

DRAFT:

BURKE SHIRE COUNCIL

Resilient Coast - Resilient Gulf
Coastal Hazard Adaptation Strategy



An aerial photograph of a landscape featuring a winding river, a large forested island, and a road with a building. The image is overlaid with a blue gradient and a colorful diagonal stripe in the top left corner.

Acknowledgement to Country

We acknowledge the Traditional Owners of the Burke Shire, the Gangalidda Garawa and the Waanyi people and their elders past, present and emerging.

Resilient Coast - Resilient Gulf: Summary

Situated on the southern shoreline of the Gulf of Carpentaria, the Shire of Burke has around 250 km of coastline. Extensive mangrove forests, vast salt pans, estuaries, beaches, rocky shores, large seagrass beds, reefs and other marine areas typify the landscape. The powerful rivers of the region drain to these areas, with increasingly anastomosing channels as they flow towards the coast. The southern gulf coast is home to a thriving ecosystem with healthy populations of sea turtles, dugongs, crocodiles, and shorebirds.

The Burke Shire area is the ancient and traditional home of the Gangalidda Garawa and Waanyi peoples and their connection to the land and sea spans many thousands of years. The coastal areas form an integral part of the Traditional Owners' identity and way of life.

Burketown is the main township in the Shire positioned along the Albert River. Subject to flooding from both the catchment and coast, town residents can experience extended periods of isolation, particularly in the wet season. This Strategy aims to guide council towards increasing resilience for Burketown and the wider coastal zone of Burke Shire.

Coastlines are dynamic, ever-changing with each tide and storm event. Erosion and flooding by sea water (also referred to as storm tide inundation) are natural processes that has shaped and will continue to shape the coast into the future.

These processes are referred to as coastal hazards when they impact on how we use and enjoy the coast. The Burke Shire coast is prone to coastal hazard impacts, driven by tropical cyclones, and the annual summer monsoon season. Coastal hazard impacts are predicted to increase with a changing climate and rising sea levels.



The Queensland Government and the Local Government Association of Queensland (LGAQ) provided funding to Queensland coastal councils to develop a strategic long-term approach to managing coastal hazards. With the funding awarded to Burke Shire Council, we have been able to develop this Coastal Hazard Adaptation Strategy – Resilient Coast – Resilient Gulf.

The Resilient Coast - Resilient Gulf Strategy enables us to be better prepared in the future to reduce the negative impacts of coastal hazards on our communities, environment, cultural values, infrastructure, liveability and essential services. This Strategy is designed to benefit the community both now and into the future (to 2100) so that our children and their children can maintain way of life and their connection to Land and Sea Country.



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1. Introduction

1.1 Our coastline

Situated on the southern shoreline of the Gulf of Carpentaria, the Burke Shire coast spans about 250 km. The Gulf of Carpentaria is dominated by a broad, low-gradient basin, bordered in the north by shallow sills. A broad shelf sits to the north of the coast of Burke Shire, with a large sand bank between the coast and the Wellesley Islands. The Gulf has been repeatedly submerged and exposed by fluctuating sea levels over the last 1 million years. These sea level changes resulted in the environment changing from open ocean to isolated basins and lakes, to exposed terrestrial environments.

Extensive mangrove forests, vast salt pans, estuaries, beaches, rocky shores, large seagrass beds, reefs and other marine areas typify the landscape. Coastal vegetation is mainly comprised of mangroves, saline grasslands and saltmarsh communities. With low population density, vegetation in the coastal zone is largely undisturbed. However, extensive mangrove dieback has been observed in recent years.

The landscape has been shaped through the millennia by natural processes involving the wind, water and waves. The continual cycles of sand loss (erosion) and rebuilding (accretion) of the shoreline, and flooding of coastal areas by sea water and king tides, are all part of these natural processes. These processes are referred to as coastal hazards when they have the potential to impact on infrastructure, access, services, our lifestyle, culture and the economy.

The Burke Shire is the traditional home of the Gangalidda Garrawa and Waanyi Peoples for many thousands of years. In more recent history, Australian settlers introduced cattle grazing and mining along with other modern economic enterprises. While there is a history of conflict between the Indigenous people and white settlers, today, Burke Shire provides an example of coexistence and cooperation.

The coastal landscape has significant cultural, social and economic significance for the local community, who value the protection and sustainability of the Land and Sea Country.



Figure 1. Burke Shire Council LGA.

Tourism and its associated businesses is important to the Burke Shire economy and is highly dependent on healthy coastal ecosystems. Visitors travel to the region to experience the pristine environment, diverse wildlife and world-renowned fishing. Aboriginal cultural experiences such as those provided by Yagurli Tours are also a major draw for visitors. The estimated value of tourism to the region is around \$2.4 million per annum and is an important contribution to the region's economy (BSC 2021b).

1. Introduction (cont.)

1.2 A Strategy for the future

Context

The QCoast₂₁₀₀ program is a state-wide initiative of the Queensland Government and Local Government Association of Queensland (LGAQ). Its purpose is to help coastal councils proactively plan for managing coastal hazard impacts, from present day to 2100.

The Burke Shire Council was awarded funding through the QCoast2100 program to establish the Resilient Coast – Resilient Gulf Strategy and develop a locally specific Coastal Hazard Adaptation Strategy (CHAS).

The Resilient Coast – Resilient Gulf Strategy (the Strategy) has been:

- developed to proactively manage the impact of coastal hazards for our future generations
- developed in close consultation with Council, Traditional Owner groups, and local stakeholders and community members
- tailored to include the whole coastal landscape and community.

Purpose

The purpose of the **Resilient Coast – Resilient Gulf** Strategy (and Coastal Hazard Adaptation Strategy) is to:

- inform future decisions regarding the protection and management of our coast and foreshore areas
- inform future land use and master planning
- guide the management of public utilities, facilities and services such as water supply, wastewater, roads and boat ramps
- inform the management of areas of environmental and cultural significance
- foster collaboration and the shared custodianship of our coastline.

How we developed the Strategy

The **Resilient Coast – Resilient Gulf** has been developed using a specific process outlined in the QCoast₂₁₀₀ Minimum Standards and Guidelines¹ (Figure 2).

The process has included a series of technical studies and activities that sought to:

- identify coastal hazard areas
- understand vulnerabilities and risks to local community assets and infrastructure (e.g. roads and boat ramps)
- engage with the community to understand their preferred approach to managing coastal hazards, known as adaptation
- determine adaptation actions, costs, priorities, and timeframes for implementation.



Figure 2. QCoast₂₁₀₀ process for developing a Coastal Hazard Adaptation Strategy.

¹(LGAQ and DEHP 2016)

1. Introduction (cont.)

1.3 Listening to the community

The **Resilient Coast – Resilient Gulf** Strategy has been informed by many conversations with community leaders and key stakeholder groups over a period of nearly 12 months in 2020-2021.

Many engagement activities were undertaken during the development of the Plan including:

- targeted conversations with Councillors, Traditional Owners, community leaders and business owners
- multiple workshops and project updates with key council staff
- guided site visit around Burketown with local Elders and council staff
- community listening and pop-up events in April 2021 at Nidinja Durlga Community Hall
- a four week public exhibition period in May 2021.

The engagement activities and events were supported with a project specific web site <https://www.burke.qld.gov.au/coastal-hazard-adaptation-strategy>, regular project updates as well as a series of tailored fact sheets relevant to coastal hazard adaptation.

The fact sheets are provided as Supplement A to this Strategy. The fact sheets include:

- Factsheet 1 Coastal landscapes, hazards and adaptation
- Factsheet 2: Coastal hazards
- Factsheet 3: How can we adapt?
- Factsheet 4: The role of economics
- Factsheet 5: Resilient homes

Local radio, as well as Council's website and social media pages were used to publicise specific events, share information, and encourage participation.



1. Introduction (cont.)

1.4 What information is in the Strategy

The Strategy includes an overview of:

- coastal features that are important and meaningful to the local community (values)
- a description of the types of coastal hazards that may be experienced in the Burke Shire area including areas that may be exposed in the future to erosion and flooding by sea water (or tidal inundation)
- the implications of this exposure (risk) including potential cultural, environmental and economic impacts
- Council's approach to managing these impacts and details on how the Council and community can adapt to future coastal hazards, including a framework for shared responsibilities, adaptation responses and options
- Shire-wide adaptation actions
- specific adaptation actions for Burketown
- a plan for implementation and continual review and improvement.

