

LIVINGSTONE SHIRE COUNCIL

SHORELINE

MANAGEMENT PLAN



2022 - 2032



Australian Government



Queensland
Government



ecosure
improving ecosystems



Livingstone
SHIRE COUNCIL

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Acknowledgement of Country

The Darumbal and Woppaburra People are the Traditional Custodians of the lands considered in this document. The Darumbal people are the Traditional Custodians of the Rockhampton, Capricorn Coast Area, with Darumbal having a large extent of surrounding sea country to Woppaburra country. The Woppaburra People are the Traditional Custodians of what are now known as the Keppel Islands which lay off the Capricorn Coast in Central Queensland.

Darumbal and Woppaburra people have lived here since creation spirits made this country during the dreaming, and over thousands of generations have developed a deep understanding and knowledge of the plants and animals of this area. Darumbal and Woppaburra people understand the connections between living organisms and the landscape and recognise the importance of maintaining and protecting the natural world around us for future generations.

Livingstone Shire Council acknowledges the Darumbal and Woppaburra People as the Traditional Custodians of this land and pays respect to their Elders past, present, and emerging. Council acknowledges the profound and ongoing relationship the Darumbal and Woppaburra People have to this land, and the knowledge they have of the places, plants, animals, and spirit of this area.

Introduction

Background

Australia's east coast has been a popular location for tourists, businesses, and residents throughout modern history. While people are drawn to the laid-back lifestyle and breathtaking beauty offered by the coast, living in harmony with the shoreline has never been an easy feat – erosion, storm tide inundation, cyclones, storms, and sea level rise are some of the risks associated with life on the coast. Livingstone Shire has seen significant growth in recent years: with residents migrating north during the COVID-19 pandemic and families relocating away from major centres, the area is experiencing a period of significant development. With such growth, there is increasing pressure put on Livingstone Shire's shoreline.

The shoreline is a constantly changing landscape. Beaches and sand dunes are dynamic environments in a continual cycle of erosion and accretion. Sand dunes form a natural protective mechanism, creating a buffer zone between the ocean and the natural and built landscapes behind. The wind, waves, currents, storms, and cyclones associated with Queensland's coasts affect the rate and direction of sand movement within the beach system and thus are responsible for much of the change we see in natural beach systems. In times of high wind and wave activity the dunal system is eroded and sand stored in these areas is deposited offshore. Accretion (the build-up of sand back onto dune systems) is more likely to occur during winter months on the Capricorn Coast when onshore currents deposit sediment travelling north from the Fitzroy River parallel to the coast. Successful accretion requires a healthy, vegetated dune system and a denuded dune is unlikely to recover following an erosion event.

The disruption of these natural processes of erosion and accretion can compromise the effectiveness of the dunal system and reduce its effectiveness as a natural buffer to the forces of the ocean. This can lead to damage or destruction of natural landscapes and built infrastructure such as roads, houses, parks, and playgrounds landward of the dunes. In the past, the reaction to significant erosion events has been the construction of protective structures such as groynes and revetment walls. In some cases, however, these structures have decreased the amenity of the beach and in some instances have further disrupted the local coastal processes and worsened erosion.

Purpose of the plan

Livingstone Shire Council has a multitude of responsibilities regarding the shoreline, including:

- Management and control of most of the coastline (on behalf of the Queensland Government).
- Custodianship of many coastal assets including roads, bridges, footpaths, beach accesses, parks, playgrounds, and more.

-
- Stewardship of the natural assets (flora and fauna) of the coast including sand dunes, native coastal vegetation, migratory shorebird species, turtles, and other animals who live or nest on our beaches.
 - A responsibility to keep members of the Livingstone Shire community as safe as practically possible from the threat of coastal hazards.

With these responsibilities in mind, the Shoreline Management Plan has been developed to assess the status of our shoreline and to provide guidance on management measures to address key issues and further protect our coastal assets and encourage ecosystem resilience. This includes recommendations for on-ground works, nature-based solutions to build environmental resilience, future studies, partnerships, and community engagement that will contribute to the wellbeing and strength of Livingstone Shire's shoreline.

Developing the plan

The 2022 Shoreline Management Plan replaces the 2008 Shoreline Management Plan. Between 2008 and 2022 several significant changes occurred in relation to the coastline which necessitated a full review of the document. These changes include:

- The completion of the Our Living Coast Strategy (Council's Coastal Hazards Adaptation Strategy) in 2021.
- Changes to Council's structure and governing plans, policies, and procedures.
- Changes to Council's approaches to disaster management, natural resource management, and planning.
- Changes to State and Federal regulations regarding the coast.
- Changes to the status of Livingstone Shire's shoreline because of storms and cyclones.
- Changes to the makeup and needs of the community of Livingstone Shire.
- Changes to best practice guidance on coastal management because of improved research and more advanced climate science.

The 2022 Shoreline Management Plan was developed by Ecosure On behalf of Council and included engagement with relevant Council officers, external organisations and community groups, and the broader Livingstone Shire community. Support from the Queensland and Australian Governments, through the Queensland Resilience and Risk Reduction Funding programme, enabled the development of this Plan.

Coastal management in Queensland

Several authorities have responsibilities in coastal management in Queensland. Most State coastal land has been reserved for public purposes under the *Land Act 1994* (including coastal management and protection purposes), is designated as a protected area under the *Nature Conservation Act 1992*, is designated as esplanades or roads, or is unallocated State land. Land reserved for public purposes is usually managed by a trustee, typically a local government authority. Local governments or other trustees must manage these reserves according to the purpose for which they are reserved.

Local governments also typically manage roads and esplanades in coastal areas unless these areas are declared to be state-controlled roads (in which case the Department of Transport and Main Roads takes responsibility for management). The Department of Environment and Science manages protected areas and unallocated State land.

Some coastal land is also managed by private and public bodies with responsibilities for specific infrastructure, such as marinas, public boat ramps, and jetties. These areas are often managed under a lease, reserved for a specified infrastructure purpose, or held as freehold land. Owners and occupiers of private coastal land can also undertake certain activities on their land. These activities must comply with relevant policies and laws which include adhering to requirements of the *Environmental Protection Act 1994* among others.

Review schedule

This plan is based on a ten-year planning horizon (to 2032). At the end of this horizon, a full review of the plan is expected to provide accurate assessments and relevant strategies for the next ten-year period.

It is anticipated that minor reviews of the plan will be conducted:

- Biennially (every two years), or
- Following a major weather event that has significant and widespread impacts on Livingstone Shire's coastline (for example, a severe tropical cyclone), or
- Following major revision of the Coastal Hazard Adaptation Strategy (expected to be updated in 2031), Nature Conservation Act, Environmental Protection Act, or other documentation or strategies with significant relevance to this strategy.

Minor reviews may include actions to remedy beach-specific hazards or issues, policy or legislative changes, or changes to Council's operations, or new funding opportunities.

The study area

The coastline of Livingstone Shire measures approximately 300 kilometres, from the mouth of the Fitzroy River in the south to Stanage Bay in the north. The coastal zone encompasses coastal wetlands, estuaries and inlets, sandy beaches and rocky headlands, townships, offshore islands, and a rich diversity of cultural, economic, and environmental values.

The coastline from Stockyard Point to Cattle Point (at the mouth of the Fitzroy River) is a drowned landscape with a complex topography. This area of coastline is neither totally sheltered from, nor fully exposed to, deep ocean swells due to the position of the reef and islands adjacent to the coast. This means some areas of the Livingstone Shire shoreline experience erosion and accretion at vastly different rates. As a result, the beach profiles increase in gradient from south to north in correlation to the low wave energy experienced in the protected southern area to the higher wave energy of the more exposed northern area.

The Fitzroy River is the key sediment input site on the Livingstone Shire coast, with much smaller amounts of sediment entering the system from creeks and gullies along the shoreline. Longshore currents move sediment from the Fitzroy River catchment in a northerly direction and deposit it on the beaches of Livingstone Shire. A large proportion of the sand on Livingstone's beaches is therefore made up of fine alluvial sediment. The remainder originates from the bed of the Keppel Bay and the erosion of the Holocene sand dunes in the area (which were formed in the last 10,000 years).

Livingstone Shire's shoreline is comprised of multiple tenure arrangements and includes local parks, beach protection reserves, private property, unallocated state land, resorts, esplanades, and roads. The Shoalwater Bay Military Training Area is situated within the Livingstone Shire local government area and encompasses a large stretch of coastline and several important assets including the Corio Bay and Shoalwater Bay Ramsar wetlands (wetlands of international significance). Council staff are in regular communication with Defence Force personnel overseeing the environmental protection of these sites. There are also several small national parks situated along Livingstone Shire's coast, which has allowed for the appropriate management of the fragile terrain and vegetation of these sections. This plan does not incorporate these sites as they are overseen by the relevant government agencies.

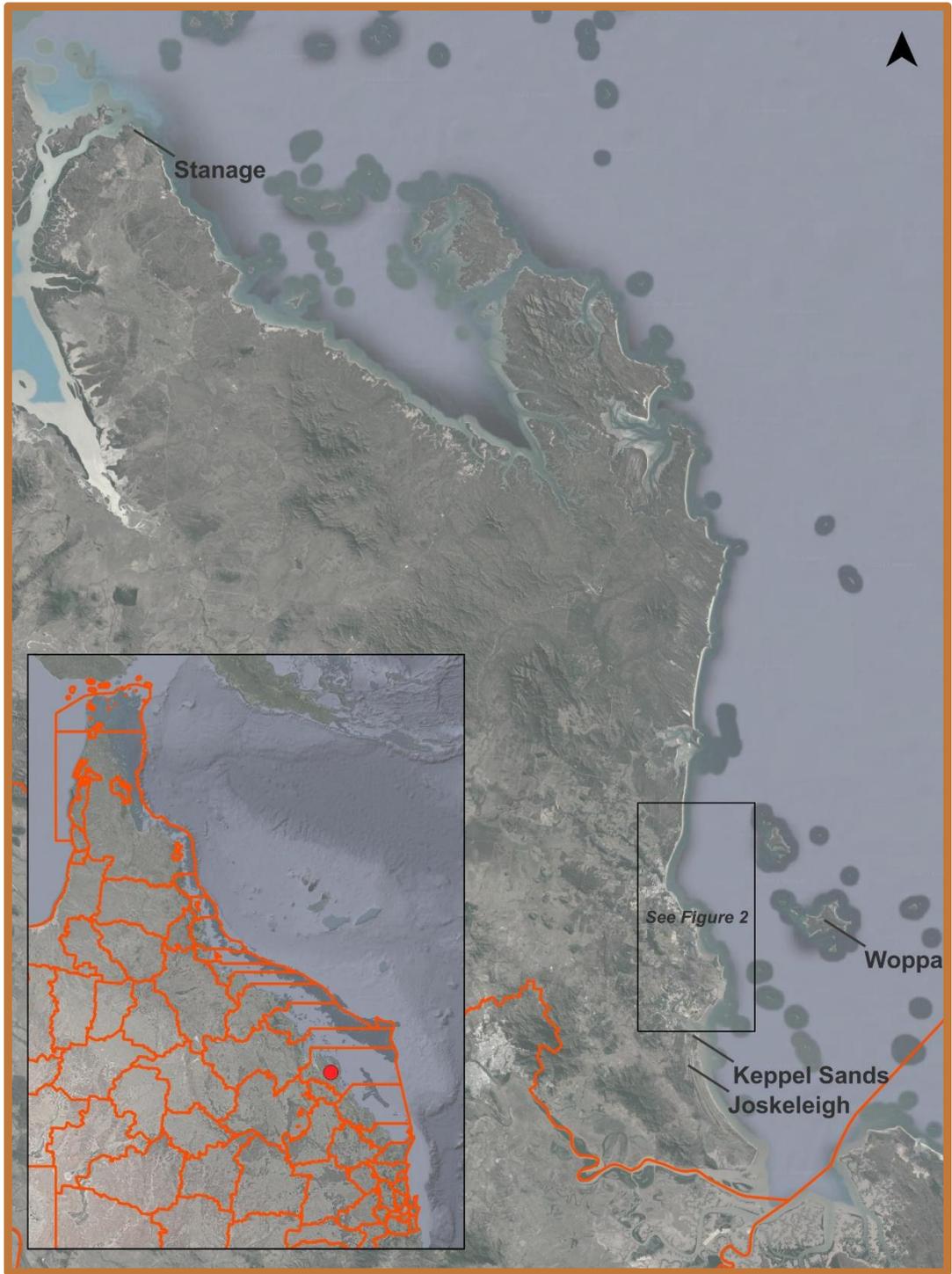


Figure 1: The study area (Livingstone Shire beaches)



Figure 2: The study area (Farnborough to Zilzie)

Stanage

Located at the northernmost point of the shire overlooking Thirsty Sound is the coastal town of Stanage. Separated from other coastal communities in the shire by expansive agricultural and conservation areas, the town is home to 83 people in three village clusters (Plum Tree, Alligator Bay, and Alligator Point). The area is known for its excellent fishing and rich ecology, with Alligator Beach being a significant rookery for the Flatback Turtle.

The two villages near Alligator Point have direct access to a protected beach backed by a vegetated foreshore and beachfront properties on Schnapper Drive. Accommodation is available to visitors in the village near Alligator Point. The third and largest village, Plum Tree, is located further west along Banksia Road and features a boat ramp, Coast Guard, shop/post office and residential properties. While the settlement is largely located on elevated land, the area is characterised by low lying agricultural areas and extensive natural areas similarly found within nearby Broadsound Islands National Park, Charon Point Conservation Park and Shoalwater Bay Conservation Park.

While the coastline around Stanage is somewhat protected by many offshore islands, it is exposed to northerly and easterly winds. Large tides and fast tidal currents are typical in this area. The shoreline is made up of rocky headlands and sandy bays.

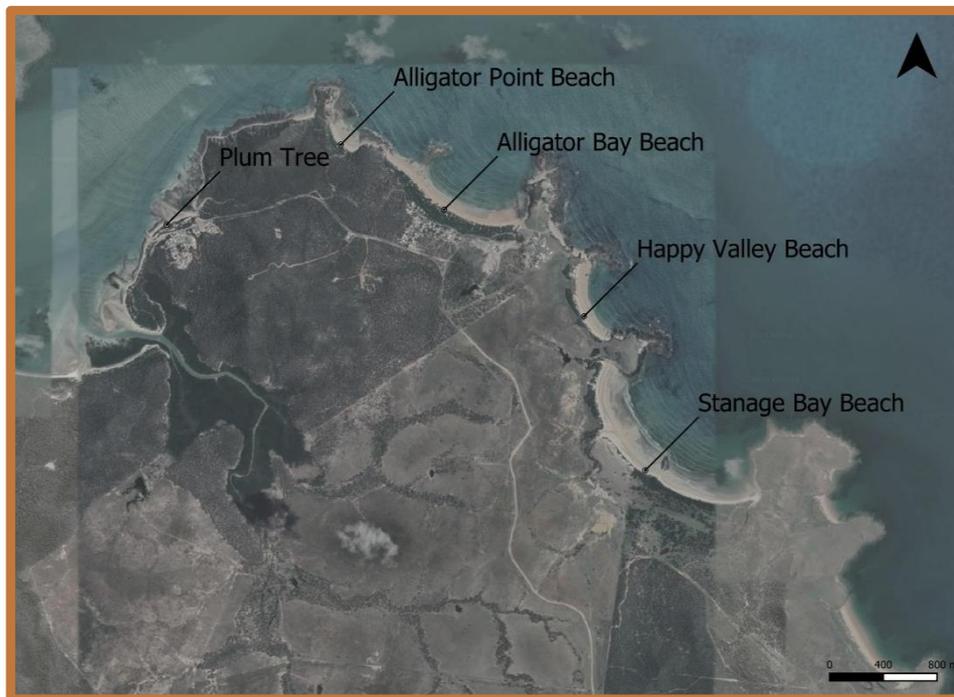


Figure 3: Stanage

Farnborough and Bangalee

This section of the coastline extends from Corio Bay in the north to Spring Head in the south. The area is dominated by large extents of agricultural and conservation areas which form part of Byfield National Park. The infrastructure of the former Capricorn International Resort still covers a substantial area within Farnborough. Rural residential properties are scattered throughout the southern area around Farnborough Road. The beach and dune system along the northern section of this beach is mostly undeveloped, with more developed sections closer to Yeppoon at Bangalee and Todd Avenue.

The sand on Farnborough Beach is derived from a mix of relic sands and Fitzroy River sediment. This section of the coastline is influenced by onshore transport as well as a southerly nearshore longshore current in the north.

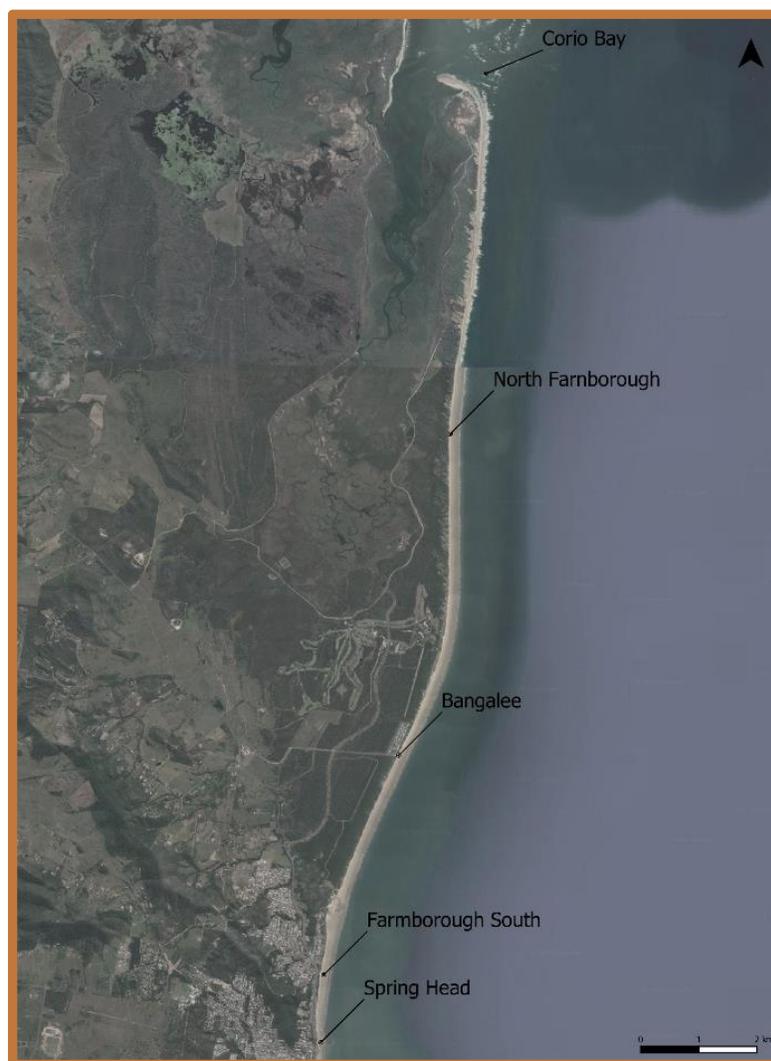


Figure 4: Farnborough and Bangalee

Yeppoon and Cooee Bay

The section of coastline incorporating Yeppoon and Cooee Bay forms the commercial and tourist centre of the Shire with around 9,500 residents. The Yeppoon centre includes a variety of low to medium scale land uses that have commercial, retail, business, social, and employment functions. The centre and surrounding residential areas are located adjacent to an expansive recreational foreshore parkland that is a hub for social and active recreation and includes surf and sailing clubs.

Yeppoon Main Beach is a 1.4-kilometre-long sandy beach, extending from the low intertidal rocks at Spring Head to the mouth of Ross Creek, where there is a small breakwater. Ross Creek creates a natural separation between the long stretch of beach at Yeppoon and the small beaches of Fisherman's Beach and Cooee Bay. Offshore of this section, an advective current transports sediment from the Fitzroy River north. The onshore current then deposits this sediment along the coast. This section of the shoreline is therefore made of predominately Fitzroy River and Coorooman Creek sediment.



Figure 5: Yeppoon and Cooee Bay

Lammermoor, Rosslyn, and Kemp Beach

From Wreck Point to Bluff Point, this section of the shoreline is home to around 2,700 people, most of whom live around Lammermoor Beach. These beaches are popular with locals and visitors and provide important natural protection to coastal infrastructure. Lammermoor and Kemp Beaches are backed by vegetated foredunes and Scenic Highway, with beachfront residential properties at the northern end of Lammermoor Beach and in Statue Bay.

Rosslyn Bay Harbour is located within this coastal stretch and serves as a hub for the local marine industry, recreational activities, and coastal tourism. It is the only all-tide, open water access point on the Capricorn Coast. Like the beaches of Yeppoon and Cooee Bay, these beaches are comprised of sediment from the Fitzroy River and Coorooman Creek.

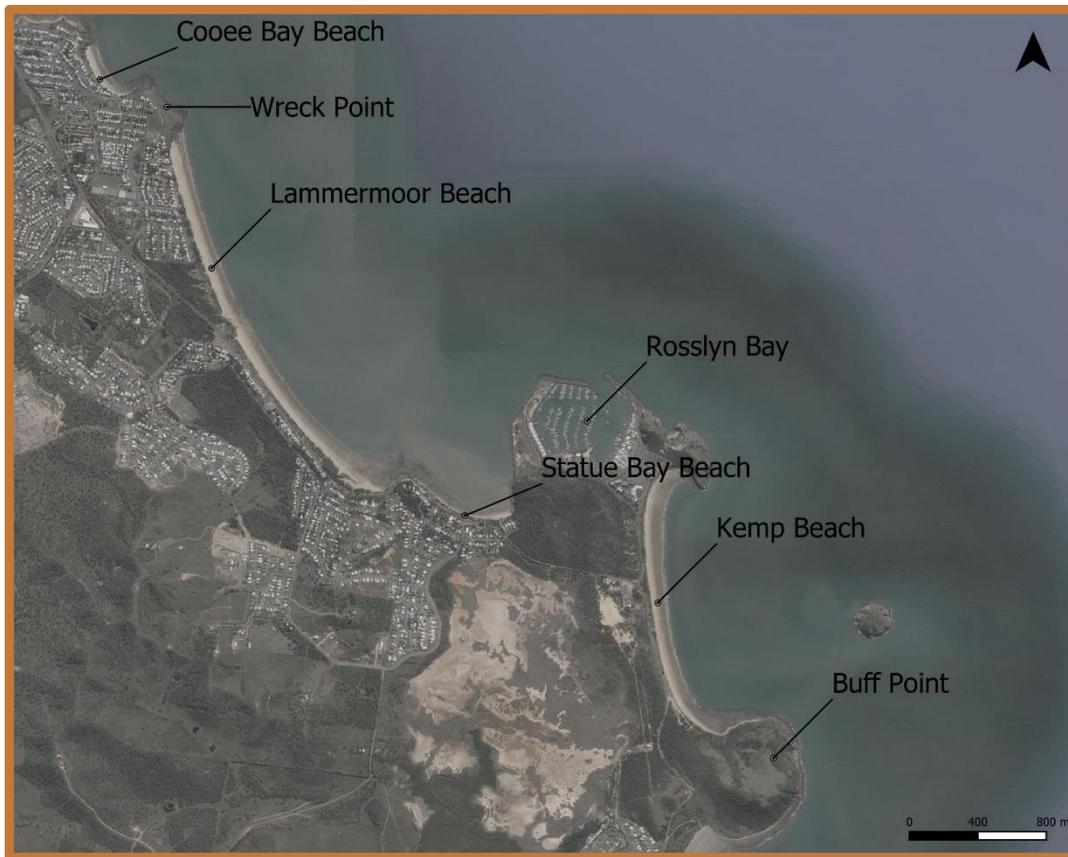


Figure 6: Lammermoor, Rosslyn, and Kemp Beach

Mulambin, Causeway Lake, and Kinka Beach

Mulambin and Kinka Beaches form the coastline between Bluff Point in the north and Kinka Creek to the south. The area has a combined population of 1,663 people. Coastal land in this area includes cultural heritage sites of high value. Mulambin Beach lies on the south side of Bluff Point and extends to the vegetated peak of Pinnacle Point which offers scenic coastal views. It is backed by casuarina-covered dunes, the Scenic Highway, and residential areas including a popular caravan park.

Causeway Lake is a shallow, man-made lake located at the northern end of Kinka Beach which was created in 1939 by construction of a bridge and rock wall across the mouth of Mulambin Creek. Kinka Beach is a long beach with extensive tidal sand flats. Backed by a dune system, buried seawall, and the Scenic Highway, the area supports a caravan park and residential properties. The beach ends at Kinka Creek which is an important wetland and a haven for native wildlife. Sediment from the Fitzroy River and Coorooman Creek make up the sand of these beaches.

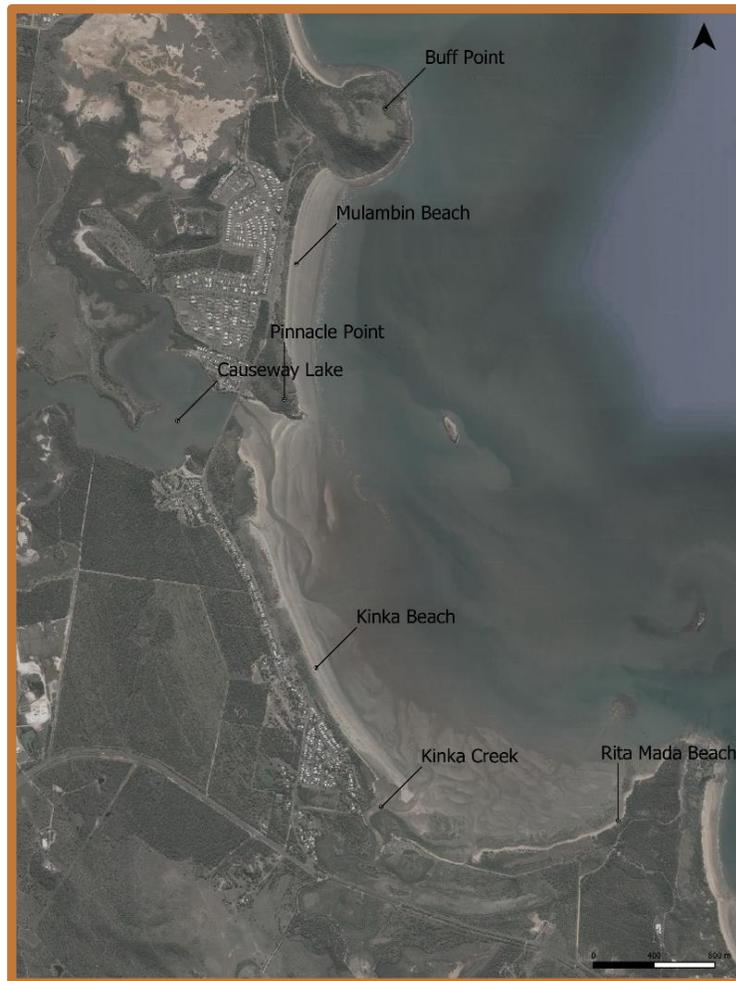


Figure 7: Mulambin, Causeway Lake, and Kinka Beach

Emu Park and Zilzie

This section of Livingstone Shire's coastline is characterised by a mix of long embayments and smaller beaches between rocky outcrops. Emu Park Main Beach and Fisherman's Beach are the most popular amongst the community and visitors. Bell Park and Kerr Park, also located on the foreshore, support a variety of active play equipment and the Surf Life Saving Club. More recently, the Anzac Memorial developed between Emu Park Main Beach and the Singing Ship have drawn high numbers of visitors, while the Fisherman's Beach Caravan Park continues to service the needs of tourists.

