



2023

Sarina Beach Local Coastal Plan

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SARINA INLET IS PART OF A
**NATIONALLY
IMPORTANT
WETLAND**



OWEN JENKINS DRIVE PARK
IS A **POPULAR
RECREATIONAL
AREA** *FOR FAMILIES*



PERPETUA POINT PROVIDES VIEWS OVER
**SARINA INLET AND
SARINA BEACH FORESHORE**



COASTAL DUNE
SYSTEMS PLAY A
CRUCIAL ROLE IN
THE ECOSYSTEM.
VEGETATION IS
CRITICAL TO DUNE
FORMATION AND
STABILISATION.



SARINA BEACH
IS A KNOWN
**SEA TURTLE
NESTING AREA**



THE COASTAL UNIT CONTAINS
ESSENTIAL HABITAT FOR THE
**COASTAL
SHEATHTAIL
BAT**



THE COASTAL UNIT
CONTAINS
ESSENTIAL HABITAT
FOR THE
MANGROVE MOUSE



SARINA BEACH IS
A POPULAR SPOT FOR
**VISITORS
TO THE
REGION**



Infographic 1.

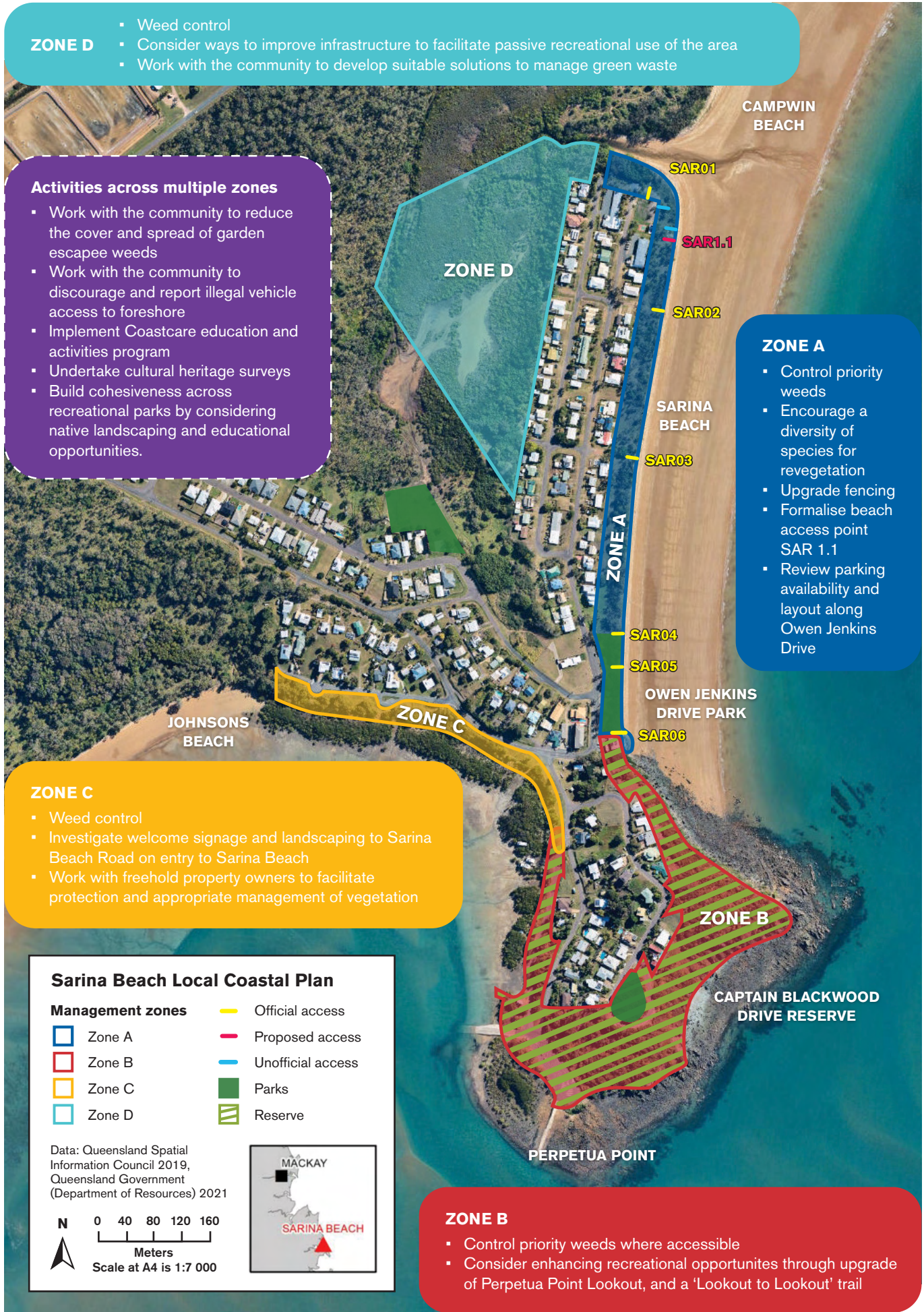


Figure 1: Visual summary of recommendations

1 Executive Summary

Sarina Beach is a small, coastal residential settlement and recreational hotspot located approximately 40km south of Mackay. Mackay Regional Council (MRC) (hereafter referred to as council) manages its coastal land at Sarina Beach through an integrated program of planning, on-ground works, monitoring and community engagement. As part of this program, *Coastal Management Guidelines* (MRC 2012) have been developed to provide a framework for management decisions and activities for coastal land under council's jurisdiction. Individual Local Coastal Plans, such as this plan for Sarina Beach, provide site-specific recommendations for individual coastal units.

The *Sarina Beach Local Coastal Plan* describes the environmental and social values of the coastal unit, as well as the key threats and management issues. Sarina Beach is a small town with a residential population of approximately 661 people. The coastal unit extends from a small creek north of the Sarina Beach Motel, around the headland of Perpetua Point and inland to the edge of Johnsons Beach. Sarina Beach itself lies in the northern extent of the coastal unit, north of Perpetua Point. This stretch of sandy beach experiences a large tidal range, exposing rock pools and reef habitats at low tides. The foreshore around Perpetua Point to Johnsons Beach is rocky and, in places, fringed with mangroves. Other remnant vegetation throughout the coastal unit includes Eucalypt woodlands. The vegetation, tidal flats, rocky headland and creek areas provide habitat for a range of native species including the vulnerable mangrove mouse (*Xeromys myoides*) and near-threatened coastal-sheathtail bat (*Taphozous australis*). The sandy beach provides nesting habitat for marine turtles.

Key pressures within the coastal unit include climate change, sea level rise, the presence of non-native vegetation and impacts to the dune system which serves as a buffer between residential settlements and the beach itself. Recommendations to manage these threats include weed control, revegetation and protection of the dunes through fencing and access management (Figure 1).

The social values of the coastal unit are described and opportunities to improve recreational facilities and values have been identified, including upgrading existing infrastructure and enhancing existing recreational areas through the provision of facilities and interpretive signage. The MRC will aim to address recommendations on a prioritised basis as resources become available.

Community engagement is recognised as a critical part of the success of on-ground works, and opportunities for the community to learn about coastal ecosystems and get involved in management activities at Sarina Beach will be provided through the Coastcare program.

MRC have reviewed the recommendations put forward in this *Local Coastal Plan* (listed in section 7 of the document) and have developed a prioritised list of actions (Table 3). These will help protect and improve the condition of assets in the coastal unit, ensuring that best-practice management principles are implemented, and on-ground activities are prioritised and undertaken in a coordinated and strategic way. This plan will help attract additional funding to the region (including from State and Federal sources) to protect coastal resources and improve recreational opportunities for our community.

Key recommendations include:

- Weed control across all zones targeting major weeds including Singapore daisy, lantana, prickly pear, Chinese violet, mother-of-millions, purple joyweed, devil's horsewhip, periwinkle, mother-in-law tongue, painted spurge, and coral creeper.
- Formalise an additional beach access point between SAR01 and SAR02 and extend post and rail fencing to protect the dune at the northern end of Zone A.
- Revegetation to assist dune stabilisation and enhance native vegetation cover, diversity and connectivity along the coastal corridor. Planting to maintain selected view corridors and to be view sensitive.
- Investigate additional recreational opportunities such as upgrades to lookout facilities at Perpetua Point, design and installation of additional interpretive signage. Improve landscaping and signage along Sarina Beach Road to welcome visitors on arrival to Sarina Beach.
- Work with neighboring Freehold property owners and local residents to reduce illegal vehicle access to Sarina Beach and Johnsons Beach.



2 Introduction

Council has a major role to play in the management of public coastal lands. Council is responsible for the public land along the coast including Esplanade, Reserves and areas zoned as Open Space. The *Coastal Protection and Management Act 1995* and associated *Queensland Coastal Plan* (DEHP 2013a) underpin coastal management in Queensland. These documents, along with multiple other pieces of State and Federal legislation and council's own Local Laws and *Coastal Management Guidelines* (MRC 2012), direct the management of these public coastal areas (Figure 2).

The *Coastal Management Guidelines* recognise that the coast is characterised by a diverse range of natural features including: sandy beaches, rocky headlands, rainforest, woodland, grassland, extensive intertidal flats and substantial areas of coastal wetland. The Mackay coastline is a dynamic and forever changing landscape, shaped and formed by a range of factors including wave action, changing tides, predominant winds and human influences. Mackay also has a large tidal range that exceeds six metres (EPA 2004).

The Mackay region is prone to severe storm events and tropical cyclones that impact coastal areas causing localised erosion. After a storm some areas recover quickly. However, if there is not enough time for adequate recovery before another storm event or if the coastline is a predominantly eroding coast, the impacts of erosion can accumulate, altering the shape of the coastline over time.

Management options to improve the resilience of coastal areas to future storm events are available. Maintaining a sufficient buffer of vegetated dune or other coastal ecosystems, such as mangrove, acts to bind and retain sediment in coastal areas. The *Mackay Coast Study* (EPA 2004) describes the need to protect coastal areas not only for their importance as assets to tourism and recreation, *but also as the maintenance of wide sandy beaches and well-vegetated dune systems provides a natural barrier to storm wave energy and protects inland areas against extreme water levels* (EPA 2004 p.4). Effective coastal management can therefore be viewed as a risk mitigation strategy.

Within the region, development has occurred in some areas that are prone to erosion (EPA 2004). Some areas are already seeing changes in their local coastlines. With future predicted increases in sea level rise and more extreme weather events including cyclones, there is an increasing need to forecast the impact on coastal areas and plan effective, achievable action for protection of coastal values, including:

- The safety and longevity of communities - this includes property, infrastructure and services required for healthy communities.
- Meeting of recreational needs - locals and visitors utilise coastal areas for activities that add to their health and fitness, provide relaxation and offer opportunities to enjoy nature.
- Continuity of economic services - fisheries and tourism rely heavily on healthy and attractive coastal areas.
- Environmental values – the provision of ecosystem services relies upon healthy coastal vegetation communities and natural environmental processes. Marine turtles and shorebirds require sandy beaches and healthy dune systems for nesting and feeding and many other native flora and fauna require coastal areas for habitat and food.

Adaptation options for coastal areas need to be well considered to ensure the region is best placed for the future. Maladaptation can occur when proper planning and best science are not incorporated into decision-making processes.

Council manages coastal areas through an integrated program of planning (i.e. Local Coastal Plans (formerly Beach Plans) and the Regional Planning Scheme), on-ground works, monitoring and community engagement. Council initially sponsored, with the assistance of State and Federal funding, the Mackay Coasts and Communities Program (Figure 3), building also on studies undertaken by the former Sarina Shire Council pre-amalgamation as part of the Sarina Coastal Sustainable Landscape Project. In addition to setting a vision for the future



of the Mackay coast, this program embedded the principle of engaging local communities in coastal management activities (Figure 3). The program's approach was to identify and support site-specific actions to protect and rehabilitate coastal vegetation, provide recreational assets such as beach access; deliver local education and promote community participation in coastal management. The instrument used to document agreed activities and against which success of the program has been measured were Local Coastal Plans. While this initial program has now ceased, the approach established by the program has continued.

Visit council's [Coastal Management](#) page for more information on the program.

Historically, a strong emphasis has been on the protection, conservation, rehabilitation and management of the coastal unit and its biological diversity. Actions implemented over past years in line with the Sarina Beach Beach Plan (Sarina Shire Council *et al.* 2008) include:

- Weed control, removal of juvenile coconuts and revegetation along the esplanade with native species

- Installation and alignment of coastal fencing along the esplanade of Sarina Beach
- Establishing and/or improving beach access and turtle nesting signage

The Local Coastal Plan balances environmental protection with access to and recreational use of the beach. The LCP aims to:

- Protect and enhance the social and environmental values of the coastal unit.
- Guide management recommendations and actions across the 10-year lifespan of the plan.
- Provide a clear indication of management priorities and appropriate timeframes for commencing on ground works.
- Provide the foundation for monitoring and assessing priority action outcomes.

Council is committed to ensuring that communities are well informed throughout the process of Local Coastal Plan development.

2 STATUTORY OBLIGATIONS

There are a range of statutes at Regional, State and Federal level that are relevant to, and may guide the management of natural resources and recreation within the Mackay area. These are shown in Figure 3.



FEDERAL GOVERNMENT

- *Biosecurity Act 2015* provides management principles for diseases and pests that may cause harm to human, animal or plant health or the environment, and for other related purposes.
- *Environmental Protection and Biodiversity Conservation Act 1999* provides a high level of protection for Matters of National Environmental Significance (MNES). In particular it provides protection for important populations of migratory species.
- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* provides for the preservation and protection of areas and objects in Australia and in Australian waters that are of particular significance to Aboriginals in accordance with Aboriginal tradition.



