

## 6 The Sunshine Coast shoreline and preferred erosion management options

The process for determining what erosion management option is considered preferable at a particular beach unit involves the identification of coastal processes and resources and the associated natural, social and economic values and determining the impacts and relative significance of each.

For the purposes of the SEMP, the coastline has been divided into four shoreline management zones made up of 28 beach management units, or 'localities', for individual investigation based on physical boundaries that affect coastal processes, such as headlands and river entrances. Maps for the four shoreline management zones are displayed in Appendix A, namely:

- Zone 1: Coolum to Mudjimba
- Zone 2: Mudjimba to Point Cartwright
- Zone 3: Point Cartwright to Caloundra Headland
- Zone 4: Caloundra Headland to Southern Boundary

Beach management units are introduced and discussed in this section under their respective zones.

This section provides an overview of the zone and beach specific processes, resources, values, erosion issues and management options. Each management zone is introduced through a discussion of the processes and high-level values and is accompanied by mapping. All beach management units within that zone are identified and a brief overview is provided for lower risk beach management units where the erosion threat is low or action to protect public land or other infrastructure is not required in the next 10 years. It is proposed that these lower risk issues will be dealt with in more detail by the coastal land management planning or, for medium to high priority issues in the longer term, be administered and dealt with in future reviews of the SEMP or through other strategic planning processes, as is appropriate.

### 6.1 General management, monitoring and review

#### 6.1.1 Dune building programs

Many of the Sunshine Coast dune environments have become fragmented and show signs of deterioration. Often this may be associated with increasing use of the beach environment; urban development; variable buffers for urban and recreational infrastructure; and, impacts from climate related events.

SEMP related works are proposed to be undertaken to protect major infrastructure and our iconic beaches. Dune building programs will increase the resilience of these environments and support the outcomes identified within the SEMP through prioritised works including:

- dune building;
- weed management and re-establishment of native vegetation;
- community education and information sharing; and,
- management of public access to rehabilitation areas.

**Table 6.1** outlines the dune building priorities for the next four years.

**Table 6.1:** Proposed dune building priorities

Beach Management Unit	Description of Works
Dune Education (all beach units)	Develop dunal education campaign & key signage
Marcoola Beach (unit 4)	Marcoola SLSC fencing and vegetation access management and stabilisation works
Maroochydore Beach (unit 9)	Establishment of revegetation works and fencing after each scheduled sand pumping event, including signs, maintenance and supplementary planting
Mooloolaba Beach South (unit 13)	Signage, planting, frontal and hind dune fencing
Pt Cartwright to Kawana Beach (unit 14)	Primary weed control works and management of access from Beach access 204 through to southern side of Kawana SLSC
Warana and Bokarina Beaches (unit 15)	maintenance of vegetation cover, investigate formalisation of beach access
Shelly Beach (unit 20)	Revegetation and dune stabilisation around stormwater outlet
Lamerough Canal to Bells Ck (unit 27 - Diamond Head)	Revegetation, weed management and stabilisation works

### 6.1.2 General beach management and erosion management at beach accesses and bathing reserves (common to all beach units)

The Sunshine Coast Council manages approximately 263 beach accesses and 10 gazetted bathing reserves. Typically, bathing reserves are serviced by surf lifesaving infrastructure including vehicle accesses and observation towers. In isolation, individual examples of these infrastructure are not likely to constitute ‘major infrastructure’ that would justify significant hard protection works designed to handle the major defined storm event. However, this infrastructure is important to the region through facilitating safe recreational and tourism uses of our beaches. Accesses and observational towers are typically managed through ‘as needed’ sand relocation, beach scraping and dune restoration works (i.e. soft erosion management options). Depending on the scenario, this may occur as pre-emptive works or in response to storm erosion and is subject to formal approval/permit processes. These works can increase shoreline resilience and afford protection from smaller storm events. However, infrastructure that is within the erosion extent associated with the major defined storm event remains vulnerable to that event. Aside from implementing hard protection works, current approaches to deal with this threat include removing the infrastructure from the erosion zone; designing infrastructure so that it is able to be removed prior to large events; or, accepting that it is expendable.

Site-specific discussion around existing and ongoing operational works such as beach and access maintenance, surf lifesaving tower management and dune management are not the focus of this SEMP. These are considered prudent general beach management activities common to most beach management units.

### 6.1.3 Monitoring (common to all beach units)

Monitoring of our shoreline and beaches is considered an important task for a number of reasons, including:

- Determination of whether there is a long term trend of erosion, stability or accretion;
- Better understanding of short-term (storm) fluctuations;
- Keeping track of buffer distances and works ‘trigger points’ to major infrastructure; and,
- Meeting statutory requirements and establishing the performance of our major tidal and other coastal works and programs.

Monitoring of Sunshine Coast beach profiles over the past 40 years indicates that our beaches are dynamically stable. That is, the current shoreline position is generally within its recorded historical range. However, modelling undertaken as part of the Background Study suggests that sand transportation rates have the potential to drive minor long-term net erosion. Also, shoreline recession will increase with time as projected increases in sea levels and storm intensity are realised. Many of the preferred options in

this SEMP are linked to shoreline erosion triggers where shoreline recession past nominated points triggers the initiation of shoreline protection works or further investigation. As such, monitoring is an integral part of our coastal management framework.

The Background Study also identifies that an improved understanding of the natural fluctuations of Sunshine Coast beaches should be developed. This can be achieved by long-term coordinated monitoring of beaches to understand the fluctuations in response to storm, sand transport and other seasonal and dynamic changes. This knowledge will assist erosion management planning, and monitoring will provide measurement of the shoreline relative to trigger points.

***Preferred action:***

A key preferred action proposed under this SEMP is the design and establishment of a coordinated monitoring program. The monitoring program could be based primarily on land based mobile scanning technology to monitor short term erosion and beach recovery at vulnerable sites and areas associated with works. This could also be supplemented by remote sensing (LiDAR, aerial photography); surveyed profiles, site inspections and other available data. It is proposed that two surveys could be undertaken per survey year (February and July) to capture seasonal changes, or only in July during lower energy winter conditions when more sand is more likely to be accreting on the beach. This could be undertaken every 2 to 3 years using mobile scanning technology and every two years prepare a report that considers this information in the context of wave climate. The beaches for the entire Sunshine Coast local government area could be surveyed using mobile scanning technology (indicative cost of \$100,000 per survey year for February and July including data and program management). For the intervening years, the monitoring program could focus on stretches of beach near coastal works as per development approval conditions, where applicable, and erosion hotspots identified in this SEMP.

Additionally, probing or coring to establish extent of coffee rock of beaches could provide additional information to better understand beach dynamics and shoreline responses to storms (estimated cost \$20,000 over five years);

***Additional considerations:***

Community partnerships were utilised during the 1980s to supplement formal monitoring as part of the COPE (Coastal Observation Programme – Engineering) monitoring program. Community based monitoring programs carry the benefits of tapping into local knowledge, enhancing a sense of stewardship and being relatively inexpensive.

Other technology that could be considered for specific projects or as a complimentary option includes beach camera systems, such as Coastal COMS (Coastal Observation and Monitoring Solutions). These systems can provide valuable physical information including the shoreline position, the beach width and wave statistics. The existing Coastal watch cameras located at Mooloolaba, Alexandra Headland and Maroochydore could potentially be utilised for monitoring purposes.

## **6.2 Sand Sourcing Study**

This SEMP identifies beach nourishment as a preferred management option for many beach management units. However, this option is currently restricted due to the limited availability of sand and legislative and values constraints that may be applicable to possible sand sourcing locations, such as, for example, Fish Habitat Areas. This necessitates an additional body of work that investigates the location and availability of potential offshore sand deposits. Potential sand sources of interest include the Hamilton Patches and North Banks south of Caloundra or other sites offshore from the Maroochy River mouth and offshore southeast of Point Cartwright.

Therefore, a preferred action is to undertake a sand sourcing study (indicative cost \$150,000). If viable sand deposits are located in nearby offshore areas, the Port of Brisbane Corporation (PBC) may be able to provide services to extract the sand and place it in the active nearshore environment. PBC has also indicated a willingness to explore the potential to use maintenance dredge material to nourish southern Sunshine Coast beaches. The cost of utilising this material will be dependent on the distance from the dredge site to the placement location. The quality and suitability of the maintenance dredge sand would

need to be investigated prior to using this material for nourishment purposes. The study should also prioritise the allocation of available sand resources to specific beach units based on need and cost effectiveness.

## 6.3 Zone 1: Coolum Beach to Mudjimba

### 6.3.1 Overview

#### **Spatial Extent and Values**

Shoreline management zone 1 extends from the Sunshine Coast Council northern boundary, north of Coolum, to the tombolo (sand deposit extending seaward) at Mudjimba Beach: the most easterly extent of the mainland onshore from Mudjimba Island. For the purposes of this SEMP, 5 beach management units have been identified in this management zone, see **Appendix A Zone 1** map.

This shoreline management zone carries significant natural values, comprising vast extents of designated *significant sand dunes* and associated ecosystems, including high ecological value wetlands and sections of Noosa National Park; Mount Coolum National Park and numerous conservation reserves. Many localities are located throughout this stretch of coast, typically comprising low to medium density residential landuse with pockets of high density tourism accommodation. This zone carries significant human use values associated with access to many recreational opportunities including surfing, kayaking, bush walking, fishing and a relaxed beach side lifestyle.



**Figure 6.1:** Potential net longshore sand transport rates (m<sup>3</sup>/yr) for Zone 1 and further north.

#### **Coastal Processes**

The beaches north of Coolum are more exposed to the predominant south-easterly swells and experience larger waves than the more southern beaches. The potential net northerly sand transport rates in this section are estimated to reach up to 25,000m<sup>3</sup> per year in the northern section, with this potential rate decreasing to approximately 8,300m<sup>3</sup> per year just south of Mudjimba, see **Figure 6.1**. For much of this zone, a well-established dune and vegetation buffer allow the beach to respond naturally to erosion events resulting in, at present, a low threat of erosion to Council managed assets.

Point Arkwright provides Coolum Beach with some sheltering from south-easterly swell. The Coolum Beach Surf Club has no vegetation or dune buffer but is protected by a low seawall, a wide beach and nearshore rock/reef.

Mudjimba Island modifies the height and direction of swell approaching the adjacent shore from all prevailing directions (south-southeast to north-northeast) and has a significant effect on the coastline between Mudjimba and Point Arkwright. The longshore transport patterns adapt to the modified prevailing waves and, over time, have created the tombolo at Mudjimba, the long shore extent of which is approximately five kilometres long, north to south.

Development within this shoreline management zone is generally landward of the current active beach system and therefore the shoreline is able naturally respond to erosion events. While significant short-term fluctuations in the shoreline position are observed, the historical beach profile data and aerial photography suggest that the beaches are relatively stable in the long term.



### 6.3.2 Beach Management units

*Shoreline management zone 1: Coolum Beach to Mudjimba* comprises 5 beach management units, 1 of which is identified as carrying a priority erosion issue under this SEMP. The beach management units of this zone include:

1. Coolum Beach (**priority erosion issue identified** - refer to section 6.3.3.1)
2. The Bays
3. Yaroomba Beach
4. Marcoola Beach
5. Mudjimba beach

A brief overview of the beach management units that are not considered to carry a current priority erosion issue is provided below. Beach management units that have not been identified as carrying a priority erosion issue may still face erosion pressures. These pressures are considered to represent either a sufficiently low risk or long-term consideration that may be more appropriately dealt with by the Coastal Land Management Plan (CLMP) or Coastal Hazard Adaptation Strategy (CHAS)/risk management planning, respectively.

#### 6.3.2.1 The Bays – beach unit 2

The Bays beach management unit covers the shoreline of First, Second and Third Bays, which are located between Point Perry and Point Arkwright. These bays include small sandy pocket beaches. These beaches are largely removed from the prevailing longshore sediment transport processes. Sand making up the beaches is likely to be derived locally from the near shore zone with some exchange between adjacent areas under certain conditions. Sand movement is expected to be dominated by cross-shore processes.

The beaches are in good condition, being relatively stable due to sediment transport control being provided by the headlands and rocky outcrops. The existing buffer between the shoreline and David Low Way exceeds 70m along Second and Third Bay and provides a suitable level of natural protection to the road. This buffer reduces to approximately 20m at First Bay and may represent an immediate low-level erosion risk to infrastructure, depending on the nature of the insitu rock. The stability of the natural rock protection provided to the road should be assessed by geotechnical engineer within two years.

#### 6.3.2.2 Yaroomba Beach – beach unit 3

This beach management unit covers the shoreline from Point Arkwright to the shoreline adjacent to the northern extent of Marcoola Esplanade, approximately 3.5km south. Yaroomba Beach is more exposed to the prevailing wave climate than the more southern beaches, which drives higher sediment transport rates. Sediment transport control provided by rocky outcrops at Point Arkwright. The dune and vegetation buffer of this beach unit is typically between 60m and 160m. The main dune exceeds 10m in height at most locations and the dune vegetation is generally in very good condition.

Modelling undertaken as part of the *Coastal Processes Study* (BMT WBM 2013b) indicates that the existing natural buffer is expected to provide sufficient shoreline protection to Council controlled infrastructure against erosion associated with the current defined storm event.

The Coastal Land Management Plan should consider the option of maintaining current arrangements such that natural processes are preserved. It is recommended that dune restoration is considered under the future CLMP for the section along Yinneburra Street to improve resilience of the dune and reduce the potential erosion threat.

#### 6.3.2.3 Marcoola Beach – beach unit 4

This beach management unit extends from the shoreline adjacent to the northern extent of Marcoola Esplanade to the shoreline adjacent to the intersection of Mudjimba Esplanade and David Low Way. The

dune and vegetation buffer along this section typically ranges between 70m and 100m. Modelling undertaken as part of the *Coastal Processes Study* (BMT WBM 2013b) suggests this width will provide adequate shoreline protection against the erosion associated with the current defined storm event.

The visible scarp at the top of the frontal dune provides an indication of recent erosion events, which have extended back to the 1974 scarp in places. Analysis of aerial photography suggests some recession (approximately 5m) of the frontal dune has occurred since 2008. Temporary loss of the frontal dune is the shoreline's natural response to short term large wave attack and, in isolation, is not considered to be evidence of any long term trend) of erosion (that is permanent loss). Longshore sediment transport calculations indicate relatively low transport rates along this section. Therefore, shoreline recession due to long-term erosion is expected to be minor. As with all beach management units, implementation of the proposed coordinated monitoring program will provide greater certainty around medium to long-term recession-accretion trends.

The existing condition of the frontal dune at the Marcoola Surf Club is degraded and recent stabilisation works have suffered damage from storm events in early 2013. While not a Council controlled asset, it is obvious that the Surf Club tower is currently vulnerable and the erosion threat to the main building will increase if the dune system is not stabilised. This should be considered under the Coastal Land Management Plan and if dune restoration is achieved then the option to maintain current arrangements may be considered appropriate, which may include beach scraping to improve conditions in front of the surf lifesaving tower, with continued dune management and monitoring of the shoreline. See also *Section 6.2.1 General beach management and erosion management at beach accesses and bathing reserves*.

#### *6.3.2.4 Mudjimba Beach – beach unit 5*

This beach management unit extends from the shoreline adjacent to the intersection of Mudjimba Esplanade and David Low Way to the most easterly point of the tombolo (sand deposit extending the mainland seaward) at Mudjimba Beach. A well-established dune and vegetation buffer exists along the Mudjimba shoreline and therefore the immediate erosion threat to major Council controlled infrastructure is low. A Council controlled viewing platform currently has its foundations protected by a loose rock revetment. Within the next 50 years, the threat to infrastructure may increase if sea level rise projections and an increase in storm intensity are realised. The most vulnerable major is a 500m section of Mudjimba Esplanade where the existing buffer width is approximately 40m. These long term issues require further consideration under Coastal Hazard Adaptation/risk management planning.

With respect to the scope of this SEMP, the existing vegetation buffer and control provided by Mudjimba Island provide stability to the Mudjimba shoreline and therefore the option of maintaining current arrangements is viable and should be considered under the Coastal Land Management Plan. This option should incorporate shoreline monitoring. Encouraging dune growth and improved stability through revegetation and controlling dune access is also a prudent option.

### 6.3.3 Priority beach management units – priority erosion issue identified

#### 6.3.3.1 Coolum Beach – beach unit 1

##### Overview

The **Beach unit 1** map of **Appendix A** provides spatial context to this beach management unit and provides an overview of the major mapped values, where available.

##### Site description and values

This beach management unit covers the shoreline adjacent to the intersection of David Low Way and Emu Mountain Road south through to Point Perry. The southern extent of the beach unit is sheltered from south easterly swell by Point Perry. This beach unit carries significant recreational and tourism related values, including significant development along the southern shoreline. The main land uses of the area including bathing reserve, medium to high density residential (including tourism accommodation), commercial (cafes, restaurants, retail, Coolum Surf Club), Holiday Park (Coolum Beach), community facilities and open space (parkland, skate park). The significant human use value is more concentrated in the southern section of the beach. This beach management unit carries significant natural values north of the Coolum community hub, with significant sand dunes, including blowout parabolic dunes in the northern section, and a significant section of Noosa National Park.

Natural rock is present along the shoreline between Point Perry and the Surf Club and provides some erosion protection to David Low Way. The Surf Club and foreshore area, including the skate park, is protected by a seawall. The seawall is approximately 150m long and changes alignment every 50m. North of the seawall, a 30m wide dune buffers the adjacent to the Holiday Park. North of the Holiday Park, the buffer widens considerably and includes coastal creeks and wetlands.

**Erosion Management Considerations (EMCs)** – refer to Figure 6.1 for locations of the listed considerations.

1. Efforts to protect the southern Coolum Beach shoreline commenced in the late 1960s with the main asset being the rock seawall in front of the Surf Club. Today the beach appears relatively stable and, aside from short-term storm related changes, the profile is in general equilibrium with the existing seawall structure. The terraced seawall has not been designed to dissipate wave energy and may require adaptation works if it is to be expected to provide long-term protection and not adversely affect beach amenity. The long-term suitability of the existing structure is uncertain and stability under the conditions of the defined storm event, and other scenarios, should be assessed.
2. The majority of the existing Holiday Park is not under immediate threat from the defined erosion event. However, future coastal hazard adaptation /risk assessment planning could consider appropriate long term use of the most seaward extent of the park (approximately one third of the total park area).
3. There are no priority erosion issues north of the Holiday Park due to the relatively



**Figure 6.1:** Air photo showing the erosion management considerations for Coolum Beach



natural state of the beach and its capacity to accommodate natural processes in a relatively low risk scenario.

**Figure 6.2**, below, shows the wide beach at Coolum Beach as seen from the existing seawall looking towards Point Perry.



**Figure 6.2:** Coolum Beach looking towards Point Perry from the existing seawall.

**Table 6.2**, on the next page, presents an overview of the indicative costs and likely impacts of specific options considered for this beach management unit and includes a brief comment on whether each option is considered viable and in the strategic interest of the community.

**Table 6.2:** Overview of options, costs and impacts for the **Coolool Beach management unit**

**Current state:** developed (south) natural (north) **Main values of significance in vicinity:** **Natural values:** Significant dunes, conservation reserve; Noosa National Park, Turtle breeding **Human use** – Beach amenity (recreation/ tourism)/ infrastructure (Hard – Seawall (south); Soft – land/open space and Holiday Park). No listed heritage site identified

**Current usage:** Moderate to high utilisation; low impact use **Specific Threat:** Unknown long term stability of existing seawall (other options are presented for an overview of constraints associated with these alternatives)

Erosion Management Option	Indicative investment	Likely impact on significant resources & values						Viability Comments (fit for purposes of asset protection or amenity maintenance?)	Strategic Interest Comment	Preference	
		Natural Processes – Sand transport, accretion, and erosion	Natural Values			Human Use Values					
			Sig. Dune & Ecosystems	Eco. Valuable waters	FHA	Beach Amenity	Infra-structure				Heritage
Existing arrangements plus monitoring	Low	Neutral	Neutral				Neutral to <b>Negative</b>	Neutral to <b>Negative</b>	Viable but it is prudent to determine the integrity of the seawall.	Appropriate for the natural/undeveloped beach extent though risks must be better quantified for the existing seawall given high recreational and economic values.	Low risk sites only
Beach Nourishment	Not Applicable	Neutral	Positive				Very Positive	Positive	Without groyne or artificial reef would also require significant nourishment of northern beaches for this option to be successful (unlikely to be viable or needed)	N/A – Not likely to be viable in the long term.	Not Applicable
Groynes	Not Applicable	Negative	Negative				Negative to Positive	Negative to Positive	Not considered viable in isolation due to down drift erosion	N/A for identified issue regarding seawall. See comment on offshore reef for other applications.	Not Applicable
Seawalls – RPEQ assessment of existing	low	Neutral (exg)	Neutral (exg)				Neutral to <b>Negative</b>	Very Positive	Existing seawall requires RPEQ assessment of integrity against the defined event.	Investigation to assess the existing seawall is a relatively low cost and prudent action.	Preferred
Offshore Submerged Reef	High to Very High	Negative	Negative (down drift) to Positive				Negative to Positive	Negative to Positive	Would require sand supply and nourishment. Feasible only if a viable source of beach nourishment sand is identified by sand sourcing study. Review following study and consultation.	Feasibility has not been demonstrated and this option carries significant costs and impacts on natural processes; requires beach nourishment and groyne fields to accommodate this.	Secondary

## Preferred management plan for Coolum Beach

### ***Priority actions:***

Table 6.2 identifies the high value open space and infrastructure located in the southern developed section of Coolum Beach. The integrity of the existing seawall should be assessed. Also, any beach nourishment works would require a suite of high cost and high impact hybrid options. Therefore, the preferred priority actions include:

1. Assessment of the existing seawall by qualified engineer. If the structure is deemed to require upgrading or augmentation then a concept design for an upgraded seawall may be required. Assessment of the seawall should occur within 5 years and, if required, upgrading of the seawall is dependent on advice from the assessing engineer.
2. The option for amending the use of an eastern portion of the Holiday Park is a longer-term consideration and could be considered under a future Coastal Hazard Adaptation Strategy or longer term risk assessment planning.