Further south of Emu Park is Zilzie which extends down to the mouth of Coorooman Creek. The southern end of Zilzie is an emerging residential area nestled between Svendsen's Beach foreshore and the creek. The Coorooman Creek boat ramp is a favourite amongst locals for boating and fishing activities. These beaches, like those further north, are fed by sediment from the Fitzroy River and Coorooman Creek.

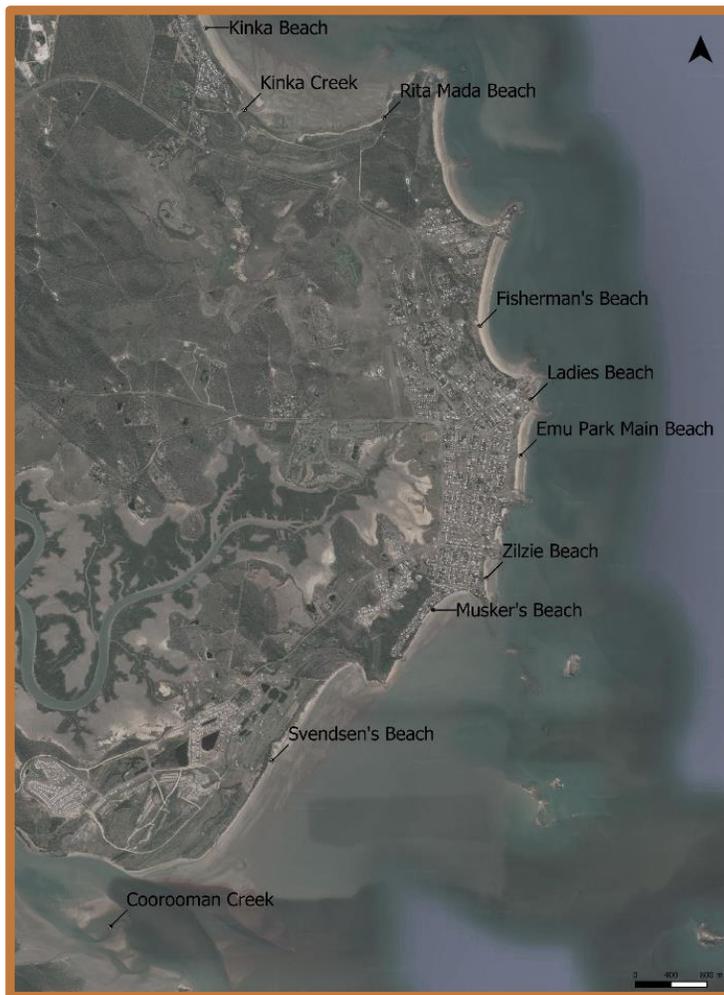


Figure 8: Emu Park and Zilzie

Keppel Sands and Joskeleigh

Keppel Sands is separated from Emu Park to the north by Coorooman Creek and Joskeleigh to the south by Pumpkin Creek. The town is surrounded by dense wetlands which are important habitat for native wildlife. Schofield Parade, a key residential street, has historically experienced erosion, resulting in the construction of an informal seawall and a groyne which assisted in reforming the dunes in the northern foreshore area.

Joskeleigh is small rural settlement five kilometres south of Keppel Sands and is the southernmost coastal community in the shire. It is home to seventy people and has forty houses on large properties. The eighteen-kilometre-long beach (locally known as Long Beach) experiences low levels of community use given the rural nature of and limited access to the area. The beach is backed by a broad foreshore area characterised by grassy dunes and coastal wetlands which have important ecological functions. The area has high historical cultural significance associated with South Sea Islander settlements.

A northerly nearshore longshore transport current helps move sediment from the Fitzroy River along the adjoining beach system. Onshore transport from the sediment-laden advective offshore current also moves sediment northward along these beaches.



Figure 9: Keppel Sands and Joskeleigh

Woppa (Great Keppel Island)

Approximately fourteen kilometres east of Rosslyn Bay, Woppa (Great Keppel Island) is the largest island in the group of islands often referred to as the Keppel Group. The Keppel Group is the traditional home of the Woppaburra People and includes Konomie (North Keppel Island), Mamalonbi (Myall Island), Ballaba (Middle Island), Burye Burye (Humpy Island), and others. In 2014 the Woppaburra People's Traditional Use of Marine Resources Agreement (TUMRA) came into effect. It covers 561 square kilometres of the Great Barrier Reef Marine Park and was the first offshore agreement of its kind. In 2021 the Woppaburra People were formally recognised as native title holders over 567 square kilometres including Woppa (Great Keppel) and Konomie (North Keppel). Woppa is home to a small residential community as well as holiday accommodation and camping facilities. Woppa has seventeen sandy beaches which are located between rocky headlands, with some beaches exposed to ocean swell while others are protected by surrounding islands. Much of the island is undeveloped and contains large tracts of bushland.

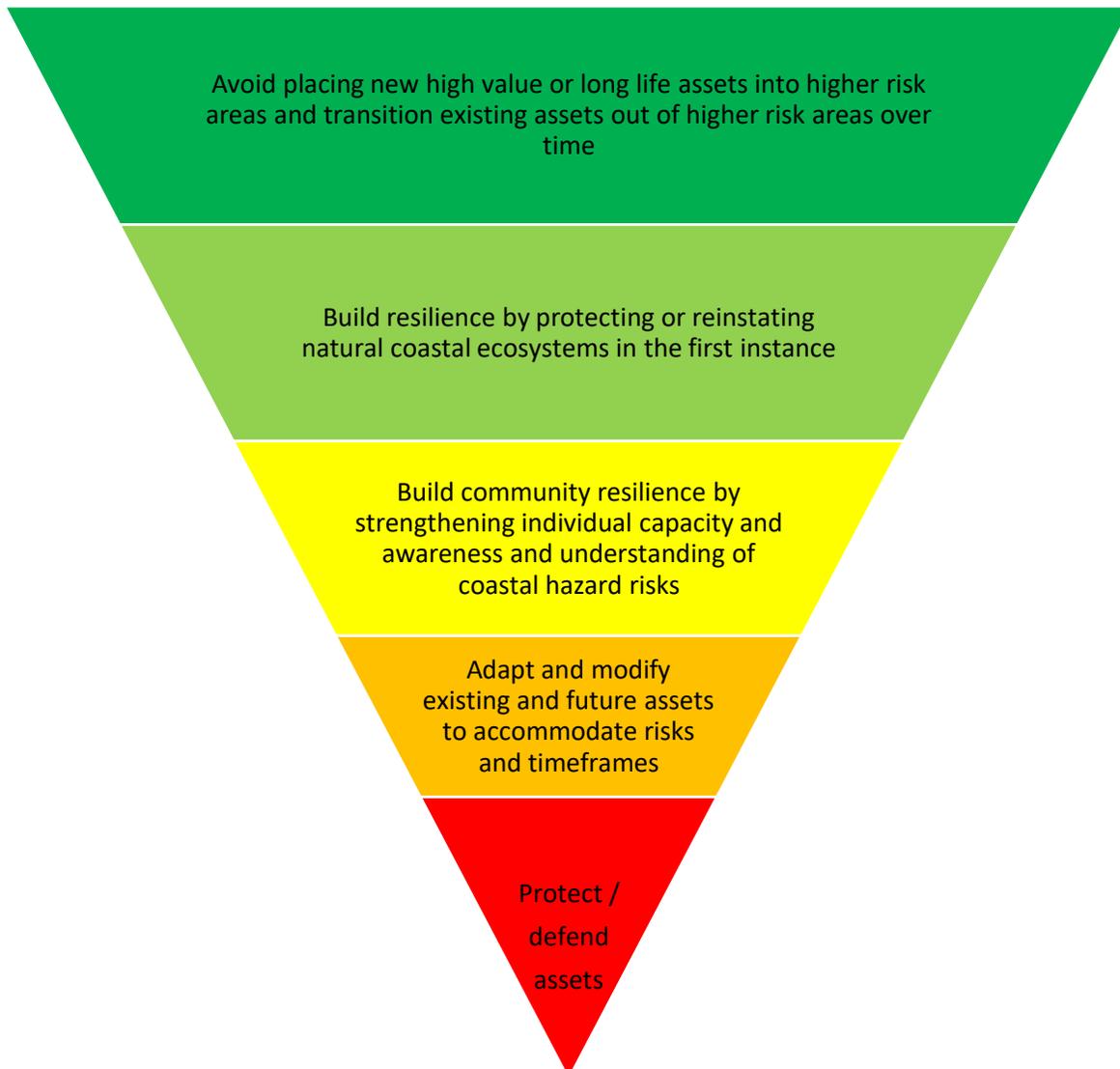
Fisherman's and Putney Beaches are the most frequented beaches on the island with close proximity to accommodation and recreational activities. These two beaches are subject to westerly and northerly winds. Extensive erosion during Tropical Cyclones Marcia (2015) and Debbie (2016) caused extensive erosion and damage to assets around Putney Beach, which resulted in the installation of a geotextile revetment wall. Several issues have left much of this revetment wall exposed and the structural integrity of the wall was, at the time of writing this Plan, uncertain. The preference of the Woppaburra People is to avoid the use of hard infrastructure and to embrace natural coastal processes on the island.



Figure 10: Woppa (Great Keppel Island)

Shoreline management options

Throughout the development of the Our Living Coast Strategy, Council undertook extensive community and stakeholder engagement to develop a series of adaptation approaches. These approaches reflect both the community's desire and Council's aspiration to maintain the beauty and natural functioning of Livingstone Shire's coastline wherever possible. A hierarchy of preferred adaptation approaches was developed as a result, which equally applies to the Shoreline Management Plan. In order from first to last preference, the adaptation approaches available to Livingstone Shire are:



Within this hierarchy, the highest value is placed on the solutions which have greatest value for money (lower cost and higher impact) and are less likely to impact the function or amenity of the coastline. Those options which are less desirable (adapting and modifying assets and protecting/defending assets using engineering solutions) are those that are higher cost, have a benefit to only small sections of the coastline, and are likely to affect the natural functioning and appearance of the coast.

Maintain and improve

These actions maintain the current risk profile. These actions rely strongly on regular monitoring to understand the extent of coastal change at the local level and to identify when a trigger point for management is reached. These actions also include activities and programs often already being undertaken such as community awareness raising, active management of natural areas and ecosystems, emergency response, land use planning and asset management.

Some of these actions, particularly ecosystem management, have a direct benefit to the coastline and can, when done effectively, reduce the level of risk to further coastal impacts. While some other actions do not directly reduce the risk of coastal hazards, they are important to improve and strengthen the resilience of our coastal system over time. Without these actions, determining when further intervention will be required is likely to be challenging.

Monitor

Monitoring will inform how risk profiles are changing over time and if adaptation actions are appropriate and effective. Monitoring will also improve Council's and the community's understanding of coastal processes and coastal hazards over time. Monitoring covers a wide variety of activities and may involve examining beach condition, changes in mangrove and vegetation coverage, turtle nesting periods and use of beaches, changes in dune habitat coverage and dune stability, and other measures.

Community awareness and education

This includes building on existing Council programmes and resources as well as coastal hazard specific campaigns and communications materials including signage, events and newsletters, and social media. Messaging could include information about local coastal hazards, risks, monitoring and adaptation mechanisms, as well as the significant flora and fauna found within the coastal zone of Livingstone Shire.

Emergency planning and response

These management options may include monitoring and early warning systems, including evacuation strategies and community engagement. Council, State Emergency Service, volunteers, and local disaster management

groups are particularly key in leading the response to keep the community safe. Council's Disaster Management Plan provides information on preparation, response, and recovery to potential coastal hazard events.

Ecosystem management

These options seek to support and strengthen natural coastal habitats, dune processes, and protect and restore degraded wetland habitat through habitat management programs such as planting of vegetation on dunes, and within and around wetlands and waterways. Special consideration will be given to the protection and management of turtle nesting areas and migratory bird habitat. Of note are the two Ramsar wetland areas located within Livingstone Shire boundaries (though managed by State and Federal Government agencies) at Corio Bay and Shoalwater Bay. Strengthening and supporting natural systems provides both ecological and amenity benefits and provides an opportunity to involve and build community capacity to manage coastal hazard risks and undertake monitoring.

Geotechnical investigation and detailed erosion study

The selection of adaptation responses in some areas will benefit from site-specific geotechnical investigation and detailed erosion studies to better understand natural coastal hazard processes at the local level. Geotechnical investigations can also locate potential offshore sand reserves for beach nourishment purposes.

Planning responses

These adaptation options involve implementing land use planning responses that are risk appropriate for the location in the coastal hazard area. Land use and development policy, and zoning and development controls will be used to maintain the current risk profile in areas of acceptable and tolerable risk. In coastal hazard areas where the risk is high or intolerable, land use planning will be used to reduce or avoid increasing the future risk exposure of people, buildings, community facilities and infrastructure.

These actions build on current planning scheme requirements and may also involve development controls such as setbacks and planning processes such as master planning or trigger-based development approvals. Particular attention will be given to avoiding future vulnerable uses and people (e.g., aged care, schools, hospitals, emergency services) and reducing the future intensity of uses within higher risk areas.

Modify

These adaptation actions actively seek to 'modify' and reduce the risk of current and future coastal hazards and apply to coastal hazard areas where the risk is intolerable or will become so in the future. These actions include various engineering (soft and hard) options and hazard resilient design measures to protect assets and reduce the impacts of coastal hazards.

Soft engineering approaches

These approaches seek to protect beaches and foreshore areas from coastal hazards using localised soft engineering solutions, such as:

- Dune construction and restoration - artificial construction of new dunes or improving the function of existing dunes using imported sand from inactive sand sources.
- Dune augmentation - increasing the crest height/width or functional integrity of existing dunes through the addition of imported sand from offshore/inactive sand sources.
- Beach nourishment - manual placement of sand on the beach using inactive sand sources to maintain existing beaches and dunes.
- Beach scraping - manual pushing of a thin layer of sand from the beach face (above high tide) towards the dunes to stabilise dunes from further slumping; usually implemented following minor erosion.

Implementation of these actions is intended to complement the existing function of natural areas and should only be undertaken where and when it is environmentally appropriate to do so. Seasonal changes including turtle and bird nesting periods need to be considered in decision making processes.

Hard engineering approaches

Hard engineering solutions to protect areas adjacent to foreshores and creek outlets from coastal hazards include:

- Levees/dykes - an artificial barrier often constructed of earth covered in vegetation to prevent inundation.
- Seawalls/scour protection - a wall or embankment constructed of rock or concrete along the dune parallel to the beach or along a waterway to stop coastal erosion. Can be designed to also limit inundation.
- Groynes and artificial headlands - an artificial barrier constructed perpendicular to the beach to trap and hold beach sediments.
- Tide flaps or valves on stormwater pipes - permit one-way flow only and stop saltwater flowing upstream.
- Tide gates - permanent artificial barriers across a waterway to stop elevated water levels from moving to upstream areas.
- These approaches are not preferred by Council and will be considered only where other adaptation options are unavailable or have failed. This is because these approaches are costly, impair the visual amenity of coastal areas, do not provide guaranteed results, and can impede natural processes in coastal areas.

Modify infrastructure and hazard resilience design

These strategies allow for the continued use of infrastructure, buildings, and assets where the coastal hazard risk is acceptable or tolerable, but when upgrading or building new assets, the design is to be resilient to or accommodate coastal hazard impacts.

Appropriately locating and designing roads, water, drainage, wastewater and solid waste treatment, electricity and telecommunications can help services to remain operational during and after a coastal hazard event. Examples include raising land levels and building on piles to increase the height of building floor levels to reduce the level of exposure to temporary inundation. Asset management and maintenance decisions are informed by a complete understanding of coastal hazard risks, and asset owners should consider implications for the design life and resilience of assets to coastal hazards.

Planned transition

These strategic adaptation actions involve planned or managed interventions to transition an area to an alternative land use and may involve the relocation of assets that are exposed to unacceptable risks.

Relocate infrastructure

This involves the relocation of assets, infrastructure, and buildings to lower risk areas or outside of the coastal hazard extent. Monitoring will be important to determine when relocation may be socially and economically acceptable.

Accept risk and embrace coastal processes

These actions involve embracing natural coastal processes without intervention or change to current management arrangements, including:

- Acknowledge and accept natural cycles of accretion and erosion.
- Accept loss of land affected by coastal hazards on unprotected shorelines.
- Allow coastal dunes and habitats to migrate landward.
- Allow dunes to recede without intervention and accept there will be damage or loss to infrastructure.

Management issues, options, and recommendations

Stanage

Current condition

Erosion/accretion

The area of Stanage includes Plum Tree, Alligator Point Beach, Alligator Bay Beach, Happy Valley Beach, and Stanage Bay Beach. Most of the bays and headlands are in an easterly position with exposure to wind and wave activity from the north and the east. Plum Tree faces north and is sheltered from the same wind and wave activity. There are some offshore islands to the southeast and northeast, which provide some shelter from prevailing winds and waves. The beaches bounded by headlands have minimal sand movement as a crenulated bay provides an ideal stable beach environment. However, rough seas and large tides from the east and north can contribute to erosion processes while calmer south easterly and westerly seas and winds allow for sand accretion to occur.

The western coast of Stanage is in a sheltered area from both the mainland and several islands. The Styx River and Herbert Creek both enter the ocean on the western side of Stanage and therefore provide a large amount of sediment for the beaches on that side. The estuaries also provide fine sediment for the extensive mudflats that are present along the sheltered coastline between Stanage and Quail Island.

The erosion prone area of Alligator Point Beach extends approximately fifteen metres from the toe of the dune. The erosion prone areas of Alligator Bay Beach, Happy Valley Beach and Stanage Bay Beach, extend between 120 to 135 metres from the toe of the dune.

There are ten properties, which may be partially within the erosion prone area at Stanage Bay:

- One property at Plum Tree (Thirsty Sound Volunteer Coast Guard),
- Seven at Alligator Bay Beach, and
- Two at Alligator Point.

Eight of the ten properties appear to be either permanent or holiday residences. Schnapper Drive at Alligator Bay and Banksia Road (including the boat ramp) are mapped within the erosion prone area or will be impacted by sea level rise.



Figure 11: Erosion prone areas in Stange

Field assessments undertaken in April 2022 found that erosion was most notable along Alligator Point Beach, where impacts included tree loss along the foredune.



Figure 12: Erosion leading to tree loss at Alligator Bay Beach

Recommendations

- Increased monitoring of erosion along beaches with adjacent residential areas, such as Alligator Bay Beach and Happy Valley Beach.
- Future developments should be located outside of the mapped erosion prone areas where practicable.

Vegetation

The Stanage Bay area contains a variety of native vegetation including large areas of remnant vegetation. Vegetation adjacent to the beaches at Alligator Point Beach and Alligator Bay Beach is ‘of concern’ coastal vine forest (beach scrub) and goats foot (*Ipomea pes-caprae*), and beach spinifex (*Spinifex sericeus*) with coastal she-oak (*Casuarina equisetifolia*) low woodland. Outside of these areas the vegetation is typically *Eucalyptus* dominated woodlands to open woodlands. There are also sections of mudflats to the west that support extensive mangrove communities. The rocky headlands at Alligator and Arthur Point are home to other ‘of concern’ vegetation communities including *Lophostemon* species, *Acacia* species, *Eucalyptus* species, *Allocasuarina littoralis* (black she-oak) and *Melaleuca viridiflora* (broad-leaved paperbark) tall open shrubland, and other tussock grass and shrubland communities.

Further information on the regional ecosystems corresponding to those broad vegetation groups can be found in Appendix 1.

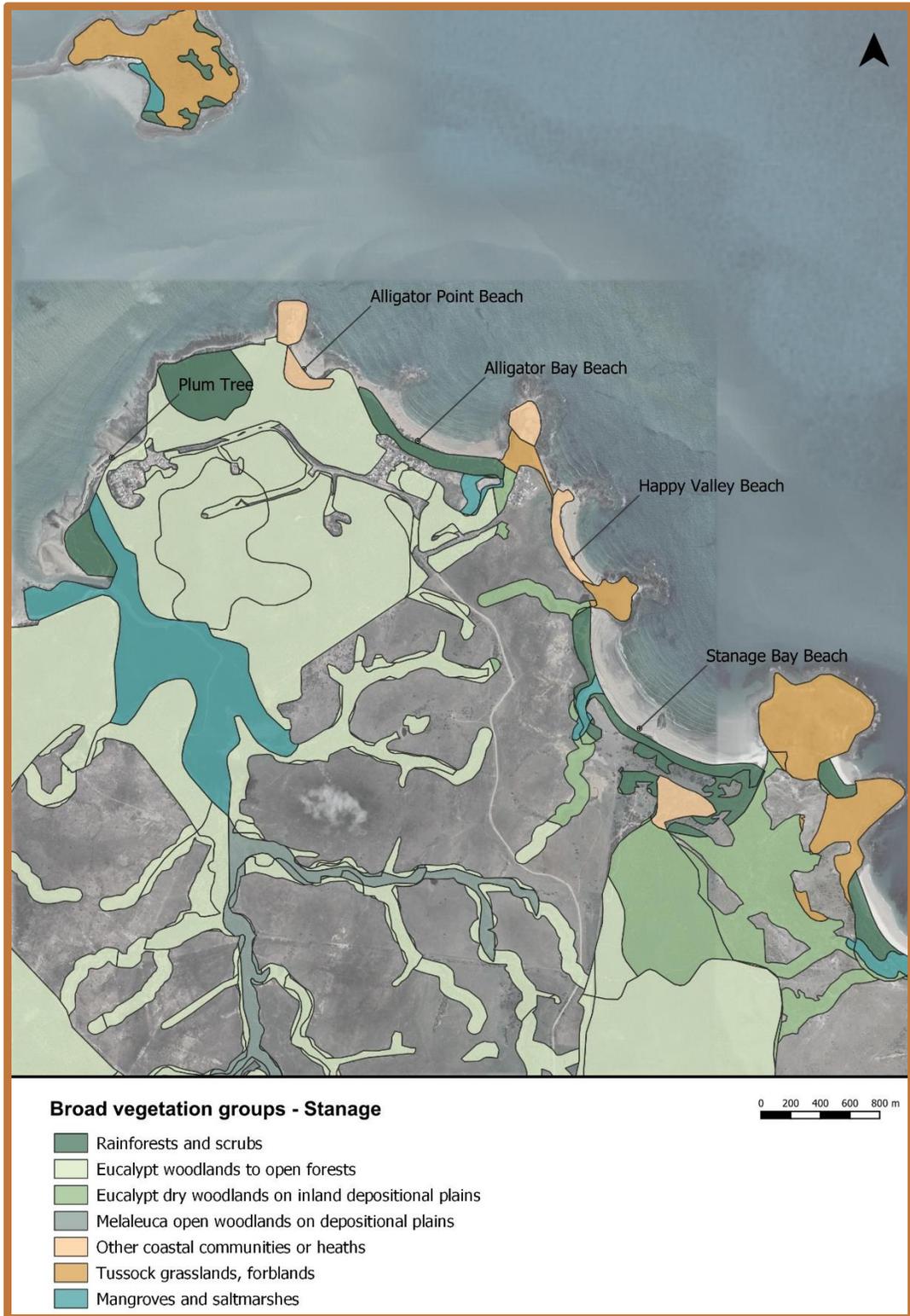


Figure 13: Dominant broad vegetation groups (regulated vegetation) in Stange

During field assessments of the Stanage area several weeds were identified along the shorelines. Weeds in the dunal area included mother-of-millions (*Bryophyllum* spp.), prickly pear (*Opuntia stricta*), mothers-in-law tongue (*Dracaena trifasciata*), agave (*Agave* spp.), Jamaican snake weed (*Stachytarpheta jamaicensis*), Mossman River grass (*Cenchrus echinatus*), Guinea grass (*Megathyrsus maximus*), Leucaena (*Leucaena leucocephala*), periwinkle (*Apocynaceae* sp.) and red natal grass (*Melinis repens*). Weeds at Stanage Bay, especially in the foredune and amongst coastal vegetation, pose a threat to overall vegetation health and condition. Management of weeds is a priority but the removal of weeds (especially within the foredune) should be done in conjunction with revegetation/restoration activities, so that the dune stability is not compromised.

Some previous vegetation vandalism was observed during field assessments including removal of trees for firewood by campers and removal of vegetation to create a four-wheel-drive access track to Alligator Bay Beach. It was also noted that vegetation dieback of vine thicket (beach scrub) communities appeared to be occurring along the beach front at Alligator Bay Beach in isolated areas. The cause was unclear, however could be due to direct exposure to the beach with no other vegetation buffer.



Figure 14: Cleared area for vehicle access



Figure 15: Tree removal on foredune

Recommendations

- Communicate with the property owners adjacent to the shoreline and implement a community education program to encourage community custodianship over coastal areas and discourage the removal and replacement of native vegetation.
- Pest management program to be worked in conjunction with a coastal ecological restoration plan.
- Endemic species to be used for revegetation activities, based off the regional ecosystem(s) present at the revegetation site.
- Monitor native vegetation dieback at Alligator Bay Beach.
- Create a strategy to address dune vegetation vandalism and implement educational signage. Increased monitoring will be required to assess if the educational program is effective or if other measures need to be considered.

Public access and facilities

Stanage has limited public access and facilities along the coast. The beach can be accessed at Plum Tree from the boat ramp. Stanage is very popular with fisherman, and the implementation of a sheltering rock wall and pontoon has made launching and retrieving vessels much easier, however the carparking and access is unsealed and at the time of the assessment was washed out with potholes. There is a public toilet at the Plum Tree boat ramp but no bins obviously available which has led to some people leaving rubbish around the boat ramp.

Alligator Point Beach can be accessed via a four-wheel drive track via Banksia Road, which leads to a campground which does not have any facilities. There was no vehicle access to the beach due to the installation of bollards and large rocks. The camp was clean at the time of assessment.