INTERNATIONAL AGREEMENTS

- *China and Australia Migratory Bird Agreement (CAMBA)*, the *Japan and Australia Migratory Bird Agreement (JAMBA)*, and the *Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA)* provide for conservation of shorebirds (waders) across the migratory flyway for these species.



STATE GOVERNMENT

- *Land Act 1994* provides for the designation of the reserves and assignment of Trustees for the protection of environmentally and culturally valuable and sensitive areas and features.
- *Recreation Areas Management Act 2006* provides for the establishment, maintenance and use of recreation areas; and aims to coordinate, integrate and improve recreational planning, recreational facilities and recreational management for recreation areas.
- *Vegetation Management Act 1999* provides management principles for vegetation within Queensland.
- *Coastal Protection and Management Act 1995 (Coastal Act)* provides a comprehensive framework for the coordinated management of the Queensland Coast, and establishes the Queensland Coastal Plan 2012 as the primary statutory instrument under the Coastal Act.
- *Nature Conservation Act 1992* provides management principles for wildlife within Queensland.
- *Native Title (Queensland) Act 1993* identifies the presence of Native Title over land.
- *Land Protection (Pest and Stock Route Management) Act 2002* provides the regulatory basis for control of pest species. In particular the Act classifies pest species and provides obligations for landholders.
- *Fisheries Act 1994* provides protection for marine plants including mangroves and saltmarshes, and provides the regulatory environment for control of recreational fishing activities.
- *Planning Act 2016* established an efficient, effective, transparent, integrated, co-ordinated and accountable system of land use planning, development assessment and related matters that facilitates the achievement of ecological sustainability.
- *Environmental Protection Act 1994* regulates environmentally relevant activities, including release of emissions on land, air or water and noise.
- *Marine Parks Act 2004* regulates use of Marine Park to protect marine environment.
- *Waste Reduction and Recycling Act 2011* provides regulatory regime for management of litter and illegal dumping.
- *Queensland Coastal Plan 2012* provides policy guidance to coastal land managers including best practice coastal management principles which support the development of local management plans.



LOCAL GOVERNMENT

- *Mackay Regional Council Local Law No. 4 (Local Government Controlled Areas, Facilities and Roads) 2011* provides for the management of council controlled lands by enabling the prohibition of vehicle access and protection of vegetation and infrastructure.
- *Mackay Regional Council Local Law No. 2 (Animal Management) 2011* provides for the management of animals in the natural environment,

including ensuring that they are under effective control and requiring removal of faeces in a public place.

- *Coastal Management Guidelines 2012* provides a framework for management decisions and activities for land under Mackay Regional Council jurisdiction in the coastal zone.
- *Mackay Regional Council Planning Scheme Policy - Open Space* outlines Mackay Regional Council's commitment to provide a balanced

mix of public open space that in turn will provide for a range of active and passive recreational opportunities for the community.

- *Reef Guardian Council program* recognises council's commitment to protect, conserve and enhance the values of the Great Barrier Reef for future generations through effective and responsible land-based management practices.

Figure 2: Regulatory framework.



Mackay Coasts and Communities Program implementation model

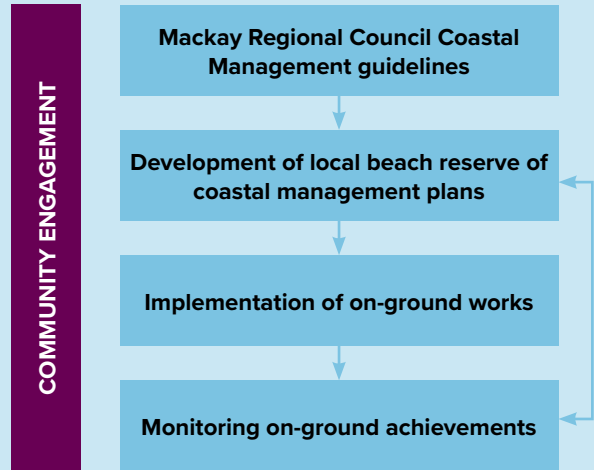


Figure 3: Mackay Coasts and Communities program Implementation Plan.

3 Coastal Unit Description

Sarina Beach is located approximately 40km south-east of Mackay and is approximately a 40 minute drive from the Mackay City Centre. Sarina Beach is situated on the northern headland of the Sarina inlet between Coral Point Reef in the north and Perpetua Point in the south. The coastal unit is characterised by sandy beaches interspersed with rocky headlands and mangrove inlets. Sarina Beach shares approximately 2km of beach with Campwin Beach, with the two separated at low tide by Leeper Reef and adjoining rock flats. The coastal waters southward of Perpetua Point are part of the Sarina Inlet - Ince Bay Aggregation, which is a nationally important wetland characterised largely by mangrove and salt flat estuarine habitats.

The extent of the coastal unit stretches from the road reserve parcel behind Poole St where it borders a small, unnamed creek north of access point SAR01, southward along Sarina Beach, wrapping inland around Perpetua Point to include the rocky foreshore adjoining Ferries Terrace (Figure 4). The Sarina Beach hinterland consists of wetlands and tree-covered slopes. The Sarina Beach coastal unit is distinctive with respect to its tourist accommodation and infrastructure, and a community who are driven to enhance economic opportunities through tourism to the area. Facilities in the Sarina Beach area include a store and petrol station, motels, caravan park, boat ramps and a surf lifesaving club.

Sarina Beach can be described as a low-density residential township (Figure 5). Much of the land within the Sarina Beach area is Freehold (Figure 6) and zoned for Rural or Township land-use (Figure 5), but the coastal strip encompassing the road reserve parcel behind Poole St, extending along the foreshore over Owen Jenkins Drive Park, Captain Blackwood Drive Reserve and the road reserve on Sunset Drive is council-owned Reserve tenure or Open Space land. This land, as well as the coastal vegetation along Ferries Terrace and the parcels of land dedicated for Sport and Recreation or Community

Facilities, are the council-managed area relevant to this *Local Coastal Plan*.

The coastal unit is divided into four management zones based on common management values and issues. Zone A covers the coastal strip along Owen Jenkins Drive and incorporates Owen Jenkins Drive Park. Zone B incorporates all of the Reserve tenure land around Captain Blackwood Drive Reserve, the steep vegetated hills and rocky headland of Perpetua Point, the road and parking area servicing the boat ramps and the parcel of land zoned as Community Facilities, which is currently a surf lifesaving club. Zone C incorporates the other parcel of land zoned as Community Facilities, the road reserve on Sunset Drive and the coastal vegetation along Ferries Terrace (Figure 7). Zone D incorporates the road reserve parcel behind Poole Street.

Approximately 12.7ha of remnant coastal vegetation occurs within the coastal unit and includes Eucalypt woodlands and mangrove ecosystems. Threats to these vegetation communities include non-native vegetation and encroachment of non-natives from neighboring Freehold land, inappropriate pedestrian and vehicle access, and coastal development.

The Sarina Beach foreshore has been relatively stable since the 1960s, with episodic erosion and deposition periods influenced by weather events such as storms and cyclones. There is little sediment supply into the Sarina Beach area, so it is important to retain the sand currently present within the system to prevent shoreline recession. Protecting and enhancing coastal vegetation, particularly along the sandy foredune in Zone A, is critical to retaining this sand in the system.

The coastal unit contains a number of recreational opportunities. Owen Jenkins Drive Park in Zone A is utilised regularly by residents and visitors to the Sarina Beach area, and contains several shelters, picnic tables, barbeques,

a playground, toilets and other facilities. Plans have been approved to upgrade the shelters and barbeque facilities as well as install paths to facilitate all ability access to the park. The Reserve in Zone B, Captain Blackwood Drive Reserve, offers additional recreational opportunity in terms of the lookout area. There is significant opportunity to develop this lookout area into a regional asset and tourism destination, potentially in alignment with the Regional Self-Drive Lookout Trail.

Sarina Beach Road and intersection with Sunset Drive in Zone C offers an open mown area opposite the service station and motel. Two benches have been installed in the location. While unsuitable for additional recreational infrastructure due to the limited space and topography, as the entrance to Sarina Beach, landscaping and signage could be improved to welcome visitors on arrival to the township. Zone D is largely mangrove and tidal flat communities, and is mostly inaccessible to the public. There is local interest in utilising this area to offer additional passive, nature-based recreational opportunities.

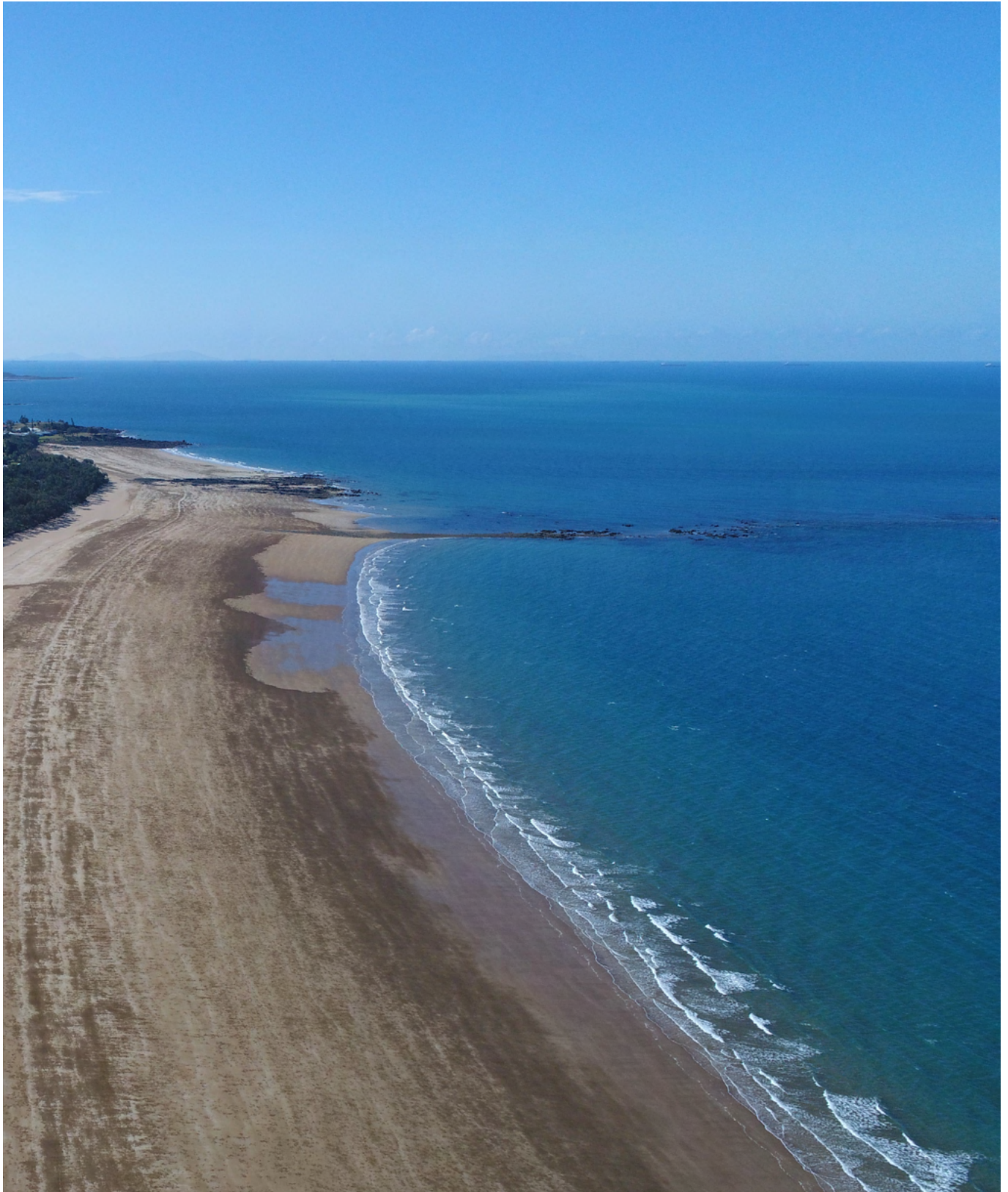




Figure 4: Extent of Sarina Beach coastal unit.

