Sunshine Coast COUNCIL

Shoreline Erosion Management Plan 2014

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Disclaimer

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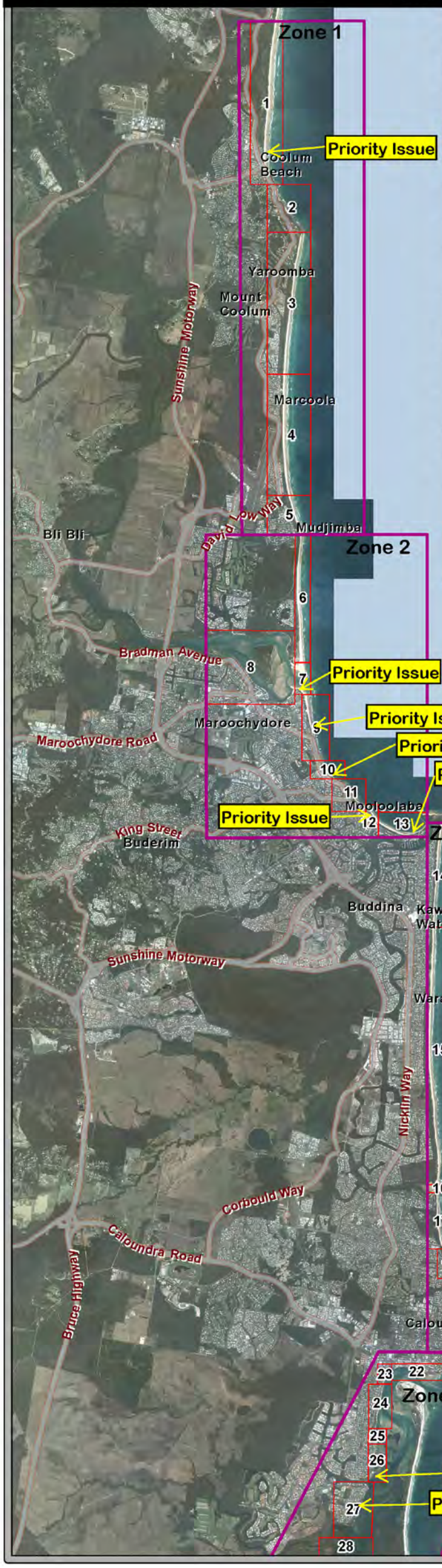
Shoreline Erosion Management Plan Overview



Beach unit number	Beach unit name	Proposed response
Zone 1: Coolum Beach to Mudjimba Beach		
1	Coolum Beach	Assess sea wall
Zone 2: Mudjimba to Point Cartwright		
7	Maroochy River Entrance	Maintain existing geotextile groynes. Consider upgrade to rock
9	Maroochydore Beach	Beach renourishment and construct sea wall (trigger)
10	Alexandra Headland Beach	Assess sea wall and upgrade if necessary. Prepare shoreline defence plan.
12	Mooloolaba Beach North	Beach renourishment. Repair sea wall. Assess main sea wall and prepare sea wall design.
13	Mooloolaba Beach South	Extend renourishment pipeline 300m.
Zone 3: Point Cartwright to Caloundra Headland		
18	Dicky Beach	Repair sea wall
19	Moffat Beach	Prepare sea wall design
Zone 4: Caloundra Headland to SCC southern boundary		
21	Kings Beach	Assess groyne and upgrade if necessary
26	Nelson St to Lamerough Canal	Maintain, replace/ upgrade groynes. Beach renourishment. Revetment wall north and south of boat ramp.
27	Lamerough Canal to Bells Creek	Upgrade/ renew and extend existing revetment wall. Enhance/ establish groynes. Renourish beach.

Figure 1: Overview of the SEMP shoreline management zones, beach management units and priority erosion issues

Contents

1 Introduction

The coastline is central to the identity, economic prosperity and lifestyle for a large part of the Sunshine Coast community. Residents and tourists alike enjoy an abundance of recreational, social, business and cultural opportunities provided by local beaches, estuaries and headlands. For this reason, the effective and proactive management of our coastline is a high priority for the Sunshine Coast Council.

An important aspect of coastal planning is the management of sites that are susceptible to coastal erosion. Generally, these are sites where significant infrastructure (e.g. buildings, parks, roads, etc.) are located in close proximity to the shore. This infrastructure is often of great value to the community and therefore it is important that the development of appropriate erosion management responses balance the associated social/cultural, economic and environmental values that the infrastructure provides.

Council's approach to identify sites susceptible to coastal erosion and the determination of preferred management responses is provided in this Shoreline Erosion Management Plan (SEMP).

1.1 Purpose of the SEMP

The SEMP is a proactive planning document that sets out Council's preferred management options for addressing current and potential coastal erosion issues. The SEMP identifies priority sites where Council controlled, or otherwise strategically significant infrastructure, is threatened by coastal erosion and provides appropriate, sustainable management responses for these sites. This is achieved by:

- Determining what significant public infrastructure lies in the defined *erosion prone area* and is at risk of coastal erosion in the short to medium term;
- Considering the relevant legislative and policy requirements associated with coastal management;
- Considering the economic, social and environmental advantages and disadvantages and the financial implications associated with different management options, and
- Recommending a preferred management approach.

The main benefits associated with preparing a SEMP include:

1. Ensuring Council's approach to erosion management occurs in accordance with the State Policy for Coastal Management; the Sunshine Coast Waterways and Coastal Management Strategy, and the draft Coastal Management Policy (Public Lands);
2. Development of coordinated, regionally consistent and prioritised approach to address shoreline erosion issues for the entire Sunshine Coast;
3. Improved understanding of the constraints and opportunities for shoreline management prior to embarking on concept/detailed design and development application processes;
4. Knowledge building and sharing, including with the community, on the key topics of coastal processes, erosion hazards, and the opportunities and constraints associated with various erosion management options; and
5. Supports informed decision making.

In addition, a SEMP can form the basis for a preliminary approval or development application for a scheme of works throughout the local government area, thereby assisting with the timely advancement of the relevant development approvals.

1.2 Scope of the SEMP

The geographic scope of the SEMP includes the shoreline of the entire Sunshine Coast Council local government area that is exposed to the open ocean, as well as the lower Maroochy River estuary and the northern section of the Pumicestone Passage.

The SEMP focuses on a 10-year time period and considers current erosion issues, as well as short to medium term potential erosion that is associated with a defined storm event. The defined storm event is made up of an offshore design wave height with a 2% Annual Exceedance Probability (AEP) combined with a 1% AEP storm surge. These storm conditions were used to identify the *erosion prone area*, which was then used to determine potential threats to significant community assets. This approach is consistent with the method promoted in the Queensland Government's Coastal Hazard Technical Guideline (Qld EHP 2013).

If significant Council controlled assets, such as land, beaches, open space, roads, paths, buildings and other facilities were located within the *erosion prone area*, consideration was given to the associated values and the protection of that infrastructure from erosion. Beaches and dunes are considered significant due to the ecological, social, recreational and economic opportunities they provide. From an erosion management perspective, beaches play an important buffering role in protecting coastal communities.

The SEMP may also consider specific sites where non-Council controlled assets may be creating or exacerbating an erosion issue on a Council controlled beach or other asset.

The scope of the SEMP does not include[1]:

- threats posed by inundation (flooding) or local disaster responses associated with the defined storm event;
- determination of whether or not significant public infrastructure is expendable;
- potential threats to existing infrastructure associated with the future effects of climate change, which is expected to be to be further considered under future coastal hazard adaptation planning that considers inundation, erosion and other natural hazards in the broader context of strategic landuse and strategic infrastructure network planning;
- detailed consideration of land where no significant permanent infrastructure is at threat from erosion (including natural dunes; undeveloped shores and seasonal fluctuations of beaches), where it is appropriate for natural processes to run their course; and
- private land or other private assets.

1.3 Background study

The SEMP was informed by two detailed technical studies prepared by expert coastal engineering consultants. The studies included:

1. *Legislative Framework and Generic Shoreline Management Options (BMT WBM 2013a)*, which provides a summary of the state and federal government legislation relevant to coastal management, an overview of the potential options for managing coastal erosion, and information regarding the statutory requirements under which the SEMP was developed; and
2. *Coastal Processes Study for the Sunshine Coast (BMT WBM 2013b)*, which provides a detailed investigation into the key physical processes that shape the coastline. The report includes an overview of tides, storm tides, sand supply and movement, computer modelling of coastal processes (i.e. waves, sediment transport and storm erosion, discussion of present and future shoreline erosion, and calculation of the erosion prone area associated with the defined storm event.ernment area that is exposed to the open ocean, as well as the lower Maroochy River

[1] Responses to many of these matters will be determined by future assessments and planning which respond to the State Planning Policy 2013, Australian Standard AS 5334-2013 *Climate change adaptation for settlements and infrastructure – A risk based approach* and, the Qld EHP 2013 Guideline for Preparing a Coastal Hazard Adaptation Strategy (CHAS).

2 Planning and legislative framework

The planning and legislative framework for coastal management in Queensland is complex and there are numerous pieces of legislation, regulations and policies that require consideration when developing shoreline erosion management strategies. Key state coastal legislation and policies are summarised below.