Alligator Bay Beach can be accessed via Schnapper Drive to another campground above the foredune. The camp has no facilities, and there was signs of rubbish and vegetation vandalism surrounding the camp. A four-wheel drive access track to the northern end of the beach had been cleared. Four-wheel drive activity was noted along the dune and above the high tide line which are sensitive areas for turtle nesting.

Stanage Bay Road has seen significant improvements since the previous shoreline management plan (2008), and as the area becomes more accessible the public, access and facility issues will only be exacerbated.

Recommendations

- Close four-wheel drive vehicle access to Alligator Bay Beach.
- Investigate land/reserve available for public toilets, tables and barbecues in an area that suits the public, community, and council goals.
- Update dated educational signage around Alligator Bay Beach.
- Design and install signage at boat ramps encouraging visitors to take rubbish home with them.

Land tenure

The majority of Stanage Bay is zoned for Environmental Management and Conservation, except for existing residential lots which are zoned as township under the Livingstone Shire Planning Scheme 2018. The land tenure of Stanage is made up of Freehold, Reserve, and State and Lease Land. Most of the shoreline and adjacent land is State Land except for the reserve area near Plum Tree Beach. This reserve is for environmental purposes and has a trusteeship with the Department of Natural Resources. The beaches (low to high water mark) within this beach unit are currently not gazetted (no registered plan number) or listed in the Parks and Reserve Register which can cause compliance issues with Local Laws.



Figure 16: Land tenure in Stanage

Recommendation

- Designate and assign a lot number to the beaches and adjacent areas (including road reserves where roads will not be constructed) and zone as Environmental Management and Conservation areas.

Urban pressures

The development pressures on the shoreline are of great importance as the type and quantity directly relates to current and future maintenance and management required. The following urban pressures were identified for Stanage:

- Existing and future visitors using the boat ramp and adjoining lands for vehicle parking.
- Illegal camping in dunal/open grassland areas adjacent to beach communities.
- Future development – should camping grounds be formalised, the location will see an increase in pedestrian access and recreation facility demands upon beaches.

Recommendations

- Consult with the resident community and visitors in order to develop a plan outlining the position for future camping grounds, placement of public facilities, and accesses.
- Increase and formalise the car and boat parking area at Plum Tree boat ramp outside of the erosion prone area.
- Signage to discourage illegal camping.

Stormwater outflows

The Stanage area does not have stormwater infrastructure, therefore there are no constructed stormwater outflow points. Roof water from residential areas is used to fill rainwater tanks to supply water. All stormwater from the area that naturally enters the beach zone enters through the dunes, across the surface or via gullies, creeks, and natural drains. From the Alligator Bay Beach camp area, channelling through the dune has occurred from stormwater runoff. Control measures have been previously implemented to address the channelling; however, the coir logs have degraded, and the channelling has become deep and wide.

Considering the small size of the community and reduction in runoff from roof water capture, the stormwater of Stanage can be classed as healthy overall.

Recommendation

- Address channelling from the Alligator Bay Beach camp area soon. This may include replacement of coir logs and concurrent planting to stabilise the area.

Storm tides

There is no storm tide data for Stanage Bay.

Recommendation

- Complete storm tide assessment/mapping of Stanage Bay area.

Areas of high conservation value

Stanage is an area of high conservation value with diverse fauna and flora. Alligator Beach is a known turtle rookery with turtles and other marine animals feeding in Alligator Bay. The proximity of Stanage to Shoalwater Bay, as well as the dugong protection areas, increases the conservation value of this area.

Areas of Indigenous cultural significance may be located within this beach unit. Prior to commencement of any works, it is recommended that consultation with the local Indigenous community be conducted. This will ensure areas of cultural significance are protected and maintained.

Recommendations

- Ensure future projects do not have a detrimental effect on the turtle rookery.
- Consult the local Indigenous community before any works occur.

Management practices

Council responds to coastal management issues in the area on an as-needs basis. Longer term planning and adaptation strategies are listed in the Our Living Coast Strategy (Council's Coastal Hazards Adaptation Strategy).

Issues

- Beaches not being gazetted and designated as Environmental Management and Conservation areas can lead to issues with Councils' enforcement of local laws.
- Littering and waste in dunes.
- Destruction and vandalism of native vegetation around campgrounds.
- Unregulated vehicle access to beaches.
- Limited parking and waste facilities associated with the boat ramp.
- Weed infestations within foredunes.
- Isolated dieback of beach scrub/vine thickets at Alligator Bay Beach.

Recommendations

- Communicate with the property owners adjacent to the shoreline and implement a community education program to encourage community custodianship over coastal areas and discourage the removal and replacement of native vegetation.
- Increased monitoring of erosion along beaches with adjacent residential areas, such as Alligator Bay Beach and Happy Valley Beach.
- Future developments should be located outside of the mapped erosion prone areas where practicable.
- Pest management program to continue and be worked in conjunction with a coastal ecological restoration plan.
- Endemic species to be used for revegetation activities, based off the regional ecosystem(s) present at the revegetation site.
- Monitor native vegetation dieback at Alligator Bay Beach.
- Create a strategy to address dune vegetation vandalism and implement educational signage. Increased monitoring will be required to assess if the educational program is effective or if other measures need to be considered.
- Close four-wheel drive vehicle access to Alligator Bay Beach.
- Investigate land/reserve available for public toilets, tables and barbecues in an area that suits the public, community, and council goals.
- Update dated educational signage around Alligator Bay Beach.
- Design and install signage at boat ramps encouraging visitors to take rubbish home with them.
- Designate and assign a lot number to the beaches and adjacent areas (including road reserves where roads will not be constructed) and zone as Environmental Management and Conservation areas.
- Consult with the resident community and visitors in order to develop a plan outlining the position for future camping grounds, placement of public facilities, and accesses.
- Increase and formalise the car and boat parking area at Plum Tree boat ramp outside of the erosion prone area.
- Signage to discourage illegal camping.
- Address channelling from the Alligator Bay Beach camp area soon. This may include replacement of coir logs and concurrent planting to stabilise the area.
- Complete storm tide assessment/mapping of Stanage Bay area.
- Ensure future projects do not have a detrimental effect on the turtle rookery.
- Consult the local Indigenous community before any works occur.

Farnborough and Bangalee

Current condition

Erosion/accretion

Farnborough Beach is mostly sheltered from prevailing southeast winds and waves by Konomie (North Keppel Island) and Woppa (Great Keppel Island). A sand spit has formed at the northern end of the beach and is subject to more wind and wave action than the southern area. Consequently, due to the greater sediment transport in this area, the dunes are higher and more susceptible to blowouts than the southern area of Farnborough Beach.

The Department of Environment and Science erosion prone area map for this area specifies the section of coast which may be subject to erosion over a fifty-year planning period. On the northern end of Farnborough (north of the Capricorn International Resort), the erosion is mapped as extending approximately 150 metres from the toe of the dune. Adjacent to the resort and Bangalee, the erosion is mapped as extending approximately 115 metres. At the southern end of Farnborough, adjacent to Todd Avenue, the mapped erosion prone area extends 200 to 300 metres. Adjacent to the Beachside Holiday Caravan Park the erosion extends to 110 metres.

In Bangalee, all houses on the eastern side of Kiama Avenue are mapped within the erosion prone area, as well as up to the front doors of houses on the western side of Kiama Avenue. To the south, around Todd Avenue, many properties are encompassed by the erosion prone area. Along Farnborough Road between the Spring Head and Todd Avenue intersection, many properties, and the Beachside Holiday Caravan Park, are within the erosion prone area.

Four-wheel drive activity from Bangalee to Sandy Point, where people have accessed the dune systems from the beach, has also led to degraded dunes and blowouts from the wind. Further north on Farnborough Beach, in areas controlled by the Iwasaki Foundation and the Department of Environment and Science, incursions by four-wheel drives into dunal areas have caused significant destruction and are becoming a growing concern among beach users. Council will continue to work with partners, including beach managers. Council, however, has limited capacity to address these issues as the area of concern is not within Council's jurisdiction (that is, Council's local laws are not applicable in these areas as they are governed by other agencies, including the State Government and private landholders).

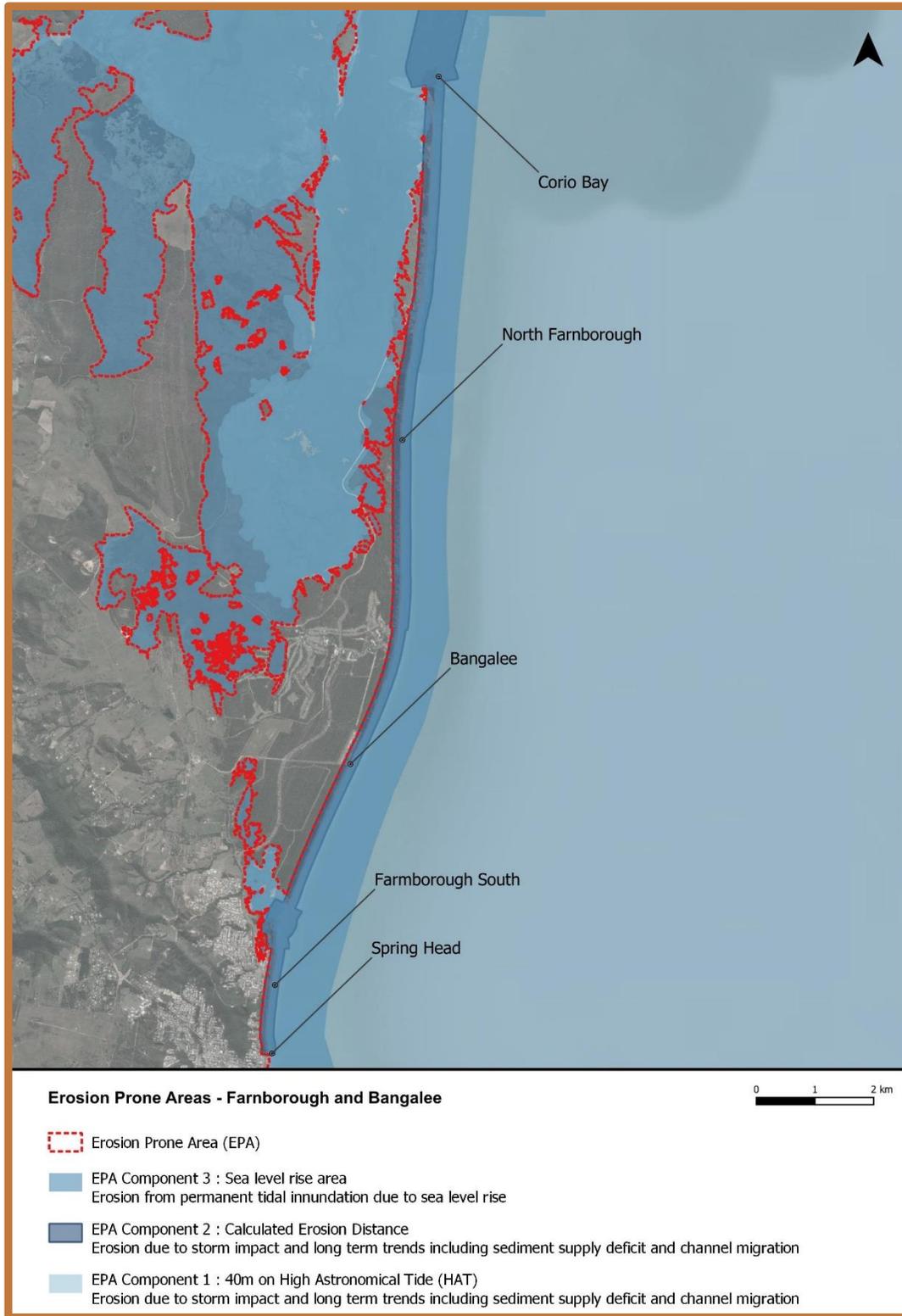


Figure 17: Erosion prone areas in Farnborough and Bangalee

A comparison of available satellite imagery between 1992 and 2021 found that there has been little change in the distance between the dune and fixed structures (e.g., houses). Between 2015 and 2021, the dunes opposite Bangalee and south to Barwell Creek have varied from year to year (either eroding or accreting) but the variation between the two is minimal. Currently around six metres of dune has been gained which makes up for the losses from Tropical Cyclone Marcia in 2015.



Figure 18: Bangalee 2013



Figure 19: Bangalee 2021

Opposite Kean Street approximately seventy-five metres of accretion has occurred. The likely cause of this is the move of the mouth of Barwell Creek from running south along the shore to directly east (out to sea). It was observed in the previous Shoreline Management Plan (2008) that the relocation of Barwell Creek mouth first took place in 2003, when it gradually shifted back south. The creek shifted naturally to its current location facing east around 2010. It is likely that the longshore current will push the creek back south towards the dune.

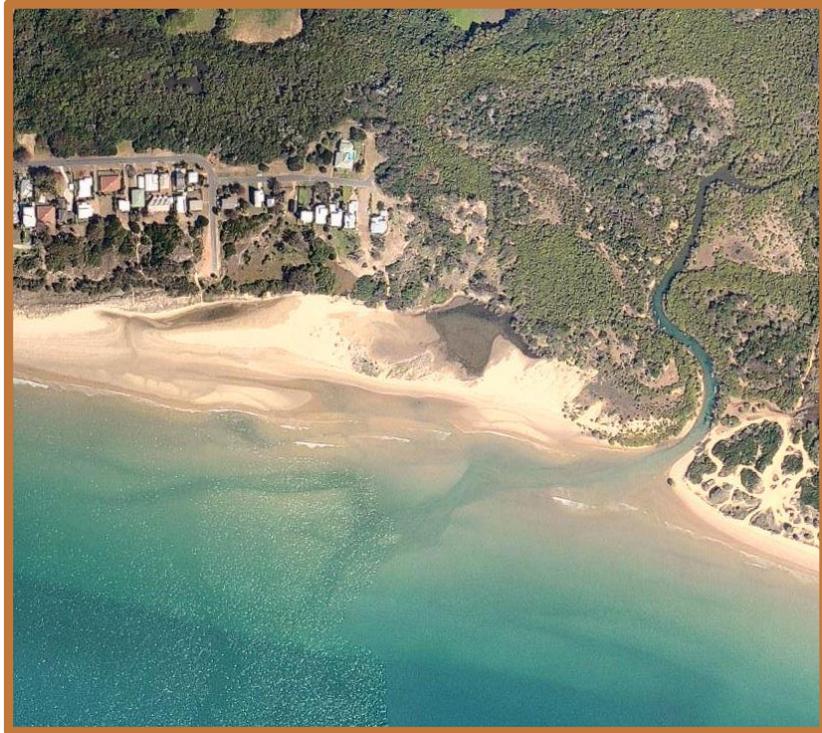


Figure 20: Kean Street to Barwell Creek 2013

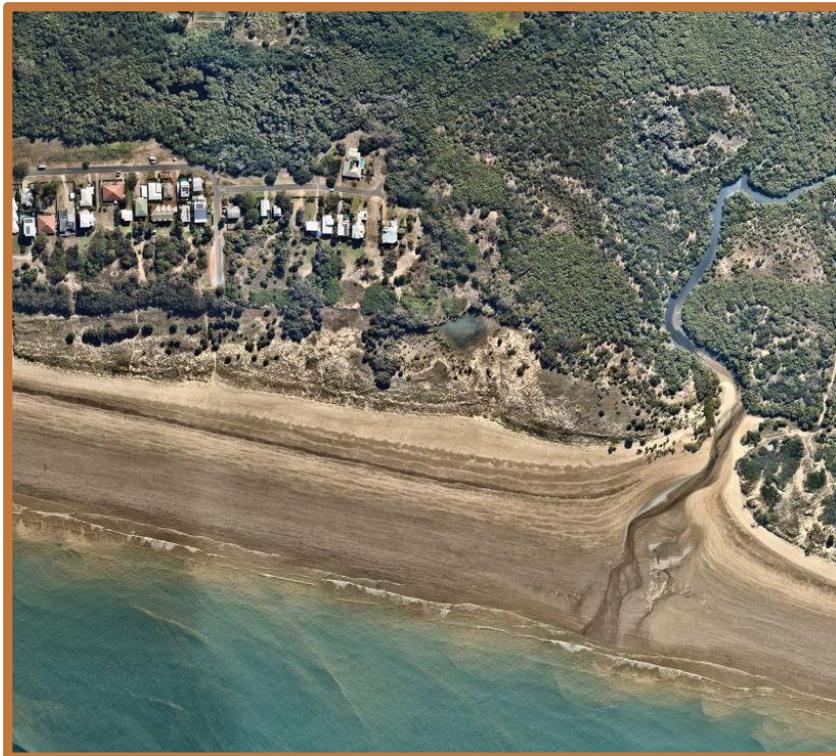


Figure 21: Kean Street to Barwell Creek 2021

Accretion or erosion is minimal from Corbett Street south to Spring Head, and the area has not changed significantly between 1992 and 2021. Farnborough Road is located within the mapped erosion prone area from Kerr Street to Spring Head.

Recommendations

- Future development should not extend further seaward than the existing building alignment, or where no alignment exists, should be located as far landward as practicable to ensure that wherever possible, future property protection works (if necessary) are located within the boundaries of the private property.
- Future development of beachfront properties north of Barwell Creek is located outside of the erosion prone area to ensure that future coastal management outcomes are not compromised.
- Monitor the mouth of Barwell Creek to see if its course tracks back south along the beach.
- Monitor vehicle access and activity on the beach, limit access to dune systems by four-wheel drive vehicles.
- Continue to work with partners (including the Iwasaki Foundation and the Department of Environment and Science) to address dune incursions while acknowledging Council has limited capacity to address these issues as the area of concern is not within Council's jurisdiction.

Vegetation

Farnborough Beach has extensive connected remnant vegetation north of Barwell Creek, with the most prominent cleared areas around Bangalee and the resort area. The main vegetation communities within these areas can be summarised as beach scrub/vine thicket, coastal grass and shrub land, coastal vine forest and mangroves. Most of these vegetation communities are listed as 'of concern' regional ecosystems. Capricorn Coast Landcare, with support from the Fitzroy Basin Association and Livingstone Shire Council, have conducted extensive vegetation rehabilitation in dunal areas of Farnborough Beach.

Multiple weeds were identified along Farnborough Beach and the pest problem noted in Shoreline Management Plan (2008) is persisting currently. Weeds interrupt natural processes and can adversely impact native vegetation. Some of the weeds identified during field assessments include lantana (*Lantana camara*), prickly pear (*Opuntia stricta*), mother-of-millions (*Bryophyllum* spp.), Guinea grass (*Megathyrsus maximus*), siratro (*Macroptilium atropurpureum*), mothers-in-laws tongue (*Dracaena trifasciata*), and other garden escapees.

Many dunal areas of Farnborough have experienced Pandanus dieback because of Pandanus leafhopper (*Jamella australiae*) infestations in the area. Further information on the regional ecosystems corresponding to those broad vegetation groups can be found in Appendix 1.

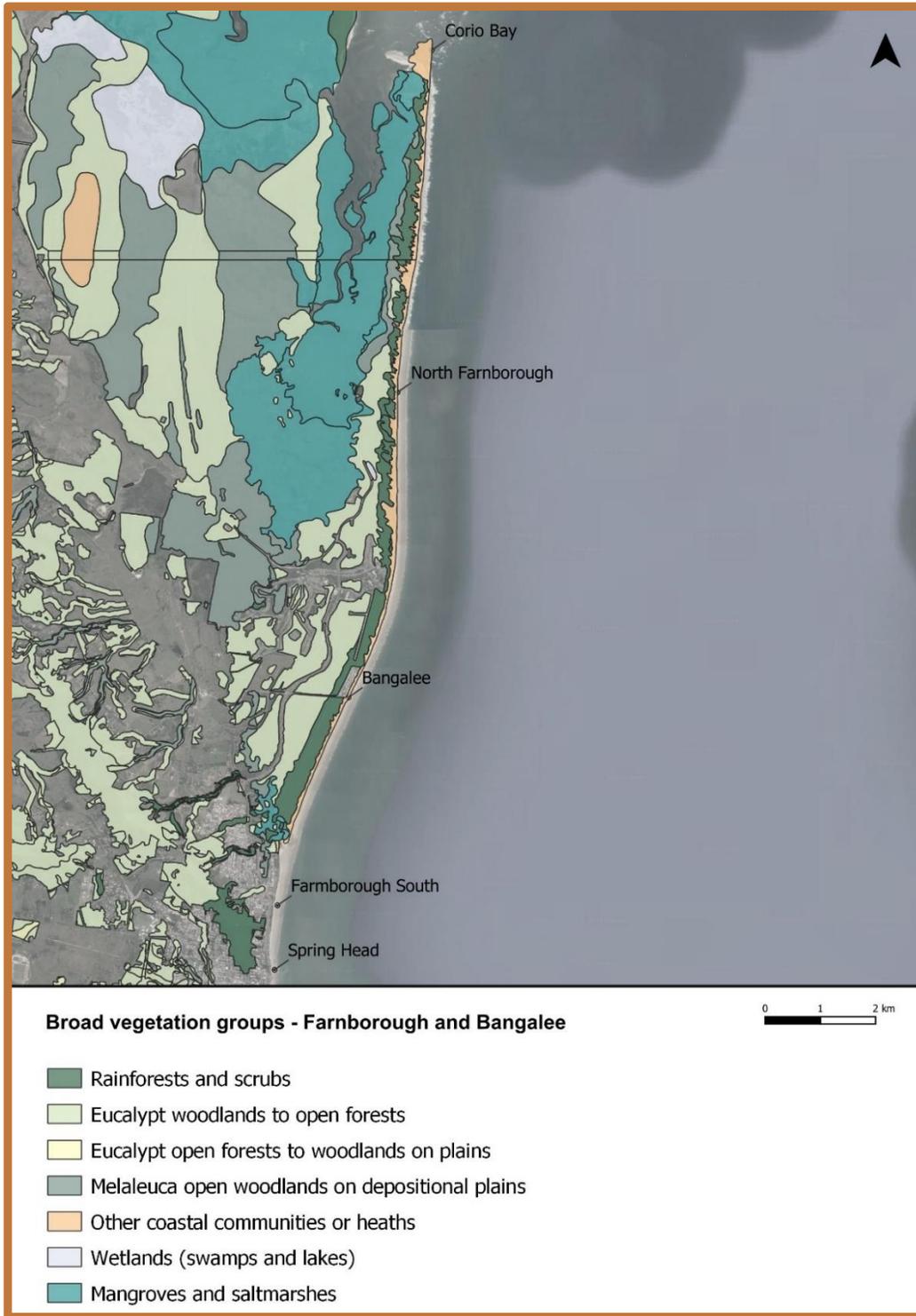


Figure 22: Dominant broad vegetation groups (regulated vegetation) in Farnborough and Bangalee

The recreational use of Farnborough Beach has led to degraded vegetation due to tree vandalism for firewood and unauthorised access to the dunes. Clearing at Bangalee, as well as at beach front properties along Todd Avenue, has led to the complete removal of vegetation in some areas. In Bangalee, several beachfront homeowners have developed non-native gardens in the foredunes behind their homes, outside their property boundary.

Recommendations

- Communicate with the property owners adjacent to the shoreline and implement a community education program to encourage community custodianship over coastal areas and discourage the removal and replacement of native vegetation.
- Work with community to develop a revegetation strategy for the Bangalee foredune that works in both the interest of council, community, and the local ecology.
- Revegetation of Farnborough south to stabilise sand gained south of Barwell Creek.
- Pest management program to continue and be worked in conjunction with a coastal ecological restoration plan.
- Develop and implement a plan for reintroducing native species on the foreshore between Barwell Creek and Spring Head.
- Create a strategy to address dune vegetation vandalism and implement educational signage. Increased monitoring will be required to assess if the educational program is effective or if other measures need to be considered.
- Conduct and support community planting activities focusing on reinstating Pandanus trees and continue working with specialists to develop biocontrols for the Pandanus leafhopper (*Jamella australiae*).
- Continue to work with the Fitzroy Basin Association and Capricorn Coast Landcare to support the rehabilitation works being undertaken on Farnborough Beach.

Public access and facilities

Northern Farnborough has numerous access points for pedestrians, while Bangalee's primary pedestrian access is from Hinz Avenue near the vehicles access. Southern Farnborough, between Barwell and Spring Head, has adequate amenity blocks and beach showers. There are many non-designated paths where people have formed their own beach access from private properties. These paths have created wind blowouts in the foredunes and have encouraged the spread of weeds. Vehicles are permitted to traverse the beach from Bangalee to Sandy Point. There are several points along the dune where vehicles have accessed the foredune, either for access to shade, parking above high tide, or recreational four-wheel drive access to the dunes. The four-wheel drive beach access provided at Bangalee has resulted in significant amounts of sand being lost from the beach and blowing up into the adjacent residential area.



Figure 23: Dune blowout from unauthorised pedestrian access track, Bangalee.

Recommendations

- Fencing of dunes at Bangalee and Todd Avenue between freehold property and the dunal area to encourage the use of formalised beach access.
- Consider strategies to improve the stability of the vehicle access at Bangalee to limit the amount of sand being blown up into the carpark where it is lost (including looking at methods to alter the position of the access and a planting plan to capture sand around the access track).

Land tenure

North of Bangalee to Sandy Point the dune is zoned as an environmental management and conservation area. The conservation area is approximately 135 metres wide from the high tide mark until around 5 kilometres north of the resort area, where all of Sandy Point is zoned as Environmental Management and Conservation areas. Outside of these areas it is zoned as either Rural or Tourism (around the resort). The foredune is zoned as an Environmental Management and Conservation area south of Bangalee for another 1.4 kilometres, and then it is un-zoned. The same can be noted for the dunal area in-front of Bangalee which is also not zoned. Dunal systems in front of residential areas along Todd Avenue are also not zoned.

Areas from the Beachside Holiday Caravan Park to Spring Head are zoned as Open Space. Bangalee and the residences around Todd Avenue are both zoned as Low Density Residential, and residential lots around Farnborough Road from Kerr Street to Spring Head as Medium Density Residential. The tenure of Sandy Point is National Park with all other previously stated areas having Freehold tenure, except for the Beachside Holiday Caravan Park and Yeppoon Rotary Park which are both mapped as a Reserve.



Figure 24: Land tenure in Farnborough and Bangalee

Recommendation

- Designate and assign a lot number to the beaches and adjacent areas (including road reserves where roads will not be constructed) and zone as Environmental Management and Conservation areas.

Urban pressures

Farnborough Beach lies to the east of the northern suburbs and rural hinterland of Yeppoon. Users include pedestrian, vehicular, and residents with pressures on the foreshore and beaches in this locality including:

- Unregulated or illegal works on state coastal land including unauthorised access ways, infrastructure such as fences, retaining walls, sheds, or pergolas, and dumping of fill or garden waste.
- Increased vehicle use on beaches due to growing population and visitation and increased four-wheel-drive ownership.