2. A vision for a resilient coast

During the development of the Strategy, the community were invited to:

- identify why the coast was important to them
- what their vision was for a resilient coast
- what issues were currently a cause for concern.

This information provides that foundation of the Strategy, ensuring that the values and needs of the local community lie at the heart of future management and investment.

2.1 What is a resilient coast?

The coastline experiences constant, and often rapid change. Wind, waves, tides and currents continually work to move sand and sediment to shape the shoreline. Extreme weather events such as tropical cyclones can periodically result in significant erosion and flooding by sea water. **When these processes threaten local values, properties, or our local way of life, they can be considered coastal hazards.**

A resilient coast has social, economic and environmental strategies in place to avoid, and reduce the impact of hazardous events or disturbances (e.g. coastal hazards). These strategies are discussed in Section 4. Caring for our coastal areas and keeping them clean and healthy increases the natural resilience of our coast. Understanding natural processes helps to avoid and reduce exposure to coastal hazards, making our community safer and more resilient.

Resilience also means the ability for the coastal areas to respond to or reorganise in ways that maintain natural processes and the values of the region, while also being able to proactively adapt to change.

2.2 What the community values about their coastline

The rich and diverse community and landscape of the Burke Shire supports a number of interrelated values. Values are those aspects that the local community has identified as being important and meaningful to their lifestyle and wellbeing.

The coastal values identified in Burke shire include:

- A pristine coastal environment
- Access fishing grounds, cultural and natural sites
- Traditional fishing and hunting activities at sea and country
- Grow the tourism economy and promote sustainable forms of visitation
- Live with nature and allow water to move across seasons
- Observe and monitor shorelines and waterways movements and the changing water landscape



Resilience

Resilience is the ability for something to withstand stress and continue to function and recover from damage. Resilience applies to the coastal environment as well as the community. Resilience happens when coastal ecosystems are clean and healthy, and when the community is prepared and safe for coastal hazards.



3. What are coastal hazards?

Coastal hazards include temporary flooding of low-lying coastal land (storm tide inundation), and / or erosion of the shoreline (both short-term and long-term).

Inundation and erosion are natural processes that contribute to shaping the unique landforms of our coast. However, when these processes have an adverse impact on communities, infrastructure and some natural assets, they are considered coastal hazards. In the Burke Shire area, major coastal hazard impacts are typically associated with monsoon weather patterns and tropical cyclones. Cyclones generate large storm tides causing temporary flooding and potentially isolating communities for extended periods of time. Projected sea level rise will lead to more frequent inundation events as well as increase the extent of tidally affected areas.

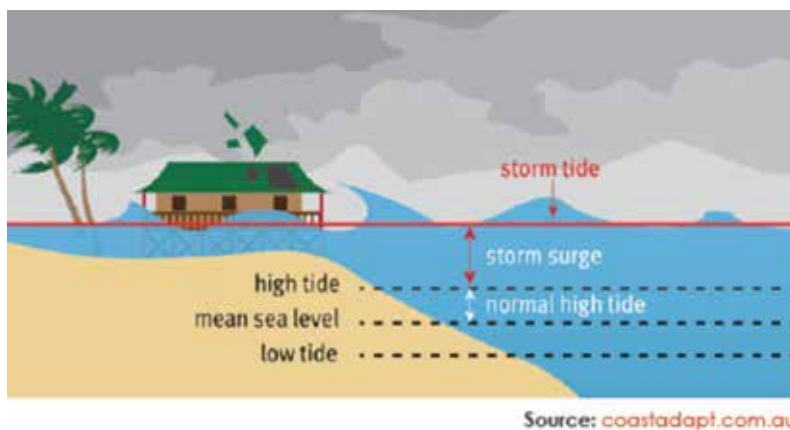


Coastal hazards

Coastal hazards are when natural coastal processes threaten local values, properties, or our local way of life. Some coastal hazards include storm tide inundation, erosion, and tidal inundation.

3.1 Storm tide inundation

Storm tide inundation is the temporary flooding of low-lying coastal land from a locally raised sea level (the 'storm tide'). The storm tide is a combination of the normal tide, storm surge, and wave action (Figure 3). Storm surge is driven by the low atmospheric pressure and high winds associated with events such as tropical cyclones.



Source: coastadapt.com.au

Figure 3. Components of storm tide (Source: coastadapt.com.au).



Storm tide inundation

Storm tide inundation is when big storms cause temporarily higher water levels leading to flooding of normally dry land. Storm tide inundation is often accompanied by big waves and strong winds which together can cause widespread destruction.

3. What are coastal hazards? (cont.)

3.2 Coastal erosion

Coastlines naturally erode and accrete periodically over time, driven by sediment supply, tidal currents and waves.



Erosion

Erosion is when coastal forces such as waves, winds, tides and currents remove sand from the beach or soil and sand from the riverbanks. This can cause the shoreline position and riverbanks to move landwards. Big erosion events can threaten buildings, roads and important cultural areas.

3. What are coastal hazards? (cont.)

Short-term erosion

Coastal erosion occurs when winds, waves and coastal currents take sand away from the shoreline. This can be a temporary change, often associated with storm activity (termed storm bite), and the beach will then gradually rebuild (Figure 4).

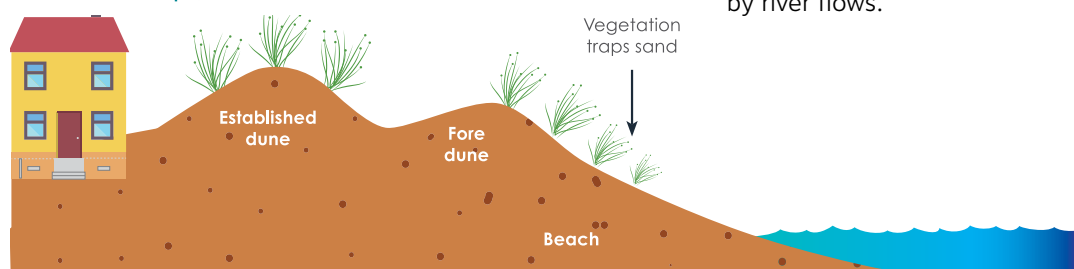
When a beach is stable, all the sand moved offshore during a storm eventually moves back onto the beach (potentially taking months to years). In this case, short-term beach erosion does not result in a long-term landward movement of the shoreline.

Long-term erosion

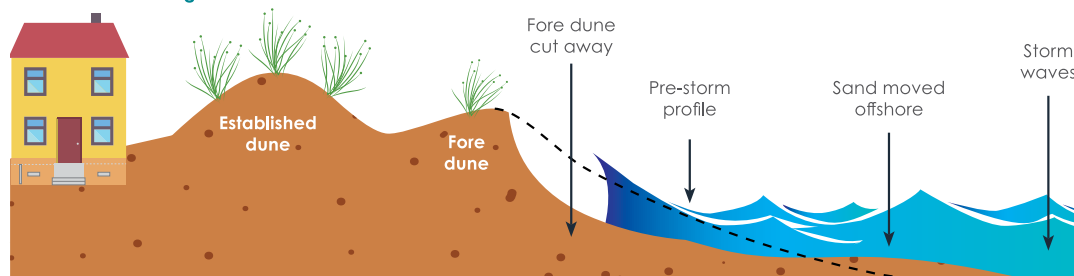
In other cases, due to changing sediment supply or climate conditions, the beach may not be able to rebuild between storm events. Without intervening, long term erosion (termed recession) may occur, which is the landward movement of the shoreline over a longer timeframe (decades).

Both short term and long-term erosion processes may impact on coastal assets, depending on how close to the shoreline assets are located. Most of the open coast within the Burke Shire is undeveloped with little to no permanent built assets. Therefore the natural cycles of erosion and accretion of the beaches occur without posing a hazard. There are some instances of riverbank erosion near Burketown however this is generally caused by river flows.

