringing heavy rainfall.[33]
- See also, key projections for *'Coastal storm surges due to severe storms and sea level rise'*.

Heavy rainfall and storm events are becoming more intense, with tropical cyclones projected to be fewer, but of greater intensity.[3,33] The latest projections indicate that tropical cyclones are expected to track further south into south-eastern Queensland and north-eastern New South Wales (NSW).[33,34] This presents a major risk for low-lying coastal towns along the east coast of this region.

Atmospheric and oceanic changes as the climate warms are also expected to cause more intense storms and rainfall.[3,33] The water-holding capacity of the atmosphere increases with warming temperatures, particularly close to the ocean.[33,35] As the ocean also warms, evaporation and transport of water into weather systems increases.[35] Both of these factors can lead to increased rainfall and more severe storm events such as east coast lows.[33]

How will this impact Byron Shire?

- Flooding of public and private land including agriculture
- Isolation of vulnerable communities, e.g those with causeway access
- Intermittently Closed and Open Lakes and Lagoons (ICOLL) and coastal ecosystem management
- Degradation of water quality due to erosion and runoff
- Damage to infrastructure, e.g roads and stormwater infrastructure
- Leachate overflow from landfill sites

Case Study 2 – Biodiversity Conservation and Climate Change

Byron Shire lies in one of the most biodiverse regions of Australia, with ecosystems ranging from ancient old growth rainforests to tall Eucalyptus forests, rocky outcrops, heaths, sedgelands, fresh water swamps, mangroves and saltmarshes. Biodiversity conservation is an important aspect of adapting to climate change in order to protect and maintain the health of these important ecosystems.

Extreme weather events such as extreme heat, drought, heavy rain, and flooding are expected to have widespread impacts on biodiversity. Impacts can include increased land degradation, shifts in animal and plant abundance and seasonal activity, and reduced soil health leading to reduced capacity to store carbon.

This Climate Change Adaptation Plan (CCAP) aims to support the implementation of the Biodiversity Conservation Strategy, which details specific actions needed to mitigate the effects of climate change and support biodiversity conservation in Byron Shire. Some of these actions included in the CCAP include:

- Identify and map wildlife corridors, refugia and Priority Restoration Areas.
- Ensure wildlife corridors, and Priority Restoration Areas are informed by current science on climate change impacts including plant communities and species at most risk.
- Update planning controls and council policy to reflect wildlife corridor, refugia and Priority Restoration Areas mapping.
- Update planting lists to identify species likely to be adaptable to climate change.
- Identify open forest ecosystems requiring restoration through the reintroduction of fire.

Adaptation Actions – Flooding due to extreme rainfall

Risk	Current Controls	Adaptation Actions	Council directorate and partnerships
Increased risk of leachate overflow from Council Resource Recovery Centre and closed landfill sites into the environment (eg. estuaries), contamination of water table and private land, non-compliance with Environmental Protection Agency (EPA) licence, and public health issues.	Leachate Management Plan Stormwater Management Plan EPA Controls Leachate collection system with recent maintenance to damaged tanks and manifold. Leachate storage tank systems upgraded. Environmental health contamination assessments	**Plans and Policies** 1. Review Leachate Management Plan to ensure inclusion of Climate Change impacts. 2. Review the Stormwater Management Plan for the Byron Resource Recovery Centre. **Community Education and Preparedness** **Physical Controls** 3. Create an inventory in consultation with Department of Primary Industry and Environment (DPIE) Crown Lands of any known former landfills and their attributes (eg. lined/unlined, proximity to sensitive environment/populations). Inventory to rank the landfills as high/med/low in terms of priority for investigating risks to the environment (in general) and from climate change impacts. 4. Develop strategies to mitigate closed landfill sites risks, e.g. if all leachate has been found to migrate from a site, then the expensive exercise of retrofitting liners/leachate collection will not be of benefit; however stabilising embankments of adjacent waterways and natural drainage lines and revegetation programs may offer the best cost-benefit/environmental outcomes/resilience against climate change impacts. 5. Review contaminated land Geographic Information Systems (GIS) mapping layers to ensure completeness and availability of further information. 6. Implement the Environmental Management System for all known landfill sites and resource recovery centre (to track EPA, licence conditions etc).	Infrastructure Services In partnership with: EPA DPIE Crown Lands
Negative impacts on Intermittently Closed and Open Lagoons and Lakes (ICOLL) management leading to flooding risk and impacts on water dependent ecosystems.	Flood Plain Management Plans ICOLL and Beach Lagoon Management and Entrance Opening Strategies	**Plans and Policies** 7. Develop and implement Coastal Management Programs (CMP) in accordance with Coastal Management Manual. 8. Review and maintain Flood Plain Management Plans on a regular basis. **Community Education and Preparedness** 9. Inform landowners of climate change, the impacts of exacerbated coastal processes and the importance of preserving both dune and wetland vegetation. 10. Incentivise private land owners to protect and restore wetland and suitable areas for migration. **Physical Controls** 11. Periodically review and amend Entrance Opening Strategies with consideration of: a) pending updated coastal hazard assessment, b) outcomes of climate change on groundwater studies, and c) ongoing updates to State policy for ICOLL management.	Sustainable Environment and Economy Infrastructure Services In partnership with: NSW Government
Loss or damage to Council's natural and built assets and infrastructure negatively impacting Council's ability to deliver services to the community.	North Byron Flood Risk Management Plan Flood Plain Risk Management Plans Byron Flood Warning Network Emergency Action Sub Plan Asset Management Plans	**Plans and Policies** 7. Develop and implement CMP in accordance with Coastal Management Manual. 12. Develop and periodically review Emergency Action Sub Plan as part of CMP. 8. Review and maintain Flood Plain Management Plans on a regular basis.	Infrastructure Services Sustainable Environment and Economy Corporate and Community Services

		Community Education and Preparedness	In partnership with: State and Federal Government Emergency Services
		Physical Controls	
		13. Develop overland flow path studies for Byron Shire's urban areas. 14. Include OP Activity for infrastructure repairs and clean up as required after flood events. 15. Carry out grant-funded road infrastructure repairs following severe rainfall events e.g Ocean Shores, New Brighton, South Golden Beach.	
Loss or damage to private property due to intense rain periods and flooding.	North Byron Flood Risk Management Plan Flood Plain Risk Management Plans Development Control Plan (DCP) and Local Environment Plan (LEP) Byron Flood Warning Network Emergency Action Sub Plan	**Plans and Policies**	Infrastructure Services Sustainable Environment and Economy Corporate and Community Services In partnership with: NSW Government BCRN Emergency Services
		7. Develop and implement CMP in accordance with Coastal Management Manual. 16. Further review of current planning controls for flood affected land in line with NSW Government SEPP Planning for Natural Hazards (currently open for review). 8. Review and maintain Flood Plain Management Plans on a regular basis.	
		Community Education and Preparedness	
		17. Promote usage of Climate Wise Communities and Emergency Dashboard to encourage residents to develop their own emergency plan and stay informed of emergency services during extreme weather events. 18. Council staff to continue community education and awareness partnerships with community organisations and Aboriginal stakeholders, eg. Get Ready Business workshops, Resilience and Street Meet workshops, and Caring for Country and Aboriginal Custodianship workshops. 19. Support Byron Community Resilience Network (BCRN) members by providing upskilling opportunities based on areas of identified need e.g. management of spontaneous/emergency support volunteers, Psychological First Aid and disaster recovery principles and arrangements.	
		Physical Controls	
		13. Develop overland flow path studies for Byron Shire's urban areas. 20. Provide staff training in emergency preparedness in partnership with Emergency Services and collaborate with Emergency Services where needed for recovery efforts.	
Stormwater infrastructure having insufficient capacity to cope with water flows leading to public health and safety issues, environmental issues and damage to private property.	Stormwater Management and Maintenance Systems CRM Local drainage assessment and mitigation Strategies Capital Works Drainage Program	**Plans and Policies**	Infrastructure Services Executive Team In partnership with: Emergency Services
		21. Finalise Capital Works Renewal Program (CWNP) for the Shire's Stormwater Network.	
		Community Education and Preparedness	
		17. Promote usage of Climate Wise Communities and Emergency Dashboard to encourage residents to develop their own emergency plan and stay informed of emergency services during extreme weather events.	
		Physical Controls	
		22. Investigate installation of a generator for alternate power supply for the South Golden Beach flood pump. 23. Ensure any future flood pumps have an alternate power supply.	
Impacts on agricultural land use and food security due to flooding.	Byron Shire Development Control Plan Agricultural Extension Officer	**Plans and Policies**	Sustainable Environment and Ecnomomy In partnership with:
		Community Education and Preparedness	
		24. Promote workshops and information on preparing for flood and other disasters from Local Land Services	