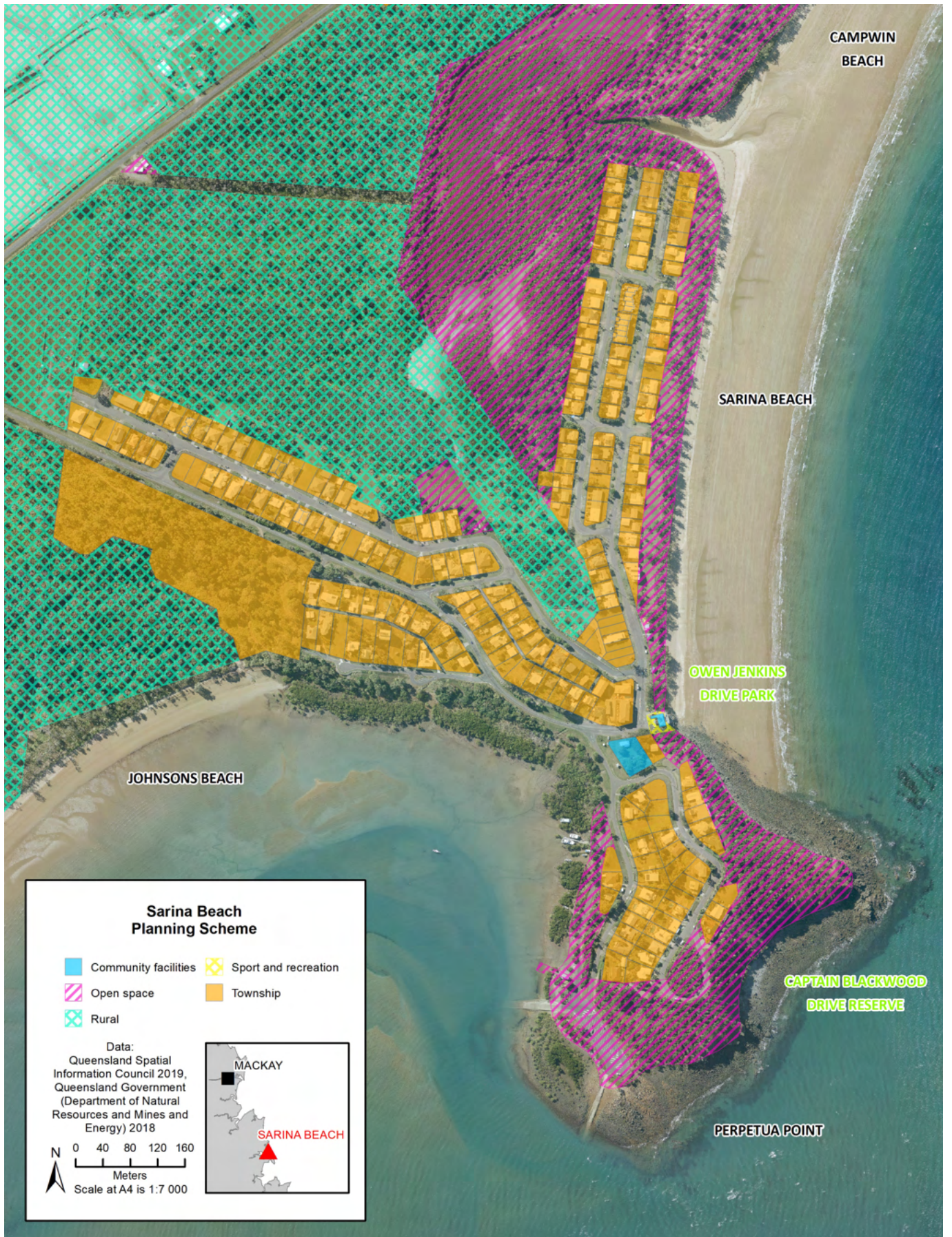


Figure 5: Planning scheme zonation at Sarina Beach.



Figure 6: Land tenure at Sarina Beach.



Figure 7: Coastal management zones at Sarina Beach.

The Mackay region is inshore from the Great Barrier Reef and activities must comply with the regulatory zoning conditions introduced by the Great Barrier Reef Marine Park Association (GBRMPA) in 2004. Marine Park zoning is an important component of managing marine areas (GBRMPA 2011). The area offshore from Sarina Beach and north to Campwin and Grasstree Beach is within a Habitat Protection Zone (Blue Zone) (Figure 8). Habitat Protection Zones prohibit certain activities, such as trawling, to protect sensitive habitats in the Marine Park. Other high-impact activities, including tourism operations, shipping and harvest fishing for specific species require a permit, however low-impact, recreational activities including boating, crabbing and line fishing do not require a permit.

For additional details regarding zoning restrictions, visit the GBRMPA [website: www.gbrmpa.gov.au](http://www.gbrmpa.gov.au)

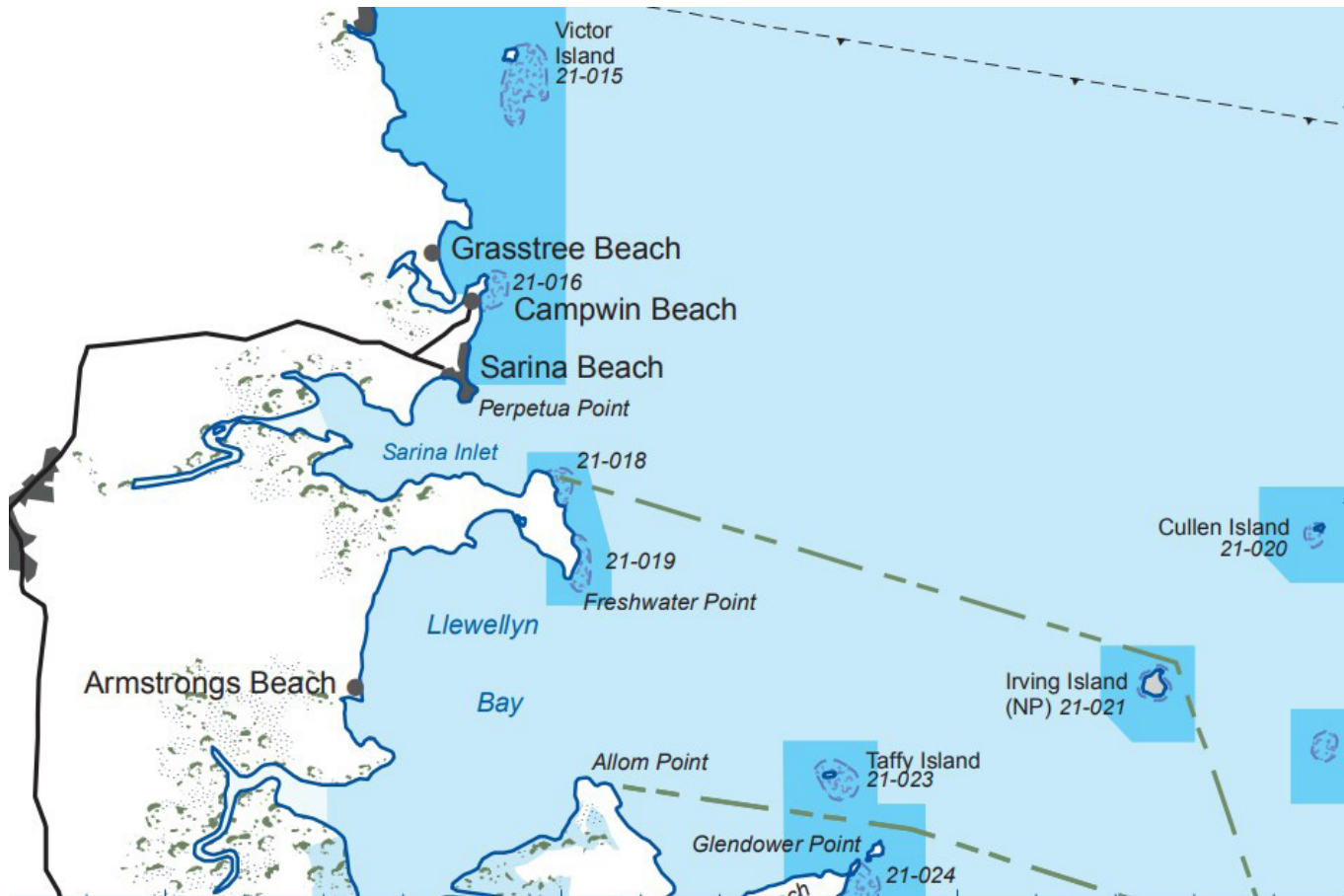


Figure 8: Great Barrier Reef Marine Park Area Zoning - Excerpt from Zoning Map 10 (GBRMPA 2011) indicating the zoning around Sarina Beach. Zones A of the coastal unit is within a Habitat Protection Zone (Blue Zone).

4 Environmental Values and Management Issues

Sarina Beach coastline maintains vegetated and non-vegetated patches, reflecting dynamic changes to vegetation resulting from impacts such as clearing for residential development (Figure 9). The ecological communities surrounding Sarina Beach coastal unit sustain important wildlife populations of Regional, State and National Significance. Corridors of remnant vegetation provide important stepping-stones to allow native species to cross the landscape. In addition, the ecosystems are important in maintaining natural processes and providing ecosystem services to the local community and region. Carbon storage, water filtration, climate regulation, stabilisation of the shoreline, nutrient cycling and scenic and recreational values constitute just a few examples of the ecosystem services these areas provide to the local community.

This section outlines the distribution and significance of coastal vegetation and wildlife in the Sarina Beach area and its environmental values. The major threats and management issues relevant to the environmental values will be discussed, including dune systems and erosion processes.

4.1 VEGETATION

The vegetation component of this plan considers three important facets that define the integrity and condition of vegetation in the coastal unit.

Remnant vegetation is the historical vegetative cover of an area and is captured within official Regional Ecosystem mapping. It includes both woody and non-woody vegetation and is dominated by species characteristic of the vegetation's undisturbed canopy. Remnant vegetation is distinguished by the dominant canopy having greater than 70% of the height and greater than 50% of the cover relative to the undisturbed height and cover of that stratum (Queensland Government 2016).

Vegetation zonation is the sequence of different vegetation communities or zones that occur along a coastline. The zones reflect changes in the nutrient and moisture content of dune soils, which increase in a landward direction, and changes in the degree of exposure to strong winds, salt spray and sandblast, which decrease in a landward direction (DEHP 2015). When vegetation communities are heavily disturbed, for example by weed encroachment or mowing, vegetation zonation is inhibited.

Non-native vegetation is discussed in terms of the weed species that are present and may require management.

4.1.1 Remnant vegetation

Remnant vegetation is mapped at a scale of 1:100,000 by the Queensland Government for legislative and management purposes (Queensland Government 2016). Regional Ecosystems (RE) are vegetation communities in a bioregion that are consistently associated with a particular combination

of geology, landform and soil. The Regional Ecosystem Description Database describes each RE and lists both the biodiversity status and the Vegetation Management Class of each (Table 1). The biodiversity status is determined based on an assessment of the amount of a RE remaining (as a percentage of its historic range) and its condition and this is used to determine the Vegetation Management Class, under the *Vegetation Management Act 1999* (DEHP 2013b). A regional ecosystem is listed as Endangered, Of concern or No concern at Present/Least concern based on these factors. It is important to note that RE mapping provides no indication of the current condition of this vegetation at the local scale.

The importance of coastal vegetation includes, but is not limited to:

- Providing a significant refuge and source of food for local and migratory fauna species.
- Providing a seed bank for future generations of vegetation, thereby protecting the natural biodiversity of the area.
- Facilitating dune growth by colonising and trapping windblown sand and preventing its escape from the beach system.

In coastal areas, vegetation can be scorched by high temperatures and salt, as well as abraded by windblown sand. Species that can withstand these effects benefit from onshore winds by intercepting wind-borne nutrients from the sea. These nutrients are deposited on the leaves of coastal plants and washed into the sand by the first showers of rain, thereby introducing nutrients to the system and allowing less hardy species to colonise the coastal area (Gold Coast City Council 2007).

In Queensland, approximately 80% of people live on the coast (DEHP 2013a). As a result, remnant coastal vegetation is often fragmented and subject to high levels of disturbance (Caton and Harvey 2010). Coastal development characteristically results in a loss of coastal vegetation, as it often facilitates disturbance throughout the coastal zone through mowing and/or clearing areas of vegetation for recreation. Remnant coastal vegetation however, remains a critical part of the landscape, providing important ecosystem services, habitat corridors, and recreational values.

General principles for the conservation of remnant vegetation include:

- Controlling weeds to allow native species to regenerate.
- Discouraging the dumping of garden and general waste.
- Replanting areas adjoining remnant vegetation patches with native species, to build a buffer between the core vegetation and adjacent land uses.

- Controlling activities such as four-wheel driving, foot and vehicle traffic (Nordstrom *et al.* 2000).

Within the coastal unit there is 12.07ha of remnant vegetation, most of which is located throughout Zones B, C and D. While the foredune along the length of Sarina Beach in Zone A is mostly well vegetated, the vegetation is highly altered from its natural state. Here, coastal vegetation exists as a thin strip along a steep and narrow dune system or as mature trees within Owen Jenkins Drive Park. Therefore a large proportion of the remaining vegetation is not considered remnant vegetation. Native species identified within Zone A included coastal she-oak (*Casuarina equisetifolia*), goat's foot (*Ipomoea pes-caprae*) native hibiscus (*Hibiscus tiliaceus*), birds beak grass (*Thuarea involuta*), pandanus (*Pandanus sp*), octopus bush (*Argusia argentea*), beach spinifex (*Spinifex sericeus*) and coastal lollybush (*Clerodendrum inerme*).

Eucalyptus woodlands (RE 8.12.22) comprise a large part of the remnant vegetation within the coastal unit, extending throughout Zone B within Reserve tenure land around Perpetua Point. This area is steep and difficult to access, so active management of this vegetation by council is very difficult. The vegetation is largely undisturbed, though some weeds are noted throughout the zone including leucaena (*Leucaena leucocephala*). Notably, RE 8.12.22 is habitat for the endangered cycad species *Cycas ophiolitica*. Dry eucalyptus woodland vegetation communities, such as RE 8.12.22, are recommended for burning in the Clark Connors Range Fire Management Guidelines (Reef Catchments, 2009) approximately every 3-6 years (Appendix 1). However, site specific risks should be taken into account when considering burn regimes for the area, including nearby private property and at Perpetua Point, the steep slope and wind factor. Management of bushfire risk around the coastal unit, particularly with regard to the dry eucalypt patches, is important to reduce threats to human life, built assets and the vegetation community itself. Bushfires in this type of vegetation regularly cause loss of mature, hollow-bearing Eucalypts which support glider and owl populations. In 2018 a bush fire threat resulted in the Queensland Fire and Emergency Service (QFES) issue an emergency alert for residents to evacuate their homes, causing ongoing concerns around fire risk. It is recommended that council engage with fire brigades and Queensland Fire Emergency Services to assess fire risk and work together to develop a fire management plan for the Sarina Beach area.

Remnant patches of eucalyptus woodlands meet mangroves (RE 8.1.1 and 8.1.2) along the edge of Zone C. Generally, the closed canopy woodland area within Zone C is in good condition and is currently managed by the Mackay Regional Council in partnership with Sarina Catchment Landcare Management Association (SCLMA). Further west, the canopy becomes more open and the presence of non-native species is higher. Major threats to the vegetation in Zone C include inappropriate motorbike, quadbike and four-wheel drive access and the spread of non-native plant species.