### ***Additional actions:***

- Coordinated monitoring of beach profiles in accordance with the program for the entire coast.
- Dune building for the northern stretch of beach could be considered under a future Coastal Land Management Plan.
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### ***Indicative costs:***

The expected cost of structural assessment of the existing seawall by a qualified engineer is \$25,000.

Costs associated with coordinated monitoring for the entire Sunshine Coast are included in Section 6.1: General management, monitoring and review.

## 6.4 Zone 2: Mudjimba to Point Cartwright

### 6.4.1 Overview

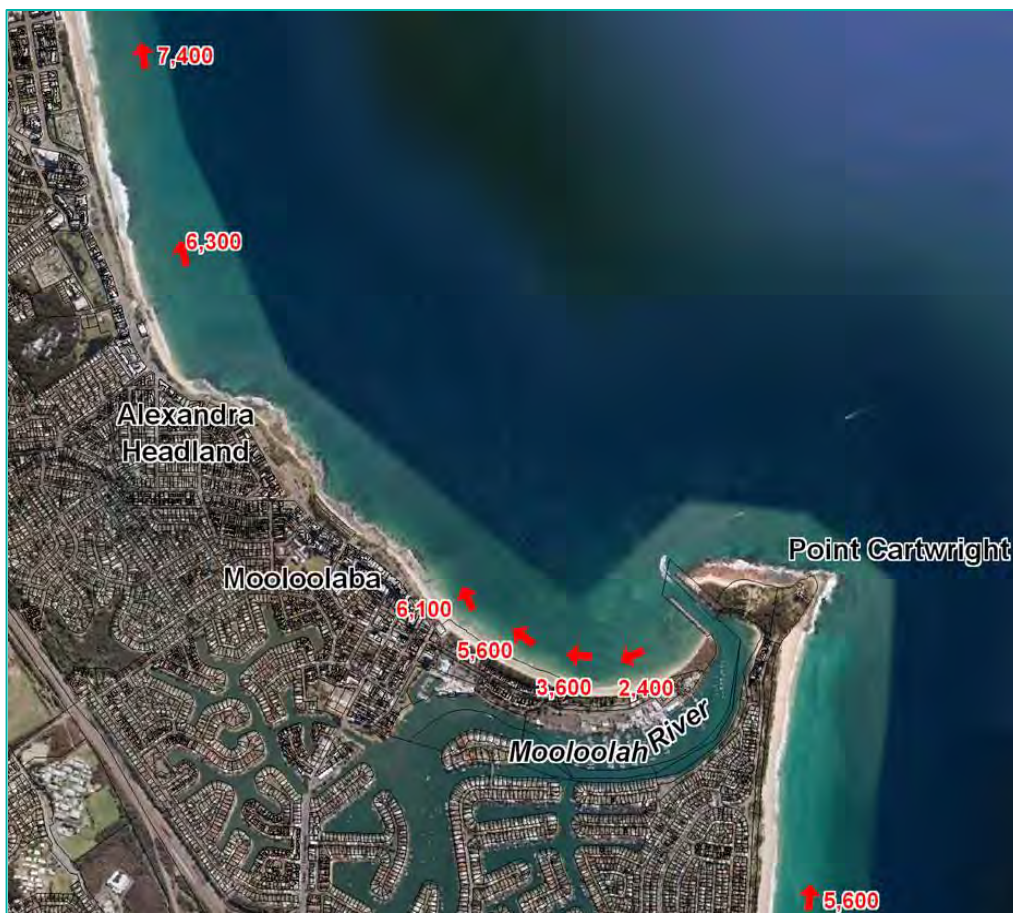
#### Spatial Extent and Values

Shoreline management zone 2 extends from the tombolo (sand deposit extending the mainland seaward) at Mudjimba Beach (Old Woman Island) to the Mooloolah River (western side of Point Cartwright). For the purposes of this SEMP, 8 beach management units have been identified in this Zone, see **Appendix A Zone 2 map**.

This shoreline management zone carries significant natural and human use values, with the most notable including:

- significant dune systems and associated conservation reserves of Maroochy North Shore;
- declared Maroochy River Fish Habitat Area;
- medium to high density development of Maroochydore to Mooloolaba coastal strip;
- Gazetted bathing reserves (covering beaches at Northshore, Maroochydore, Alexandra Headland, Mooloolaba) and beach conservation reserves .

The developed coastal strip is popular with locals and tourists for the services and recreational opportunities associated with sandy beaches and estuaries. The Maroochydore Principal Activity Centre is located in this coastal management zone with the associated community hub extending to the coastal strip and foreshores of the Maroochy River Estuary and Cornmeal Creek.



**Figure 6.3:** Potential net longshore sand transport rates ( $m^3/yr$ ) between Maroochydore Beach and Mooloolah River.

#### Coastal processes

Maroochy North Shore is more exposed to open ocean conditions than the southern beach management units in this zone, with a corresponding potential net sand transport rate of  $8300m^3$  per year compared to those shown in **Figure 6.3** for the beach management units between the Maroochy and Mooloolah Rivers. Note that the potential inflow of sand from Buddina Beach to Mooloolaba Beach is  $5600m^3/yr$ , indicating only a weakly erosive potential with no significant loss due to longshore transport processes.



Sand that is lost from Buddina beach can spend several years accumulating in deposits around Point Cartwright. Depending on wave conditions, this sand may end up at Mooloolaba Bay or Beach or bypass this section moving directly to Alexandra Headland Beach.

Pincushion Island is currently connected to the North Shore Beach (also known as Twin Waters Beach) by a wide sand spit. During high tide a small portion of the sand spit is inundated allowing minor flows to the north of the island. Prior to 1999, the beach on the southern side of the river was connected to Pincushion Island and the river entrance was located north of Pincushion Island. At that time a significant buffer existed between the shoreline and the Holiday Park (which has been known as both Pincushion Caravan Park and Cotton Tree Caravan Park). As part of the process of the entrance relocating to the south of Pincushion Island, a large quantity of sand, which was the beach and dune connecting Pincushion Island, moved into the entrance. This caused substantial shoaling in the lower part of the estuary, downstream of Goat and Channel Islands.

The Background Study indicates that much of the shoreline erosion appears to be largely seasonal and related to short-term storm erosion. However, the exposure of coffee rock along many of the beaches could indicate that long term recession is occurring, albeit at a very slow rate. As such, the threat to infrastructure and development over the planning period is primarily associated with the defined storm event.

From a risk management perspective, it would be prudent to ensure that the high level of development that exists within the erosion prone area at Mooloolaba, Alexandra Headland and Maroochydore be afforded a sustainable level of protection over the life of this plan and that long-term options be determined under Coastal Hazard Adaptation/Risk Management planning.

It is also preferable that continual monitoring of the beaches be undertaken to understand the short-term fluctuations and identify any long-term erosive trends.



**Figure 6.4:** Zone 2 Looking south from Maroochy River Northshore

#### 6.4.2 Beach management units

The shoreline erosion management *Zone 2: Mudjimba to Point Cartwright* comprises 8 beach management units, 5 of which are identified as carrying a priority erosion issue under this SEMP. The beach management units of this zone include:

1. Maroochy North Shore



2. Maroochy River Entrance (**priority erosion issue identified** – see section 6.4.3.1)
3. Maroochy Estuary
4. Maroochy Beach (**priority erosion issue identified** – see section 6.4.3.2)
5. Alexandra Headland Beach (**priority erosion issue identified** – see section 6.4.3.3)
6. Alexandra Bluff to Mooloolaba Beach
7. Mooloolaba Beach North (**priority erosion issue identified** – see section 6.4.3.4)
8. Mooloolaba Beach South (**priority erosion issue identified** – see section 6.4.3.5)

A brief overview of the beach management units that are not considered to carry a current priority erosion issue is provided below. Beach management units that have not been identified as carrying a priority erosion issue may still face erosion pressures. These pressures are considered to represent either a sufficiently low risk or long-term consideration that may be more appropriately dealt with by the Coastal Land Management Plan (CLMP) or Coastal Hazard Adaptation Strategy (CHAS)/risk management planning, respectively.

#### 6.4.2.1 Maroochy North Shore – beach unit 6

This beach management unit extends from the Tombolo (sand deposit extending the mainland seaward) at Mudjimba (opposite Old Woman Island) to the Maroochy River entrance. This beach management unit has a natural character due to the lack of intensive development. The dunal system forming part of this beach management unit is recognised as being a *significant coastal dune*, being identified as core habitat under Council's Biodiversity Strategy and contains Regional Ecosystems (REs) of *Open-forest to low closed forest* (RE 12.2.5) and *Strand and foredune complex* (RE 12.2.14). The main land uses in this area include bathing reserve, dog off leash area, low density residential (including resort accommodation) and conservation reserve (Maroochy River Conservation Reserve and Maroochy-Mudjimba Foreshore Bushland Conservation Reserve and Mudjimba Community Revegetation Area).

The area remains one of the more natural beach settings in the region. The North Shore Road is set well back from the beach (approximately 100m), with relatively stable vegetated dunes between the road and the beach. The beach is in good condition and occasionally coffee rock is exposed in the beach face. Stability of the beach is connected to the presence of Mudjimba Island and the tombolo that forms in the lee of the island. This forms an effective control point stabilising the beach to the north and south. The sand transport rate along North Shore Beach is slightly higher than beaches to the south. This is due to a reduced influence of Point Cartwright and Moreton Island on sheltering the shoreline from wave energy. There is still transport to the north and south with a potential net transport of about 8,300m<sup>3</sup>/year to the north. However, growth of the North Shore sand spit southwards across the river entrance indicates that the net transport of recent times may be to the south.

#### 6.4.2.2 Maroochy River Estuary – beach unit 8

This beach management unit covers the Maroochy River main channel only and extends from inside of the river entrance to the upstream side of Chambers Island. The waters, shoreline and adjacent open space are significant for their high recreational values, providing opportunities for fishing, bathing, boating, walking and general enjoyment of the open space. Chambers Island, Goat Island and Channel Island and sections of the north bank near the entrance of the Maroochy River are declared Fish Habitat Area. Maroochy River Conservation Park includes Goat (southern island) and Channel (northern island) Islands in the lower estuary and there are sand banks in this area that accommodate migratory bird populations .

There are existing shoreline protection arrangements for this beach unit such as revetment walls , groynes and beach nourishment. In considering the nature of the southern and northern Maroochy River shorelines (i.e. substantial development on the southern shore and a substantially natural

northern shore), it is preferred that the natural attributes of the north shore remain. The erosion management preference for the remaining shoreline is to continue with the existing management arrangements, which aim to maintain the social and economic values associated with the Holiday Park and open space while avoiding interference with the Fish Habitat Area and Conservation Park.

#### *6.4.2.3 Alexandra Bluff to Mooloolaba Beach – beach unit 11*

This beach management unit extends from the bluff south of Alexandra Headland Beach to the Beach Terrace rock outcrop at Mooloolaba. The beach adjacent to the State controlled land associated with the Ocean Breeze Holiday Park is very narrow and is located above the rocky foreshore area. The beach may have historically extended further inland prior to construction of the rock revetment that is located in front of the Holiday Park. Dry sand exists in front of the revetment and provides amenity for the Holiday Park users.

This beach unit is not identified as carrying a priority erosion issue due to the lack of Council controlled assets combined with the low energy environment, minimal beach and subsequently low erosion threat.

### 6.4.3 Priority beach management units – priority erosion issue identified

#### 6.4.3.1 Maroochy River Entrance – beach unit 7

##### Overview

The **beach unit 7** map of **Appendix A** provides spatial context to this beach management unit and an overview of the major mapped values, where available.

##### Site description and values

The Maroochy River entrance and adjacent areas are highly valued recreational and tourist destinations. The Cotton Tree Holiday Park site (including the site previously known as the Pincushion Holiday Park) located on the southern side of the entrance is a registered State heritage site and is popular for the recreational opportunities. The more natural northern side of the entrance is also a popular recreational spot and the spit connecting the mainland to Pincushion Island is recognised as habitat for migratory birds<sup>3</sup>. The popular recreational activities are generally water based and include fishing, bathing and launching small watercraft. A dog off leash area is located on sections of the North Shore bank and beach.

Historically, the river entrance has been mobile, at times being located to the north side or the south side and of Pincushion Island. At times, the river entrance has encompassed Pincushion Island, making it an Island. Currently, the lower estuary downstream of Channel and Goat Islands contains a significant amount of sand that is likely to have been eroded from the frontal dunes that were previously connected to Pincushion Island. In a similar cycle in the 1960-1970s, sand from the same location closed off the southern entrance of the Maroochy River, forcing all flow through the northern channel. This eroded the inside of the northern spit to such an extent that it caused the channel to eventually break through just south of Twin Waters. Council has approval to relocate some of this sand in the lower estuary to Maroochydore Beach. Otherwise, this sand is likely to stay in this area until a flood event flushes it through the entrance. The northern spit and the shoals continue to force the main channel close to the southern bank of the river, exerting continued erosive pressure in this area. This is unlikely to change until the main channel relocates to the north, with the natural version of this event being most likely to be associated with flood conditions. Artificial channel relocation to an area north of Pincushion Island has previously been considered as an option to relieve this erosive pressure on the south bank but was not considered appropriate at that time.

During the 1990s, the southern channel became very dominant and erosive pressure on the riverbank near the Cotton Tree Holiday Park necessitated installation in 1995 of two geotextile groynes. Continued erosive pressure resulted in a breakthrough of the entrance south of Pincushion Island in 1999. The subsequent threat to the Holiday Park from shoreline recession necessitated the construction of the southern geotextile groyne and the installation of geotextile seawall sections in 2001. A further three geotextile groynes and additional seawall components were constructed in 2003. The aim of installing these groynes and seawalls is to protect the Holiday Park and shoreline while maintaining amenity on the beaches between the groynes. The arrangement of the groynes was designed with the assistance of a physical model at the Queensland Government Hydraulics Laboratory. This area is not well vegetated.

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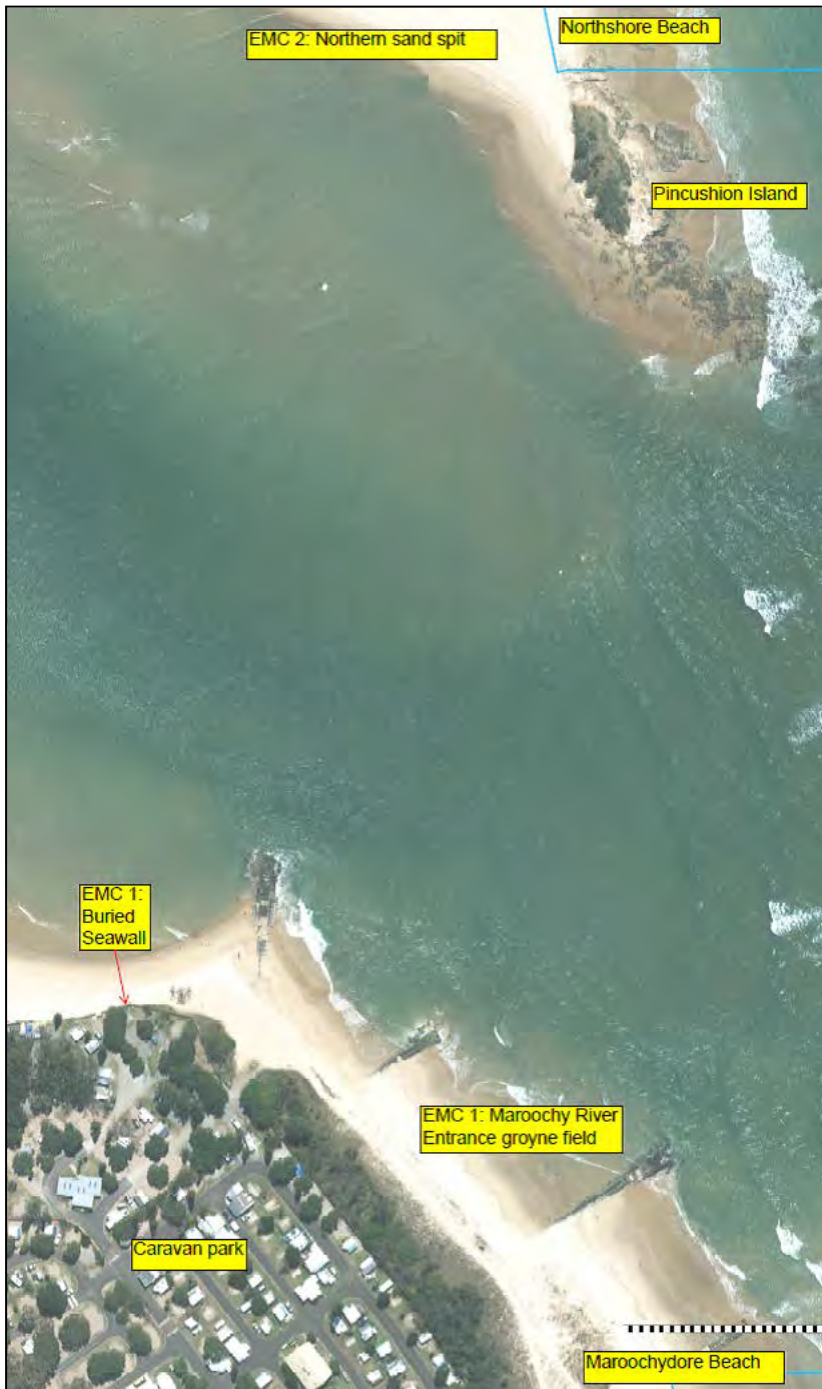
<sup>3</sup> See <http://www.sunshinecoast.qld.gov.au/sitePage.cfm?code=shorebirds>

**Erosion management considerations (EMCs)** – refer to *Figure 6.5* for locations of listed considerations

The Statutory Erosion Prone Area (to 2100) is identified as the width of the spit, which is several hundred metres wide and includes much of the Holiday Park. The only other infrastructure within this beach management unit is the car park located at the end of North Shore Road. The defined storm event erosion width for the exposed section of this beach management unit is approximately 50m (see Section 3.1.8 Table 3.4).

The main Erosion Management Considerations (EMC) include:

1. The construction of the protection works in 2001-2003 (see above discussion) was undertaken



to protect the Holiday Park and shoreline. This preserves the significant recreational and economic values associated with this area. These works included a geotextile seawall (generally buried and out of sight) and, despite some geotextile bags have moved and slipped at the ends of the groynes, the groynes and have proven successful in resisting shoreline recession and generally provides a wide beach. Therefore, it is considered reasonable to maintain the existing structures with an option to replace them with equivalent rock structures if favourable life cycle costing is identified when planning for renewal of the structures. The geotextile structures have the advantage of being perceived by some as more user-friendly and as having less subjective visual impact than rock. Realignment of the seawall closer to the Holiday Park boundary would make it less likely to be exposed and, therefore, subjective visual impacts may be mitigated.

2. In the late 1990s, proposals were discussed with the State for dredging a channel, or new entrance, north of Pincushion Island. Also, discussed was a proposal to cut a high flow relief channel through the spit to carry flood flows. Previous State Departments have not supported such proposals and, therefore, no works application was made. Subsequently, unauthorised and unsuccessful tidal works relating to the proposal were undertaken.

**Figure 6.5:** Annotated air photo showing erosion management considerations for Maroochy River Entrance.



Figures 6.6 and 6.7 show aerial and land based perspective views of the existing geofabric groynes at the Maroochy River entrance.



**Figure 6.6:** Maroochy River Entrance showing geotextile groynes.



**Figure 6.7:** Geotextile Groyne at Maroochy River Entrance with Pincushion Island in the Background



Table 6.3, on the next page, presents an overview of the indicative costs and likely impacts of specific options considered for this beach management unit and a brief comment on strategic interests and whether each option is considered viable.