		25. Secure long-term funding of Agricultural Extension Officer beyond current grant funding. 26. Promote the use of the Emergency Dashboard to assist in stock and produce movement before critical flood levels effect distribution. **Physical Controls**	Local agricultural landholders North Coast Local Land Services
Increased rates of erosion, resulting in surface water runoff and stormwater pollution, affecting the natural and physical environment.	Water Sensitive Urban Design Policy and Strategy North Byron Flood Risk Management Plan Byron Drainage Strategy	**Plans and Policies** 7. Develop and implement CMP in accordance with Coastal Management Manual. **Community Education and Preparedness** **Physical Controls** 27. Identify nutrient, sediment and bacterial sources and implement actions to reduce inputs from diffuse and point sources (agricultural, urban and industrial sources) in accordance with Marine Estate Management Authority (MEMA) Strategy and CMP. 28. Extend the current Water Quality Monitoring System to include the Brunswick Catchment. 29. Implement the BSC Beach Watch Sampling Program.	Sustainable Environment and Economy Infrastructure Services In partnership with: Belongil Catchment Drainage Board Southern Cross University MEMA
Increased success and distribution of weed and pest species resulting in threat to or loss of native ecosystems.	Integrated Pest Management Strategy Pest Animal Management Plan Biodiversity Conservation Strategy Coastal Koala Plan of Management	**Plans and Policies** 30. Implement BSC Integrated Pest Management Strategy. **Community Education and Preparedness** 31. Finalise and implement Aboriginal Custodianship and Caring for Country workshops. 32. Partner with community organisations such as Landcare, North Coast Local Land Services, and Rous County Council to improve community capacity to identify and manage invasive species. 33. Continue to provide rural land holders with extension services including information and resources on resilient land use practices. **Physical Controls** 34. Continue bush regeneration works in partnership with Landcare and assess future need for additional staff. Bush regeneration works to emphasise importance of canopy re-establishment to minimise harm from weather fluctuations.	Sustainable Environment and Economy Infrastructure Services In partnership with: *tender for ACCC workshops not yet awarded* Landcare North Coast Local Land Services Rous County Council
Increased risk of mosquito vector activity and mosquito-borne diseases leading to public health implications.	Mosquito Management Plan Stormwater Maintenance Program Byron DCP	**Plans and Policies** 35. Continue urban planning maps and DCP controls for mosquito habitat zones. **Community Education and Preparedness** 36. Continue Tackling Mosquitos Together campaign aimed at reducing the disease risks of mosquitoes in the Northern Rivers through community education. **Physical Controls** 37. Ongoing monitoring and sampling in accordance with Mosquito Management Plan.	Sustainable Environment and Economy In partnership with: NSW Health North Coast Public Health Unit

Coastal storm surges due to severe storms and sea level rise –

Key projections -

- Sea levels will continue to rise into the 21st Century throughout Australia, including the east coast.[33]
- See also, key projections for *'Flooding due to extreme rainfall'*.

The Byron Shire region is at risk of coastal erosion and inundation due to sea level rise and more severe storms and storm surges occurring along the coast.[11,33] Extreme coastal sea levels arise from a combination of factors including king tides, storm surges and wind waves.[33] Storm surges can arise from the passage of weather systems and their associated strong surface winds and falling atmospheric pressure.[33] For example, east coast lows are responsible for some of Australia's most damaging natural disasters due to gale force winds, heavy widespread rainfall, and large ocean swells, all of which can lead to coastal inundation, erosion, and flash flooding.[36]

Some parts of Byron's coast, including Main, Clarks, and Belongil Beaches, have already experienced major coastal erosion due to past storm surge events. Belongil Beach is under particular threat with some areas having undergone shoreline retreats of up to 1.1 +/- 0.3 metres per year since 1988 (Appendix 2).[37] The increasing frequency of these events will reduce the ability for the coast to naturally replenish itself between storm surges.

The effects are also amplified due to sea level rise.[11,33] Taking up 90% of the extra energy from enhanced greenhouse gas concentrations, the world's oceans are heating both at depth and at the surface.[3,38] Global warming results in thermal expansion of water which is contributing to the rise in global mean sea level (GMSL).[38] This is compounded by increasing rates of ice loss from Greenland and Antarctica and continued glacier mass loss.[38]

How will this impact Byron Shire

- Coastal erosion, shoreline retreat, and inundation
- Increased risk to public safety
- Damage to infrastructure and utilities, e.g power outages
- Tourism, recreation, and public amenity impacts
- Damage to property (moved to bottom of list)

Case Study 3 – Coastal Hazard Planning Provisions (planned retreat).

Since 1988, Byron Shire Council has applied coastal hazard planning provisions to development in the coastal zone. These provisions permit certain development in defined coastal hazard precincts such as Belongil Beach, until coastal hazards present a significant risk. In such a case, the development is triggered for relocation or removal.

This is also known as 'planned retreat'. Planned retreat allows the use and occupation of the coastal land until coastline hazards threaten property; that is once the erosion escarpment encroaches within a 20 or 50 metre distance from a development.

Current planning controls on and provisions for development within coastal hazard areas are implemented through the Byron Local Environment Plan (LEP) 1988, Byron Local Environmental Plan 2014, Byron Shire Development Control Plan (DCP) 2010 and Byron Shire Development Control Plan 2014. Other councils in New South Wales have adopted similar planning approaches as part of their response to projected sea-level rise in combination with coastal hazards.