Recommendations

- Monitor for, and removal of, unregulated infrastructure from dunal areas.
- Educate drivers about the damage vehicles cause to dunal areas.
- Policing of vehicles exceeding speed limits on the beach north of Bangalee.

Stormwater outflows

Farnborough Beach north of Barwell Creek has natural stormwater drainage relying on the lay of the land to carry the water to adjoining creeks and to the coast. Barwell Creek's flow meanders east across the beach to the water's edge. It is likely that over time the channel will move south with the movement of the beach sand and the nearshore current. The channel has caused dune erosion in the past and has been manually relocated before. As this natural process will continue, an investigation into a major relocation of the creek's channel through the existing dunal area should be undertaken. This major relocation would reduce the frequency for the need of local relocation which currently occurs.

South of Barwell Creek the developed land has kerb and channelling stormwater that discharges into the various creeks, gullies, and table drains and enters the sea directly via the creek, across the surface or, through the dunes. Sediment from development and the rural area is entering this system.

Recommendation

- Continued monitoring of Barwell Creek to see if it tracks back to the south. Consider major relocation if the creek tracks south again (strategies like those used at Williamson Creek at Lammermoor may be beneficial).

-
- Develop a best-practice management strategy for stormwater outlets for sections of Farnborough Beach closer to Yeppoon so they are not exposed during erosion events.

Storm tide

The Bangalee township is situated relatively high above sea level so will not be impacted unless it experiences a storm tide event greater than 6 metres. In events 6 metres or higher, the township will be inundated and isolated from Hinz Avenue prior to Iwasaki Road.

In events 4 metres or higher, residences will be inundated on the west side of Todd Avenue and residences on the north end of the avenue will be cut off from Kean Street. All of Todd Avenue will be cut off at a 4.5 metre event as well as Farnborough Road (opposite Rotary Park). A six metre event will cut off all of Farnborough Road north of Normanby Street.

Recommendation

- Public are made aware of inundation risks and emergency procedures in the event of a storm tide leading to temporary isolation.

Areas of high conservation value

Sandy Point, north Farnborough, is a National Park and the dunal zone is a very sensitive ecosystem. On the 11th of March 1996, The Shoalwater and Corio Bays Area Wetland was designated a Ramsar Wetland. This area includes the intertidal areas of Corio Bay, ensuring Sandy Point is recognised as having a high conservation value and being an important site for local and migratory birds.

Farnborough Beach between the residences at Todd Avenue and Barwell Creek is also a nesting beach for migratory shorebirds. Dogs were observed off-leash in this area during field assessments in March 2022.

Farnborough Beach has also played a major role in the cultural heritage of the Yeppoon township and surrounding area as it has been a place of recreation for many generations as well as a vehicle thoroughfare before the road around Spring Head was established.

Areas of Indigenous cultural significance may be located within this beach unit. Prior to commencement of any recommended works, it is recommended that consultation with the local Indigenous community be conducted. This will ensure areas of cultural significance are protected and maintained.

Recommendations

- Local enforcement of on-leash areas where shorebird nesting occurs during nesting seasons.
- The local Indigenous community be involved in any future recommended works.
- Educate drivers about the damage vehicles cause to dunal areas and to stay on the foreshore.

Management Practices

Council responds to coastal management issues in the area on an as-needs basis. Longer term planning and adaptation strategies are listed in the Our Living Coast Strategy (Council's Coastal Hazards Adaptation Strategy).

Issues

- Encroachment of development into dunal area through fencing, mowing, building, and dumping.
- Council enforcement of local laws due to beaches not being gazetted and designated as Environmental Management and Conservation areas.
- Non-designated beach access and infrastructure form residence.
- Dunal blowouts.
- Vehicles on dunes at Farnborough.
- Vehicles exceeding speed limits on Farnborough Beach.
- Weed infestations.
- Littering and fill of dunal area.

Recommendations

- Future development should not extend further seaward than the existing building alignment, or where no alignment exists, should be located as far landward as practicable to ensure that wherever possible, future property protection works (if necessary) are located within the boundaries of the private property.
- Future development of beachfront properties north of Barwell Creek is located outside of the erosion prone area to ensure that future coastal management outcomes are not compromised.
- Monitor vehicle access and activity on the beach, limit access to dune systems by four-wheel drive vehicles.
- Continue to work with partners (including the Iwasaki Foundation and the Department of Environment and Science) to address dune incursions while acknowledging Council has limited capacity to address these issues as the area of concern is not within Council's jurisdiction.
- Communicate with the property owners adjacent to the shoreline and implement a community education program to encourage community custodianship over coastal areas and discourage the removal and replacement of native vegetation.
- Work with community to develop a revegetation strategy for the Bangalee foredune that works in both the interest of council, community, and the local ecology.
- Revegetation of Farnborough south to stabilise sand gained south of Barwell Creek.
- Pest management program to continue and be worked in conjunction with a coastal ecological restoration plan.
- Develop and implement a plan for reintroducing native species on the foreshore between Barwell Creek and Spring Head.

-
- Create a strategy to address dune vegetation vandalism and implement educational signage. Increased monitoring will be required to assess if the educational program is effective or if other measures need to be considered.
 - Conduct and support community planting activities focusing on reinstating Pandanus trees and continue working with specialists to develop biocontrols for the Pandanus leafhopper (*Jamella australiae*).
 - Continue to work with the Fitzroy Basin Association and Capricorn Coast Landcare to support the rehabilitation works being undertaken on Farnborough Beach.
 - Fencing of dunes at Bangalee and Todd Avenue between freehold property and the dunal area to encourage the use of formalised beach access.
 - Consider strategies to improve the profile of the vehicle access at Bangalee to limit the amount of sand being blown up into the carpark where it is lost (including looking at methods to alter the position of the access slightly northward and a planting plan to capture sand around the access track).
 - Designate and assign a lot number to the beaches and adjacent areas (including road reserves where roads will not be constructed) and zone as Environmental Management and Conservation areas.
 - Monitor for, and removal of, unregulated infrastructure from dunal areas.
 - Policing of vehicles exceeding speed limits on the beach north of Bangalee.
 - Continued monitoring of Barwell Creek to see if it tracks back to the south. Consider major relocation if the creek tracks south again (strategies like those used at Williamson Creek at Lammermoor may be beneficial).
 - Develop a best-practice management strategy for stormwater outlets for sections of Farnborough Beach closer to Yeppoon, so they are not exposed during erosion events.
 - Public are made aware of inundation risks and emergency procedures in the event of a storm tide leading to temporary isolation.
 - Local enforcement of on-leash areas where shorebird nesting occurs during nesting seasons.
 - The local Indigenous community be involved in any future recommended works.
 - Educate drivers about the damage vehicles cause to dunal areas and to stay on the foreshore.

Yeppoon and Cooee Bay

Current condition

Erosion/accretion

Yeppoon Main Beach is affected by both easterly and north-easterly wind and wave action as the gap between North and Great Keppel Islands is directly east of Yeppoon. In the past (1931 and 1949), large amounts of sand eroded leading to the loss of buildings and land. A seawall along the length of Yeppoon Main Beach was originally built in the 1930s to protect coastal infrastructure, however it failed after cyclonic wave damage in 1976 and was rebuilt. In the 1990s erosion again undermined the stability of the seawall, and it was rebuilt and strengthened in the early 2000s.

Erosion prone area mapping along Yeppoon Main Beach from the toe of the rock wall is 100 metres wide. Anzac Parade and businesses along the beachfront are all within the mapped erosion prone area. Given the height of the seawall and how heavily modified Main Beach is, it is unlikely significant erosion would occur unless the seawall fails.

At Fisherman's Beach, the erosion prone area extends forty to fifty metres from the toe of the dune, and houses along Wattle Grove are within the area. At Cooee Bay the erosion prone area extends 130 metres from the toe of the dune and incorporates properties on Livingstone Lane and the northern section of Cathne Street.

A comparison of satellite imagery of Fisherman's Beach between 2012 and 2021 shows that the beach has been eroding over that period with an approximate loss of five metres, despite having vegetation regrowth on the dune after Tropical Cyclone Marcia. Cooee Bay Beach has a similar recent history; however, the overall loss appears to be less. Yeppoon Main Beach has shown little to no change in the same period.



Figure 25: Erosion prone areas in Yeppoon and Cooee Bay

Recommendations

- Future development should not extend further seaward than the existing building alignment, or where no alignment exists, but rather it should be located as far landward as practicable to ensure that wherever possible, future property protection works (if necessary) are located within the boundaries of private property.
- Regular monitoring of the Main Beach seawall for erosion undermining.
- Conduct beach nourishment on Yeppoon Main Beach to improve beach amenity and avoid undermining of the rock wall. A potential source of sand is construction sites behind the sea wall.
- Sand filling of voids in the rock wall to allow native beach vines to grow, improve amenity and reduce habitat for vermin such as rats.

Vegetation

Yeppoon Main Beach is highly modified and the only vegetation that occurs is along the top of the rock wall which includes marine couch (*Sporobolus virginicus*), goat's foot (*Ipomea pes-caprae*), beach spinifex (*Spinifex sericeus*), and pigface (*Carpobrotus glaucescens*). Sand replenishment of the rock wall allows for this limited vegetation to spread down the wall, but the sand gets washed out over time and now needs replenishing again. Fisherman's Beach and Cooee Beach both have narrow vegetated strips with some native ground covers, but limited tree cover. Along Ross Creek there are remnant mangrove forests which are fringed by *Eucalyptus* woodlands. Wreck Point also contains a small, isolated patch of remnant native grassland which is listed as 'of concern'. Beaches in Yeppoon and Cooee Bay have experienced Pandanus dieback because of Pandanus leafhopper (*Jamella australiae*) infestations in the area.

Introduced plants compete with native vegetation cover along the top of Yeppoon Main Beach. For Fisherman's Beach and Cooee Bay weeds are introduced by people, animals, and vehicles, and from the dumping of garden waste in the dunal and headland areas. Introduced plants include cultivated lawn grasses, Guinea grass (*Megathyrsus maximus*), siratro (*Macroptilium atropurpureum*), and Mossman River grass (*Cenchrus echinatus*).

Further information on the regional ecosystems corresponding to those broad vegetation groups can be found in Appendix 1.



Figure 26: Dominant broad vegetation groups (regulated vegetation) in Yeppoon and Cooee Bay

Recommendations

- Communicate with the property owners adjacent to the shoreline and implement a community education program to encourage community custodianship over coastal areas and discourage the removal and replacement of native vegetation.
- Revegetation with plantings of endemic species on beaches and dunes.
- Replenish sand on seawall to encourage native recruitment of ground covers.
- Pest management program to continue and be worked in conjunction with a coastal ecological restoration plan.
- Education and empowerment of residents about the importance of dune areas.
- Create a strategy to address dune vandalism and implement educational signage. Increased monitoring will be required to assess if the educational program is effective or if other measures need to be considered.
- Conduct and support community planting activities focusing on reinstating Pandanus trees and continue working with specialists to develop biocontrols for the Pandanus leafhopper (*Jamella australiae*).

Public access and facilities

Between Spring Head and Wreck Point there are eleven public beach access points. Public facilities provided at the Yeppoon Main Beach include public amenity blocks, disability access ramps, beach showers, car parking, tables, chairs, pathways, a covered amphitheatre, and the Yeppoon Lagoon public pool and playground. Formalised carparking is available at Cooee Bay Beach. Several undesignated access tracks exist along Cooee Bay Beach.

Recommendations

- Develop a management plan for sustainable access to Cooee Bay Main Beach that accommodates increased population and use of the beach as the area is activated with walking tracks and to accommodate stormwater issues.

Land tenure

The land adjacent to Yeppoon Main Beach is zoned Open Space which provides the community with a recreational area that has equitable accessibility and helps link open space along the coastline. The open space areas have the land tenure of Reserve with The Strand gazetted in 1983 as a reserve for recreation while the Reserve surrounding Fig Tree and Ross Creeks is zoned with areas of Open Space as well as Environmental Management and Conservation areas, which were gazetted as such in 1936. Other properties within 500 metres of the beach are zoned Medium Density Residential or Major Centre. The residential properties in this area are classed as Medium and High-Density Development with the greater density close to the central business district of Yeppoon.

Both Fisherman's and Cooee Bay beaches are bordered by Low-Medium Density Residential zoned properties which all have Freehold land tenure. At the southern end of Cooee Bay there are several properties classed as Business. There is also a reserve for park and recreation which was gazetted in 1982 at Wreck Point. The beaches (low to high water mark) and dunal areas within these coastal units are currently not gazetted



Figure 27: Land tenure in Yeppoon and Cooee Bay

Recommendation

- Designate and assign a lot number to the beaches and adjacent areas (including road reserves where roads will not be constructed) and zone as Environmental Management and Conservation areas.

Urban pressures

Main Beach has its own primary multi-purpose function arena. It is a day visitor centre for residents and visitors from further afield. The potential pressures on this immediate area include increased demand for car parking and traffic areas.

The area from Fisherman's Beach to Wreck Point is an older part of the urban footprint of Yeppoon. Pressures to Fisherman's Beach include construction of unapproved access points and a call for formed car parking adjacent to Ocean Parade.

Current and potential pressures at Cooe Bay Beach include:

- Construction of unapproved access points.
- Importance of ocean views for properties fronting and adjacent to the beach could threaten mature endemic species.
- Management of dunes contained in private freehold land.

Recommendations

- Testing and stockpiling (if appropriate) of sand removed from building sites for beach nourishment.
- Education of residents on removal of vegetation and green waste dumping.
- Educational signage for day visitors/locals on the importance of beaches and dunes, as well as the local flora, fauna, and heritage areas for the area.

Stormwater outflows

From Spring Head to Wreck Point any stormwater produced enters the sea via the natural drainage points of Ross and Fig Tree Creeks as well as through a pipe network that has eleven discharge points along the coastline. These pipes discharge directly to the beaches and carry a large amount of fresh water which falls in the area. One such pipe that flows onto the Yeppoon Main Beach has a Gross Pollutant Trap installed to help reduce the amount of foreign material entering the beach unit. On Cooe Bay Beach a storm drain outlet had notable channelling and undermining at the toe of the drain. The section of the Esplanade at the junction of Cliff Lane is another location in Cooe Bay where stormwater outflow from the road impacts the beach access.



Figure 28: Channelling at drain located at Cooee Bay

Recommendations

- Schedule for the monitoring and maintenance of Gross Pollutant traps.
- Ensure channelling from the stormwater outlet repairs before undermining becomes worse.

Storm tide

Main Beach beachfront properties are built on higher ground and are outside of mapped storm tide areas, except for 6 metre events which will potentially inundate the bottom of the Esplanade and the southern end of Anzac Parade, cutting off the Council office and inundating Appleton Park. Figtree Creek and surrounds are vulnerable to storm tides and Appleton Drive/Whitman Street could be cut off from a three-metre event or above. During a six-metre event, streets and several properties behind Anzac Parade are all mapped as being within the inundation area.

With storm tide events above four metres the intersection of Wattle Grove, Ocean Parade, and the Scenic Highway will be cut off, leaving residences along Wattle Grove stranded. Properties along Fisherman's Beach will likely not be inundated unless the storm tide is five metres or higher.

Matthew Flinders Drive will become inundated on the southern end of Cooee Bay with storm tide events above four metres. Properties along Cooee Bay Beach will become inundated in events above 5.5 metres. The largest threat of inundation is from Ross Creek and the mangroves southwest of Cooee Bay which will see the Scenic Highway and many properties inundated in events from 3.5 metres.

Recommendation

- Public are made aware of inundation risks and emergency procedures.

Areas of high conservation value

The Fig Tree and Ross Creek system has a high environmental conservation value that contains a flying fox community, mangroves, and fish habitat. Wreck Point is also mapped as containing a small patch of 'of concern' coastal grassland community.

These coastal units have a high cultural heritage conservation value which has occurred through the extended use of this area as a recreational site for many generations. Below is an indication of the cultural history of Yeppoon Main Beach:

- 1860s-1890s: Tourism, including walking, horse riding and buggy riding along the beach, was very popular. Yeppoon Main Beach was used for male swimming area while women swam in a small shady area near rocks at the base of the Bluff.
- 1894: Road constructed around Bluff so women's bathing area was no longer used; women began bathing at northern end of Main Beach.
- 1918: Private one roomed bathing huts for changing on the beach constructed.
- 1920s: Donkey, camel, pony, and elephant rides along the beach.
- 1926: Strand Hotel hosted entertainment to raise money for beach beautification.
- 1926: Yeppoon First Aid and Lifesaving club formed; Lifesavers operated from Beach Pavilion (including café, toilets, restrooms) built by Council.
- 1930: Lifesaving clubhouse built.
- 1931: Cyclone destroyed 42 of 49 private bathing huts, 60 metre section of rubble wall and 20 metre section of walkway at Bluff, and recently completed Lifesaving clubhouse. Public meeting held after cyclone, materials from private huts destroyed were donated to Council for building public sheds. Council not able to do construction and the Beach Improvement scheme and "Yeppoon Beach Improvement Company" was launched.

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- 1937: At the opening of the “Yeppoon Foreshore Improvement Scheme” Livingstone Shire Council chairman William Todd stated *“When this wall is completed the unsightly sand dunes that continue from the main street to Ross Creek will be done away with and in their stead there will be green lawns, seats, shade trees and plenty of parking spaces for cars”*. The Yeppoon Foreshore Improvement Scheme built a long sea wall with bathers’ amenities including sun shelter, beach café and bathing shelter.
 - 1936: A bitumen road built from Strand Hotel to what is now Anzac Parade.
 - 1949: A cyclone caused significant sand loss and resulted in beachfront buildings constructed during 1930s washing away.
 - 1976 and early 1990s: Cyclonic waves and storms damaged the Yeppoon Main Beach seawall leading to its reconstruction to its current state in the early 2000s.
 - Early 2000s: Yeppoon Main Beach Esplanade revitalisation project.
 - 2018: Grand opening of the Yeppoon Lagoon and upgrade to the amphitheatre on the esplanade.

The Main Beach front of Anzac Parade has been classed as a culturally significant as well as the site of the Ross Creek seawall. Areas of Indigenous cultural significance may be located within this beach unit in the natural areas which remain. Prior to commencement of any recommended works, it is recommended that consultation with the local Indigenous community be conducted. This will ensure areas of cultural significance are protected and maintained.

Recommendation

- The local Indigenous community be consulted before any future recommended works occur.

Management practices

Because of the continual erosion of the beach and its popularity as a recreational area, Yeppoon Main Beach has seen the implementation of multiple erosion control methods, the first being a timber fence in the 1920s. Between 1935 and 1937 a rubble wall was built along the beach front, which was followed by the levelling of the sand dunes in 1955 and extension of the existing rubble wall following cyclone damage. The breakwater at the entrance to Ross Creek was built in the 1960s and large amounts of sand removed from the area between 1965 and 1972. Another extension to the rubble sea wall occurred in 1976 after further damage to the dune and wall. The construction of the sea wall has been a “hard” erosion control measure which has led to the destruction of the natural beach building processes for Yeppoon Main Beach.

Between 2000-2003 The Strand area was renovated, and a new seawall was constructed. This sea wall was built with a buried toe to discourage undermining and the slope of the wall has been built at an angle which encourages sand accretion.

Issues

- Maintenance and monitoring of beach access and facilities.
- Weeds growing in dunal areas and main beach seawall.
- Sand has washed out from seawall which prevents native ground covers from recruiting along wall.
- Unauthorised access points to beaches.
- Dumping of garden waste into dunal areas.
- Council enforcement of local laws due to beaches not being gazetted and designated as Environmental Management and Conservation areas.

Recommendations

- Communicate with the property owners adjacent to the shoreline and implement a community education program to encourage community custodianship over coastal areas and discourage the removal and replacement of native vegetation.
- Future development should not extend further seaward than the existing building alignment, or where no alignment exists, but rather it should be located as far landward as practicable to ensure that wherever possible, future property protection works (if necessary) are located within the boundaries of private property.
- Regular monitoring of the Main Beach seawall for erosion undermining.
- Conduct beach nourishment on Yeppoon Main Beach to improve beach amenity and avoid undermining of the rock wall. A potential source of sand is construction sites behind the sea wall.
- Revegetation with plantings of endemic species on beaches and dunes.
- Replenish sand on seawall to encourage native recruitment of ground covers.
- Pest management program to continue and be worked in conjunction with a coastal ecological restoration plan.
- Education and empowerment of residents about the importance of dune areas.
- Create a strategy to address dune vegetation vandalism and implement educational signage. Increased monitoring will be required to assess if the educational program is effective or if other measures need to be considered.
- Conduct and support community planting activities focusing on reinstating Pandanus trees and continue working with specialists to develop biocontrols for the Pandanus leafhopper (*Jamella australiae*).
- Develop a management plan for sustainable access to Cooee Bay Main Beach that accommodates increased population and use of the beach as the area is activated with walking tracks and to accommodate stormwater issues.
- Designate and assign a lot number to the beaches and adjacent areas (including road reserves where roads will not be constructed) and zone as Environmental Management and Conservation areas.
- Testing and stockpiling (if appropriate) of sand removed from building sites for beach nourishment.
- Education of residents on removal of vegetation and green waste dumping.

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- Educational signage for day visitors/locals on the importance of beaches and dunes, as well as the local flora, fauna, and heritage areas for the area.
 - Schedule for the monitoring and maintenance of Gross Pollutant traps.
 - Rectify channelling from the stormwater outlet (including through use of gross pollutant traps) before undermining becomes worse.
 - Public are made aware of inundation risks and emergency procedures.
 - The local Indigenous community be consulted before any future recommended works occur.

Lammermoor, Rosslyn, and Kemp Beach

Current condition

Erosion/accretion

Lammermoor has both a north and south nearshore longshore current with the rocky section near the central part of the beach dividing the two currents. There is also an onshore current onto Lammermoor which is assisting the accretion of Fitzroy River sediments travelling north in the advective current. It is believed that both sections of Lammermoor were once quite wide beaches with large amounts of sand moving north, depositing in this region before Bluff Point joined the mainland. Since the joining the amount of deposition has decreased and these beach areas are now reliant on the small amount from the onshore current.

Both Lammermoor and Statue Bay Beaches are protected from south-easterly and easterly winds and waves by Great Keppel Island and Bluff Point, with the main wind and wave direction affecting the beaches being northerlies and north easterlies. With the combination of the nearshore longshore currents and the wind and wave direction, erosion of Lammermoor Beach occurs at the central section of the beach with accretion of sand at either end. Statue Bay Beach has accretion towards the sheltered eastern end of the beach, while the exposed and rocky western end is more susceptible to erosion from the prevailing wind and waves.

Kemp Beach has had a history of erosion, with significant erosion occurring in the mid-2000s which damaged access infrastructure and caused the loss of mature vegetation in areas. Great Keppel Island lies directly east, off the coast from Kemp Beach and this may be expected to protect the beach from easterly waves. However, the easterly waves are refracted around the island and enter the beach. Bluff Point helps protect the beach from south-easterly winds and waves, while the northerly and north-easterly winds are hindered by Double Head and North Keppel Island offshore.

The land use adjacent to Kemp Beach has also influenced the erosion process. The road and park are both hard surfaces which do not allow for the infiltration of stormwater before reaching the dunal area. Consequently, a more concentrated flow of water reaches the dunal edge than if it had soaked into the ground. This has caused washing away and undermining of the dunal area and an increase in the erosion process.

Kemp Beach, between the years of 1975 and 1996, experienced accretion at both ends of the beach while erosion had taken place in the central area of the beach. Between 1996 and 2007 Kemp Beach had accretion at the central and northern end of the beach with erosion of the southern end. Between 1975 and 2007 there has been an overall loss of 370 cubic metres of sand for the entire beach out to 800 metres. From the data it was found that Kemp Beach, over thirty years, has been relatively stable. The data collected in 2008 does not indicate that the sand from the beach has been stored further offshore as was hoped. No hydrological studies were completed with this plan.

An investigation of Lammermoor Beach erosion from the previous Shoreline Management Plan found a long-term trend of erosion, which is supported by analysis of recent imagery. This has been exacerbated by Tropical Cyclone Marcia in 2015. Statue Bay was heavily modified when Scenic Highway was upgraded in 2018, and the northern areas of Statue Bay, which was previously eroding, are now being supported by a rock wall below the highway. The southern end of the bay has had some minor accretion. The centre of Kemp Beach has still been showing a long-term trend of erosion with an analysis of recent satellite imagery showing a loss of approximately five metres. It is a similar situation in the southern and northern ends.

It was observed on the southern end of Kemp Beach at the edge of the rocky headland of Buff Point that there was erosion/undermining of the hillside.



Figure 29: Undermining on the southern end of Kemp Beach

Lammermoor Beach has mapped erosion prone areas extending 130 to 140 metres inland from the toe of the dune, which encompasses all beachfront properties as well as some properties behind them. Along Statue Bay the erosion prone area extends 120 to 130 metres inland from the toe of the dune and encompasses all

beachfront properties as well as neighbouring properties behind them. At Kemp Beach the erosion prone area extends 100 metres inland from the toe of the dune and encompasses Beaches Restaurant, Rosslyn Bay Resort, and the service station.