**Table 6.3:** Overview of options, costs and impacts for the beach management unit: **Maroochydore River Entrance**



**Current state:** Developed (south side) natural (north Side) **Main values of significance in vicinity:** **Natural values:** Listed Significant Dunes and Ecosystems (North Shore Beach); Maroochy River Fish Habitat Area and Conservation Park; Maroochy River – Mudjimba Foreshore Conservation Reserve. **Human use values**– Beach amenity (recreation/ tourism); Infrastructure (Hard – seawall, groynes, Holiday Park; Soft – open space). **Heritage site:** Cotton Tree Holiday Park

**Current usage:** High utilisation; low impact use **Specific Threat:** open space and Holiday Park within current erosion prone area

Erosion Management Option	Indicative Investment	Likely effect on significant resources & values							Viability Comments (fit for purposes of asset protection or amenity maintenance?)	Strategic Interest Comment (viability and impact on values)	Preference
		Natural Processes – Sand transport, accretion, and erosion	Natural Values			Human Use Values					
			Sig. Dunes & Ecosystems	Eco. Valuable waters	FHA	Beach Amenity	Infra-structure	Heritage			
Existing arrangements plus monitoring	Very Low	Neutral	Neutral		Neutral	Neutral to Negative	Negative	Negative	Likely to result in negative impacts to the Holiday Park.	Unacceptable given the importance of the existing Holiday Park and high recreational and economic values associated with the river entrance and adjacent areas.	Not preferred
Beach Nourishment	Low(amenity) to High (protection)	Neutral	Neutral to Positive		Neutral to Positive	Very Positive	Neutral to Positive	Neutral to Positive	An adequate protection buffer from nourishment requires an additional 20m of beach. Some benefit will come from nourishment works at Maroochydore Beach.	No specific nourishment of this beach is proposed as benefit will be derived from Maroochydore Beach. As needed scour and amenity related nourishment is considered acceptable and relatively low cost.	Secondary
Groynes – existing (upgrade / renewal)	Moderate to High	Negative	Neutral		Neutral	Negative (down drift) to Positive	Negative to Positive	Negative to Positive	Existing Groynes have proved effective. Enhancing existing structures to improve effectiveness of Maroochydore Beach nourishment should be considered. Consider formalisation of structures in rock.	Review of upgrade and concept plan for formalisation of structures should be pursued as required. Enhancement may improve effectiveness of southern nourishment works. Negative impacts of groynes through down drift erosion may be negated by nourishment and positive effect of groynes on this activity.	Preferred
Seawall – Upgrade/ renewal	High to Very High	Negative	Neutral		Neutral	Neutral to Negative	Very Positive	Very Positive	Existing buried geotextile wall has proved effective in the protection of land assets and is unobtrusive. Consider rock upgrade.	Review of need for rock upgrade and concept plans for formalised structures should be pursued as required in line with applicable asset management plans.	Preferred

Table continues

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Offshore Submerged Reef	Not Applicable	Negative	Negative (down drift) to Positive (updrift/landward)		Negative to Positive	Negative to Positive	Negative to Positive	Negative to Positive	Not considered viable due to the riverine and tidal dynamics of the area and likely negative impact to Maroochy River entrance. Also a high cost.	N/A	Not Applicable
Channel Relocation and/or high flow channel (requires ongoing intervention)	High to Very High	Negative	Neutral to Negative		Neutral to Negative	Positive (south side) to Negative (loss of beach north side)	Positive	Positive	May relieve erosion pressure and would require hard protection works to maintain connection of the island. This option would result in loss of shorebird habitat and dog-off-leash beach on the north side. Previous proposals for this option have not been favourably received nor has application been made due to perception that approval would be unlikely.	While relocation may occur naturally, intervention to relocate the entrance or maintain this significantly interferes with coastal processes. Additional protection works would be required to maintain the connection. This is not considered a preferable option worth pursuing during the implementation period of this SEMP. Strong justification would be required for this option to gain approval as intervening to relocate the entrance, or maintaining it after a natural breakthrough, is likely to constitute significant interference with natural coastal processes, which is against State and Council policy.	Not preferred

## Preferred management plan for Maroochy River Entrance

### **Priority Actions:**

**Table 6.3**, above, indicates that the existing arrangements are considered to be working effectively in the protection of the Holiday Park and shoreline while facilitating recreational use of the shoreline. The preferred priority actions to ensure continued protection include:

1. The existing geotextile groynes should be maintained by replacing damaged and distorted containers as required, in accordance with the relevant asset management plan. It should be noted that the geotextile containers have a lifecycle of about 25 years under ideal conditions. While not a specific priority action coming from this SEMP, comparative life cycle costing consideration should be given to reconstructing these structures using rock when planning for renewal of the structures. It is acknowledged that formalising the groynes with rock may reduce subjective visual amenity and 'user friendliness' of the structures and minimisation of these impacts should be considered in the design of such structures.

### **Additional Actions:**

- Coordinated beach monitoring should occur in line with the proposed program for the entire coast.
- Dune restoration works are a relatively low cost and prudent measure to improve sand capture/retention, dune habitats, and beach amenity and these options should be considered for the southern bank. Particular priorities for the North Shore should be considered under the future Coastal Land Management Plan.

### **Indicative Costs:**

The cost of maintaining the four geotextile groynes with 10 containers in each (total of 40) every five years is \$300 per container. It is not known whether the fabric of the containers will last more than 10 to 20 years; therefore, a cost estimate is difficult to provide as the whole structure may need to be replaced. If replacement becomes necessary, or Council wishes to formalise the location of the structures then rock groynes should be considered. While noting this is not a priority recommendation of this SEMP, being dependent on concept design and lifecycle costing analysis, the cost of rebuilding the four groynes (total of 310m) in rock, including removal of the existing geotextile structure, is expected to be \$5000/m giving a total cost of \$1.6 million. It is expected that about 1% of capital cost will be required in maintenance cost every year, giving an annual maintenance cost of about \$16,000 per year.

Costs associated with coordinated monitoring for the entire Sunshine Coast are included in Section 6.1: General management, monitoring and review.

### 6.4.3.2 Maroochydore Beach – beach unit 9

#### Overview

The **beach unit 9** map of **Appendix A** provides spatial context to this beach management unit and provides an overview of the major mapped values, where available.

#### Site description and values

For the purposes of the SEMP, this beach management unit extends from the groyne field at the Maroochy River entrance the northern corner of the seawall at the park/skate park adjacent to the Alexandra Headland Surf Club.

Maroochydore Beach is a focal point for tourism and beach related recreation and surf lifesaving culture, carrying significant recreation and economic values. Major land uses in this area include bathing reserve, open space, Holiday Park, medium density residential and commercial uses (cafes, restaurants, surf club and retail). The Maroochydore Surf Club is hosting the 2016 National Surf Life Saving championships and this use requires a nominated sufficient beach width.

Sand transport in this area is expected to have a low net northward migration. However, this would be seasonal and may reverse from year to year. The presence of the geotextile groyne field (constructed 2001 and 2003) and recently installed beach re-nourishment works provides improved stability to the beach and improved erosion resilience.

#### Erosion management considerations (EMCs) – refer to **Figure 6.9** for locations of listed items

1. Historically, the dune buffers of this beach management unit have generally been in good condition with a vegetated foredune between 20m and 50m wide. Extensive areas of coffee rock are also common in the nearshore area. The current defined storm erosion width (see **Section 3.1.8 Table 3.4 ETA532 and ETA 530**) varies from approximately 49m to 72m in the vicinity of Alexandra Parade. At present, infrastructure is vulnerable to erosion from the defined storm event. The width between the toe of the frontal dune and Alexandra Parade (a State controlled arterial road) is less than 20m at some locations. A buffer width of 15m has been previously defined as the “trigger” for seawall construction along this section. Note however, that this trigger is well within the defined erosion area and, therefore, infrastructure remains vulnerable to the defined event. In addition to Alexandra Parade, other infrastructure that is located within the defined erosion prone area includes the Maroochy Surf Club and the Sea Breeze Holiday Park. The Surf Club is currently protected by a seawall.

The location of Alexandra Parade and the Holiday Park carries a significant short-term erosion risk. Storm events in recent years have caused a lowering of the beach, exposed extensive areas of coffee rock, eroded dunes and damaged beach access infrastructure. The section of beach adjacent to Aerodrome Road/Alexandra Parade has been subject to erosion that has exposed imported fill material. The fill material is likely to provide some stability to the shoreline but this is not considered a suitable long-term shoreline protection measure and this also negatively affects beach amenity.





**Figure 6.9:** Annotated air photo locating the erosion management considerations for the Maroochydyore Beach Unit

Long-term protection of the erosion prone infrastructure will probably require construction of a buried rock seawall along the seaward edge of Alexandra Parade-Aerodrome Road and the Holiday Park. A seawall provides a high level of protection to infrastructure but can negatively affect beach amenity, which may be mitigated by the current sand renourishment program. Note that the purpose of a buried seawall in the context of this SEMP is to provide protection from erosion damage but not prevent inundation of the area landward of the wall.

2. Current renourishment operations include the relocation of approximately 125,000m<sup>3</sup> of sand from the lower Maroochy River to Maroochydyore Beach. The program involves extraction of the sand by a small dredge and pumping of this sand to the beach via a pipeline. The sand relocation works may be repeated in subsequent years, depending on the shoreline condition and success of the initial relocation (to be determined via monitoring) and associated approvals. These works will provide additional storm erosion buffering to assets adjacent to Maroochydyore Beach and improve beach amenity. The volume of sand estimated to be eroded by the defined storm is 240,000m<sup>3</sup>. Therefore – while noting that nourishment is required to maintain beach amenity – fit for purpose asset protection will require hybridisation with a seawall for nourishment volumes less than 350,000m<sup>3</sup>. The Maroochy River sand source is limited and consequently this volume from this source may not be a sustainable long-term strategy. Ongoing monitoring at the river entrance will assist in determining the viable use options for this sand resource. The offshore sand sourcing study identified in **Section 6.2** will help determine if a solution that includes significant long-term beach nourishment for fit for purpose protection of infrastructure is viable. If a viable source of suitable material is identified then a cost-benefit analysis of various options (and combinations of options) could be completed. Following the results of monitoring, additional options to maximise the benefit of the nourishment

works, such as sand recycling and/or offshore artificial reefs, may be considered as part of the hybrid solution.

The relative degree of protection provided by exposed coffee rock in this area is unknown and should be further investigated. Protection may be provided as a result of the elevation of the coffee rock relative to the adjacent beach and the capacity for it to reduce approaching wave energy. Any protection currently provided by exposed coffee rock may diminish if sea level rise projections are realised.

**Figure 6.10**, below, is a photograph looking south at Maroochydore beach, showing exposed coffee rock, beach access infrastructure and dunes prior to erosion that occurred early 2013.



**Figure 6.10:** Maroochydore Beach erosion adjacent to the Seabreeze Holiday Park and Aerodrome Road/Alexandra Parade, March 2013

**Table 6.5**, next page, presents an overview of the indicative costs and likely impacts of specific options considered for this beach management unit, and a brief comment on strategic interests and whether each option is considered viable.



**Table 6.5:** Overview of options, costs and impacts for the beach management unit: **Maroochydore Beach,**

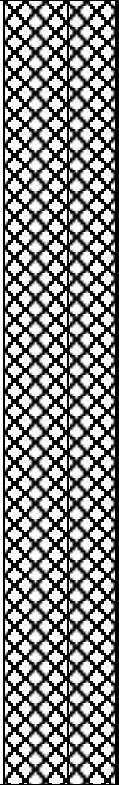

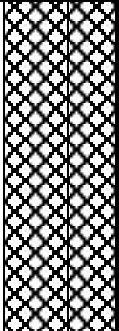

**Current state:** developed **Main values of significance in vicinity:** **Natural values:** Cotton Tree to Alex Conservation Reserve (dunes) **Human use** – Beach amenity (recreation/ tourism; Infrastructure (Hard – Alexandra Parade/ Aerodrome Rd, Holiday Parks, seawall (surf club); Soft – open space). **Heritage:** No listed heritage site identified

**Current usage:** High utilisation; low impact use **Specific Threat:** Road, car park & Holiday Park within erosion prone area

Erosion Management Option	Indicative Investment	Likely impact on significant resources & values						Viability Comments (fit for purposes of asset protection or amenity maintenance?)	Strategic Interest Comment	Preference		
		Natural Processes – Sand transport, accretion, and erosion	Natural Values			Human Use Values						
			Conservation reserve	Eco. Valuable waters	FHA	Beach Amenity	Infra-structure				Heritage	
Existing arrangements plus monitoring	Very Low	Neutral	Neutral				Neutral to Negative	Very Negative		Negative impacts likely to Road and Holiday Park infrastructure likely.	Unacceptable given high economic and recreational values.	N/A
Beach Nourishment – currently underway for buffer enhancement and amenity. (Hybridise with staged seawall)	Moderate to High	Neutral	Positive				Very Positive	Neutral to Positive		Fit for purpose protection is likely to require additional sand supply on top of lower estuary source. Sand recycling is a viable option for amenity purposes. Sand sourcing study may identify additional material available in nearby offshore areas. Hybridise with staged seawall for asset protection.	Nourishment is considered crucial to maintaining sufficient beach width for associated recreation, tourism and economic values. It is not considered fit for purpose to protect infrastructure where a buffer to protect against the defined storm is not achieved and maintained. Though improved resilience against smaller events is provided. Any enhanced nourishment program is contingent on securing a viable source of sand. Approval has been acquired for current sand sourcing activities in lower estuary.	Preferred - Hybrid
Groynes – hybrid option	Moderate to High	Negative	Negative (down drift) to Positive				Negative to Positive	Negative to Positive		Upgrade or new construction of groyne/s may improve retention of renourished sand but potentially impact surf characteristics.	May improve effectiveness of beach nourishment. Down drift erosion (negative effects) mitigated by nourishment and scraping. May affect surf characteristics and aesthetic of the beach.	Not preferred

Table continues

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Seawall (buried) – protection of Alexandra Pde/ Aerodrome Rd and Holiday Park	Very High	Neutral (buried/no natural dune locked) to <b>Negative (natural dunes locked)</b>	<b>Negative</b>		Neutral to <b>Negative</b>	<b>Very Positive</b>		This option is considered viable as a high confidence measure to provide protection to Roads and the Holiday Park.	A buried seawall along Aerodrome Rd should not significantly affect nourishment activities as it remains covered in all but major storm conditions. The existing dune is, in part, made up of inert fill and acts as a 'hard' dune. Exposed sections of seawall protection works can, depending on location and alignment, negatively affect natural processes and recreational amenity and may therefore be dependent on mitigation through nourishment hybridisation. The current renourishment program is capable of mitigating these effects.	<b>Preferred - Hybrid</b>
Offshore Submerged Reef	Very High	<b>Negative</b>	<b>Negative (down drift) to Positive</b>		<b>Negative to Positive</b>	<b>Negative to Positive</b>		Feasible only if a source of suitable sand is identified. Cost effectiveness of offshore reefs is not well established. May have negative effects in down drift section of shoreline.	No viable sand source has been identified for an artificial offshore reef. Review following completion of sand sourcing study as potential hybrid option though this option is not preferred unless further information regarding cost effectiveness is shown.	<b>Not Preferred</b>



## Preferred management plan for Maroochydore Beach

### **Priority Actions:**

Maroochydore Beach carries significant social and economic values and includes significant land based infrastructure that requires protection. As outlined in **Table 6.5**, beach renourishment is considered crucial to support beach amenity and related social and economic values. Beach renourishment by itself is not likely to provide sufficient protection to infrastructure from the defined storm related erosion event. The preferred priority actions for Maroochydore Beach include:

1. Currently a series of works is being undertaken to manage the shoreline within this beach management unit. This includes a sand renourishment pipeline, with sand sourced from Maroochy River Estuary under permit and clear of the Fish Habitat Area. It is recognised that there is a limited volume of sand available from this source and that this option may not be fit for the purpose of infrastructure protection in the long-term, though it will allow for the protection of beach amenity and provide improved storm buffering. The initial proposed nourishment volume is approximately 125,000m<sup>3</sup> to provide a 20m wide berm. Monitoring of the shoreline and effectiveness of the beach renourishment is required and the management plan needs to be reviewed as required.
2. A hybrid option involving the renourishment program and a buried seawall is preferred for this beach unit. This is due to the value of infrastructure within the current defined storm erosion area, notably the State controlled Aerodrome Road/ Alexandra Parade and the Council controlled Sea Breeze Holiday Park. The seawall should be built as far landward as is practicable from the existing Alexandra Headland skate park seawall to the existing protection at the Maroochy Surf Club. Maximisation of the dune buffer and maximisation of recreational and visual amenity – both in the parkland and on the beach – are to be key considerations in the design and management of this seawall. It is considered that a staged approach would be appropriate. Sections may be staged where sufficient buffer is able to be maintained by beach nourishment and it should be recognised the previously quoted trigger of 15m from the foot of the dune to the infrastructure represents the point past which constructability of a buried the seawall, therefore the project, may be compromised and emergency works may be necessary.

At most locations, it is expected that the seawall would be buried and would only become visible in response to the defined storm conditions or significant series of smaller events. This will also result in the buried wall not interfering with normal processes short of major event/s capable of exposing the wall. Feasibility and seawall design studies have commenced and advocacy and partnering with the Queensland Department of Transport and Main Roads is required if the project in the vicinity of Alexandra Parade is to progress. The Sunshine Coast community has a significant interest in this road, the surf club, open space and other assets and so Council may wish to consider an advocacy or partnership role in any future investigations, planning and construction with respect to protection of assets not controlled by Council.

3. The buffer to infrastructure varies along the beach unit. Monitoring of the shoreline is required and if a recession trend is noted then construction of the seawall should commence when the eroded shoreline (toe of the frontal dune) is within the defined storm erosion area (depending on associated assets and risk) but before a 15m trigger is reached. This is so that construction can occur in dry conditions and provide adequate buffer to any vulnerable work sites but this may change depending on construction requirements of the final seawall design; the state of the beach; and, severity of the projected storm season.

A better understanding of the Maroochydore Beach system could be developed through systematic shoreline and bathymetric (beach and offshore profile) monitoring. This information could also be used to guide more sophisticated modelling and design approaches. Consequently, physical data collection is considered an essential component of any beach nourishment program so that the benefit of the works can be recognised and quantified. Additionally, the extent of protection provided by exposed coffee rock should be investigated.

Rerunning of the defined storm event model with data on the renourished beach and nearshore profile will provide valuable information regarding the effect of the works on the erosion associated with this event. This may identify changes to the potential threat and better inform the scheduling of the ideal scenario/trigger for construction of the proposed seawall.

***Indicative Costs:***

Relocating sand from the lower Maroochy River to Maroochydore Beach required the installation of a 2km poly pipeline. The estimated cost to mobilise a suitable dredge to the Maroochy River is \$250,000 but this cost could be reduced if works were carried out in conjunction with other required dredge works (e.g. Mooloolah River maintenance dredging). Delivery of sand to the beach via the pipeline is expected to cost approximately \$10 per m<sup>3</sup>, depending on the distance from the dredge location to the discharge point. Based on this estimate, the average cost to deliver 125,000 m<sup>3</sup> of sand to Maroochydore Beach is \$1 million. The total estimated cost for the initial sand relocation exercise is up to \$1.875 million (completed September 2013). Additional works in subsequent years would utilise the same pipeline and therefore the relative cost would reduce significantly.

The cost of a seawall will be influenced by the design and source of rock material. The most cost effective source of material is likely to be from Council's Dulong Quarry. Assuming the Dulong Quarry can provide suitable material, the estimated cost of a seawall to 4m AHD and including associated landscaping etc. is \$5,000/m. The total length of seawall required is 1680m for the entire beach management unit, giving an initial capital cost of \$8.4 million. It is expected that about 1% of capital cost will be required for maintenance every year, giving an annual maintenance cost of \$84,000 per year for the full seawall.

Costs associated with coordinated monitoring for the entire Sunshine Coast are included in Section 6.1: General management, monitoring and review.

### 6.4.3.3 Alexandra Headland Beach – beach unit 10

#### Overview

The **beach unit 10** map of **Appendix A** provides spatial context to this beach management unit and provides an overview of the major mapped values, where available.

#### Site description and values

The Alexandra Headland beach management unit extends from the northern end of the seawall protecting the surf club, park and skate park to the Alexandra Headland rock outcrop.

Alexandra Headland Beach is a focal point for tourism and beach related recreation and surf lifesaving culture, carrying regionally significant recreation and economic values. Major land uses in this area include bathing reserve; open space; medium density residential and commercial uses (cafes, restaurants, surf club and retail outlets).

The southern beach is in reasonable condition with a vegetated fore dune providing a thin buffer to Alexandra Parade. The southern end of this beach, adjacent to Alexandra Headland, experiences minor scour and occasional but minor water quality issues associated with a stormwater drain that discharges at this point. There is also a short seawall in this area that provides erosion protection to part of Alexandra Parade.

Coffee rock is often exposed in the beach and nearshore areas at the northern end of this beach management, in front of the Surf Club and skate park unit. There is a significant seawall approximately 2-3m high in front of the Surf Club and skate park that may contribute to the persistent exposure of coffee rock through reflection of wave energy and it inducing turbulence related scour, though the elevation of the coffee rock is also a likely factor.

Sand transport in this area has a potential net northerly movement of about 6,000 m<sup>3</sup>/year, though sand does move in both northerly and southerly directions depending on prevailing conditions.

#### Erosion management considerations (EMCs) – refer to **Figure 6.11** for locations of listed considerations

The defined storm erosion width for this beach extends approximately 60m to 72m from the existing toe of the beach (see **Section 3.1.8 Table 3.4** ETA 529.8 and ETA 530).

1. The Alex Surf Club and skate park are constructed within the erosion prone area but these are afforded some protection by the existing seawall. The seawall is likely to have contributed to the loss of the beach in front of the wall, but natural elevation of the coffee rock in this area may also contribute to this. Anecdotally, the elevated coffee rock probably influenced the selection of this location for construction of the club. Beach nourishment of the area in front of the existing seawall is unlikely to prove viable as the seawall is too far seaward - reflecting wave energy and causing turbulence - and the level of the coffee rock will result in any material placed in this area being quickly lost to the prevailing coastal processes.
2. Further south, Alexandra Parade and the Surf Club car park are protected by a small buffer that is as narrow as 20-30m at some locations. The road at this location is State controlled arterial infrastructure. This infrastructure is within the defined storm erosion area and may require protection works to defend against current and future erosion threats.



**Figure 6.11:** Annotated air photo showing the erosion management considerations for Alexandra Headland Beach

**Figure 6.12** next page, is a photograph looking showing the persistently exposed coffee rock in front of the seawall.





**Figure 6.12:** Exposed coffee rock at the toe of the Alexandra Headland sea wall

**Table 6.6** on the following page presents an overview of the indicative costs and likely impacts of specific options considered for this beach management unit and a brief comment on strategic interests and whether each option is considered viable.