Adaptation Actions – Coastal storm surges due to severe storms and sea level rise

Risk	Current Controls	Adaptation Actions	Council directorate and partnerships
An increase in the number of extreme coastal storm events may increase the risk of loss/damage to public utility services causing power outages/interruptions to Council buildings and services (air-conditioning, communications, equipment, IT, lighting, etc.) negatively impacting Council's ability to maintain service levels and staff safety.	BCP and DRP Back up Generators Guardian Information Management System (IMS)	**Plans and Policies** **Community Education and Preparedness** 17. Promote usage of Climate Wise Communities and Emergency Dashboard to encourage residents to develop their own emergency plan and stay informed of emergency services during extreme weather events. **Physical Controls** 38. Implement enhanced Disaster Recovery Facility for Information Technology. 39. Transition to cloud based computing. 40. Ongoing staff training in IMS (to ensure staff are prepared) and continuous improvement of the software.	Corporate and Community Services, Infrastructure Services In partnership with: Emergency Services
Increase in sea level may increase groundwater table levels resulting in inflow, leakage or surcharge to and from building and transport infrastructure foundations, land releases and agricultural practices etc.	DCP and LEP Recycled Water Management Strategy (water balance approach).	**Plans and Policies** 41. Implement 30-year Capital Works Plan. **Community Education and Preparedness** **Physical Controls** 42. Undertake a Water Mass Balance Assessment to determine likely groundwater changes due to sea level rise. 43. Investigate the impacts of ground water rise due to climate change. 44. Collaborate with adjacent LGA's, regional water authorities such as Rous Country Council and State Government to better understand the ground water issues. 45. Collaborate with Regional water authorities on water security, including groundwater infrastructure optimisation and investigation into local borefield sites as per RCC Future Water Project 2060 and NSW Government Draft Far North Coast Regional Water Strategy.	Infrastructure Services In partnership with: NSW Government Adjacent LGA's Rous County Council
Uncertainty in decision making around coastal planning and development relating to sea level rise and coastal processes resulting in legal liability.	Coastal SEPP LEP and DCP Flood Plain Management Plans Public indemnity Insurance	**Plans and Policies** 7. Develop and implement Coastal Management Programs in accordance with the Coastal Management Manual. 8. Review and maintain Flood Plain Management Plans on a regular basis. 46. Continue to advocate for NSW Government legislative changes regarding coastal issues. **Community Education and Preparedness** 47. Inform landowners of climate change, the impacts of exacerbated coastal processes and the importance of preserving both dune and wetland vegetation. **Physical Controls** 48. Update flood models, as required, to combine joint analysis of ocean and rainfall events incorporating climate change considerations.	Sustainable Environment and Economy In partnership with: NSW Government
Loss and/or damage to Council infrastructure negatively affecting Council's ability to provide services to the community. (Relates to transport assets;	LEP and DCP Controls Coastal SEPP Floodplain Risk Management Plans Asset Management Plans Draft Sustainable Visitation Strategy	**Plans and Policies** 7. Develop and implement Coastal Management Programs in accordance with the Coastal Management Manual. 49. Finalise and implement a sustainable and resilient economic plan. **Community Education and Preparedness**	Sustainable Environmental and Economy Infrastructure Services

community and recreation facilities; water & sewer assets, public onsite sewage management systems). Impacts to private and public land use and infrastructure due to erosion, re-alignment of shores, increased flooding, inundation, wave overtopping events and salinisation, negatively affecting landholders, residents, businesses and Council. Loss and/or damage to coastal nature reserves (conservation spaces incl. foreshore vegetation); beaches; public recreational sites (passive & active); public recreational facilities; scenic amenity and public accesses, resulting in negative impacts on recreational activities, surf lifesaving activities, local economy and tourism.	Dune Care Plan	31. Finalise and implement Aboriginal Custodianship and Caring for Country workshops. 47. Inform landowners of climate change, the impacts of exacerbated coastal processes and the importance of preserving both dune and wetland vegetation. 17. Promote usage of Climate Wise Communities and Emergency Dashboard to encourage residents to develop their own emergency plan and stay informed of emergency services during extreme weather events. 18. Council staff to continue community education and awareness partnerships with community organisations and Aboriginal stakeholders, eg. Get Ready Business workshops, Community Resilience and Street Meet workshops, and Caring for Country and Aboriginal Custodianship workshops 19. Support BCRN members by providing upskilling opportunities based on areas of identified need e.g. management of spontaneous/emergency support volunteers, Psychological First Aid and disaster recovery principles and arrangements. 50. Incentivise and support local landholders to restore Priority Restoration Areas through grant-funded landholder extension and education regarding PRA map. 51. Continue to support local Dune Care and Landcare groups. **Physical Controls** 52. Undertake audit of road and other Council infrastructure at risk of increased flooding or erosion, e.g. Cassons Lane, New Brighton. 53. Undertake a vulnerability assessment of key assets and infrastructure to coastal hazards as part of preparing a CMP. 54. Undertake cost benefit analysis and plan for retreat, relocation or protection of priority assets at high risk. 55. Undertake cost-benefit of protecting marginal low-lying land versus conversion e.g. to wetland (carbon sequestration/fish habitat values). 56. Maintain a store of coastal seed in an appropriate (cooled and insect proof) facility for future use. 57. Carry out bush regeneration program on coastal reserves to maintain resilience against storm surges. 58. Continue to limit and maintain beach access tracks to prevent sand blow out and fragmentation of remnant vegetation.	In partnership with: *tender for ACCC workshops not yet awarded* NSW Government Local dune care and bush regeneration groups such as Landcare and Dune Care
Loss and/or changes to key ecosystems, negatively impacting on tree, plant and animal species, which could reduce ecosystem services such as nutrient and sediment removal from wetland, salt marsh and littoral rainforest areas. An increase in sea level may	Biodiversity Conservation Strategy LEP and DCP Controls Coastal SEPP Dune Care Plan Coastal Koala Plan of Management	**Plans and Policies** 7. Develop and implement Coastal Management Programs in accordance with the Coastal Management Manual. **Community Education and Preparedness** 31. Finalise and implement Aboriginal Custodianship and Caring for Country workshops. 50. Incentivise and support local landholders to restore Priority Restoration Areas through grant-funded landholder extension and education regarding PRA map. 51. Continue to support local Dune Care and Landcare groups. **Physical Controls**	Sustainable Environmental and Economy In partnership with: *tender for ACCC workshops not yet awarded* NSW Government Local dune care and bush regeneration groups such as

negatively impact water quality due to the salinisation (salt wedge) and inundation of coastal freshwaters / salt marshes and mangroves resulting in damage/loss to the natural environment.		57. Carry out bush regeneration program on coastal reserves to maintain resilience against storm surges. 58. Continue to limit and maintain beach access tracks to prevent sand blow out and fragmentation of remnant vegetation. 59. Plan for the migration of significant vegetation and habitat with sea level rise (minimise "coastal squeeze" through audit of physical and land use barriers).	Landcare and Dune Care

Extreme heat

Key projections –

- More frequent and intense hot days (e.g above 35°C) are projected for the east coast (including far north coast NSW) of Australia.[32,33]
- Mean, minimum and maximum temperatures are projected to increase on the far north coast of NSW.[32]

Climate change is driving longer, hotter, and more frequent extreme heat events.[32,33] Since 1960, the number of record hot days has doubled in Australia, with 33 days that exceeded 39°C recorded during 2019 alone.[3,39] Heatwaves can have major ~~health and wellbeing~~ impacts on vulnerable groups such as the elderly, children, and outdoor workers, as well as implications for health care systems, agriculture, biodiversity and infrastructure.[39]

Average annual temperatures are expected to continue rising across the North Coast NSW region over the next decade, with an increasing number of temperature extremes.[11,33] The region currently experiences an average of 10 hot days above 35ºC annually, however this is also projected to increase by up to 5 days by 2030, and up to 10 days in inland regions of the north coast of NSW.[11] Extreme heat can also drive up greenhouse gas emissions due to increasing resource and energy requirements for cooling.

How will this impact Byron Shire?

