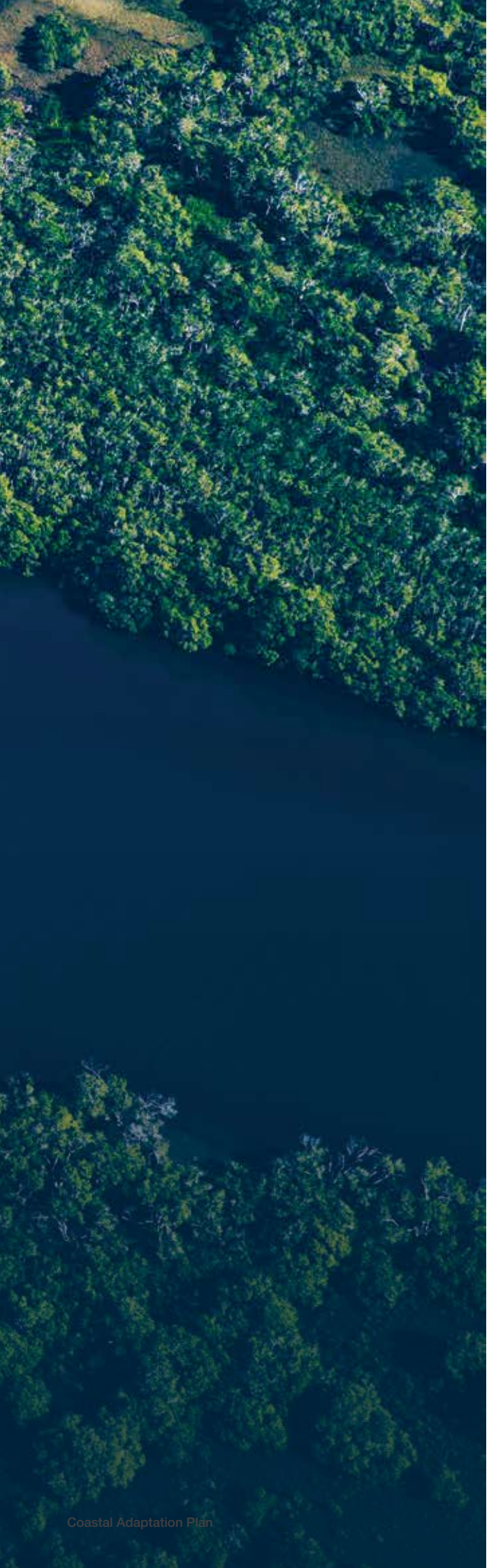
COASTAL ADAPTATION PLAN

CITY OF GOLDCOAST.™

This Coastal Adaptation Plan (CAP) has been prepared in association with the Queensland Government's QCoast2100 initiative to assist the Council of the City of Gold Coast (Council) with its long term planning for coastal resilience, and is not intended for use for any other purpose. Council makes no representation and gives no warranty about the accuracy, reliability, completeness, fitness or suitability for any purpose of the information contained in the CAP. Further the information in the CAP is based on modelled predictions of future conditions, and is liable to change, and Council does not guarantee the currency of the information in the CAP now or in the future. To the full extent that it is able to do so in law, Council expressly disclaims all responsibility and liability (including without limitation liability in contract, negligence or other tortious action) for any error, inaccuracy, omission, lack of completeness, lack of currency, or lack of fitness for purpose in the information in the CAP and for any loss, damage or injury (including consequential loss damage or injury) suffered by any person as a result of the use of or reliance by a person on information contained in the CAP.



Learning from the past as we look to the future

The Gold Coast has a rich and colourful history, intrinsically linked to our love of the beaches, waterways and ocean.

In many ways, we are 'water people', growing up in the waves and producing some of the best ocean sportsmen and women in the world.

Our coastline is forever changing and history shows that mother nature never rests.

The significant damage to our foreshores, canals and river systems in the 1970s gave us all a wake-up call as to the power of storm surge, cyclone activity and flooding rains.

This plan responds in three ways: by managing, mitigating and where possible, avoiding the impacts of these events.

Storms, tidal inundation and erosion remain top-of-mind as we plan for an uncertain future.

As Mayor, I'm proud of the good work being done at a local, state and national level.

Our Coastal Adaptation Plan mirrors the work of the State Government and covers both short, and long-term, planning for our city.

We are one of 31 councils in Queensland proactively working to manage our coastal challenges.

As this plan evolves and is delivered, the community will be kept well informed on key actions – and we value your input in helping us make informed decisions.

Together, we can ensure the Gold Coast remains one of the safest destinations to live, work, play and invest.

Tom Tate
Mayor

Our resilient city

Building on decades of experience and innovation managing our coastal and waterway environments, the City of Gold Coast, with the support of the QCoast2100 program, sought to identify the potential risks to the city's assets posed by coastal hazards now and into the future. After conducting two rounds of community engagement, it became clear that the protection of parklands and recreational and natural spaces was highly valued.

We also learned the community desired more planting and vegetation in coastal areas, including rehabilitation of creekside parks and sand dunes. In addition however the community expressed support for existing initiatives such as dune management, revegetation and rehabilitation, as well as the establishment of buried sea walls, rock groynes and artificial reefs. We found that stakeholders wanted more information about the areas around the city subject to potential coastal hazards as well as the types of mitigation action options available. Feedback also revealed that people wanted to know more about what they could do, as individuals, residents and landowners, as well as coming together as a community. Overall the initial draft plan received positive feedback as well as requests for more detailed information, while the community also contributed interesting or innovative suggestions.

Based on the feedback from the community and key stakeholders, we developed a plan to guide future investigations and actions, the Coastal Adaptation Plan (the Plan). This document now includes more detail regarding action options, location-specific information about assets at risk and potential actions, and an explanation of some of the key components of the Plan.

Our resilience to coastal hazards now and into the future will require the community and the City to work collaboratively and share information and improve our understanding of risks. We trust that our shared values are appropriately reflected in the City's approach to mitigating future potential coastal hazards and that our whole community feels empowered to work together towards the future of our resilient city.

"I THINK IT'S MORE IMPORTANT THAN EVER THAT WE HAVE A GREAT COASTAL ECOSYSTEM TO ENJOY, JUST LIKE EVERYONE BEFORE US GOT TO."

Grace – Junior Commodore,
Southport Yacht Club / Hollywell Sailing Squadron

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Introduction

Our coastal city

Gold Coast is one of Australia's most iconic coastal cities, with 52 kilometres of golden sandy beaches, more than 400 kilometres of waterways and an enviable climate. Our lifestyle is valued and enjoyed by residents, visitors and local business operators alike.

The natural waterways and constructed canals extend through the landscape providing opportunities for recreation, lifestyle and family activities, as well as providing valuable environmental services.

The foreshore and waterways provide a connection with nature, linkages for recreation and economic opportunities to the many residents and coastal and waterway business operators.

Now a city of nearly 640,000 people, our home has undergone significant transformation over the last 60 years. It will continue to change into the future.

The Plan, developed with the support of the $QCoast_{2100}$ program, sets the framework to investigate future actions which will contribute to maintaining the City's resilience to a changing climate, now and into the future.

Australia's premier tourist destination, our enviable coastal lifestyle is world famous.

Our dynamic coast

Queensland's dynamic coast is always changing.

The Gold Coast environs were historically coastal wetlands and littoral rainforests beside open, sandy beaches. During a relatively stable climatic period, our city evolved into a collection of popular coastal seaside holiday villages, before undergoing significant urban growth that substantially transformed the city's low-lying land.

Residents and visitors are drawn to the coast for the lifestyle it provides, and most are used to the daily influence of tides and impacts of occasional storms. Into the future, the Queensland Government has adopted a projected rise in mean sea level of 0.8 metres by 2100. The possibility of cyclone activity could increase across the Queensland coast, with severe storms predicted to track south more often. Along with other impacts, this could result in changes to coastal and inland tidal areas with increased risks from erosion, storm tides and flooding in low-lying areas.

Effective and timely implementation of the Plan is more important than ever.

Our resilient city

The City of Gold Coast (City) has a long and successful history of managing our coastal and waterway environments to maintain our beautiful beaches, estuaries, rivers and creeks, waterfront living opportunities and enviable coastal lifestyle.

Initiatives such as the installation of artificial reefs, beach nourishment, bank protection works, buried sea walls and rehabilitation of degraded coastal landscapes are priority activities that the City undertakes on an ongoing basis to preserve our valued coastal areas for generations to come. The Plan forms part of a long-term collaborative project to undertake adaptation planning for the mitigation of coastal hazards over the medium and long-term in the city. Its development builds on a long history of planning, action and corporate strategies that support coastal management. We all have a role to play in maintaining our resilience to coastal hazards and this document is the start of a broader discussion to assist everybody to mitigate the impacts of a changing coast.

Aligning with our corporate strategies

The City has a long history of managing coastal hazards along the open coast and waterways. Artificial reefs, rock groynes, canal revetment walls, buried sea walls, sand dredging and beach nourishment have been established and managed well for decades in order to protect and preserve our dynamic coastal city. The City's ongoing commitment to coastal management is supported by our key strategies and planning documents, including the Corporate Plan – Gold Coast 2022.

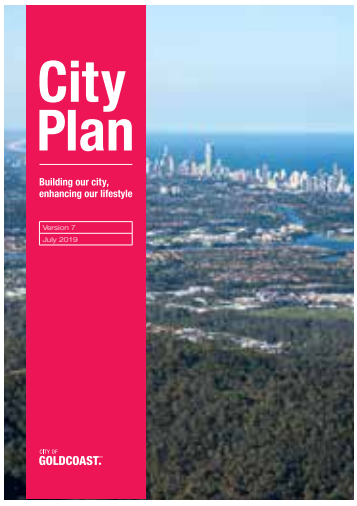
Corporate Plan: Gold Coast 2022

Gold Coast 2022 supports the implementation of the City Vision – 'inspired by lifestyle, driven by opportunity'.

The plan describes the outcomes the City is working towards, and the key plans and programs we aim to deliver, in order to achieve those outcomes.

Gold Coast 2022 aims to protect our enviable lifestyle, ensuring that future generations are proud to call the Gold Coast home.