Zone D is an intertidal, saltpan area where mangrove and samphire forblands (RE 8.1.1 and 8.1.2) are present. Given the saline environment, weed encroachment into these ecosystems is unusual. However, threats from illegal dumping

of green waste and inappropriate vehicle access exist. There is a build up of woody debris within Zone D which has likely accumulated through high tides, flooding and illegal dumping of green waste. It is recommended that council reduce the green waste in this zone to reduce the fire risk to nearby residential areas and protect the adjoining mangroves. These mangrove estuarine wetlands serve as important detention areas and settling ponds which help improve water quality, nutrient and sediment loads entering the World Heritage Area, and provide good passage for fish migrations. They are also very important habitats for roosting shorebirds, as well as nurseries for reef fish species (Fukuda *et al.* 2007). Zone D also contains a small, unmapped patch of RE 8.2.2, microphyll vine forest on coastal dunes. This ecosystem is considered Of Concern at a state scale and Endangered at a national scale. It is also one of the Regional Ecosystems that comprise the critically endangered Threatened Ecological Community known as littoral rainforest and coastal vine thickets of eastern Australia, listed in the EPBC Act (1999). Key threats to this community include inappropriate fire regimes, weed invasion, and the impacts of coastal development.

Regional Ecosystems found on council-managed land are further described in Appendix 2.

Opportunities exist to protect and enhance the native vegetation throughout the coastal unit via weed control, revegetation and facilitation of natural regeneration. Vegetation rehabilitation will enhance the complexity of vegetation zonation, increase the environmental value of the area, improve dune stability, act as a buffer against wind, salt and extreme weather events and reduce impacts of artificial lighting on turtle hatchlings. Additional native vegetation will also provide habitat for local fauna. In areas where the native vegetation remains largely intact, the approach to be taken will be one of assisted natural regeneration. By controlling weeds and limiting disturbance, natural recruitment of dunal species will occur. Supplementary planting may be undertaken in these areas to enhance vegetation complexity and to replace removed weed species. In areas where natural recruitment is not occurring or where vegetation has been cleared, revegetation should be used as a technique to restore and enhance native vegetation.

All revegetation activities should consider the guiding principles documented in Appendix 3.

The community of Sarina Beach is interested in promoting the diversity of native species throughout the foredune within Zone A, and there are opportunities to involve the local community in the design and implementation of revegetation throughout this area. A species list of view-sensitive trees and shrubs could be used to inform revegetation along Owen Jenkins Drive Park to facilitate viewing of the ocean from the picnic areas. This would be beneficial for those who are unable to access the beach via the official beach stair access points. In 2008-2009, council undertook 2.2ha of revegetation within Zone A, with 2200 native species planted. Earlier pictures of the area (from the 1970s) show the foredune and park area as almost completely denuded of vegetation, so the establishment of native species such as coastal hibiscus, coastal she-oaks and pandanus is considered evidence of the success of this revegetation program and native recruitment. Revegetation should continue

throughout Zone A, supported by fencing to control pedestrian traffic and manage disturbance to the dune system. It is recommended that the community is involved in the planning of this revegetation to increase stewardship and ownership, and to reduce conflict. Where vegetation is preventing pedestrian access in the park area it should be trimmed in line with the fence. Branches that are not interfering with access can be retained if they are not considered a hazard.

Cross tenure collaboration between council and private landholders, is essential for preserving and enhancing the remaining native vegetation. Council should work with landholders to ensure the appropriate management of large adjacent blocks of Freehold land containing remnant vegetation, such as the Johnsons Beach area and the area west of Poole Street. In both areas threats to vegetation extend

from the Freehold properties through remnant REs on council-managed land, particularly with regards to fire, weeds and inappropriate vehicle access.

All revegetation activities should be guided by the coastal revegetation principles documented in Appendix 3 and consider appropriate species from the list provided in Appendix 4. The species selected for revegetation at any particular location will ultimately depend on current and pre-clearing regional ecosystem mapping and site-specific conditions such as aspect, topography, existing vegetation, soil condition and the availability of appropriate plants. Local experts should be consulted for specific advice regarding unique vegetation communities, where appropriate.

Table 1: Regional Ecosystem (RE) communities of the Sarina Beach coastal unit.

Regional Ecosystem (RE)	Short description (Environmental Protection Agency 2005)	Approximate area (ha) on Reserve, Esplanade, State Land tenure	Vegetation Management Act status	Biodiversity status	EBPC Act status
8.1.1	Mangrove closed forest of marine clay plains and estuaries.	7.3ha	Least concern	No concern at present	n/a
8.1.2	Samphire open forbland to isolated clumps of forbs on saltpans and plains adjacent to mangroves (estuarine wetland).		Least concern	Of concern	n/a
8.12.22	<i>Eucalyptus drepanophylla</i> and/ or <i>Corymbia clarksoniana</i> +/- <i>C. erythrophloia</i> +/- <i>E. platyphylla</i> +/- <i>E. exserta</i> +/- <i>C. trachyphloia</i> woodland on hills and ranges at low to moderate altitudes in drier areas.	3.76ha	Least concern	No concern at present	n/a
8.2.2	Microphyll vine forest on coastal dunes.	0.6ha	Of concern	Endangered	Critically endangered
8.3.5	<i>Eucalyptus platyphylla</i> and/or <i>Lophostemon suaveolens</i> and/or <i>Corymbia clarksoniana</i> woodland on alluvial plains.	0.38ha	Of concern	Endangered	n/a

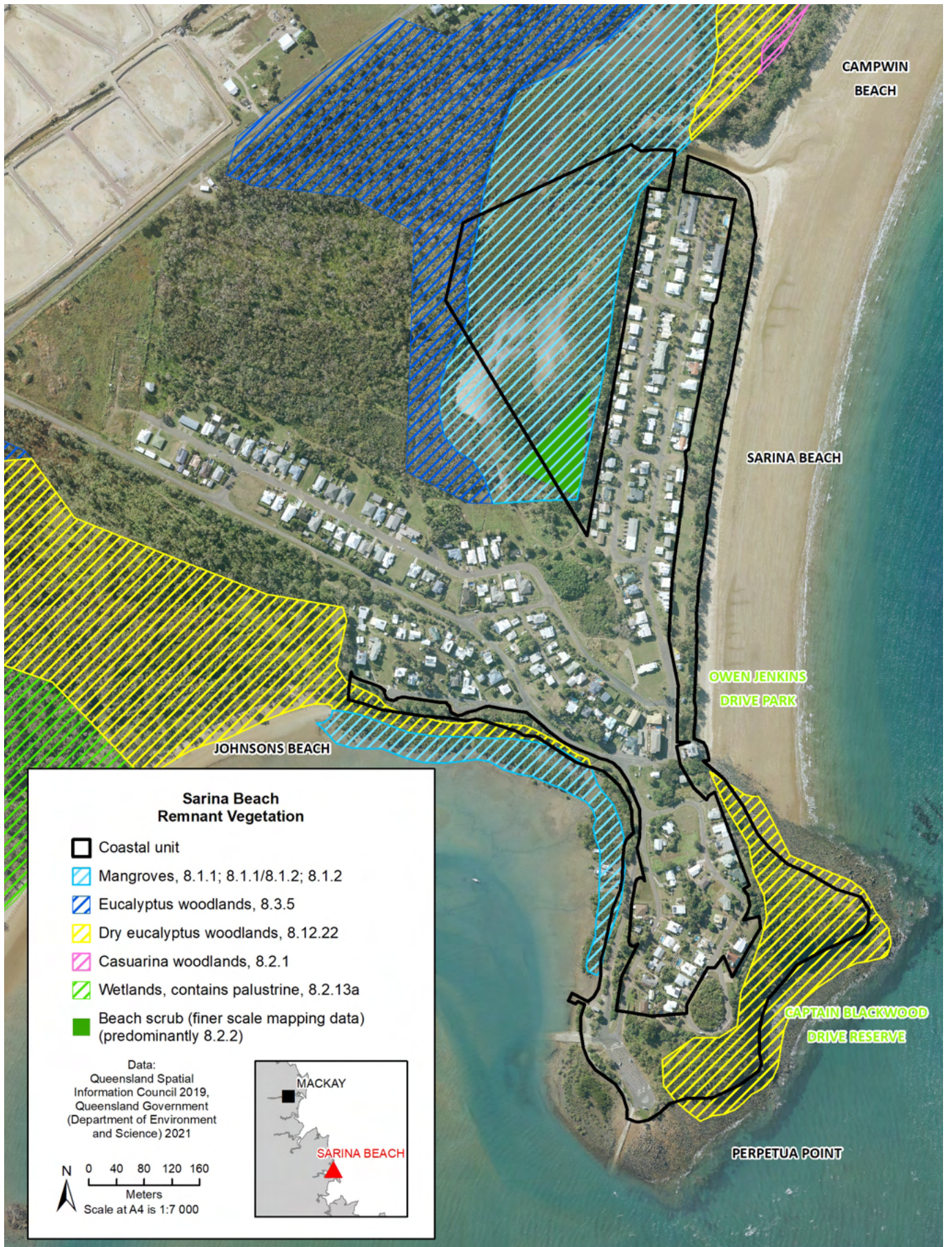


Figure 9: Remnant vegetation communities of the Sarina Beach coastal unit.

4.1.2 Vegetation Zonation

A key feature of dune vegetation is the sequence of different vegetation communities that occur with increasing distance landward. Typically, this involves a gradual transition from bare sand, to ground cover, to open forests or woodlands (DEHP 2015). Zonation processes are those which facilitate this progression and are discussed in this *Local Coastal Plan* as recruitment and colonisation. Natural zonation refers to what is effectively a normally behaving ecosystem, where recruitment and colonisation can occur unhindered over natural gradients (Figure 10).

Within Zone A, the dune system is noted to be relatively short and steep with vegetation zonation processes occurring over a compressed area (Figure 11). Mown parkland and esplanade behind the dune has resulted in a narrow strip of coastal vegetation (Figure 12). At the southern end of Zone A, within Owen Jenkins Drive Park, it is noted that the fence is located very close to the dune edge. It is recommended that this fencing is offset landward by one to two meters to increase the vegetation buffer along the foredune while maintaining sufficient open parkland area for recreational purposes. Throughout Zone A there is little evidence of recruitment of native tree and shrub species, with very few juveniles being observed over the past five years. The northern edge of Zone A, in front of Sarina Beach Motel, is noted as having particularly sparse vegetation (Figure 13). This area is recommended for more dense revegetation efforts and post and rail fencing will be extended from Owen Jenkins Park and Esplanade areas to the northern end of the length of Zone A to define tenure, designate access points to the beach and protect / maintain the dune stability against erosion.

Weed control and rehabilitation activities should be implemented to improve the dune structure and the condition along the length of the beach. Revegetating the dune system in this way will also enhance connectivity of vegetation, increase the aesthetic value of the area, provide shade and privacy for residences neighbouring publicly reserved areas. Weed control and infill planting would also assist vegetation establishment, and in doing so restore natural zonation, increase diversity, reduce wind speeds, increase natural shade and provide habitat for local fauna.

Certain vegetation species have become dominant along the foreshore. To improve species diversity in the coastal unit, effective revegetation management practices (trimming, cutting and pruning) will be implemented to encourage natural recruitment and address the community's concerns about restricting access and view.

Within Zone B, natural zonation processes are occurring, with the major exception being areas that were cleared for the development of parking areas and roads within the Reserve tenure.

Within Zone C, the road reserve on Sunset Drive has little native vegetation present and is almost completely mown (Figure 14). The remainder of Zone C supports a relatively intact zonation of native species, with mangrove systems dominating the foreshore, transitioning to *Eucalyptus* woodlands.

The vegetation in Zone D, behind Poole Street, is in relatively good condition. The saline environment restricts growth of non-native species, and with no access through the majority of this parcel, the vegetation is mostly undisturbed.

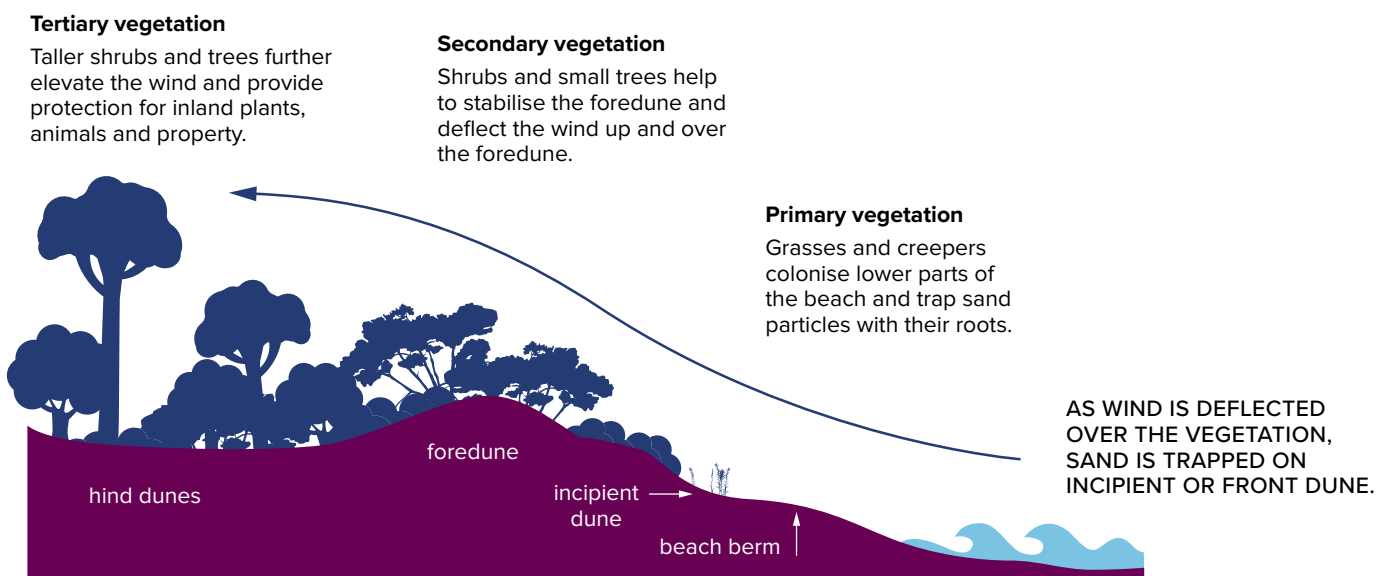


Figure 10: Role of dune vegetation.