- Community health, safety and wellbeing, e.g increased risk of heatstroke, mental health issues, and even fatality in some vulnerable groups
- Pressure on public health services
- Increased water resource needs, particularly during peak tourism seasons
- Impacts on agriculture affecting crops and livestock (moved up the list)
- Animal and plant species at risk of heat stress
- Increased distribution of weeds and pests

Case Study 4 – Supporting resilient agriculture in Byron Shire

Agriculture is the predominant land use in Byron Shire, and is an important part of the local economy. It has many positive environmental outcomes when managed sustainably, such as increased soil biota and terrestrial biodiversity, soil moisture retention and drawing down carbon into soil. Byron Shire Council works closely with local landholders and farmers to promote sustainable and regenerative land use practices.

There are several actions within this Plan that aim to support our farmers, including maintaining close relationships and networks with local landholders and agribusinesses in the wider region. For example, Action 77 – *Continue to provide rural land holders with extensions services including information and resources on resilient land use practices*. By promoting a connected and sustainable farming network throughout the Shire, we can ensure our farmers are more resilient against the impacts of climate change.

What does this look like?

- Over 50 one-on-one farm site consultations with local farmers
- Creation of the Byron Farmers Network with over 240 local members
- Funding to implement over 140 hectares of regenerative grazing practices
- Ongoing sharing of resources such as workshops, grants, and farm field days

Adaptation Actions – Extreme heat

Risk	Current Controls	Adaptation Actions	Council directorate and partnerships
Increased risk to public health such as heatstroke, mental health, and loss of life within the vulnerable community.	Byron Town Centre Masterplan Mullumbimby Masterplan	**Plans and Policies** 60. Develop a Communications Plan for extreme weather events, including measures to reduce public health and safety impacts from extreme temperatures. 61. Review extreme weather protocol for people experiencing homelessness to ensure sufficient controls against extreme temperature events. 62. Develop an 'Urban Cooling Strategy'. **Community Education and Preparedness** 63. Develop partnership with NSW Health in identifying future initiatives for public health and safety. 17. Promote usage of Climate Wise Communities and Emergency Dashboard to encourage residents to develop their own emergency plan and stay informed of emergency services during extreme weather events. 18. Council staff to continue community education and awareness partnerships with community organisations and Aboriginal stakeholders, eg. Get Ready Business workshops, Community Resilience and Street Meet workshops, and Caring for Country and Aboriginal Custodianship workshops. 19. Support BCRN members by providing upskilling opportunities based on areas of identified need e.g. management of spontaneous/emergency support volunteers, Psychological First Aid and disaster recovery principles and arrangements. 64. Develop an urban heat mapping vulnerability index to inform the Climate Wise Communities website. **Physical Controls** 65. Implement landscaping from heat mapping within Byron Town Centre Masterplan. 66. Implement Stuart Street Greenspine project from Mullumbimby Masterplan and street tree plan.	Executive Team In partnership with: NSW Health BCRN
Increased water consumption on both private and public land placing a higher demand on Council service levels and resources.	Byron Recycled Water Management Strategy Water Restrictions Water Sensitive Urban Design Policy and Strategy BASIX Bulk water supply operations Strategic Business Management Plan 30-year Capital Works Plan.	**Plans and Policies** 67. Finalise draft 'Safe and Secure Water Supply Strategy' for Mullumbimby and collaborate with Rous County Council to assist implementation. **Community Education and Preparedness** 68. Continue to promote sustainable water usage through campaigns such as 'Love Water, Save Water' and other programs in partnership with Rous County Council. **Physical Controls** 45. Collaborate with Regional water authorities on water security, including groundwater infrastructure optimisation and investigation into local borefield sites as per RCC Future Water Project 2060 and NSW Government Draft Far North Coast Regional Water Strategy. 69. Undertake a water mass balance assessment of Byron Bay and Mullumbimby towns. 70. Finalise Smart Water Meter Pilot, assess findings and implement recommendations	Infrastructure Services In partnership with: Rous County Council NSW Government
Change to ecosystems resulting in threats and decline to soil biota, plant and animal species within the natural environment.	Flying Fox Camp Management Plan Biodiversity Conservation Strategy Bush Restoration Programs Coastal Koala Plan of Management Biodiversity Development Control	**Plans and Policies** 71. Identify and map wildlife corridors, refugia and Priority Restoration Areas. 72. Ensure wildlife corridors, and Priority Restoration Areas are informed by current science on climate change impacts including plant communities and species at most risk.	Sustainable Environment and Economy Infrastructure Services

	Plan	73. Update planning controls and council policy to reflect wildlife corridor, refugia and Priority Restoration Areas mapping. **Community Education and Preparedness** 31. Finalise and implement Aboriginal Custodianship and Caring for Country workshops. 50. Incentivise and support local landholders to restore Priority Restoration Areas through grant-funded landholder extension and education regarding PRA map. **Physical Controls** 74. Monitor research and development in Flying Fox camp cooling methodologies and implement findings during heat stress events.	In partnership with: *tender for ACCC workshops not yet awarded* Biodiversity Advisory Committee Landcare Bangalow Koalas
Increased risk of disrupted food security due to decreased agricultural productivity.	Sustainable Agriculture Strategy Rural Land Use Strategy Agricultural Extension Officer	**Plans and Policies** 75. Continue to implement Rural Land Use Action Plan **Community Education and Preparedness** 76. Continue to support and promote local agriculture throughout Byron Shire. 77. Continue to provide rural land holders with extension services including information and resources on resilient land use practices. 78. Continue to support local farmers markets and food producers to promote localised food security. 79. Continue to connect land holders with agricultural producers to increase uptake of agriculture on vacant land in Byron Shire. 80. Secure long term funding for the Agriculture Extension Officer position beyond current grant funding. **Physical Controls**	Sustainable Environment and Economy In partnership with: Local landholders and producers
Increased irrigation and maintenance demands for green infrastructure such as parks and reserves.	Open Space Asset Management Plan Byron Recycled Water Management Strategy Roadside Vegetation Management Plan Integrated Pest Management Strategy Mowing Regimes	**Plans and Policies** **Community Education and Preparedness** **Physical Controls** 81. Develop a business case and approve test site for park turf adaptations. 82. Adapt parks to native slow growing turf species (Zoysia) as they become more available. 83. Develop deep root growth in turf by using long, less frequent irrigation schedules.	Infrastructure Services In partnership with: Rous County Council
Increased need to retrofit existing building assets so that they remain habitable, and/or require alternative materials to be considered for new asset construction.	New assets/large capital projects constructed in accordance with appropriate building codes BASIX Net Zero Emissions Strategy and Action Plan	**Plans and Policies** **Community Education and Preparedness** 84. Increase promotion of resilient and energy efficient building design in partnership with community and government organisations. **Physical Controls** 85. Develop a business case and approve an implementation timeframe to upgrade Council administrative centres, eg. Mullumbimby Administration Centre and Depot. 86. Investigate and develop business case for Cavanbah Centre fan upgrades. 87. Lobby NSW Government for higher Sustainability Index (BASIX) standards (NSW Government Design and Place SEPP review).	Infrastructure Services Sustainable Environment and Economy

Increased fire weather –

Key projections –

- Fire risk will increase during summer and spring, with projected increases in average and severe Forest Fire Danger Index values for the far north coast of NSW.[32]
- Projected warming and drying in eastern Australia will lead to fuels that are drier and more ready-to-burn.[33]
- See also, key projections for *'Extreme heat'.*

The Forest Fire Danger Index (FFDI) is used in NSW to quantify fire weather. The FFDI combines observations of temperature, humidity and wind speed, and is classified as severe when the FFDI is above 50.[32] Fire weather is projected to increase across the North Coast NSW region, including Byron Shire, particularly in the summer months. When combined with long periods of drought, bushfire conditions are amplified.[32]

A prolonged and widespread decline in rainfall saw 2019 as the driest and hottest year on record, with 99.9% of NSW categorised as in 'drought' and 54.2% categorised as 'intense drought'.[40,41] This culminated in a longer fire season and the unprecedented Black Summer Fires which continued into 2020.[40] The severity and extent of the Black Summer Bushfire season has never been seen before, and is now attributed to a combination of effects brought on by a changing climate.[42,43,44]

How will this impact Byron Shire?