2.1 The Coastal Protection and Management Act 1995

The *Coastal Protection and Management Act 1995* (the Coastal Act) governs coastal management in Queensland. The Coastal Act provides for management of the coastal zone, recognising the diverse range of coastal resources and values, and has the following objectives:

- Provide for the protection, conservation, rehabilitation and management of the coastal zone, including its resources and biological diversity;
- Have regard to the goal of the National Strategy for Ecologically Sustainable Development in the use of the coastal zone;
- Ensure decisions about land use and development safeguard life and property form the threat of coastal hazards; and
- Encourage the enhancement of knowledge of coastal resources and the effect of human activities on the coastal zone.

The main means of achieving this management under the Coastal Act is the regulation of development and the preparation of management plans.

The Coastal Act governs all development in the coastal zone. This includes assessment of applications for tidal works and for operational works on state coastal land. Tidal works include the construction or demolition of groynes, jetties, pipelines, embankments, training walls, seawalls etc. as well as works in tidal water necessarily associated with these activities. Other works in the coastal zone not classified as tidal works include nourishment, dredge disposal, reclamation, and interfering with costal dunes in an erosion prone area.

The Coastal Act also governs the extraction of quarry material from the coastal zone. This includes sand and similar sediment, usually extracted for use in beach nourishment programs. A resource entitlement, provided by the State under the Coastal Act, is required for use of this material.

The preferred management responses proposed under the SEMP consist of beach nourishment, tidal works and operational works on other State coastal land that is under Council control.

2.2 The Queensland Coastal Plan

The Queensland Coastal Plan (QCP) is the primary statutory plan under the Coastal Act, and comprises the State Policy for Coastal Management 2011 (Qld DERM 2011a), which is expected to be replaced by the draft Coastal Management Plan (Qld EHP 2013a), when finalised.

The State Policy for Coastal Management contains the policies and principles that guide coastal management in Queensland.

Additional direction regarding the management and development of the coastal zone is provided by the State Planning Policy (Coastal Environment, Natural Hazards), as made under the Sustainable Planning Act 2009 (SP Act).

The State Policy for Coastal Management lists 13 core principles, 11 of which are highly relevant to the SEMP[2].

[2] State Policy Coastal Management – Part 3

1. *Natural coastal processes, including erosion and accretion, are able to occur without interruption;*
2. *Structures (including all infrastructure) in erosion prone areas are designed, located and managed to ensure that impacts on coastal processes are avoided or minimised;*
3. *Dunes are to be protected and dune vegetation is maintained and enhanced;*
4. *Protect areas of high ecological significance (HES) and conserve other ecological values;*
5. *The living culture of Indigenous Traditional Owners and their connection with cultural resources on the coast and in marine areas is maintained and enhanced;*
6. *Public access and use of the coast is maintained and enhance for current and future generations;*
7. *Buildings and structures (including all infrastructure) are established on State coastal land only where they are essential, provide a public service and cannot be feasibly located elsewhere;*
8. *Management and use of coastal land is guided by plans of management;*
9. *Coastal land managers achieve effective coastal management through regular monitoring, reviewing and reporting mechanisms;*
10. *Knowledge and awareness of coastal resources and their management is shared with the community, and*
11. *The community is engaged in coastal management decision-making processes.*

As the SEMP focuses upon erosion management, the most relevant principles are those regarding structures and protecting coastal processes in erosion prone areas. State policies regarding the protection of resources (natural and cultural) and values (economic, social and natural) are core considerations in determining the preferred erosion management options under the SEMP.

2.3 The State Planning Policy (SPP) 2013

The State Planning Policy 2013 (SDIP 2013) defines the State interest in Local and State land use planning and development assessment, relating to:

- liveable communities and housing;
- economic growth;
- environment and heritage;
- hazards and safety; and,
- infrastructure.

The SPP contains specific provisions relating to the protection and enhancement of the coastal environment while supporting opportunities for coastal-dependent development, compatible urban form, and safe public access to the coast. Additional provisions support evidence based planning to avoid or mitigate the risks associated with natural hazards for the protection of people and property and enhanced community resilience to these hazards. These provisions relate to development assessment and land use planning. The SPP supporting guidelines outline that coastal hazard risk assessment should consider both existing and proposed land uses. Contributing to this end, this SEMP only addresses the current short-term erosions risks to Council managed assets and considers triple bottom line values as they relate to the State and local values and interests). In addition, some of the proposals in this SEMP will be subject to assessment against the SPP 2013.

2.4 Council's broader policy framework

Pro-active and sustainable management of coastal foreshores is a priority of Sunshine Coast Council. Council's Corporate Plan (2009-2014) identifies a number of emerging priorities directly relevant to the SEMP. These include:

1.4 Sustainable tourism industry;

2.2 Natural environment preserved for the future;

2.3 Viable ecosystems that maintain biodiversity values;

2.4 Healthy waterways and foreshores;

4.1 Safe and healthy communities, and

7.4 Timely and appropriate infrastructure and service provision.

The *Sunshine Coast Waterways and Coastal Management Strategy 2011-2021* identifies coastal values and prescribes a strategic and coordinated approach to the protection, sustainable use and enjoyment of coastal foreshores. The Strategy's principles and strategic outcomes for coastal foreshores provide direction on the development of policy; coastal land management; shoreline erosion management; and community engagement on coastal management issues.

In addition, other strategies, particularly the Sunshine Coast—The Natural Advantage: Regional Economic Development Strategy 2013-2033, Sunshine Coast Open Space Strategy 2011, and Sunshine Coast Social Infrastructure Strategy 2011, provide further context within which coastal resources and values are identified and considered. Figure 2.1 shows the relationship between Council's broader policy framework and the coastal policy and planning framework.

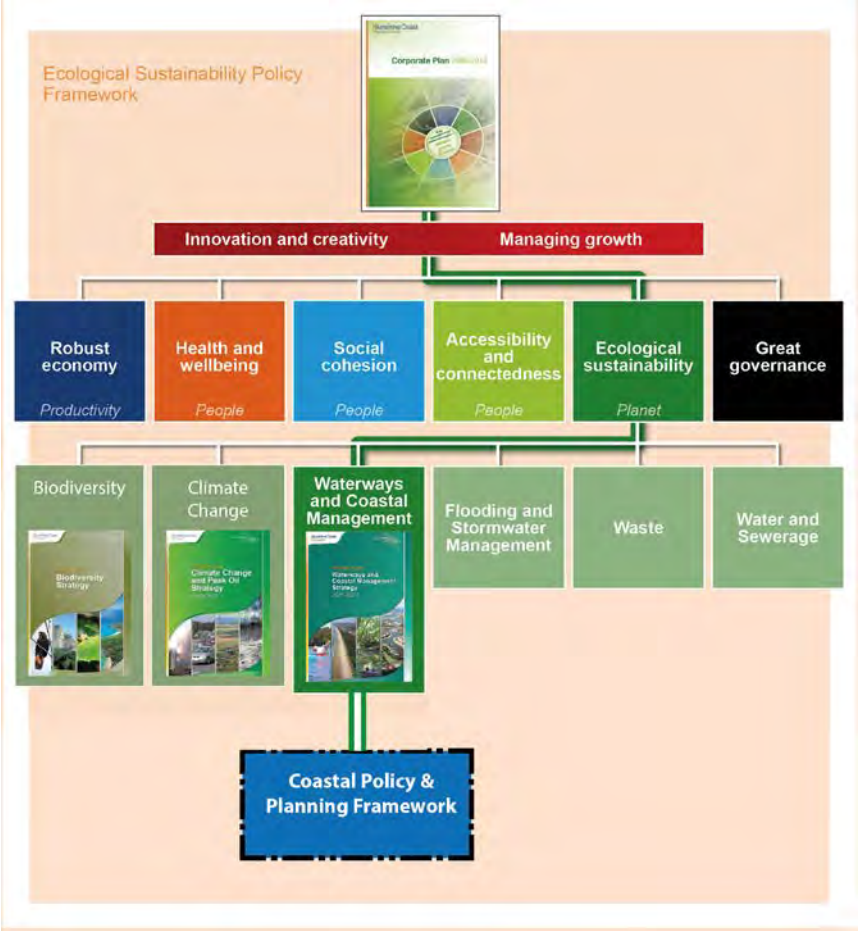


Figure 2.1. The relationship between Council's coastal policy and planning framework, the broader policy framework and the Corporate Plan.

2.5 Council's coastal policy and planning framework

The coastal policy and planning framework (Figure 2.2) includes the following draft and proposed Council documents:

Draft Coastal Management Policy (Public Lands) – this document provides the overarching guidance on Council's management of coastal public lands. The policy articulates Council's position and is guided by the *Waterways and Coastal Management Strategy; the State Policy for Coastal Management 2012; and the State Planning Policy 2013*.

Draft Shoreline Erosion Management Plan (SEMP - this document) - this plan identifies coastal processes, values and short term (current) erosion threats to Council controlled land and other infrastructure. The SEMP puts forward a preferred management approach to address erosion threats so that agreed coastal values (including natural and human use values) are proactively managed in the strategic interests of the community. The SEMP proposes measures to be implemented in the short to medium term (within 10 years) in association with a coordinated shoreline monitoring program.