Normal beach shape, calm conditions



Beach erosion during storm



Beach and dune repair after storm

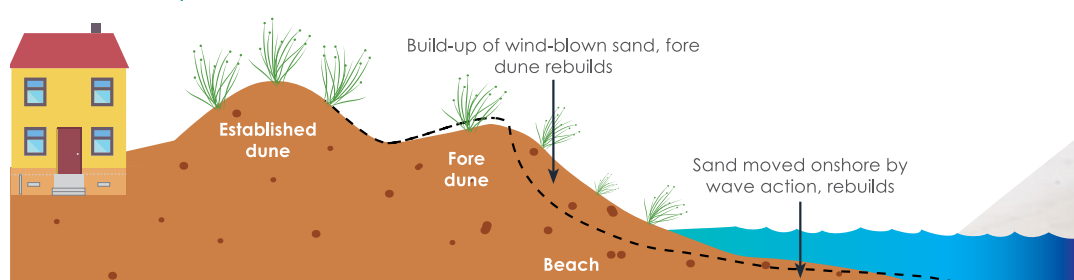


Figure 4. Natural short-term erosion and dune rebuilding process.

3. What are coastal hazards? (cont.)

3.3 Tidal inundation due to sea level rise

Tidal inundation is regular flooding from the tidal cycle, including up to the Highest Astronomical Tide (HAT). Very high tides, also known as king tides, can impact low lying areas. This can lead to increased damage especially if a king tide coincides with a cyclone or other storm. Areas of low-lying coastal land will experience increasing tidal inundation with sea level rise. A 0.8 m sea level rise by 2100 is currently planned for by the Queensland State Government.



Tidal inundation

Tidal inundation is when normal astronomical tides cause flooding of low-lying coastal land. Areas exposed to tidal inundation are expected to periodically flood. With global average sea levels expected to rise, areas effected by tidal inundation are also expected to increase.

3. What are coastal hazards? (cont.)

3.4 Current and future exposure

Updated mapping

The Burke Shire coastline occasionally experiences cyclone and storm events which can cause erosion and inundation. King tides can also cause flooding of low lying land. Coastal hazard impacts are predicted to increase with a changing climate and rising sea levels.

As part of the **Resilient Coast – Resilient Gulf** Strategy, hazard mapping has been completed for multiple planning horizons (present day, 2050 and 2100) and event probabilities selected by Burke Shire Council for the CHAS process. The hazards mapped include:

- **Storm tide inundation:** data from the Gulf of Carpentaria Storm Tide and Inundation Study (GHD 2013) was used to create maps for the Burketown area.
- **Erosion prone area / Tidal areas:** the combined area of the Highest Astronomical Tide plus a defined horizontal buffer, plus any additional area inundated due to sea level rise were mapped for the Burketown area.

As required by the Queensland Government, a projected sea level rise of 0.8 m by 2100 has been adopted for the **Resilient Coast – Resilient Gulf Strategy** (with 0.3 m by 2050).

Planning horizons

Mapping for both tidal areas and storm tide inundation includes multiple planning timeframes or horizons. Different event likelihoods² were mapped for storm tide inundation (Table 1).

Table 1. Likelihood of occurrence scenarios for storm tide mapping

Likelihood of occurrence	Hazard AEP	Planning horizons
Very likely	HAT	Present-day, 2050, 2100
Likely	2%	Present-day, 2050, 2100
Possible	1%	Present-day, 2050, 2100
Rare	0.5%	Present-day, 2050, 2100

Maps of the 2100 1% AEP are provided in Supplement B to the Strategy.

² Likelihoods are defined by Annual Exceedance Probabilities (AEPs) which indicate the probability that an event will occur in any given year.



Likelihoods

Likelihoods are words to describe how common or rare an event is. Likely events are expected to happen regularly and multiple times within the average lifespan. Possible events are expected to happen every so often and a few times in the average lifespan. Rare events are unusual and might occur once or twice in the average lifespan.

AEP

Annual Exceedance Probability, or AEP, is the likelihood that certain conditions will occur in a given year. AEP values are based on computational modelling that considers measured coastal data and multiple thousands of simulated scenarios.

Planning horizons

Planning horizons are points in the future for which strategic decisions are made. This Strategy considers planning horizons of present day (2021), 2050, and 2100.

Storm tide inundation zones and erosion prone/tidal areas do not represent a predicted loss of coastal land. The maps provide an indication of areas that may be exposed to erosion or inundation processes (now or in the future), and in many cases the impacts can be avoided, minimised or managed through adaptation planning.

Additional detail on the mapped components and the approach is provided in the Phase 3 summary report (BSC 2020a).

3. What are coastal hazards? (cont.)

3.5 Potential impacts on the Burke Shire

How we identified potential impacts

Coastal hazards have the potential to negatively impact Burke Shire communities, infrastructure, essential community services such as water supply, and our lifestyle today and long into the future.

As part of the **Resilient Coast – Resilient Gulf Strategy**, technical assessments have been used to determine the coastal hazard risk for a range of assets that exist in the communities. Risk is the possibility of loss, damage, or injury. In a coastal context, risk arises from exposure to coastal hazards such as storm tide inundation, and erosion. Risk can be measured by considering both the likelihood and consequence of loss, damage, or injury.

The risk assessment has included analysis of:

- data on infrastructure assets (drainage, sewerage, electricity, telecommunications, stormwater, water supply, and roads)
- information on homes and other buildings (e.g. building type, material, and indicative floor level)
- coastal protection structures such as sea walls and other beach and foreshore assets such as boat ramps
- cultural heritage sites and sites of cultural and historical significance
- the Burke Shire Planning Scheme

FUTURE IMPACTS

Projected sea level rise and an increase in cyclone intensity for the Queensland coastline is anticipated to increase the extent and impact of coastal hazards.

Coastal erosion:

- Increased water levels will accelerate coastal erosion
- Sediment transport patterns may be altered by shifts in wave direction, triggering changes to the form and location of shorelines
- Low-lying land may be permanently inundated
- Increased cyclone and storm activity will escalate the severity of coastal erosion events

Storm tide inundation:

- Sea level rise will increase the apparent severity and frequency of storm tide inundation and will cause inundation to occur further inland
- Increased cyclone and storm intensity will add to the magnitude of storm tide events and the extent of inundation.

Source: Coastal Hazard Technical Guideline (DEHP 2013)

3. What are coastal hazards? (cont.)

Risk is assessed based on the likelihood of an asset being exposed to a coastal hazard, combined with the consequence of that exposure (**Table 2**) (BSC 2020c)

Table 2. Risk matrix

		Consequence				
		Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood	Likely 10% AEP	Low	Medium	High	Very high	Very high
	Possible 1% AEP	Low	Medium	Medium	High	Very high
	Rare 0.2% AEP	Low	Low	Medium	Medium	High

A tailored approach to assessing consequence was developed, based on community feedback on the important elements for the coastal zone (lifestyle, coastal access, public safety, environmental values, cultural landscapes, property and infrastructure, and economy and growth) (Table 3).

To complete the risk assessment:

- The likelihood of exposure (likely, possible, rare) was determined for each asset / land parcel, separately for erosion and inundation
- The consequence of exposure (insignificant, minor, moderate, major, catastrophic) was determined for each asset / land parcel, separately for erosion and inundation
- Coastal hazard risk was assessed (low, medium, high, very high), based on the likelihood and consequence for each asset / land parcel, separately for erosion and inundation.