- Risk to public safety, e.g reduced air quality, injury, or loss of life
- Loss or damage to natural ecosystems
- Impacts on agriculture affecting crops and livestock (moved up in list)
- Loss or damage to residential property and infrastructure
- Pressure on emergency responses and resources

Case Study 5 - What is an Asset Protection Zone (APZ)?

An APZ is an identified area between a built asset such as residential property, and bushfire-prone vegetation such as nature reserves. APZ parameters are defined by the Rural Fire Service (RFS) and are used to ensure that there is an appropriate buffer zone to minimise the transfer of fire between the asset and the bushfire fuel. The aim of an APZ is to minimise the risk of damage to property or infrastructure in the event of a bushfire and are used by Council as development controls.

To maintain APZ's on Council-managed lands, Council works with RFS and Fire and Emergency Services to carry out bushfire fuel reduction and modification work as required. This can include both fuel reduction burns as well as manual modification of vegetation to minimise bushfire risk to surrounding residential areas.

Adaptation Actions – Increased Fire Weather

Risk	Current Controls	Adaptation Actions	Council Directorate and Partnerships
Increased public health and safety risks within the community, such as injury, reduced air quality due to smoke, loss of life, and / or ongoing trauma. Loss and/or damage to private property including residential and businesses due to fire, fallen trees, accidents due to smoke reducing visibility levels. Inability to deliver critical services to the high risk, vulnerable and isolated members of the community.	Far North Coast Bushfire Management Plan Ocean Shores Bushfire Mitigation Plan Fire Management Plan for Reserves at Ocean Shores Promote/share Emergency Services notices WHS Systems Flexible working arrangements Local Emergency Management Plan and Officer Fire Trail Management Program Local Area Recovery Plan Extreme Weather Protocol	**Plans and Policies** 88. Prepare and resource implementation of Bushfire Fuel Management Plans for Council owned and managed lands in the north of the Shire. 89. Review Ocean Shores Bushfire Mitigation Plan. 90. Continue audit of Asset Protection Zones (APZ) for Ocean Shores and implement recommended actions. Engage consultant to apply APZ audit to other fire prone Council managed land. **Community Education and Preparedness** 17. Promote usage of Climate Wise Communities and Emergency Dashboard to encourage residents to develop their own emergency plan and stay informed of emergency services during extreme weather events. 18. Council staff to continue community education and awareness partnerships with community organisations and Aboriginal stakeholders, eg. Get Ready Business workshops, Community Resilience and Street Meet workshops, and Caring for Country and Aboriginal Custodianship workshops 19. Support BCRN members by providing upskilling opportunities based on areas of identified need e.g. management of spontaneous/emergency support volunteers, Psychological First Aid and disaster recovery principles and arrangements. 91. Secure long-term funding of Disaster Resilience Officer and continue Byron Community Resilience Networks projects. **Physical Controls** 92. Continue manual fuel reduction/modification with Council bush regeneration team and local Aboriginal organisations. 93. Carry out fire trail maintenance works with NPWS. 94. Continue to assist residents with fuel reduction burns in partnership with RFS/NSW F&R/NPWS. 95. Council staff with a role in bushfire management to receive regular training updates including Bushfire Risk Information Management Systems (BRIMS) training and attendance at relevant fire management and fire ecology conferences and workshops.	Corporate and Community Services Infrastructure Services In partnership with: Byron Community Resilience Network Red Cross State Emergency Services Rural Fire Service NSW Fire & Rescue NSW Police Far North Coast Bushfire Committee Tweed/Byron Local Aboriginal Land Council Landcare NSW National Parks and Wildlife Services
Changes to the natural environment resulting in an increased risk to ecosystems.	Biodiversity Conservation Strategy Biodiversity DCP planning controls	**Plans and Policies** 71. Identify and map wildlife corridors, refugia and Priority Restoration Areas (PRA). 72. Ensure wildlife corridors and PRA's are informed by current science on climate change impacts including plant communities and species at most risk. 96. Update planting lists to identify species likely to be adaptable to climate change. 97. Identify open forest ecosystems requiring restoration through the reintroduction of fire. **Community Education and Preparedness** 31. Finalise and implement Aboriginal Custodianship and Caring for Country workshops.	Sustainable Environment and Economy Infrastructure Services In partnership with: *tender for ACCC workshops not yet awarded* Biodiversity Advisory Committee Landcare Bangalow Koalas

		50. Incentivise and support local landholders to restore Priority Restoration Areas through grant-funded landholder extension and education regarding PRA map. **Physical Controls** 34. Continue bush regeneration works and assess future need for additional staff. Bush regeneration works to emphasise importance of canopy re-establishment to minimise harm from weather fluctuations.	Northern Rivers Fire and Biodiversity Consortium
Increased negative public perception of the risks of trees and bushland on public and private land, resulting in increased requests to clear trees or illegal clearing of trees.	Biodiversity Conservation Strategy Biodiversity DCP Planning Controls	**Plans and Policies** **Community Education and Preparedness** 18. Council staff to continue community education and awareness partnerships with community organisations and Aboriginal stakeholders, eg. Get Ready Business workshops, Community Resilience and Street Meet workshops, and Caring for Country and Aboriginal Custodianship workshops. 98. Support the work of the Northern Rivers Fire and Biodiversity Consortium. 99. Develop and adopt a bushfire information brochure to accompany a Development Consent package – include bushfire buffer planting guidance from Biodiversity DCP, and education about how planned fire in open forest can help conserve biodiversity and improve bush fire safety. **Physical Controls** 	Corporate and Community Services Sustainable Environment and Economy In partnership with: Northern Rivers Fire and Biodiversity Consortium RFS NSW Fire & Rescue Far North Coast Bushfire Committee Landcare
Increased demand for use of Council facilities as refuges and for access to utilities which may lead to public health and safety issues.	Local Area Emergency Officer on the various Emergency Committees Community Resilience Network Disaster Dashboard Extreme Weather Protocol Local Emergency Management Plan and Officer Local Area Recovery Plan	**Plans and Policies** **Community Education and Preparedness** 17. Promote usage of Climate Wise Communities and Emergency Dashboard to encourage residents to develop their own emergency plan and stay informed of emergency services during extreme weather events. 18. Council staff to continue community education and awareness partnerships with community organisations and Aboriginal stakeholders, eg. Get Ready Business workshops, Community Resilience and Street Meet workshops, and Caring for Country and Aboriginal Custodianship workshops. 19. Support Byron Community Resilience Network (BCRN) members by providing upskilling opportunities based on areas of identified need e.g. management of spontaneous/emergency support volunteers, Psychological First Aid and disaster recovery principles and arrangements. **Physical Controls** 100. Audit Council's Evacuation and Recovery Centres and utilities to assess capability of handling increased demand to maintain public health and safety, and implement recommendations.	Infrastructure Services Corporate and Community Services In partnership with: Byron Community Resilience Network State Emergency Services NSW Police NSW Fire & Rescue RFS Red Cross North Coast Bushfire Committee

5.4 What can you do to be prepared and improve community resilience?

Find out what severe weather events your neighbourhood could be at risk of and make a plan –

Visit our Climate Wise Communities webpage and explore the risks to your area by using the Ready Check. You can then make an emergency plan so you and your family are prepared before and during a severe weather event.