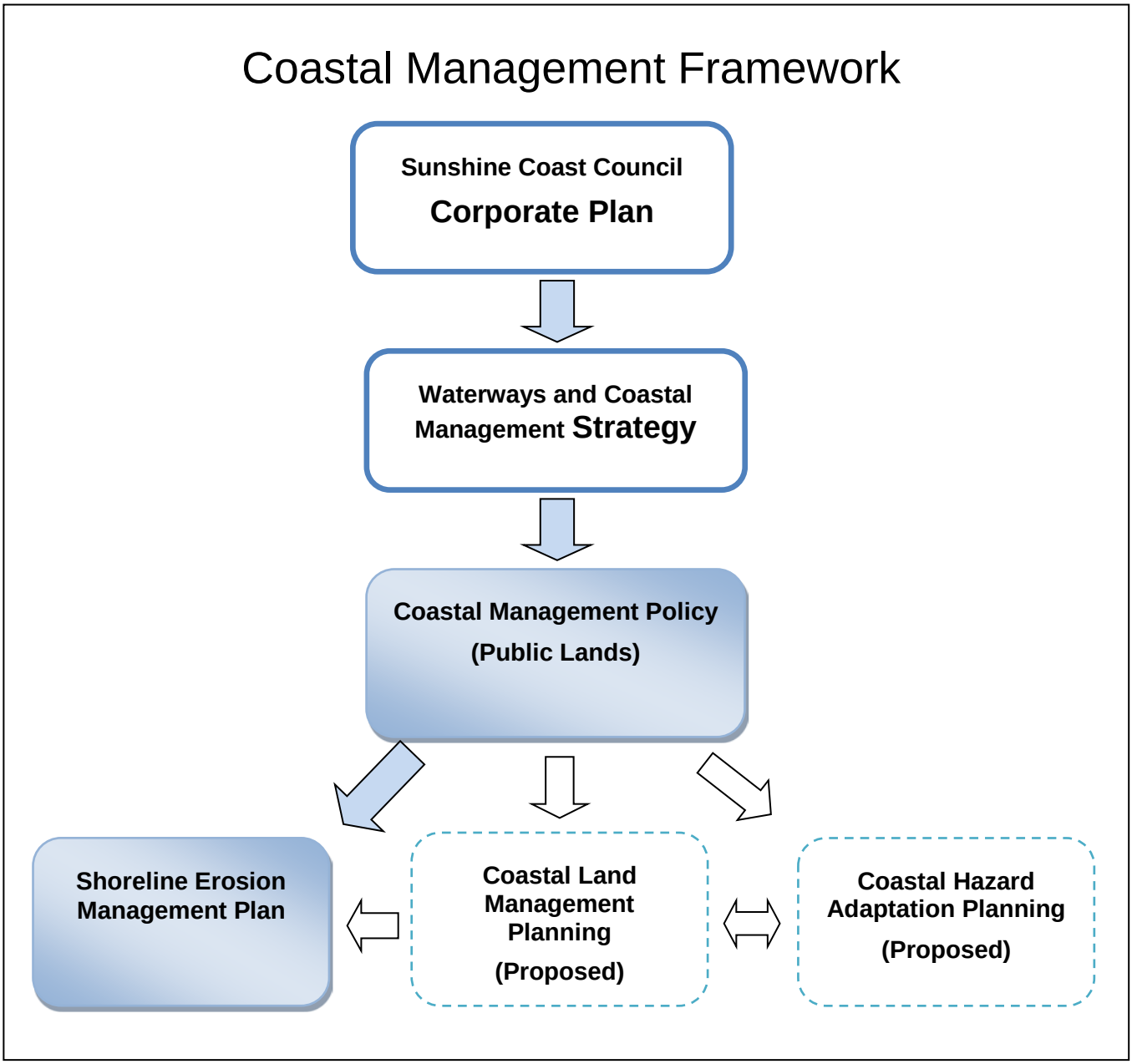


Figure 2.2: Sunshine Coast Council's coastal policy and planning framework.

Coastal Land Management Planning – planning to provide guidance for the general management of beaches and dunes, covering issues such as beach access, dune and coastal vegetation protection and management of coastal lakes, lagoons and estuaries. A Coastal Land Management Plan would address Council controlled land adjacent to the shoreline for the length of

the Sunshine Coast and highlight the associated character and community values. The development of tailored management plans to maintain or enhance these attributes would be guided by a Coastal Land Management Plan.

Coastal Hazard Adaptation Planning – planning to inform medium to long term (20 to 100 year) horizons for managing coastal hazard impacts associated with projected climate change (at 2030, 2060 and 2100), in particular: erosion, sea level rise and storm tide inundation considerations. Ideally, this plan would be developed as part of a process that considers all natural hazards in the context of strategic land use and strategic infrastructure network planning and disaster management. This plan was formerly a statutory requirement under the QCP (SPP 3/11 Coastal Protection Policy), which has been repealed. The State Planning Policy 2013 outlines state interests and development assessment provisions. It supports evidence based planning to avoid or mitigate the risks associated with natural hazards. The SPP 2013 supporting guidelines promote the preparation of coastal hazard risk assessments that, most notably: identify levels of appropriate risk; set measurable goals for managing risks; and, develop land use responses as part of a holistic risk management or adaptation strategy for the local government area.

2.6 Overview of development approval triggers

Coastal erosion management works require development approval under the Integrated Development Assessment System (IDAS) of the *Sustainable Planning Act 2009* (SP Act). Assessment under the SP Act for potential shoreline erosion management works is required according to triggers including, but not limited to:

- Operational works in a tidal area or Coastal Management District (CMD) – e.g. removing or interfering with quarry material, tidal works, removing or interfering with coastal dunes – Coastal Act;
- Operational work below high water mark – Coastal Act;
- Vegetation clearing – *Vegetation Management Act 1999*; and
- Fisheries matters – e.g. removal, destruction or damage to marine plants and work in fish habitat areas (FHAs) – Fisheries Act 1994.

Approvals under the IDAS process may require assessment by both local and state government against relevant statutory instruments and policies. In such cases, the Department of State Development, Infrastructure and Planning (DSDIP) acts as the State Assessment and Referral Agency (SARA) and, where relevant, is the State assessment manager. Assessment may involve consideration of an application against the relevant Acts, planning policies and the State Development Assessment Provisions (SDAP). SARA may coordinates advice from other relevant State agencies, which may include:

- Department of Environment Heritage and Protection (DEHP);
- Department of Natural Resources and Mines (DNRM);
- Department of Agriculture, Fisheries and Forestry (DAFF);
- Department of National Parks, Sport, Recreation and Racing (DNPRSR)
- Department of Transport and Main Roads (DTMR), and
- Maritime Safety Queensland (MSQ).

Further information regarding the triggers for State agencies to be included in the development assessment process is provided in the *Legislative Framework and Generic Shoreline Protection Options* report (BMT WBM 2013a).

There are numerous additional statutory instruments that provide further context with respect to coastal management planning and works approval requirements. Particularly, matters of National Environmental Significance under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Such matters may include wetlands of international significance; listed species, populations and ecosystems; and, migratory species. Detailed

information regarding specific requirements is contained in the Technical Shoreline Study report titled: *Legislative Framework and Generic Shoreline Management Options (BMT WBM 2013a)*.

3 Coastal processes, resources and values

3.1 Key coastal processes

The Sunshine Coast shoreline is dynamic and is subject to fluctuations in its location and form. The key coastal processes of interest to this SEMP include the accretion, erosion and transport of sediment (sand, silt and clay), with the main focus being on sand. These key coastal processes are influenced by higher level processes, such as:

- the natural water cycle;
- wind and other meteorological processes;
- waves, currents, sea level and tides;
- estuary dynamics;
- biological processes, and
- geological processes.

Together, these higher level processes shape the shoreline through effects on coastal topography; by influencing sea level and providing the energy that drives the erosion, accretion and transport of sediments in the coastal environment. Queensland coastal processes are significantly influenced by prevailing southeast trade winds (driven by high pressure systems) and extreme events driven by low pressure systems, such as tropical cyclones (usually in summer) and east coast lows (usually in winter). See *Queensland Coastal Processes and Climate Change* (Qld DERM 2011) for more on these weather systems.

This SEMP is concerned mainly with identifying erosion threats to Council controlled assets and the consideration of management options. Threats may arise where development is located in erosion prone areas or otherwise too close to the active shoreline, such that it may be subject to damage or interfere with sediment processes. Therefore, the interaction of landform, sea level, tides, waves, nearshore currents, wind and sediment transport, accretion and erosion processes are considered most crucial to determine potential threats and management options with respect to Council controlled assets.

This section provides locally specific detail on the main processes that influence shoreline erosion, including:

- Sea level and astronomical tides
- Historic sea levels of the Sunshine Coast
- Storm tides
- Surface waves and nearshore currents
- Cross-shore sand transport – accretion and storm erosion
- Longshore sand transport
- Wind accretion, erosion and transport
- Modelled potential erosion associated with the defined event

A more technical assessment of these processes, including an overview of local investigations and modelling is provided in the Coastal Processes Study (BMT WBM 2013b). Figure 3.1 presents a conceptual beach profile and the terms commonly applied to the main physical features.