**Table 6.6:** Overview of options, costs and impacts for the **Alexandra Headland beach management unit**

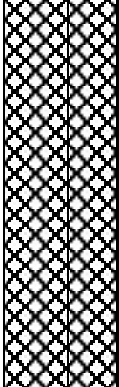

**Current state:** developed **Main values of significance in vicinity:** **Natural values:** Cotton Tree to Alexandra Headland Conservation Reserve (Dunes) **Human use** – Beach amenity (recreation/ tourism); Infrastructure (Hard –Alexandra Parade, seawall, Surf Club, skate park, car park, toilet facilities, footpaths; Soft –open space). **Heritage:** No listed heritage site identified

**Current usage:** High utilisation; low impact use **Specific threat:** infrastructure and beach susceptible to erosion

Erosion Management Option	Indicative Investment	Likely impact on significant resources & values						Viability Comments (fit for purposes of asset protection or amenity maintenance?)	Strategic Interest Comment	Preference		
		Natural Processes – Sand transport, accretion, and erosion	Natural Values			Human Use Values						
			Conservation Reserve	Eco. Valuable waters	FHA	Beach Amenity	Infra-structure				Heritage	
Existing arrangements plus monitoring	Very Low	Neutral	Neutral				Neutral to Negative	Negative		Significant negative impacts to infrastructure from the defined storm event are likely.	Unacceptable given high recreational and economic values of the beaches and adjacent infrastructure.	N/A
Beach Nourishment – Maintenance of beach amenity as hybrid option with seawall	Low to Moderate	Neutral	Positive				Very Positive	Positive		Nourishment in front of the existing seawall is unlikely to be successful. This may be viable for area south of surf club for the purpose of maintaining beach amenity, if a sustainable sand source is identified.	No cost effective benefit in front of existing sea wall. May be appropriate for beach south of surf club if demonstrated as required following monitoring. No viable source of sand is currently identified.	Preferred/Hybrid
Groynes – requires nourishment hybrid option	Moderate to High	Negative	Negative (down drift) to Positive				Negative to Positive	Negative to Positive		may improve retention of sand from nourishment (if viable) but potentially impact surf characteristics	May improve effectiveness of beach nourishment. Down drift erosion (negative effects) mitigated by nourishment and scraping. May affect surf characteristics and aesthetic of the beach.	Not Preferred
Seawall – Assess and maintain existing; consider new installation for southern beach.	High to Very High	Negative	Negative				Neutral to Negative (during major event)	Very Positive		1) Assess long term integrity existing seawalls (preferred prudent measure). 2) Buried seawall considered a viable protection option for the road and car park south of surf club. Design should commence immediately.	Buried seawall protection for southern section likely to negatively affect natural processes & beach amenity under major event conditions only. Seawall works may require pre-emptive/ responsive hybridised option including beach nourishment. Assessment of the existing walls will determine if any work is required.	Preferred - hybrid

Table continues



Offshore Submerged Reef	High to Very High	Negative	Negative (down drift) to Positive (landward./updrift)		Negative to Positive	Negative to Positive		Feasible only if a viable source of beach nourishment sand is identified.	No viable sand source has been identified. Review and consult with stakeholders following sand sourcing study	Secondary
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## Preferred Management Plan for Alexandra Headland Beach

### **Priority Actions:**

Infrastructure south of the surf club is at risk as it is within the current defined storm erosion area. Alexandra Parade is an arterial road managed by the State, so the Queensland Department of Transport and Main Roads carries responsibility for the road. The Sunshine Coast community has a significant interest in this road, the surf club and open space and so Council may wish to consider an advocacy or partnership role in any future investigations, planning and construction with respect to protection of the road or surf club facilities.

**Table 6.6** provides an overview of options considered for the two main issues at this beach management unit. Note that while an offshore submerged reef could be feasible if a viable sand supply is identified, it would be expensive and there is conjecture as to the effectiveness of such reefs. This option may be worth reconsidering at a later date but is not a current priority. In light of the Background Study and assessment, the preferred actions for Alexandra Headland beach management unit are:

1. The structural integrity of the existing seawall should be assessed by a qualified engineer to determine its likely performance with respect to the defined storm erosion event. Depending on the outcome of this assessment, an upgrade may be required within the SEMP planning period. While there may be an opportunity to reconsider the alignment of the wall - should assessment show that the existing seawall is required to be upgraded - this is unlikely to provide any significant benefit to beach amenity due to the elevated level of the coffee rock in this area and expected climate change impacts on erosion prone areas. Beach nourishment in this section is not considered viable given the seaward extent of the seawall and the elevation of the coffee rock and the adverse influence of these factors on sand retention.
2. A concept design for a buried seawall to protect the car park and the State controlled Alexandra Parade should be investigated as it may be necessary to provide protection during the SEMP implementation period. Works should be initiated prior to reaching a buffer trigger point of 15m, noting that the road is currently vulnerable to the defined storm event and the 15m trigger point pertains to constructability of the buried wall. Sand nourishment for the southern beach may be required to provide additional buffer to infrastructure or in response to major events, but this is dependent on identification of a viable sand source.

### **Additional Actions:**

- Coordinated shoreline monitoring should occur in line with the program proposed for the entire coast.
- Dune restoration for the southern beach may be considered under a future Coastal Land Management Plan.

### **Indicative Costs:**

The expected cost for a structural assessment of the existing seawall by a Registered Professional Engineer Qld (RPEQ) engineer is \$20,000. If required, a new rock seawall in the southern part of this beach management unit to 4m AHD including associated landscaping will be \$5,000/m. The total length of seawall required is 360m giving an initial capital cost of \$1.8M. It is expected that about 1% of capital cost will be required in maintenance cost every year, giving an annual maintenance cost of approximately \$18,000 per year.

Costs associated with coordinated monitoring for the entire Sunshine Coast are included in Section 6.1: General management, monitoring and review.

#### 6.4.3.4 Mooloolaba Beach North – beach unit 12

##### Overview

The **beach unit 12** map of **Appendix A** provides spatial context to this beach management unit and provides an overview of the major mapped values, where available.

##### Site description and values

Mooloolaba Beach, also known as *Mooloolaba Main Beach*, is one of the Sunshine Coast's focal points for tourism and beach related recreation and carries regionally significant recreation and economic values. Major land uses in this area include bathing reserve; open space; and, medium and high-density residential (including tourism accommodation) and commercial uses (cafes, restaurants, surf club and retail outlets).

For the purposes of this SEMP, Mooloolaba beach is categorised into northern and *southern* beach management units. This is in recognition of the different processes and adjacent land uses associated with each beach component. However, many of the issues and options considered in the Background Study and this SEMP (such as reduced beach width and beach nourishment and scraping) are common to all of Mooloolaba Beach and such options are to be investigated, designed and implemented across both beach management units.

This beach management unit extends from the rocky outcrop at the northern end of Beach Terrace to the Mooloolaba Surf Club. The slope of the beach profile is slightly steeper for this northern beach unit as it is exposed to higher wave energy than the southern beach unit. Much of the beach is intertidal, with a relatively thin width of non-tidal beach, particularly near the Surf Club, and buffers are typically thin and sparsely vegetated.

Public facilities are located in the active beach zone and have these have potential to adversely affect beach amenity through exacerbating localised storm erosion.

Sand transport in this area is low, with a net movement to the north. Sand transport past the rocky headland occurs mostly in the nearshore and high tide zone, predominantly during storm events. Beach nourishment occurs at Mooloolaba Beach South via a 300mm diameter sand-pumping pipeline. The sand is sourced from navigation related dredging operations at the mouth of the Mooloolah River and Mooloolaba Bay.

**Erosion management considerations (EMCs)** – refer to **Figure 6.13** for locations of listed considerations

The width of the defined storm erosion width for this beach management unit varies from approximately 16m in the northern section to approximately 35m south of the surf club (see **Section 3.1.8 Table 3.4** ETA 522 and ETA 523).

1. Mooloolaba Esplanade and car park, toilet facilities and Beach Terrace are within the defined storm erosion prone area, with no or minimal buffer and, in places, light concrete armouring (geotextile formed concrete) which is showing signs of deterioration. Hard protection works will likely be required given the projected erosion threat to existing development along this shoreline. Hard protection in the northern section may be delayed due to existing buffers being approximately equal to the width of the defined storm erosion area and particularly if improved protection is provided through dune restoration activities and beach nourishment at Mooloolaba Beach South. Beach amenity may be reduced from time to time when seawalls perform their role of protecting infrastructure during storms, even during events that are smaller than the defined event. It is expected that the beaches may take weeks to months to recover from these events (depending on conditions) and preservation of beach amenity will be dependent on beach nourishment.



**Figure 6.13:** Annotated air photo locating the erosion management considerations for Mooloolaba Beach North

**Figure 6.14,** below, shows the minimal buffer to infrastructure and deteriorating protection works in the northern section of this beach management unit.





**Figure 6.14:** deteriorating rock seawall and light geo-formed concrete armoring at Mooloolaba Beach North

**Table 6.7**, on the following page, presents an overview of the indicative costs and likely impacts of specific options considered for this beach management unit and a brief comment on strategic interests and whether each option is considered viable.



**Table 6.7:** Overview of options, costs and impacts for the beach management unit: **Mooloolaba Beach North**

**Current state:** developed **Main values of significance in vicinity:** **Human use** – Beach amenity (recreation/ tourism); Infrastructure (Hard – seawall, Surf Club, car park, toilet facilities, footpaths; Soft –open space). **Heritage:** No listed culture/ heritage site identified

**Current usage:** High utilisation; low impact use **Specific Threat:** infrastructure and beach susceptible to erosion

Erosion Management Option	Indicative Investment	Likely impact on significant resources & values					Viability Comments (fit for purposes of asset protection or amenity maintenance?)	Strategic Interest Comment	Preference		
		Natural Processes – Sand transport, accretion, and erosion	Natural Values			Human Use Values					
			Sig. Dune & Ecosystems	Eco. Valuable waters	FHA	Beach Amenity				Infra-structure	Heritage
Existing arrangements plus monitoring	Very Low	Neutral				Neutral to Negative	Negative		Significant negative impacts are likely.	Unacceptable given the impacts to high recreational and economic values.	N/A
Beach Nourishment* and scraping	Moderate to High	Neutral to Positive (bypass of river training walls that impede flow of sand)				Very Positive	Positive		Long term viability for protection of land infrastructure to Beach terrace requires additional sand source. Extension of existing pipeline from southern beach unit will improve responsiveness.	Preferred option as hybrid with existing walls and potential future walls to protect regionally significant recreational and economic values.	Preferred - hybrid
Groynes plus nourishment* – hybrid option	Moderate to High	Negative				Negative (down drift) to Positive	Negative to Positive		May improve retention of sand from nourishment (if viable) but potentially impact beach characteristics.	May improve effectiveness of beach nourishment. Down drift erosion (negative effects) mitigated by nourishment and scraping. May affect beach characteristics.	Not Preferred
Seawall – integrity check of existing; and new to protect toilet facilities, road and car park	High to Very High	Negative (already a highly modified environment)				Neutral (already modified) to Negative	Very Positive		Assessment of existing is a prudent measure. Viable option in such a modified environment. Offers protection to land assets though beach amenity may suffer greater effects of erosion events.	Seawall protection works are likely to require hybrid option including beach nourishment, which is already occurring to the south. Designs should be prepared and triggers for construction set. Renewal/upgrade of existing degraded seawall is prudent.	Secondary - hybrid
Offshore Submerged Reef	High to Very High	Negative				Negative to Positive	Negative to Positive		Not considered viable due to relatively low wave energy and sediment transport rates / sediment supply.	N/A	N/A

\* = these options are to be investigated, designed and implemented as part of the priority actions for the Mooloolaba Beach South beach management unit; in the context of the entire Mooloolaba Beach (North and South)

## Preferred management plan for Mooloolaba Beach North

### **Priority Actions:**

1. The existing operations of seawall maintenance, sand nourishment and beach scraping should continue, as needed. The existing seawalls should undergo a structural integrity check. The existing pipeline used for nourishment of the southern beach management unit should be extended so that pre-emptive and responsive nourishment can occur all the way to Beach Terrace. The rocky outcrop at Beach Terrace is expected to provide some sand transport control in limiting the loss of nourishment sand to the north, behaving like a groyne. Long-term viability of beach nourishment is dependent on securing a significant supply of sand. In the interim the current dredging and nourishment operations will assist in maintaining beach amenity and the minor buffering capacity of the existing dunes.

To improve infrastructure protection from storm erosion and beach amenity the beach nourishment option would require sourcing approximately 75,000 m<sup>3</sup> of sand (already undertaken for Mooloolaba South as part of an ongoing programme). However, it is recognised that at present a viable source of sand has not been secured. The beach nourishment option is dealt with in more detail in the section covering Mooloolaba Beach South. Nourishment of the southern beach will have some beneficial flow on effects to the northern area via longshore sand transport. However, the sand movement rate is low in Mooloolaba Bay, necessitating extension of the sand pumping pipeline.

Should beach nourishment prove unviable or monitoring within five years shows that sufficient protection of infrastructure from erosion cannot be provided, an upgraded rock seawall along this beach management unit may be required. A seawall feasibility and concept design study should be completed within five years so that construction can commence quickly, as deemed necessary. The seawall will need to integrate various protective structures that already exist in the area and be designed for the defined storm event, with allowance for climate change considerations appropriate to the design life of the protection works. Although a rock revetment/seawall will protect stormwater pipes from erosion, consideration should be given at the time of construction of the seawalls to diverting all stormwater to the Mooloolah River or the existing single outlet located at the northern end of the Beach Terrace car park. This will improve beach amenity.

### **Additional Actions:**

- Coordinated shoreline monitoring in line with the program proposed for the entire coast.
- Dune restoration for the northern stretch of beach should be considered under a future Coastal Land Management Plan. This option will contribute to alleviating short term storm erosion risk and is a cost effective measure that also contributes to the protection of regionally significant recreational and economic values. This option should be undertaken in combination with existing sand pumping and scraping operations and the preferred program, as discussed.

### **Indicative Costs:**

The indicative costs of the investigation, design and construction/installation of the extension to the existing sand pumping systems is included under Mooloolaba beach South beach unit. This will allow more responsive and direct intervention for this beach unit. Natural sand transport processes to the north will assist in distribution of the sand from the renourishment works.

The expected cost for an integrity check of the existing seawalls is \$25,000.

The expected cost for major beach nourishment works, if a viable sand source is identifiable, is included in the recommendation for Mooloolaba Beach South (see Mooloolaba Beach South Unit section, below).

Repair/renewal of existing seawalls is estimated at \$400,000.

Should monitoring indicate that hard protection is required, the expected cost of a rock seawall to 4m AHD including associated landscaping is approximately \$5,000/m, though this would be subject to feasibility studies and conceptual design. The indicative length of rock revetment/seawall is 480m giving an initial capital cost in the order of \$2.4 million. It is expected that about 1% of capital cost will be required in maintenance costs every year giving an annual maintenance cost of about \$24,000 per year. This may not be required during the implementation period of this SEMP though the design should be prepared within 5 years.

Costs associated with coordinated monitoring for the entire Sunshine Coast are included in Section 6.1: General management, monitoring and review.

### 6.4.3.5 Mooloolaba Beach South – beach unit 13

#### Overview

The **Beach unit 13** map of **Appendix A** provides spatial context to this beach management unit and provides an overview of the major mapped values, where available.

#### Site description and values

Mooloolaba Beach South, along with the Mooloolaba Beach North beach management unit, is one of the Sunshine Coast's focal points for tourism and beach related recreation, carrying regionally significant recreation and economic values. This beach is also known as *Mooloolaba Spit Beach*. Major land uses in this area include bathing reserve; open space; medium and high-density residential (including tourism accommodation) and commercial uses (cafes, restaurants and retail outlets). The training walls at the mouth of the Mooloolah River serve the Mooloolaba State boat harbour, which houses pilot services for the port of Brisbane, in addition to recreational, charter and commercial fishery vessels.

This beach management unit is in the lee of Point Cartwright and therefore the wave conditions are relatively mild and the beach slope is relatively flat. However, the beach is exposed to north-east swell. Generally, the shoreline location is reasonably stable but can suffer erosion when the prevailing wave conditions do not promote sand transport around Point Cartwright. This may occur during periods of persistent south-easterly winds/waves and the shoreline becomes particularly susceptible to erosion during northerly wind/wave storm events.

Sand transport in this area is very low. During significant storms from the south, sand moves around Point Cartwright from Buddina Beach and past the river training walls. Sometimes this sand can remain in deposits near Point Cartwright for multiple years and either make its way to Mooloolaba Bay and /or Beach or bypass the beach and keep moving towards Alexandra Headland and Maroochydore Beaches. The sand moves onto Mooloolaba Beach under northerly wave conditions, but the shoreline is also more exposed to waves from this direction and larger waves or events can cause significant erosion. Interestingly, the hydrodynamic modelling carried out as part of the Background Study (BMT WBM 2013b) indicates that eddies can occur in Mooloolaba Bay in some scenarios involving combined spring tides and wave conditions. However, these are generally weak and not considered to be significant in the context of the overall sand transport occurring within the bay.

Historically, shoals in the river entrance were occasionally dredged and the sand was relocated to the west of the entrance. This sand would eventually find its way onto the beaches to the north by natural processes. More recently, a 300mm sand pumping pipeline has been constructed to renourish the beach. In combination with sand scraping, the pipeline allows for pre-emptive and reactive placement of sand to somewhat buffer the effects storms and improve beach amenity. The buried pipeline moves sand dredged from the river mouth and the bay to the shoreline. This system is expected to deliver up to 10,000m<sup>3</sup> of sand to Mooloolaba beaches annually. It should be noted that this is considered acceleration of natural processes and is usually referred to as beach *re-nourishment*. Beach *nourishment*, in the true sense of the term, uses sand source/s external to the recipient beach system.

Immediately after construction of the Mooloolah River training walls, the beach fluctuated more than usual until the sand reserves east of the training walls stabilised. The shoreline location has remained relatively stable in recent years and provides a quiet area popular for families due to the mild surf conditions and shallow water.

Open space is the dominant landuse in central section of this beach management unit. In the north toward the Mooloolaba Surf Club, there is more intensive development that is generally well set back from the beach and benefits from a vegetated buffer zone. Recently, geofabric sand containers have been installed to protect the shoreline adjacent to the Urunga Esplanade car park. Most recently, significant erosion damage resulted in the loss of the lifeguard tower and concrete slabs near the southern extent of the surf club.

**Erosion management considerations (EMCs)** – refer to **Figure 6.15**, on the next page, for locations of listed considerations

The width of the defined storm erosion width along this beach management unit ranges from approximately 35m near the surf club to approximately 24m closer to the river (see **Section 3.1.8 Table 3.4** ETA 522 and ETA 521.5). The most north-easterly tip of Parkyn Parade and car parks at Urunga Parade and Rotary Park Court are within the defined storm erosion area. Other significant development within the vicinity of this beach management unit is outside of the current defined storm erosion area, but this should be monitored and reviewed following future Coastal Hazard Adaptation Strategy/risk assessment planning.

1. This shoreline has a relatively low dune system and vegetation buffer and is vulnerable to storm erosion. This beach has historically shown periods of significant erosion and recovery. These processes are natural and should preferably be left to run their course without intervention using hard protection options. Largely this is possible except for sections where hard infrastructure is located in the defined storm erosion area. The Rotary Park Court car park and the most north-easterly tip of Parkyn Parade are within the defined storm erosion area. Currently a sand pumping pipeline extends from the river to just west Urunga Esplanade. This pipeline allows for quick recovery from storm events, maintenance of beach amenity and a degree of erosion buffer to the low dunes. Beach scraping complements sand nourishment operations.
2. Urunga Esplanade car park is located within the defined storm event erosion area. A geofabric sandbag seawall (emergency works) and sand nourishment (with beach reprofiling) provides medium term protection. Formalisation and extension of protection works may be required and should be considered as part of coastal hazard adaptation/ risk management planning. Careful consideration should be given to any proposal to extend the current seawall protection works.





**Figure 6.15:** Annotated air photo locating the erosion management considerations for Mooloolaba Beach South

**Figures 6.16 and 6.18** show the low beach and dunes of the beach management unit and the Urunga Esplanade car park, respectively.



**Figure 6.16:** Photograph showing the low beach and dunes, looking towards the river.



**Figure 6.17:** Urunga Esplanade car park is located within the defined storm event erosion area and is protected by a geofabric sandbag seawall and sand nourishment

**Table 6.8** presents an overview of the indicative costs and likely impacts of specific options considered for this beach management unit and a brief comment on whether each option is considered viable and in the strategic interests of the community.

**Table 6.8:** Overview of options, costs and impacts for the beach management unit: **Mooloolaba Beach South**

**Current state:** developed **Main values of significance in vicinity:** **Natural values:** Mooloolaba Foreshore conservation reserve (Dunes) **Human use** – Beach amenity (recreation/ tourism); Infrastructure (Hard – Urunga St and Rotary Park car parks; seawall (Urunga St car park); NE section of Parkyn Parade; paths/boardwalk; Soft –open space). **Heritage:** No listed heritage site identified

**Current usage:** High utilisation; low impact use **Specific Threat:** Low beaches prone to erosion. Urunga Esp. & Rotary Park Court car parks and north-eastern tip of Parkyn parade are within the defined event erosion area.