Figure 11: Groundcovers on the incipient foredune transitioning to a thin strip of native trees on the foredune.



Figure 12: Mown parkland in Owen Jenkins Drive Park.



Figure 13: Sparse vegetation in front of Sarina Beach Motel.



Figure 14: Mown road reserve on Sunset Drive.

4.1.3 Non-native vegetation

The presence of non-native vegetation can be detrimental to the function of the dunal environment. Non-native vegetation can displace native dunal vegetation due to its ability to grow aggressively, smother native dunal species and compete for available nutrients. We often refer to plants that have adverse impacts on the environment as weeds or invasive plants. In some cases, weeds such as Guinea grass (*Megathyrus maximus*) and lantana (*Lantana camara*) can also increase fuel loading and fire intensity, these are considered transformative weeds.

It is important to note that while not all weeds require immediate removal due to low impacts on native species, under the *Biosecurity Act 2014* (DAFF 2014), council and the local community have a general biosecurity obligation to take reasonable and practicable steps to minimise the risks associated with invasive plants and animals on land under their control. This legislation came into force on the 1st July 2016 and changes the classifications of weed species from what has been referred to in earlier Beach Plans. Subsequently, weeds are now discussed in the terms outlined below.

- **Prohibited** matter are plants, animals, diseases or viruses listed within the *Biosecurity Act 2014*. These are not found in Queensland but would have a significant adverse impact on our health, way of life, the economy or the environment if they entered the state. If one of these species is detected it must be reported within 24 hours to 13 25 23 and all reasonable steps must be undertaken to minimise their risks.
- **Restricted** matter are plants, animals, diseases or viruses listed within the *Biosecurity Act 2014*. These are found in Queensland and have a significant adverse impact on our health, way of life, the economy or the environment. It is desirable to manage them and prevent their spread, thereby protecting un-impacted parts of the State. There are seven categories of restricted matter, four of which relate to weeds. Different categories describe the action that must be taken with respect to the weed. Several restriction categories may apply to some weeds. Restricted weeds recorded at Sarina Beach include lantana, Singapore daisy (*Sphagneticola trilobata*), mother-of-millions (*Bryophyllum sp.*) and prickly pear (*Opuntia sp.*). These species are considered Category 3 restricted weeds within the *Biosecurity Act 2014*, with some prickly pear species also considered Category 2, 4 and 5.
- **Environmental weeds** are described as those that can cause major transformations to natural ecosystem function. These species are capable of outcompeting native vegetation and, in some cases, have the potential to increase fuel loads in ecosystems. Environmental weeds within Sarina Beach include painted spurge (*Euphorbia cyathophora*), pink periwinkle (*Catharanthus roseus*), siratro (*Macroptilium atropurpureum*), Cobbler's peg (*Bidens pilosa*), Purple Joy Weed (*Alternanthera brasiliana*), Coral creeper (*Barleria repens*), Chinese violet (*Asystasia gangetica*), Agave (*Agave attenuata*), Mock orange (*Murraya paniculata exotica*), Leucaena (*Leucaena leucocephala*), Balsam Pear (*Momordica charantia*),

Eastern cassia (*Senna pendula*) and Seaforth burr (*Cenchrus echinatus*).

- **Nuisance weeds** are problematic on a local scale and should be managed on a case-by-case basis. A multitude of herbaceous weeds and garden escapees result from the close proximity of coastal reserves to residential settlements and include mother-in-law's tongue (*Sansevieria trifasciata*), Gazania (*Gazania rigens*) and Devils horsewhip (*Achyranthes aspera*).

Non-native vegetation, including the weeds described, is a key threat to remnant vegetation throughout the Sarina Beach coastal unit. Throughout Zone A, the most prevalent non-native species is Singapore daisy, a Category 3 restricted species. It is a groundcover that spreads rapidly and outcompetes native species, especially in lawns, irrigated areas and around drains. Singapore daisy has established over significant areas of the foredune within Zone A, and is excluding native groundcover species. It is recommended that this species is considered a priority for staged removal and replacement with native groundcover species. Other restricted weeds found at Sarina Beach, but in lower densities, include mother-of-millions (*Bryophyllum sp.*) and prickly pear (*Opuntia sp.*). Council should continue to remove these weeds as they are detected, to prevent their widespread establishment throughout the foreshore.

A wide range of environmental weeds and nuisance garden escapee weeds exist throughout Zone A. Seaforth burr (*Cenchrus echinatus*), siratro (*Macroptilium atropurpureum*), mother-in-law's tongue (*Sansevieria trifasciata*) (Figure 15), Chinese violet (*Asystasia gangetica*) (Figure 16), painted spurge (*Euphorbia cyathophora*), coral creeper (*Barleria repens*) (Figure 17), Eastern cassia (*Senna pendula*), balsam pear (*Momordica charantia*) and devil's whip (*Achyranthes aspera*) are noted as present in the area. Chinese violet and coral creeper have also established widely throughout the management zone, covering a large geographical area. Prioritisation for control is to focus on weeds classified as prohibited and restricted under the *Biosecurity Act 2014*. Council should take a multi-pronged approach to managing garden escapee weeds. The direct control of the weeds throughout the foreshore should be paired with a community education campaign. It is recommended that council talks directly with landholders with esplanade frontage about the widespread establishment of garden escapee weeds, supply residents with the 'Are Your Garden Plants Going Bush?' brochure and 'Grow Me Instead' brochure to offer non-weedy alternatives. This may also provide the opportunity to promote council's free plant giveaway programs. The Mackay Natural Environment Centre's nursery trailer could be utilised to provide opportunities for locals to receive their free plants offered as part of the native plant program. This compliments other community planting initiatives operated by groups such as Sarina Catchment Landcare Management Association and Reef Catchment. Dumping of lawn clippings onto the foredune is also identified as a key vector of spread for non-native grasses and groundcover species.

Within Zone B, throughout Captain Blackwood Drive Reserve, leucaena has been noted as an environmental weed, but the steep terrain makes access difficult and means that

management options are limited. Around the boat ramp and along the edge of the access road to the boat ramp, Singapore daisy exists in dense mats, extending into Zone C. The area would benefit from targeted weed control while promoting natural regeneration of native plant species.

Along the Sarina Inlet Trail within Zone C, native vegetation is currently being actively managed by Mackay Regional Council. However, throughout the mown lawn area in the road reserve on Sunset Drive, Singapore daisy is well-established. Additionally, where the vegetation thins and the canopy is more open along Ferries Terrace, weeds are more prevalent. Key species for targeting in Zone C include Singapore daisy, Guinea grass, lantana, siratro and mother-in-law's tongue. Along the Sarina Inlet Trail, mock orange (*Murraya paniculata exotica*) and cobbler's peg are noted as environmental weed species for control. It is also recommended that council engage with the adjoining landholder/s along Johnsons Beach to educate and facilitate the control of weeds throughout the remnant vegetation in this area, to prevent reintroduction or spread from the Freehold land into council-managed areas.

Zone D, as a saline environment, has few weeds present. Along the edge of the vegetation which adjoins the residential properties on Poole Street there is a narrow band outside of tidal influence. This narrow band hosts an abundance of weeds including painted spurge, Seaforth burr, cobbler's peg and grassy weeds such as Guinea grass. The weeds increase the fire risk of this area. It is recommended that council controls weeds in this band of vegetation, phasing in the planting of native ground cover species to reduce maintenance over time.

Coconut palms (*Cocos nucifera*) are a non-native that is also established throughout the coastal zone. These palms are a

source of green waste (fronds) throughout the coastal unit. Council recognises that some community members may value coconuts for their aesthetic appeal, and at Sarina Beach the coconuts hold cultural value as the inspiration for the annual Sarina Beach Coconut Festival. The removal of adult coconuts from recreational and open space areas is beyond the scope of this plan. However, juvenile coconuts that occur within areas managed for environmental purposes will be removed in accordance with the coastal weed control principles (Appendix 5). Removal will be undertaken in a staged manner. Coconuts can be a significant risk to pedestrians, increase fire risk and intensity through the accumulation of vegetative waste and smother native vegetation, preventing regeneration.

It is recommended that weed management continues throughout the coastal unit and this, together with revegetation activities to replace removed weed species, will prevent future weed reoccurrence and assist the re-establishment of native vegetation. Coastal management activities will be explored by Council as part of routine activities.

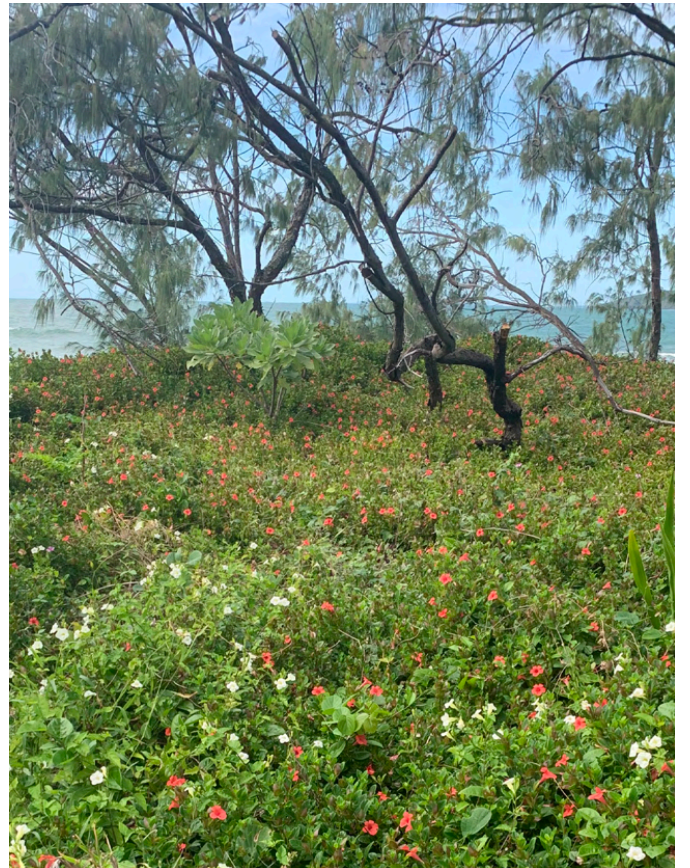
The removal of non-native species from the coastal unit will improve the condition of native vegetation, enhancing habitat quality and its resilience to natural disturbance whilst also reducing the risk of fire. Using appropriate weed control techniques in a progressive manner as time and resources permit, as per Appendix 5, will assist the rehabilitation of coastal vegetation communities. A list of weed species common to the Mackay region can be found in Appendix 6.



Figure 15: Mother-in-laws tongue (*Sansevieria trifasciata*) on the foredune in Zone A.



Figure 16: Chinese violet (*Asystasia gangetica*) on the foredune in Zone A.



Figures 17: Coral creeper (*Barleria repens*) on the foredune in Zone A.



Figure 18: Coconut palms do little to stabilise dune sediment from erosion. It is evident from these pictures taken at McEwens Beach that the confined root-ball is stabilising only a very limited area of dune. More extensive and far-reaching root systems, such as those from coastal she-oaks, would stabilise a larger area of dune.

4.2 WILDLIFE

All sandy beaches in the Mackay region provide potential habitat for marine turtle nesting and turtles are commonly sighted in Sarina Bay. Green turtles (*Chelonia mydas*) and flatback turtles (*Natator depressus*) are the most common species to utilise beaches around Mackay for nesting. Both species are listed as vulnerable in State (*Nature Conservation Act 1992*) and Federal (*Environment Protection and Biodiversity Conservation (EPBC) Act 1999*) legislation. Given their status, a *Recovery Plan for Marine Turtles in Australia* has been in place

since 2003 (DEE 2017) and provides an overview of threats and recovery actions required for these species. Key threats to turtles and their reproductive success are identified as the following:

- Light and noise pollution from nearby houses disorients hatchlings during their movement to the ocean.
- The presence of foxes (*Vulpes vulpes*), feral pigs (*Sus scrofa*), dogs and other domestic pets in the area, particularly those not on leashes, pose a number of threats including mortality of hatchlings from predation, exposing

of clutches from digging and injury to turtles while laying eggs.

- Distribution and type of vegetation (i.e. root system), including excessive shading, or lack thereof, plays an influential role determining the sex of the hatchling.
- Unofficial tracks through the dune system, where tracks appear brighter than surrounding areas due to light reflection, can disorientate both hatchlings and adults.
- Beach vehicle access, as turtles are not able to penetrate the compacted sand or navigate wheel ruts.

It is recommended that council continue to work with local groups to protect turtle nesting habitat through managing unofficial access, beach vehicle access including motorbikes and educating residents about lighting issues.

Essential Habitat mapping identifies sites and locations considered to contain important habitat for flora and fauna species of conservation significance. It is only mapped over either remnant or regrowth vegetation and is based on either confirmed sightings, records of breeding, known suitable habitat or resources occurring at a location, or habitat that forms part of a potentially important corridor (DEHP 2014).