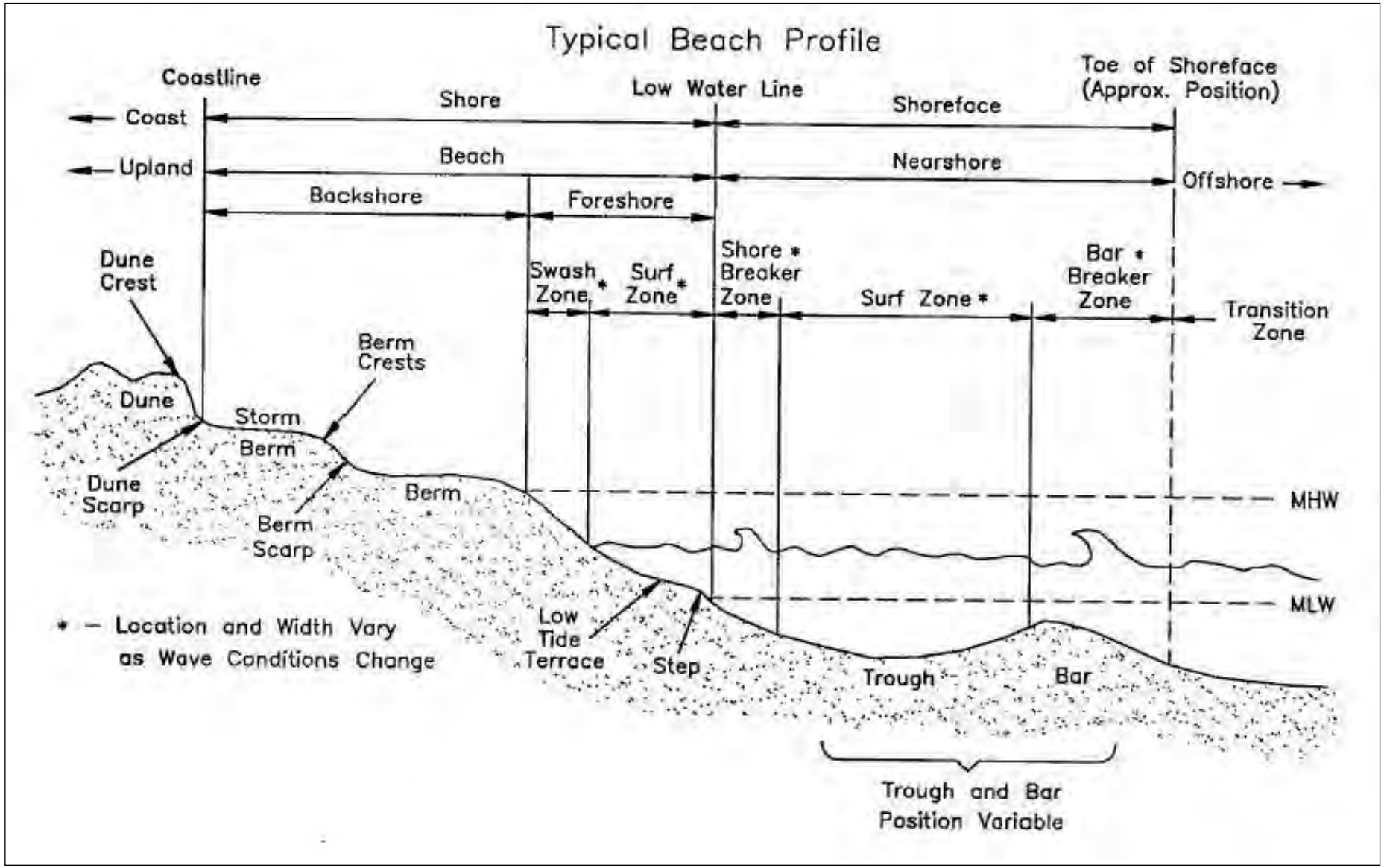


Figure 3.1: Conceptual overview of a typical beach profile that identifies common features/zones and terms (Source USACE 2008, Pt4 CH1). MHW = Mean High Water; MLW = Mean Low Water.

3.1.1 Sea level and astronomical tides

Tides are the familiar rise and fall of sea levels due to gravitational influence of the Earth (and rotation), moon and sun. Tides are an important consideration in management of shoreline erosion as they result in wave and current energy being focused at different parts of the coastal and estuarine shoreline over the tidal cycle and can directly cause sediment erosion and transport.

Sunshine Coast tides usually occur twice daily, making them *semi-diurnal* as opposed to *diurnal*, which is one tide per day. Astronomical tides of particular importance include:

- Neap tides – the event of minimum tidal range occurring after the first and third quarters of the moon, when the moon and sun are at right angles, relative to Earth
- Spring tides – the event of larger than average tidal range occurring after full and new moons, when the sun, moon and Earth are in approximate alignment
- Highest and Lowest Astronomical Tide (HAT and LAT) – the events occurring when spring tides coincide with the orbits of the sun and moon bring them closest to Earth

Table 3.1 presents the standard tide height and level at Mooloolaba. Larger tidal ranges result in stronger currents and higher tides result in greater landward influence of the tide. The table shows that the range of the mean spring tide at Mooloolaba Beach is 1.40m and the extreme non-storm related tidal range resulting from Highest and Lowest Astronomical Tide conditions is 2.17m. The tidal range for mean neap tides is 0.75m. Note that tides are usually referred to as being a particular *height* above the LAT. The tidal *level* relative to the Australian Height Datum (AHD) is provided for reference.

Table 3.1: Mooloolaba Standard Port Tidal Planes (Maritime Safety Qld 2010)

Tide	Height (mLAT)	Level (mAHD)
Highest Astronomical Tide (HAT)	2.17	+1.18
Mean High Water Springs (MHWS)	1.66	+0.67
Mean High Water Neaps (MHWN)	1.33	+0.34
Mean Sea Level (MSL)	0.96	-0.03
Mean Low Water Neaps (MLWN)	0.58	-0.41
Mean Low Water Springs (MLWS)	0.26	-0.73
Lowest Astronomical Tide (LAT)	0.00	-0.99

3.1.2 Historic Sea levels of the Sunshine Coast

Earth's glacial cycles have caused large variations in sea level over geological timescales. During the last inter-glacial period, approximately 120,000 years ago, sea levels were 1-3m higher than they are at present. This higher sea level would cause the shoreline to be further inland than it is at present; inundating currently dry land and creating islands of the headlands of Coolum and Point Cartwright, for example, and low barrier sand spits formed between the island 'headlands' with shallow tidal deltas landward from them.

Around 18,000 years ago, sea levels were approximately 120m below the present level, which results in the shoreline being located some 40km seaward of the current shoreline.

While current mean sea level has remained reasonably constant for the past 6,500 years, with periods approximately 1m higher than present, it needs to be recognised that sea levels have been rising. Globally, the average sea-level rise has risen by about 210 mm over the period 1880 to 2009 (Church and White, 2011) and this trend is continuing. This is a clear indicator that short-term approaches may not be as effective in the future so further evaluation is required to determine the most appropriate responses to likely long-term changes in coastal hazards.

3.1.3 Storm tides

Storm tides are the temporary elevation in sea level brought about by a combination of the storm surge and the normal astronomical tide. The storm surge is a result of decreased atmospheric pressure and wind/wave set-up. Storm tides usually accompany major storms, cyclones and east coast low pressure systems. Figure 3.2 provides a conceptual overview of the storm tide and its components, showing the combination of astronomical tide, storm surge and wave set-up. Note that the storm tide is referenced in metres above Australian Height Datum (AHD) to the mean water level (MWL) of the storm tide, or the Still Water Level (SWL) of the storm tide where wave set up is not included.

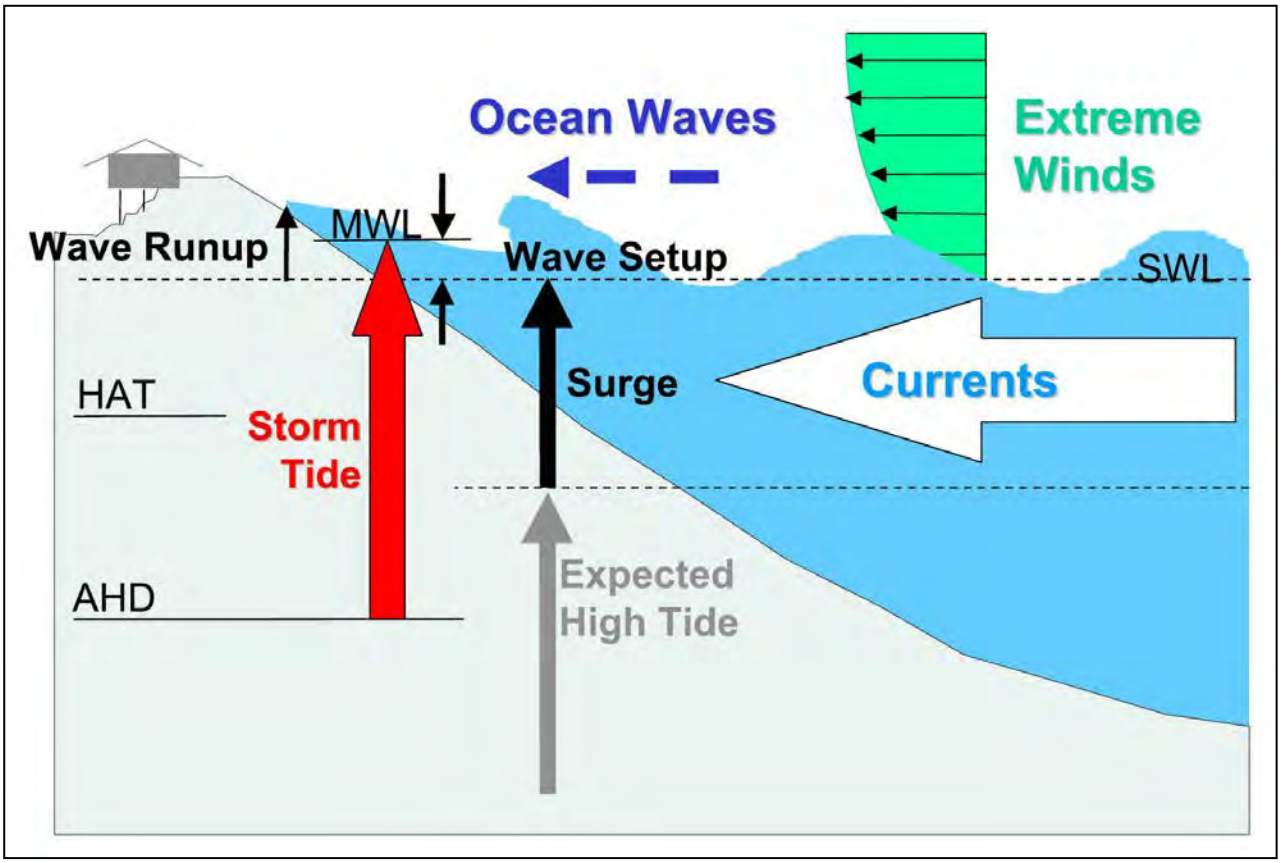


Figure 3.2: Conceptual overview of the components comprising the storm tide (Qld DNRM 2001)