Erosion Management Option	Indicative Investment	Likely impact on significant resources & values						Viability Comments (fit for purposes of asset protection or amenity maintenance?)	Strategic Interest Comment	Preference		
		Natural Processes – Sand transport, accretion, and erosion	Natural Values			Human Use Values						
			Conservation Reserve	Coastal waters	FHA	Beach Amenity	Infra-structure				Heritage	
Existing arrangements plus monitoring	Very Low	Neutral	Neutral				Neutral to Negative	Negative		Negative impacts likely to the Spit parklands, beaches.	Unacceptable given the high recreational and economic values.	N/A
Beach nourishment and scraping (current approach)	Moderate	Neutral	Positive				Very Positive	Positive		Currently undertaken via pipeline to maintain beach amenity and buffer. Long term viability for protection of land and infrastructure for entire beach to Beach Terrace requires additional sand source.	Preferred option to protect regionally significant recreational and economic values associated with beach amenity. Long-term nourishment program for protection of land infrastructure is contingent on securing a viable source of sand and may require hard option hybrid in sections.	Preferred
Groynes – hybrid option	Moderate to High	Negative	Negative (down drift) to Positive (Updrift)				Negative to Positive	Negative to Positive		May improve retention of sand from nourishment (if viable) but potentially impact beach characteristics.	May improve effectiveness of beach nourishment. Down drift erosion (negative effects) mitigated by nourishment and scraping. May affect beach characteristics.	Not Preferred
Seawall - formalisation of existing emergency works	High to Very High	Neutral (buried) to Very Negative	Negative				Neutral to Negative	Very Positive		Offers protection to land assets at the expense of beach amenity. Only identified hard assets are car parks at Urunga Esp. and Rotary Park Court; and the most north-easterly tip of Parkyn Parade. Such works are viable and mitigation may be able to be achieved through the existing sand pumping pipeline.	Seawall protection works in this beach management unit are likely to negatively affect natural processes & beach amenity. However, the sand pumping pipeline allows for hybridisation of hard options and protection of beach amenity. Formalisation (using rock) of emergency works is not preferred under this current SEMP – review as part of coastal hazard adaptation / risk management planning.	Secondary - hybrid



Offshore Submerged Reef	High to Very High	Negative	Negative to Positive		Negative to Positive	Negative to Positive		Not considered viable due to relatively low wave energy and sediment transport rates / sediment supply	N/A	N/A
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**Preferred management plan for Mooloolaba Beach North**

**Priority Actions:**

- As needed, continue with existing sand pumping and beach scraping/profiling works and maintenance of existing geotextile bag seawall. Extension of the existing sand pumping pipeline is advisable so that it is able to better service the entire Mooloolaba Beach. This represents a low to moderate cost and prudent option that will provide immediate management control with the added flexibility of being able to be incorporated as a part of a future hybrid option, should hard protection options are required in the future. The introduction of approximately 75,000 m<sup>3</sup> of sand will improve buffers to open space and other infrastructure and maintain beach amenity across all of Mooloolaba Beach (both north and south beach management units). However, it is recognised that at present there is limited sand available for the long-term viability of this option for use as infrastructure protection, that is above and beyond restoration/ maintenance of beach amenity.  
  
If a viable sand source can be secured, beach nourishment could provide ongoing benefits to beach amenity and improved buffers. Potential sources of sand include offshore (currently unproven and part of the proposed sand sourcing study; see **Section 6.2**) and sand from Port of Brisbane Corporation (PBC) channel maintenance dredging. Due to the distance from PBC dredging locations to Mooloolaba the use of maintenance dredge material may not be cost effective.
- While the location of Rotary Park Court and the north-easterly tip of Parkyn Parade are within the defined event erosion area, they are afforded greater buffer than Urunga Esplanade car park. A decision on how to best protect these other hard assets should follow 2 years of monitoring of the shoreline and the effectiveness of beach nourishment, scraping and dune restoration efforts. Coordinated shoreline monitoring should occur in line with the proposed program for the entire coast.
- Ongoing monitoring will indicate: whether a trend in recession is occurring; if erosion projections are being realised; and, the effectiveness of existing protection works at maintaining beach amenity and protecting infrastructure.

**Additional Actions:**

- Dune restoration works for the northern stretch of beach should be considered under a future Coastal Land Management Plan. This option will contribute to alleviating short term storm erosion risk and is a cost effective measure that also contributes to the protection of regionally significant recreational and economic values. This option should be undertaken in combination with existing sand pumping and scraping operations and the preferred program, as discussed.

**Indicative Costs:**

The capital costs of extending the existing 300mm pipeline by 300m is estimated at \$300,000. The nourishment of the shoreline from the Mooloolah River to the rocky outcrop adjacent to Beach Terrace with approximately 75,000m<sup>3</sup> of material is estimated to carry a total nourishment works cost of \$1.1 million, assuming access is available to Port of Brisbane Corporation maintenance dredge material at no less than \$15/m<sup>3</sup>. The cost to mobilise, operate and demobilise a small dredge specifically for nourishment works would be similar if a suitable source of offshore material was identified. The existing program should also continue to redistribute sand dredged from the Mooloolah River entrance to the southern Mooloolaba Beach (typically >10,000m<sup>3</sup>/year) and undertake beach scraping works as is deemed necessary.

Costs associated with coordinated monitoring for the entire Sunshine Coast are included in Section 6.1: General management, monitoring and review.

## 6.5 Zone 3: Point Cartwright to Caloundra Head

### 6.5.1 Overview

#### Spatial Extent and Values

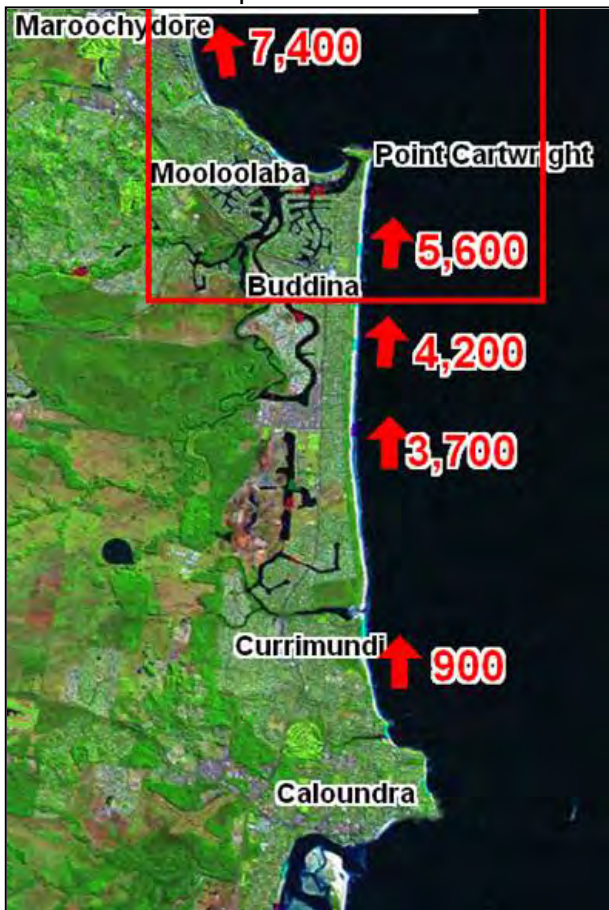
Shoreline management zone 3 extends from Point Cartwright to the eastern extent of Caloundra Headland. For the purposes of this SEMP, 7 beach management units have been identified in this management zone. For context refer to the **Zone 3** map of **Appendix A**.

This coastal management zone includes many natural features, including:

- the rocky headlands of Point Cartwright, Moffat Beach and Caloundra;
- intermittently Closed-Open Lagoons of Currimundi Lake and Tooway Creek; and
- vast extents of significant sand dunes and associated ecosystems, including the dunes and core habitat of Warana, Bokarina and Wurtulla Beaches and Currimundi Lake Conservation Park.

Significant residential, commercial and industrial development exists adjacent to Nicklin Way. Much of this urban development comprises numerous localities of low to medium density residential development in between the coastline and constructed waterbodies (i.e. Parrearra

Channel and Lake Kawana). The large population establishes significant human use values within this shoreline management zone. Some of the many recreational opportunities include surfing, boating, bush walking, fishing and a relaxed beach side lifestyle.



**Figure 6.18:** Potential net longshore sand transport rates ( $m^3/yr$ ) for Coastal Management Zone 3.

#### Coastal Processes

The northerly sand transport potential between Currimundi and Point Cartwright is estimated to be relatively low. No immediate coastal erosion problems are present in the northern beach units although these beaches are more exposed to the predominant south easterly swells and experience larger waves. The potential net northerly sand transport rates in this section are estimated to reach up to  $5,600m^3$  per year and this potential rate decreases to approximately  $900m^3$  per year near Currimundi, see **Figure 6.18**. For most of this shoreline management zone, a well-established dune and vegetation buffer allows the beach to respond naturally to erosion events resulting in, at present, a relatively low erosion threat.

The shoreline and inner shelf between Caloundra Headland and Currimundi are characterised by exposed sections of bedrock separated by patches of sand less than 1m thick (Jones 1992). There is a limited onshore supply of sand and the exposed rock may suggest a slowly eroding

shoreline. Caloundra Headland represents a sand transport divide, with longshore transport directed away from the headland to both the north and south. The sediment budgets of the beaches north and south of Caloundra Headland are therefore considered independent of one another.





**Figure 6.19:** Zone 3 Looking north form Shelly Beach

### 6.5.2 Beach management units

The shoreline erosion management Zone 3: *Point Cartwright to Caloundra Head* comprises 7 beach management units, 2 of which are identified as carrying a priority erosion issue under this SEMP. The beach management units of this zone include:

1. Point Cartwright to Kawana Beach
2. Warana Bokarina and Wurtulla Beaches
3. Currimundi Lake Entrance
4. Currimundi Beach South
5. Dicky Beach (***priority erosion issue identified*** - refer to section 6.5.3.1)
6. Moffat Beach (***priority erosion issue identified*** - refer to section 6.5.3.2)
7. Shelly Beach

A brief overview of the beach management units that are not considered to carry a current priority erosion issue is provided below. Beach management units that have not been identified as carrying a priority erosion issue may still face erosion pressures. These pressures are considered to represent either a sufficiently low risk or long-term consideration that may be more appropriately dealt with by the Coastal Land Management Plan (CLMP) or Coastal Hazard Adaptation Strategy (CHAS)/risk management planning, respectively.

#### 6.5.2.1 Point Cartwright to Kawana Beach – beach unit 14

This beach management unit extends from Point Cartwright to approximately 400m south of the Kawana Waters Surf Club. Council owns the Surf Club building and is the trustee of the State owned land. Development of this section commenced in the 1960s during which time sections of the natural dune system was altered, often used as a source of fill for the adjacent development. The erosion width associated with the defined event for this beach management unit is

approximately 40m. A relatively narrow dune system buffers the public and private assets along Pacific Boulevard.

This section of coastline is relatively exposed to the prevailing waves and experiences periods of both northerly and southerly directed sediment transport, with net transport to the north. The potential longshore sediment transport suggests that very weak, long-term shoreline recession may be occurring. Recent beach profile surveys were reviewed as part of the Background Study and they indicate that the current profile is within the limits of the historical surveys and the beach is considered dynamically stable in the short term.

Coordinated monitoring should be undertaken and dune management considered under the Coastal Land Management Plan. A shoreline defence concept design study should be prepared if monitoring identifies shoreline recession to within 40m from Pacific Boulevard or other significant asset between the Kawana Water Surf Club and Mungala Street.

#### *6.5.2.2 Warana Bokarina and Wurtulla Beaches – beach unit 15*

The beach management unit extends from the southern extent of Kawana Beach bathing reserve to the Currimundi Lake Entrance. Development along this stretch of coast is outside the defined storm erosion area, which is expected to be sufficient in the medium to long term. Maintaining the current arrangements with regular coordinated monitoring of beach movement should be considered under the Coastal Land Management Plan.

#### *6.5.2.3 Currimundi Lake Entrance – beach unit 16*

This beach management unit covers the lake entrance only. Continuation of the current management regimen should be considered when preparing the Coastal Land Management Plan for the Currimundi Lake Entrance beach management unit. That is, continuation of berm maintenance and artificial opening/closing of the lake entrance. These works are presently carried out as required and in accordance with a management plan. A more proactive approach for recognising 'triggers for action' could be achieved by the installation of a tide gauge to provide a continuous measurement of water level inside the lake and expanding the existing water quality monitoring program.

#### *6.5.2.4 Currimundi Beach South – beach unit 17*

This beach management unit begins at the Currimundi Lake Entrance and extends to the small rocky outcrop at the northern extent of Dicky Beach. The beach is in good condition and has a good, albeit narrow, vegetated dune buffer. The Background Study longshore sediment transport modelling estimates a net littoral sediment transport rate of approximately 1000m<sup>3</sup>/yr to the north. This beach management unit, along with Currimundi Lake Entrance, are popular recreational destinations.

This relatively small beach management unit is dominated by significant dunes and the Buderim Street conservation Reserve in the south with the northern section towards the Currimundi Lake entrance comprising residential and commercial development. There is a narrow dune buffer approximately 30m wide and approximately 10m high to road reserve and private residences along Watson Street. Coffee rock is present along the northern bank of the Currimundi Lake entrance and this hard substrate is expected to influence the location of southern shoreline.

Aerial photos taken in 2008 and 2010 have been compared and shows the loss of a small part of the frontal dune. The most significant erosion event during this period was associated with Tropical Cyclone Hamish in March 2009. Currimundi residents have raised concerns with Council regarding the apparent trend of erosion and risk to property located behind the main dune. It is noted that the storm erosion threat to these properties was first identified in 1974 by the then Beach Protection Authority; however, an extended period of natural beach and dune recovery and stabilisation followed and, consequently, protection works have not been undertaken. The residences are just

outside the current (modelled) defined storm erosion area. The responsibility for protection of private property rests with the landowners. Any works should be planned and coordinated appropriately so as to avoid or minimise negative impacts to the beach and natural process that may affect the beach and lake entrance to the north.

The long-term management of this beach unit and Currimundi Lake Entrance beach unit should be considered a priority for long term adaptation/risk management planning.

#### *6.5.2.5 Shelly Beach – beach unit 20*

Shelly Beach is a small pocket beach extending for approximately 1km between Caloundra and Moffat Headlands. The beach's rocky outcrops provide sand transport control points and offer stability to the beach. Shelly Beach is noticeably steeper and the sand is coarser (containing more shell grit) than most other beaches on the Sunshine Coast. The mixed beach material is likely to be locally derived from the nearshore zone with only a low supply from adjacent beaches. This beach is known as a turtle nesting beach.

Development along Shelly beach is protected by a narrow vegetated dune system. The width of the dune buffer is less than 20m at the central section where a stormwater flow path intersects the beach. Historically, the stormwater runoff has moved laterally along the shoreline and cut through the frontal dune before discharging to the sea. In the past, this flow path has affected the dune system and may reduce the short-term erosion buffer protection to a number of private properties. A stormwater management study would identify whether shoreline recession and dune damage caused by stormwater runoff can be minimised (or eliminated). If so, restoration of the dune system should provide suitable protection to storm erosion and could be further considered under the Coastal Land Management Plan. Beach nourishment would further reduce the impact of storm erosion events; however, sourcing sand that is appropriately matched to the existing sand type and texture may prove difficult. If a viable source of sand can be identified, nourishment of Shelly Beach is likely to be successful without additional structures such as groynes due to the natural control provided by the rocky headlands.

### 6.5.3 Priority beach management units – priority erosion issue identified

#### 6.5.3.1 Dicky Beach – beach unit 18

##### Overview

The **beach unit 18** map of **Appendix A** provides spatial context to this beach management unit and provides an overview of the major mapped values, where available.

##### Site description and values

The southern boundary of the locality of Dicky Beach is marked by Tooway Creek; however, for the purposes of this SEMP, the beach management unit extends from the rocky outcrop at the northern tip of Moffat Beach to the rocky outcrop adjacent to Buderim St. The rocky outcrop at the northern extent of this beach management unit, while relatively small, provides a minor control point for sand transport and limits the northern movement of sand that is common north of Caloundra Headland. Like Moffat Beach to the south, the exposed bedrock in the nearshore zone suggests longshore transport rates are low and that sand supply is likely to be dominated by cross-shore sand transport processes.

Dicky Beach has retained a natural dune system that provides material to balance the sediment budget during storm events. It is noted that this buffer is narrow between the southern rock outcrop and Bunbubah Creek.

##### Erosion management considerations (EMCs) – see **Figure 6.20** for location of the EMCs

The width of the defined storm erosion area for this beach management unit is approximately 45m to 50m (see **Section 3.1.8 Table 3.4** ETA 490 and ETA 488). Council assets are within the short-term storm erosion area, including the Lower Neill St car park and the skate park south of Bunbubah Creek. Generally, the current storm erosion threat at Dicky Beach is relatively low.

A well-established dune and vegetation buffer, approximately 50m wide, exists north of Bunbubah Creek and this currently provides a suitable buffer with respect to the defined storm erosion. Occasionally, minor works are undertaken to control the alignment of the Bunbubah Creek entrance to maintain the section of beach that is typically patrolled by the Dicky Beach Surf Club (Also known historically as the North Caloundra Surf Lifesaving Club). Council is trustee of the Surf Club land and owns the Surf Club building. South of Bunbubah Creek, the vegetation buffer is somewhat narrower; however, the nearshore rock provides additional protection against extreme wave attack. The main erosion management considerations for Dicky Beach include:

1. The skate park and north eastern tip of the Dicky Beach Holiday Park, located south of Bunbubah Creek, is within the defined storm erosion area. This asset is not currently protected and consideration should be given to the case for protection under Coastal Hazard Adaptation/risk assessment planning.
2. The Lower Neill Street car park is located within the defined storm erosion area and is protected by an existing seawall. This existing seawall has deteriorated to the extent that the car park and the culturally significant Norfolk Pines may be under threat of erosion associated with the defined storm event. The existing wall, although in need of repair, is providing some erosion protection.





**Figure 6.20:** Air photo showing the erosion management considerations for Dicky Beach

**Figure 6.21**, on the next page, shows the deteriorated state of the existing seawall at Lower Neill Street, Dick Beach.





**Figure 6.21:** Degraded rock seawall protecting Lower Neill St car park, Dicky Beach

**Table 6.9**, on the following page, presents an overview of the indicative costs and likely impacts of specific options considered for this beach management unit and a brief comment on strategic interests and whether each option is considered viable.

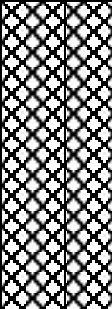
**Table 6.9:** Overview of options, costs and impacts for the beach management unit: **Dicky Beach**

**Current state:** developed **Main values of significance in vicinity:** **Natural values** conservation reserve **Human use** – Beach amenity (recreation/ tourism)/ infrastructure (Hard – public skate park, car park and seawall. Soft – open space). **Heritage sites/items:** SS Dicky wreck (currently inundated), culturally significant Norfolk Island Pines

**Current usage:** High utilisation; low impact use **Specific Threat:** Erosion threat to public open space, car park, pine trees, & beach.

Erosion Management Option	Indicative Investment	Likely impact on significant resources & values						Viability Comments (fit for purposes of asset protection or amenity maintenance?)	Strategic Interest Comment	Preference		
		Natural Processes – Sand transport, accretion, and erosion	Natural Values			Human Use Values						
			Conservation reserve	Eco. Valuable waters	FHA	Beach Amenity	Infra-structure				Heritage - pines	
Existing arrangements plus monitoring	Low	Neutral	Neutral to Negative				Neutral to Negative	Negative	Negative	Negative impacts to public infrastructure likely.	Appropriate for sections where risk is low. Supplement with coordinated monitoring and evaluation program. Loss of car park & culturally valued Norfolk Pines may result from inaction.	OK at low risk sites only
Beach Nourishment and scraping	Low to Moderate	Neutral	Positive				Very Positive	Neutral to Positive	Positive	Scraping currently occurs on an as needs basis. Material is potentially available in nearby offshore areas.	Nourishment by itself will not provide fit for purpose protection of assets though it may mitigate adverse impacts of hard options and assist in recovery after storm events.	Secondary/Hybrid
Groynes	Not Applicable	Negative	Negative (down drift) to Positive				Negative to Positive	Negative to Positive	Negative to Positive	Natural rock outcrops provide suitable sand transport control	Not Applicable	Not Applicable
Seawall – renewal of Lower wall at Neill St car park / pine trees	Moderate to High	Negative	Negative				Negative	Very Positive	Very Positive	This is an existing protection item that requires renewal/repair.	Repair/renewal of the existing seawall at Lower Neill St is prudent. Intervention to protect the skate park, north eastern tip of the Holiday Park must consider costs, future landuse and the potential impacts on natural processes, including the creek entrance and beach amenity (consider as part of Coastal Hazard Adaptation/ risk management planning).	Preferred – renewal of existing seawall

Table continues

Offshore Submerged Reef	Not Applicable	Negative	Negative to Positive		Negative to Positive	Negative to Positive	Negative to Positive	Not considered viable due to low longshore sediment transport rates / sediment supply	Not Applicable	Not Applicable
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### Preferred management plan for Dicky Beach

#### Priority actions:

1. Careful consideration should be given under Coastal Hazard Adaptation Strategy/risk management planning to long-term financial costs and benefits associated with protection or otherwise of the skate park and the exposed section of the Holiday Park. Protection works in this area may have particular adverse impacts on natural processes to the Bunbubah Creek entrance.
2. The existing seawall protecting Lower Neill Street should be repaired/renewed to protect the car park and road assets. Consequently, this will also provide protection to the culturally significant Norfolk Island Pines.