Image - Climate wise

Know where to access emergency information –

Explore our Emergency Dashboard and bookmark to your browser for ease of access. You will find up-to-date information from Council, BOM, Emergency Services and combat agencies all in one place during severe weather events.

Image - Emergency Dashboard

Other simple actions you can take at home –

- **Know your neighbour** – increase your resilience by building relationships and networks within your local community. Keep an eye on our website for upcoming workshops and street meets in your area.

- **Join a local community group** – there are many throughout the shire that can teach you new skills in resilience, land management, or local food security. For severe weather events, the NSW State Emergency Service (SES) or Rural Fire Service (RFS) are at the forefront of emergency response and are always looking for local volunteers**.**

- **Make simple changes to lower your carbon footprint** – head to our Sustainable Living webpage to explore the ways you can reduce your greenhouse gas emissions.

- **Learn about resilient building design** - there are many actions you can take to ensure your home stays cool during heatwaves, and is protected against the elements during severe weather events.

6.0 Appendices

Appendix 1 – 100 Adaptation Actions

Adaptation Actions	Timeline	Budget Considerations	Council Directorate
1. Review Leachate Management Plan to ensure inclusion of Climate Change impacts.	2022-23	Staff time	IS
2. Review the Stormwater Management Plan for the Byron Resource Recovery Centre.	2022-23	Staff time	IS
3. Create an inventory in consultation with Department of Primary Industry and Environment (DPIE) Crown Lands of any known former landfills and their attributes (eg. lined/unlined, proximity to sensitive environment/populations). Inventory to rank the landfills as high/med/low in terms of priority for investigating risks to the environment (in general) and from climate change impacts.	2022-23	Staff time/ future budget required	IS
4. Develop strategies to mitigate closed landfill sites risks, e.g. if all leachate has been found to migrate from a site, then the expensive exercise of retrofitting liners/leachate collection will not be of benefit; however stabilising embankments of adjacent waterways and natural drainage lines and revegetation programs may offer the best cost-benefit/environmental outcomes/resilience against climate change impacts.	2023-24	Staff time/future budget required	IS
5. Review contaminated land Geographic Information Systems (GIS) mapping layers to ensure completeness and availability of further information.	2023-24	Staff time	IS
6. Implement the Environmental Management System for all known landfill sites and resource recovery centre (to track EPA, licence conditions etc).	2022-23	Staff time/future budget required	IS

7. Develop and implement Coastal Management Programs (CMP) in accordance with Coastal Management Manual.	In progress/ongoing 2021-25	Staff time/future budget required	SEE
8. Review and maintain Flood Plain Management Plans on a regular basis.	2022-25 / as required	Staff time	IS
9. Inform landowners of climate change, the impacts of exacerbated coastal processes and the importance of preserving both dune and wetland vegetation.	Ongoing	Staff time	SEE
10. Incentivise private land owners to protect and restore wetland and suitable areas for migration.	Ongoing	Staff time	SEE
11. Periodically review and amend Entrance Opening Strategies with consideration of: a) pending updated coastal hazard assessment, b) outcomes of climate change on groundwater studies, and c) ongoing updates to State policy for ICOLL management.	In progress/ongoing	Staff time	SEE
12. Develop and periodically review Emergency Action Sub Plan as part of CMP.	2022-25	Staff time/future budget required	IS
13. Develop overland flow path studies for Byron Shire's urban areas.	2025-26	Staff time/future budget required	IS
14. Include OP Activity for infrastructure repairs and clean up as required after flood events.	As required	Future budget required	IS
15. Carry out grant-funded road infrastructure repairs following severe rainfall events e.g Ocean Shores, New Brighton, South Golden Beach.	As required. Ocean Shores in progress.	Grant funded	IS
16. Further review of current planning controls for flood affected land in line with NSW Government SEPP Planning for Natural Hazards (currently open for review).	As required	Staff time	SEE

17. Promote usage of Climate Wise Communities and Emergency Dashboard to encourage residents to develop their own emergency plan and stay informed of emergency services during extreme weather events.	In progress / ongoing	Staff time/grant funded	CCS/IS
18. Council staff to continue community education and awareness partnerships with community organisations and Aboriginal stakeholders, eg. Get Ready Business workshops, Community Resilience and Street Meet workshops and Caring for Country and Aboriginal Custodianship workshops.	In progress / ongoing Workshops 2022-23	Staff time/grant funded	CCS
19. Support Byron Community Resilience Network (BCRN) members by providing upskilling opportunities based on areas of identified need e.g. management of spontaneous/emergency support volunteers, Psychological First Aid and disaster recovery principles and arrangements.	In progress / ongoing	Staff time/grant funded	CCS
20. Provide staff training in emergency preparedness in partnership with Emergency Services and collaborate with Emergency Services where needed for recovery efforts.	As required	Staff time/ future budget may be required	Executive Team
21. Finalise Capital Works Renewal Program (CWNP) for the Shire's Stormwater Network (2016-2046).	Ongoing	Future budget required	IS
22. Investigate installation of a generator for alternate power supply for the South Golden Beach flood pump.	2024-25	Future budget required	IS
23. Ensure any future flood pumps have an alternate power supply.	2024-25	Future budget required	IS
24. Promote workshops and information on preparing for flood and other disasters from Local Land Services	Ongoing	Staff time	SEE
25. Secure long-term funding of Agricultural Extension Officer beyond current grant funding.	2023-24	Future budget/grant funding required	SEE
26. Promote the use of the Emergency Dashboard to assist in stock and produce movement before critical flood levels effect distribution.	As required	Staff time	SEE

27. Identify nutrient, sediment and bacterial sources and implement actions to reduce inputs from diffuse and point sources (agricultural, urban and industrial sources) in accordance with Marine Estate Management Authority (MEMA) Strategy and CMP.	2022-25	Staff time/future budget required	SEE
28. Extend the current Water Quality Monitoring System to include the Brunswick Catchment.	2022-23	Future budget required	SEE
29. Continue to implement the BSC Beach Watch Sampling Program.	Ongoing	Staff time/budget allocated	SEE
30. Implement BSC Integrated Pest Management Strategy.	2022-23	Future budget required	SEE
31. Finalise and implement Aboriginal Custodianship and Caring for Country workshops.	In progress 2021-22	Grant funded	CCS
32. Partner with community organisations such as Landcare, North Coast Local Land Services, and Rous County Council to improve community capacity to identify and manage invasive species.	Ongoing	Staff time	SEE
33. Continue to provide rural land holders with extension services including information and resources on resilient land use practices.	Ongoing	Staff time/grant funded	SEE
34. Continue bush regeneration works and assess future need for additional staff. Bush regeneration works to emphasise importance of canopy re-establishment to minimise harm from weather fluctuations.	Ongoing	Staff time/future budget may be required	IS
35. Continue urban planning maps and DCP controls for mosquito habitat zones.	Ongoing	Staff time	SEE
36. Continue Tackling Mosquitos Together campaign aimed at reducing the disease risks of mosquitoes in the Northern Rivers through community education.	In progress 2021-22	Staff time / budget allocated	SEE
37. Ongoing monitoring and sampling in accordance with Mosquito Management Plan.	Ongoing	Staff time/budget allocated	SEE