3. What are coastal hazards? (cont.)

	Place and planning and sustainability			Community and lifestyle		Environment
Consequence	Property and infrastructure	Economy and growth	Public safety	Lifestyle	Traditional Owner values	Environmental values
Catastrophic	Widespread major damage or loss of property or infrastructure with total value >\$25 million. Full recovery/repair may take many years.	Regional economic decline, widespread business failure and impacts on state economy.	Loss of lives and/or permanent disabilities. permanent disabilities.	Widespread semi-permanent impact (~1year) to highly utilised community services, wellbeing, or culture of the community with no suitable alternatives.	Severe and widespread, permanent impact on multiple sites of indigenous significance, including loss of land, connection to land, and ability to continue traditional practices. Recovery unlikely.	Severe and widespread, permanent impact on multiple regionally or nationally significant ecosystem services and natural features of the region. Recovery unlikely.
Major	Major damage or loss of property or infrastructure with total value >\$10 million. Full recovery/repair may take several years.	Lasting downturn of local economy with isolated business failures and major impacts on regional economy.	Widespread serious injuries/ illnesses.	Major widespread long-term (~1 month) disruption to well-utilised services, wellbeing, or culture of the community with very few alternatives available.	Severe and widespread semi-permanent impact on one or more sites of indigenous significance, including loss of land, connection to land, and ability to continue traditional practices. Full recovery may take many years.	Severe and widespread semi-permanent impact on one or more regionally or nationally significant ecosystem services and natural features of the region. Full recovery may take many years.
Moderate	Moderate - major damage to property or infrastructure with total value >\$1 million. Full recovery may take less than 1 year.	Significant impacts on local economy and minor impacts on regional economy.	Isolated serious injuries/ illnesses and/or multiple minor injuries/ illnesses.	Minor medium- to long-term (~1 week) or major short-term disruption to moderately utilised services, wellbeing, or culture of the community with limited alternatives.	Substantial impact on one or more sites of local indigenous significance. Full recovery may take several years.	Substantial impact on one or more locally significant ecosystem services and natural features of the region. Full recovery may take several years.

3. What are coastal hazards? (cont.)

	Place and planning and sustainability			Community and lifestyle		Environment
Consequence	Property and infrastructure	Economy and growth	Public safety	Lifestyle	Traditional Owner values	Environmental values
Minor	Minor damage to properties or infrastructure with total value >\$200,000.	Individually significant but isolated impacts on local economy.	Minor and isolated injuries and illnesses.	Small to medium short-term disruption (~1 day) to moderately utilised services, wellbeing, finances, or culture of the community with some alternatives available, or more lengthy disruption of infrequently utilised services.	Small, contained and reversible short-term impact on sites of indigenous significance. Full recovery may take less than 1 year.	Small, contained and reversible short-term impact on isolated ecosystem services and natural features of the region. Full recovery may take less than 1 year.
Insignificant	Minimal damage to properties or infrastructure with total value >\$50,000.	Minor short-term impact on local economy.	Negligible injuries or illnesses.	Very small short-term disruption (~1 hour) to services, wellbeing, finances, or culture of the community with numerous.	Little to no impact to sites of indigenous significance.	Little to no environmental impact.

4. How can we adapt to future coastal hazards?

4.1 Framework for adaptation

A strategic approach

managers are taking a strategic approach to managing the risk of coastal hazards and enhancing the resilience of our coastal zones.

Common elements of this strategic approach include:

- Identifying adaptation objectives that align and support community values, goals and aspirations.
- Assigning a strategic adaptation response to different localities, to guide decision making with a pathways approach across present day, intermediate and 2100 planning horizons.
- Assessing the range of adaptation options suitable in different locations to help avoid, mitigate, and manage the risk of coastal hazards.
- Developing a strategic plan (this document) for coastal adaptation, with prioritised actions over a 5–10 year timeframe.

A tailored approach has been developed to guide decision making on adaptation response and options across the Burke Shire coastal zone with additional focus on Burketown.



Adaptation

Adaptation is adjusting to actual or expected conditions and events. Adaptation can have good or bad outcomes and should be guided by understanding the desired state of being. Good adaptation to coastal hazards means taking action to reduce risk and increase resilience.

4. How can we adapt to future coastal hazards? (cont.)

Adaptation objectives

The purpose of clarifying adaption objectives is to help guide an appropriate adaptation response, and to screen adaptation options, across different localities.

Objectives for the Resilient Coast – Resilient Gulf Strategy, were informed by consultation with stakeholders and the community, include to:

- Maintain a pristine coastal environment
- Maintain boating access to fishing grounds, cultural and natural sites
- Allow for traditional fishing and hunting activities at sea and country
- Continue connection and access to places of spiritual and cultural significance
- Grow the tourism economy and promote sustainable forms of visitation
- Live with nature and allow water to move across seasons
- Observe and monitor shorelines and waterways movements and the changing water landscape
- Homes and buildings are strong and safe during cyclones and storms
- There is genuine collaboration within the community and with external groups in managing natural resources and in improving resilience
- The youth is aware and involved and understands coastal hazards and risks

These objectives provide a reference for considering the suitability of different coastal hazard adaptation options across Burke Shire.



4. How can we adapt to future coastal hazards? (cont.)

Adaptation response

The tailored framework for the **Resilient Coast – Resilient Gulf Strategy** includes four adaptation responses – Avoid, Monitor, Mitigate, and Transition (Table 4)

A general adaptation response was determined for two management areas – Burketown, and other coastal areas – for each time frame (planning horizon) (Table 5). This helps to determine the appropriate approach for each area.

Avoid

The general first principle is to avoid placing new development or built assets in coastal hazard areas. The preference is to develop (or transition over time) land use in coastal hazard areas to locations with lower risk for coastal hazard impacts, while allowing for uses that maximise economic, cultural, social and environmental value to region. Any new development or infrastructure in coastal hazard areas must be in accord with local and State Planning Policy and approvals requirements and include necessary mitigation measures.

It is also important to avoid creating new risks or increasing existing ones. Maintaining infrastructure in good condition and protecting coastal areas from future harm will increase the natural resilience and help to avoid or delay the need for more active management.

Monitor

At localities where the coastal hazard risk profile is low, the adaptation response is to monitor risk by observing changes and regularly reviewing what these changes mean in terms of changing risk – look and learn. Best practice is to undertake maintenance/asset management activities and continue active stewardship of the coastal zone. Where these observations suggest an increased risk (as indicated by local trigger levels), then the adaptation response may change to mitigate.

Continuing to collect and record data on hazards, assets, culturally significant sites and places, and places of high environmental value will help to grow knowledge and inform future decisions.

Mitigate

At localities where coastal hazard risks have been identified, the adaptation response is to proactively manage the risk through implementing a range of adaptation options. Adaptation options will be tailored to each locality, incorporating site-specific processes, community input, and statutory planning considerations. If, over time, the risk profile is observed to increase (as indicated by local trigger levels), and active management becomes infeasible (due to economic or other factors), then the adaptation response may shift to transition requiring a change in land use or relocation of assets.

Transition

In some specific areas within a locality, if the coastal hazard risk profile is very high, and mitigation becomes infeasible (due to economic or other factors), a strategic decision may be made in consultation with the local community to transition to an alternative land use. Transition is likely to be a gradual process over time, where mitigating hazards for a period is part of the transition process. A range of adaptation options will be part of the transition process.

4. How can we adapt to future coastal hazards? (cont.)

Table 4. Adaptation responses for Burke Shire

Adaptation response		Coastal hazard adaption		
	Avoid	Monitor	Mitigate	Transition
	Avoid placing new development or assets in coastal hazard areas.	Monitor the risk of coastal hazards. Monitor until local trigger levels are reached to initiate mitigation.	Actively mitigate the risk of coastal hazards through a range of adaptation options. Mitigate until local trigger levels are reached to initiate transition.	A strategic decision to transition to an alternative land-use in some areas. Mitigation may be part of the transition process.
Adaptation options		Monitoring and initiatives to enhance adaptive capacity	Full range of adaptation options Table 6	

Table 5. Adaptation response for each NPA community

Management area	2020	2050	2100	Comments
Burketown	Monitor	Mitigate	Mitigate	Monitor the impact of future storm tides and king tides level on the township. Area is already exposed to large scale river floods.
Other coastal areas*	Monitor	Monitor	Mitigate	Monitor the impact of future storm tides and king tides level on rural areas and natural areas outside of Burketown, in particular around areas of cultural interest, fishing, hunting and gathering and tourism areas.