#### Additional actions:

- Management of the Bunbubah Creek entrance to maintain the section of beach typically patrolled by the Dicky Beach Surf Club should continue as required.
- Coordinated monitoring and dune restoration and stabilisation is a prudent approach to improve resilience of dunes and maintenance of natural process and values and beach amenity. This measure tends to be more appropriate for low risks sites or where erosion threats are very long term considerations. The dune restoration and stabilisation program is to be informed by monitoring and evaluation program and managed/ prioritised under the CLMP according to available funding.
- Assuming suitable material can be sourced, beach nourishment could be used to improve beach amenity following erosion events. The natural controls provided by the rocky outcrops would help to retain any material added to the system.

#### Indicative costs:

Repair of the existing rock revetment/seawall is estimated at \$200 000.

Costs associated with coordinated monitoring for the entire Sunshine Coast are included in Section 6.1: General management, monitoring and review.

### 6.5.3.2 Moffat Beach – beach unit 19

#### Overview

The **beach unit 19** map of **Appendix A** provides spatial context to this beach management unit and provides an overview of the major mapped values, where available.

#### Site description and values

This beach management unit extends from southern extent of Dicky Beach to Moffat Headland. Moffatt Beach carries significant human use values, being particularly popular for bathing and surfing. Culturally significant Norfolk Island Pines (landscape character listing for Caloundra Esplanades in Caloundra City Plan) are located in the public open space at the northern extent of this beach unit. With the exception of the Tooway Creek entrance, the upper beach is relatively narrow, typically less than 30m wide. A rock revetment seawall, upgraded by Council in 2008, extends for approximately 230m from Moffat Headland to the boat ramp at the Bryce Street car park. The seawall primarily protects the parkland and car parks.

Existing management of the Tooway Creek entrance involves as needed beach scraping and nourishment to maintain beach amenity and specific flushing characteristics of the creek. Beach scraping is also used to replenish the southern bank adjacent to Eleanor Park. North of Tooway Creek, a rock seawall protects a single private property. The seawall was constructed by the property owner/s as emergency works following a series of erosion events in 2009. North of this seawall, beach scraping is used to restore beach amenity following storm erosion.

Moffat Headland and the rocky outcrop at the northern extent of Moffat Beach provide sand transport control points. Due to these controls, the exchange of sand between the adjacent beaches is expected to be low (Shelly Beach to the south and Dicky Beach to the north). Sand transport at Moffat Beach is likely to be dominated by cross-shore processes whereby sand is transported rapidly offshore during storm events and slowly onshore under calmer conditions. **Figure 6.22** shows the distribution of sand in the nearshore zone with the exposed bedrock suggesting an very limited supply of sand.

**Erosion management considerations (EMCs)** – refer to **Figure 6.22** for locations of the listed considerations

The majority of the natural dune system at Moffat Beach was developed in the 1960s. A public rock seawall protects most of the public land on southern shoreline. Current unaddressed erosion management considerations include:

1. The Council controlled 'beach and dune system', to the north of Tooway Creek is currently vulnerable to erosion. Consequences of a moderate to large storm event may include the loss of park frontage and the loss of public assets (including beach, beach access infrastructure and open space that includes culturally valued Norfolk Island Pines). A private seawall constructed as emergency works is located to the south of this area.





**Figure 6.22:** Annotated air photo of Moffat Beach showing the listed erosion management considerations

**Table 6.10**, on the next page, presents an overview of the indicative costs and likely impacts of specific options considered for this beach management unit, including a brief comment on strategic interests and whether each option is considered viable.



**Table 6.10:** Overview of options, costs and impacts for the beach management unit: **Moffat Beach**

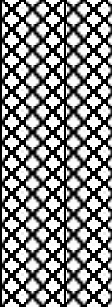
**Current state:** developed **Main values of significance in vicinity:** **Natural values** Council identified beach & dune system **Human use** – Beach amenity (recreation/ tourism)/ infrastructure (Hard – public and private seawalls; Soft – open space). **Heritage items/sites:** Culturally Significant Norfolk Pines

**Current usage:** High utilisation; low impact use **Specific Threat:** Erosion threat to public open space, pine trees, & beach.

Erosion Management Option	Indicative Investment	Likely impact on significant resources & values						Viability Comments (fit for purposes of asset protection or amenity maintenance?)	Strategic Interest Comment	Preference		
		Natural Processes – Sand transport, accretion, and erosion	Natural Values			Human Use Values						
			Beach and Dune system	Eco. Valuable waters	FHA	Beach Amenity	Infra-structure				Culture/Heritage	
Existing arrangements plus monitoring	Very Low	Neutral	Neutral to Negative				Neutral to Negative	Negative	Negative	Negative impacts to public assets are likely.	Loss of open space & culturally valued Norfolk Pines may result from inaction.	Not Preferred
Beach Nourishment and scraping (Hybrid – with existing structures)	Low to Moderate	Neutral	Positive				Very Positive	Positive	Positive	Beach scraping to renourish unprotected areas currently occurs on an as needs basis. Considered hybrid given existing structures. Northern rock outcrop provides control. Major nourishment requires a viable sand source.	This option may serve as a hybrid option or a preferred soft approach as long as risk remains appropriate – that is loss of open space and pines is considered acceptable by stakeholders. Review following monitoring, evaluation and further investigations. Potentially, nourishment alone may not protect the park against the defined event.	Hybrid /Preferred
Groynes	Not Applicable	Negative	Negative (down drift) to Positive				Negative to Positive	Negative to Positive	Negative to Positive	Natural headland and rock outcrop provide suitable sand transport control.	Not Applicable	Not Applicable
Seawall – hybrid option with nourishment for protection of public open space and pine trees	High	Negative	Negative				Negative	Very Positive	Very Positive	Offers protection to open space at the expense of beach amenity. Pine trees may not survive.	Intervention to protect open space and/or the pines must consider costs and the potential impacts on natural processes and beach amenity. Note that the northern park provides a 15m buffer (west) to private property. This option is not preferred initially but should reviewed following consultation, monitoring, evaluation and further investigation of defined storm impacts in this area.	Hybrid/Secondary

Table continues

Table continued from previous page

Offshore Submerged Reef	Not Applicable	Negative	Negative to Positive		Negative to Positive	Negative to Positive	Negative to Positive	Natural bedrock already exists in the nearshore area. Not considered viable due to low longshore sediment transport rates / sediment supply.	Not Applicable	Not Applicable
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### Preferred Management Plan for Moffat Beach

#### Priority Actions:

1. Shoreline recession of the northern parkland in response to storm events is anticipated, particularly at the down drift end of the existing private rock seawall. A heritage management plan may be required for development that affects the Norfolk Island Pine trees in this area, and such a plan should consider the potential impacts of each of the options (noting that a seawall is not the preferred initial action) on the trees and issues associated with potential loss of the trees due to erosion. The trees should be assessed by an arborist as soon as possible to establish the current physical integrity of the trees and identify any potential safety issues. A design for a seawall should be prepared if this is seen as favourable following public consultation, preparation of the heritage management plan and monitoring.  
  
In the interim, maintenance of the dune and beach adjacent to the northern parkland using beach scraping and nourishment should occur as required.
2. Existing management arrangements for the Tooway Creek entrance to maintain beach amenity on the southern bank and protect Eleanor Park should continue as required.

#### Indicative Costs:

The estimated cost of a conservation management plan is estimated at \$10,000. A seawall design is expected to cost approximately \$20,000.

The cost of the beach scraping option is relatively low and consistent with Council’s existing management approach at Moffat Beach. Funding for such works is likely to be sourced from the routine maintenance budget. If viable, beach nourishment to replenish the upper beach and dune system in areas adjacent to the emergency seawall may cost up to \$200,000. The estimated cost for beach nourishment is largely dependent on the proximity to the nourishment material and the delivery method.

The cost of continued management of the Tooway Creek entrance will come from existing maintenance funds within Council.

Costs associated with coordinated monitoring for the entire Sunshine Coast are included in Section 6.1: General management, monitoring and review.

## 6.6 Zone 4: Caloundra Headland to SCC southern boundary

### 6.6.1 Overview

#### Spatial Extent and Values

Shoreline management zone 4 encompasses the southern side of Caloundra Headland and the northern section of Pumicestone Passage that is within the Sunshine Coast Council Local Government Area. For spatial context, refer to the **zone 4** map of **Appendix A**. This SEMP identifies 8 beach management units within this zone. The most southern beach management unit extends from Bells Creek to the southern SCC boundary; however, no priority erosion issues are identified south of Bell's Creek due to the typically natural/undeveloped state of the shoreline and lack of Council controlled infrastructure. This full extent of the most southern beach management unit (number 28) is not displayed in the SEMP mapping to keep the map at a practical scale.

The Kabi Kabi people have a strong connection with the Pumicestone Passage and Bribie Island lasting thousands of years. Culturally significant sites in the area relating to this connection include middens, fish traps, artefacts, quarries and scarred trees.

The Pumicestone Passage carries significant natural and human use values. The Passage is protected as part of the Moreton Bay Marine Park; is declared as High Ecological Value Marine waters; and, forms part of a Ramsar listed wetland, which carries national environmental significance and protection under the Environmental Protection and Biodiversity Conservation Act 1999 (commonwealth).

The Pumicestone Passage is highly valued for water based recreational opportunities and is considered a significant tourism drawcard for the Sunshine Coast. The shoreline and waters of the Pumicestone Passage are important to the entire region and provide great benefit to the local community hubs of Caloundra, Golden Beach and Pelican Waters.



**Figure 6.23:** Sediment transport divide – sand transport to the north and south of Caloundra Head (from Jones 1992)

#### Coastal processes

Caloundra Headland represents a divide in the transport of sand. North of the headland, sand travels in a net northerly direction and, conversely, south of the headland sand travels in a net southerly direction (see **Figure 6.23**). Jones (1992) identifies that the large sand deposits of the *Hamilton Patches* and *North Banks* are separated from the mainland and Bribie Island beach systems by a deep nearshore channel. That is, these sand deposits do not contribute sand to Bribie Island or the mainland sand budgets.

The defined storm event was not modelled for the zone 5 beach units as, with all but Kings Beach being part of the Pumicestone Passage Estuary, they have little or no direct exposure to open ocean storm conditions. However, the Background Study does review the coastal processes within the Passage and identifies the following main points (see also *BMT WBM 2013b*):

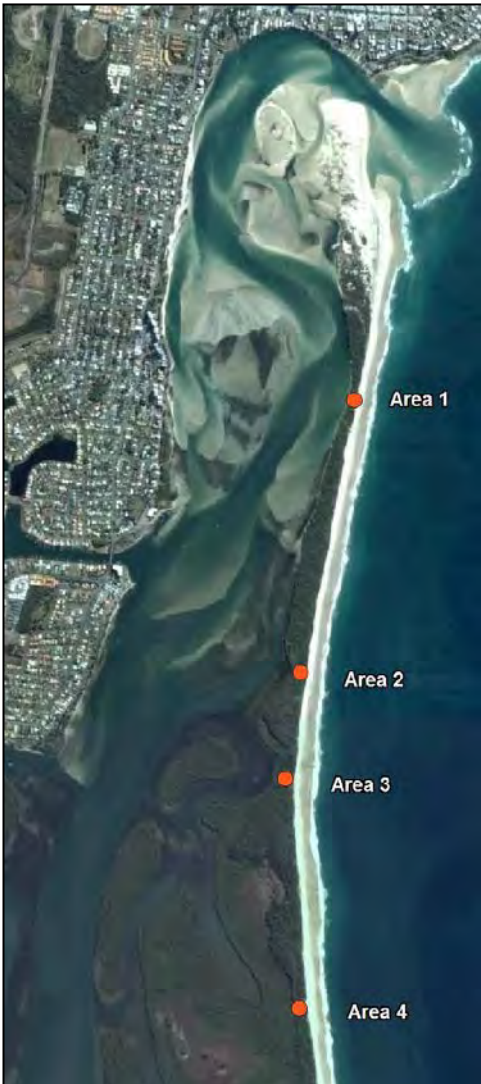
- Tidal currents dominate the sand transport in the northern section of Pumicestone Passage. The flood tide transports sand from north to south with flood tide sand transport observed in aerial photography as far south as Bells Creek. The small prevailing waves (south easterly)

within the passage work the sand onto the shoreline. The existing geofabric sand container groynes at Golden Beach have accumulated sand on their southern side. This indicates a net northern sediment transport direction in the nearshore region at the time, being primarily driven by the small prevailing south easterly waves. The sediment supply from Bells Creek and Lamerough Canal consists mostly of fine sandy material but these waterways are not considered to supply significant amounts of sand to the beach system.

- Aerial photos show that over time changes to the mainland shoreline within Pumicestone Passage have been relatively small, with the exception of the shoreline between Nelson Street and Earnshaw Street. This section has been subject to erosion/accretion associated with the migration of the main flood and ebb channels.

### 6.6.2 Potential Bribie Island breakthrough

The term 'breakthrough' refers to the erosion of the island to the extent that a new deep-water entrance is established. Four main areas on the northern tip of Bribie Island are identified as being most susceptible. A risk assessment (Aurecon 2009) identified various breakthrough scenarios and the potential risk this posed to the mainland. **Figure 6.24** shows the four most likely points of breakthrough.



**Figure 6.24:** Most likely areas for a potential breakthrough

Currently the mean sea level in the Passage is approximately 10 to 15cm higher than the open ocean but the tidal range is attenuated by 50% (Aurecon 2009). Under the current climatic and sea level conditions, the most important and immediate effects of a breakthrough on the northern Pumicestone Passage are a potential increase in tidal range at Golden Beach through to Halls Creek and a rise in the HAT level of 15cm. Depending on the location of a breakthrough, there may also be location specific increase in exposure to storm surge. These impacts are expected to revert to pre-breakthrough conditions once the point of breakthrough establishes as a new entrance and the delta/sand bar system stabilises. However, multiple concurrent breakthroughs may result in a greater increase in HAT level and tidal range than that associated with a single breakthrough. This may result in conditions that more closely resemble the sea levels and tidal range of the open ocean, and be permanent if the multiple breakthroughs remain open.

Council does not have management control of any part of the Bribie Island coast. The State Government manages the Bribie Island Recreation Area, which includes the National Park and beach to the low-water mark. The State recognises the erosion of the northern tip of Bribie Island as being a long-term natural process that results from a lack of sand coming into the beach system. Monitoring over the last 10 years indicates that the island is being eroded at a rate of approximately 1m per year and some sections are less than 20m wide. Storm related erosion could result in a breakthrough at any time. The State Government position is to let natural processes run their course and that impacts to the mainland should be managed through actions on the mainland, not through Island based erosion protection works.

Proactive long-term shoreline erosion management strategies for the mainland can be complicated due to the dynamics and uncertainties associated with the site-specific erosion related consequences of the various potential breakthrough points. The most significant coastal hazard risks for the Pumicestone Passage mainland relate to medium to long term scenarios where sea level rise and other climate change related projections are considered. Particularly where potential permanent inundation and storm surge hazards increase significantly. Due to the disaster management, strategic land use and strategic infrastructure network planning implications, responses to these medium to long term conditions are most appropriately dealt with under Coastal Hazard Adaptation/risk management planning that integrates all natural hazards, not just erosion, as identified in the Draft Single State Planning Policy (Qld Gov. 2013).

In the short to medium term, the main erosion related impacts to the mainland would likely be related to channel migration and, until the new entrance and delta stabilise, increased sea levels



and larger waves travelling through the new entrance. This SEMP includes coverage of recent, ongoing and planned erosion management issues (non-climate change related) and works for the northern Pumicestone Passage mainland. This includes remedial and pre-emptive beach nourishment and new and upgraded revetments and groynes. Additionally, regular monitoring of the shoreline position (beach surveying) and regular review of aerial photography, particularly following a breakthrough, will be essential to understand the short-term fluctuations, identify emerging erosive trends and develop sound long-term shoreline management strategies. A breakthrough has the potential to affect some of the existing values of the Passage, which may need to be reflected in Federal and State statutory protections and constraints. The State and Federal Governments should be engaged on this issue.

### 6.6.3 Beach Management Units

The shoreline erosion management *Zone 5: Caloundra Bar to Southern Boundary* comprises 8 beach management units, three of which are identified as carrying a priority erosion issue under this SEMP. The beach management units of this zone include:

1. Kings Beach (**priority erosion issue identified** - refer to section 6.6.3.1)
2. Bulcock beach
3. Leach Park
4. Oxley St to Beattie St
5. Beattie St to Nelson St
6. Nelson Street to Lamerough Canal (**priority erosion issue identified** - refer to section 6.6.3.2)
7. Lamerough Canal to Bells Creek (**priority erosion issue identified** - refer to section 6.6.3.3)
8. Bells Creek to Southern Local Government Boundary

A brief overview of the beach management units that are not considered to carry a current priority erosion issue is provided below. Beach management units that have not been identified as carrying a priority erosion issue may still face erosion pressures. These pressures are considered to represent either a sufficiently low risk or long-term consideration that may be more appropriately dealt with by the Coastal Land Management Plan (CLMP) or Coastal Hazard Adaptation Strategy (CHAS)/risk management planning, respectively.

#### 6.6.3.1 *Bulcock Beach – beach unit 22*

This beach management unit is highly utilised and valued by the local community and tourists and includes a bathing reserve, patrolled beach, boardwalk, picnic areas, toilet facilities and private resort waterfront. The area is located at the northern entrance to Pumicestone Passage where boating access to the open sea is made via the Caloundra Bar.

The foreshore area within this beach management unit has undergone considerable redevelopment since 2009 as part of the Bulcock Beach Redevelopment Project. In most areas, the existing revetment has not been upgraded; however, some new seawall and/or seawall realignment works have occurred south of the Ithaca Caloundra City Surf Life Saving Club - a Council owned building on Council controlled land. The shoreline extending around Deepwater Point is armoured by a rock revetment that protects car parking, toilet facilities and a section of the Sunshine Coast Coastal Path.

#### 6.6.3.2 *Leach Park – beach unit 23*

Leach Park includes a public boat ramp and Sailing Club and is therefore an important area for recreational boaters. The park also provides open space for the local community and visitors to the adjacent holiday apartments and Tripcony Holiday Park. This park also includes a section of the Sunshine Coast coastal pathway.

Leach Park has recently undergone improvement works and forms part of the wider Golden Beach Foreshore Master Plan. Stage one works were completed in December 2010 and included an upgrade of the existing revetment seawall and formalisation of a sandbag groyne, with degraded sandbags replaced by rock.

As needed beach nourishment complements the rock groynes. Nourishment between the structures will immediately add value to the redevelopment; however, it may be a challenge to maintain a sandy shoreline at this location due to the proximity of the present main channel flow. Nourishment operations should consider additional sites south to Bells Creek.

#### *6.6.3.3 Oxley Street to Beattie Street – beach unit 24*

This section of shoreline offers high recreational and scenic amenity value to the Golden Beach community and includes a bathing reserve and patrolled beach. This beach unit is characterised by a sandy shoreline that is stabilised by a geofabric sand container groyne field that was established during 1999 and 2000 in response to erosion pressure (seven groynes over approximately 1200m of shoreline). At many locations, the geofabric containers also provide scour protection to stormwater outfalls that form part of the local drainage infrastructure. The upper beach and foreshore area has been further stabilised by coastal vegetation, which is providing a suitable buffer to storm erosion at most locations. The existing groynes will be maintained according to their life cycle plan and may require renewal in approximately 10 years.

#### *6.6.3.4 Beattie Street to Nelson Street – beach unit 25*

A very narrow buffer exists within this beach management unit and a low sandstone seawall protects most of the shoreline. Some sections of this wall require repair. The area provides a popular and scenic pedestrian thoroughfare.

Foreshore works are close to completion (new groyne scheduled for construction in 2015/16 at \$245k) between Jellicoe Street and Nelson Street, including: new hard protection (rock seawall) and widening of the shoreline to accommodate a 3m wide pedestrian/cycle path that will form part of the *Sunshine Coast Coastal Path*. There are two geofabric groynes at the northern extent of this beach unit. The expected lifespan of these groynes is moderate and individual sand containers are replaced as required, in accordance with a regular maintenance program.

#### *6.6.3.5 Bells Creek to Southern Local Government Boundary – beach unit 28*

No priority erosion issues are identified south of Bell's Creek due to the typically natural state of the shoreline and lack of Council controlled assets. This most southern beach management unit is not fully displayed in the SEMP Zone mapping so as to keep the map at a practical scale.

## 6.6.4 Priority beach management units – priority erosion issue identified

### 6.6.4.1 Kings Beach – beach unit 21

#### Overview

The **beach unit 21** map of **Appendix A** provides spatial context to this beach management unit and provides an overview of the major mapped values, where available.

#### Site description and values

This beach management unit covers the shoreline extent of the Kings Beach bathing reserve. Kings Beach is Caloundra's 'main beach' and carries significant recreational, heritage and water based natural value. It's waters are designated as part of the Moreton Bay Marine Park (Habitat Protection Zone). The beach carries significant human use values and potential, being within the Caloundra Major Activity Centre hub; comprises listed heritage sites; and offers high value recreational and tourism opportunities. A heritage listed swimming pool pavilion and the Metropolitan Caloundra Surf Lifesaving Club are located at the northern extent of the beach above the rocky platform. A range of public facilities are maintained adjacent to the Kings Beach foreshore, including Surf Lifesaving facility, children's playground equipment, picnic facilities and a car park. Holiday apartments are located at the southern extent of the beach.