Table 3.2 provides storm tide levels derived by studies commissioned by the former Maroochy and Caloundra Councils in 2005 and 2008, respectively. From Table 3.2, it is evident that a large 100 year Average Recurrence Interval (ARI) storm tide level for Maroochydore Beach has been estimated as 1.61 metres AHD (excluding wave setup). As is the case with the astronomical tide, storm tides are an important consideration in shoreline erosion management as the increased sea level and wave energy can directly cause severe erosion. Storm tides are a natural occurrence and are considered a coastal hazard that can pose risk to life and property.

Table 3.2: Sunshine Coast Storm Tide Levels (Connell Wagner 2008; Connell Wagner, Lawson and Treloar 2005)

Location	Storm Tide Level Excluding Wave Setup (mAHD)		
	20 year ARI	50 year ARI	100 year ARI
Caloundra	1.40	1.49	1.56
Minyama	1.50	1.53	1.56
Mooloolah River	1.50	1.54	1.58
Mooloolaba Beach	1.49	1.53	1.55
Maroochydore Beach	1.53	1.58	1.61
Pincushion Island	1.55	1.60	1.63
Cotton Tree Park	1.55	1.60	1.63
Chambers Island West	1.68	1.74	1.78
Mudjimba Beach	1.54	1.59	1.63
Mount Coolum	1.54	1.59	1.63
Stumers Creek	1.56	1.61	1.64

Table 3.3 (below) identifies the risk of encountering a particular ARI event over a specific period. For example, the probability of experiencing a 95yr ARI (close to a 1% Average Exceedance Probability) within any ten-year period is 10%.

Table 3.3: Risk of encounter (R) for an Average Recurrence Interval event over specific planning horizons (N) (Webb et al., 2012)

% Risk of Encounter (R)	Planning Horizon in Years (N)					
	1	10	20	50	100	500
99	0.2	2.2	4.3	11	22	109
90	0.4	4.3	8.7	22	43	217
64	1.0	10	20	49	98	489
50	1.4	14	29	72	144	721
20	4.5	45	90	224	448	2241
10	9.5	95	190	475	949	4746
5	19	195	390	975	1950	9748
1	99	995	1990	4975	9950	49750

3.1.4 Surface waves and nearshore currents

Surface waves are commonly formed by the action of wind blowing over the sea surface and are characterised by a range of heights, periods and wavelengths. In the region of wave generation, wind acts on the water surface creating wave conditions that influence what is referred to as *seas*. Waves that leave the area of generation become more ordered and uniform and are then referred to as *swell* or swell waves.

Surface waves are a major factor affecting the formation of the shoreline through providing energy for erosion and for cross-shore, rip and longshore currents (in combination with tides and local winds) that drive sediment transportation in the nearshore environment.

Wave rose plots (wave direction and height) are available in the *Coastal Processes Study* (BMT WBM 2013b).

3.1.5 Cross-shore sand transport – accretion and storm erosion

Cross-shore sand transport is relevant to management of shoreline erosion as it is an important component of beach and dune erosion and accretion.

Cross-shore sand transport is a natural cyclical coastal process that involves (See also Figure 3.3 below):

- erosion of sand from the beach berm or dune during large storm wave events (also referred to as short-term erosion), usually during the coast's wet/'storm' season, and transport of this sand to the nearshore area, where it usually forms a sand bar in the bar breaker zone (refer to Figure 3.2 for clarification of beach terms); and
- storage of the sand in the nearshore area where, under milder low energy wave conditions during the dry season, it is slowly transported landward and accretes on the beach. While this process correlates with seasonal conditions, it can take many weeks or months after a significant event for this process to transport obvious and significant sand volumes back to the beach and years for dunes to rebuild. Further transport of dry sand by wind is required for dune building to occur.

Dynamically stable beaches are those that show no significant long term net erosion or accretion, although they may experience specific seasonal events that temporarily shift the balance of sand. Beaches are considered stable where there is balance in the amount of sand that is held in the beach, dunes and nearshore bars, and the sand that is coming into and leaving the beach via longshore transport (see section 3.1.6). Note that erosion can occur quickly while the accretion and subsequent dune building process can be much slower, potentially taking seasons for dunes to be restored to pre-event condition.

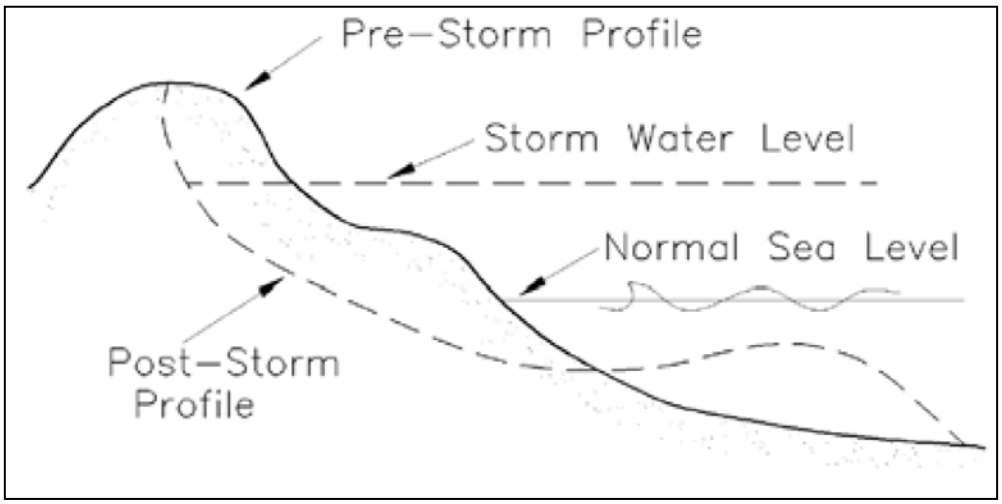


Figure 3.3: Profile of beach storm erosion and accretion concept experienced during cross shore sediment transport (source: Coastal Engineering Manual 2008)

Figure 3.3 depicts a cross section of the concept of beach erosion and accretion under different wave conditions, usually seasonal, where large waves erode beach and transport the sand into the nearshore

area and smaller low energy waves return the sand from the nearshore area to the beach. Figure 3.4 depicts the typical seasonal shift in beach profiles for the Sunshine Coast, where the summer 'storm season' results in a general lowering of the beach through increased wave and current energy; and, the calmer winter conditions result in restoration of the beach.

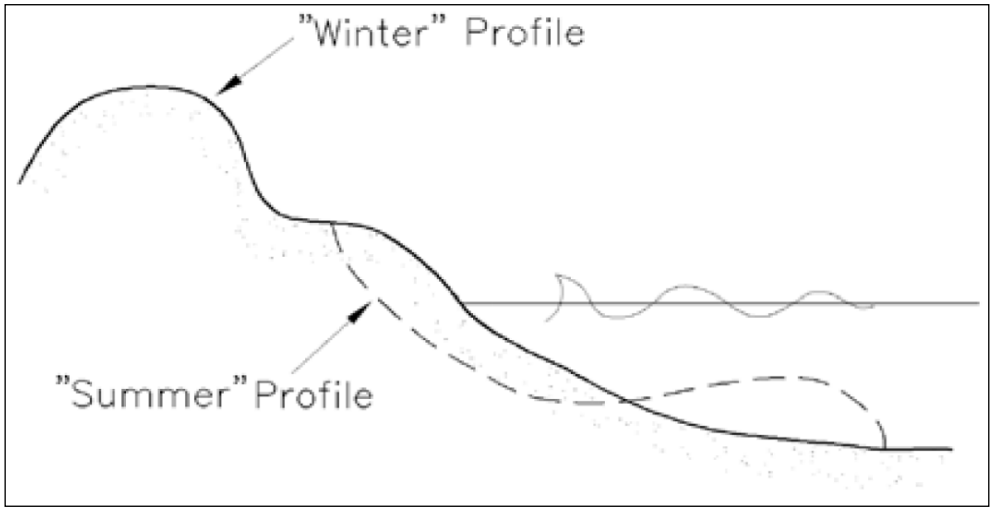


Figure 3.4: Schematic changes in seasonal profiles relating to increased storm and wave activity (adapted from source: Coastal Engineering Manual, 2008)

3.1.6 Longshore sand transport

Longshore sand transport results predominantly from waves breaking at an angle to the shore, which mobilises sand and, along with winds and tides, creates a current in the nearshore area. These processes results in the transportation of sand in the general direction of the wave action. Figure 3.5 provides a conceptual overview of the longshore sand transport process that result in sediment erosion, accretion and transportation within the nearshore environment. The combination of tidal and wave generated currents drives sand transport in the longshore current and a "zig zag" like sand transport pattern in the swash zone.