Planning our adaptation for our highly valued beaches, estuaries, rivers, creeks and waterways, and the opportunities and experiences they offer us, is integral to protecting and maintaining our coastal city lifestyle.



Gold Coast City Plan

The Gold Coast City Plan underpins strategic actions designed to enhance our lifestyle.

The City Plan applies to all premises in the local government area to regulate new development under the *Planning Act* and is intended to contribute to achieving the relevant objectives of the City's corporate strategies.

The City Plan is prepared with a 20-year-horizon, however it is reviewed periodically and contemplates natural hazards to the year 2100 as required by the Queensland State Planning Policy, to ensure it responds appropriately to balance the needs of our community.

The Coastal Adaptation Plan will be reflected in the City Plan over time to support us in building a more resilient city into the future.

Corporate Strategies

Our corporate strategies provide the vision and direction for how we manage priorities including the Ocean Beaches Strategy, Gold Coast Water Strategy and Our Natural City Strategy.

The Coastal Adaptation Plan will complement and provide direction to inform the City's relevant corporate strategies.

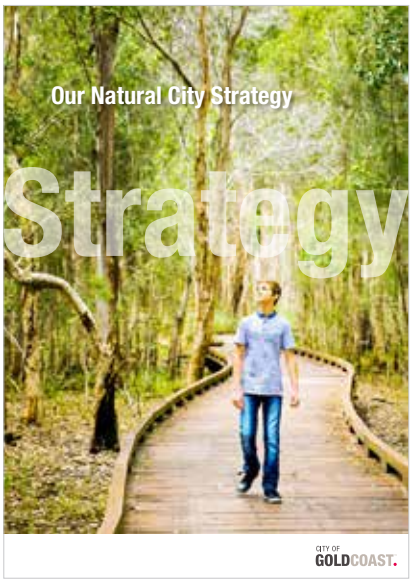
Priorities

Everyone can enjoy a beach experience.

Our beaches are healthy and clean.

Our infrastructure is protected from coastal hazards.

There is joint stewardship of ocean beaches.

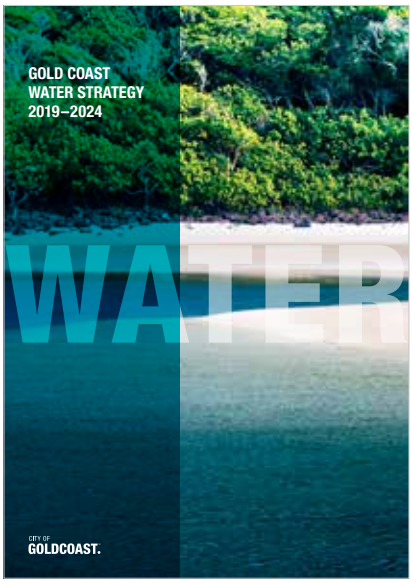


Priorities

Connecting people with nature.

Protecting places for nature.

Partnering to secure and enhance our natural assets.



Priorities

Healthy catchments and waterways.

An innovative approach to the provision of water services.

Vibrant water environments.

City-wide resilience to a changing environment.

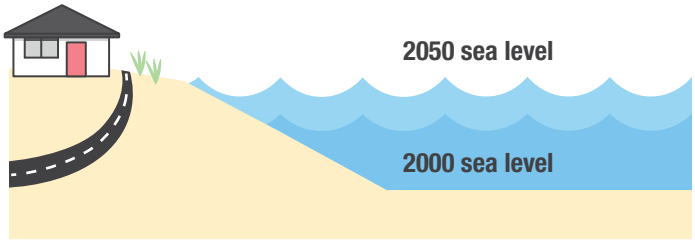
Types of coastal hazards

Flooding of low-lying areas

Sea level rise

A projected rise in mean sea level of 0.8 metres by the year 2100 has been adopted as a planning benchmark by the Queensland Government based on climate modelling for probable scenarios presented in the Intergovernmental Panel on Climate Change (IPCC).

This hazard could result in permanent sea water inundation of low-lying property and infrastructure if effective coastal adaptation strategies aren't delivered.



Storm tide

Storm tide is the water level that results from the combination of a storm surge and the normal tide. For example, a two metre storm surge on top of a high tide that is 1.5 metres above the mean sea level will produce a storm tide that is 3.5 metres above mean sea level.

Storm tide will result in temporary inundation during severe weather such as cyclones and east coast lows. Our coast is vulnerable to storm tide inundation along our low-lying sandy foreshores and wetlands.

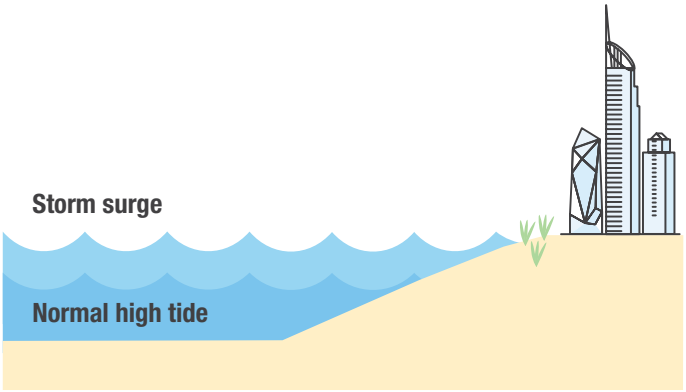


Photo supplied by Dan Hamilton

Erosion along Gold Coast beaches, 2017

Coastal erosion

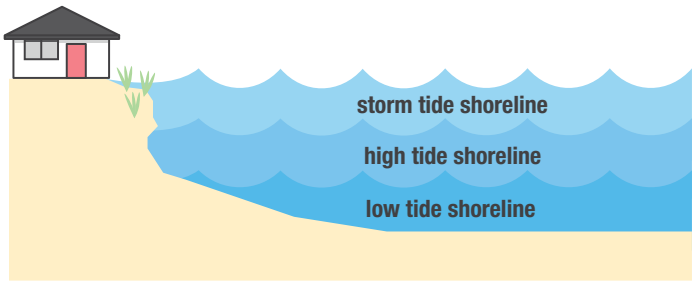
Coastal erosion refers to the erosion of the foreshore from wave action and tidal inundation. Coastal erosion (or shoreline retreat) is the temporary or permanent loss of coastal lands due to the net removal of sediments from the shoreline.

It can be either:

- a rapid-onset hazard (occurs very quickly, over a period of hours to weeks)
- a slow-onset hazard (occurring over many years to decades).

Coastal erosion is driven by the action of wind, waves, tides and currents, and is often associated with extreme weather such as coastal storms. Many coastal foreshores naturally undergo cycles of erosion and accretion on time-scales of weeks to years. However, over the long term, sea level rise is expected to exacerbate slow-onset coastal erosion.

Significant weather events that give rise to immediate hazard conditions and require an emergency response are explored in the '*City of Gold Coast's Local Disaster Management Plan*'.



"We need to assess what is the right course of action for our coastlines."

Lachlan – Coolangatta SLSC

Developing a plan

The Coastal Adaptation Plan builds on our existing coastal management efforts through the recommendation of effective adaptation options.

An adaptation option is a recommended solution to avoid, manage and mitigate coastal hazards now and into the future.

The solution could maintain or change an existing approach in the following areas: land use planning and development assessment; infrastructure planning and management; asset management; community planning; business continuity planning; and emergency management.

Extensive stakeholder input and the best available science, engineering and economic studies underpin these options.

The Plan draws on our experience from more than 50 years of innovative research and technology, where we have proven success in protecting coastal assets.

It meets the objectives of the City Plan and Corporate Plan, with the actions, investigations and implementation recommended subject to long-term funding decisions by Federal and State Governments and the City.

The Plan has been developed under $QCoast_{2100}$, the Queensland Government's Coastal Hazards Adaptation program. $QCoast_{2100}$ assists Councils in their long-term planning for coastal resilience and in minimising the risk of coastal hazards to communities and valuable city assets such as roads, utilities, parks, natural areas and heritage places.

The City of Gold Coast is one of 31 Queensland Councils embracing this opportunity to plan for future coastal hazards.

The $QCoast_{2100}$ program is delivered across eight phases with the development of the plan expected to:

- identify coastal hazard areas
- understand vulnerabilities and risks to a range of assets (including tangible and intangible assets)
- engage with the community and external stakeholders to understand their preferred approach to adaptation
- determine the costs, priorities and timeframes for implementation.

Image courtesy of $QCoast_{2100}$ (DEHP, 2016)

Working together to build a resilient city

Working with stakeholders

Everyone has a role in maintaining and building a resilient city – including Queensland Government agencies, other infrastructure providers and asset owners external to the City. To inform the Plan, we reached out to other asset custodians and service providers.

These stakeholders included Seqwater, Gold Coast Waterways Authority, Telstra, NBNCo, Allgas Energy, Energy QLD, GoldLinQ, Tourism and Events Queensland, Destination Gold Coast, Boating Industry Association, Queensland Water Police (Gold Coast), Gold Coast Airport and Griffith University.

The City, as well as our community, has an important role in the protection and management of the coast and will be responsible for implementing adaptation actions relating to City-managed public infrastructure and assets. However, successful adaptation will require collaboration and partnerships between the City, other government and non-government stakeholders and our valued community.

Engaging with our community

The first round of engagement, which supported the development of the Plan, occurred in September 2020 with a second round conducted early in 2021 to gauge community support for the draft Plan.

We invited feedback from the whole community to understand their values, priorities and concerns. We received a fantastic response with really valuable feedback provided with round 2 commentary resulting in significant improvements to the Plan.

Community Engagement Outcomes

The community values our parklands and recreational areas adjacent to waterways, both coastal and riverine.

Respondents requested to see more plants and vegetation in coastal areas, including rehabilitation of creekside parks and sand dune revegetation.

The community values our local marine life and would like wildlife populations considered in our planning for coastal hazard adaptation.

Support was expressed for our existing initiatives such as dune management, revegetation and rehabilitation, and the establishment of buried sea walls, rock groynes and artificial reefs.

More information about the areas around the city subject to potential coastal hazards was requested – see the City map provided at page 28.

Respondents wanted more detail around the types of mitigation action options available to us – are listed – a variety of adaptation actions to consider together at pages 26 and 29.

More information regarding disaster and emergency management was requested – this can be found in the '*City of Gold Coast Local Disaster Management Plan*'.