Essential Habitat for the mangrove or water mouse (*Xeromyx myoides*), which is listed as Vulnerable under the Queensland Government's Nature Conservation Act 1992, includes the area inland from Sarina Beach and remnant vegetation behind Poole Street (Figure 19). This species is a small native rodent recorded from coastal saltmarsh, samphire shrublands, saline reed beds and grasslands, mangroves and coastal freshwater wetlands. Other names for this species include the false water rat and yirrkoo. Mature animals appear to utilise taller communities dominated by yellow mangrove (*Ceriops tagal*) and orange mangrove (*Bruguiera spp.*), however juveniles are sometimes located in low forests of yellow mangrove. The quantity and quality of storm water entering the catchment will be of relevance to the health of the mangrove mouse population. The mangroves themselves provide habitat for fish and turtles as well as larger vertebrates such as crocodiles (*Crocodylus porosus*). Mangroves are particularly important to Northern Queensland because they provide habitat for juvenile coral reef fish which are important to the economy and serve as intermediate nurseries which increases the survivorship of many species of these young fish (Mumby *et al.* 2004).

The coastal unit also contains Essential Habitat for the coastal sheath-tail bat (*Taphozous australis*) (Hourigan 2011). These bats are known to live in highly-specialised habitats such as beach scrub, mangroves, *Melaleuca* swamps and coastal heathlands. Any threat to these vegetation communities constitutes a threat to the coastal bat, which is classed as Near Threatened under the Nature Conservation Act 1992. Coastal sheath-tail bats are suspected to be easily disturbed when at roost and could be negatively impacted by noise. There is currently no

widespread decline documented for the species, however disturbance due to high rates of human visitation at roost sites can have negative impacts on the species and may cause low breeding success or roosts to be abandoned. Coastal sheath-tail bats are believed to forage within a short distance of the coast. This species is distributed in a thin band along the north-east Queensland coast from Shoalwater Bay to Cape York Peninsula. Its distribution throughout its range is believed to be uneven, due to its reliance on suitable coastal roost sites. The loss of foraging habitat as a consequence of coastal development, combined with roost disturbance (with increasing human access to the coast) may pose a threat to this species.

The Australian Government's INFFER analysis shows that the Mackay region, including Sarina Beach, is likely or known koala habitat. This is supported by koala sightings within the community throughout zones B, C and D. Koalas are listed as threatened under the Queensland Government's Nature Conservation Act 1992. The Regional Ecosystems represented by these coastal units include important food plants for koalas as follows; *Eucalyptus sp.*, *Corymbia sp.*, *Lophostemon sp.* and *Melaleuca sp.* Koala presence is likely to be transient as they move through the area particularly during breeding season.

From the southern tip of the coastal unit stretching southward is the Sarina Bay – Ince Bay Aggregation, a wetland listed in the Directory of Important Wetlands in Australia (Figure 20). The site is part of a low coastal plain with adjacent small islets, inshore coral reef, extensive shallow water, subtidal and intertidal mudflats and associated marine waters from Sarina Inlet to Cape Palmerston (DES 2021). This wetland aggregate features mostly estuarine wetlands such as mangroves and salt flats, and is home to 270 species of animals including birds, mammals, reptiles and fishes. Seagrass grows within the intertidal area and large populations of dugong are recorded in the area.

Currently, the major threats to wildlife along the coastal unit include loss of habitat through development, erosion, weed incursion, infrastructure, feral and domestic animals and artificial lighting. Opportunities exist to protect native wildlife by improving habitat through weed control and assisted regeneration of coastal vegetation, and increased compliance monitoring for on-leash dog-walking areas, especially during roosting season for migratory shorebirds, notably the critically endangered Eastern Curlew (*Numenius madagascariensis*) Holding community days to remove marine debris from the beach will further enhance the habitat values of the beach.

Signage throughout the coastal unit serves to protect the wildlife values of the area, including off-leash dog area signage, and signage explaining that the area is turtle nesting habitat (Figure 21). It is recommended that council continue to maintain this signage, to continue to inform the general public about what they can do to protect significant species and ecosystems.

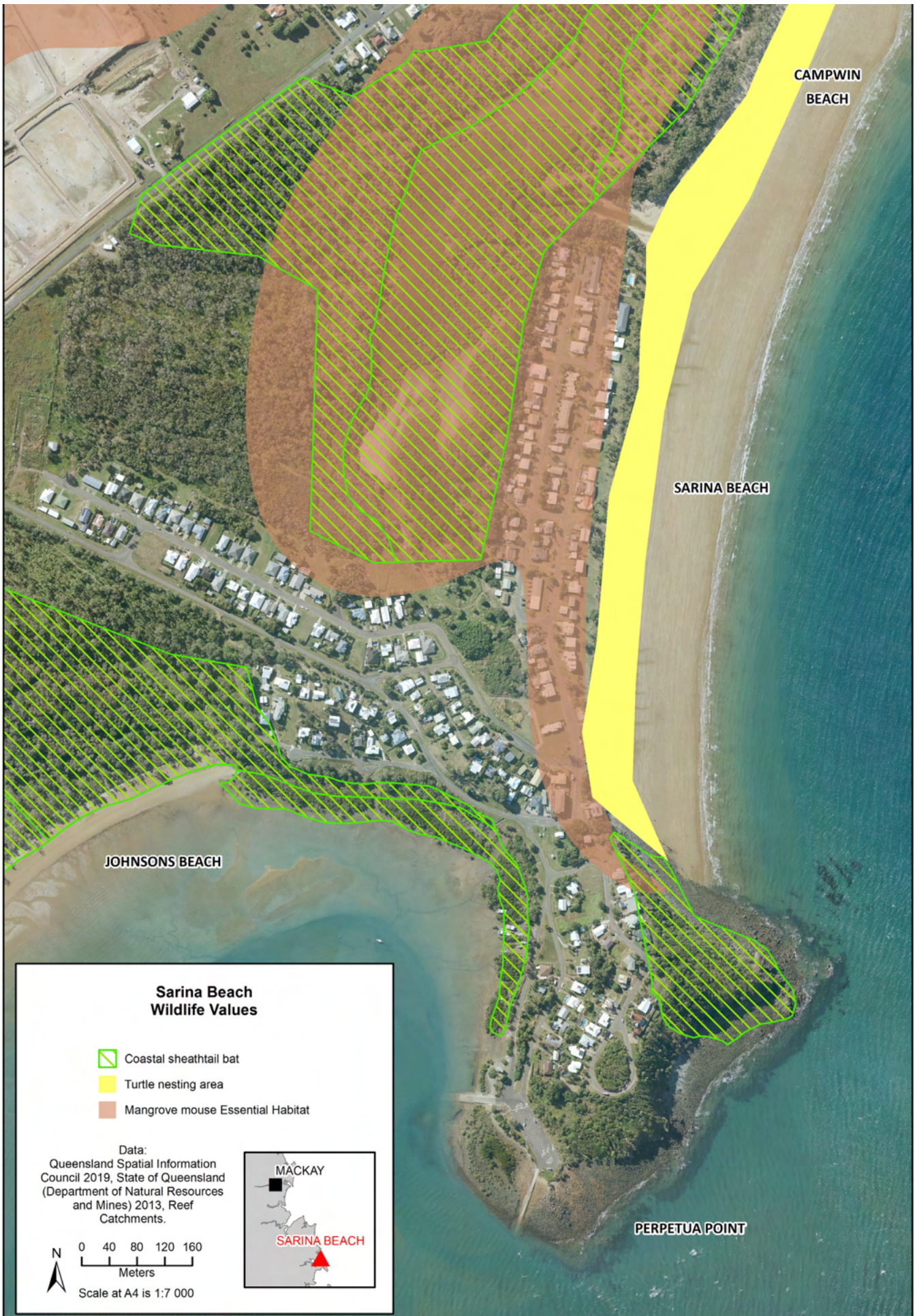


Figure 19: Sarina Beach wildlife values.

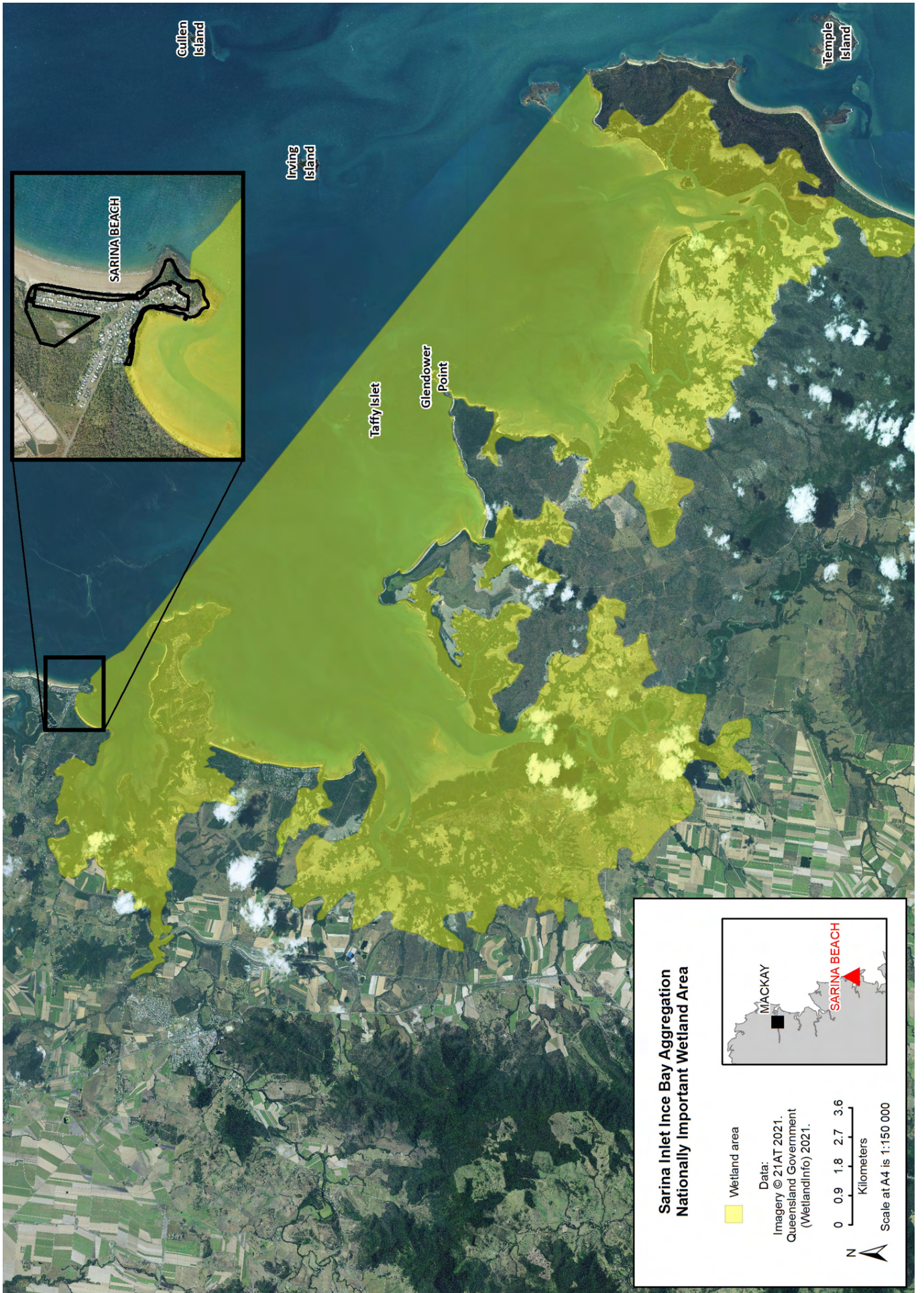


Figure 20: Sarina Bay – Ince Bay Aggregation Nationally Important Wetland area.



Figures 21: Interpretive signage to raise awareness of turtle nesting season and how to minimise human impacts to turtle nesting.

4.3 EROSION

4.3.1 Coastal processes and erosion

Sarina Beach foreshore and a large portion of the broader Mackay region beaches maintain sand dunes in the coastal unit. Coastal dune systems play a crucial role in facilitating coastal ecosystem processes and in the protection of property in the coastal unit (DERM 2011a). As part of the broader sand movement process, healthy dune systems act to dissipate the kinetic energy of waves, which may otherwise propel into adjacent infrastructure and property. The sand and dunes create friction when waves pass over them, slowing the waves down and dissipating their energy. Healthy coastal dunes help protect coastal infrastructure during intense wind, storm and cyclone events (Figure 22). The dunes also act to replenish the foreshore with sand after major sand-loss events.

However, human-induced changes have altered coastal areas and therefore dune formation. For example, the loss of coastal vegetation for open space and coastal development reduces the capacity of beaches to catch and trap wind-borne (aeolian) sand grains. Once the protective capacity of the dune system is weakened in this way, coastal erosion can take place, leading to significant damage to landforms and infrastructure via coastal recession.

The community may have a negative association with erosion and coastal recession, though in many cases it is a natural phenomenon. There are constant interactions between coastal landforms and the ocean, and this creates a dynamic and ever-changing environment. Sandy coastlines migrate landward and seaward in response to natural phases of sand erosion (loss) and accretion (gain). Sand movements can form dunes onshore, sand bars offshore, or instigate beach erosion. All of these movements are governed by wind, waves and tidal activity over varying time scales.

Over short time scales there are natural beach fluctuations in response to intense weather activity. For example, during a storm, strong waves carve away sand from the beach and dunes, resulting in escarpments onshore and sand bars offshore. Gradually, sometimes over many years, the sand that was lost offshore is pushed back onshore by gentler high tides (Figure 22). This process is natural and, in many cases, cannot be stopped.

However, long term erosion or accretion is driven by fundamental changes in the dynamics of sand deposition and removal from a beach system. This is an on-going problem and preventing beach recession would often require continual nourishing. This is illustrated in (Figure 22), where too much sand from coastal dunes is lost seaward to allow the dune to be restored to its original state.

Challenges to dune health are often unavoidable in developed areas. However, intervention and management can help to protect the coastal landforms.