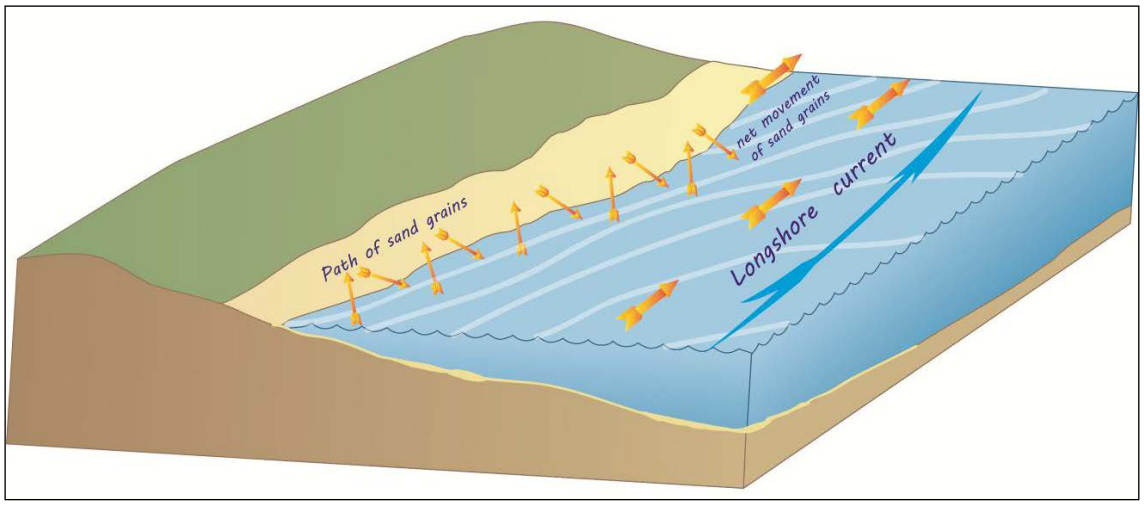


Figure 3.5: Conceptual overview of longshore processes a zig-zag pattern in the swash zone due to tidal influences and longshore sand transport according to the prevailing waves and currents (symbols courtesy of the Integration and Application Network 2013)

Beaches remain stable in the long term, without net recession or accretion, where there is a balance between the longshore transport of sand entering the system and the longshore transport of sand leaving the system, assuming that:

- there are no sediment sinks within the system; or
- sand is not removed from the active beach system; and/or

- there is no landward loss of sediment by wind transport.

3.1.7 Wind drivey accretion, erosion and transport

The Sunshine Coast experiences a seasonal wind climate. South-easterly trade winds dominate between April and September. During the summer months lighter east to north-easterly sea breezes are observed. November to April is generally accepted to be the tropical cyclone season. Tropical cyclones and east coast low pressure systems often bring destructive wind to the region, generating storm surges and extreme waves. See **Figure 3.6** for the 3pm wind rose plot for Sunshine Coast Airport. This figure indicates that in the afternoons:

- It is rarely calm on the Sunshine Coast;
- The dominant wind direction is south easterly;
- Wind blows from SE about 30% of the time;
- Wind speed is 10 – 19 km/hr approximately 36% of the time; and
- Wind speed is 20 km/hr or greater approximately 55% of the time.

Sand that has accreted on beaches, in dunes or backshore areas may be subject to erosion and transportation by wind, depending largely on the wind velocity, sand qualities (such as grain size, mass and dryness) and presence of vegetation and other structures. Onshore winds may result in sand transport from beaches and dunes landward to dunes or backshore areas. Offshore winds may result in transport from backshore areas, dunes and beaches seaward to dunes or the nearshore environment.

The presence of dunes shelters adjacent areas, particularly on the leeward side, which supports further dune growth (USACE 2008, Pt3 Ch4). The absence of dune vegetation may result in significant wind erosion of the dunes and result in blowouts where significant sand volumes are blown inland and dunes may then be more vulnerable to further erosion by wind and water.

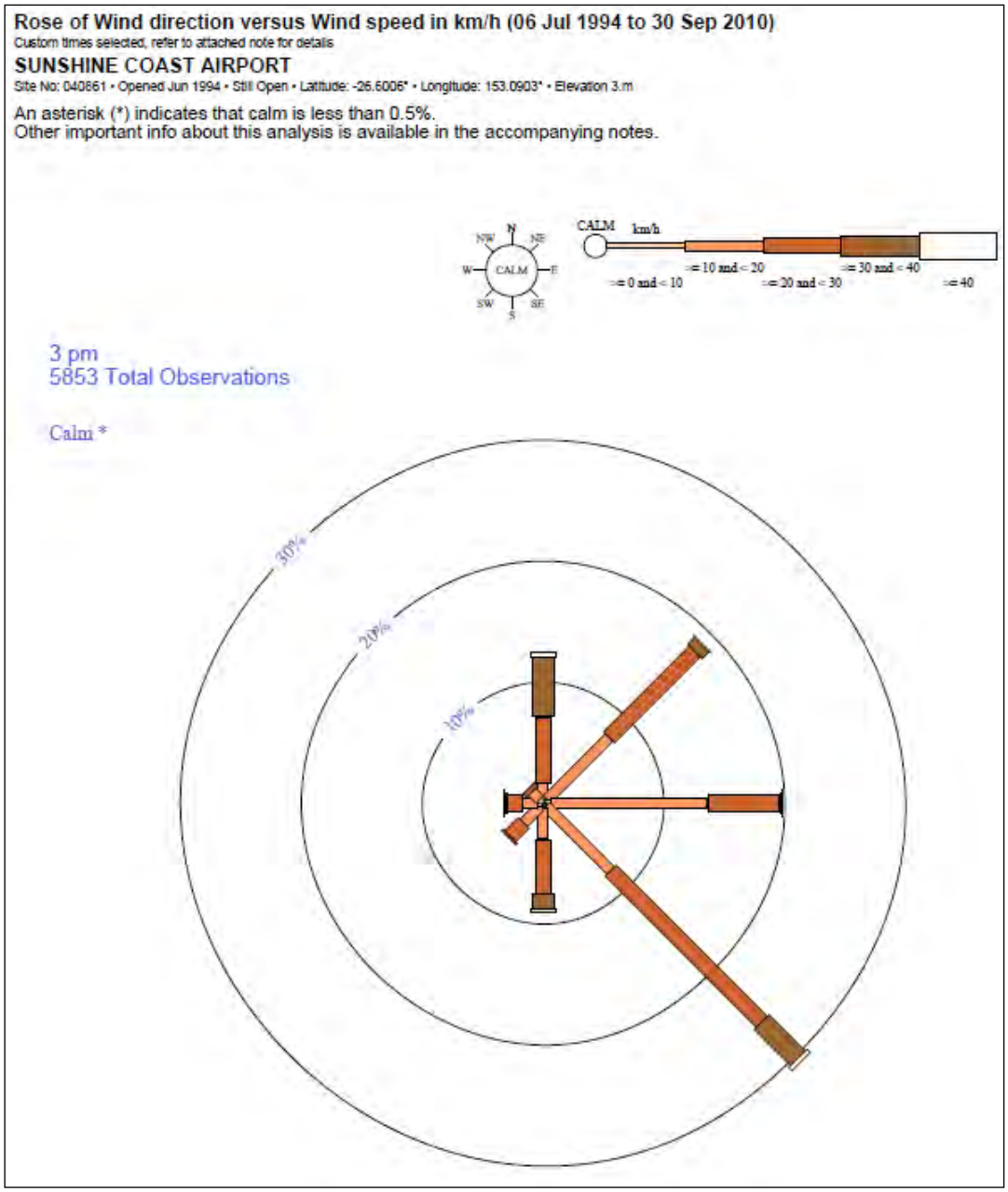


Figure 3.6: Wind rose plot illustrating the wind frequency, speed and direction for Sunshine Coast Airport. The length of the lines represents the percentage of time the wind blows from a particular direction (source: Bureau of Meteorology 2012).

3.1.8 Modelled potential erosion associated with the defined event

Storm erosion occurs when increased wave heights and water levels result in the erosion of sand from the upper beach ridge and dune (See Section 3.1.5). The eroded sand is transported offshore where it is deposited as a sand bar located in the vicinity of the wave break area. After the effects of the storm event subside, the sediment is slowly transported onshore where it restores the exposed beach.

Storm erosion assessment was performed as part of the Background Study (BMT WBM 2013b) at locations where sufficient beach profile data was available. The assessment calculates upper beach and dune erosion associated with storm induced surge and wave conditions. The amount of shoreline recession is determined from the significant wave height, the storm surge plus tide level and the initial beach profile shape. The model assumes the volume of material eroded from the upper beach/dune system and deposited offshore is balanced by a setback of the shoreline.

Two beach profile survey datasets were obtained from the former Qld Department of Environment and Resource Management (DERM) and interpreted to assess the beach dynamics and shoreline behaviour in the study area. These profile datasets included:

- Coastal Observation Program-Engineering (COPE) station upper beach profile data; and
- ETA cross-shore beach profile surveys.

COPE was a coastal observation campaign developed by the Beach Protection Authority (BPA) in the 1970s and ran until the late 1990s. As part of the COPE program, regular beach surveys (typically monthly) were undertaken from a specified location on the upper dune to the waterline.