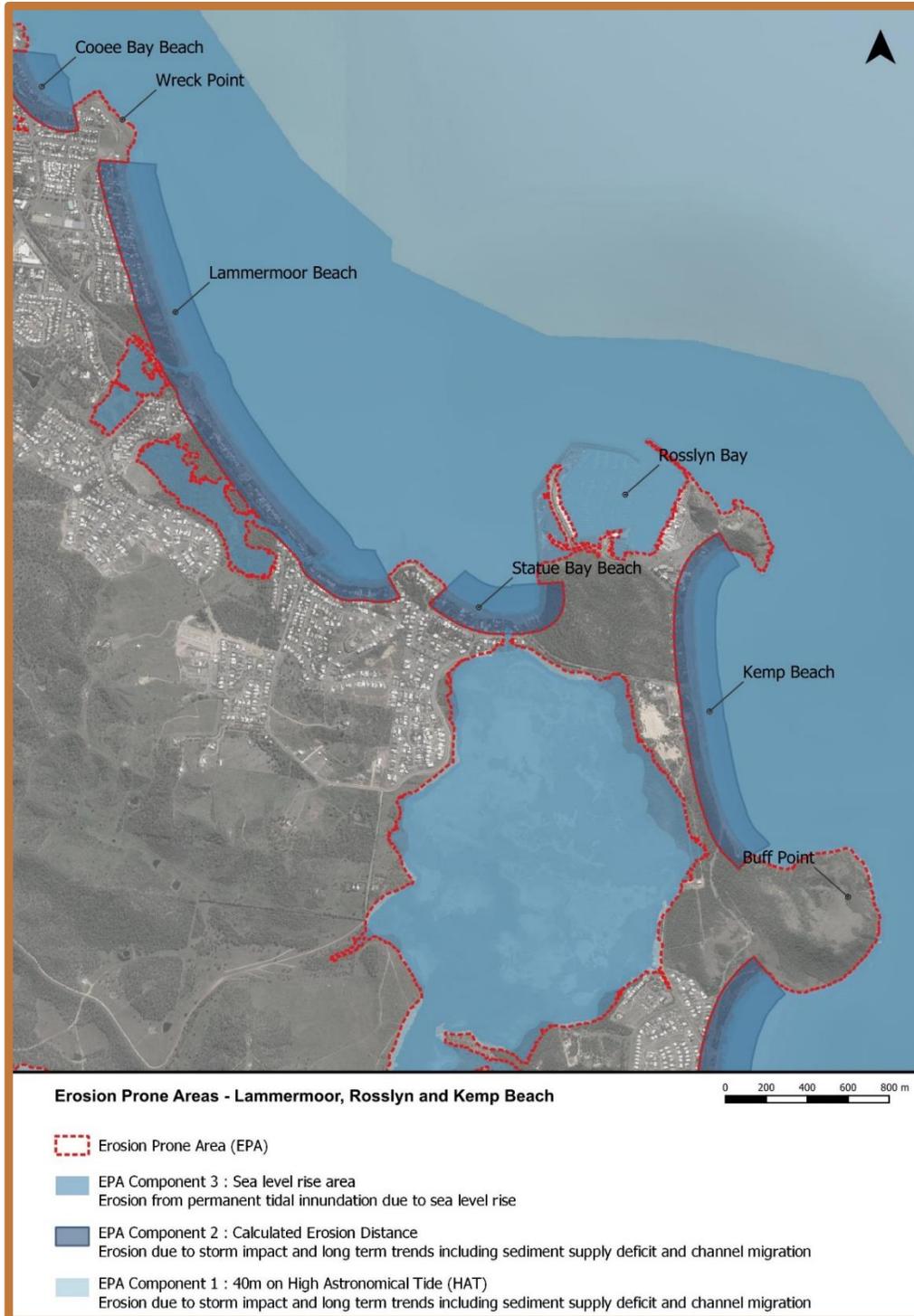


Figure 30: Erosion prone areas in Lammermoor, Rosslyn, and Kemp Beach

Recommendation

- Future development should not extend further seaward than the existing building alignment, or where no alignment exists, should be located as far landward as practicable to ensure that future property protection works (if necessary) are constructed and, wherever possible, within the boundaries of the property the work is designed to protect.

Vegetation

Lammermoor Beach has a narrow strip of remnant vegetation comprised of a complex of coastal ground covers under *Casuarina* low woodland, which runs along the length of the beach from the mouth of Williamson Creek and ends 250 metres short of Wreck Point. This vegetation is patchy and has been cleared by residents for ocean views in many places. Two larger patches of vegetation exist, one along Williamson Creek and the other north and around Lioness Park and Lammermoor Native Gardens. These mapped coastal ecosystems are listed as ‘of concern’ and comprise of mid-dense woodland communities mixed with microphyll vine forest (beach scrub). No remnant native vegetation is mapped along the front of Statue Bay, but a large patch of ‘of concern’ vegetation separate Statue Bay from Rosslyn Bay which is part of the National Park. At Kemp Beach, there is little mapped remnant vegetation along the beachfront except for a patch connecting to Double Head in the north. There are larger patches of remnant ‘of concern’ vegetation mapped west of the road at Kemp Beach, as well as a large area of salt flat/mangrove running off Mulambin Creek. Vegetation removal at Kemp Beach has occurred in-front of Beaches Restaurant and along Lammermoor Beach in front of houses.



Figure 31: Clearing for ocean views by residents

Northern sections of Lammermoor Beach (north of Lioness Park) have weedy dunal areas. This is the result of the spread and naturalisation of environmental weeds and from unauthorised non-native gardening in the dune system. Some concerning weeds in these areas include prickly pear (*Opuntia stricta*), mother-of-millions (*Bryophyllum* spp.), lantana (*Lantana camara*), Guinea grass (*Megathyrsus maximus*), and coastal morning glory (*Ipomea cairica*). Coral creeper (*Barleria repens*), which is of increasing concern in the Livingstone Shire area, can also be found in this area. Similar species were also identified at Kemp Beach. Further information on the regional ecosystems corresponding to those broad vegetation groups can be found in Appendix 1.

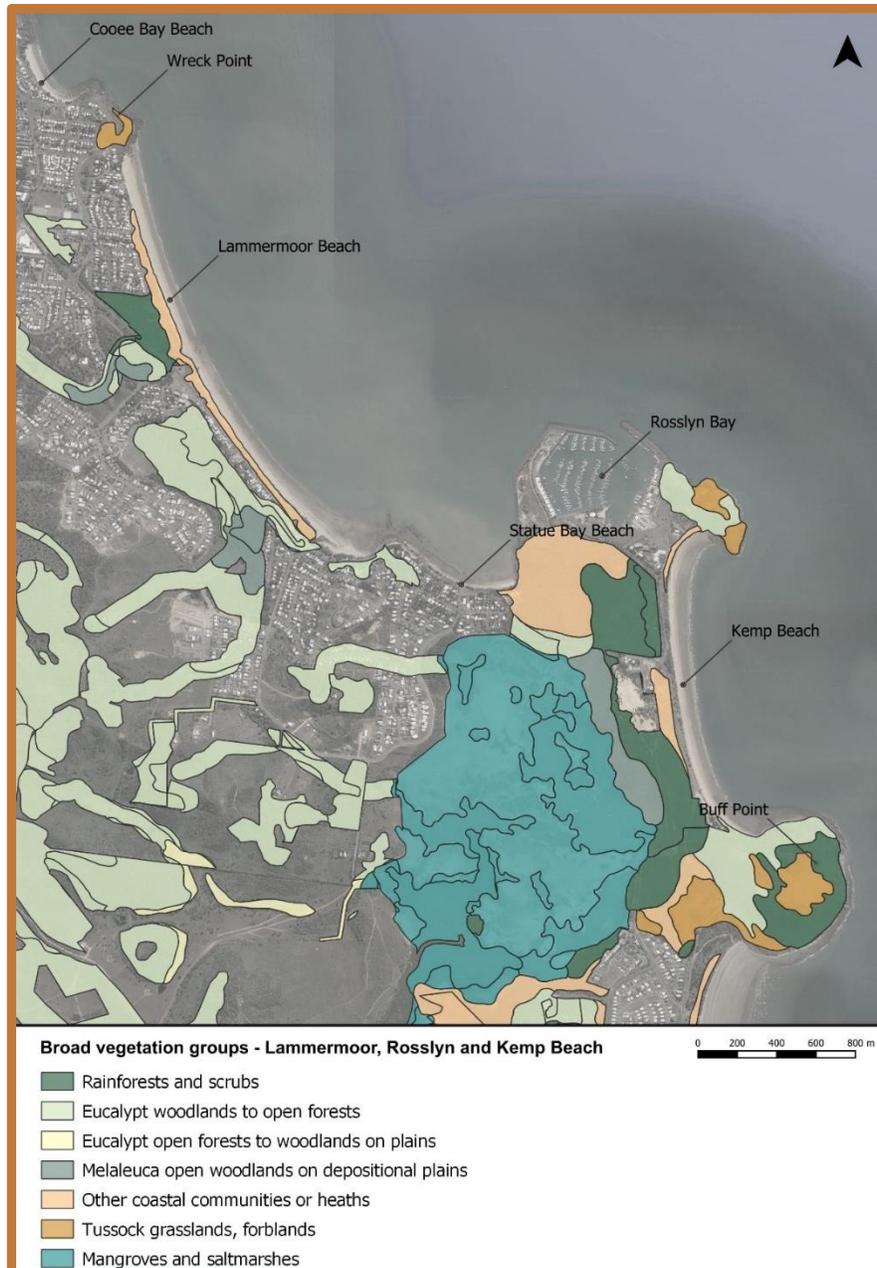


Figure 32: Dominant broad vegetation groups (regulated vegetation) in Lammermoor, Rosslyn, and Kemp Beach

Recommendations

- Communicate with the property owners adjacent to the shoreline and implement a community education program to encourage community custodianship over coastal areas and discourage the removal and replacement of native vegetation.
- Develop and implement a foreshore revegetation plan for Kemp Beach.
- Pest management program to continue and be worked in conjunction with a coastal ecological restoration plan.
- Education and empowerment of residents about importance of dunal vegetation.
- Create a strategy to address dune vegetation vandalism and implement educational signage. Increased monitoring will be required to assess if the educational program is effective or if other measures need to be considered.

Public access and facilities

Lammermoor Beach has nine public access paths and various unsigned paths. There are also public facilities at Lioness Park including amenities, barbecues, and benches. Lammermoor has recently had a footpath built between Lioness Park and Statue Bay.

Kemp Beach has recently had a footpath built which runs along the length of the beach. There are also amenities available on the southern end of Kemp, as well as beach showers on the northern end. Kemp Beach has various access points including:

- Five along the Scenic Highway
- Two from Vin E Jones Memorial Drive, and
- One from the Double Head National Park along Shoreline Close.

There is limited carparking along Vin E Jones Memorial Drive which leads to people parking on the top of the dune and causes the area to be void of vegetation. This is especially pronounced in front of Beaches Restaurant. There are signs discouraging people from using undesignated access tracks at the northern end of Kemp, but a lack of fencing (compared to southern end) to deter people from doing so. There are also fewer bins and dog waste bags available on the northern end of Kemp compared to the south.

Recommendations

- Formalise car parking along Vin E Jones Drive near beaches or place bollards to deter vehicles from parking in dunes.
- Fence above dune along north Kemp to deter people from accessing beach outside of designated tracks.
- Provide additional bins and dog waste bags to northern Kemp Beach.

Land tenure

The Wreck Point to Rosslyn Bay Breakwater Beach Unit is bounded by Low and Medium Density Residential, Environmental Management and Conservation, Open Space, Special Purpose, and Rural zoned land. The Environmental Management and Conservation area adjoining Lammermoor Beach is Lioness Park, which is part of a Reserve for local government. There is an Environmental Management and Conservation land adjoining Statue Bay which is a National Park. The remaining adjoining land has Freehold tenure. The beaches (low to high water mark) within this beach unit are currently not gazetted (no registered plan number) or in the Parks and Reserve Register so are unable to be governed under local laws.

Kemp Beach is abounded by mostly Environmental Management and Conservation, Rural and Low Density Residential zoned land except for Rosslyn Bay Marina and the associated development in this area which is zoned as Special Purpose and Medium Density Residence.

There are five National Park sections which make up the Capricorn Coast National Park, three of which are near Kemp Beach. The National Park sections are located at Rosslyn Head, Double Head (the northern end of the beach) and Bluff Point to the south. The park that runs the length of the beach along the Scenic Highway is the Mary Crowe Park and was reserved for recreation in 1992. The remaining land in the vicinity of Kemp Beach has a land tenure of Freehold or State Land. Kemp Beach (low to high water mark) is currently not gazetted.

Recommendation

- Designate and assign a lot number to the beaches and adjacent areas (including road reserves where roads will not be constructed) and zone as Environmental Management and Conservation areas.



Figure 33: Land tenure in Lammermoor, Rosslyn, and Kemp Beach

Urban pressures

Lammermoor Beach is flanked to the west by existing urban residential development. Urban pressures include:

- Encroachment of beaches by residential lots.
- Removal of coastal vegetation for ocean views.
- Creation of undesignated access to beaches.

Statue Bay is a small cove which has limited recreational opportunities as it is shallow and does not offer expansive white sands. Beach users predominately arrive by vehicle or foot to net or fish from the beach. There is no formed car parking adjacent the Scenic Highway at Statue Bay. The dunes of the beach at this location gradually incline up to meet the road so there is no “access point”. Pressures identified include:

- Possible encroachment into coastal zone by adjacent urban dwellings.

Kemp Beach is a popular area for recreational use and attracts many beach users due to its accessibility from the Scenic Highway. Potential urban pressures identified at Kemp include:

- Removal of coastal vegetation for ocean views at northern end of beach.

Stormwater outflows

There are several stormwater outflow points into this beach unit, with three natural flows. Williamson Creek and the wetland area above Lioness Park are the two major drainage systems for Lammermoor. Sand frequently builds up and blocks the Williamson Creek outflow point into the sea as well as the creek from the wetlands area. This has occurred through sand movement and the lack of rainfall to push the creeks through the beach and allow drainage to occur. Poor drainage causes the creek to become stagnant allowing mosquito breeding and the decomposition of vegetated matters. A works schedule should be developed to ensure maintenance of the outflow is carried out. This would also help protect the dunes to the south of Williamson Creek which have been eroding from the meandering of the creek. The third natural drainage point is into Statue Bay and is via a gully which catches the stormwater from the elevated blocks to the south.

There are eight piped stormwater outflow points into the beach unit allowing drainage from a large area of the extensive stormwater system in the area. It was noted that there was significant channelling from the outflow point at the end of the Maida Street Esplanade. The channel is at least 2 metres deep and wide, has washed out to the foot of the drain and there is failing jute matting which was in place to hold the sands banks.

Most of the shoreline along Kemp Beach runs to the unallocated State Land that lies to the west of the Scenic Highway. Shoreline erosion is from the coastal side because of the accelerated stormwater runoff from the adjoining roadway and recreation reserve. While the park is continually compacted by vehicles, stormwater runoff will continue to be a problem.

Recommendations

- Maintenance program for keeping Williamson Creek mouth free of sand.
- Consider the need for another stormwater outlet onto the beach adjacent to the end of Maida Street.
- Install gross pollutant traps socks/nets on the pipes entering Williamson Creek and the outflow between Ray and Chrisney Streets.
- Limit vehicle traffic to designated roads and parking areas, and revegetate the remaining parkland.
- Redirect runoff (through swales/re-levelling) along Kemp Beach from the western side of the Scenic Highway and have it diverted to the west, so it does not cross the Highway and enter the beach system.

Storm tide

Lammermoor Beach

Williamson Creek crossing the Scenic Highway will be inundated during a three-metre storm tide event or above. Residences around Williamson Creek will be inundated at four metres. The Scenic Highway at Lioness Park will be inundated during a 4.5 metre storm tide event or above, which will cut off evacuation to the north along the Scenic Highway. At Statue Bay, Rosslyn Street properties are vulnerable to storm tide events at three metres. Vin E Jones Memorial Drive and the Scenic Highway at Kemp Beach are situated high above sea level and will not be inundated even in a six-metre event. Infrastructure at Rosslyn Bay will be inundated in events above four metres.

Recommendation

- Public are made aware of inundation risks and emergency procedures.

Areas of high conservation value

Lammermoor has several valued environmental conservation areas. The area surrounding Lioness Park, which is a natural wetland area, has many species of plants and is an important link in the local ecology. Williamson Creek the other environmental conservation area has mangroves and estuarine vegetation. The creek is contained in a reserve but is being threatened by pollution and encroachment from residences in the area.

The areas of high environmental conservation value along Kemp Beach have been included in the nearby National Parks, therefore ensuring the protection of the unique and sensitive headland vegetation communities. The area around Bluff Point is known as a popular turtle feeding ground, which can be viewed from the top of Bluff Point.

Areas of Indigenous cultural significance may be located within these beach units. Prior to commencement of works, it is recommended that consultation with the local Indigenous community be conducted. This will ensure areas of cultural significance are protected and maintained.

Recommendations

- Promote the importance of the wetlands adjacent to Lammermoor Beach.
- Protection of Williamson Creek riparian zone through an environmental reserve.
- The local Indigenous community be consulted before any future recommended works occur.

Management practices

Council responds to coastal management issues in the area on an as-needs basis. Longer term planning and adaptation strategies are listed in the Our Living Coast Strategy (Council's Coastal Hazards Adaptation Strategy).

Issues

- Weed Infestation of dunes.
- Lack of bins and dog waste bags at the northern end of Kemp Beach.
- Channelling from stormwater drainage outlets and run-off from roads and park lands onto beaches.
- Stagnation and closing of mouth of Williamson Creek from sand movement.
- Trend of erosion along Lammermoor Beach, Statue Bay, and Kemp Beach.
- Clearing for ocean views by coastal residents.

Recommendations

- Future development should not extend further seaward than the existing building alignment, or where no alignment exists, should be located as far landward as practicable to ensure that future property protection works (if necessary) are constructed and, wherever possible, within the boundaries of the property the work is designed to protect.
- Communicate with the property owners adjacent to the shoreline and implement a community education program to encourage community custodianship over coastal areas and discourage the removal and replacement of native vegetation.
- Develop and implement a foreshore revegetation plan for Kemp Beach.
- Pest management program to continue and be worked in conjunction with a coastal ecological restoration plan.
- Education and empowerment of residents about importance of dunal vegetation.
- Create a strategy to address dune vegetation vandalism and implement educational signage. Increased monitoring will be required to assess if the educational program is effective or if other measures need to be considered.
- Formalise car parking along Vin E Jones Drive near beaches or place bollards to deter vehicles from parking in dunes.
- Fence above dune along north Kemp to deter people from accessing beach outside of designated tracks.
- Provide additional bins and dog waste bags to northern Kemp Beach.

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- Designate and assign a lot number to the beaches and adjacent areas (including road reserves where roads will not be constructed) and zone as Environmental Management and Conservation areas.
 - Maintenance program for keeping Williamson Creek mouth free of sand.
 - Consider need for another stormwater outlet onto the beach adjacent to the end of Maida Street.
 - Maintain or replace gross pollutant traps socks/nets on the pipes entering Williamson Creek and the outflow between Ray and Chrisney Streets.
 - Limit vehicle traffic to designated roads and parking areas and revegetate the remaining parkland.
 - Redirect runoff (through swales/re-levelling) along Kemp Beach from the western side of the Scenic Highway and have it diverted to the west, so it does not cross the Highway and enter the beach system.
 - Public are made aware of inundation risks and emergency procedures.
 - Promote the importance of the wetlands adjacent to Lammermoor Beach.
 - Protection of Williamson Creek by the changing of the riparian zone from freehold land to environmental reserve.
 - The local Indigenous community be consulted before any future recommended works occur.

Mulambin, Kinka Beach, and Causeway Lake

Current condition

Erosion/accretion

Mulambin Beach is a relatively stable beach with a new incipient dune accreting since its loss during Tropical Cyclone Marcia. There has been little notable change in the beach between 2005 to 2021 when comparing satellite imagery. The erosion prone area at Mulambin Beach extends 125 to 135 metres from the toe of the dune and does encompass some ocean facing properties along the Scenic Highway.

Kinka Beach has a long history of erosion issues. Prior to 1988 Kinka Beach relied on a large rock seawall to protect coastal residents but the installation of a sand dam wall to stabilise the outflow from Causeway Lake led to the natural accretion of sand, which buried the wall under a natural sand dune. Analysis of satellite imagery between 2005 and 2021 found there was significant growth of the dunes and accretion of sand along most of Kinka Beach, with the vegetated areas doubling in many locations. Field observations found there was recent erosion of the incipient dune along the central section of the beach. The erosion prone area at Kinka Beach extends over 300 metres from the toe of the dune and encompasses most properties on the beachfront.



Figure 34: Incipient dune erosion, central Kinka Beach



Figure 35: Incipient dune erosion and vegetation loss, central Kinka Beach

There were no notable erosion issues around the mouth of Mulambin/Causeway Creek, however the continued shallowing of Causeway Lake due to sediment build-up is an ongoing issue which receives much public attention, as the shallowing limits the areas' suitability for different recreational uses (such as skiing). Dredging of the lake will likely have negative impacts to the local ecology both within the lake and downstream, which will need to be studied in detail and addressed. A loss of function of the sand dam wall that could occur following a breach poses another potential threat to the Kinka beach and could cause further erosion.

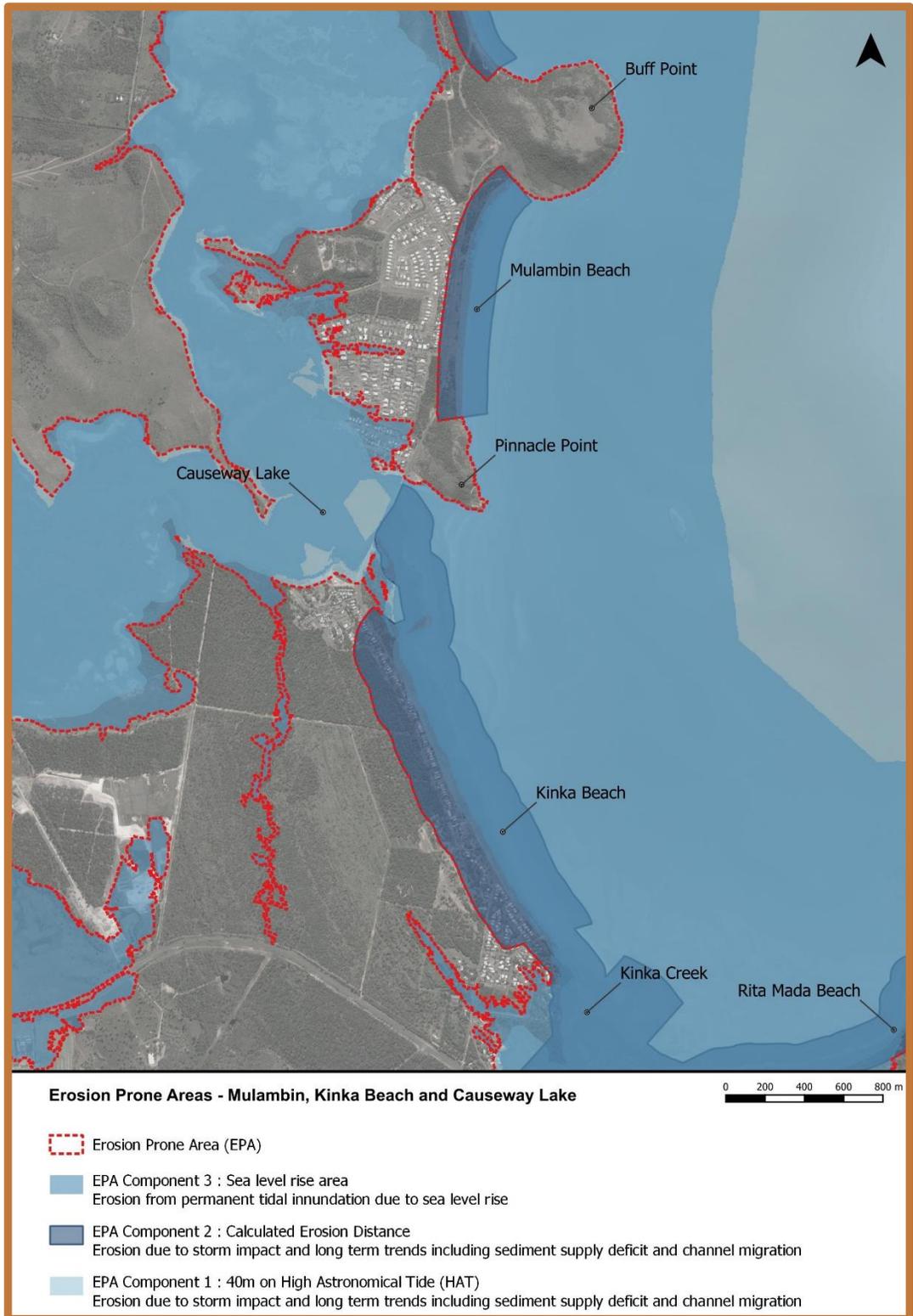


Figure 36: Erosion prone areas in Mulambin, Kinka Beach, and Causeway Lake

Recommendations

- Future development should not extend further seaward than the existing building alignment, or where no alignment exists, should be located as far landward as practicable to ensure that wherever possible, future property protection works (if necessary) are located within the boundaries of the private property.
- Detailed study into all potential impacts resulting from dredging Causeway Lake.
- Reinststate the sand dam to maintain a stable mouth at Mulambin Creek exiting east against the rocky headland instead of tracking south.

Vegetation

Mulambin Beach has two large, vegetated areas at Pinnacle and Bluff Points, and the beachfront itself has a narrow strip of 'of concern' remnant vegetation. The beach front vegetation is comprised of coastal she-oak (*Casuarina equisetifolia*) and a complex of native ground covers like goat's foot (*Ipomea pes-caprae*) and beach spinifex (*Spinifex sericeus*). Serious weed infestations were observed along this beach unit including lantana (*Lantana camara*), rubber vine (*Cryptostegia grandiflora*), Mossman River grass (*Cenchrus echinatus*), and painted spurge (*Euphorbia cyathophora*).

Kinka Beach is mapped as having a narrow strip of 'of concern' vegetation between Kinka Creek and Causeway Lake. The beach front vegetation is comprised of coastal she-oak (*Casuarina equisetifolia*) and a complex of native ground covers including goat's foot (*Ipomea pes-caprae*) and beach spinifex (*Spinifex sericeus*). The illegal clearing of vegetation along Kinka Beach (particularly around Coolwaters Esplanade) has been reported as an ongoing problem and is worsening erosion and preventing accretion in this area. Vegetation has also been degraded through regular and recent burning which has reportedly been arson. Weed infestations were observed along the edge of the dunal vegetation and the Scenic Highway as well as along most of the access tracks.

Causeway Lake is surrounded by tidal mudflats, mangroves and a mixed *Corymbia* and *Melaleuca* woodland complex. The mouth of Causeway Lake is comprised of the same vegetation that can be found along both Kinka and Mulambin beaches. Vegetation removal has occurred at the mouth of the lake south of the bridge where fisherman have made their own access through the mangroves. The lake mouth area has weeds including lantana (*Lantana camara*) and Mossman River grass (*Cenchrus echinatus*).

Further information on the regional ecosystems corresponding to those broad vegetation groups can be found in Appendix 1.



Figure 37: Dominant broad vegetation groups (regulated vegetation) in Mulambin, Kinka Beach and Causeway Lake

Recommendations

- Communicate with the property owners adjacent to the shoreline and implement a community education program to encourage community custodianship over coastal areas and discourage the removal and replacement of native vegetation.
- Pest management program to continue and be worked in conjunction with a coastal ecological restoration plan.
- Revegetation activities in areas degraded by resident clearing and fire and along newly formed sections of dune at Kinka Beach.
- Education and empowerment of residents about importance of dune areas.
- Create a plan to address dune vegetation vandalism and implement educational signage. Increased monitoring will be required to assess if the educational program is effective or if other measures need to be considered.