Dunes should be protected where possible by maintaining and enhancing native vegetation. Ground cover, shrub and tree species stabilise dunes with their root systems and catch wind-borne sand sediments to replenish the dunes and foreshore. The loss of this vegetation can lead to accelerated rates of erosion of the dunes. The natural build-up of sand in frontal dunes needs to be encouraged as a reservoir for sand during periods of wind and wave erosion. Plant communities provide vegetative cover, which stabilises the dune and thus make the system resilient to pressures such as sea level rise, storms, and floods. Supporting vegetation as a surface cover increases dune stability but also biodiversity and ecological function of the dune system (DEHP 2013a). Coastal vegetation is also important in protecting infrastructure and houses, as it slows wind speeds and reduces the amount of salt and sand transported inland.

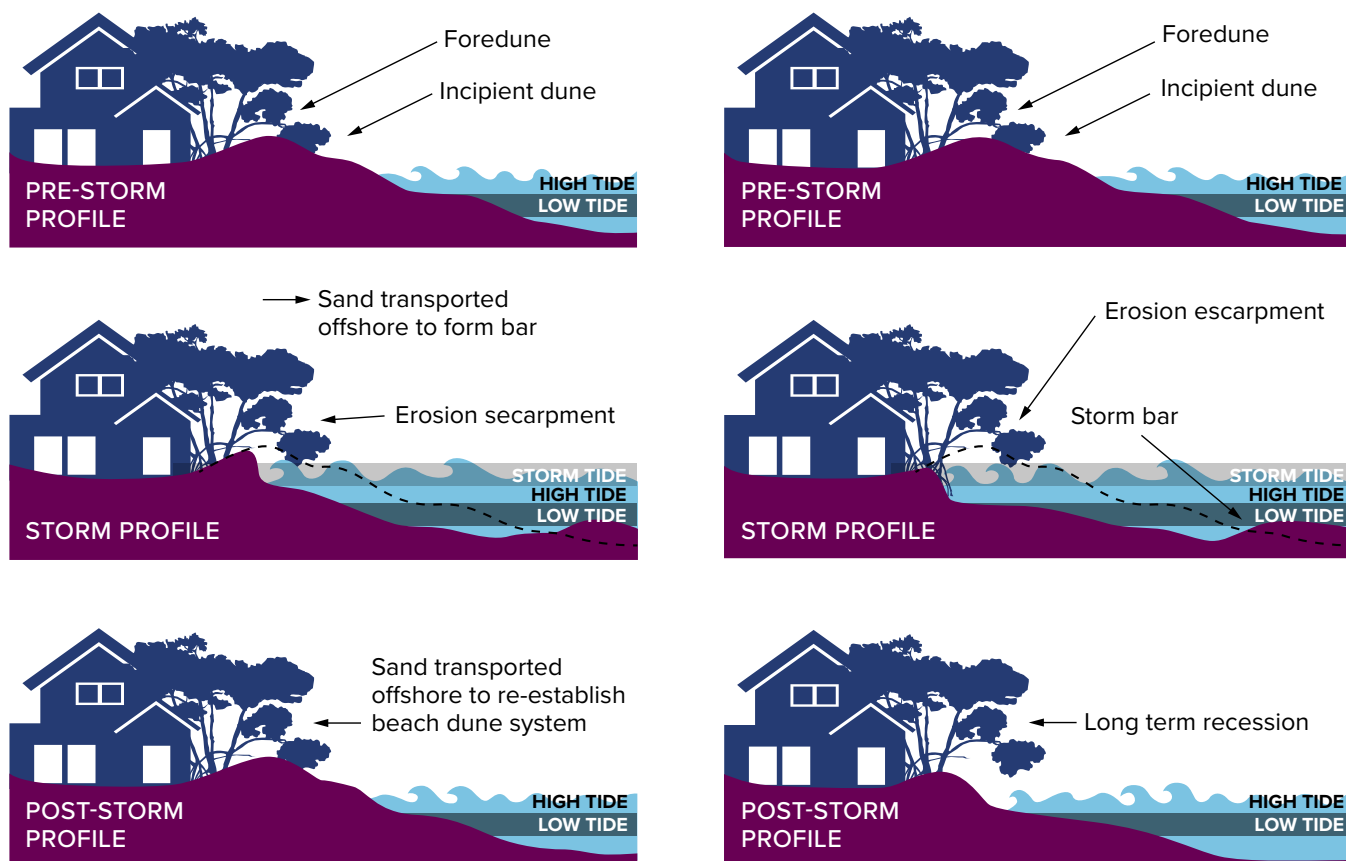
Damage to dunal vegetation in the Mackay region often occurs through pedestrian and vehicle traffic, and acts of vandalism. Intentional removal of coastal dune vegetation, as well as inappropriate pedestrian and vehicle access, displaces sand and where it continuously occurs, can lead to localised eroded areas. Clearly established pathways to the foreshore can help to mitigate the threat of people and vehicles destroying dunal vegetation by directing activity to a small number of well-maintained pathways. To prevent the degradation of dune systems and for public safety, it is important for users to stay on designated tracks. A range of consultation and education opportunities should be provided to the local community to mitigate damage to dunal vegetation.

Another major threat to the natural function of dunes is hard infrastructure (e.g. seawalls). Often these structures are built in the attempt to protect property from shoreline recession. Seawalls and other hard structures reflect wave energy onto other areas, rather than gradually dissipate the energy like dunes do. This leads to scouring around the edges and in front of seawalls and accelerates the loss of sand on the surrounding beach.

Ensuring that erosion prone areas remain free of hard infrastructure and well covered by native vegetation allows natural processes to occur unhindered. This provides the best opportunity for managing shoreline erosion and retaining environmental values (EPA 2004). Where infrastructure is installed, such as seawalls, the amount of sand that is lost seaward is much greater than the natural amount, thereby accelerating erosion and beach recession.

Council's policy for managing coastal erosion is outlined in their *Coastal Erosion Protection Works – Contribution and Costs Recovery Policy* (MRC 2018a). The purpose of this policy is to guide when it may be appropriate for council to deliver coastal erosion protection works, and how the costs will be shared in such situations.

This section describes the geomorphology and processes shaping the Sarina Beach coastal area, the threats and management considerations, as identified in the geomorphic review of the Sarina Beach coastal unit undertaken by Alluvium (Alluvium, 2021).



Beach erosion/accretion cycle showing no permanent sand loss or coastline retreat (Source: DERM).

Long term beach recession showing profile displaced landward due to permanent sand loss (Source: DERM).

Figure 22: Beach erosion processes.

4.3.2 Landscape context

Sarina Beach is situated approximately 40km south of Mackay and 11km northeast of Sarina. The focus area of Section 4.3 incorporates the coastal unit as well as Johnsons Beach (Figure 23), which is relevant to local coastal processes that impact Sarina Beach and is therefore included for context. However, Johnsons Beach is not within the scope of this *Local Coastal Plan* and no recommendations are made for this area.

Sarina Beach is a moderately exposed east-facing intertidal beach, and it is separated from Campwin Beach to the north

by a small creek. Prevailing low energy conditions due to the protection offered by the Great Barrier Reef means that coastal hazards are mostly associated with tropical cyclones. Immediately southwest of the coastal unit, Johnsons Beach is bordered by Perpetua Point and Point Salisbury within the Sarina Inlet. Sarina Inlet is a dynamic zone characterised by extensive tidal flats and influenced by inflows from the Plane Creek system, as well as coastal processes (wind, wave and sediment dynamics). The inlet is bound by Perpetua Point to the north and Freshwater Point to the south.



Figure 23: Sarina Beach study site.

Sarina Beach occupies approximately 800m on the southern end of a 2km sandy shoreline extending from south of Coral Point to Perpetua Point. Residential development is established along the majority of the shoreline, with a setback from the beach in order of 20–30m and about 5m of dunal vegetation at most locations. This setback facilitates an adequate buffer zone for well-established coastal vegetation (remnant and sections of revegetation works completed by council), which assists with the building and storing of sand in the upper beach. The Surf Lifesaving Club is located at the southern end of the beach and a rock wall is present directly in front to provide protection, however, it is informal and concrete debris has

been scattered along the rock wall (Figure 24). There is also a buried rock wall at the northern end of Zone A, in front of the Sarina Beach Motel.

The undeveloped shoreline of Johnsons Beach is strongly influenced by a large tidal range across extensive tidal flats in the sheltered bay. The beach is approximately 1km long and consists of a narrow, low energy high tide beach fronted by tidal flats up to 300m wide and the deep tidal channel of the inlet. The northern end of the beach grades into extensive mangrove ecosystems until the more exposed rocky shores of the peninsula are reached at Perpetua Point



Figure 24: Sarina Beach Surf Lifesaving Club and seawall in front.

4.3.3 Topography and geology

LIDAR (Figure 25) shows the topography of the Sarina Beach region. Sarina Beach is characterised by wide tidal flats backed by a frontal dune system. The tidal flats are significant, with a relatively flat gradient extending out to about 200-300m offshore. The elevation of the tidal flats typically slopes from approximately mean sea level to mean low water level, seaward. The dune system along Sarina Beach is typically approximately 8m AHD with a low gradient slope and a concave-downward profile. From behind the dune, the topography levels at 8m AHD across the residential development, then it slopes down to the low-lying areas with typical elevations of 3.5 to 4m AHD.

The topography around Johnsons Beach shows a distinct tidal channel and very flat gradient tidal flats extending to the channel. Towards the southern end of Johnsons Beach, a small back-barrier creek system drains across the tidal flats.

The dune along Johnsons Beach is slightly lower than Sarina Beach, having a typical height of 7m AHD. The topography behind the dunes remains consistent as the dune height for approximately 400m.

The Mackay region has an extensive outcrop of bedrock along the coast. The deposition of sediments during the Holocene has resulted in the formation of the present coastline (EPA 2004). Sarina Beach is comprised mainly of fine to coarse-grained quartzose to shelly sand and some gravel. The Perpetua Point headland is composed of Campwyn volcanic formation and quartz monzodiorite to granodiorite from the Early Cretaceous period. The geology at Johnsons Beach is mostly sand, mud and gravels and backed with fine to coarse-grained quartzose to shelly sand and some gravel from the central beach to the southern end.

The coastal geology for the Sarina region is summarised in Table 2 and presented in Figure 26.

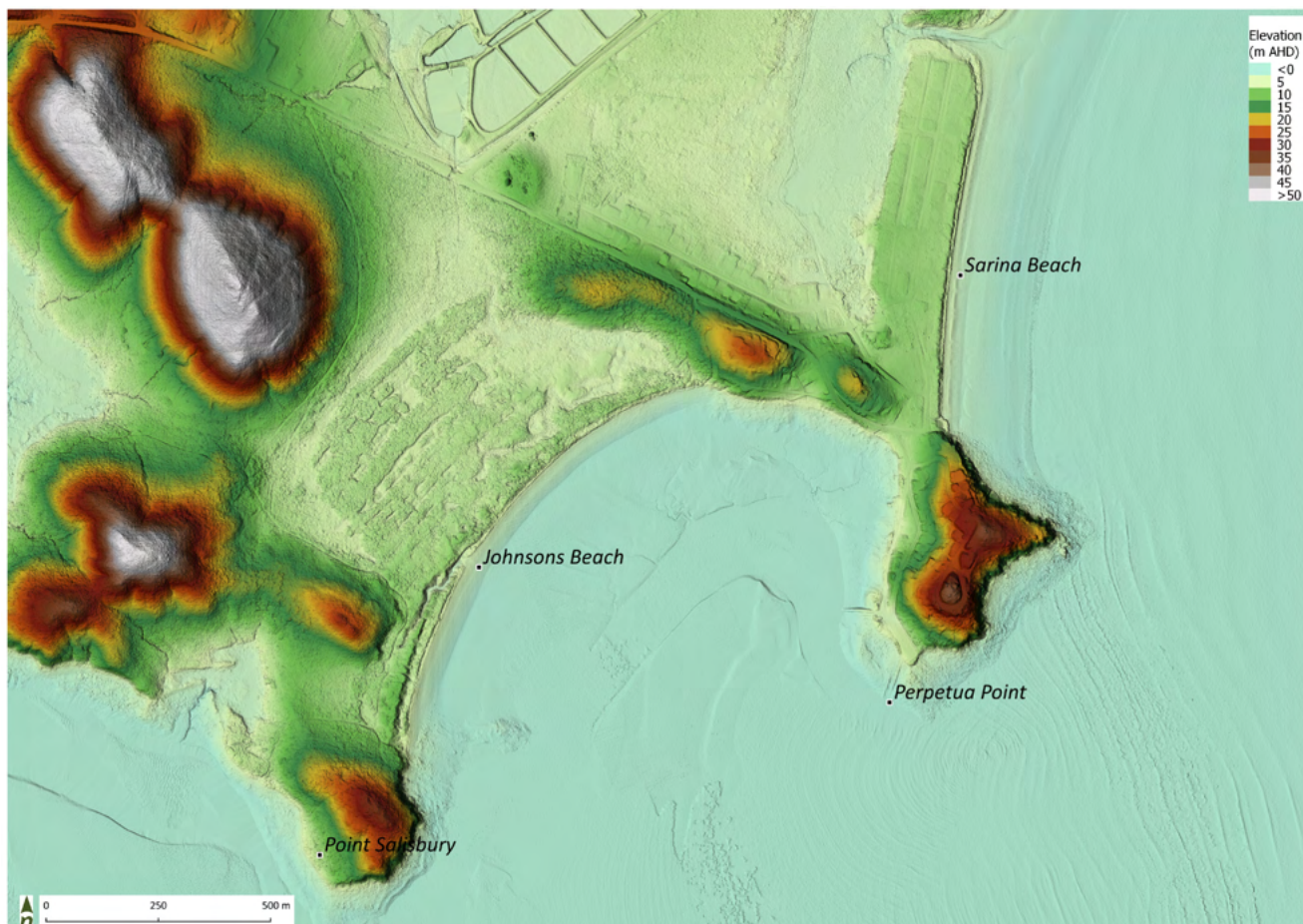


Figure 25: Sarina Beach and surrounds – elevation (LiDAR) data (m AHD).