For individuals, residents and landowners who want to take action beyond coming together as a resilient community – you can join the City Panel and keep informed about activities such as community plantings.

What the community values

2 – 23 September 2020

7926 page visits to the website

570 informed participants

183 pins on the map*

Draft Coastal Adaptation Plan

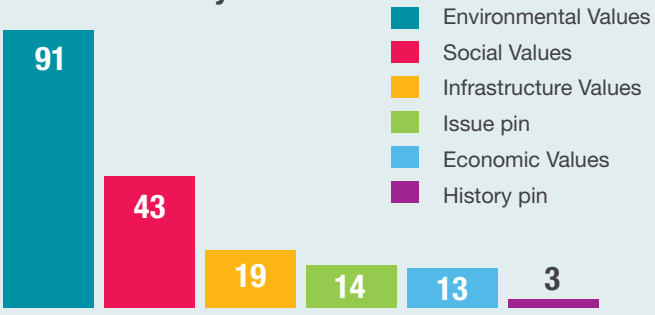
19 January – 19 February 2021

12,400 page visits to the website

2600 informed participants

548 survey responses

* Pins received by values



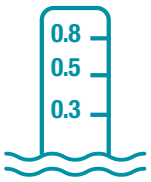
Impacts on our city over time

We are preparing for our city's future resilience by developing the Coastal Adaptation Plan, which will be assimilated into the City's relevant strategies. While our open coast will also be exposed to erosion, our estuaries are mainly susceptible to sea level rise and storm tide.

This means the places we love and value that are in or close to affected areas may also be exposed to these hazards, such as our beaches, parks, important community infrastructure like roads and drainage, and private assets.

Present day

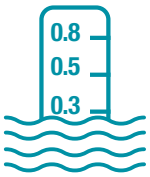
Under current climate conditions our beaches and some of our infrastructure are already exposed to coastal hazards with the risk anticipated to increase in the future.



2050

By 2050, it is projected that the mean sea level will have risen 0.3 metres. This may expose additional land and infrastructure to potential coastal hazards. The city area vulnerable is projected to increase by 20 per cent compared to present day if no action is taken to reduce this impact. This includes an additional:

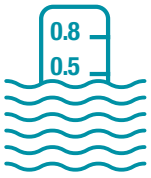
- 36 kilometres of water and sewage pipes
- 33 kilometres of roads
- 746 hectares of conservation area



2070

By around 2070 it is projected that the mean sea level will have risen by 0.5 metres. This could result in the area of the Gold Coast exposed to potential coastal hazards increasing by approximately 30 per cent from present day if no action is taken to reduce this impact. This includes an additional:

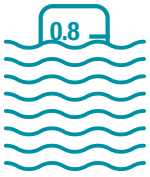
- 96 kilometres of water and sewage pipes
- 67 kilometres of roads
- 1154 hectares of conservation area

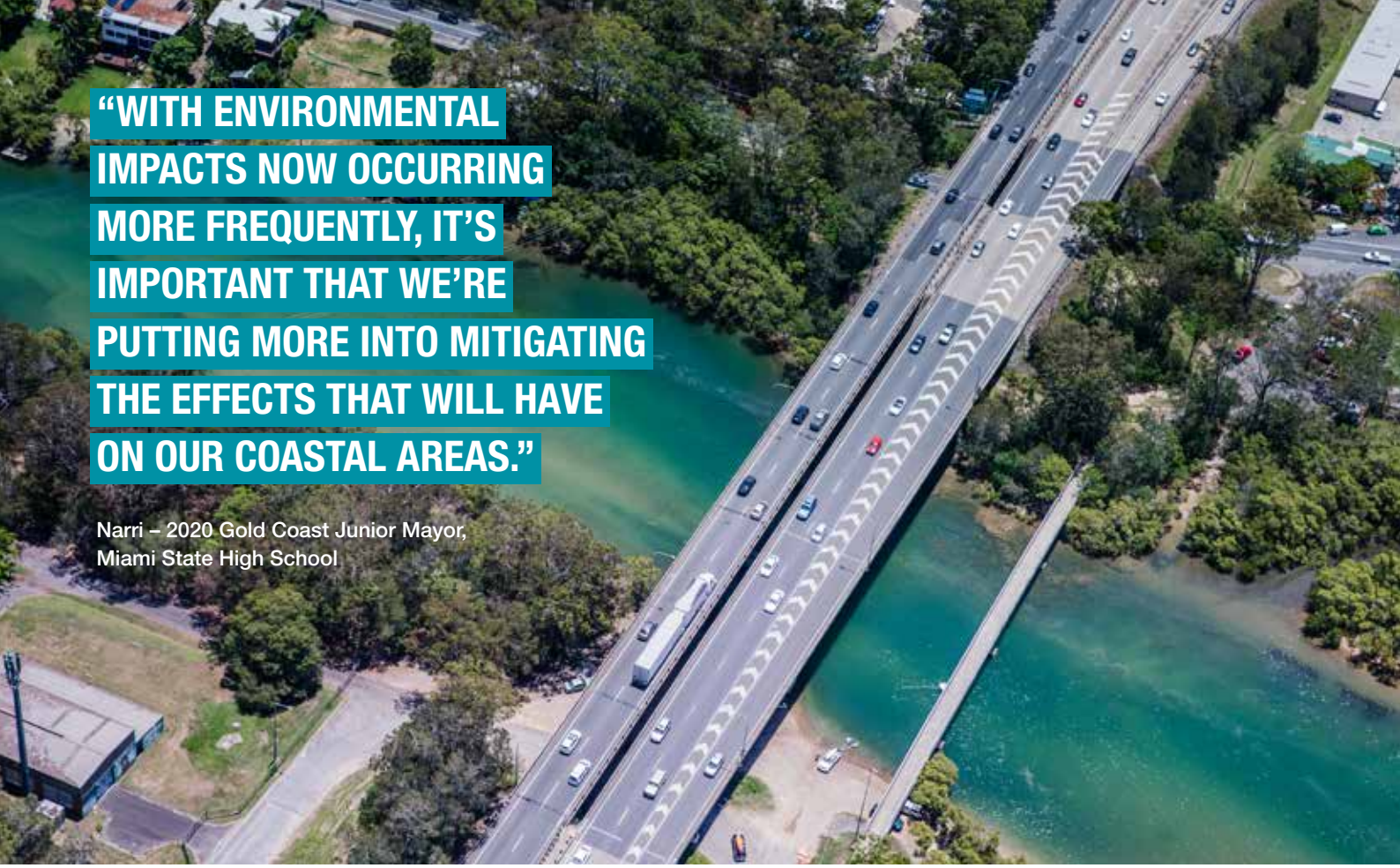


2100

By 2100, the projected sea-level rise of 0.8 metres adopted by the Queensland Government may be realised. This could result in an additional area of the Gold Coast exposed to coastal hazards increasing by approximately 42 per cent from present day if no action is taken to reduce this impact. This includes an additional:

- 221 kilometres of water and sewage pipes
- 143 kilometres of roads
- 1558 hectares of conservation area





"WITH ENVIRONMENTAL IMPACTS NOW OCCURRING MORE FREQUENTLY, IT'S IMPORTANT THAT WE'RE PUTTING MORE INTO MITIGATING THE EFFECTS THAT WILL HAVE ON OUR COASTAL AREAS."

Narri – 2020 Gold Coast Junior Mayor,
Miami State High School

Understanding the risks from coastal hazards

The development of the Coastal Adaptation Plan included an analysis to identify the city's assets at risk from potential coastal hazards over time.

This assessment evaluated assets and associated risks across 11 catchments: Albert River, Broadwater, Coomera River, Currumbin Creek, Nerang River, Pacific Beaches, Pimpama River, Sandy Creek, South Moreton Bay, Tallebudgera Creek and Tweed River (see asset at risk in our city map at page 28).

In this assessment, we considered the likelihood of the hazard, the consequences of any impacts, and the resulting level of risk posed to these assets. We researched which of these assets were key to our city and most valued. Acknowledging feedback received from the community informed what we value most, with community assets prioritised as:

1. beaches, parks, open space, recreation areas and marine life;
2. flood mitigation and stormwater infrastructure;
3. water and sewerage infrastructure;
4. roads and bridges;
5. cultural and heritage assets.

We also considered the effectiveness of existing controls such as the artificial reefs, buried seawalls and the beach nourishment program.

This assessment informs consideration of future adaptation options that would suit all our needs in the long-term future to protect what the community value.

Most importantly, we have a better understanding of the importance of ongoing coordination, monitoring, evaluation and modification to achieving effective coastal adaptation.

RISK ASSESSMENT PROCESS

Asset identification

What are the built, natural and community assets at risk from coastal hazards?

Risk analysis

What are the likelihood and the consequence of coastal hazards on those assets? (Level of risk – high, medium or low.)

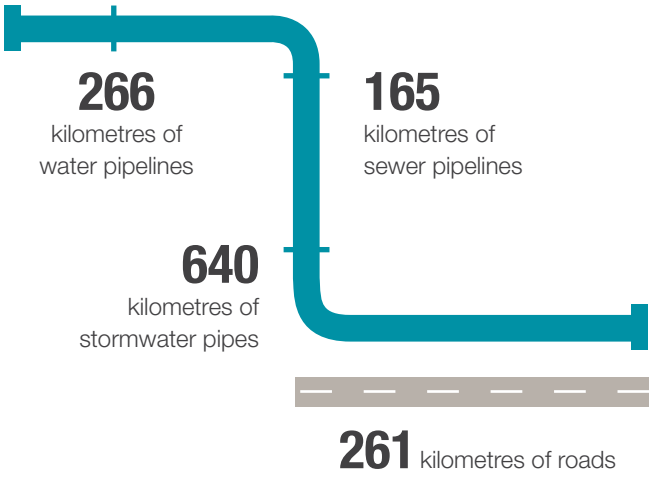
Risk evaluation

What is a tolerable/acceptable level of risk? Are there controls or mitigating actions alreadyin place?

What City services are at risk?

Analysis identified that there are many City assets we value and rely on that may be at risk – including built infrastructure such as buildings, reticulated water and sewerage services, storm-water infrastructure, roads, bridges, pathways, as well as parks, waterways and foreshores.