The ETA beach survey program consisted of cross-shore survey lines from a given onshore location extending to a typical water depth of 15 - 20m. The ETA program was conducted between 1973 and 1993 and the locations assessed in this study are shown in Figure 3.7, with modelling input parameters and outputs presented in Table 3.4. Additional ETA profiles resurveyed specifically for this study have also been considered. The estimated erosion widths provided in Table 3.4 are considered a major event. The erosion widths are considered conservative and overestimated where rocky outcrops occur in the dune, beach or where reefs occur in the nearshore area.

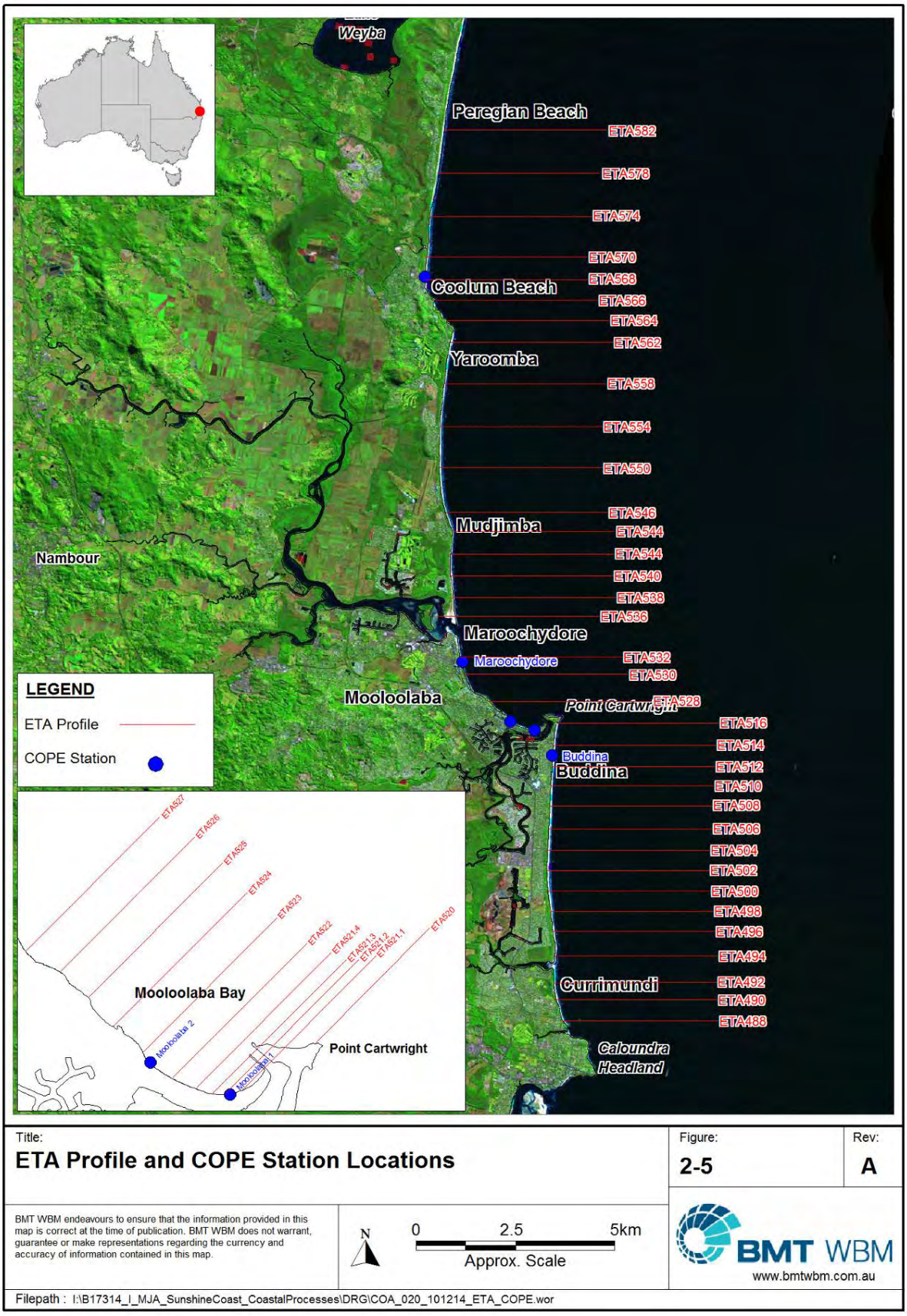


Figure 3.7: Extract from *BMT WBM 2013b* showing beach profile locations where, if enough information was available, the extent of the defined storm erosion was assessed.

Table 3.4: Storm Erosion assessment modelling parameters and output (from *BMT WBM 2013b*)

Approximate Location	Initial Profile Location	50yr ARI Offshore Design Wave Height (m)	Defined storm Tide Level Including Wave Setup (mAHD)	Vellinga (1980) Defined storm Erosion Width Potential (m)
	ETA488	5.7	2.05	50.3
	ETA490	5.7	2.05	45.5
Currimundi	ETA492	5.5	2.05	28.6
	ETA494	5.5	2.05	27.1
	ETA496	5.5	2.05	13.9
	ETA498	5.8	2.10	53.3
Bokarina	ETA500	5.8	2.10	39.2
	ETA502	5.8	2.10	34.6
	ETA504	5.8	2.10	31.8
	ETA506	5.8	2.10	39.9
	ETA508	5.4	2.12	44.8
Buddina	ETA510	5.4	2.12	40.4
	ETA512	5.4	2.12	36.9
Point Cartwright	ETA514	5.4	2.12	51.4**
Mooloolaba	ETA521.5	2.6*	1.90	24.0
	ETA522	2.6*	1.97	35.2
	ETA523	2.6*	1.97	16.1
	ETA527	3.1*	2.16	32.1
Alexandra Headland	ETA529.8	6.0	2.16	59.9
	ETA530	6.0	2.16	72.4
Maroochydore	ETA532	6.0	2.16	49.3
	ETA538	6.0	2.17	44.7
Mudjimba	ETA540	5.7	2.17	39.9
	ETA542	5.7	2.17	42.5
	ETA544	5.7	2.17	51.4
	ETA546	5.7	2.17	34.7
	ETA548	5.7	2.17	16.3
	ETA550	5.7	2.17	23.9
	ETA554	5.7	2.17	29.0
Mt Coolum	ETA558	5.8	2.17	37.6
	ETA562	5.8	2.17	43.3
Point Arkwright	ETA564	5.8	2.17	35.0**

	ETA566	5.8	2.17	52.9**
Coolum	ETA568	5.8	2.17	16.3
	ETA570	5.8	2.17	19.7
	ETA574	5.6	2.30	28.2
	ETA578	5.6	2.30	24.6
Peregian	ETA582	5.6	2.30	32.8
Sunshine	NA	5.9	2.30	36.2

*Wave model output from within Mooloolaba Bay

**Rocky headland location, erosion width expected to be significantly over estimated

3.2 Sand transport on the Sunshine Coast

3.2.1 Sand movement on the open coastline

The majority of the sand that makes up our beaches and dunes has been transported by longshore currents over long periods of time from as far south as the mid-north coast of New South Wales. Over thousands of years, longshore currents and the prevailing winds have transported the sand that has settled to create North and South Stradbroke Island, Moreton Island, Bribie Island, the Cooloola sand mass and Fraser Island. It is thought that much of the sand transport occurred during periods of lower sea level.

Longshore currents deliver a large volume of sand to the southern side of the Tweed River and approximately 500,000m^3 of sand per year is pumped from this area past the river mouth to the beaches of the Gold Coast. The Sunshine Coast receives probably less than 5,000m^3 of sand per year from south to north longshore currents. This low volume is the result of several factors that contribute to establishment of relatively weak longshore currents and correspondingly low rates of sediment transport, including:

- relative sheltering of the Sunshine Coast from the prevailing south easterly swells by Moreton Island, an effect that also creates a sediment sink (long term sand storage) in Moreton Bay;
- the relatively straight alignment of the coastline and wide continental shelf resulting in effective refraction of waves so that they arrive almost parallel to the shore.

Caloundra Headland represents a divide in the direction of sand movement, with slow northern transport of sand on the northern side of the headland and slow southern sand transport on the southern side. The Sunshine Coast has several long beaches (i.e. Currimundi to Buddina, Mudjimba to Point Arkwright and Coolum Beach) where waves breaking at an angle to the shoreline generate longshore currents that dominate sediment transport. These currents run from south to north and result in an overall northern movement of sand.

The currents in Mooloolaba Bay are more complex and have been comprehensively reviewed in the *Coastal Processes Study* (BMT WBM 2013b). At any given time, the sediment transport processes within Mooloolaba Bay may be influenced by a combination of tides, wind and waves.

The *Coastal Processes Study* (BMT WBM 2013b) identifies tidal currents as the dominant sand transport mechanism 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 south easterly waves within the passage work the sand in a north westerly direction onto the shore of the mainland. 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, primarily driven by the small prevailing south easterly waves.

A literature review undertaken as part of the Background Study identifies that monitoring over the past 40 years indicates that, despite episodes of significant erosion, beaches have experienced minor net

erosion. This indicates that beaches appear to be dynamically stable, though additional coordinated monitoring is required for confirmation.