4.3.4 Sediment transport pathways

Sediment transport is predominantly in a northerly direction and is influenced by trade winds, waves and flooding tides. However, sediment transport rates are generally low and with limited amount of sand moving south at the low intertidal rocks in front of Sarina Beach and Campwin Beach, as well as at the lee of Freshwater Point headland, as illustrated in Figure 27. Sediments leaving the Sarina Inlet system would be transported northward by prevailing south-easterly waves and tides.

Johnsons Beach is protected from direct wave attack by Freshwater Point, which extends 4km to the east and the entrance tidal shoals of Sarina Inlet. Complex interactions of creek inflows, waves and tides in this part of Sarina Inlet influence local variations in longitudinal and cross-shore sediment transport along Johnsons Beach. The form of the beach is strongly influenced by the tides, with each flood and ebb tide driving observable changes in the shoreline morphology. The flood tide currents are typically stronger than the corresponding ebb tide currents, influencing the southerly movement of sediment along Johnsons Beach.

4.3.5 Sediment supply and trajectory

The main historical sediment sources to the Sarina Beach and Johnsons Beach shoreline include the very limited supply from longshore sediment transport from the south, as well as sediment delivered from Sarina Inlet. Sediment supply from

Sarina Inlet has substantially reduced due to infrequent rainfall events in recent years. However, the sediment compartment within the whole Sarina region appears to be somewhat confined with little internal interaction (Short 2020).

The net long term trajectory of sediment supply to the region is uncertain. A review of the trajectory of sediment supply to Sarina Beach and Johnsons Beach could be incorporated into a regional study on long-term sediment supply for the broader Mackay coastline. Council is currently proposing to undertake a region-wide Shoreline Erosion Management Plan, which will provide the opportunity to assess long-term sediment supply trajectory.

4.3.6 Shoreline changes

Sarina Beach is one of two east-facing beaches bounded by Coral Point to the north and Perpetua Point to the south. Since the establishment of residential properties in the late 1960s, the overall shoreline has been relatively stable with little recession and accretion over the last 31 years (1988 to 2019) (Figure 28). The comparative shoreline positions and net shoreline movement have been presented in Figure 28. Sarina Beach and Johnsons Beach have been maintaining a stable net shoreline position in the last 31 years, with accretion and recession rates ranging between -1 to +1 m/year at most locations.



Figure 26: Sarina Beach and surrounds – geology map (reproduced from GeoResGlobe (Queensland Government)).

Table 2: Formation name for geology map (Figure 26).

Formation name

DCvc	<i>Campwyn volcanics - Sandstone, siltstone, mudstone (locally with radiolarians), pebbly sandstone, breccia, mafic hyaloclastite, rhyolitic ignimbrite; minor conglomerate, lapilli tuff, limestone.</i>
Kg/d	<i>Mainly dark pink, pinkish grey or greenish pink, medium-grained, equigranular, leucocratic biotite quartz monzodiorite to granodiorite (locally granophyric) in south (Early Cretaceous).</i>
Qhcb	<i>Holocene Moderately well-sorted, fine to coarse-grained quartzose to shelly sand and some gravel: beach ridges and cheniers.</i>
Qhcm	<i>Mud and sandy mud; mangrove swamps; estuarine deposits.</i>
Qhe/m	<i>Mud, sandy mud, muddy sand and minor gravel: estuarine channels and banks, supratidal flats and coastal grasslands.</i>
Qhe/s	<i>Sand, muddy sand, mud and minor gravel; estuarine channels and intertidal sand banks and flats.</i>



Figure 27: Sarina Beach indicative transport and distribution pathways.



Figure 28: Historical shoreline movement (1988 to 2019). Source: DEA Coastlines by Geoscience Australia.

Historical photos (Figure 29) show a much wider grassed reserve area with very little native dunal vegetation along Sarina Beach several decades ago. It can be observed from Figure 30 that there was no vegetation in the incipient dune zone, which is vital to the stability and growth of the entire

dune system. Council undertook the Sarina Coastal Sustainable Landscapes Project in 2008 (MRC 2008), including vegetation planting, fencing and dune enhancement, which assisted in stabilising the dune system along the beach.



Figure 29: Historical photos of the Sarina Beach foreshore: across from Sand Piper Motel in 1973 (left), in front of Kirkwood Grove (right). (Provided by local residents).



Figure 30: Historical photos of the Sarina Beach taken in 1974 (left) and 1980 (right) showing an absence of an incipient dune system. (Provided by local residents).



Figure 31: Historical aerial imagery from 2005, 2009, 2013, 2017 and 2021.

Historical aerial imagery (Figure 31) indicates that the middle of the beach receded slightly after the construction of the seawall in front of the Surf Lifesaving Club. It receded again in 2013,

likely caused by Tropical Cyclone (TC) Oswald. The vegetation buffer width fluctuated along the foreshore, but the dune system is visually more established after the revegetation effort

in 2008. Overall, the Sarina Coastal Sustainable Landscapes Project is considered successful in stabilising and maintaining the sand dune system along Sarina Beach.

Beach erosion was anecdotally reported during TC Joy in 1990, and the beach demonstrated the ability to rebuild and recover. Approximately 15 years of measured beach survey

data are available from the Coastal Observation Programme Engineering (COPE) program at Sarina Beach. A COPE pole was installed on Sarina Beach from August 1976 (no recordings until April 1981) to 1996 (DSITI 2015). Figure 32 presents historical photographs showing the sand level at the reference COPE pole and the distance to the vegetation line.

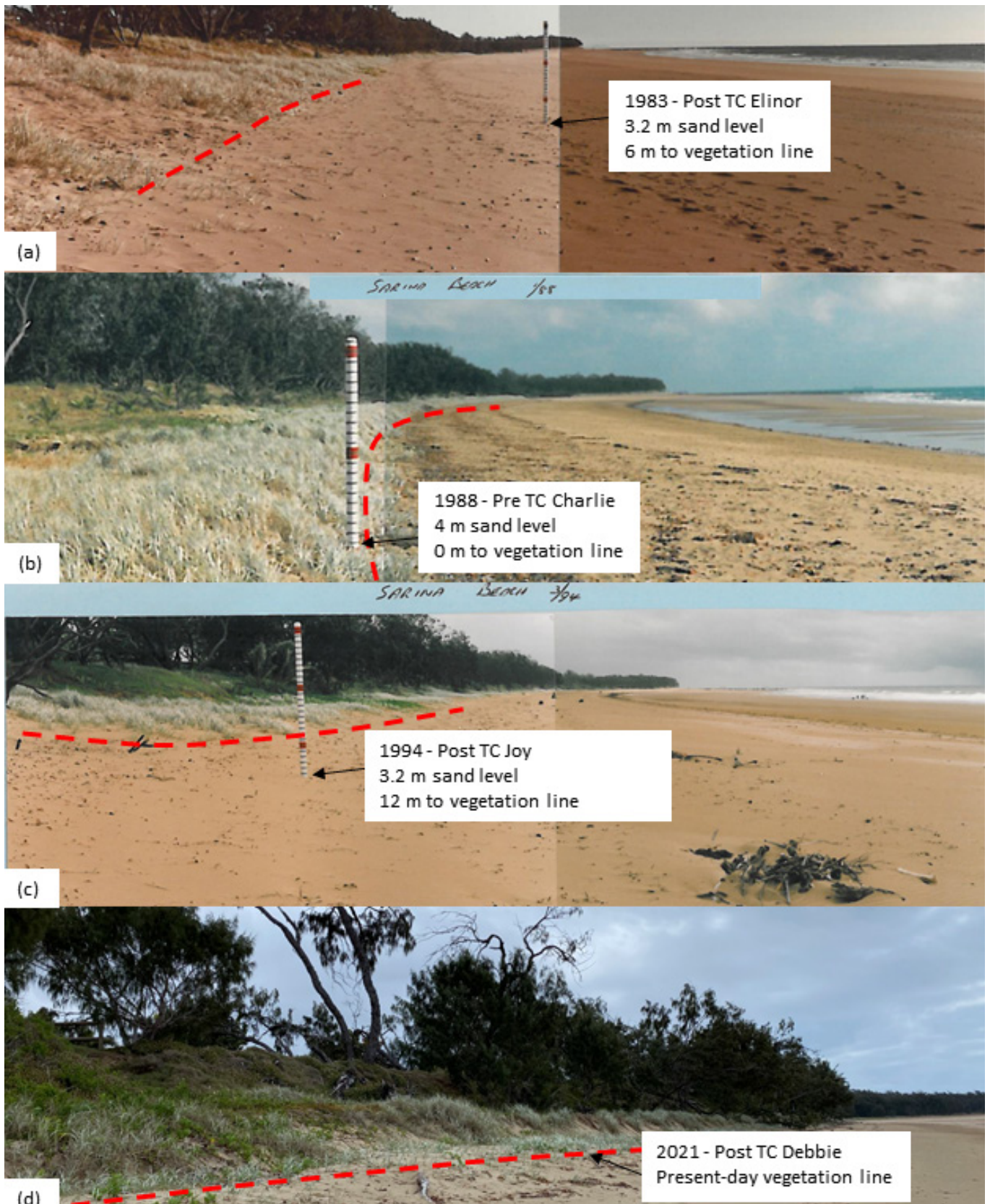


Figure 32: Sand level at the reference COPE pole and distance to vegetation line, looking north – (a) August 1983, (b) January 1988, (c) March 1994, and (d) August 2021.

The episodic erosion indicated in the historical photographs (Figure 32) show that Sarina Beach is susceptible to erosion from storm events but appears to have the capacity to rebuild in intervening periods. The presence of a well-vegetated dune system along the length of Sarina Beach between the coast and the road/residential zone provides a critical buffer during significant storm events to reduce the magnitude of erosion, protect private property, and as a source of sand to re-nourish the beach. This is particularly important if major storm events

occur in close succession (before the natural rebuilding of the beach has occurred). Classical features of a prograding system can be observed in the beach profile, including the development of the incipient foredune, established foredunes, and erosion scarps from previous storm events.

Figure 33 shows the Surf Lifesaving Club, south of Sarina Beach, covered in seafoam generated from storm surge combined with the high tide during TC Debbie in 2017.



Figure 33: Surf Lifesaving Club at present-day (left). Surf Lifesaving Club covered in seafoam during TC Debbie in 2017 (right) (photo by Trinity Turner).



Figure 34: Looking south towards Johnsons Beach and Sarina Inlet.

The southeast-facing Johnsons Beach is sheltered by Freshwater Point and Perpetua Point and is therefore not exposed to the prevailing south-easterly wind and wave conditions. Tidal currents ebb and flood through the narrow inlet, moving marine sand from the beach into the inlet to form a deep tidal channel and shallow sandy tidal delta. The sheltered embayment provides a suitable environment for mangrove communities to establish, especially in areas where fine sediments accumulate and become inundated by seawater during daily tidal cycles.

No major change in shoreline position is observable over the last 31 years (1988 to 2019) at Johnsons Beach. Historical

imagery indicates that the mangrove area on the northern end of Johnsons Beach has shown a slight recession, likely linked to the localised change in sediment distribution within the inlet. Mangrove areas tend to fluctuate along the coast, and it is consistent with the dynamic nature of this section of the coastline. Where established, mangroves provide additional protection for the shoreline from wave energy.

Disturbance, including beach driving and informal access tracks, have been observed along Johnsons Beach (Figure 35). The informal access tracks cutting across the dune have resulted in vegetation damage and localised beach erosion.



Figure 35: Tyre tracks on Johnsons Beach (top). Informal access track through the dunes and localised erosion scarps (bottom).

Sarina Beach and Johnsons Beach are vulnerable to sea level rise, which will inundate the low-gradient tidal flat and cause tide-related ecosystems to shift landward. The deeper water across the flats and on the more exposed sections will also increase breaker waves, shoreline recessions, and sediment transport. The large tidal range, occasional storms, and tropical cyclones are major factors determining long-term beach and backshore morphology. Seasonal and cyclic change is expected.

4.3.7 Coastal hazard areas

Coastal hazards include erosion, storm tide inundation, and long-term (permanent) tidal inundation in low-lying areas due to sea level rise. The State Government define Erosion Prone Areas (EPA) for the Queensland Coastline. The EPA represents coastal land that may be impacted between now and 2100 by default and open coast erosion, as well as permanent inundation due to sea level rise (0.8m by 2100). Areas prone to temporary exposure to storm tide inundation are characterised by medium (>1m depth) to high (< 1m depth) hazards.

A substantial extent of Sarina Beach and Johnsons Beach shoreline and settlement is situated within the EPA (Figure 36). The default and open coast components of the EPA are likely to be the dominant component of the EPA affecting residential shorelines at Sarina Beach. The EPA does not represent a predicted loss of coastal land, however, it does indicate that these areas will be increasingly prone to erosion and inundation, and where planning will be required to mitigate coastal hazard impacts. This has implications for longer-term strategic planning associated with coastal hazard adaptation. Any works completed to address erosion management over the next few decades should be in the context of longer-term coastal hazard adaptation and seek to achieve multiple strategic outcomes.

The low-lying areas of Sarina Beach and Johnsons Beach are likely to be prone to storm tide inundation by 2100 (Figure 36). Storm tide inundation is the temporary inundation of land due to storm surge associated with extreme events (e.g. cyclones). Any future erosion protection works for the shoreline should consider ways to mitigate storm tide hazards (e.g. increasing dune height with beach nourishment).



Figure 36: Queensland State Government Erosion Prone Area – Department of Environment and Science – shaded areas indicate land that may be prone to coastal erosion process by 2100. Coastal erosion processes include default and open coast erosion and increased tidal area (permanent inundation) due to 0.8m of sea level rise (left). Areas prone to storm tide inundation by 2100 (right).