Analysis of our 11 catchments and our built infrastructure revealed that by 2100, the following assets may be at risk from future coastal erosion:



Natural areas and other assets at risk

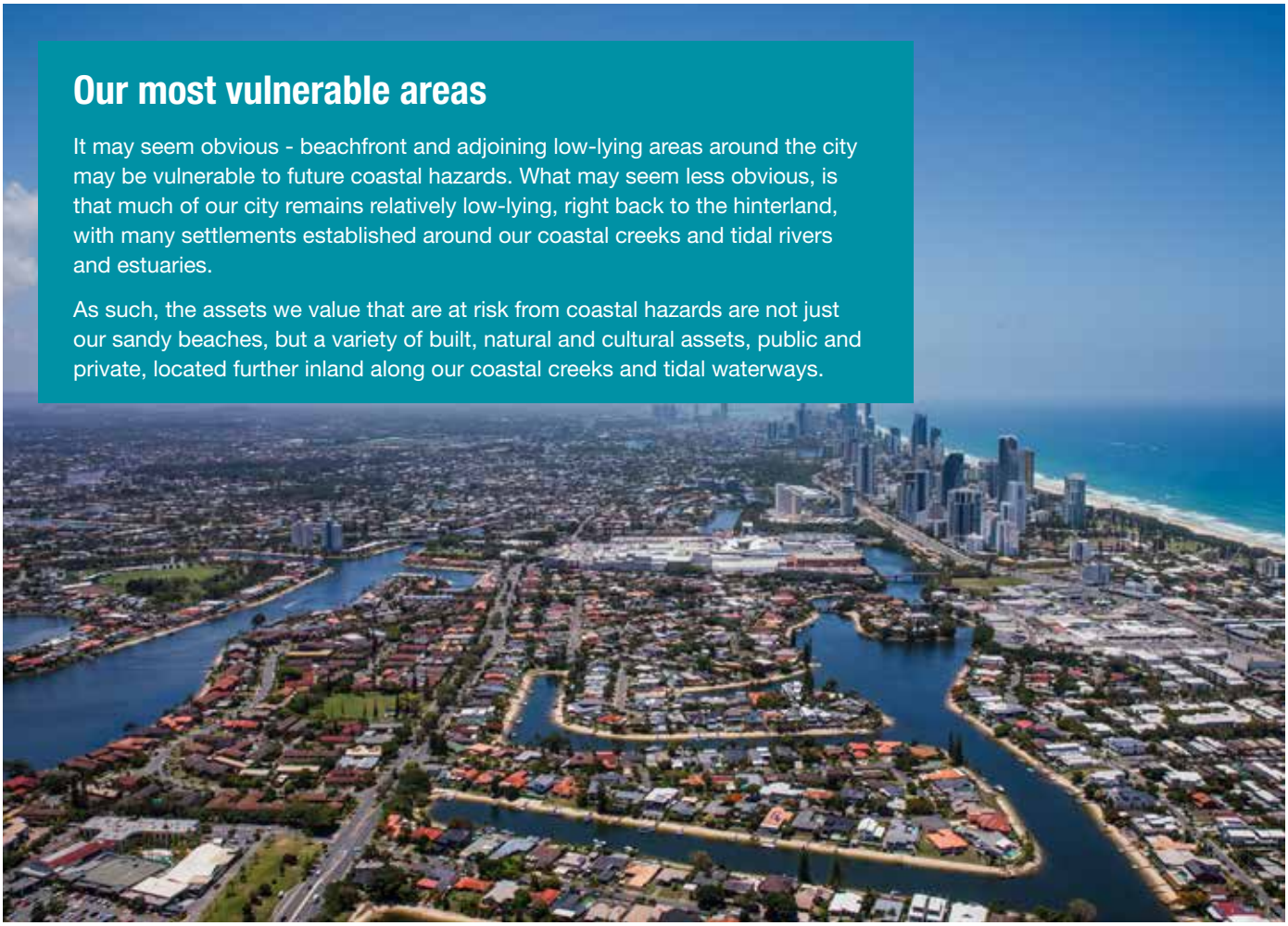
We value those assets that contribute to the quality of our lifestyle: our parks, our foreshores, our natural areas, our marine life, our coastal creeks, estuaries, wetlands and tidal waterways, our recreational facilities and those areas that provide access to outdoor recreation opportunities such as boating, fishing, swimming and surfing.

By 2100, natural areas exposed to risks may include:

conservation area
5411 hectares

open space
1669 hectares

We also considered impacts of future coastal hazards on other assets and interconnectivities such as telecommunications infrastructure, transport linkages, education, health and medical services, commerce and waste management.



Our most vulnerable areas

It may seem obvious - beachfront and adjoining low-lying areas around the city may be vulnerable to future coastal hazards. What may seem less obvious, is that much of our city remains relatively low-lying, right back to the hinterland, with many settlements established around our coastal creeks and tidal rivers and estuaries.

As such, the assets we value that are at risk from coastal hazards are not just our sandy beaches, but a variety of built, natural and cultural assets, public and private, located further inland along our coastal creeks and tidal waterways.

Coastal adaptation in action – a case study

Damian Leeding Memorial Park

The Damian Leeding Memorial Park foreshore stabilisation project was undertaken in 2018.

The tidal foreshore along the Coomera River was undergoing significant erosion causing a risk to infrastructure and public safety.

The project sought to:

- protect the foreshore bank from erosion and flood events
- create a safe river foreshore for park users
- protect the foreshore from boat wash
- improve water quality and river health
- create mangrove habitat for wildlife
- reuse old hardwood and fallen trees to stabilise the foreshore bank
- implement a permanent and more natural solution to bank stabilisation.


Before


During

The benefits of continuing to proactively plan for and manage our coastal hazards into the future means we can all continue to enjoy what we value, particularly our enviable lifestyles.


After

Beach erosion to the north of San Souci Hotel, Main Beach, Queensland, 1960. Bob Avery, photographer. Gold Coast Libraries Local Studies Collection.

Car bodies and boulders were used to halt the progress of beach erosion on the Gold Coast, Queensland, 1967. Photographer unidentified. Gold Coast Libraries Local Studies Collection.

Our coastal management history

With 52 kilometres of beaches and more than 400 kilometres of tidal waterways and canals, the city is predominantly established along beachfront and riverfront land. Although the city has an average of 287 days of sunshine each year and a daily average temperature of 25 degrees, the region is subject to significant climate variability. As such, we have to be adaptable to be resilient.

The city has experienced significant periods of stormy weather, tropical cyclones and east coast lows over the years, with some of the most significant beach erosion events occurring between the 1950s and 1970s. It was these extreme events that resulted in significant community concern and political will to push for a formal Queensland Government response. This resulted in the creation of a key strategic management document for our coastline in 1971, The Delft Report 27. This report included key coastal management recommendations such as:

- training of the Nerang River and Currumbin Creek entrances
- nourishment of Gold Coast beaches from Burleigh Headland to The Spit and from Rainbow Bay to Kirra
- restoring sand supply past the Tweed River entrance.

The Queensland Government also formalised the sea wall design for the Gold Coast, which has ensured that all sea walls constructed since the 1970s have been of a uniform design. The sea wall design, the installation of which remains a requirement under the City Plan, has remained relatively unchanged to this day.

By maintaining partnerships with the Queensland Government, academic institutions and the community, the City has well-established management actions – coastal and riverine, engineered and natural – for the management of the city's coastal beaches, creeks and waterways under our current climatic conditions.

Car bodies used to try and stop the progress of beach erosion on the Gold Coast, Queensland, 1967. Photographer unidentified. Gold Coast Libraries Local Studies Collection.

Scarping and damage to beachfront property caused by severe beach erosion on the Gold Coast, Queensland, 1967. Gold Coast Libraries Local Studies Collection.

Our current coastal and estuarine management actions

We are already doing a lot of work along our coast to manage present day coastal hazards. We take a comprehensive approach to mitigating coastal hazards with works undertaken along our coastline and our beaches, as well as our inland waterways and creeks.

The City for many years has required waterfront and beach front development to incorporate measures to enhance resilience against coastal hazards as currently prescribed in the City Plan Coastal erosion hazard overlay code.

Palm Beach shoreline project

Data collected since the 1960s showed that Palm Beach was one of the city's most vulnerable beaches to coastal erosion, having the lowest volume of sand compared to similar Gold Coast beaches.

After carefully considering an appropriate solution, an artificial reef, combined with sand nourishment was adopted as the best option for Palm Beach. This also enhanced surf amenity, an important outcome for the local surfing community.

In 2017, sand nourishment commenced and more than 470,000 cubic metres of clean sand was delivered along the shores of Palm Beach. This was part of a wider program delivering more than three million cubic metres of sand along all Gold Coast beaches.

Rock groynes

In 2013, in response to an investigation of coastal protection options, as well as expressed community stakeholders' desires to improve recreational surfing amenity at Kirra Point, the City invested $800,000 in lengthening the rock groyne wall to 180 metres. These works, undertaken as part of the City's Three Point Plan for Coastal Protection, were a key element of the ongoing strategic initiatives to invest in the future management of Gold Coast foreshores and align to the Ocean Beaches Strategy. This was part of a wider program that delivered more than three millon cubic metres of sand along Gold Coast beaches.

Buried sea walls

Our beaches are always changing due to natural coastal processes and weather patterns. Erosion can impact beachfront infrastructure and properties, and where relocation of infrastructure is not possible, engineered sea walls are used as a component of the city's defence mechanisms against coastal erosion.

The construction of buried sea walls forms part of our shoreline management response to coastal erosion. We have an ongoing sea wall construction and certification program that prioritises public sea walls for construction, renewal and recertification. The sea wall program is critical in meeting the Ocean Beaches Strategy objective of ensuring that our infrastructure is protected from coastal hazards. Furthermore, the City has established minimum standards for the installation of private sea walls to protect private assets along the coast. Without these buried sea walls, modelling has shown the extent of land vulnerable to erosion would be greater.

Broadwater Parklands mangrove wetland

The Gold Coast's Broadwater Parklands is a multi-million dollar sustainable urban waterfront redevelopment. Open spaces blend seamlessly with the beach and a number of created natural habitat areas. The City of Gold Coast and the Queensland Government collaborated on this redevelopment to enhance natural coastal assets and provide high quality recreational open space.