4. How can we adapt to future coastal hazards? (cont.)

Table 6. Adaptation options by theme

Theme	Adaptation options	Description	Supplement C summary sheet number
Shire-wide initiatives to enhance adaptive capacity	Community stewardship	Developing programs and partnerships to enhance stewardship of the coastline	Sheet 1
	Knowledge sharing	Facilitating knowledge sharing and education on hazards and adaptation	Sheet 2
	Monitoring	Monitoring changes in coastal hazard risk and effectiveness of adaptation	Sheet 3
	Research	Strengthen research collaborations with Universities and research organisations in exploring coastal hazards and future adaptation	NA
Planning updates	Land use planning	Informing statutory planning and strategic plans, including consideration of land purchase or land swap/relocation	Sheet 4
	Disaster management	Updating emergency response planning	
	Early warning systems	Early warning systems for erosion and storm tide inundation	
Maintaining and improving existing infrastructure	Increase infrastructure resilience	Modifying critical infrastructure (e.g., raising floor levels) Modifying drainage networks Building resilient homes	Sheet 5
	Resilient homes	Build homes following resilience guidelines and requirements	
	Relocate infrastructure	Relocating critical infrastructure	
Coastal management and engineering	Nature-based foreshore protection and maintenance	Minimising riverbanks disturbance, maintaining riparian vegetation	Sheet 6
	Last line of defence structures	Rock and revetments and riverbank protection and stabilisation to reduce the risk and impact	Sheet 7
	Structures to minimise inundation	Consider the potential for the construction of levees to protect the town from tidal floods	Sheet 8

4. How can we adapt to future coastal hazards? (cont.)

4.2 Determining adaptation actions

A range of adaptation actions have been identified to enable a strategic approach to coastal hazard adaptation across the Burke Shire and to ensure we achieve the goals and aspirations of the community (Section 2.3). A suite of priority actions across the five themes (Table 6) have been defined for the greater Burke Shire coastal region as well as specific actions for Burketown as part of the adaptation response pathway.

The following sections (Sections 5, 6) provide an overview of the shire-wide actions, as well as the actions for Burketown. Actions identified for present day should be considered priority with an aim to be implemented in the next 5 – 10 years.

The program of priority actions for each location has been informed by a suite of decision making processes and tools. The decision making process for determining recommended adaptation options for the Resilient Coast – Resilient Gulf Strategy is illustrated in Figure 8

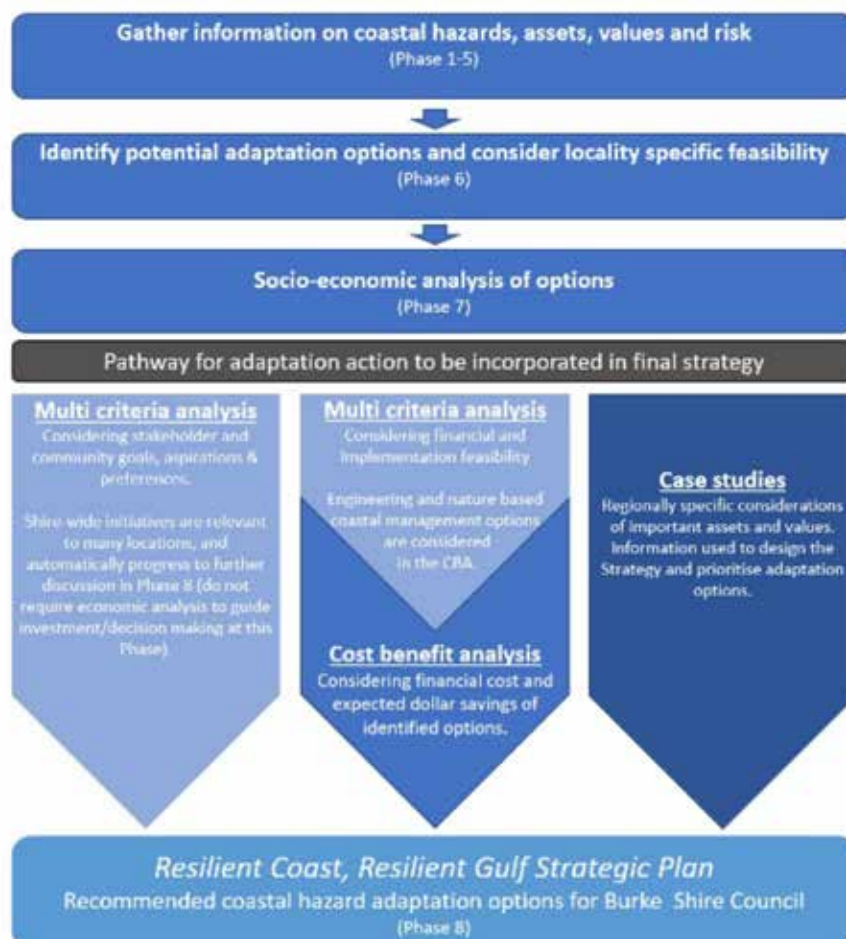


Figure 5. Decision making process for the identification of final adaptation options for Burke Shire.

4. How can we adapt to future coastal hazards? (cont.)

Multi Criteria Analysis

effectiveness of each action in achieving the adaptation objectives as well as general feasibility for the Burke Shire region. This process enabled the identification of some actions that were subject to further economic analysis. It also shows that some actions if implemented would provide good value to the Burke Shire community and help to achieve the adaptation objectives.

Supporting case studies

Two case studies were also used to consider in more detail the importance of certain assets in achieving the adaptation objectives. Information from these case studies helps to justify certain adaptation options that might not have been financially feasible.

CASE STUDY:

Resilient homes in Burketown

The first case study examined the importance of resilient homes in Burketown.

A potential response to manage coastal hazard risk and the associated building damages is to invest in upgrading existing structures to increase building resilience. This does not reduce the likelihood that a building may be flooded. However, through simple modification to the building (such as using waterproof internal wall materials), the disruption and costs of future flood events can be much lower. This type of approach has previously been used for flood-prone structures and results in less damage and disruption from a flood event.

The Queensland Reconstruction Authority (QRA) provides some indicative costs for improving existing homes so that they are more resilient to flooding (QRA, 2019). The economic viability of resilient homes is largely a function of the expected frequency and magnitude of the flood events.

CASE STUDY:

Early warning systems

The establishment of a reliable early warning system for coastal hazards would assist Burke Shire residents in making early preparations to safeguard themselves and their assets.

Currently, the Bureau of Meteorology (BOM) is responsible for issuing warnings for events such as bushfires, floods, and tropical storms. The Burketown Airport weather station provides a 7-day weather forecasts for Burketown (Bureau of Meteorology, 2021b). BOM issues warnings to residents 1-4 days prior to potential inundation events originating from the Nicholson River Flood Watch Area of which Burketown is located, however, there are no early warnings system in place for the Albert River or coastal hazards such as storm tide inundation or coastal erosion (Bureau of Meteorology, 2021a).

Another BOM tool available is the MetEye web application, which provides accessible and more detailed information on rainfall and thunderstorm severity.

The Queensland Reconstruction Authority is working with the BOM and local communities across North West Queensland to develop the Flood Warning Infrastructure Network project which aims to establish flood warning infrastructure across high-risk areas such as Burke (Queensland Reconstruction Authority, 2020)

4. How can we adapt to future coastal hazards? (cont.)

Combining these decision making tools

These tools were used together to determine a recommended program of actions that meets the needs of the Burke Shire communities and aim to effectively accomplish the adaptation objectives of the Strategy.

Actions across capacity building, monitoring and land use planning are the core focus for Burke Shire.

Baseline actions of coastal and river ecosystems protection and monitoring, including weed control, are key for enhancing community resilience.

The promotion of sustainable forms of tourism, including guided visits to natural and cultural sites, will also represent an opportunity to support the local economy, improve community cohesion and to build networks with external visitors, which will contribute to the general resilience of the community.

Effective collaborative frameworks between Council, the Carpentaria Land Council Aboriginal Corporation and regional Natural Resource Management organisations will be a key to implement conservation programs and to improve natural resources resilience.

There is currently not a strong financial case or community support for structural (engineering) adaptation options in present day, however, some structural options may become economically viable over time as the risk continues to increase. Results may also change over time and should be the subject of future Strategic Plan reviews and updates.