Public access and facilities

Mulambin Beach has four pedestrian access tracks as well as a boat launch on the northern end of the beach. Signage at the boat launch makes it clear that the beach should be accessed to launch and retrieve vessels only, however it was observed that tyre tracks were present on the beach away from the launch area. Amenities and barbecues are present on both the northern and southern ends of the beach, as well as a large strip of grassed area.

Kinka Beach has eight access tracks along the beach as well as several smaller paths used by locals. Kinka Beach has no other facilities. Causeway Lake has amenities and shaded seating areas at its mouth, as well as other facilities and parklands around the lake itself. There is no official access to the creek on the southern side however people have made tracks through the mangroves from the road's edge.

Recommendations

- Policing of unauthorised beach access by cars and motorcycles on Mulambin Beach from the boat ramp.
- Create a designated access point for fisherman on the southern side of Causeway Creek.

Land tenure

The beachfront of Mulambin Beach is zoned as Environmental Management and Conservation areas from Bluff to Pinnacle Point, which is backed by Low Density Residential, Open Space and Rural zoned Freehold land. Pinnacle and Bluff Points are tenured as National Park while the beachfront is Reserve.

The northern point of Kinka Beach at the mouth of Causeway Lake is zoned as a Reserve, with the remainder of the beach front and dunal area unzoned. The beach is backed by Low Density Residential and Rural zoned land which is Freehold.

The edges of Causeway Lake adjacent to residential areas are zoned as Open Space, while the remainder is mostly Rural land. There are some areas of National Park which are part of Causeway Lake Conservation Park.



Figure 38: Land tenure in Mulambin, Kinka Beach, and Causeway Lake

Recommendation

- Designate and assign a lot number to the beaches and adjacent areas (including road reserves where roads will not be constructed) and zone as Environmental Management and Conservation areas.

Urban pressures

Both Mulambin and Kinka Beaches will likely see continued development pressure into the future. Both beaches can expect pressures from increased use of beach access and facilities. Some current urban pressures include the removal of coastal vegetation for ocean views.

Recommendation

- Educational signage for day visitors/locals on the importance of beaches and dunes, as well as the local flora and fauna.

Storm tide

Communities behind Mulambin Beach are vulnerable to storm tide events from three metres, with Causeway Lake being the major source of storm tide issues. Most of the properties behind this beach will be inundated during a six-metre event, except for beachfront properties on the Scenic Highway. At Kinka Beach, the southern area near Kinka Creek is vulnerable from storm tide events from three metres, with the remaining properties being vulnerable to events of 4.5 metres. Both communities are vulnerable to isolation.

Recommendation

- Public are made aware of inundation risks and emergency procedures.

Areas of high conservation value

Mulambin Beach is abutted by two National Parks at Pinnacle and Bluff Points which are both of high conservation value, containing valuable coastal vegetation. The areas surrounding Causeway Lake include highly valuable areas of mangrove and tidal flats which serve as fish nurseries. Kinka Beach has dunal vegetation as well as other remnant vegetation backing onto the residential beachfront properties.

Areas of Indigenous cultural significance may be located within these beach units. Prior to commencement of future works, it is recommended that consultation with the local Indigenous community be conducted. This will ensure areas of cultural significance are protected and maintained.

Recommendations

- Continue to work with the Queensland Parks and Wildlife Service in the management and maintenance of areas adjacent to Bluff Point and Pinnacle Point.
- The local Indigenous community be consulted before any future recommended works occur.

Management practices

Council responds to coastal management issues in the area on an as-needs basis. Longer term planning and adaptation strategies are listed in the Our Living Coast Strategy (Council's Coastal Hazards Adaptation Strategy).

Issues

- Continued shallowing of Causeway Lake.
- Weedy foredunes.
- Vegetation along Kinka Beach degraded from frequent fires.
- Vehicles accessing Mulambin Beach from the boat launch area and driving outside of authorised areas.

Recommendations

- Future development should not extend further seaward than the existing building alignment, or where no alignment exists, should be located as far landward as practicable to ensure that wherever possible, future property protection works (if necessary) are located within the boundaries of the private property.
- Detailed study into all potential impacts resulting from dredging Causeway Lake.
- Communicate with the property owners adjacent to the shoreline and implement a community education program to encourage community custodianship over coastal areas and discourage the removal and replacement of native vegetation.
- Pest management program to continue and be worked in conjunction with a coastal ecological restoration plan.
- Revegetation activities in areas degraded by resident clearing and fire and along newly formed sections of dune at Kinka Beach.
- Education and empowerment of residents about importance of dune areas.
- Create a plan to address dune vegetation vandalism and implement educational signage. Increased monitoring will be required to assess if the educational program is effective or if other measures need to be considered.
- Policing of unauthorised beach access by cars and motorcycles on Mulambin Beach from the boat ramp.
- Create a designated access point for fisherman on the southern side of Causeway Creek.
- Designate and assign a lot number to the beaches and adjacent areas (including road reserves where roads will not be constructed) and zone as Environmental Management and Conservation areas.

-
- Educational signage for day visitors/locals on the importance of beaches and dunes, as well as the local flora and fauna.
 - Public are made aware of inundation risks and emergency procedures.
 - Continue to work with the Queensland Parks and Wildlife Service in the management and maintenance of areas adjacent to Bluff Point and Pinnacle Point.
 - The local Indigenous community be consulted before any works occur.

Emu Park and Zilzie

Current condition

Erosion/accretion

The southern end of Tanby Point (Ritamada) Beach experiences significant fluctuations in erosion and accretion, with a net loss of over twenty-three metres between 2015 and 2020 alone. Fisherman’s Beach is protected by two headlands and the Keppel Island Group which influence the impact of waves on these beaches. South-easterly and easterly winds influence the erosion and accretion of Fisherman’s Beach. The dunal zone of the beaches is relatively wide except for the southern end of the beach where it narrows considerably. Little erosion was observed on the northern end of Fisherman’s Beach. The southern end of the beach had erosion above the rock wall on the north side of the boat ramp as well as below Bell Park. The erosion prone area of Fisherman’s Beach extends 150 metres from the toe of the dune.

Figure 39: Erosion above the rock wall north of the boat ramp at Fisherman’s Beach



Figure 40: Erosion undermining trees adjacent to Bell Park



Emu Park Main Beach is sheltered between rocky outcrops and headlands which keeps it relatively protected. Emu Park Main Beach is relatively stable but has had a trend of erosion between 2005 and 2021. Recent observations found that there was serious erosion undermining occurring adjacent to the Surf Lifesaving Club boat shed. Emu Park Main Beach erosion prone area extends 120 to 130 metres from the toe of the dune.

Figure 41:
areas in Emu



Erosion prone
Park and Zilzie

Zilzie Beach is sheltered and stable, and comparison of imagery between 2005 and 2021 found that there was little change with minor loss overall. Field observations found that there was mature tree loss from root erosion and storm damage. The Zilzie Beach erosion prone area extends 120 metres from the toe of the dune.



Figure 42: Minor erosion along beach front



Figure 43: Tree loss to erosion/storms

Erosion was observed at Musker’s Beach, especially at the southern end of the beach. A comparison of imagery between 2005 and 2021 found that the beach was relatively stable until 2015. North Musker’s Beach lost over 5 metres of dune and between 2 to 5 metres in the south. A sandbag sea wall was constructed at Musker’s Beach in 2014 in response to erosion concerns. Following this, significant vegetation loss occurred in 2015 after Tropical Cyclone Marcia, which continued between 2016 and 2021. The Musker’s Beach erosion prone area extends 100 metres from the toe of the dune.



Figure 44: Musker’s Beach north vegetation on seawall



Figure 45: Musker’s Beach south erosion undermining existing vegetation

Recommendations

- Future development should not extend further seaward than the existing building alignment, or where no alignment exists, should be located as far landward as practicable to ensure that wherever possible, future property protection works (if necessary) are located within the boundaries of the private property.
- Monitoring of the beach profile at Musker’s Beach south of existing seawall where erosion is occurring.
- Intervention may be needed at Bell Park and the boat ramp on the southern end of Fisherman’s Beach where erosion is occurring. Maintained lawns may not be sufficient to bind soil, and consideration should be made for native revegetation.
- Develop a Shoreline Erosion Management Plan specific to Musker’s Beach.

Vegetation

Fisherman's Beach has a wide vegetated dune area along the centre of the beach, which narrows to the north and south. The vegetation is comprised of beach she-oak (*Casuarina equisetifolia*) medium woodland with complex native ground cover communities which is backed by microphyll vine forest (beach scrub) and *Melaleuca – Corymbia* woodland. A large section of the central area of Fisherman's Beach lacks tree cover, though this area does have a variety of native ground covers. Weeds in these areas were very prominent around access tracks and in exposed areas and included Japanese sunflower (*Tithonia diversifolia*), and Mossman River grass (*Cenchrus echinatus*).

Emu Park Main Beach lacks native tree cover entirely but does have native and non-native ground cover. Zilzie Beach has a narrow strip of vegetation which is not mapped as being remnant but would be a suitable site for revegetation activities. Musker's Beach is bare of native tree cover, especially on the northern end, and has limited native shrub and tree cover on the southern end. Musker's Beach lack of tree cover appears to be from a combination of natural loss to erosion as well as intentional removal by residents for ocean views. Several beaches in Emu Park, including Emu Park Main Beach, have experienced Pandanus dieback because of Pandanus leafhopper (*Jamella australiae*) infestations in the area.



Figure 47: Lack of any tree or shrub cover at Musker's Beach



Figure 46: Musker's Beach south erosion and vegetation loss

Further information on the regional ecosystems corresponding to those broad vegetation groups can be found in Appendix 1.



Figure 48: Dominant broad vegetation groups (regulated vegetation) in Emu Park and Zilzie

Recommendations

- Communicate with the property owners adjacent to the shoreline and implement a community education program to encourage community custodianship over coastal areas and discourage the removal and replacement of native vegetation.
- Pest management program to continue and be worked in conjunction with a coastal ecological restoration plan.
- Conduct and support community planting activities focusing on reinstating Pandanus trees at Emu Park Main Beach and continue working with specialists to develop biocontrols for the Pandanus leafhopper (*Jamella australiae*).
- Revegetation at Zilzie Beach and Fisherman's Beach where it is unlikely there will be conflict with local community. Revegetation should bolster native tree and shrub cover and be consistent with the regional ecosystem that was formerly in the area (coastal she-oak (*Casuarina equisetifolia*) woodland with native ground cover complex). This will help build resilience of the beach against future erosion issues.
- Develop a vegetation plan for the area landward of the bag wall at Musker's Beach, as well as a list of appropriate species to plant on the bags (i.e., those whose roots will not interfere with the bags), and a plan to manage the exposed sections of the wall (including appropriate minor maintenance to reprofile exposed bags after erosion events).
- Develop and implement a plan for revegetation (or improving vegetation) north of the creek along Bell Park.
- Education and empowerment of residents about importance of dune areas.
- Create a strategy to address dune vegetation vandalism and implement educational signage. Increased monitoring will be required to assess if the educational program is effective or if other measures need to be considered.

Public access and facilities

The provision of showers and other facilities as well as off-leash dog access at Tanby Point Beach attracts many visitors, which is putting pressure on the thin strip of land between Haven Road and the beach. Parking on Haven Road to access the beach is putting increasing pressure on the dune system and is also creating safety issues on this stretch of road.

Fisherman's Beach has several formalised access tracks as well as several undesignated access points. This beach has limited public facilities except around Bell Park where there is a boat ramp, amenities, and sheltered barbecues and seating. Emu Park Main Beach has several access points and facilities on its northern end around Kerr Park. Zilzie and Musker's Beaches have several access points and non-designated access points.

Recommendation

- When the current facilities at Tanby Point Beach require replacement or significant repairs, consider moving facilities further west on Haven Road to an area where more parking and facilities can be provided. Develop a revegetation plan for the road shoulder when the facilities are relocated.

Land tenure

Fisherman's Beach, from Bell Park to the Emu Park Bowls Club are zoned as Open Space, with a Reserve tenure. The dune system from the Emu Park Bowls Club to the northern point of Fisherman's Beach is unzoned. Twenty-nine lots at the back of the dune off Golding Street are zoned as Environmental Management and Conservation areas. The remaining lots in this area are either Low or Medium Density Residential which are Freehold, and one lot (L125) between Pattison Street and Sleeman Street which has a Reserve tenure.

Emu Park Main Beach dune system is unzoned, except for Kerr Park in the north which is zoned as Open Space. The dune system backs onto Low to Medium Density Residential Freehold land. Zilzie Beach dune and park area is also unzoned and is backed by Low Density Residential.

North Musker's Beach has Low Density Residential lots right to the toe of the dune with residential lots having ambulatory boundaries in this area. South of this the dune system has been gazetted and zoned as Environmental Management and Conservation areas.

Recommendation

- Designate and assign a lot number to the beaches and adjacent areas (including road reserves where roads will not be constructed) and zone as Environmental Management and Conservation areas.

Urban pressures

Environmental groups in Emu Park have reported concerns with the frequent use of the northern section of Fisherman's Beach as an off-leash dog area, as parking facilities are not sufficient for the amount of use the area is experiencing. Other primary urban pressures come from coastal development around Emu Park and Zilzie. Current pressures include:

- Unregulated or illegal works on state coastal land, including unauthorised access-ways, infrastructure such as fences, retaining walls, sheds or pergolas and dumping of fill or garden waste.
- Clearing for ocean views.
- Light pollution impacting marine turtles identified by Fitzroy Basin Association Team Turtle volunteers.

Recommendations

- Monitor for, and removal of, unregulated infrastructure from dunal areas.
- Implement policy for responding to vegetation clearing and tree vandalism.
- Implement strategy to identify and address light pollution along beaches and prevent development where it is likely to increase light pollution.

- Develop a strategic plan for the Emu Park Main Beach precinct to incorporate storm water management, management of open spaces, management of the original rock wall, support for the dune (south of the Surf Life Saving Club), access management, and native revegetation zones.
- Develop a strategy to enable off-leash dog use of beaches only where facilities (including car parking) can adequately cater for the use of these beaches.



Figure 49: Land tenure in Emu Park and Zilzie

Stormwater outflows

There are many outflow points for the extensive stormwater network in the Emu Park and Zilzie area. The flow of stormwater enters the beach through the dunes via pipes and open drains. The stormwater outflow points have minimal litter present; however residents report drains at the South of Tanby Point and Fisherman's Beaches, wash contaminants including oil, pesticide, and fertiliser onto these beaches. Additionally, reports indicate the large storm water drain at the northern end of Fisherman's Beach is causing erosion in the adjacent areas and reduces storm surge protection offered by dunes in this area. Stormwater outflows have also required multiple interventions at Musker's Beach access.

Recommendation

- Monitor the storm water drain at the northern end of Fisherman's Beach and develop a strategy to reduce the volume of water flowing through this drain.

Storm tide

Emu Park and Zilzie are situated relatively high above sea level and inundation of properties/homes will start to occur in storm tide events from 4.5 metres. The developments located south of Zilzie on Monaco Drive and Monte Carlo Avenue are vulnerable to inundation in events greater than three metres.

Recommendation

- Public are made aware of inundation risks and emergency procedures.

Areas of high conservation value

The area has environmental conservation values as the beaches in this unit (from Tanby Point to Zilzie) are known to be turtle nesting sites. It is therefore important that the dunal area be protected and the natural processes of the beach be allowed to continue. A review of the street lighting arrangements needs to occur to assess the visibility of the lights from the beach. Such a review would help to reduce turtle confusion during nesting season with possible implementation of 'turtle friendly' lighting arrangements.

Culturally this beach unit has been an important site for recreation for the Emu Park community. In the late 1800s and early 1900s, Main Beach was the site for men's bathing while women were allowed to swim at the secluded sandy bay of Ladies Beach between Emu Point and Main Beach. The beaches have been the site for visitors since the 1860s and have continued to play an important role in the tourism of the town ever since.

Areas of Indigenous cultural significance may be located within this beach unit. Prior to commencement of any future works, it is recommended that consultation with the local Indigenous community be conducted. This will ensure areas of cultural significance are protected and maintained.

Recommendations

- Identify turtle nesting beaches which suffer from light pollution issues and implement turtle friendly lighting measures such as light shields, long wavelength (turtle friendly) lights, and mounting park lights as low as possible so that they are not visible from the beach.
- The local Indigenous community be consulted before any future recommended works occur.

Management practices

Council responds to coastal management issues in the area on an as-needs basis. Longer term planning and adaptation strategies are listed in the Our Living Coast Strategy (Council's Coastal Hazards Adaptation Strategy).

Issues

- Weedy dunal areas.
- Sparse coastal vegetation.
- Erosion occurring at Fisherman's Beach boat ramp, Bell Park, Emu Park Main Beach, and Musker's Beach.
- Unregulated or illegal works on state coastal land, including unauthorised access-ways, infrastructure such as fences, retaining walls, sheds, or pergolas, and dumping of fill or garden waste.
- Potential light pollution impacting turtle nesting beaches.

Recommendations

- Future development should not extend further seaward than the existing building alignment, or where no alignment exists, should be located as far landward as practicable to ensure that wherever possible, future property protection works (if necessary) are located within the boundaries of the private property.
- Monitoring of the beach profile at Musker's Beach south of the existing seawall where erosion is now occurring.
- Intervention may be needed at Bell Park and the boat ramp on the southern end of Fisherman's Beach where erosion is occurring. Maintained lawns may not be sufficient to bind soil, and consideration should be made for native revegetation.
- Develop a Shoreline Erosion Management Plan specific to Musker's Beach.
- Communicate with the property owners adjacent to the shoreline and implement a community education program to encourage community custodianship over coastal areas and discourage the removal and replacement of native vegetation.
- Pest management program to continue and be worked in conjunction with a coastal ecological restoration plan.

-
- Conduct and support community planting activities focusing on reinstating Pandanus trees at Emu Park Main Beach and continue working with specialists to develop biocontrols for the Pandanus leafhopper (*Jamella australiae*).
 - Revegetation at Zilzie Beach and Fisherman’s Beach where it is unlikely there will be conflict with local community. Revegetation should bolster native tree and shrub cover and be consistent with the regional ecosystem that was formerly in the area (coastal she-oak (*Casuarina equisetifolia*) woodland with native ground cover complex). This will help build resilience of the beach against future erosion issues.
 - Develop a vegetation plan for the area landward of the bag wall at Musker’s Beach, as well as a list of appropriate species to plant on the bags (i.e., those whose roots will not interfere with the bags), and a plan to manage the exposed sections of the wall (including appropriate minor maintenance to reprofile exposed bags after erosion events).
 - Develop and implement a plan for revegetation (or improving vegetation) north of the creek along Bell Park.
 - Education and empowerment of residents about importance of dune areas.
 - Create a strategy to address dune vegetation vandalism and implement educational signage. Increased monitoring will be required to assess if the educational program is effective or if other measures need to be considered.
 - When the current facilities at Tanby Point Beach require replacement or significant repairs, consider moving facilities further west on Haven Road to an area where more parking and facilities can be provided. Develop a revegetation plan for the road shoulder when the facilities are relocated.
 - Designate and assign a lot number to the beaches and adjacent areas (including road reserves where roads will not be constructed) and zone as Environmental Management and Conservation areas.
 - Monitor for, and removal of, unregulated infrastructure from dunal areas.
 - Implement policy for responding to vegetation clearing and tree vandalism.
 - Implement strategy to identify and address light pollution along beaches and prevent development where it is likely to increase light pollution.
 - Develop a strategic plan for the Emu Park Main Beach precinct to incorporate storm water management, management of open spaces, management of the original rock wall, support for the dune (south of the Surf Life Saving Club), access management, and native revegetation zones.
 - Develop a strategy to enable off-leash dog use of beaches only where facilities (including car parking) can adequately cater for the use of these beaches.
 - Monitor the storm water drain at the northern end of Fisherman’s Beach and develop a strategy to reduce the volume of water flowing through this drain.
 - Public are made aware of inundation risks and emergency procedures.
 - Identify turtle nesting beaches which suffer from light pollution issues and implement turtle friendly lighting measures such as light shields, long wavelength (turtle friendly) lights, and mounting park lights as low as possible so that they are not visible from the beach.
 - The local Indigenous community be consulted before any future recommended works occur.



Keppel Sands and Joskeleigh

Current condition

Erosion/accretion

There is a long history of erosion and accretion for Keppel Sands Beach. This section of Livingstone’s shoreline is influenced mostly by easterly wind and waves. The shape of the coastline helps to protect Keppel Sands from north-easterly waves and winds.

A groyne that is located at the north end of the Keppel Sands Beach has helped create a crenulated bay and promoted accretion along the beach. The rock wall along the southern half of the beach has been built on top of the dunal area with no buried toe, therefore the threat of erosion and undermining of the rock wall is present.

Field observations at Keppel Sands in March 2022 found that erosion was occurring on the north end of the beach, as well as above the groyne and sandbags situated at the northern section of the beach where the groyne adjoins the beach.



Figure 50: Keppel Sands Beach north 2 metre tall erosion bank



Figure 51: Erosion occurring above groyne sandbags

The erosion prone area extends forty metres from the toe of the dune in north Keppel Beach, and seventy metres on the southern end of the beach and encompasses much of the township.

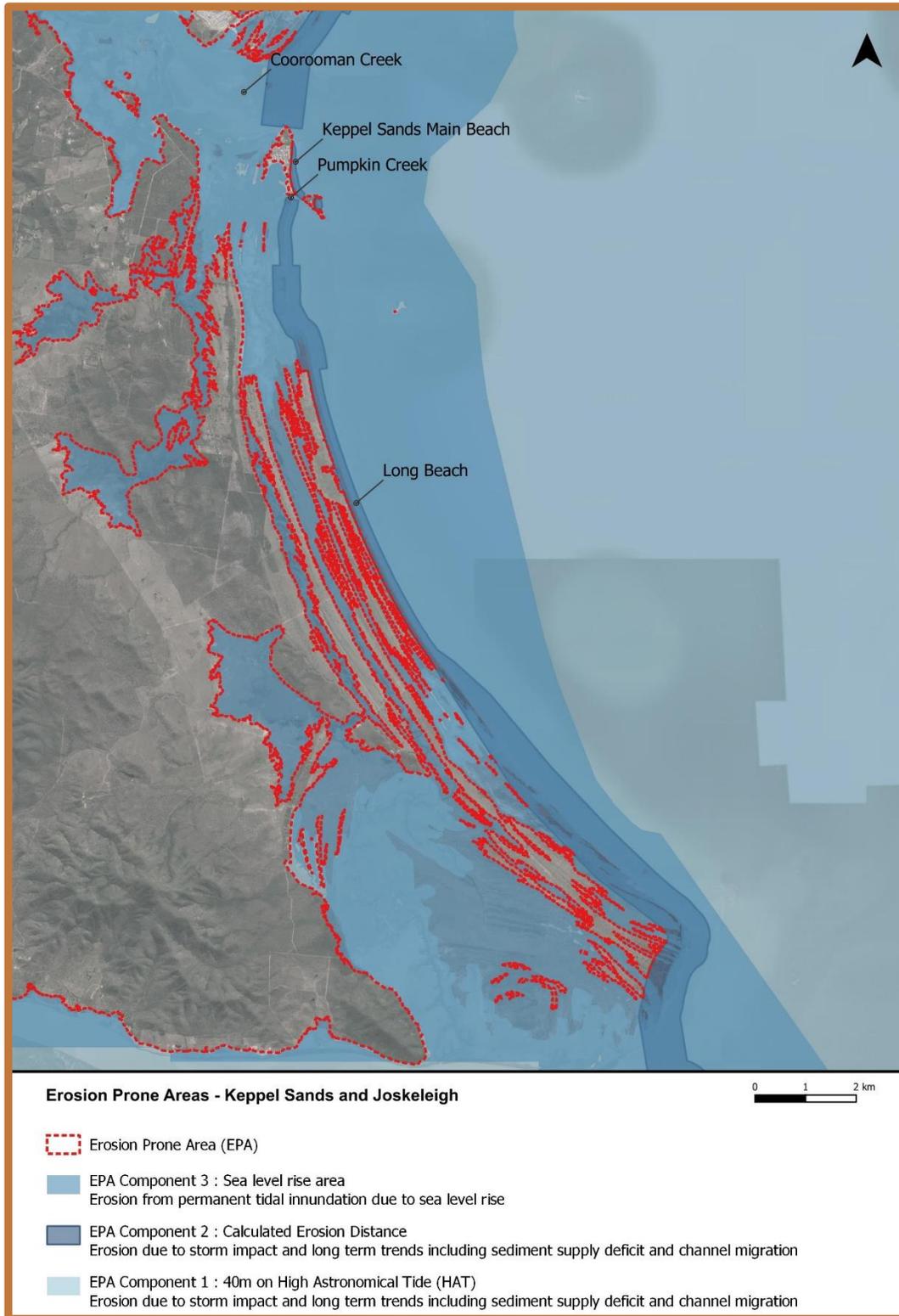


Figure 52: Erosion prone areas in Keppel Sands and Joskeleigh

Recommendations

- Future development should not extend further seaward than the existing building alignment, or where no alignment exists, should be located as far landward as practicable to ensure that wherever possible, future property protection works (if necessary) are located within the boundaries of the private property.
- Rectify erosion of dune along northern Keppel Sands Beach, as well as erosion above the sandbags on the northern groyne.
- Plan monitoring for success of erosion prevention measures.
- Monitor erosion at south Keppel Beach seawall for erosion undermining.

Vegetation

Vegetation on the headland north and south of Keppel Sands Main Beach is an ‘of concern’ vegetation complex of exposed rocky headlands. Vegetation types include kangaroo grass (*Themeda triandra*) grassland and wind-sheared shrubland and woodland. The northern end of Keppel Beach has a dune system with limited native tree cover and a ground cover of goat’s foot (*Ipomea pes-caprae*) and beach spinifex (*Spinifex sericeus*) and weeds.

Southern Keppel Sands Beach is highly modified with the seawall and does not have a dune system. Above the rock wall there is patchy tree cover of coastal she-oak (*Casuarina equisetifolia*) and locals have landscaped with other non-native species. The west side of the township backs onto limited vine forest, woodland, and a large expanse of mangroves along the Pumpkin Creek system. Tree removal (especially coastal she-oak) was notable along the beachfront and a local reported that intentional tree poisoning had occurred recently.



Figure 53: Recently killed coastal she-oak (*Casuarina equisetifolia*) and weedy ground cover



Figure 54: Non-native landscaping along top of seawall

The dunal areas of Keppel Sands Beach did have weed infestations including restricted matter such as broadleaved pepper tree (*Schinus terebinthifolius*), mother-of-millions (*Bryophyllum* spp.), lantana (*Lantana camara*), and prickly pear (*Opuntia stricta*). Infestations of environmental weeds such as Guinea grass (*Megathyrsus maximus*), painted spurge (*Euphorbia cyathophora*), Japanese sunflower (*Tithonia diversifolia*),

and para grass (*Urochloa mutica*) were also present. These areas have experienced Pandanus dieback because of Pandanus leafhopper (*Jamella australiae*) infestations in the area. Further information on the regional ecosystems corresponding to those broad vegetation groups can be found in Appendix 1.