Construction was undertaken between 2008 and 2010. Reclamation works dredged 120,000 cubic metres of sand from heavily built-up Southern and South Wave Break channels to create 3.2 hectares of recreational space, enhancing the previously narrow strip of the foreshore adjacent to the Gold Coast Highway. The project also created 1.2 hectares of intertidal reclamation for a mangrove wetland.

Key components of the revegetation efforts included:

- 20,000 seedlings, plants and propagules planted to restore over 2 kilometres of foreshore
- 30,000 plants placed within redeveloped areas of the Parklands
- 2200 seeds (propagules) planted within the mangrove wetland area in 2010
- Translocation works moved around 833 square metres of seagrass from the area to be reclaimed in 2009.

This type of mangrove wetland rehabilitation had not been previously undertaken by the City. The wetland receives and filters significant stormwater run-off from an urban catchment of nearly seven hectares. The mangroves capture fine sediment, nutrients and rubbish, improving the quality of water entering the Broadwater.

Surfers Paradise Sand Backpass Pipeline

The Gold Coast's most visited beach, Surfers Paradise, can be vulnerable to the impacts of storm erosion and king tides that compromise foreshore infrastructure and reduce beach amenity. To help address this issue, the City has commenced the construction of a 7.8-kilometre pipeline to return natural sand from The Spit back to the iconic beach. This pipe will funnel sand from the existing Sand Bypass Jetty at The Spit onto the upper beach along Gold Coast northern beaches including Surfers Paradise and will help protect them from beach erosion.

The City has been actively working with the Gold Coast Waterways Authority (GCWA) who operates the Sand Bypass Jetty at the northern end of The Spit. The Sand Bypass Jetty was constructed to maintain the Seaway navigation channel by capturing sand and transferring it across to South Stradbroke Island. GCWA are providing a significant contribution to the project by capturing the sand through the Sand Bypass Jetty and allowing the City to construct infrastructure that will enable the transportation of a portion of that sand back to Surfers Paradise.

The pipeline will enable us to conduct annual renourishment campaigns, proactively increasing the resilience of the Gold Coast northern beaches and complements the 2017 beach nourishment project which replenished Gold Coast beaches with three million cubic metres of sand.

The City will undertake monitoring of The Spit, Main Beach, Narrowneck, Surfers Paradise and South Stradbroke Island shorelines to ensure that the project has no significant negative impacts on shoreline position. This project is a long-term investment in maintaining our beaches and supports the resilience of our coastline and the outcomes of the Ocean Beaches Strategy.

Broadwater Parklands mangrove wetland

Gold Coast Waterways Sand Bypass Jetty, Gold Coast Seaway

The Tweed River Entrance Sand Bypassing Project

The Tweed Sand Bypassing Project (TRESBP) is a joint initiative of the New South Wales and Queensland State Governments that provides sand for southern Gold Coast beaches (and ultimately the whole of the Gold Coast). One of the project's primary objectives is to restore and maintain the coastal sand drift to the beaches on the southern Gold Coast.

The sand transport system collects sand from the southern side of the Tweed River and pumps it under the river to outlets on the northern side. From there sand is transported by waves and currents to nourish the southern Gold Coast beaches. The project periodically dredges sand that accumulates at the Tweed River entrance and transports this to southern Gold Coast beaches. The system is designed to transport the natural quantities of sand that move northwards along the coast.

The City's coastal hazard protection actions seek to support and enhance the protective functions of natural landscape features.

Dune management and beach nourishment

Caring for our dunes is a long-term collaboration between the City and beach users. The City works to protect our dunes and promote healthy native vegetation by:

- controlling weeds and exotic plants
- planting native endemic species
- installing dune fencing and maintaining public access ways
- supporting community activities under the BeachCare program
- beach cleaning and litter patrols.

In 2017, the City spent five months topping up our beaches with sand so they'd be more resilient to the impacts of storms and severe weather.

The Gold Coast Beach Nourishment Project (GCBNP) delivered more than 3 million cubic metres of sand across many of our beaches.

In addition, the City conducts annual creek dredging of up to 30,000-40,000 cubic metres of sand which is then used to replenish Burleigh and Palm Beach respectively.

Waterways and canals

The Gold Coast possesses the largest number of canals in Australia, and under current legislation, is responsible for maintaining those canals. Maintenance activities undertaken by the City includes periodic dredging to keep canals clean, removal of vegetation that may impede or obstruct maintenance, maintaining the profile of the canals as they were constructed, and the maintenance of banks through the installation of rock protection or placement of dredged sand to maintain the original canal profile. Management of coastal and inland waterways is critical to mitigating coastal hazards.

Narrowneck artificial reef

In 1999, the City constructed an artificial reef offshore from Narrowneck using sand containers made from geotextile fabric. The reef reduces the erosion impact of large waves. As these waves cross the reef their intensity becomes less threatening to the beach. The reef promotes a build-up of sand near the structure and this sand acts as a buffer to protect the beach during storms.

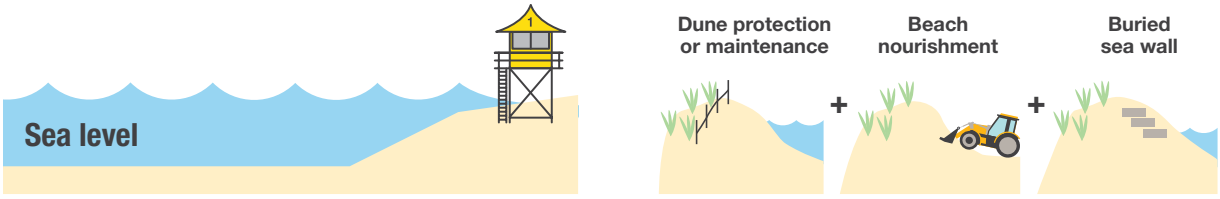
Artificial reefs also provide ecological value through establishing rocky reef habitat. This is an important and positive aspect of this form of natural coastal protection as it not only enhances coastal ecosystems, but provides recreational and commercial opportunities. Reef Check, a community based citizen science group, now actively monitor these sites' biodiversity.

Adaptation approaches – what else can we do?

An adaptation option is a recommended solution to mitigate the impacts from coastal hazards and can include hybrid green (or 'soft') and 'hard' solutions. Our resilience into the future will be enhanced through a shared responsibility for the maintenance of public and private assets. Extensive stakeholder input and the best available science, engineering and economic studies underpin options for resilience. Options can be grouped under three main approaches.

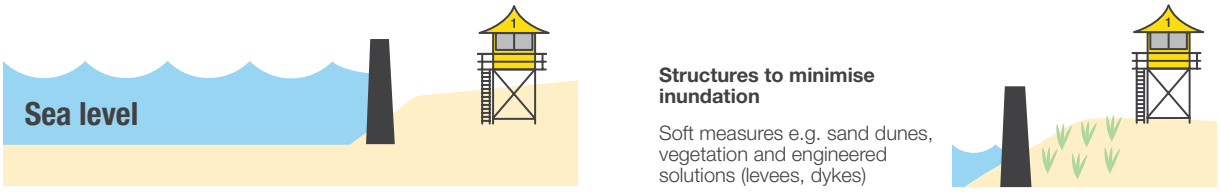
Maintain

A **maintain** adaptation approach involves the continued use of an asset at the current risk level. Examples include: maintaining current management activities, such as beach nourishment and ecosystem based responses; and the continual review and investment in disaster management, land use planning, specific asset management, coastal dune and habitat management and community awareness raising. It may combine long-term strategies with short-term defences. These activities do not remove the risk or the hazard.



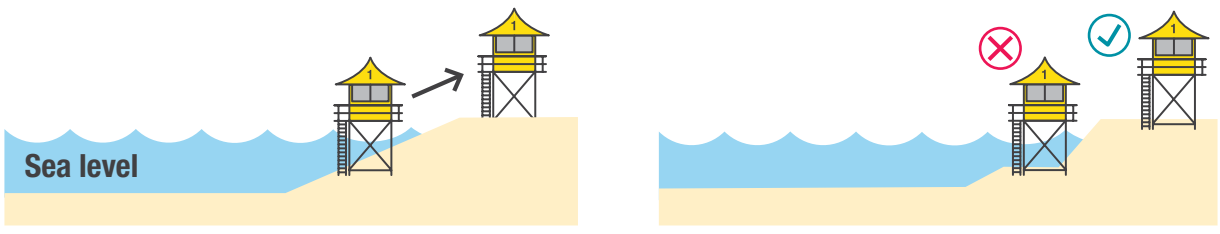
Modify

A **modify** adaptation approach uses physical measures to mitigate against coastal hazard risks. Solutions may include options such as raising key infrastructure like access roads; installing sea walls or tide barriers to protect the land areas from the sea; or modifying our established urban pattern where risks become intolerable. It can also involve actions like beach nourishment in locations where it has not previously been implemented.



Transform

A **transform** adaptation approach is the relocation and repositioning of assets that have an intolerable exposure to risk. It can also include changing the way that land is used to reduce the risk. These sorts of activities can often be aligned with existing scheduled asset replacement activities.