5. Shire-wide adaptation actions

The Resilient Coast – Resilient Gulf Strategy priority actions across the Shire include a range of actions relevant to the five themes identified for the plan:

- Council-wide initiatives to enhance stewardship and monitoring
- Planning updates
- Maintaining and improving infrastructure
- Nature based coastal management
- Coastal engineering.

Priority 5 – 10 year actions for each of these themes are summarised in the tables below, with some additional information available in Supplement C. Adaptation response and actions specific to each locality are provided in the location summaries.

Theme	Strategic action no.	Description	2021 Priority strategic actions (completed within 5 – 10 years)
1. Shire wide initiatives to enhance adaptive capacity	1.1. Community stewardship	Develop programs and partnerships to enhance stewardship of the coast and riverbanks	1.1.1 Assign coastal management work program to relevant council area/staff 1.1.2 Seek co-funding / resources for further initiatives through grants and stakeholder partnerships for CHAS related initiatives, including landcare grants, Queensland Reconstruction Authority grants (QRRRF) and other state and federal grants. 1.1.3 Establish collaborative partnership in coastal hazard management with Carpentaria Land Council Aboriginal Corporation (CLCAC), Southern Gulf NRM and Northern Gulf NRM 1.1.5 Promote coastal hazard education in schools in collaboration with external partners and providers (e.g. CLCAC and others)
	1.2. Knowledge sharing	Facilitate knowledge sharing and education on hazards and adaptation. Knowledge sharing includes collaborative partnerships.	1.2.1 Identify networks / forums for knowledge sharing (internal and external), including opportunities to share information with Carpentaria Shire Council 1.2.3 Facilitate training for staff in coastal resilience management 1.2.4 Promote cross-sector partnerships and initiatives to enhance resilience and strategic adaptation for tourism. 1.2.5 Support research collaborations with Universities and research organisations through partnerships (e.g. Arc Linkage, NESP funding) 1.2.6 Support research in catchment management and its impact on coastal vulnerability (e.g. impact of water quality on vegetation; land loss and erosion in the catchment related to land use)

5. Shire-wide adaptation actions (cont.)

Theme	Strategic action no.	Description	2021 Priority strategic actions (completed within 5 – 10 years)
1. Shire wide initiatives to enhance adaptive capacity	1.3. Monitoring	Monitor changes in coastal hazard risk and effectiveness of adaptation	1.3.1 Establish partnership with CLCAC to monitor shorelines and the impact of erosion and inundation. 1.3.2 Establish partnership with Delta Downs and CLCAC to support monitoring the risk of saltwater intrusion into pastoral land and water bodies 1.3.3 Establish a shoreline and beach condition monitoring system at Karumba Point, led by Council staff 1.3.4 Establish a foreshore and riverbank condition monitoring system in collaboration with CLCAC rangers 1.3.5 Expand and support the CLCAC shoreline monitoring program with georeferenced photo points to monitor erosion and land loss to sea inundation 1.3.6 Expand and support the CLCAC marine pollution reduction program to maintain healthy marine vegetation to reduce erosion impacts
	1.4 Research	Strengthen research collaborations with Universities and research organisations in exploring coastal hazards and future adaptation	1.4.1 Establish collaboration with key universities and research centres to progress suitable actions in the Strategy 1.4.2 Apply for collaborative government funding grants for relevant actions
2. Planning updates	2.1. Land use and strategic planning	Use the outcomes of the CHAS to inform statutory planning and other strategic plans.	2.1.1 All planning matters undertaken by Council to incorporate and have regard to the new coastal hazard information presented in the Coastal Hazard Adaptation Strategy 2.1.2 Consider implications (within Council) of the Strategy for future development approvals and conditions including: - approval conditions for lots of un-developed land with existing approvals - implications for future development approvals and conditions. 2.1.3 For the next scheduled Planning Scheme update, use the updated Erosion Prone Area and storm tide inundation extent and outcomes of the Strategy to inform decisions on development areas and strategic land use planning.

5. Shire-wide adaptation actions (cont.)

Theme	Strategic action no.	Description	2021 Priority strategic actions (completed within 5 – 10 years)
2. Planning updates	2.2. Disaster management	Update emergency response planning.	2.2.1 Use the updated Erosion Prone Area and storm tide mapping, assets exposure and risk assessment to update the Burke Shire Local Disaster Management Plan.
	2.3 Early warning systems	Early warning systems for erosion and storm tide inundation.	2.3.1 Investigate potential use of early warning system service using up-to-date technologies (e.g. EWN/ Weatherzone) 2.3.2 Provide early warning training to the Burke community using updated technologies (e.g. organise community resilience day, use social media) 2.3.3 Prepare new Storm Tide Guide and guidance for residents
3. Modifying infrastructure	3. 1. Resilient infrastructure	Modifying critical infrastructure (e.g., raising levels)	3.1.1 Review at risk infrastructure (from the Strategy data outputs) and embed risks into current asset management plans. This could include 'betterment' at critical asset refurbishment/ renewals points. Linked to 3.2.1 3.1.2 Review of road renewals and upgrades (prioritisation). Linked to 3.2.1 3.1.3 Consult with utility providers on future services and upgrades and implications of coastal hazard areas. 3.1.4 Consider developing specific coastal hazard overlay code in future planning updates. Linked to action 2.1
	3.2 Resilient homes	Build homes following resilience guidelines and requirements	3.2.1 Integrate resilient homes criteria in the planning approvals procedures 3.2.2 Promote resilient homes within the community and building sector (link in with knowledge sharing initiatives) 3.2.3 Consider developing specific coastal hazard overlay code in future planning updates. Linked to action 2.1
	3.2. Relocate infrastructure	Relocate critical infrastructure	3.2.1 When updating asset management plans, consider the long term (2100) coastal hazard risk, and consider options for relocation if needed Linked to 3.1.1 & 3.1.2.

5. Shire-wide adaptation actions (cont.)

Theme	Strategic action no.	Description	2021 Priority strategic actions (completed within 5 – 10 years)
4. Coastal management and engineering	4.1. Nature based foreshore protection and maintenance	Minimise riverbank disturbance, maintain riparian vegetation.	4.1.1. Create pilot riparian vegetation protection and maintenance programs at specific locations in collaboration with CLCAC 4.1.2 Extend riparian vegetation protection and maintenance program to all relevant locations 4.1.3 Continue and expand the rubber vine eradication program along tidal waterways and riverbanks
	4.2 Last line of defence structures	Rock and revetments and riverbank protection and stabilisation to reduce the risk and impact of tidal erosion.	4.2.1 Monitor erosion areas at key sites along rivers and waterways and design triggers for intervention 4.2.2 Identify possible funding sources to implement works if triggered
	4.3 Structures to minimise inundation	Consider the potential for the construction of levees to protect the town from tidal floods.	4.3.1 Identify funding sources for preliminary feasibility study 4.3.2 Monitor inundation risk and create triggers

6. Burketown

6.1 Coastal landscape

The main Burke Shire township of Burketown lies along the banks of the Albert River about 30 km from the Gulf of Carpentaria coast. Most of the town has a relatively low elevation and is very flat. Flooding from the surrounding rivers as well as from elevated sea levels due to storm surge periodically cut off access into town. The population of about 225 people are accustomed to these periods of isolation and have developed community resilience to these events.

Key local values

Locals in Burketown value the remoteness of their community, their connection to the land and their culture. Key local values identified during this project include a pristine coastal environment to be accessed and sustainably harvested; maintain and support the local pastoral economy; promote sustainable tourism and create economic and social opportunities for the community from cultural and natural tourism and visitations; live with nature and water, rather than trying to control its force; provide safe housing and infrastructure for the community in case of natural disasters.



Figure 6. Map of Burketown and surrounding area

6. Burketown (cont.)

6.2 Potential impacts from coastal hazards

Exposure

Burketown is currently exposed to storm tide inundation. This exposure is expected to increase by 2100. Exposure to tidal inundation, while presently impacting minimal assets is expected to increase by 2100.

Risk

55%. Other zones such as commercial and industrial areas are at lower risk at present day, however are still expected to see a substantial increase in area at medium risk with commercial zones increasing from 9% to 89% and industrial zones from 6% to 83%.