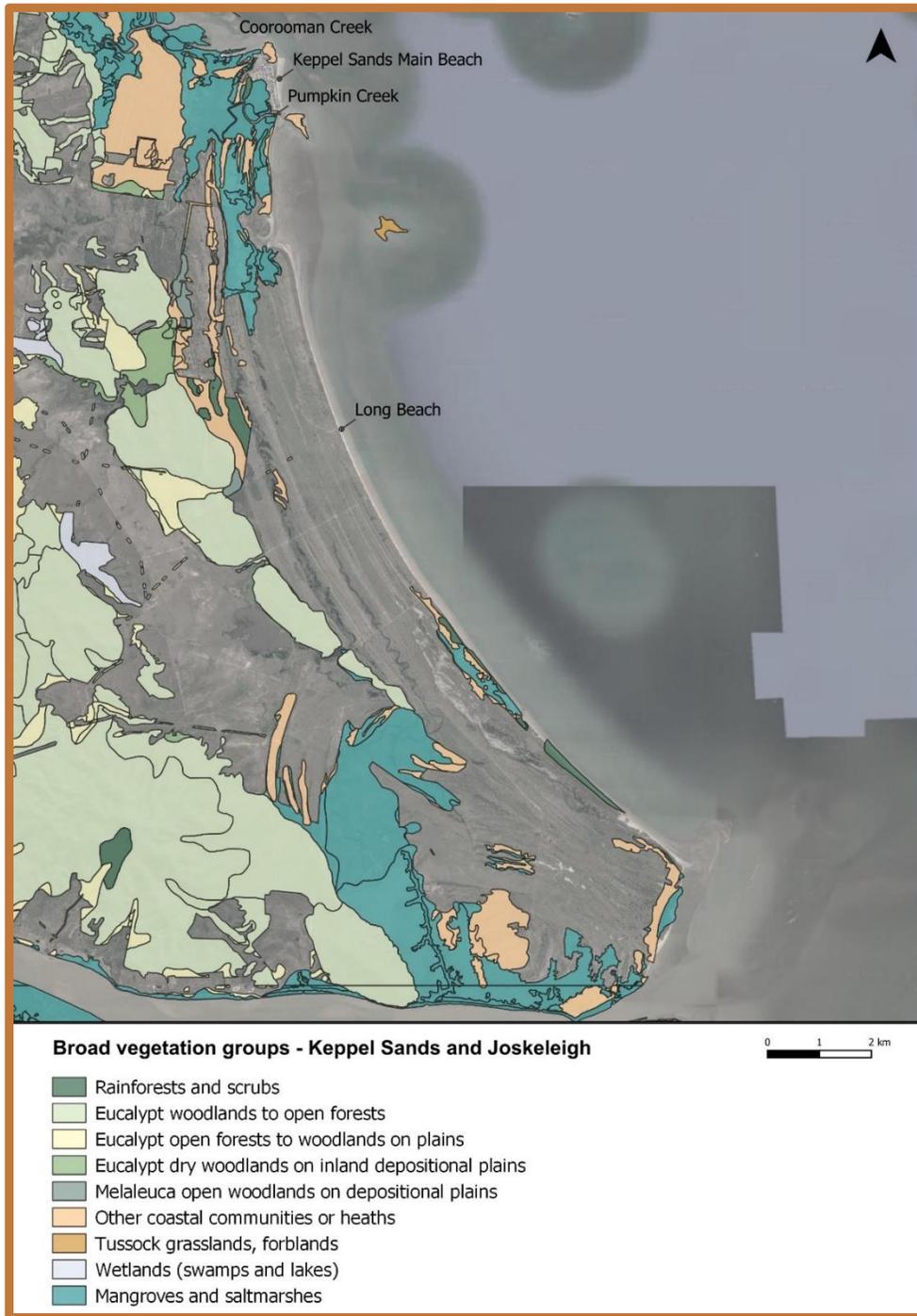


Figure 55: Dominant broad vegetation groups (regulated vegetation) in Keppel Sands and Joskeleigh

Recommendations

- Communicate with the property owners adjacent to the shoreline and implement a community education program to encourage community custodianship over coastal areas and discourage the removal and replacement of native vegetation.
- Pest management program to continue and be worked in conjunction with a coastal ecological restoration plan.
- Community education on the value and key role native vegetation plays in dunal systems.
- Create a strategy to address dune vegetation vandalism and implement educational signage. Increased monitoring will be required to assess if the educational program is effective or if other measures need to be considered.
- Conduct and support community planting activities focusing on reinstating Pandanus trees and continue working with specialists to develop biocontrols for the Pandanus leafhopper (*Jamella australiae*).

Public access and facilities

Keppel Sands Beach has eleven pedestrian access points along the beach, both signed and unsigned. There are parks at both ends of the beach which have facilities including barbecues, amenities, and seating areas. There are also boat ramps on either end of Keppel Sands, one launching into Coorooman Creek and the other into Pumpkin Creek. It was noted that there was a lack of bins at the boat ramps.

Recommendation

- Design and install signage at boat ramps encouraging visitors to take rubbish home with them.

Land tenure

The headlands north and south of Keppel Beach are zoned as Environmental Management and Conservation areas, with a tenure of Reserve. The lots along the beachfront are zoned as Township and are Freehold. There are a few areas zoned as Open Space or Special Purpose. Like other coastal units, the beachfront and dune systems are not gazetted.



Figure 56: Land tenure in Keppel Sands and Joskeleigh

Recommendation

- Designate and assign a lot number to the beaches and adjacent areas (including road reserves where roads will not be constructed) and zone as Environmental Management and Conservation areas.

Urban pressures

The urban pressures of Keppel Sands include:

- Existing community use.
- Potential infill or redevelopment.
- Unregulated or illegal works on state coastal land, including unauthorised access-ways, infrastructure such as fences, retaining walls, sheds or pergolas and dumping of fill or garden waste.
- Heavy use of the groyne as a fishing area which is causing damage to the base of the groyne and may impact its structural integrity in the future.



Figure 57: Green waste dumping above the seawall at Keppel Sands.

Recommendation

- Monitor for, and removal of, unauthorised infrastructure and illegal dumping within dunal areas.

-
- Develop and implement a vegetation and rehabilitation plan for the access near the groyne at Keppel Sands, including the potential to move this access further away to avoid heavy foot traffic impacting the base of the groyne.

Stormwater outflows

The stormwater runoff from Keppel Sands is via natural runoff and enters the beach system as such. At either end of Keppel Sands both creeks play an important role in the flow of stormwater and sediments from the surrounding land into the beach system.

Storm tide

Keppel Sands is vulnerable to storm tide events greater than 3 metres. Notably, the threat from storm tide is not from the beachfront but rather from the creeks and mangrove systems behind the township. The township is extremely vulnerable to isolation from storm tide events as there is only one road in and out of the community (Keppel Sands Road) which is low lying and mapped as being inundated from events 3 metres and upwards.

Recommendation

- Public are made aware of inundation risks and emergency procedures.

Areas of High Conservation Value

Environmentally the creeks are important fisheries and have high conservation value. The headland vegetation and the mangrove areas are also important environmental areas.

Both Keppel Sands and Long Beach have a high cultural conservation value with a rich South Sea Islander history in the area. Keppel Sands Beach was also popular in the 1920's with beach horse races.

Areas of Indigenous cultural significance may be located within this beach unit. Prior to commencement of works, it is recommended that consultation with the local Indigenous community be conducted. This will ensure areas of cultural significance are protected and maintained.

Recommendation

- The local Indigenous community be consulted before any future recommended works occur.

Management practices

Council responds to coastal management issues in the area on an as-needs basis. Longer term planning and adaptation strategies are listed in the Our Living Coast Strategy (Council's Coastal Hazards Adaptation Strategy).

Issues

- Erosion occurring on the northern end of the beach, as well as above the sandbags at the northern groyne.
- Non-native gardening along beachfront at the top of the dune.
- Removal of native vegetation for coastal views.
- Weedy dunal areas.
- Green waste dumping in dunal areas.
- Dunal areas are not gazetted leading to issues with local law enforcement.
- Entrapment and inundation risks from storm tide events.

Recommendations

- Future development should not extend further seaward than the existing building alignment, or where no alignment exists, should be located as far landward as practicable to ensure that wherever possible, future property protection works (if necessary) are located within the boundaries of the private property.
- Rectify erosion of dune along northern Keppel Sands Beach, as well as erosion above the sandbags on the northern groyne.
- Plan monitoring for success of erosion prevention measures.
- Monitor erosion at south Keppel Beach seawall for erosion undermining.
- Communicate with the property owners adjacent to the shoreline and implement a community education program to encourage community custodianship over coastal areas and discourage the removal and replacement of native vegetation.
- Pest management program to continue and be worked in conjunction with a coastal ecological restoration plan.
- Community education on the value and key role native vegetation plays in dunal systems.
- Create a strategy to address dune vegetation vandalism and implement educational signage. Increased monitoring will be required to assess if the educational program is effective or if other measures need to be considered.
- Conduct and support community planting activities focusing on reinstating Pandanus trees and continue working with specialists to develop biocontrols for the Pandanus leafhopper (*Jamella australiae*).
- Design and install signage at boat ramps encouraging visitors to take rubbish home with them.
- Designate and assign a lot number to the beaches and adjacent areas (including road reserves where roads will not be constructed) and zone as Environmental Management and Conservation areas.
- Monitor for, and removal of, unauthorised infrastructure and illegal dumping within dunal areas.
- Develop and implement a vegetation and rehabilitation plan for the access near the groyne at Keppel Sands, including the potential to move this access further away to avoid heavy foot traffic impacting the base of the groyne.

-
- Public are made aware of inundation risks and emergency procedures.
 - The local Indigenous community be consulted before any future recommended works occur.

Woppa (Great Keppel Island)

Current condition

Erosion/accretion

Putney Beach has continued to have significant erosion issues in recent decades. The dunal front has been entirely lost from Great Keppel Island Hideaway at the south-western end of Putney Beach to around 300 metres northeast. During significant storm events, such as Tropical Cyclone Marcia, buildings were lost to erosion along the beach. A seawall has been constructed in this area using geofabric bags filled with beach slurry, though this is now failing as no sand accretion appears to be occurring. The eastern end of the beach has been relatively stable, but some erosion was observed.



Figure 58: Erosion on eastern Putney Beach



Figure 59: Erosion between Putney and Fisherman's Beach behind the seawall

It is unclear whether recent erosion is the result of changing weather conditions or part of a natural cycle of erosion and accretion. More detailed studies are required to assess the forces affecting this section of coastline and determine the most appropriate management response. The erosion prone area at Putney Beach extends 160 metres from the toe of the dune. At Fisherman's Beach, it extends eighty to 100 metres from the toe of the dune. Many of the businesses and infrastructure are mapped within the erosion prone area.



Figure 60: Erosion prone areas in Woppa (Great Keppel Island)

Recommendations

- Future development should not extend further seaward than the existing building alignment, or where no alignment exists, should be located as far landward as practicable to ensure that wherever possible, future property protection works (if necessary) are located within the boundaries of the private property.
- Any new or relocated assets should have a large buffer zone and be placed as far landward as possible to prevent the need for future protection works.
- Ongoing survey of beach profiles to monitor success of management actions.
- Develop a Shoreline Erosion Management Plan specific to Putney and Fisherman's Beach.
- Conduct a detailed study into the forces at work on Putney and Fisherman's Beaches, which can provide insight and assist in determining the most appropriate management responses.
- Engage with stakeholders in impacted areas to investigate options for ongoing management of erosion in that area.

Vegetation

Great Keppel Island is wholly vegetated except for the tourist areas on the western side of the island, which includes large extents of 'of concern' vegetation communities such as mixed eucalypt woodland and coastal grassland communities. Around the tourist areas the vegetation is highly disturbed and modified. Around Putney Beach the primary vegetation community on the beach front is coastal she-oak (*Casuarina equisetifolia*) low woodland with sparse herbland and open scrub.

This vegetation is backed by mixed *Melaleuca* species open forest. Weeds observed on the island include yellow oleander (*Cassipouira thevetia*), lantana (*Lantana camara*), Easter cassia (*Senna pendula*), and agave (*Agave* spp.). Grazing by feral goats is a source of pressure that could have significant impact on the native vegetation of Woppa.

Further information on the regional ecosystems corresponding to those broad vegetation groups can be found in Appendix 1.

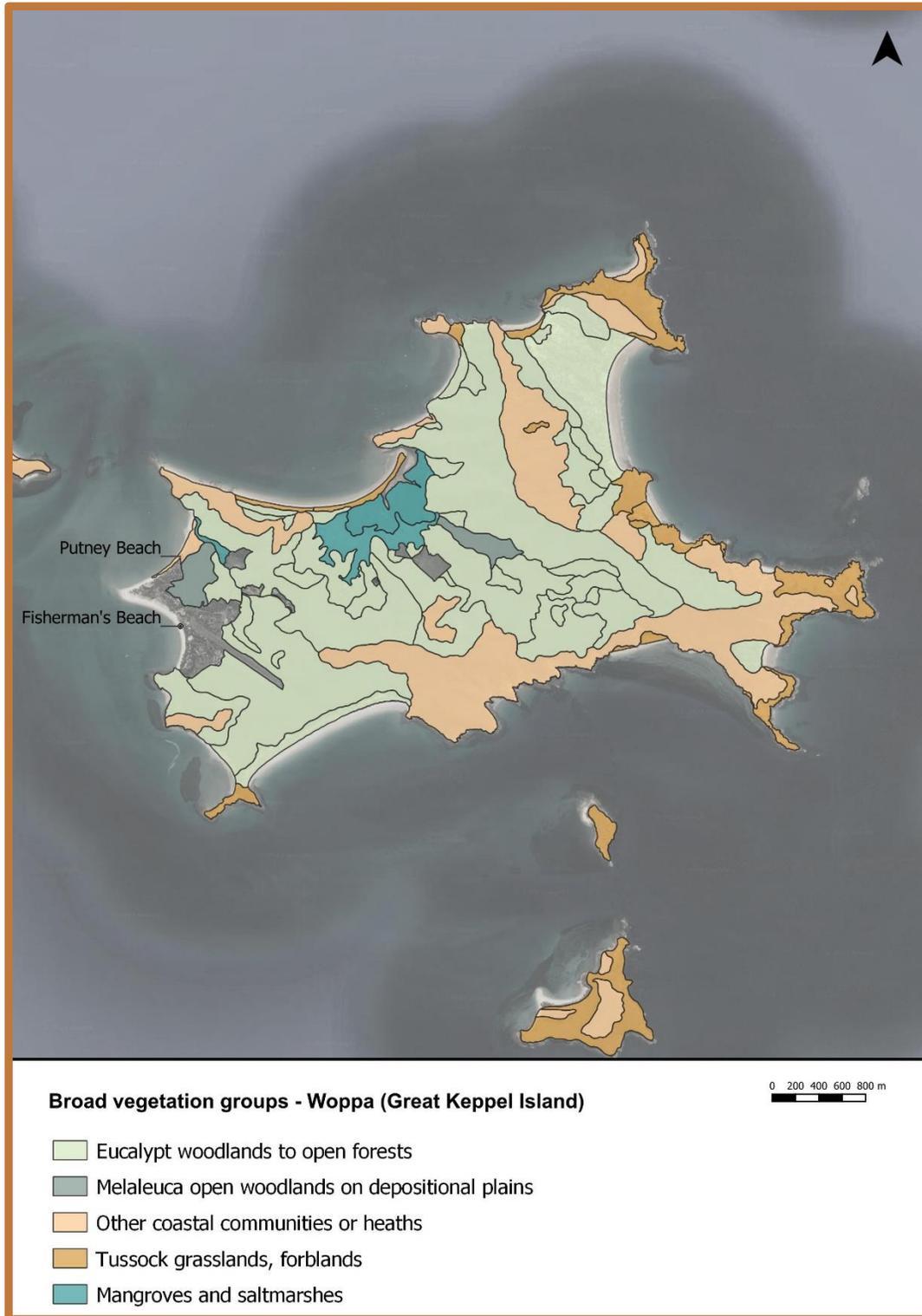


Figure 61: Dominant broad vegetation groups (regulated vegetation) in Woppa (Great Keppel Island)

Recommendations

- Communicate with the property owners adjacent to the shoreline and implement a community education program to encourage community custodianship over coastal areas and discourage the removal and replacement of native vegetation.
- Pest management program to continue and be worked in conjunction with a coastal ecological restoration plan.
- Create a strategy to address dune vegetation vandalism and implement educational signage. Increased monitoring will be required to assess if the educational program is effective or if other measures need to be considered.
- Control of feral goats to remove pressure on native vegetation

Public access and facilities

Putney Beach has vehicle access northeast of the seawall and pedestrian access from several locations. There are limited public facilities due to the proximity to private facilities. Fisherman's Beach has vehicle access which is mostly used for collecting people from the ferry, and public amenities situated halfway along the beach.

There are pedestrian paths adjacent to both beaches as well as various access points, except for along the seawall where there is limited access down the seawall to the beach at low tide due to the height of the wall.

Land tenure

The island is zoned either as Major Tourism areas, on the west side where the resort and other tourist infrastructure is, or Environmental Management and Conservation areas which comprises the remainder of the island. Most of the island is under Lease with the remainder under Freehold tenure. Like other beachers in the Shire, the beach fronts are not gazetted or zoned which raises compliance issues.



Figure 62: Land tenure in Woppa (Great Keppel Island)

Recommendation

- Designate and assign a lot number to the beaches and adjacent areas (including road reserves where roads will not be constructed) and zone as Environmental Management and Conservation areas.
- Implement better management of vehicle and pedestrian access to prevent further loss of foreshore vegetation in the frontal dunes.

Urban pressures

Currently Great Keppel Island has high potential for future development as most of the island is under lease which leaves large portions of land available for potential tourism expansion. If the abandoned resort and surrounding land is leased, this will pose significantly increased urban pressures on the island, dependent on the approved re-development plan.

Recommendation

- If the re-development of the resort proceeds, consult with State Government and the new lease holder to work collaboratively to minimise future potential pressures.

Stormwater outflows

Putney Beach and the rest of Great Keppel Island have natural overland stormwater runoff. This will likely become a greater issue if the island becomes more developed with increased hardened surfaces.

Storm tide

No storm tide information is available for Great Keppel Island.

Recommendation

- Complete storm tide risk assessment of Putney and Fisherman's Beaches.

Areas of high conservation value

The island is widely vegetated and includes large areas of 'of concern' native remnant vegetation.

The State Land on Great Keppel Island has been returned to the Indigenous owners of the Island in mid-2007. Areas of Indigenous cultural significance may be located within this beach unit. Prior to commencement of any future works, it is recommended that consultation with the local Indigenous community be conducted. This will ensure areas of cultural significance are protected and maintained.

Recommendation

- The local Indigenous community be consulted before any future recommended works occur.

Management Practices

Council responds to coastal management issues in the area on an as-needs basis. Longer term planning and adaptation strategies are listed in the Our Living Coast Strategy (Council's Coastal Hazards Adaptation Strategy).

Issues

- Failing seawall and continued erosion along Putney Beach.
- Weedy dunal areas.
- Beach fronts are not gazetted which can lead to local laws compliance issues.
- Potential for major redevelopment of the island which could create new issues.
- No storm tide information available for the island.

Recommendations

- Future development should not extend further seaward than the existing building alignment, or where no alignment exists, should be located as far landward as practicable to ensure that wherever possible, future property protection works (if necessary) are located within the boundaries of the private property.
- Any new or relocated assets should have a large buffer zone and be placed as far landward as possible to prevent the need for future protection works.
- Ongoing survey of beach profiles to monitor success of management actions.
- Develop a Shoreline Erosion Management Plan specific to Putney and Fisherman's Beach.
- Conduct a detailed study into the forces at work on Putney and Fisherman's Beaches, which can provide insight and assist in determining the most appropriate management responses.
- Engage with stakeholders in impacted areas to investigate options for ongoing management of erosion in that area.
- Communicate with the property owners adjacent to the shoreline and implement a community education program to encourage community custodianship over coastal areas and discourage the removal and replacement of native vegetation.
- Pest management program to continue and be worked in conjunction with a coastal ecological restoration plan.
- Create a strategy to address dune vegetation vandalism and implement educational signage. Increased monitoring will be required to assess if the educational program is effective or if other measures need to be considered.

-
- Designate and assign a lot number to the beaches and adjacent areas (including road reserves where roads will not be constructed) and zone as Environmental Management and Conservation areas.
 - If the re-development of the resort proceeds, consult with State Government and the new lease holder to work collaboratively to minimise future potential pressures.
 - Complete storm tide risk assessment of Putney and Fisherman's Beaches.
 - The local Indigenous community be consulted before any future recommended works occur.

Implementation plan

Please note the following guide regarding time frames suggested below:

- Short term: 2022 - 2025
- Medium term: 2026 – 2029
- Long term: 2029 – 2032

KEY: BUDGET IMPLICATIONS		
Partnership approaches	Operational budget	External funding

PLANS AND PROCEDURES							
RECOMMENDATION	RATIONALE	BEACH	TIME FRAME	RESPONSIBLE ORGANISATION	POTENTIAL FUNDING SOURCES	BUDGET IMPLICATIONS	
1	Develop beach specific Shoreline Erosion Management Plans	Each beach has specific erosion/accretion processes that need to be investigated to ensure that they can be managed in a sustainable manner	Musker’s Beach Great Keppel Island (Putney and Fisherman’s Beaches)	Short term	Council Private business owner/developer at Great Keppel Island Consultant	Great Barrier Reef Marine Park Authority Government grants Private business owner/developer at Great Keppel Island	It is anticipated that a Shoreline Erosion Management Plan for Musker’s would cost approximately \$50,000. A shoreline Erosion Management Plan for Putney and Fisherman’s Beaches is expected to cost approximately

							\$150,000. External funding would be sought for development of these plans, including the state government or private landholder /developer at Great Keppel Island.
2	Foreshore and adjacent land (including roads, esplanades, reserves, unallocated state land, and beaches) to be brought under Council trusteeship, rationalised, and zoned as environmental management and conservation areas	By ensuring reserves are correctly gazetted and included in the parks and reserves register, Council can govern such areas under local law; this will allow the correct use and management of the foreshore, dunal, and adjacent lands to occur	All coastal units	Short to medium term	Council	Council budget	Precise costs will be determined as part of future budget deliberations. A business case will be prepared prior to undertaking this action.
3	Future development should not extend further seaward than the existing building	Protection of dunal area, public and private assets	All coastal units	Short term	Council	Council budget	This strategy is included in the current Livingstone Planning

	alignment or where no alignment exists, should be located as far landward as practicable to ensure that wherever possible, future property protection works (if necessary) are located within the boundaries of the private property	and property and reduce Council liability for such loss					Scheme and will continue to be implemented with existing resources.
4	Create a strategy to address dune vegetation vandalism and implement signage	A procedure and signage to combat dunal vandalism is needed to deter people from destroying our dunal vegetation as the offenders are not always known	All coastal units	Short term	Council	Council budget	This strategy is already underway and will be achieved with existing resources.
5	Develop and implement a procedure to remove unregulated or illegal infrastructure from beach and dunal areas	Unregulated or illegal infrastructure such as accesses, fences, retaining walls, sheds, gardens, lawns, and watering	All coastal units	Short term	Council	Council budget	This strategy will be achieved with existing resources.

		systems within dunal areas					
6	Develop a procedure to trigger retention of excess sand on operational/building works, including requirements to test and stockpile sand (where appropriate) from building sites to be used for beach nourishment	This has been successfully conducted in the past, but does not currently occur and much needed sand is lost	All coastal units	Short term	Council	Council budget	Costs for this strategy may be met by relevant developers (as a development condition). This strategy is unlikely to result in additional costs to Council.
7	Ensure adherence of new developments to principles of Water Sensitive Urban Design	Maintain existing stormwater flows and natural drainage paths	All coastal units	Short term	Council	Government grants	Discussions regarding this strategy are occurring as part of the Local Government Infrastructure Program planning process. Water Sensitive Urban Design principles are also incorporated into other strategic documents. Grants may support demonstration sites but are unlikely to result in additional costs to Council.

8	Consider benefited rates systems for maintenance of beach accesses and facilities (new developments close to beaches)	Increase in use from residents of new development leads to increase in maintenance costs	All coastal units	Medium term	Council	Rates (benefited rates system)	Considering implementing a benefited rates system will be achieved with existing resources.
9	Ensure future or existing projects do not have a detrimental effect on wildlife	Consideration of wildlife will help to ensure the beaches are sustainably managed	All coastal units	Ongoing	Council State government	Council budget	This strategy is incorporated into other strategic documents. Developing and implementing future strategies/ policies will be achieved with existing resources.
10	Include the existing 'Turtle Code' in the Livingstone Planning Scheme to manage impacts of new developments	Consideration of wildlife will help to ensure the beaches are sustainably managed	All coastal units	Short term/ongoing	Council	Council budget	The Turtle Code has been developed by the Queensland Government and will be included in a future planning scheme as part of standard amendments. This can be achieved with existing resources.
11	Develop plan to identify sources of light pollution,	Fitzroy Basin Association have	All coastal units	Short term	Council	Council budget	A process of changing lights is already

	and how to address issues, and prevent future problems	reported that Main and Shelley's Beach in Emu Park have light pollution issues which leads to adult and hatchling turtles being exposed to increased risk of predation as well as becoming disoriented when trying to navigate back to the ocean.				Fitzroy Basin Association Ergon	underway and is expected to continue (as lights are replaced Council will continue using more turtle sensitive lights in relevant locations).
12	Develop a coastal ecological restoration plan which will: - Detail strategy for revegetation and restoration of degrading coastal environments. - Plan management of issues specific to each coastal unit. - Provide strategy for the management of weeds.	No formal plan exists which breaks down the environmental issues of each coastal unit and how to manage them going into the future	All coastal units	Short term	Council Consultant	Government grants	External funding opportunities will be sought to enable this strategy. Precise costings to be finalised ahead of funding submissions but ongoing costs to Council are expected to be negligible.