38. Implement enhanced Disaster Recovery Facility for Information Technology.	Phase 1 – complete Phase 2 –In progress Phase 3 – 2023-24	Staff time/ budget allocated	CCS
39. Transition to cloud based computing.	Phase 1 – complete Phase 2 –In progress Phase 3 – 2023-24	Staff time/budget allocated	CCS
40. Ongoing staff training in IMS (to ensure staff are prepared) and continuous improvement of the software.	Ongoing	Staff time	CCS/IS
41. Implement 30-year Capital Works Plan (2016-2046)	In progress/ongoing	Staff time/future budget required	IS
42. Undertake a Water Mass Balance Assessment to determine likely groundwater changes due to sea level rise.	2024-25	Future budget required	IS
43. Investigate the impacts of ground water rise due to climate change.	2024-25	Staff time	IS
44. Collaborate with adjacent LGA's, regional water authorities such as Rous Country Council and State Government to better understand the ground water issues.	2024-25	Staff time	IS
45. Collaborate with Regional water authorities on water security, including groundwater infrastructure optimisation and investigation into local borefield sites as per RCC Future Water Project 2060 and NSW Government Draft Far North Coast Regional Water Strategy.	2024-25	Staff time	IS
46. Continue to advocate for NSW Government legislative changes regarding coastal issues.	Ongoing	Staff time	SEE
47. Inform landowners of climate change, the impacts of exacerbated coastal processes and the importance of preserving both dune and wetland vegetation.	Ongoing	Staff time	SEE
48. Update flood models, as required, to combine joint analysis of ocean and rainfall events incorporating climate change considerations.	Ongoing	Staff time	IS
49. Finalise and implement a sustainable and resilient economic plan.	In progress / ongoing	Staff time/budget allocated	SEE

50. Incentivise and support local landholders to restore Priority Restoration Areas through grant-funded landholder extension and education regarding PRA map.	Ongoing	Staff time/grant funding	SEE
51. Continue to support local Dune Care and Landcare groups.	Ongoing	Staff time	SEE/IS
52. Undertake audit of road and other Council infrastructure at risk of increased flooding or erosion, e.g. Cassons Lane, New Brighton.	2022-25	Staff time/future budget required	IS
53. Undertake a vulnerability assessment of key assets and infrastructure to coastal hazards as part of preparing a CMP.	2022-25	Staff time/future budget required	SEE/IS
54. Undertake cost benefit analysis and plan for retreat, relocation or protection of priority assets at high risk.	2022-25	Staff time/future budget required	SEE/IS
55. Undertake cost-benefit of protecting marginal low-lying land versus conversion e.g. to wetland (carbon sequestration/fish habitat values).	2022-25	Staff time/future budget required	SEE/IS
56. Maintain a store of coastal seed in an appropriate (cooled and insect proof) facility for future use.	Ongoing	Future budget required	SEE
57. Carry out bush regeneration program on coastal reserves to maintain resilience against storm surges.	Ongoing	Staff time/future budget required	SEE/IS
58. Continue to limit and maintain beach access tracks to prevent sand blow out and fragmentation of remnant vegetation.	In progress / as required	Staff time/budget allocated	SEE/IS
59. Plan for the migration of significant vegetation and habitat with sea level rise (minimise "coastal squeeze" through audit of physical and land use barriers).	2021-25	Staff time/future budget required	SEE

60. Develop a Communications Plan for extreme weather events, including measures to reduce public health and safety impacts from extreme temperatures.	2022-23	Staff time	Executive Team
61. Review extreme weather protocol for people experiencing homelessness to ensure sufficient controls against extreme temperature events.	In progress	Staff time/grant funded	CCS
62. Develop an 'Urban Cooling Strategy'.	2022-25	Staff time/future budget required)	SEE
63. Develop partnership with NSW Health in identifying future initiatives for public health and safety.	2022-23	Staff time	SEE/CCS
64. Develop an urban heat mapping vulnerability index to inform the Climate Wise Communities website.	2022-25	Staff time/future budget required	IS
65. Implement landscaping from heat mapping within Byron Town Centre Masterplan.	2022-25	Staff time/grant funded/budget allocated	IS/SEE
66. Implement Stuart Street Greenspine project from Mullumbimby Masterplan and street tree plan.	2022-23	Staff time/grant funded/budget allocated	IS/SEE
67. Finalise draft 'Safe and Secure Water Supply Strategy' for Mullumbimby and collaborate with Rous County Council to assist implementation.	In progress	Staff time/budget allocated	IS
68. Continue to promote sustainable water usage through campaigns such as 'Love Water, Save Water' and other programs in partnership with Rous County Council.	Ongoing / as required	Staff time	IS
69. Undertake a water mass balance assessment of Byron Bay and Mullumbimby towns.	2024-25	Staff time/future budget required	IS
70. Finalise Smart Water Meter Pilot, assess findings and implement recommendations	Pilot in progress. Implement recommendations	Staff time/budget allocated	IS

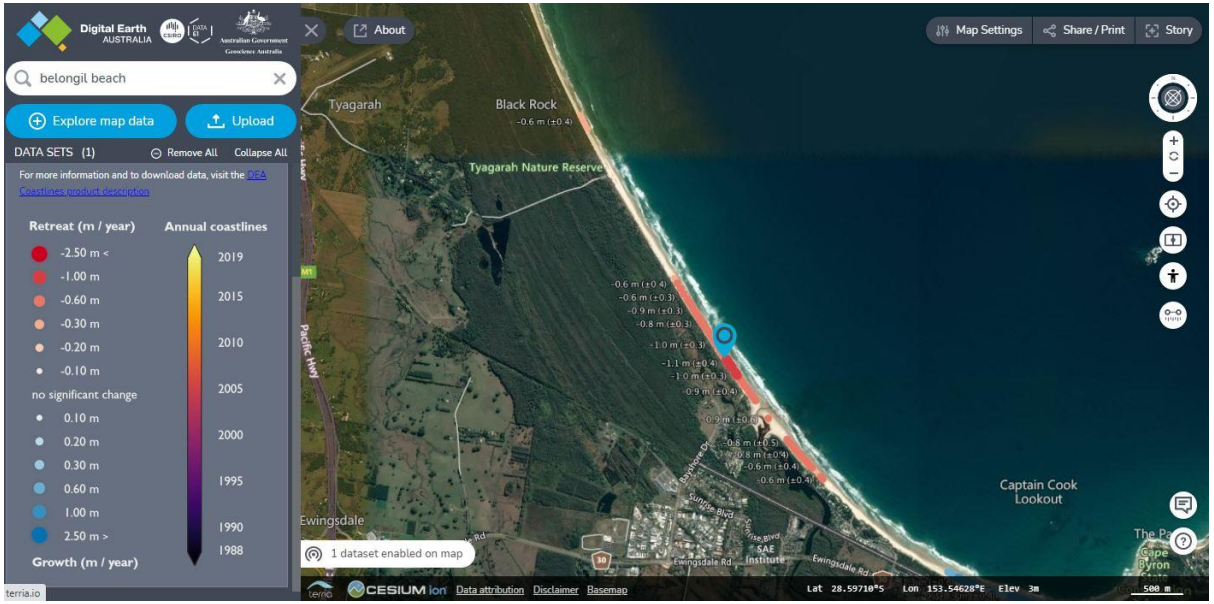
	2021-22		
71. Identify and map wildlife corridors, refugia and Priority Restoration Areas.	2021-22	Staff time/future budget required	SEE
72. Ensure wildlife corridors, and Priority Restoration Areas are informed by current science on climate change impacts including plant communities and species at most risk.	2012-22	Staff time	SEE
73. Update planning controls and council policy to reflect wildlife corridor, refugia and Priority Restoration Areas mapping.	2022-23	Staff time	SEE
74. Monitor research and development in Flying Fox camp cooling methodologies and implement findings during heat stress events.	Ongoing / triggered during heat stress event	Staff time	SEE
75. Continue to implement Rural Land Use Action Plan	In progress	Staff time/budget allocated	SEE
76. Continue to support and promote local agriculture throughout Byron Shire.	Ongoing	Staff time	SEE
77. Continue to provide rural land holders with extension services including information and resources on resilient land use practices.	Ongoing	Staff time	SEE
78. Continue to support local farmers markets and food producers to promote localised food security.	Ongoing	Staff time	SEE
79. Continue to connect land holders with agricultural producers to increase uptake of agriculture on vacant land in Byron Shire.	Ongoing	Staff time	SEE
80. Secure long term funding for the Agriculture Extension Officer position beyond current grant funding.	2022-23	Future budget required	SEE
81. Develop a business case and approve test site for park turf adaptations.	2021-22	Staff time	IS