REPOSITION

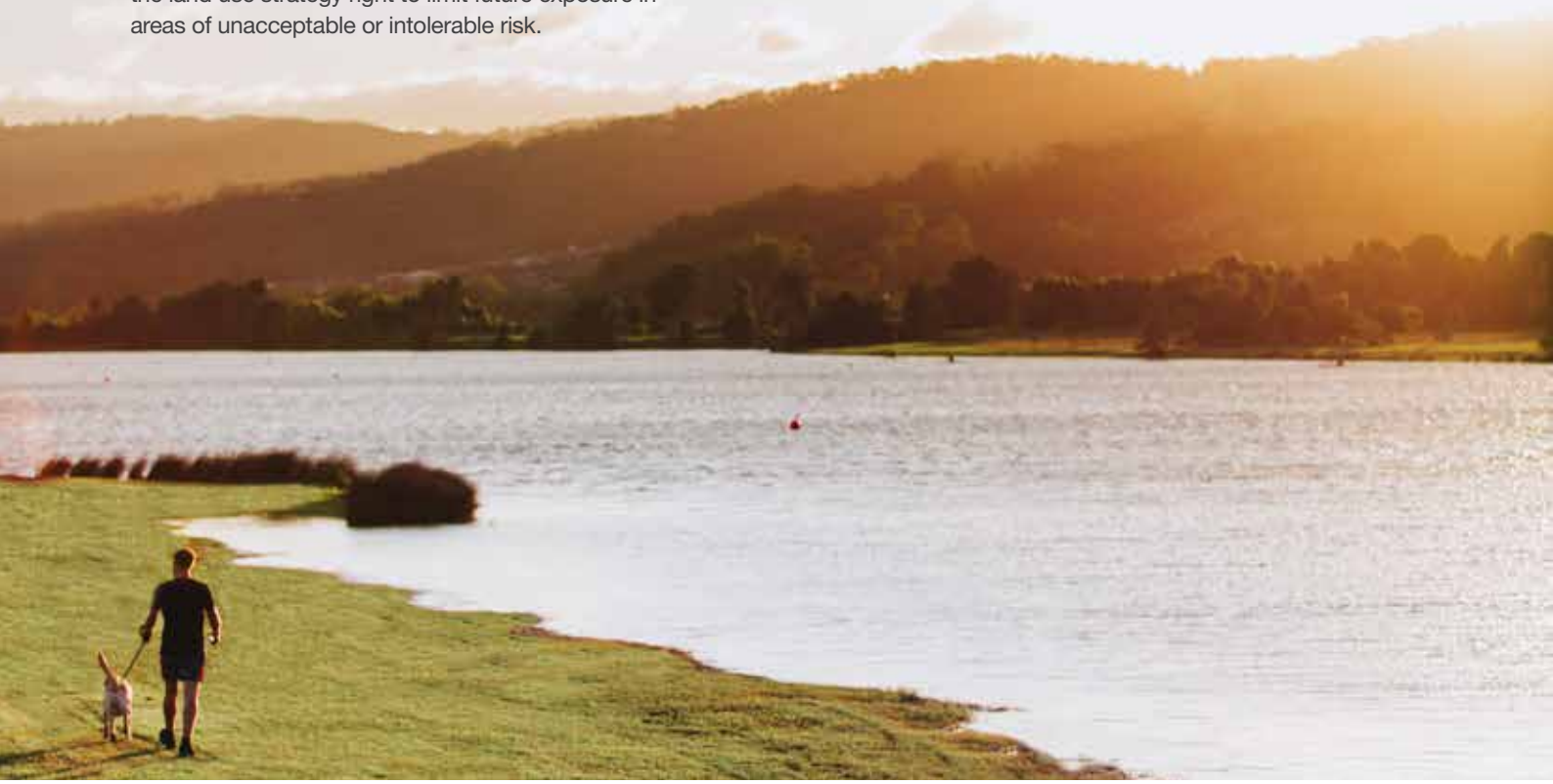
RELOCATE

Our adaptation principles

Choosing the right option for a particular location can be difficult, and it is important for solutions to have the right fit for the asset, location and the community.

With input from key stakeholders, the following adaptation principles have been developed to guide the selection of options:

- Solutions are evidence-based and tailored to the risk and local values of the area.
- Adaptation responses are designed to contribute to 'place' and the Gold Coast's iconic city image.
- Adaptation responses are not solely designed for their engineering or risk reduction function. Fitting in with 'place' is important. They are designed to 'look good' and achieve multiple public benefits.
- Adaptation options maintain or improve opportunities for safe public access to the coast, foreshore and coastal waterways.
- Adaptation responses protect and improve the function of natural coastal processes, ecological processes and wildlife habitats.
- Priority is given to natural and 'soft' solutions in the short term, over hard engineering solutions where the evidence supports these options can mitigate risk to an acceptable level.
- Prioritise public funding of adaptation solutions that consider whole of life costs.
- Protect 'public good' assets or those which have a wider community benefit, over private benefit.
- Keep people safe – prioritise higher risk areas and get the land use strategy right to limit future exposure in areas of unacceptable or intolerable risk.
- Build new high value or long-life assets outside of coastal hazard areas or areas of lower risk.
- Planned transition to a resilient city.
- Design infrastructure or assets and new development to be 'higher and stronger' and include resilient building design principles in areas where the risk is identified as tolerable or 'appropriate'.
- Build resilience by supporting residents, business owners and the community to be 'risk aware'.
- Consider ways to support residents to modify houses and buildings to be resilient to temporary inundation.
- Involve stakeholders, business, property owners and the community in implementation of actions.
- Partner with organisations such as Tweed Shire Council, Gold Coast Waterway Authority and Queensland Government, to ensure a shared and consistent approach to coastal hazard adaptation.
- Consider and invest in 'no regret' or preliminary actions.
- Align 'build back better' principles with existing scheduled asset replacement activities.
- Review our current asset management program to consider opportunities to optimise our asset resilience.
- Explore opportunities for limiting tidal ranges in waterways.



Our adaptation options

Options fall across a range of response types:

Ecosystem based responses

Engineering (hard and soft) responses

Planning and policy responses

Community-based responses

Along our open beaches, we will continue to implement actions aligned with the Ocean Beaches Strategy. This involves:

- actively managing our dunes and the associated habitat
- undertaking strategic sand nourishment to maintain storm buffers and recreational access to the beach
- maintaining the program of buried sea walls
- facilitating private protection works through coastal building lines and development setbacks
- examining the intensity of future development within hazard extents
- encouraging the design of new or upgraded infrastructure in coastal areas to be hazard resilient
- continue monitoring and protecting our coastal ecological assets over time, to ensure access for recreational and economic purposes and to enhance aesthetic values.

Within our estuarine areas, further important actions include:

- investigating localised opportunities to limit flooding (such as raising land levels, physical barriers (like levees or tide gates) and drainage modifications)
- preserving the integrity of existing natural buffers around waterways
- encouraging the design of new or upgraded infrastructure in riverine areas to be hazard resilient
- to limit flooding and erosion using building setback requirements, and to continue monitoring of waterways to protect and maintain our ecological assets over time, to ensure access for recreational and economic purposes and to enhance aesthetic values.

Our adaptation pathways across our city

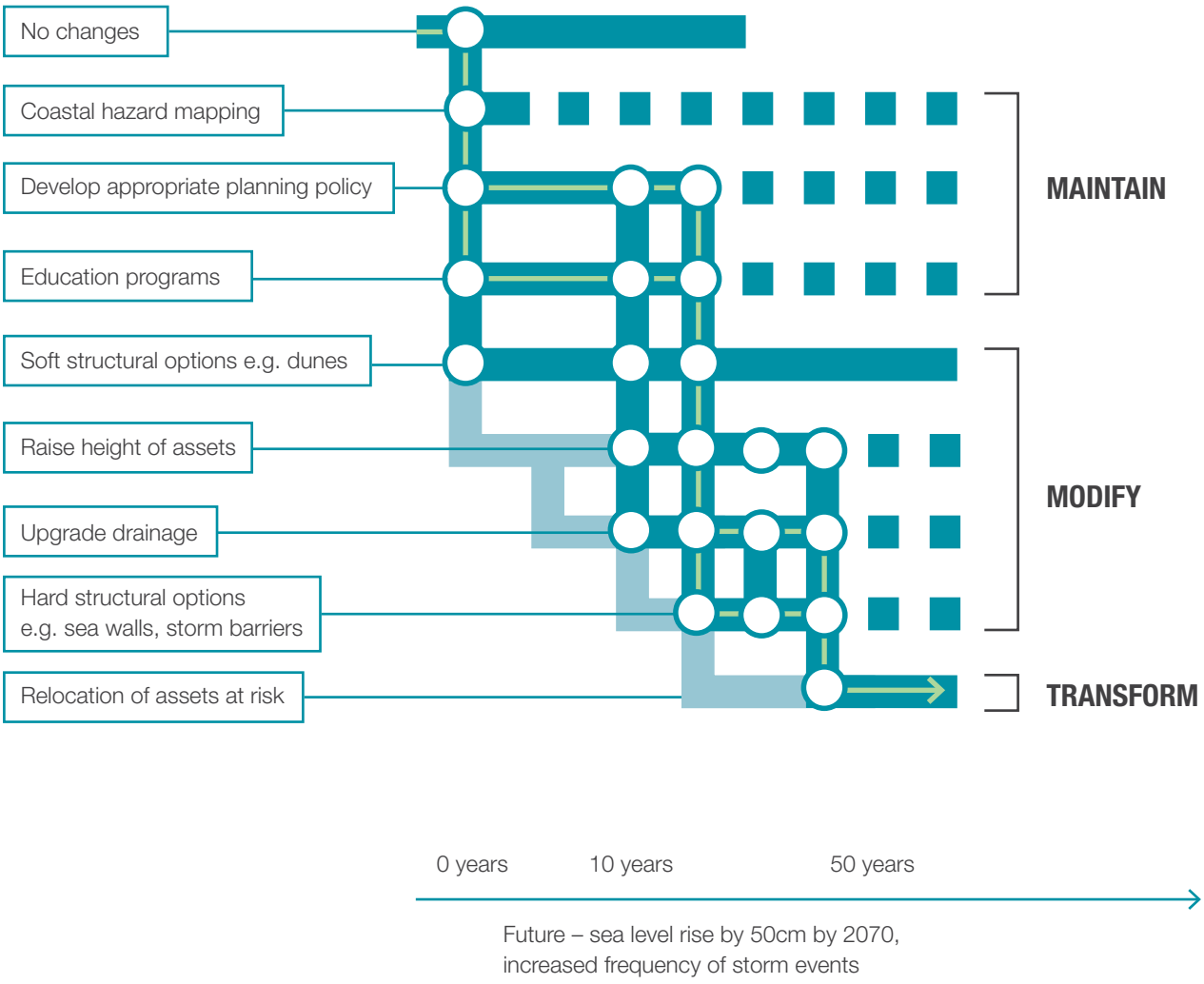
Adaptation planning using the pathways approach supports flexibility by allowing options to be adapted to changing circumstances or in response to observed changes as a result of coastal hazards.

Adaptation pathways comprise a sequence of steps that are triggered by a change in the hazard or the associated risk. Once an adaptation option is implemented, it is used until it no longer delivers its intended outcomes and a trigger point is reached, at which time another option is required.