Kings Beach is somewhat sheltered by Moreton Island from the prevailing wave energy. Wave refraction across the shallow banks at Caloundra Bar further reduces the wave energy reaching the nearshore area. The shoreline is aligned south-east and extends for 500m between a small groyne at the southern extent (built in the 1960s) and the southern face of Caloundra Headland. The groyne acts to interrupt the southerly longshore sediment transport.

**Erosion Management Considerations (EMCs)** – refer to **Figure 6.25** for locations of the listed considerations.

Hard shoreline protection in the form of a low seawall extends along the northern half of the shoreline. Large boulders visible toward the southern end of the beach provide evidence of an earlier shoreline protection effort (likely placed in the 1960s). It appears some of the old boulder seawall is now buried within the small sand dunes. Observation suggests Kings Beach does not typically suffer severe erosion during storm events but receives low volumes of incoming sand.

1. Historically, beach scraping has been used in front of the existing seawall to maintain the upper beach and dune. This regular, ongoing maintenance controls the immediate erosion threat to public assets (primarily the beach) and enhances the recreational value of the beach. Furthermore, this helps to limit the amount of sand bypassing the groyne in the southerly longshore sand transport. This approach could be greatly improved with a greater volume of sand.

Beach scraping alone does not add any material to the beach system and only helps to control the immediate erosion threat or recovery of beach amenity after a storm. Significant beach nourishment at Kings Beach (up to 50,000m<sup>3</sup>) could be considered as an option to improve beach amenity, widen the dune buffer and effectively reduce the erosion threat in the short to medium term.

2. The introduction of additional sand to the beach system should be hybridised with an upgrade and seaward extension of the southern groyne. If the groyne is not upgraded, the additional sand would have the potential to bypass the existing structure and move south toward Caloundra Bar. Even without the addition of nourishment sand, the long-term suitability of the existing groyne remains uncertain. The aging structure may not be a suitable height to interrupt sediment transport if sea level rise projections are realised.



**Figure 6.25:** Annotated aerial image of Kings Beach showing listed erosion management considerations

**Figure 6.26,** on the next page, shows the existing groyne at Kings beach.





**Figure 6.26:** Photo of the existing groyne at Kings Beach, looking towards Bribie Island

**Table 6.11**, on the next page, presents an overview of the indicative costs and likely impacts of specific options considered for this beach management unit, including a brief comment on strategic interests and whether each option is considered viable.

**Table 6.11:** Overview of options, costs and impacts for the beach management unit: **Kings Beach**

**Current state:** Developed **Main values of significance in vicinity:** **Natural values** Moreton Bay Marine Park **Human use** – Beach amenity (recreation/ tourism)/ infrastructure (Hard – seawall, groyne, miscellaneous facilities; Soft – open space). **Heritage sites/items:** State listed pool pavilion **Current usage:** High utilisation; low impact use **Specific Threat:** Sub-optimal beach sand volume and buffer

Erosion Management Option	Indicative Investment	Likely impact on significant resources & values						Viability Comments (fit for purposes of asset protection or amenity maintenance?)	Strategic Interest Comment	Preference		
		Natural Processes – Sand transport, accretion, and erosion	Natural Values			Human Use Values						
			Marine Park Habitat Zone	Eco. Valuable waters	FHA	Beach Amenity	Infra-structure				Culture/Heritage	
Existing arrangements plus monitoring	Very Low	Neutral	Neutral				Neutral to Negative	Negative	Negative	Negative impacts to beach amenity are likely.	Likely to result in unacceptable social and economic outcomes for such a high usage and valuable beach.	Not Preferred
Beach Nourishment and scraping (Hybrid – existing structure present)	Low to Moderate	Neutral	Neutral				Very Positive	Positive	Positive	Scraping is part of existing beach maintenance program. Nourishment sand is potentially available in nearby offshore areas and/or from Port of Brisbane navigation channel dredging.	Dependent on viable supply of suitable material. Consider following sand sourcing investigations. Supplement with beach scraping and groyne investigation/upgrade.	Hybrid /Preferred
Groynes – Structural assessment/ upgrade of existing	Moderate to High	Negative	Neutral				Negative (down drift) to Positive	Negative to Positive	Negative to Positive	Groyne upgrade will help maintain beach and maximise benefit of potential future beach nourishment.	Acceptable considering costs are commensurate with benefits to high usage values. Review following investigations. Supplement with beach scraping and nourishment (if viable)	Hybrid/Preferred
Offshore Submerged Reef	Not Viable	Negative	Negative				Negative (down drift) to Positive	Negative to Positive	Negative to Positive	Not considered viable due to low longshore sediment transport rates / sediment supply and dynamics of the Caloundra bar.	Not Viable	Not Viable

## Preferred management plan for Kings Beach

### **Priority Actions:**

1. The preferred priority action at Kings Beach is to assess the structural integrity of the groyne. The structure is relatively low and showing some sign of deterioration. An upgrade may be required within the planning period to ensure it continues to function as intended. Considering the high value and usage of the beach, nourishment will improve beach amenity and resilience to storm erosion. Nourishment is dependent on securing a viable, cost effective source of sand and should only be considered following the sand sourcing study, prioritisation of those sand resources and identification of a suitable sand supply. Deposits of potentially suitable marine sand exist within the *Hamilton Patches/North Banks* deposits and shipping channel areas of Moreton Bay. Port of Brisbane Corporation Shipping Channel dredge material has been utilised for beach nourishment purposes at Woorim Beach (Moreton Bay Regional Council). An enhancement of the groyne (elevation of the trunk and seaward extension) should precede any nourishment works to limit the amount of sand lost to the prevailing southerly longshore sediment transport processes.
2. Continued beach scraping with beach nourishment to optimise beach amenity and the upper beach to reduce the immediate erosion threat and loss of sand to the south.

### **Indicative Costs:**

The expected cost for a structural assessment of the existing groyne by a registered engineer is \$20,000. Nourishment of Kings Beach using material dredged by the Port of Brisbane (assuming this material is available and suitable) is expected to cost at least \$10 per m<sup>3</sup>. Therefore, the cost to nourish Kings Beach with 50,000m<sup>3</sup> of material will cost approximately \$500,000. Groyne enhancement to maximise the cost-benefit of the nourishment works is expected to cost \$6,000 per metre (including design costs and on-site placement). Therefore a 20m extension of the existing groyne is expected to cost \$120,000 (note that the cost estimate is subject to the outcome of the structural assessment of the existing groyne and subsequent detailed design).

The cost of continued beach scraping will come from existing maintenance program and not result in any additional funding requirements.

Costs associated with coordinated monitoring for the entire Sunshine Coast are included in Section 6.1: General management, monitoring and review.

### 6.6.4.2 Nelson Street to Lamerough Canal – beach unit 26

#### Overview

The **Beach unit 26** map of **Appendix A** provides spatial context to this beach management unit and provides an overview of the major mapped values, where available.

#### Site description and values

This beach management unit extends from Nelson Street to Lamerough Canal and carries high human use values owing to the extensive district recreation parks (including a section of shoreline protected by mangrove habitat), boat ramp and car park, Caloundra Power Boat Club and TS Onslow Naval Cadet Base. The recreational values of the area comprise both social and economic value groups, and are mainly based on the opportunities and access provided for boating, recreational fishing, bathing, walking, picnicking and the social interaction at the Club and Naval Cadet Base (which is used by the Caloundra Sea Scouts). The waters of this area carry significant natural value, being designated High Ecological Significance Marine Waters, Fish Habitat Area and part of the Moreton Bay Marine Park (Habitat Protection Zone and Conservation Park Zone).

The Caloundra Power Boat Club is located north of the Lamerough Canal entrance. Together with the public boat ramp, jetty and car/trailer parking space the Club is a valuable asset to the local community and visiting recreational boaters. The Club has been built on low-lying land bordered to the north by mangrove habitat that extends approximately 400m north of the Club. This area includes a pedestrian boardwalk and lookout areas. No erosion protection structures exist along this section with the wide buffer and mangrove vegetation providing suitable protection against shoreline erosion. The TS Onslow Naval Cadet Base is located to the north of the mangrove habitat. The club leases this land from the State Government.

The need for emergency works at the shoreline adjacent to Nelson Street was previously noted in 2010. Subsequently, seawall and foreshore widening works have been completed at this location as part of the Sunshine Coast Coastal Pathway project.

**Erosion Management Considerations (EMCs)** – refer to **Figure 6.27** for locations of the listed considerations

The priority erosion management considerations for this beach management unit include:

1. The State Controlled land the TS Onslow Naval Cadet Base occupies is showing obvious signs of erosion. It appears as though the erosion is being exacerbated by hard protection constructed from concrete blocks. The smooth concrete block structure is unlikely to limit wave overtopping and therefore significant erosion behind the structure will continue (refer Figure 6.27). The State and the leasee are coming to arrangements to remove the blocks. Council does not have responsibility for the erosion problem at this site.
2. Mangrove habitat protects the shoreline between the Power Boat Club and the Naval Cadets Reserve (Fraser Park). This area should be carefully managed to maintain (or enhance) its natural character and, therefore, erosion buffering capacity. Planning for works at shorelines to the north and south of this habitat must include provisions to minimise the day to day and project related disturbance to the area.
3. The shoreline at the Power Boat Club and boat ramp car park is unprotected and experiencing erosion. Council controls the boat ramp, car park and open space between the Power Boat Club and existing revetment wall at Lamerough Canal (approximately 170m) but does not have any control over the Power Boat Club land.

An area offshore from the Club was first dredged in the early 1980s to provide an anchorage area. The ongoing maintenance dredge requirements of this area are uncertain.



Sandy areas are located either side of the boat ramp. These small beaches provide safe access to the water for recreational boaters and should be maintained via as needed beach nourishment. If hard protection works are deemed necessary then the structure should consider the practicalities for allowing safe access to small water craft.

Council recently conducted a geotechnical study of the sediments outside the declared Fish Habitat Areas in this section of the Pumicestone Passage. The study identified considerable reserves of sand suitable for beach nourishment. Based on these findings, Council currently has an application with the relevant State Government authorities to extend the existing maintenance dredging / beach nourishment program from Golden Beach south to Bells Creek.

The foreshore immediately adjacent to the Caloundra Power Boat Club is relatively low lying and in poor condition. The erosion rates are likely to be low and this area could be maintained via nourishment; however, given the asset value of the Club and its facilities other options may wish to be considered by the club and State Government – particularly in light of the effects of potential breakthrough scenarios (see **Section 6.6.2**)

**Figures 6.28** and **6.29**, on the next page, show erosion at the Naval Cadet Base and boat ramp, respectively.



**Figure 6.28:** Photograph showing erosion behind concrete blocks placed at Navel Cadets Base (EMC 1)



**Figure 6.29:** Photograph showing erosion of the shoreline at the Boat Ramp car park (EMC 3)

**Table 6.12**, on the next page, presents an overview of the indicative costs and likely impacts of specific options considered for this beach management unit, including a brief comment on strategic interests and whether each option is considered viable.

**Table 6.12:** Overview of options, costs and impacts for the **beach management unit 32: Lamerough Canal to Nelson St**

**Current state:** developed, ‘natural’ mangrove **Main values of significance in vicinity:** *Natural values* Mangroves, High Ecological Value Waters, Fish Habitat Area, Moreton Bay Marine Park, Ramsar Wetland *Human use* – Beach amenity (recreation/ tourism)/ infrastructure (Hard – boat ramp, car park, jetties, paths, seawalls; Soft – open space). **Heritage sites/items:** None identified

**Current usage:** High utilisation; low impact use **Specific Threat:** Erosion threat to Council controlled open space and car park.

Erosion Management Option	Indicative Investment	Likely impact on significant resources & values						Viability Comments (fit for purposes of asset protection or maintenance of amenity?)	Strategic Interest Comment	Preference	
		Natural Processes – Sand transport, accretion, and erosion	Natural Values			Human Use Values					
			Mangroves	ECV. Valuable waters	FHA	Beach Amenity	Infra-structure				Heritage
Existing arrangements plus monitoring	Very Low	Neutral	Neutral to Positive	Neutral to Positive	Neutral to Positive	Neutral to Negative	Negative	Negative impacts to Council infrastructure likely (EMC 3).	Acceptable for lower risk shoreline at EMC2 only, though revegetation at EMC 2 is preferred (see below). Not preferred if results in a loss of significant area of district level open space.	Not Preferred	
Beach Nourishment - Amenity maintenance (general measure for all sandy beaches)	Low to Moderate	Neutral	Positive	Neutral to Positive	Neutral to Positive	Very Positive	Positive	As needed nourishment viability depends on material availability - potentially available in nearby offshore areas or navigation channels within Pumicestone Passage.	Preferred approach for lower risk areas (EMC2 and more generally) as long as risk remains appropriate. May not provide fit for purpose or cost effective protection to the boat ramp car park or open space (EMC3). Review following monitoring, evaluation and further investigations particularly in reference to potential breakthrough of Bribie Island.	Preferred (EMC 2 and generally) /Hybrid (EMC 3)	

Table continues

Groynes – EMC 3 (boat ramp car park)	Moderate to High	Negative	Negative (down drift) to Positive	Neutral to Negative	Neutral to Negative	Negative to Positive	Negative to Positive	Potentially viable to hybridise with beach nourishment to maintain beach amenity, not necessarily fit for purpose protection of assets.	As for beach nourishment, may not provide fit for purpose protection of assets though may be useful hybrid option. Review following monitoring, evaluation and further investigations particularly in reference to potential breakthrough of Bribie Island.	Secondary/ Hybrid
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### Preferred Management Plan for to Nelson Street to Lamerough Canal

#### Priority Actions:

While Council responsibility only extends to Council controlled land and beaches, it may be appropriate to consider advocacy regarding the potential impacts, and mitigation options, to social and economic values associated with State controlled land. The preferred priority actions for this beach management unit include a generic preference of beach nourishment on an as needs basis to maintain sandy beaches and mitigate the effects of hard protection work. Nourishment activity should be coordinated in association with the existing Golden Beach dredge program and is subject to approval/s. Regarding EMC 1 Naval Cadets site, the State leases this land to the Navel cadets organisation and, as with the power boat club site (see below), Council does not have management control of the land and, therefore, no Council specific actions are identified in this SEMP. Specific priority actions include:

1. EMC 2 The extensive mangrove habitat area (Fraser Park) between the Power Boat Club and the Naval Cadets site should be carefully managed to maintain its natural character and inherent erosion buffering capacity. Advocacy to park managers could include pedestrian control to minimise disturbance to mangroves and other stabilising vegetation. Awareness and protection of this area is an important consideration when undertaking coastal protection works in the vicinity, upstream or downstream of the mangrove habitat.
2. EMC 3 Boat ramp car park and adjacent open space through to the existing revetment wall at Lamerough Canal – the preference for the Council controlled boat ramp car park and open space is seawall/revetment design hybridised with as needed nourishment. The revetment works should commence within 2 years. In the interim, monitoring and as needed nourishment is recommended. Revetment/seawalls that will have a moderate to long-term life span should consider longer-term impacts associated with inundation and erosion relating to sea level rise, storm surge and/ or various Bribie Island breakthrough scenarios; and, more broadly, all natural hazards. Additional consideration of longer term Coastal Hazard Adaptation/ risk management planning will be required in such cases.

The club is not controlled by Council and the State leases the land to the club and therefore no Council specific actions are identified in this SEMP.

#### Indicative Costs:

Preparation of a detailed design for a revetment/seawall for the boat ramp car park and open space is estimate for design and construction is \$260,000 (approximately 165m). Approximately 90m of this between the boat ramp and the Boat Club is required within 2 years, with the 75m south of the boat ramp being less urgent. The design should also consider longer-term risks associated with Coastal Hazard Adaptation/ risk management planning, which may significantly increase this cost or identify other priorities for the site.

The costs of beach nourishment for this beach unit are considered as part of the general beach management program.

Costs associated with coordinated monitoring for the entire Sunshine Coast are included in Section 6.1: General management, monitoring and review.



### 6.6.4.3 Lamerough Canal to Bells Creek – beach unit 27

#### Overview

The **beach unit 27** map of **Appendix A** provides spatial context to this beach management unit and provides an overview of the major mapped values, where available.

#### Site description and values

This beach management unit extends from Lamerough Canal to Bells Creek. The residential and open space areas between Lamerough Canal and Bells Creek is built on low lying *reclaimed* land that was once wetland.

This beach management unit carries high human use values owing to the extensive district recreation parks, the Sunshine Coast Coastal Pathway (including section of shoreline protected by native vegetation), boat ramps and car park. The recreational value of the area comprises both

social and economic (tourism and commercialised recreation) value groups, and are mainly based on the opportunities and access provided for boating, recreational fishing, bathing, walking, and picnicking. Caloundra Military Jetty Memorial is identified as a heritage item. The waters of this area comprise very significant natural values being a designated High Ecological Significance Marine Waters area, Fish Habitat Area and part of the Moreton Bay Marine Park (Habitat Protection Zone and Conservation Park Zone).



**Erosion management considerations** – see **Figure 6.30** for location of the listed considerations

This section of the Golden Beach shoreline is potentially the most vulnerable to the erosion related effects of the various Bribie Island breakthrough scenarios (refer to **Section 6.6.1 Potential Bribie Island breakthrough**).

This is due to the location of likely breakthrough areas, low elevation of adjacent land and the nature of the existing shoreline protection (low revetment wall that is degraded in sections). There is minimal hard infrastructure in this beach management unit, with Council's interest mainly comprising narrow beaches (exposed at low tide), district parks and boat ramps. The shoreline just south of Joan St is within 15m of the Esplanade. It is noted that recent aerial photography suggests the dominant sediment transport direction in this area may change seasonally, with a net northerly movement of relatively low volumes of sand. The design of new

**Figure 6.30:** Annotated aerial image showing the listed erosion management considerations for Lamerough Canal to Bells Creek

structures should take into account these local *current* coastal processes and the specific threats associated with the various Bribie Island breakthrough scenarios.

Specific erosion management considerations follow (see **Figure 6.30**).

1. A low rock revetment protects the shoreline between the boat ramps and jetty. Short narrow beaches are present between Lamerough Canal and Roy Street. Sand retention on these beaches is partly controlled by rock and geofabric sand containers used to protect stormwater drains and public boat ramps. This is due to them behaving like groynes and this effect could be enhanced by a seaward extension of the structures. This would improve the resilience of the adjacent southern shoreline and increase the recreational value of the area.

Beach nourishment along this section (between Roy Street and Military Jetty) would further protect and add value to the area. The benefit of any beach nourishment works could be maximised by incorporating a flow deflection structure to Military Jetty. This type of structure has been used successfully to stabilise and widen the shoreline along the Cotton Tree foreshore of the southern bank of the Maroochy River.

Presently the toe of the existing rock seawall structure is exposed at low tide. Impacts associated with climate change (largely sea level rise) and/or potential Bribie Island breakthrough/s are likely to reduce the length of time the structure can be accessed in “dry” conditions. This may complicate the future upgrade of shoreline protection along this section.

2. A low rock revetment protects the shoreline between Roy Street and Joan Street. A very narrow beach is accessible in this section at low tide.

This section is popular for small boating craft due to calm waters and easy access. South of Roy Street the existing revetment is beginning to deteriorate and the narrow exposed shoreline suggests that there is limited opportunity to maintain a usable beach under the current arrangements. Management of this section should focus on protecting the assets and infrastructure located in the foreshore and adjacent parkland. Consideration should be given to renewing and/or upgrading this revetment to deal with the various Bribie Island breakthrough scenarios (refer to **Section 6.6.1**). Consideration should also be given to development of responses to future hazards in the medium to long term under Coastal Hazard Adaptation/ risk management planning.

3. The shoreline just south of Joan Street to the Bells Creek boat ramp is generally free of shoreline protection works and characterised by coastal vegetation and sandy beaches. The shoreline just south of Joan St is within 15m of the Esplanade. Sediment transport rates in this area are low and the offshore shoal appears relatively stable. A reasonable coastal vegetation buffer exists around Keith Hill Park and the northern bank of the Bells Creek entrance. If the vegetated parkland of this section is to be retained in the medium to long term then this section may require armouring in the future. This option should be considered based on potential Bribie Island breakthrough scenarios; staging of other priority works in the area; results of monitoring over the next 2 to 3 years; and, ideally, medium to long term Coastal Hazard/ risk assessment planning priorities.

**Figures 6.31** and **6.32**, on the next page, show example of the shoreline as discussed above for EMC 1 and EMC 2, respectively.



**Figure 6.31:** high recreation use beach south of Lamerough Canal showing narrow beaches and low sea walls (EMC1)



**Figure 6.32:** low revetment and adjacent erosion south of Lamerough Canal (EMC 2)

**Table 6.13**, on the next page, presents an overview of the indicative costs and likely impacts of specific options considered for this beach management unit, including a brief comment on strategic interests and whether each option is considered viable.



**Table 6.13:** Overview of options, costs and impacts for the **beach management unit 33: Lamerough Canal to Bells Creek**

**Current State:** developed, parklands **Main values of significance in vicinity:** *Natural values* Mangroves, High Ecological Value Waters, Fish Habitat Area, Moreton Bay Marine Park, Ramsar Wetland *Human use* – Beach amenity (recreation/ tourism)/ infrastructure (Hard – Road boat ramp, jetty, seawalls; paths Soft – open space). **Culture/ heritage sites:** Military Jetty Memorial **Current usage:** High utilisation; low impact use **Specific Threat:** Erosion threat to public open space, Esplanade, boat ramps and car park.