82. Adapt parks to native slow growing turf species (Zoysia) as they become more available.	2022-23	Future budget required	IS
83. Develop deep root growth in turf by using long, less frequent irrigation schedules.	2022-23	Staff time	IS
84. Increase promotion of resilient and energy efficient building design in partnership with community and government organisations.	Ongoing	Staff time	SEE
85. Develop a business case and approve an implementation timeframe to upgrade Council administrative centres, eg. Mullumbimby Administration Centre and Depot.	2022-23	Staff time/future budget required	IS/SEE
86. Investigate and develop business case for Cavanbah Centre fan upgrades.	2022-23	Staff time/future budget required	IS/SEE
87. Lobby NSW Government for higher Sustainability Index (BASIX) standards (NSW Government Design and Place SEPP review).	Ongoing	Staff time	SEE
88. Prepare and resource implementation of Bushfire Fuel Management Plans for Council owned and managed lands in the north of the Shire.	2022-25	Staff time/future budget required	IS
89. Review Ocean Shores Bushfire Mitigation Plan.	2022-23	Staff time	IS
90. Continue audit of Asset Protection Zones (APZ) for Ocean Shores and implement recommended actions. Engage consultant to apply APZ audit to other fire prone Council managed land.	In progress	Staff time/budget allocated/future budget also required	IS
91. Secure long-term funding of Disaster Resilience Officer and continue Byron Community Resilience Networks projects.	2022-23	Future budget required	CCS
92. Continue manual fuel reduction/modification with Council bush regeneration team and local Aboriginal organisations.	In progress / as required	Staff time/budget allocated	IS

93. Carry out fire trail maintenance works with NPWS.	As required	Staff time/budget allocated	IS
94. Continue to assist residents with fuel reduction burns in partnership with RFS/NSW F&R/NPWS.	As required	Staff time	IS
95. Council staff with a role in bushfire management to receive regular training updates including Bushfire Risk Information Management Systems (BRIMS) training and attendance at relevant fire management and fire ecology conferences and workshops.	As required	Staff time	IS/SEE
96. Update planting lists to identify species likely to be adaptable to climate change.	2022-23	Staff time	SEE/IS
97. Identify open forest ecosystems requiring restoration through the reintroduction of fire.	2022-25	Staff time	SEE/IS
98. Support the work of the Northern Rivers Fire and Biodiversity Consortium.	Ongoing	Staff time	SEE/IS
99. Develop and adopt a bushfire information brochure to accompany a Development Consent package – include bushfire buffer planting guidance from Biodiversity DCP, and education about how planned fire in open forest can help conserve biodiversity and improve bush fire safety.	2022-23	Staff time	SEE/IS
100. Audit Council's Evacuation and Recovery Centres and utilities to assess capability of handling increased demand to maintain public health and safety, and implement recommendations.	In progress	Staff time/grant funded	CCS/IS

Appendix 2 – Belongil Beach shoreline retreat since 1988. Source: [Geoscience Australia and CSIRO]

This map shows an annual shoreline retreat of between 0.6 metres and 1.1 metres (+/-0.3 metres) since 1988 along parts of Belongil Beach.



Appendix 3 –

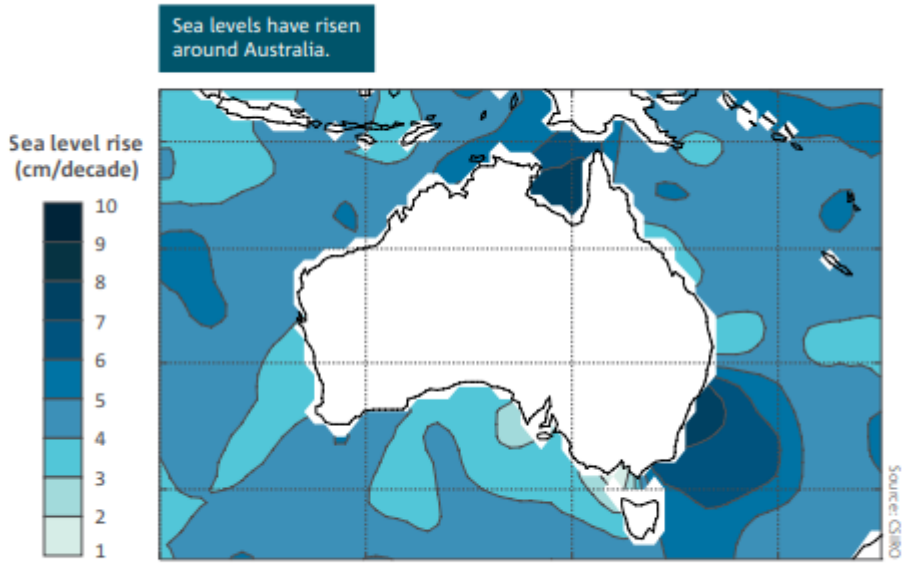
a) Summary of North Coast NSW NARCliM projection parameters. Source: Adapt NSW

Climate variable (average across the region)	Trend	Projections	
		Near future (2030)	Far future (2070)
Atmospheric CO_2	Increase	A2 IPCC emissions scenario	
Max. temperature	Increase	0.4 – 1.0°C	1.5 – 2.4°C
Min. temperature	Increase	0.5 – 1.0°C	1.6 – 2.5°C
Hot days	Increase	0 – 5 days (Richmond Valley – 5 –10 days)	3 – 12 days (Richmond Valley – 10 – 20 days)
Cold nights	Decrease	0 – 20 days	0 – over 30 days
Heatwaves	Increase (frequency)	0.9 – 1.5 events	2.5 – 4.5 events
	Increase (intensity [a])	1.5 – 7.5°C²	3 – 15°C²
	Increase (duration)	0.5 – 2.5 days	3 – 9 days
Annual rainfall [b]	Drying & wetting	–8% to +11%	–6% to +31%
Changes in average rainfall by season [b]	Drying & wetting	Summer: –17% to +14%	Summer: –10% to +39%
		Autumn: –9% to +37%	Autumn: –8% to +39%
		Winter: –40% to +30%	Winter: –35% to +38%
		Spring: –18% to +25%	Spring: –18% to +49%

[a] Amplitude is the hottest day of the hottest heatwave of the year. Units are °C² because it is the product of two temperature anomalies.

[b] Negative values represent drying and positive values represent wetting under projections for annual rainfall and seasonality rainfall. Source: Office of Environment and Heritage (2014).

b) Sea level rise in Australia (cm/decade). Source: CSIRO



The rate of sea level rise around Australia measured using satellite altimetry, from 1993 to 2019.

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