Due to changes in climate and community values and aspirations over time, it is unlikely that any one adaptation option will be sufficient. Therefore an adaptation pathway provides the flexibility to be adaptable to changing circumstances.

Trigger points can also be used in locations where hazards are not yet occurring but are likely to occur in the future. This approach effectively defers action until an identified point or event in the future. Setting a trigger point is not an excuse to delay action.

Planning controls and monitoring and preliminary investigations will be undertaken to support or reduce the scale and cost of future risk treatment. No regrets or preliminary actions can also support the collection of further information (including trial works or approvals) prior to implementing larger scale or more costly adaptation measures.



Specific adaptation action options we explored with our community and stakeholders

Build Community Resilience

Build community resilience through education and community awareness measures

- Community education and consultation
- Monitoring
- Geotechnical investigation and detailed studies

Enhance coastline or habitat resilience

Enhance coastline resilience by protecting or reinstating natural coastal ecosystems – like stabilising dunes, revegetating mangroves (cheaper, flexible and multiple benefits)

- Dune and habitat management (vegetation, re-vegetation and management)
- Dune restoration, augmentation or construction
- Land management > habitat migration
- Beach scraping
- Beach nourishment (small scale)
- Wetland buffers and restoration
- Green belts and riparian corridors
- Reduce hard surfaces

Avoid

New 'high value' or 'long life' assets are constructed outside of coastal hazard areas at unacceptable risk where practicable

- Community infrastructure planning and management
- Increase waterway building setbacks
- Review City Plan policy
- Raise land levels

Planned Transition

Transition existing assets and buildings out of higher-risk areas over time – last resort option

- Maintain current approach
- Relocate important infrastructure
- Land buy back where supported by funding
- Land swap
- Rolling easement
- Review City Plan policy

Adapt or accommodate

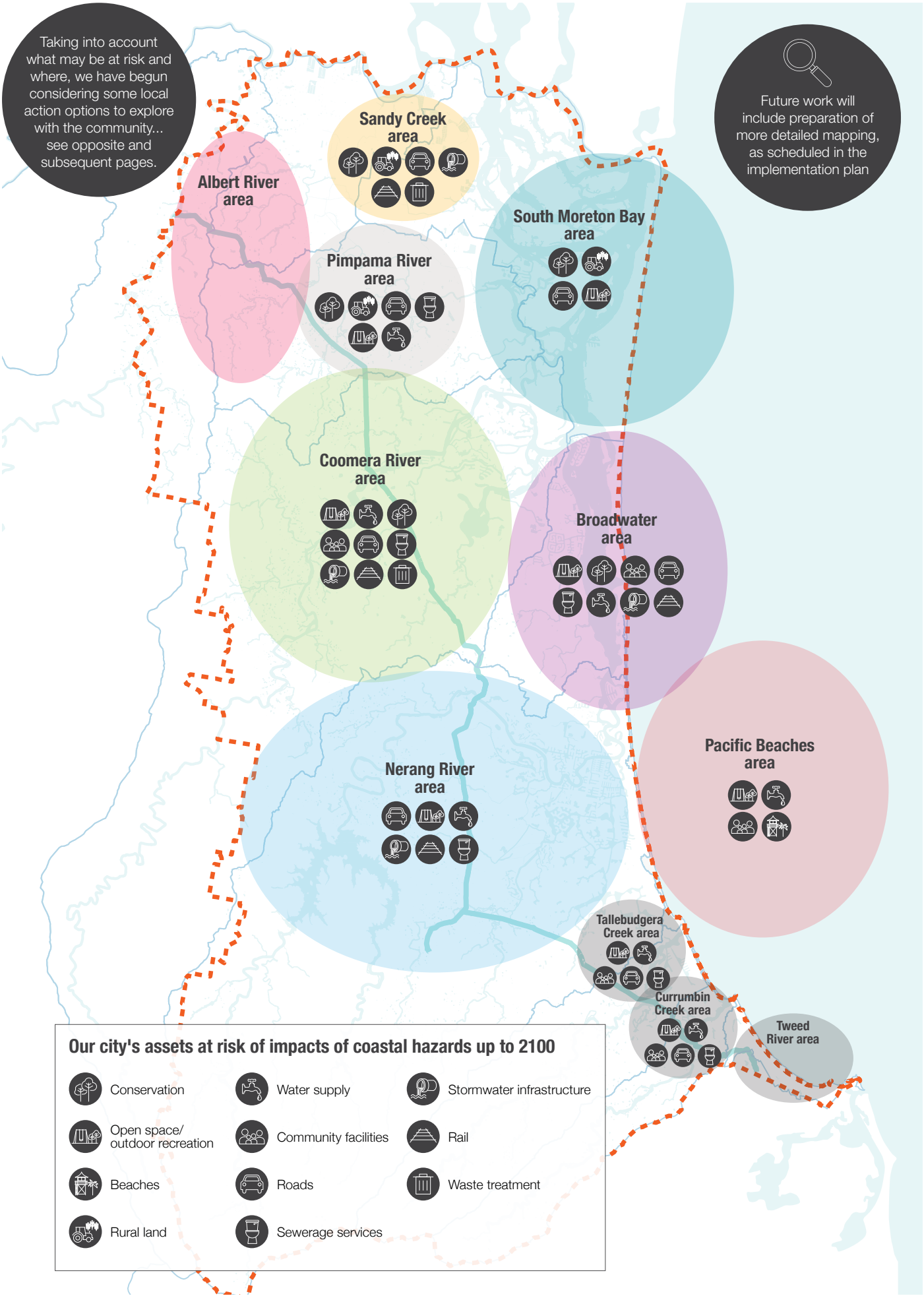
Modify existing and future buildings and infrastructure to accommodate coastal changes – build things 'higher and stronger', flood resilient building design, evacuation planning in areas of tolerable risk etc.

- Allow foreshore recession
- Emergency management planning and response
- Insurance
- Master planning
- Build redundancy into networks
- Manage creek meandering to limit impacts on assets
- Hazard resilient design for new or upgraded public and private infrastructure
- Floating development

Protect

Protect/defend priority shorelines, localities and infrastructure through beach nourishment, sea walls, levees, groynes or other structures

- Beach nourishment (large scale)
- Artificial reefs, groynes and artificial headlands
- Seawall or scour protection to protect public and private assets
- Tidal barrages, gates and surge barriers
- Levees, dykes and low earthern bunds
- Stormwater network modifications including one way valve outlets


Taking into account what may be at risk and where, we have begun considering some local action options to explore with the community... see opposite and subsequent pages.
Future work will include preparation of more detailed mapping, as scheduled in the implementation plan
Albert River area
Sandy Creek area
Pimpama River area
South Moreton Bay area
Coomera River area
Broadwater area
Nerang River area
Pacific Beaches area
Tallebudgera Creek area
Currumbin Creek area
Tweed River area
Our city's assets at risk of impacts of coastal hazards up to 2100
Conservation
Water supply
Stormwater infrastructure
Open space/ outdoor recreation
Community facilities
Rail
Beaches
Roads
Waste treatment
Rural land
Sewerage services

Location specific adaptation actions

Albert River Catchment

- Active management of riparian vegetation and habitats
- Support habitat migration through land management
- Localised protection of built assets

Sandy Creek Area

- Active management of riparian vegetation and habitats
- Transition high risk land uses where practicable to land uses that can accommodate hazards
- Support habitat migration through land management
- Localised protection of built assets
- Avoid new infrastructure in hazard areas
- Hazard resilient design for new infrastructure

South Moreton Bay Area

- Transition high risk land uses where practicable to land uses that can accommodate hazards
- Support habitat migration through land management
- Hazard resilient design for new infrastructure
- Modification or protection of key assets such as important roads, and localised protection of built assets
- Review of Woongoolba Flood Mitigation Scheme

Pacific Beaches Area

- Active dune management, maintenance and restoration
- Beach nourishment
- Maintenance of A-line seawall (including progressive gap filling)
- Hazard resilient design for new infrastructure

Coomera River Area

- Active management of riparian vegetation and habitats
- Modification or protection of key assets and localised protection of built assets
- Transition land uses where practicable to land uses that can accommodate hazards
- Support habitat migration through land management
- Avoid new infrastructure in hazard areas
- Hazard resilient design for new infrastructure
- Upgrade existing protection measures to mitigate future coastal hazards
- Stormwater management modifications

Pimpama River Area

- Active management of riparian vegetation and habitats
- Modification or protection of key assets and localised protection of built assets
- Transition high risk land uses where practicable to land uses that can accommodate hazards
- Support habitat migration through land management
- Avoid new infrastructure in hazard areas
- Hazard resilient design for new infrastructure

Broadwater Area

- Continue sand nourishment
- Investigate upgrading stormwater infrastructure
- Consider upgrading existing revetment walls
- Explore constructing new levees
- Investigate feasibility of large tide mitigation gates

Nerang River Area

- Active management of beaches and banks
- Modification or protection of key assets and localised protection of built assets
- Hazard resilient design for new infrastructure
- Upgrade existing protection measures to mitigate future coastal hazards
- Stormwater management modifications
- Explore opportunities for limiting the tidal range in waterways

Tallebudgera Creek and Currumbin Creek Areas

- Active management of beaches, banks, riparian vegetation and habitats
- Small-scale beach nourishment
- Modification or protection of key assets and localised protection of built assets
- Limit further development intensification in hazard areas where practicable
- Hazard resilient design for new infrastructure
- Upgrade existing protection measures to mitigate future coastal hazards
- Stormwater management modifications
- Explore opportunities for limiting the tidal range in waterways