Erosion Management Option	Indicative Investment	Likely impact on significant resources & values							Viability Comments (fit for purposes of asset protection or amenity maintenance?)	Strategic Interest Comment	Preference
		Natural Processes – Sand transport, accretion, and erosion	Natural Values			Human Use Values					
			Mangrove s	Eco. Valuable waters	FHA	Beach Amenity	Infra-structure	Culture/ Heritage			
Existing arrangements plus monitoring	Very Low	Neutral	Neutral	Neutral to Positive	Neutral to Positive	Neutral to Negative	Negative	Negative	Negative impacts to public infrastructure likely (open space and Esplanade south of revetment).	Acceptable for lower risk shoreline. Not preferred if loss of significant area of district level open space results. Must consider safety in addition to existing park service levels.	Not Preferred
Beach Nourishment and scraping	Low to Moderate	Neutral	Negative (where mangrove could be smothered) to Positive	Neutral to Positive	Neutral to Positive	Very Positive	Positive	Positive	Not likely to be feasible for asset protection without groyne-seawall hybrid. Long-term viability depends on reliable sand source.	Preferred as interim approach around boat ramps and where beach width is sufficient to make nourishment viable, as long as risk remains appropriate. Hybridise with groynes and seawall upgrade to create a beach in front of an upgraded and extended revetment (see 'seawall' below).	Preferred - Hybrid
Groynes (EMC 1 – enhance groyne like effects; EMC 2 – incorporate into hybrid option)	Moderate to High	Negative	Negative (down drift) to Positive	Neutral to Negative	Neutral to Negative	Negative to Positive	Negative to Positive	Negative to Positive	Viable to enhance existing groynes and protection at boat ramps to maintain local beaches; consider a flow deflection structure at jetty.	<b>Consider as part of hybrid option</b> of upgraded and extended revetment and beach nourishment (see 'seawall' below). Capital expenditure should be timed for optimal Bribie breakthrough risk management.	Preferred - Hybrid
Seawall – protection of public assets (EMC 1, 2 & part of 3)	High to Very High	Negative	Neutral to Negative (edge effects)	Neutral to Negative	Neutral to Negative	Negative	Very Positive	Neutral	Upgrade south of Roy Street likely to be required to deal with potential effect of a Bribie breakthrough. Requires groynes and nourishment to maintain/build beach.	Consider opportunity for alignment to take a hybrid option. Review hybridised option following monitoring, evaluation and further investigations to ensure capital expenditure is timed for optimal risk management. Upgrade existing revetments and consider extending south to protect parkland and Esplanade.	Preferred - Hybrid



## Preferred management plan for Bells Creek to Lamerough Canal

### **Priority actions:**

This is a priority site given the potential for Bribie Island breakthrough and this being the most vulnerable section of Golden Beach. Previous shoreline erosion management considerations for this beach unit included implementation of a groyne field (similar to that between Beattie Street and Oxley Street) and beach nourishment. The preferred priority actions for this beach management unit include:

1. General - pursue approvals and investigations relating to a Bribie Island breakthrough, including new works and the upgrade of existing structures that protect valuable foreshore areas and for the expansion of the existing maintenance dredging / beach nourishment program at Golden Beach, south to Bells Creek. This will enhance existing sandy beach areas that support safe recreational use. Council recently conducted a geotechnical study of the sediments outside the declared Fish Habitat Areas in this section of the Pumicestone Passage. The study identified considerable reserves of sand suitable for beach nourishment.
2. EMC 1 - investigation and preparation of concept design for extension of the existing protection geofabric bags near the northern boat ramps the groyne-like effect of existing protection. Installation of a deflection structure at Military Jetty may also be considered.
3. EMC 2 & 3 - upgrade and extension of the existing rock revetment between Keith Hill Park and Roy Street is required to accommodate Bribie Breakthrough scenarios. Extension should include protection of the most narrow section of parkland buffering the Esplanade (see EMC 3 – buffer of approximately 15m). Review viability of nourishment following monitoring, evaluation and further investigations. Nourishment and groynes may be required to maintain a stable beach in front of the upgraded/renewed revetment. Additional consideration should be given to medium to longer term Coastal Hazard Adaptation/risk management planning scenarios, including erosion, sea level rise and inundation (flooding) hazards, which may identify the need to extend this revetment through to the Diamond Head boat ramp near June St.

### **Indicative costs:**

The cost to pursue approvals and further investigations relating to addressing impacts of a Bribie Island breakthrough for the Golden Beach locality is approximately \$50,000.

The cost of the design and construction for revetment renewal/upgrade and feasibility study for groynes is \$200,000, including detailed site investigation and preparation of documents to support approvals. This includes the cost to upgrade/repair the existing 120m of rock revetment that is estimated at \$150,000 (\$1250/m). Groyne and associated beach establishment estimates are pending further investigation. Also, it is likely that this new revetment will be required to the north and the south of the existing revetment. The costs associated with this are unknown at this stage and are pending further investigation.

The cost to maintain small beaches adjacent to the boat ramps will come from existing navigation channel maintenance funds within Council.

Costs associated with coordinated monitoring for the entire Sunshine Coast are included in Section 6.1: General management, monitoring and review.

## Glossary and abbreviations

<b>Accretion</b>	The build-up (of the beach) by the action of waterborne or airborne sand, either solely by the action of the forces of nature or induced by the action of man, such as by the action of groynes, breakwaters or beach nourishment.
<b>Amenity</b>	Functional or valued feature or facility.
<b>Annual Exceedance Probability (AEP)</b>	The probability that the conditions associated with a given event will be exceeded in any one year.
<b>Beach</b>	The zone of unconsolidated sand that extends landward from the low water line to the place where there is a marked change in material or form, or to the line of permanent vegetation.
<b>Beach amenity</b>	Those characteristics of the Beach, both natural and artificial, that are valued and utilised to varying degrees by the community, including intrinsic natural character and physical recreational opportunities.
<b>Beach berm</b>	That area of shoreline lying between the swash zone and the dune system.
<b>Beach nourishment</b>	The artificial supply of sand to an existing beach system with sand from another system.
<b>Beach scraping</b>	The transfer of sand from the lower beach to the upper beach (within the beach system), usually by mechanical equipment, to re-distribute the sand to parts of the beach above the high tide level.
<b>Beach system</b>	The zone of active sand movement and exchange, including the dunes, beach and nearshore profile, which covers the total extent of the longshore and cross-shore sand transport.
<b>Blowout</b>	The removal of sand from a dune by wind drift after protective dune vegetation has been lost. Unless repaired promptly, the area of blowout will increase in size and could lead to the development of a migrating sand dune or sand drift and its associated problems. Sand drift can damage buildings, roads, other assets and adjoining natural features such as littoral rainforest or wetlands.
<b>Breakthrough</b>	With respect to Bribie Island: The erosion of the barrier island to the extent that a new deep-water entrance to the Pumicestone Passage is established.
<b>Breakwater</b>	Structure, usually detached from the shore, protecting a shoreline, harbour, anchorage or basin from ocean waves.
<b>Buffer zone</b>	Appropriately managed land between the beach and development, within which coastline fluctuations and hazards can be accommodated in order to minimise damage to the development.
<b>CHAS</b>	See <b><i>Coastal Hazard Adaptation Strategy</i></b>
<b>Coast</b>	All areas within or neighbouring the foreshore
<b>Coastal Act</b>	Queensland <i>Coastal Protection and Management Act 1995</i>
<b>Coastal Hazard Adaptation Strategy (CHAS)</b>	Assesses the risk urban areas face from coastal hazard (including erosion, sea level rise and inundation) impacts over the medium to long term, proposes adaptation options to mitigate these impacts, and establishes an implementation program for the mitigation options.
<b>Coastal hazards</b>	Source of potential threats to property and people from erosion of the foreshore or inundation by storm tides or sea level rise.
<b>Coastal Management District (CMD)</b>	Parts of the coastal zone declared under the <i>Coastal Protection and Management Act 1995</i> as requiring special development controls and management practices.
<b>Coastal processes</b>	The natural processes of the coast, including: sediment transport to and along the coast; fluctuations in the location and form of the foreshore, beach, dunes and associated ecosystems; tides; waves; changes in sea-level and coastal hazards; ecological processes (for example, migration of plant and animal species) and the natural water cycle (for example coastal wetlands' role in filtration and flood mitigation).

<b>Coastal resources</b>	The natural and cultural resources of the coastal zone, for example: water, sand ecosystems, and heritage items/sites.
<b>Coastal values</b>	Worth, desirability or utility associated with coastal resources or coastal processes. Values can be categorised as predominantly natural (environmental) or human use (social, cultural and economic). Values may also be protected by law, identified in policy or otherwise accepted by the community.
<b>COPE</b>	Coastal Observation Programme – Engineering
<b>Council</b>	Sunshine Coast Regional Council
<b>Cultural resources</b>	The places or objects that have anthropological, archaeological, historical, scientific, spiritual, visual or sociological significance or value, including such significance or value under Aboriginal tradition or Island custom.
<b>DEHP</b>	Queensland Department of the Environment and Heritage Protection
<b>DERM</b>	Former Queensland Department of Environment and Resource Management
<b>Defined storm erosion area</b>	The <b>erosion prone area</b> associated with the <b>defined storm event</b> .
<b>Defined storm event</b>	The storm used as the basis for assessing potential erosion impacts. For this SEMP, the 2% AEP (50year ARI) Wave and 1% AEP (100 year ARI) storm surge are used to determine the defined storm erosion area.
<b>Diffraction</b>	The “spreading” of waves into the lee of obstacles, such as breakwaters, by the transfer of wave energy along wave crests. Diffracted waves are lower in height than the incident waves.
<b>DSEWPC</b>	Australian Department of Sustainability, Environment, Water, Population and Communities
<b>Dunes</b>	Ridges, mounds or hills of sand lying landward of the beach berm. Sand dunes are usually classified as an incipient dune, fore-dune or hind-dunes. During storm conditions, incipient and fore dunes may be severely eroded by waves. During the intervals between storms, dunes are rebuilt by wave and wind effects. Dune vegetation is essential to prevent sand drift and associated problems.
<b>Dune management</b>	The general term describing all activities associated with the restoration and/or maintenance of the role and values of beach dune systems; dune management activities and techniques include planning, dune reconstruction, revegetation, dune protection, dune maintenance, and community involvement.
<b>Dune protection</b>	The management technique by which the dune system is protected from damage by recreational and development activities; dune protection activities generally include the use of fences, access ways and signposts to restrict and control access to dune systems.
<b>Dune restoration</b>	The management technique by which dunes are restored, often involving use of dune vegetation and dune protective structures to build and stabilise dunes. Activities may include weed/pest/fire control, replanting, fertilising, fencing, repair of access ways, and publicity.
<b>Economic values (coastal)</b>	Economic worth, desirability or utility that is dependent on natural and/or artificial coastal resources and/or, processes. For example: tourism and development associated with beach amenity and access; coastal dependent development; commercialisation of recreational opportunities, etc.
<b>Entrance instability</b>	The tendency of entrances to estuaries and coastal lakes to migrate along the shore, close up, reopen, form new entrances, etc in response to wave and current action and freshwater flows.
<b>Ebb tide</b>	The outflow of coastal waters from bays and estuaries caused by the falling tide.
<b>EPBC Act</b>	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
<b>ERA</b>	Environmentally Relevant Activity as defined under the Queensland <i>Environmental Protection Act 1994</i>

<b>Erosion (coastal)</b>	The wearing away of land or the removal of beach or dune sediments by wave or wind action, tidal currents or water flows. Includes permanent shoreline recession/ inundation and short-term storm related loss of land.
<b>Erosion Prone Area</b>	The width of the coast that is considered to be vulnerable to coastal erosion over a particular planning period or event. Statutory erosion prone areas are released by the State Government and are based on the planning period to 2100. Where reference is made to short-term storm erosion this area is called the <b>defined storm erosion area</b> .
<b>Flood tide</b>	The inflow of coastal waters into bays and estuaries caused by the rising tide.
<b>Fore dune</b>	The larger and more mature dune lying between the incipient dune and hind dune area. Fore dune vegetation is characterised by grasses and shrubs. Fore dunes provide an essential reserve of sand to meet erosion demand during storm conditions. During storm events, the fore dune can be eroded back to produce a pronounced dune scarp.
<b>Foreshore</b>	The area of land between the <b>HAT</b> and <b>LAT</b> .
<b>Groynes</b>	Low walls built attached and perpendicular to a shoreline to trap longshore sand transport. Typically, sand build-up on the up drift side of a groyne is offset by erosion on the down drift side.
<b>Groyne Field</b>	A system of groynes along a section of shoreline.
<b>HAT</b>	Highest Astronomical Tide. The highest tide that can occur from the influence of celestial bodies – this excludes local effects such as atmospheric pressure and wind effects.
<b>Hind dunes</b>	Sand dunes located to the rear of the Fore dune. Characterised by mature vegetation including trees and shrubs.
<b>Human use values</b>	Includes social, cultural, heritage, recreational and economic values.
<b>IDAS</b>	Integrated Development Assessment System under the <i>Sustainable Planning Act 2009 (SP Act)</i> .
<b>Incipient dune</b>	The most seaward and immature dune of the dune system. Vegetation characterised by grasses. On an accreting coastline, the incipient dune will develop into a Fore dune.
<b>LAT</b>	Lowest Astronomical Tide. The lowest tide that can occur from the influence of celestial bodies – this excludes local effects such as atmospheric pressure and wind effects.
<b>Littoral zone</b>	Area of the coastline in which sediment movement by wave, current and wind action is prevalent. The littoral zone typically extends from the onshore dune system to the seaward limit of the <i>nearshore / offshore zone</i> .
<b>Longshore currents</b>	Currents flowing parallel to the shore within the inshore/ nearshore zones. Longshore currents are typically caused by waves approaching the beach at an angle. The “feeder” currents to rip cells are another example of longshore currents.
<b>Mass transport current</b>	The net shoreward current associated with the movement of waves through the nearshore/inshore zone. Sediment transport from the offshore bar by this current is responsible for the rebuilding of storm-eroded beaches during inter-storm periods.
<b>Natural character</b>	The character of the coastal zone representing the natural pristine qualities typically of sandy beaches, vegetated dunes and clean ocean waters, of intrinsic value to the community.
<b>Natural processes</b>	See <b>Coastal Processes</b> .
<b>Natural resources</b>	The natural and physical features and processes of the coast, including wildlife, soil, water, minerals and air.
<b>Natural values</b>	Natural or environmental functions that are dependent on natural resources or processes.



<b>Nearshore zone</b>	(also known as the inshore zone) An indefinite zone of the beach system that extends from the foreshore to the offshore zone. For the modelling associated with the Coastal Processes report (BMT WBM 2013b) the nearshore zone is defined as waters between the offshore bar and the 60m depth contour, where swell waves are unbroken but influenced by the presence of the seabed.
<b>Offshore bar</b>	Also known as a longshore bar, is a submerged sandbar formed offshore in the beach system (but in the <i>nearshore zone</i> ) by the processes of beach erosion and accretion. Typically, swell waves break on the offshore bar.
<b>Offshore zone</b>	Coastal waters seaward of the nearshore zone. For the modelling associated with the Coastal Processes report (BMT WBM 2013b), the definition includes the criterion that swell waves in the offshore zone are unbroken and their behaviour is not influenced by the presence of the seabed. (See also nearshore zone).
<b>Onshore/Offshore Transport</b>	The process whereby sediment is moved onshore and offshore by wave, current or wind action.
<b>Pocket beach</b>	Small beach system typically bounded by rocky headlands. Because of the presence of the headlands and the small size of these beaches, longshore currents are relatively insignificant in the overall sediment budget.
<b>QCP</b>	Queensland Coastal Plan (2012)
<b>Reflected wave</b>	That part of an incident (landward moving) wave that is returned seaward when a wave impinges on a steep beach, barrier, or other reflecting surface.
<b>Refraction</b>	The tendency of wave crests to become parallel to bottom contours as waves move into shallower waters. This effect is caused by the shoaling processes, which slows down waves in shallower waters.
<b>Revetment</b>	Similar to a seawall but in a river or estuary (Refer to <i>Seawall</i> for definition).
<b>Rip (current)</b>	Concentrated current flowing back to sea perpendicular to the shoreline. Rip currents are caused by wave action piling up water on the beach. Feeder currents running parallel to the shore (longshore currents) deliver water to the rip current.
<b>Scarp</b>	The landward limit of erosion in the dune system caused by storm waves. At the end of a storm the scarp may be nearly vertical; as it dries out, the scarp slumps to a typical slope of 1V:1.5H to a slope of about 1V:3H. Also known as <i>dune scarp</i> .
<b>Seawall</b>	Wall built parallel to the shoreline separating land and water areas, designed primarily to limit shoreline recession and other damage due to wave action.
<b>Sea waves</b>	Waves in coastal waters resulting from the interaction of different wave trains and locally generated wind waves. Typically, sea waves are of short wavelength and of disordered appearance.
<b>Sediment budget</b>	An accounting of the rate of sediment supply from all sources (credits) and the rate of sediment loss to all sinks (debits) from an area of coastline to obtain the net sediment supply.
<b>Sediment sink</b>	A type of sediment loss from the coastline, including longshore transport out of area, dredging, deposition in estuaries, windblown sand, etc.
<b>Sediment source</b>	A mode of sediment supply to the coastline, including longshore transport into the area, beach nourishment, fluvial sediments from rivers, etc.
<b>Semi-diurnal tides</b>	Tides with a period, or time interval between two successive high or low waters, of about 12.5 hours. Tides along the SEQ coast are semi-diurnal.
<b>SEMP</b>	Shoreline Erosion Management Plan
<b>SEQ</b>	South-East Queensland

<b>Shoaling</b>	The influence of the seabed on wave behaviour. Such effects only become significant in water depths of 60m or less. Results in a reduction in wave speed, a shortening in wave length and an increase in wave height.
<b>Shore</b>	The narrow strip of land in immediate contact with the sea, including the zone between high and low water lines.
<b>Shoreline recession</b>	A net long-term landward movement of the shoreline caused by a net loss in the sediment budget.
<b>Short term erosion</b>	Also known as storm erosion – the temporary loss of land (sand) in response to a storm event. The land may move to the surf zone and move back to the foreshore under calm conditions. The defined storm event represents a critical short term erosion event of approximately 1% AEP.
<b>Social values (coastal)</b>	Beneficial social, community, cultural or heritage functions that are dependent on natural and/or artificial coastal resources or processes.
<b>Significant wave height</b>	The average height of the highest one third of waves recorded in a given monitoring period. Also referred to as $H_{1/3}$ or $H_s$ .
<b>SPP</b>	State Planning Policy
<b>Storm Profile</b>	The profile (cross-section) of a sandy beach that develops in response to storm wave attack. Considerable volumes of sediment from the beach berm, the incipient dune and the fore dune can be eroded and deposited in the nearshore zone. The landward limit of the storm profile is typically defined by a back beach erosion escarpment ( <i>dune scarp</i> ).
<b>Storm Surge</b>	The increase in coastal water level caused by the effects of storms. Storm surge consists of two components: the increase in water level caused by the reduction in barometric pressure (barometric set-up) and the increase in water level caused by the wave setup.
<b>Surf Zone</b>	Coastal waters between the outer breaker zone and the swash zone characterised by broken swell waves moving shoreward.
<b>Swash Zone</b>	That area of the shoreline characterised by wave uprush and retreat.
<b>Swell waves</b>	Wind waves remote from the area of generation (fetch), having a uniform and orderly appearance characterised by regularly spaced wave crests.
<b>Tidal prism</b>	The volume of water stored in an estuary or tidal lake between the high and low tide levels; the volume of water that moves into and out of the estuary over a tidal cycle.
<b>Tides</b>	The regular rise and fall of sea level in response to the gravitational attraction of the sun, moon and planets. Tides along the SEQ coastline are <i>semi-diurnal</i> in nature, i.e. they have a period of about 12.5 hours.
<b>Tombolo</b>	A seaward progression of the shoreline behind an offshore island due to reduced longshore transport as a result of wave diffraction around the island.
<b>Training walls</b>	Walls constructed at the entrances of estuaries and rivers to improve navigability.
<b>Values</b>	See <i>coastal values</i> . Used primarily as a noun not a verb.
<b>Wave height</b>	The vertical distance between a wave trough and a wave crest.
<b>Wave length</b>	The distance between consecutive wave crests or wave troughs.
<b>Wave period</b>	The time taken for consecutive wave crests or wave troughs to pass a given point.
<b>Wave run-up</b>	The vertical distance above mean water level reached by the uprush of water from waves across a beach or up a structure.
<b>Wave set-up</b>	The increase in water level within the surf zone above mean still water level caused by the breaking action of waves.

<b>Wave train</b>	A series of waves originating from the same fetch with more or less the same wave characteristics.
<b>Wind set-up</b>	The increase in mean sea level caused by the “piling up” of water on the coastline by the wind.
<b>Wind waves</b>	The waves initially formed by the action of wind blowing over the sea surface. Wind waves are characterised by a range of heights, periods and wavelengths. As they leave the area of generation (fetch), wind waves develop a more ordered and uniform appearance and are referred to as swell or swell waves.
<b>Windborne sediment transport</b>	Sand transport by the wind. Sand can be moved by the processes of suspension (fine grains incorporated in the atmosphere), saltation (medium grains “hopping” along the surface) and traction (large grains rolled along the surface).

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# Appendix A. Mapping

Appendix A is bound seperately



[www.sunshinecoast.qld.gov.au](http://www.sunshinecoast.qld.gov.au)

[mail@sunshinecoast.qld.gov.au](mailto:mail@sunshinecoast.qld.gov.au)

T 07 5475 7272 F 07 5475 7277

Locked Bag 72 Sunshine Coast Mail Centre Qld 4560