The airport land is currently not at risk for the 1% AEP event, but it has 77% of land at risk by 2100. Electrical generation utilities, currently not exposed, will increase to 89% exposed to the 1% AEP event by 2100. The risk to Burketown State School, the sewage treatment plant and the water treatment plant will also increase over time, with most of their area being affected by 2100.

Under a sea level rise scenario predicted for 2100, all of the township's dwellings will be exposed to large storm tide inundation events with an increase from today's 31 buildings at medium risk to 102 buildings at medium risk and 35 at high risk.



6. Burketown (cont.)

Overview of key assets and values at risk

Asset Name	Issue	Opportunity for adaptation
Wastewater treatment plant	Risk of overland flow and ponding of water	Overland flow risk may be managed by local earthworks and drainage channel, with appropriate scour protection to mitigate erosion
Water supply system	Risk of overland flow and ponding of water	Overland flow risk may be managed by local earthworks and drainage channel, with appropriate scour protection to mitigate erosion
Main bridge – Albert River	The location of the bridge means it will be affected by coastal, tidal, storm tide and flood processes	The most recent upgrades to the bridge are expected to have followed appropriate design guidance and hydraulic modelling to verify its performance in extreme conditions. Further assessment of climate change impacts would be subject to additional modelling and design calculations
China wall	The location of the causeway means it will be affected by coastal, tidal, storm tide and flood processes	Typical low-cost options such as levee banks and one-way return valves may not be sufficient to keep the roadway trafficable during the monsoon and high water levels. Other options such as road raising, and culvert upgrades may be better suited to addressing the extreme weather patterns of Far North Queensland
Airport	the erosion is considered to be the result of high flows driven by fluvial (riverine) processes, overland flow from the airport, and not coastal processes	Adaptation options would need to consider fluvial geomorphology in order to stabilise the banks and prevent further erosion to the airport land
Waste dumping facility	Given the review of flood information, it is expected the site currently has a relatively larger risk of fluvial flooding	Management options are likely to consider levee banks around the site to minimise the potential for inundation; unlikely to be warranted until a 2100 planning horizon. It is expected that levee banks to mitigate fluvial flooding may be warranted at an earlier timeframe, potentially present day
Boat ramp car park	Based on observations made during site inspection, the erosion to the north of the car park is the result of localised stormwater runoff	Management options should consider a rock lined stormwater drain adjacent to the carpark, with a rock-lined scour protection at the channel outlet
Football oval	Based on observations made during site inspection and the available mapping, the erosion to the west of the sporting fields is most likely the result of localised stormwater runoff	Management options should consider either revegetation or grass within the drain, the construction of a concrete or rock lined stormwater drain, with a rock-lined scour protection at the channel outlet

6. Burketown (cont.)

6.3 Coastal hazard adaptation

There is a number of priority actions relevant to the five themes identified for the Plan:

1. Enhancing stewardship
2. Planning updates
3. Maintaining and improving infrastructure
4. Nature-based coastal management
5. Coastal engineering.

Recommended adaptation actions for Burketown are summarised in Table 7.

Table 7. Adaptation pathway for Burketown

		Present day	2050	2100
Theme	Strategic action no.	Monitor	Mitigate	Mitigate
1. Initiatives to enhance adaptive capacity	1.1. Community stewardship	As per shire wide actions as applicable		
	1.2. Knowledge sharing	As per shire wide actions as applicable		
	1.3. Monitoring	As per shire wide actions as applicable <i>Monitor the impact of future storm tides and king tides level on the township. Area is already exposed to large scale river floods</i>		
2. Planning updates	2.1. Land use planning	As per shire wide actions as applicable		
	2.2. Disaster management	As per shire wide actions as applicable		
	2.3 Early warning systems	As per shire wide actions as applicable		
3. Modifying infrastructure	3. 1. Resilient infrastructure	As per shire wide actions as applicable		
	3.2 Resilient homes	As per shire wide actions as applicable		
	3.2. Relocate infrastructure	As per shire wide actions as applicable		

6. Burketown (cont.)

		Present day	2050	2100
Theme	Strategic action no.	Monitor	Mitigate	Mitigate
4. Coastal management and engineering	4.1. Nature based foreshore protection and maintenance – vegetation maintenance	As per shire wide actions as applicable		
	4.2 Last line of defence structures – rock revetment and riverbank protection	As per shire wide actions as applicable Monitor conditions and develop triggers for intervention at the airstrip erosion site	If not triggered earlier, prepare preliminary design for rock revetment or riverbank protection at the airstrip erosion site	If not triggered earlier, implement rock revetment or riverbank protection at the airstrip erosion site
	4.3 Structures to minimise inundation – levees	As per shire wide actions as applicable Monitor inundation to assist with future planning of any future structures to minimise inundation.	Reinvestigate community interest for a structure to minimise inundation. If supported design structure to protect town from inundation. Develop triggers for potential implementation If triggered construct structure to protect town from inundation	If triggered construct structure to protect town from inundation.

7. Other areas

7.1 Coastal landscape

Burke Shire is one of the largest Councils in Queensland with a coastal zone extending from the Northern Territory border, all the way to the Carpentaria Shire border (. With a shoreline length of the shire approximately 250 km and hundreds of kilometres more by adding the riverbanks and tidal foreshores of the numerous rivers and creeks covering the coastal region. With most of this area being maintained in its natural state, some parts of the low lying coastal area includes pastoral land which is routinely used for cattle pastures.

7.2 Coastal hazard adaptation

Coastal adaptation measures in coastal areas outside Burketown should be in line with the shire-wide actions, with a focus on:

1. Reduce the impact of weeds, pollutants and plastics on local ecosystems and the potential effect on coastal vegetation
2. The potential for monitoring the impact of advancing and raising sea water on pastoral lands and fresh water bodies key to the pastoral industry

Figure 6. Map of the coastal region in the Burke Shire



7. Other areas (cont.)

		Present day	2050	2100
Theme	Strategic action no.	Monitor	Monitor	Monitor
1. Initiatives to enhance adaptive capacity	1.1. Community stewardship	As per shire wide actions as applicable		
	1.2. Knowledge sharing	As per shire wide actions as applicable		
	1.3. Monitoring	As per shire wide actions as applicable <i>Monitor the impact of future storm tides and king tides level on rural areas and natural areas outside of Burketown, in particular around areas of cultural interest, hunting and gathering, tourism areas and pastoral lands</i> Monitor saltwater intrusion and its impact on areas used for tourism activities and tours, in collaboration with Yagurli tours Monitor saltwater intrusion and its impact into pastoral lands in collaboration with pastoral companies, lead by CLCAC Monitor changing sea levels and their impacts on natural tidal foreshore and coastal vegetation (photo monitoring)		
2. Planning updates	2.1. Land use planning	As per shire wide actions as applicable		
	2.2. Disaster management	As per shire wide actions as applicable Investigate specific disaster management plan for pastoral land		
	2.3 Early warning systems	As per shire wide actions as applicable Investigate specific early warning system for pastoral industry		
3. Modifying infrastructure	3. 1. Resilient infrastructure	As per shire wide actions as applicable		
	3.2 Resilient homes	As per shire wide actions as applicable		
	3.2. Relocate infrastructure	As per shire wide actions as applicable		
4. Coastal management and engineering	4.1. Nature based foreshore protection and maintenance – vegetation maintenance	As per shire wide actions as applicable Continue and expand rubber vine eradication program		
	4.2 Last line of defence structures – rock revetment and riverbank protection	Not applicable		
	4.3 Structures to minimise inundation - levees	Not applicable		

8. Implementation

8.1 Working together

Burke Shire Council recognises a shared responsibility is required for the successful management of coastal hazard risk in the region. Successful implementation will require continual collaboration and careful coordination between

a large number of agencies and organisation as well as a commitment by the local community to protect and look after these fragile environments. Key organisations and their key roles and responsibilities are outlined in Table 8

Table 8. Key roles and responsibilities in coastal hazard adaptation

Organisation	Key roles and responsibilities in relation to coastal hazard adaptation
Burke Shire Council	Council will provide oversight and lead the coordination for the Resilient Coast – Resilient Gulf Strategy implementation. Council's primary responsibility is the maintenance and protection of Council land and assets, and to inform statutory land use planning. Council will implement the Resilient Coast – Resilient Gulf Strategy through a range of mechanisms including: • embedding outcomes and actions from the Strategy into existing Council process and activities; and • implementing new initiatives from the Strategy. Council's role in adapting to climate change and coastal hazards varies depending on the type and ownership of different assets. Council's role includes to: • Inform the community and all stakeholders the outcomes of relevant Council-led investigations on coastal hazard risk, planning and adaptation options. • Observe and monitor coastal hazard risk for Council-managed land and assets. For land and assets owned or managed by others, Burke Shire Council may, as part of everyday activities, observe a risk from coastal hazards and will notify the relevant landowner/manager. • Proactively plan and implement strategic planning measures to reduce the risk of coastal hazard impacts on Council managed land and assets, inform appropriate land use and master planning across the region and work together with other agencies and organisations to manage their own risks • Act by implementing strategic planning measures and actions to reduce the risk of coastal hazard impacts on Council managed land and assets, and to inform appropriate land use planning across the region.