Implementation of the Coastal Adaptation Plan - Short term actions

Implementation actions and objectives	Planning and policy responses	Community based responses	Ecosystem based responses	Engineering (hard and soft) responses	Timing
Update City Plan to facilitate outcomes sought by Coastal Adaptation Plan * To understand the implications of coastal hazard risks for land use, density and development policy. * To ensure City Plan can facilitate development that appropriately responds to coastal hazards. * To ensure City Plan incorporates Coastal hazard State interests (to meet Planning Act requirements.)	✓				1 – 5 years (ongoing)
Investigate the development of combined flood and coastal hazard modelling to inform implementation of adaptation actions * To ensure future decision-making considers fluvial and pluvial hydrology and coastal hazard inundation together.	✓				1 – 5 years
Review and refine the City's existing asset register * To ensure consistency and transparency regarding asset ownership and responsibility.	✓				1 – 5 years
Review Local Disaster Management Plan * To ensure the City and the community can appropriately react to coastal hazards.	✓				Ongoing
Develop a corporate communications and engagement strategy for coastal hazards and climate matters more broadly * To build community awareness and education around risks and how individuals can act to help with adaptation. * To ensure communications regarding coastal hazards and climate matters are consistent and easily understood.		✓			Ongoing
Formalise a framework in how monitoring and review findings are stored and presented * To ensure monitoring and review tasks result in data that is accessible, easily understood and readily available to inform decision-making.	✓	✓			1 – 5 years
Audit Council's list of planned projects located on land affected by coastal hazards with a high or very high residual risk rating across any climate scenario. * To ensure planned projects consider coastal hazards and adopt appropriate modifications or changes to address coastal hazard risks.	✓	✓	✓	✓	1 – 3 years
Prepare local placed-based adaptation action plans across the Gold Coast for priority locations * To provide direction on how coastal hazard exposure and risk will be managed locally.	✓	✓	✓	✓	1 – 15 years
Investigate and confirm city-wide adaptation actions that will broadly reduce coastal hazard exposure and risk. * To provide understanding of the benefits of city-wide adaptation actions e.g. construction of tide limiting structures, and how these alter coastal hazard exposure and risk. * To confirm strategic adaptation actions that will inform subsequent adaptation actions e.g. local 'placed-based' adaptation actions and policy-based responses.			✓	✓	1 – 5 years
Identify opportunities for pilot projects for best-practice ecosystem-based responses that provide greater benefits across the City * To demonstrate benefits of an integrated adaptative approach to whole-of-catchment management. * To demonstrate benefits of an 'outcome' focussed approach to actions that produce multiple benefits across the City.			✓		1 – 10 years
Continue and expand existing monitoring systems to assist in future decision-making and timing of adaptation actions * To ensure current monitoring systems are maintained or improved. * * To ensure adequate information is available to inform decision making and implement actions.	✓	✓		✓	Ongoing
Investigate alternative sand sources for ocean beach nourishment and waterway beach restoration * To ensure continuance of ocean beach nourishment and waterway beach restoration (noting increased demand for sand by other local governments.)				✓	Ongoing
Review and update the corporate Asset Management Policy, Asset Management Strategy and various Asset Management Plans to consider implications of coastal hazards * To elevate consideration of coastal hazards into Council's Corporate asset management framework. * To strengthen planning skills for assets across Council and promote a consistent approach to informing investment decision.	✓			✓	1 – 5 years
Update environmental checklists used for capital or major maintenance works to incorporate the consideration of coastal hazard exposure and risk * To ensure coastal hazard exposure and risk is considered early for all capital or major maintenance works projects.	✓		✓	✓	1 – 5 years
Review stormwater drainage systems and flood mitigation schemes in tidally impacted areas to determine upgrade requirements * Ensure stormwater drainage systems and flood mitigation schemes are able to respond to climate change impacts'			✓	✓	1 – 10 years

Our resilient future – what's next?

Future work

Further work with our stakeholders and the community will be undertaken to determine the interconnectedness of external assets with our infrastructure and services.

Site specific hazard modelling will be undertaken for certain locations to refine understanding and support accelerated actions.

Asset management plans will be updated to consider greater coastal impacts into the future. Monitoring programs will be developed to capture changes along our coastline and inform the timing and nature of responses.

Governance

We will routinely update our relevant strategies, plans and policies to reflect the latest scientific modelling, to continue to address coastal hazards over time as required in the:

- City Plan
- Ocean Beaches Strategy
- Water Strategy
- Our Natural City Strategy.

An implementation plan will be developed which will outline the roles and responsibilities of key stakeholders.

Stakeholders

We will continue working into the future with our stakeholders including:

- Queensland Government agencies
- Local Government Association of Queensland (LGAQ)
- City of Gold Coast Internal Technical Working Group (TWG)
- External Advisory Group (EAG)
- Griffith University Cities Research Institute.

We will monitor and evaluate our progress, and evolve as needed, to ensure our ongoing resilience.

Planning

We will:

- update the City Plan where required
- develop resilient design guidelines
- continue hazard scenario-modelling of our priority areas
- undertake Coastal Precinct Planning
- plan for resilience of infrastructure and services.

Infrastructure

We will support the protection of valuable infrastructure, and will:

- update our asset management plans with the latest innovations
- continually review our design approach to coastal infrastructure
- look for opportunities to avoid coastal hazard risks where practicable.

Engagement

Our community and stakeholders are essential to a coordinated and meaningful response to coastal hazards.

We will continue to:

- liaise with the External Advisory Group
- liaise with our most valuable asset, our community.

Time-frames

Short term

In the short term, we will continue to implement those options which yield immediate benefits to our city and community. The range of actions currently underway via our existing strategies will continue and grow to meet the needs of our community.

Continual improvement of our understanding of coastal hazards in the form of updated modelling and mapping will be undertaken along with community education and engagement and additional monitoring.

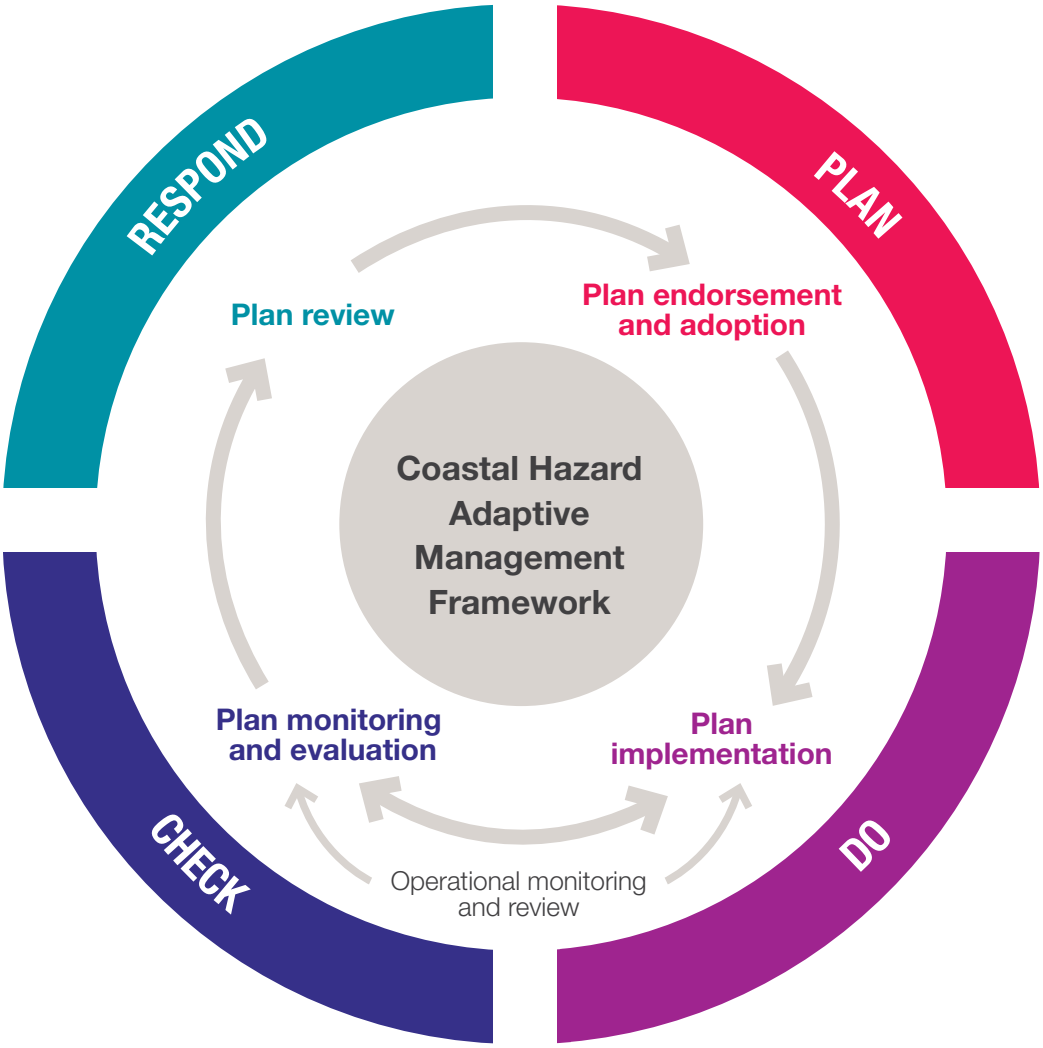
Our Corporate Plan, relevant strategies and City Plan will be reviewed and amended as needed and Coastal Precinct Planning will be undertaken to focus on specific responses to identified risks. We will also continue to review and update emergency response planning as needed.

Medium term

As environmental conditions change and our community grows, strategic adaptation pathways will be followed to support decision making and allow for actions to be prioritised and staggered for flexible management of our coastal environment into the future.

Long term

Our current plans are being developed to consider the projected long-term environmental changes and potential long-term impacts and risks of coastal hazards that have been forecast, including any revision to current forecasts. This will enable time to implement actions that respond to this in a timely manner. When decision points are triggered by environmental or social changes then the next identified action can be implemented.



Adaptable communities and cities need adaptable infrastructure.

Additional resources and sources

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Car bodies and boulders were used to halt the progress of beach erosion on the Gold Coast, Queensland, 1967. Photographer unidentified. Gold Coast Libraries Local Studies Collection.

Car bodies used to try and stop the progress of beach erosion on the Gold Coast, Queensland, 1967. Photographer unidentified. Gold Coast Libraries Local Studies Collection.

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Scarping and damage to beachfront property caused by severe beach erosion on the Gold Coast, Queensland, 1967. Gold Coast Libraries Local Studies Collection.

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- BMT
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- Watertech
- Aither

Government Departments, organisations and coastal adaptation resources:

- Australian Bureau of Meteorology
- Coast Adapt
- Griffith University – Cities Research Institute
- Local Government Association Queensland
- National Climate Change Adaptation Research Facility, Gold Coast
- QCoast$_{2100}$
- Queensland Coastal Councils Compendium – Coastal Hazard Adaptation Options
- Queensland Government

FOR MORE INFORMATION

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