	- Provide a strategy to manage vegetation vandalism and conflicts with local interests.						
13	<p>Develop specific revegetation strategies for:</p> <ul style="list-style-type: none"> - Kemp Beach - Foreshore areas between Barwell Creek and Spring Head - Kinka Beach - Landward areas of Musker's Beach, including a list of appropriate species for this area - The access near the groyne at Keppel Sands - Zilzie and Fisherman's Beach (Emu Park) including north of the creek at Bell Park 	Vegetation has been damaged or cleared in these areas and specific revegetation plans are required to ensure long-term dune integrity and habitat health	<p>Kemp</p> <p>Farnborough</p> <p>Fisherman's Beach (Emu Park)</p> <p>Emu Park Main Beach</p> <p>Lammermoor</p> <p>Kinka Beach</p> <p>Musker's Beach</p> <p>Keppel Sands</p> <p>Zilzie</p>	Short term	<p>Council</p> <p>Community groups</p>	<p>Council budget</p> <p>Government grants</p>	<p>Additional resources will be required to enable this strategy. This may involve submitting business cases for consideration during budget deliberations and will likely require support from multiple Council departments (including facilities, construction and maintenance, and open spaces). Revegetation will also involve consultation with adjoining landholders.</p>
14	Complete storm tide study and mapping for Stanage and Great Keppel Island (Putney & Fisherman's Beaches)	No data is available for these areas to monitor and	<p>Stanage</p> <p>Great Keppel Island (Putney and</p>	Short term	<p>Council</p> <p>Consultant</p> <p>State government</p>	<p>State government</p>	<p>External funding opportunities will be sought to enable this strategy. Precise costings to be finalised</p>

		make informed decisions	Fisherman's Beaches)				ahead of funding submissions but ongoing costs to Council are expected to be negligible.
15	Local representatives of Traditional Custodian Groups to be involved in any future works	Protect cultural significant sites through identification before carrying out works	All coastal units	Ongoing	Council	Council budget	<p>Council is already engaging with Darumbal on all relevant matters and will continue to do so. Any Council operations planned for Woppaburra land will involve extensive consultation throughout. This ongoing engagement is being achieved with existing resources.</p> <p>Costings for appropriate reimbursement of Traditional Custodians will be factored into budgets and funding submissions as required.</p>

INFRASTRUCTURE ESTABLISHMENT AND IMPROVEMENT

RECOMMENDATION	RATIONALE	BEACH	TIME FRAME	RESPONSIBLE ORGANISATION	POTENTIAL FUNDING SOURCES		
16	Install gross pollutant trap/sock/net on stormwater pipes	Reduce the amount of pollutants entering the beach system	Musker's Beach Lammermoor Cooee Bay Main Beach	Short term	Council	Fitzroy Basin Association	This strategy, including associated costs, should be considered during new infrastructure projects and infrastructure replacement projects.
17	Improve/maintain vehicle accesses and reduce vehicle access only to designated vehicle accesses and designated beaches	Prevent vehicles from driving within the dunal area and therefore reducing the destruction of the native vegetation and the natural landform	Alligator Bay Beach (Stanage) Farnborough Mulambin	Ongoing	Council	Council budget	This strategy is currently underway and will be achieved with existing resources.
18	Improve/formalise/maintain car/boat parking facilities,	Reduce the impact on the dunal area and increase the	Stanage Farnborough	Medium term	Council	Council budget Government grants	This strategy, including associated precise costs, should be considered during

	dune fencing and beach access paths	attractiveness of parking areas. Encourage the use of designated beach access paths. Restrict access to dunes to promote vegetation growth and beach stabilisation	Lammermoor Kemp Mulambin Kinka Beach Musker's Beach Putney Beach			(pathways, boat ramps – TMR)	facility replacements or major repairs.
19	Local channel monitoring, relocation, and maintenance program for keeping the creeks flowing	Reduce dunal erosion by meandering creeks. Improve drainage to reduce decomposition of vegetation. Complaints from residents reduced.	Fisherman's Beach (Emu Park – adjacent to Bell Park) Kinka Creek Lammermoor (Williamson Creek) Barwell Creek Causeway Creek	Ongoing	Council	Council budget	Various Council teams (including Engineering Services, Natural Resource Management, and Construction and Maintenance) undertake monitoring of creeks as part of standard operations. Where additional resources are required (e.g., for major relocation), precise costings will be included in business cases which will be considered during

							future budget deliberations.
20	Removal and clean-up of unapproved infrastructure on dunes	Community members turning natural dune areas into personal parkland by gardening, placing personal infrastructure like chairs and tables, and removing natural vegetation	Farnborough (Todd Avenue) Bangalee Musker's Beach Keppel Sands	Short term	Council	Council budget	Council has an existing encroachment policy, which is expected to be implemented as business as usual with existing resources.
21	Ongoing survey of beach profiles using CoastSnap Citizen Science network	To monitor success of management actions and to help determine future management options	Kemp Beach Fisherman's Beach (Emu Park) Musker's Beach Keppel Sands Putney Beach	Ongoing	Council	Council budget	The installation of CoastSnap sites is underway and will be completed using external funding. There may be some minor expense associated with replacing damaged sites in the future (under \$1,000 per site).

22	Beach nourishment/sand skimming	Increase the buffer to natural processes	Kemp Beach Musker's Beach Fisherman's Beach (Emu Park)	Following severe weather events (as required)	Council	Council budget	Sand skimming is undertaken with existing staffing and resources.
23	Sand nourishment and revegetation along seawall at Yeppoon Main Beach	Absence of sand and vegetation cover leads to space between the rocks for vermin to live and breed, leaves no substrate for native vegetation to grow on, allows water intrusion and removes buffer from undermining of seawall toe	Yeppoon Main Beach	Short to medium term	Council	Council budget Government grants	Relevant external grants (including programmes dedicated to foreshore redevelopment or upgrading the existing seawall) could incorporate sand nourishment. Precise costings to be finalised ahead of funding submissions but ongoing costs to Council are expected to be negligible.
24	Plan/provide/improve public facilities (tables, toilets, barbecues, shelter, paths) and make facilities	Increase the appeal of facilities and provide adequate facilities for the	Stanage Mulambin	Ongoing	Council	Council budget Government grants	Relevant external grants (including programmes dedicated to accessibility, tourism, and economic

	more accessible for those with disabilities	public to use rather than create their own accesses					development) could incorporate this strategy. Precise costings to be finalised ahead of funding submissions.
25	Design and install education signage, including: <ul style="list-style-type: none"> - Promoting of the beaches as turtle and bird nesting sites - Promoting the importance of dunal areas, wetlands, and beaches through signage - Encouraging visitors to take rubbish home with them (especially at Stanage and Keppel Sands boat ramps) 	Increase the knowledge of the community and tourists of who/what uses the beaches	All coastal units	Ongoing	Council	Council budget Fitzroy Basin Association State government	Various Council units and external partners (including the Fitzroy Basin Association and state and federal government agencies) currently design and install signs regularly. This strategy will continue with existing resources.
26	Schedule for monitoring and maintenance of engineered structures	To ensure that the structures continue to work the way they were designed to	Yeppoon Main Beach Musker's Beach Keppel Sands	Short term/ongoing	Council	Council budget	Initial assessments can be undertaken within existing resources. Should further assessments be required, business cases or funding

			Putney Beach Kinka Beach				submissions will be developed with precise costings included.
27	Provide a small camping area with amenities and gas barbecues	Illegal camping is having detrimental effect on vegetation and dunal system	Stanage	Medium term	Council	Council budget Government grants	Options for implementing this strategy include: - Seeking tourism grants - Contracting a private provider (like Council's arrangements with caravan parks)
28	Redirect stormwater to reduce impact on dunes	Reduction in the amount of stormwater flowing through dunes onto beach will reduce the erosion threat	Fisherman's Beach (Emu Park) Kemp Beach Cooee Bay Main Beach (north section) Lammermoor (Maida Street/ Esplanade)	Short term	Council	Council budget	Precise costings will be included in business cases which will be considered during future budget deliberations.

29	Develop a strategic plan for the Emu Park Main Beach precinct to incorporate storm water management, management of open spaces, management of the original rock wall, support for the dune (south of the Surf Life Saving Club), access management, and native revegetation zones	The high level of activity and anticipated population growth in Emu Park will require long-term master planning to ensure ecological, community, and economic benefits are balanced	Emu Park Main Beach	Short to medium term	Council	Council budget Government grants	Relevant external grants (including programmes dedicated to foreshore redevelopment or tourism) will be sought to fund this strategy. Precise costings to be finalised ahead of funding submissions.
30	Consider strategies to limit the impact of vehicle access at Bangalee (for example, to limit the amount of sand being blown up into the carpark where it is lost, changes to position and location of the access).	The current beach access is resulting in significant damage to surrounding dunes, and sand being lost from the beach into the car park area and surrounding private properties	Bangalee	Short to medium term	Council	Council budget	Options are already under investigation. Consideration of strategies will be met with existing resources.
31	When major stormwater outlets are upgraded in the future, consider their height	The existing stormwater outlets will be	Farnborough Beach	Medium to long term	Council	Council budget	This strategy, including associated costs, should be considered

	in relation to sea level and their impact during storm events (including seawater entry into stormwater system and amount of turbulence at outlet)	inundated in future events due to sea level rise and seawater entry into stormwater system may need to be addressed	Keppel Sands				during stormwater infrastructure replacements or major repairs.
32	Develop a management plan for sustainable access and use of Cooee Bay Main Beach and nearby public areas that accommodates increased population and use of the beach as the area is activated with walking tracks etc., and to accommodate stormwater issues	The population of Cooee Bay is expected to rise, as are numbers of visitors to the beach. Reducing informal accesses and ensuring appropriate maintenance of tracks will be necessary to maintain beach integrity	Cooee Bay Main Beach	Medium term	Council	Council budget Government grants	This strategy can be implemented as part of the broader Cooee Bay master planning process. External funding may be sought if relevant.
33	Develop a strategy to enable off-leash dog use of beaches only where facilities (including car parks and bins) can adequately	Some off-leash beaches at Emu Park (specifically Tanby Point Beach) do not have adequate	Emu Park Fisherman's Beach (Coee Bay)	Short to medium term	Council	Council budget	This strategy should be considered in future local law reviews with negligible additional costs to Council

	cater for designated use of beaches	car parking to safely cater for high usage					(beyond standard costs of local law reviews).
34	When the current facilities require replacement or significant repair, consider whether facilities should be relocated to safer areas or those that can provide more parking or a greater buffer to coastal hazards	Some foreshore facilities are causing erosion and safety issues in their current locations	All coastal units	Medium to long term	Council	Council budget	This strategy, including associated costs, should be considered during facility replacements or major repairs.
OPERATIONAL AND ONGOING							
	RECOMMENDATION	RATIONALE	BEACH	TIME FRAME	RESPONSIBLE ORGANISATION	POTENTIAL FUNDING SOURCES	
35	Audit and schedule monitoring and maintenance of gross pollutant traps	To ensure maintenance is carried out when needed so that trap/sock function correctly and extend life	Yeppoon Main Beach Lammermoor Beach Fisherman's Beach (Emu Park)	Short term	Council	Council budget	Additional budget will be required to audit gross pollutant traps on a regular basis. Precise costings will be included in business cases which will be considered during future budget deliberations.

			Musker's Beach				
36	Management of pest plants along beach, dunes, and adjacent land	Reduce infestation and promote endemic species growth. Work in conjunction with a coastal restoration strategy	All coastal units	Ongoing	Council Consultant Community groups	Council budget Fitzroy Basin Association	Council will continue working with partners and seeking funding where appropriate. This will be achieved in existing resources. Specific projects, where additional resources are required, will be presented as business cases and be considered during future budget deliberations.
37	Revegetation with plantings of endemic species on beaches and the dunes	Increase native vegetation communities and stabilise the dunal area in conjunction with a coastal restoration strategy	All coastal units	Ongoing (particularly after vegetation disturbances i.e. when new beach accesses or drainage systems are installed)	Council Community groups Schools	Council Fitzroy Basin Association Government grants	Council will continue working with partners and seeking funding where appropriate. This will be achieved in existing resources. Specific projects, where additional resources are required, will be presented as business cases and be considered during future budget

							deliberations. Where revegetation is required due to clearing for Council projects, considerations for revegetation (and associated costs) should be considered as part of the project management framework.
38	Continue to work with Traditional Custodians (Darumbal and Woppaburra) and stakeholders in the management and maintenance of vegetation, dunes, and adjoining land	Working towards a similar goal in conjunction with a coastal restoration strategy	Stanage Farnborough Lammermoor Kemp Beach Mulambin Putney Beach	Ongoing	Council	Council budget Fitzroy Basin Association Government grants	Council will continue working with Traditional Custodians and seeking funding where appropriate. This will be achieved in existing resources. Specific projects, where additional resources are required, will be presented as business cases, and be considered during future budget deliberations.

39	Educate drivers about the damage vehicles cause to dunal areas and to stay on the foreshore	Education may reduce destruction of dunal areas and increased erosion from vehicle tracks	Farnborough Svendsens/Long Beach Rita Mada/Tanby Point Kinka Beach	Ongoing	Council	Council budget Fitzroy Basin Association Government grants	Council will continue working with partners and seeking funding where appropriate. This will be achieved in existing resources. External funding will be sought where relevant.
40	Education and empowerment of residents about importance of dune areas	Knowledge/ understanding of what effects their actions have on beach/dunes may encourage good ownership of beach and pro-environmental behaviour change	All coastal units	Ongoing	Council	Council budget Government grants	Council will continue working with partners and seeking funding where appropriate. This will be achieved in existing resources. External funding will be sought where relevant.
41	Educate residents on storm tide inundation risks, emergency procedures and evacuation options	Knowledge/ understanding of the risks that storm tides pose to local areas may help empower residents who are at risk of	All coastal units	Ongoing	Council Emergency services	Council budget Government grants	Council will continue working with partners, including state government agencies, to work with residents to improve understanding of and

		inundation or entrapment to have evacuation plans in place					resilience to storm tide inundation risks. Funding opportunities include Get Ready funding overseen by the Queensland Government.
42	Conduct and support community planting activities focusing on reinstating Pandanus trees and continue working with specialists to develop biocontrols for the Pandanus leafhopper (<i>Jamella australiae</i>)	Reinstatement of Pandanus communities and ongoing control of the leafhopper will limit dieback and thus improve dune integrity	Emu Park Main Beach Yeppoon Main Beach Keppel Sands Lammermoor Farnborough	Ongoing	Council Capricorn Coast Landcare Friends of the Lammermoor Native Gardens Emu Park Bushcare	Council budget Government grants	Council will continue working with community groups and seeking funding where appropriate. This will be achieved in existing resources. Where additional resources are required, projects will be presented as business cases, and be considered during future budget deliberations.

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Appendices

Appendix 1: Regional ecosystems descriptions

The following table provides brief description of the regional ecosystems (REs) mapped within the Livingstone Shire beaches and their corresponding broad vegetation group. The Vegetation Management class (VM Class) and the Biodiversity Status (BD Status) under the *Vegetation Management Act 1999* is also listed for each RE.

Broad vegetation group (BVG)	RE	Description	VM Class	BD Status
Eucalypt dry woodlands on inland depositional plains	11.12.2	<i>Eucalyptus melanophloia</i> woodland on igneous rocks	Least concern	No concern at present
	11.3.29	<i>Eucalyptus crebra</i> , <i>E. exserta</i> , <i>Melaleuca</i> spp. woodland on alluvial plains	Least concern	No concern at present
Eucalypt woodlands to open forests	11.11.15	<i>Eucalyptus crebra</i> woodland to open woodland on deformed and metamorphosed sediments and interbedded volcanics	Least concern	No concern at present
	11.11.20	<i>Eucalyptus platyphylla</i> woodland on old sedimentary rocks with varying degrees of metamorphism and folding. Lowlands	Least concern	No concern at present
	11.11.3	<i>Corymbia citriodora</i> , <i>Eucalyptus crebra</i> , <i>E. acmenoides</i> open forest on old sedimentary rocks with varying degrees of metamorphism and folding. Coastal ranges	Least concern	No concern at present

Broad vegetation group (BVG)	RE	Description	VM Class	BD Status
	11.11.4	<i>Eucalyptus crebra</i> woodland on old sedimentary rocks with varying degrees of metamorphism and folding. Coastal ranges	Least concern	No concern at present
	11.11.7	<i>Eucalyptus fibrosa</i> subsp. <i>fibrosa</i> , <i>Corymbia xanthope</i> woodland on serpentinite	Least concern	Of concern
	11.12.1	<i>Eucalyptus crebra</i> woodland on igneous rocks	Least concern	No concern at present
	11.12.3	<i>Eucalyptus crebra</i> , <i>E. tereticornis</i> , <i>Angophora leiocarpa</i> woodland on igneous rocks especially granite	Least concern	Of concern
	11.12.6	<i>Corymbia citriodora</i> open forest on igneous rocks (granite)	Least concern	No concern at present
	11.12.9	<i>Eucalyptus platyphylla</i> woodland on igneous rocks	Least concern	No concern at present
	11.3.26	<i>Eucalyptus moluccana</i> or <i>E. microcarpa</i> woodland to open forest on margins of alluvial plains	Least concern	No concern at present
	11.3.9	<i>Eucalyptus platyphylla</i> , <i>Corymbia</i> spp. woodland on alluvial plains	Least concern	No concern at present
	8.11.12	<i>Eucalyptus crebra</i> and/or <i>E. drepanophylla</i> and/or <i>E. exserta</i> and/or <i>Corymbia clarksoniana</i> and/or <i>C. xanthope</i> and/or <i>Lophostemon confertus</i> low woodland on metamorphics on islands and headlands	Of concern	Of concern

Broad vegetation group (BVG)	RE	Description	VM Class	BD Status
	8.11.3	Variable woodland to open forest, often including <i>Corymbia intermedia</i> , <i>Eucalyptus portuensis</i> , <i>C. trachyphloia</i> , <i>E. platyphylla</i> and <i>E. drepanophylla</i> on low hills on metamorphosed sediments	Least concern	No concern at present
	8.11.8	<i>Corymbia citriodora</i> or <i>Eucalyptus moluccana</i> woodland on metamorphosed sediments (subregion 4)	Least concern	No concern at present
	8.12.12	<i>Eucalyptus tereticornis</i> and/or <i>Corymbia</i> spp. and/or <i>E. platyphylla</i> and/or <i>Lophostemon suaveolens</i> woodland to open forest on hill slopes on Mesozoic to Proterozoic igneous rocks	Least concern	No concern at present
	8.2.12	<i>Corymbia intermedia</i> and/or <i>Eucalyptus latisinensis</i> and/or <i>Acacia</i> spp. and/or other heath spp. Shrublands and woodlands on parallel dunes (subregions 4 and 5)	Of concern	Of concern
	8.2.14	<i>Banksia integrifolia</i> and/or <i>Corymbia tessellaris</i> and/or <i>Acacia disparrima</i> +/- rainforest spp. tall shrubland, on Holocene parabolic dunes	Of concern	Of concern
	8.2.6	<i>Corymbia tessellaris</i> +/- <i>Acacia leptocarpa</i> +/- <i>Allocasuarina littoralis</i> +/- <i>Banksia integrifolia</i> +/- rainforest species open forest on parallel dunes	Of concern	Of concern
	8.2.8	<i>Corymbia</i> spp. and/or <i>Eucalyptus</i> spp. and/or <i>Acacia</i> spp. and/or <i>Allocasuarina littoralis</i> open forest on Pleistocene parabolic dunes	Least concern	No concern at present

Broad vegetation group (BVG)	RE	Description	VM Class	BD Status
	8.3.5	<i>Eucalyptus platyphylla</i> and/or <i>Lophostemon suaveolens</i> and/or <i>Corymbia clarksoniana</i> woodland on alluvial plains	Of concern	Endangered
	8.3.6	<i>Eucalyptus tereticornis</i> and/or <i>Corymbia intermedia</i> (or <i>C. clarksoniana</i>) and/or <i>C. tessellaris</i> +/- <i>Lophostemon suaveolens</i> open forest on alluvial levees and lower terraces	Of concern	Of concern
Eucalyptus open forests to woodlands on plains	11.3.25	<i>Eucalyptus tereticornis</i> or <i>E. camaldulensis</i> woodland fringing drainage lines	Least concern	Of concern
	11.3.38	<i>Eucalyptus tereticornis</i> , <i>Melaleuca viridiflora</i> , <i>Corymbia tessellaris</i> and <i>Eucalyptus fibrosa</i> subsp. <i>fibrosa</i> woodland with a grassy ground layer on alluvial plains and broad drainage lines derived from serpentinite	Endangered	Endangered
	11.3.4	<i>Eucalyptus tereticornis</i> and/or <i>Eucalyptus</i> spp. woodland on alluvial plains	Of concern	Of concern
Mangroves and saltmarshes	11.1.1	<i>Sporobolus virginicus</i> grassland on marine clay plains	Least concern	No concern at present
	11.1.2	Samphire forbland on marine clay plains	Least concern	No concern at present
	11.1.4	Mangrove low open forest and/or woodland on marine clay plains	Least concern	No concern at present

Broad vegetation group (BVG)	RE	Description	VM Class	BD Status
	8.1.1	Mangrove closed forest to open shrubland of marine clay plains and estuaries	Least concern	No concern at present
	8.1.2	Samphire open forbland on saltpans and plains adjacent to mangroves	Least concern	Of concern
	8.1.3	<i>Sporobolus virginicus</i> tussock grassland on marine sediments	Of concern	Of concern
Melaleuca open woodlands on depositional plains	12.3.5	<i>Melaleuca quinquenervia</i> open forest on coastal alluvium	Least concern	No concern at present
	8.1.5	<i>Melaleuca</i> spp. and/or <i>Eucalyptus tereticornis</i> and/or <i>Corymbia tessellaris</i> woodland with a ground stratum of salt tolerant grasses and sedges, usually in a narrow zone adjoining tidal ecosystems	Of concern	Endangered
	8.2.11	<i>Melaleuca</i> spp. open forest in parallel dune swales	Of concern	Of concern
	8.2.7	<i>Melaleuca</i> spp. and/or <i>Lophostemon suaveolens</i> and/or <i>Eucalyptus robusta</i> open forest in wetlands associated with parabolic dunes	Of concern	Endangered
	8.3.13	<i>Eucalyptus tereticornis</i> and/or <i>Corymbia tessellaris</i> and/or <i>Melaleuca</i> spp. woodland on alluvial and marine plains, often adjacent to estuarine areas	Of concern	Of concern

Broad vegetation group (BVG)	RE	Description	VM Class	BD Status
	8.3.3	<i>Melaleuca leucadendra</i> and/or <i>M. fluviatilis</i> and/or <i>Casuarina cunninghamiana</i> +/- <i>Syncarpia glomulifera</i> open forest on creek banks	Least concern	Of concern
Other acacia dominated open forests, woodlands and shrublands	11.3.8	<i>Acacia argyrodendron</i> woodland on alluvial plains	Least concern	Of concern
Other coastal communities or heaths	11.2.1	<i>Corymbia tessellaris</i> woodland on flat coastal dunes	Of concern	Of concern
	11.2.2	Complex of <i>Ipomoea pes-caprae</i> subsp. <i>brasiliensis</i> and <i>Spinifex sericeus</i> and <i>Casuarina equisetifolia</i> low woodland and herbland on fore dunes	Of concern	Of concern
	11.2.5	Corymbia-Melaleuca woodland complex of beach ridges and swales	Least concern	No concern at present
	12.12.19	Vegetation complex of rocky headlands on Mesozoic to Proterozoic igneous rocks	Of concern	Of concern
	8.11.10	<i>Lophostemon</i> spp. and/or <i>Acacia</i> spp. and/or <i>Melaleuca viridiflora</i> and/or <i>Allocasuarina littoralis</i> +/- <i>Eucalyptus</i> spp. +/- <i>Corymbia</i> spp. tall open shrubland on exposed hill slopes of islands and headlands on metamorphosed sediments	Of concern	Of concern
	8.12.29	<i>Allocasuarina littoralis</i> and/or <i>Lophostemon confertus</i> and/or <i>Acacia</i> spp. and/or <i>Grevillea banksii</i> open	Of concern	Of concern

Broad vegetation group (BVG)	RE	Description	VM Class	BD Status
		shrubland on islands and headlands on Mesozoic to Proterozoic igneous and Tertiary acid to intermediate rocks		
	8.2.1	<i>Casuarina equisetifolia</i> low woodland and/or sparse herbland to open scrub on foredunes and beaches	Of concern	Of concern
	8.2.10	Sand blows with bare sand and areas of sparse herbland or shrubland	Of concern	Of concern
Rainforests and scrubs	11.11.5	Microphyll vine forest +/- <i>Araucaria cunninghamii</i> on old sedimentary rocks with varying degrees of metamorphism and folding	Least concern	No concern at present
	11.12.4	Semi-evergreen vine thicket and microphyll vine forest on igneous rocks	Least concern	No concern at present
	11.2.3	Microphyll vine forest ("beach scrub") on sandy beach ridges and dune swales	Of concern	Of concern
	8.11.2	Semi-evergreen notophyll to microphyll vine forest of foothills and uplands on metamorphosed sediments	Of concern	Of concern
	8.12.11	Semi-evergreen microphyll vine thicket +/- <i>Araucaria cunninghamii</i> on islands and coastal headlands on Mesozoic to Proterozoic igneous rocks and Tertiary volcanics	Least concern	No concern at present

Broad vegetation group (BVG)	RE	Description	VM Class	BD Status
	8.12.3	Evergreen to semi-evergreen, notophyll to microphyll, vine forest to vine thicket of foothills and uplands on Mesozoic to Proterozoic igneous rocks	Least concern	No concern at present
	8.2.2	Semi-evergreen microphyll vine thicket to vine forest on coastal dunes	Of concern	Endangered
	8.3.1	Semi-deciduous to evergreen notophyll to mesophyll vine forest, +/- sclerophyll emergents, fringing or in the vicinity of watercourses	Of concern	Of concern
Tussock grasslands, forblands	8.11.9	<i>Themeda triandra</i> and/or <i>Heteropogon contortus</i> tussock grassland or <i>Xanthorrhoea latifolia</i> shrubland with <i>Themeda triandra</i> on exposed rocky headlands on metamorphosed sediments	Of concern	Of concern
	8.12.13	Tussock grassland, or <i>Xanthorrhoea latifolia</i> shrubland, including areas recently colonised by <i>Timonius timon</i> var. <i>timon</i> shrubland, on slopes of islands and headlands, on Mesozoic to Proterozoic igneous rocks and Tertiary acid to intermediate volcanics	Of concern	Of concern
	8.2.9	Tussock grassland on coastal dunes	Of concern	Endangered
Wetlands (swamps and lakes)	8.1.4	<i>Schoenoplectus subulatus</i> and/or <i>Eleocharis dulcis</i> sedgeland or <i>Paspalum vaginatum</i> tussock grassland	Of concern	Endangered

Broad vegetation group (BVG)	RE	Description	VM Class	BD Status
	8.3.4	Freshwater wetlands with permanent water and aquatic vegetation	Of concern	Of concern