8. Implementation (cont.)

Organisation	Key roles and responsibilities in relation to coastal hazard adaptation
Gangalidda Garrawa Aboriginal Corporation and other Registered Native Title Body Corporates / Traditional Owner groups	The Gangalidda Garrawa Aboriginal Corporation holds Native Title over land and waters on the Southern Gulf Region.
Local Disaster Management Group	LDMGs are established by local governments to support and coordinate disaster management activities for their respective LGAs. In addition to a large number of legislated responsibilities, the LDMG regularly reviews different risks to the community including those associated with coastal hazards. The information in the Resilient Coast – Resilient Gulf Strategy and associated technical reports should be used to update and inform future risk assessments, planning and response initiatives.
State agencies	DATSIP – Department for Aboriginal and Torres Strait Islander Partnerships DES – Department of Environment and Science DAF – Department of Agriculture and Fisheries TMR – Department of Transport and Main Roads QRA – Queensland Reconstruction Authority Queensland Tourism
Local business and private asset owners	Fact Sheet 3 ‘Resilient homes’ provides some basic information on how buildings can adapt to coastal hazards and become more resilient.

8.2 Monitoring, evaluation, reporting and improvement

The Resilient Coast – Resilient Gulf Strategy will be reviewed every 10 years as a minimum. The next scheduled review of the Plan will be in 2030. The review should include consideration of:

- The degree to which the adaptation actions (planned or unplanned) have been implemented.
- Success of implementation of any adaption actions to date, considering:
 - Integration into Council and stakeholder plans and processes
 - Delivery of on-ground activities
- Community perspectives
- Reduction in coastal hazard risk.

Other triggers to update the Strategic Plan including consideration of:

- Any changes in the policy environment (e.g. sea level risk predictions, approach to defining coastal hazard areas).
- Updated technical information or data that may become available.
- Any new development and landscape changes in the region.

9. References

DEHP and LGAQ (2016). Developing a Coastal Hazard Adaptation Strategy. Minimum Standard and Guidelines for Queensland Local Governments. Queensland Government.

BSC (2019a) Burke Shire Council: Coastal Hazard Adaptation Strategy (CHAS). Phase 1 Summary report. Report by BMT to Burke Shire Council

BSC (2019b) Burke Shire Council: Coastal Hazard Adaptation Strategy (CHAS). Phase 2 Summary report. Report by BMT to Burke Shire Council

BSC (2020a) Burke Shire Council: Coastal Hazard Adaptation Strategy (CHAS) Phase 3 – 5. Phase 3 Summary report. Report by Alluvium, NCE and JBP to Burke Shire Council

BSC (2020b) Burke Shire Council: Coastal Hazard Adaptation Strategy (CHAS) Phase 3 – 5. Phase 4 Summary report. Report by Alluvium, NCE and JBP to Burke Shire Council

BSC (2020c) Burke Shire Council: Coastal Hazard Adaptation Strategy (CHAS) Phase 3 – 5. Phase 5 Summary report. Report by Alluvium, NCE and JBP to Burke Shire Council

BSC (2021a) Burke Shire Council: Coastal Hazard Adaptation Strategy (CHAS) Phase 3 – 5. Phase 6 Summary report. Report by Alluvium, NCE and JBP to Burke Shire Council

BSC (2021b) Burke Shire Council: Coastal Hazard Adaptation Strategy (CHAS) Phase 3 – 5. Phase 7 Summary report. Report by Alluvium, NCE and JBP to Burke Shire Council

BSC (2021c) Burke Shire Council: Coastal Hazard Adaptation Strategy (CHAS) Phase 3 – 5. Phase 8 Summary report. Report by Alluvium, NCE and JBP to Burke Shire Council

Bureau of Meteorology. (2021a). Flood Warning System for the Nicholson River. <http://www.bom.gov.au/qld/flood/brochures/nicholson/nicholson.shtml>

Bureau of Meteorology. (2021b). Map of Weather Observations for Queensland. <http://www.bom.gov.au/qld/observations/map.shtml>

Queensland Reconstruction Authority (2019). Flood resilient building guidance for Queensland homes. Queensland Reconstruction Authority, Queensland Government

10. Glossary

Adaptation - Adaptation is adjusting to actual or expected conditions and events. Adaptation can have good or bad outcomes and should be guided by understanding the desired state of being. Good adaptation to coastal hazards means taking action to reduce risk and increase resilience.

Resilience - Resilience is the ability for something to withstand stress and continue to function and recover from damage. Resilience applies to the coastal environment as well as the community. Resilience happens when coastal ecosystems are clean and healthy, and when the community is prepared and safe for coastal hazards.

Coastal Hazards - Coastal hazards are when natural coastal processes threaten local values, properties, or our local way of life. Some coastal hazards include storm tide inundation, erosion, and tidal inundation.

Storm tide inundation - Storm tide inundation is when big storms cause temporarily higher water levels leading to flooding of normally dry land. Storm tide inundation is often accompanied by big waves and strong winds which together can cause widespread destruction.

Erosion - Erosion is when coastal forces such as waves, winds, tides and currents remove sand from the beach and move it offshore. This can cause the shoreline position to move landwards. Big erosion events can threaten buildings, roads and important cultural areas.

Tidal inundation - Tidal inundation is when normal astronomical tides cause flooding of low-lying coastal land. Areas exposed to tidal inundation are expected to periodically flood. With global average sea levels expected to rise, areas effected by tidal inundation are also expected to increase.

Likelihoods - Likelihoods are words to describe how common or rare an event is. Likely events are expected to happen regularly and multiple times within the average lifespan. Possible events are expected to happen every so often and a few times in the average lifespan. Rare events are unusual and might occur once or twice in the average lifespan.

AEP - Annual Exceedance Probability, or AEP, is the likelihood that certain conditions will occur in a given year. AEP values are based on computational modelling that considers measured coastal data and multiple thousands of simulated scenarios.

Planning horizons - Planning horizons are points in the future for which strategic decisions are made. This Strategy considers planning horizons of present day (2020), 2050, and 2100.

Risk - Risk is the possibility of loss, damage, or injury. In a coastal context, risk arises from exposure to coastal hazards such as storm tide inundation, and erosion. Risk can be measured by considering both the likelihood and consequence of loss, damage, or injury.

Avoid (and maintain) - Prevent new risks from occurring and avoid placing new development or assets in coastal hazard areas.

Monitor (look and learn) - Watch for any changes to the coast that might indicate a change in the risk; collect and record information about important cultural sites and places in a culturally appropriate manner.

Actively manage - Proactively manage or reduce the risk of coastal hazards through a range of adaptation options including custodianship, care for country, and in some cases, physical intervention

Transition and change - Gradually change what an area is used for. This might include relocating buildings or assets to an area that is safe from coastal hazards

SUPPLEMENT A

Fact Sheets

SUPPLEMENT B

Coastal hazard
mapping

SUPPLEMENT C

Adaptation actions
– summary sheets