3.3 Regional coastal resources and values

In considering the most appropriate management response to current and potential shoreline erosion threats, it is important to identify and ascribe significance to coastal values (that is *function*s or *uses*). Usually, values are categorised in natural (that is environmental) or human use (that is economic, recreational and social) contexts. It is also important to identify the coastal resources (examples are given below) and processes (tides, waves, currents, wind and sediment transport, see Section 3) that support these values. Natural processes, resources and values are to a large extent interconnected and interdependent. It may be helpful to consider natural process and natural resources as interacting to deliver natural values with the resulting environment being the basis of human use values. Through ancient associations, cultural sites and traditional customs may also be considered coastal resources that deliver human use values. The integrity and stability of natural and cultural resources, and the values that they support, is influenced by natural processes and human activities (development, restoration works & recreation) in the coastal zone.

Examples of the relevant coastal resources that support natural and human use values include:

- Coastal and estuarine waters
- Beaches and dune systems
- Coastal wetlands, forests and heathland
- Headlands and rocky foreshores
- Reef systems
- Indigenous Traditional Owner cultural resources
- Cultural sites
- Sand and gravel
- Land within the coastal zone

3.4 Ascribing significance to values and impacts

The significance of specific values - and the resources, processes and/or infrastructure that support them - largely depends on the extent to which importance is ascribed or acknowledged by the local, regional and greater communities. Important values, particularly those that are iconic and/or highly susceptible to adverse impacts are typically provided a level of legal protection by federal, state and local governments. These legal protections are usually accompanied by specific policies and guidelines for the protection and management of natural, cultural and economic values and/or the supporting resources and processes. Significant values may also be recognised in non-statutory policies and documents and/or culturally by local communities.

3.4.1 Values

The Queensland State Planning Policy 2013, State Policy for Coastal Management 2012, and Council's Waterways and Coastal Management Strategy 2011 - 2021 present clear principles and policies for the protection of coastal resources, values and processes and facilitate the sustainable economic and social use of the coastal environment. Council's Economic Development, Open Space, Social Infrastructure and Biodiversity Strategies provide additional context within which coastal resources and values are identified and considered, highlighting the multiple interests and general significance of the coast to the sunshine coast community. These legislative and strategic policies identify certain constraints regarding the protection of natural, social and economic values of the coastal environment.

3.4.2 Impacts

The significance of impacts upon resources, processes and values depends on the duration, scale and cumulative effects associated with the impact, noting that some values may be more susceptible to

specific impacts than other values and that the 'scale' of an impact must consider the likely response of specific values and the extent to which the effects are permanent.

While costs are the financial inputs into a venture or project, an impact (that is the *output*) is what results from a particular course of action or inaction and may in effect be adverse (negative benefit) or beneficial (positive benefit) with respect to resources, processes and values. Overall, an impact can be considered adverse when the negative aspects outweigh the positive; and, beneficial when the positive aspects outweigh the negative. Mitigation or otherwise of adverse impacts may have further financial implications such as additional funds to mitigate an impact or, otherwise, lower land values or loss of business, for example.

3.4.3 Potential conflicts in values

A conflict in values may arise when, for example, existing development or social and economic (public) infrastructure is susceptible to adverse impacts from coastal erosion and where intervention to protect infrastructure might significantly interfere with natural processes, such as sand accretion, erosion and transport; or natural values such as loss of turtle nesting beach. In such cases, the relative significance of values needs to be established to determine the preferred course of action or inaction.

3.5 Overview of local coastal values

The natural and human use values of the coastal environment are not normally mutually exclusive such that they fit perfectly into just one category, that is natural, social or economic values. Instead, values tend to have dimensions that could be considered appropriate for inclusion in multiple categories. While acknowledging this multi-faceted nature of values, they can be categorised depending on where their main strength lies. When considering the relative significance of competing values it is important to note that 'shadow' financial values may not be able to be accurately ascribed nor relevant where clear management direction or protection is provided by legislation and/or policy. The following three sub-sections provide an overview of local coastal values that are important to the community and are relevant for consideration when preparing Shoreline Erosion Management Plans. A more general and technical discussion of values is included in BMT WBM 2013a.

3.5.1 Natural values

Natural values can be described as environmental or ecological values that are associated with biodiversity and ecosystems, populations and species and are usually intimately connected with a level of interdependency on the natural processes and resources that deliver these values (see Section 3 and BMT WBM 2013b for more on these processes). Natural values, resources and processes form the basis for most of the coastal human use values, which may also be dependent on other built infrastructure that facilitate enjoyment of the coastal environment.

Broad examples of natural values include:

- biological diversity and productivity – Regional Ecosystems, significant populations (flora and fauna), nutrient processing;
- habitat – that is essential for migratory birds, fisheries nurseries, turtle nesting, other native plants and animals;
- significant and iconic species – for example: various migratory birds, the dugong, sea turtles and the black swan.

Specifically, the Sunshine Coast carries numerous significant natural values, some of the most noteworthy include:

1. Large extents of significant sand dunes;
2. Significant National Parks (NP), including Mount Coolum NP, Mooloolah River NP, Noosa NP, Bribie Island NP;
3. A small but significant proportion of Queensland's mainland breeding populations of the endangered loggerhead turtles;
4. Numerous Regional Ecosystems, conservation reserves and core habitat areas and linkages;

5. Ramsar listed wetland and Moreton Bay Marine Park listing for Pumicestone Passage;
6. Numerous *High Ecological Value* (HEV) designations for marine waters and coastal wetlands;
7. Two *Fish Habitat Areas* (FHA):
    a. Pumicestone Channel FHA;
    b. Maroochy River FHA; and
8. Numerous listed (e.g. endangered, vulnerable, threatened) and iconic species.

3.5.2 Social values

Social values can be described as a human use values that are based on cultural associations or recreation, including passive and active recreation. Passive recreation can include appreciation of the coastal environment; landscape/water views; or, simply being in the environment. Active recreation includes all types of activities such as, for example, walking, swimming, fishing, surfing, kite boarding, boating, and surf lifesaving competition.

The local Aboriginal people have an ancient and ongoing association with the environment and its management, including a complex cultural, spiritual and social relationship with natural waterways and coastal foreshores. There are many sites and places (e.g. Mudjimba Island) of cultural significance alongside Sunshine Coast waterways that contain material items linked to traditional law, customs, stories and spiritual ownership. Many native animals, birds and plant species, including aquatic species, also have Aboriginal cultural significance. The recognition, protection and conservation of Indigenous and post-European cultural values associated with coastal foreshores need to be factored into all decisions affecting our natural waterways and coastline.

Recreational, fishery and maritime activities have shaped cultural heritage since European settlement, driving strong community associations with the coastal environment. Surfing culture and the Surf Lifesaving movement continue to be iconic components of the Sunshine Coast community. Notable examples of listed heritage sites include, for example, the Kings Beach Bathing Pavilion, the former Caloundra Lighthouse, the SS Dicky wreck and Cotton tree Holiday Park.

The coast is at the core of the Sunshine Coast identity and has influenced the settlement patterns and lifestyle. Many organised and informal clubs and groups arise based on a common appreciation of the coast and drive to contribute to preservation and safe enjoyment of its values, including, for example: surf lifesaving clubs, surfboard rider clubs, boating clubs and community, environmental and rehabilitation groups. Many coastal management activities have strong social and community dimensions; however, many are also recognised as having an economic dimension. For example, efforts associated with the rehabilitation of dunes to primarily improve ecological resilience may also contribute to improved function of the dune as an erosion protection buffer and preserve areas that facilitate revenue generating activities and opportunities, for example, through tourism.

3.5.3 Economic values

Economic values can be considered those human use values that have a significant dimension associated with facilitating business or generating, or protecting, financial value. This may include tourism, commercialised recreation, increased land values, service industries and capitalisation of resources (for example: fishing, sand extraction or land development).

In terms of profile and employment, tourism is one of the largest industries on the Sunshine Coast, attracting millions of visitors each year (for example, approximately 4.5 million beach visitors per year between 2009 and 2011, Raybould et al., 2013). Tourism contributes approximately $1.56 billion to the regional economy and directly provides approximately 20% of jobs on the Sunshine Coast. The Sunshine Coast tourism industry is largely based on the recreational opportunities provided by the coastal environment.

A recent study (Raybould *et al*., 2013) estimated the recreational value of Sunshine Coast beaches to local residents at almost $200 million each year and beach related tourist expenditure at $270 million per year.

All of the coast's beaches are highly valued and considered significant by the local and tourism communities alike. Most beaches have a strong natural values set and/or strong social and economic value sets. Human use values are usually associated with recreational and economic opportunity. The beaches and other coastal environments that have high significance with respect to recreational utilisation and tourism, including tourism accommodation, include:

- Coolum Beach
- Marcoola beach
- Maroochydore Beach
- Alexandra Headland Beach
- Mooloolaba Beach
- Kings Beach
- Bulcock beach
- Pumicestone Passage

Additional values and functions of the coast that are considered to have a strong economic dimension include:

- Maritime infrastructure - e.g. Mooloolaba State boat harbour
- Shore stabilisation and erosion protection buffers (beaches and dune systems, wetlands, reef systems)
- Flood mitigation (protection) capacity of wetlands and estuaries
- Scientific and technological significance driving professional research and scholarship
- Locality for development including opportunities for tourist facilities, existing urban settlements and primary industry
- Extractive Industry including quarrying and sourcing of sand for beach nourishment
- Commercial fishing in beach and estuary environments
- Navigation, navigation markers and dredging operations facilitating navigation and safe depths in estuaries and bar crossings
- Assimilation of urban stormwater and treated wastewater
- Commercialised recreation and sports including major events with a strong coastal dimension
- Support services and industries that supply equipment and services that facilitate enjoyment, protection or management of coastal values – e.g. boat charters; bait shops; surf shops; volunteer and professional surf lifesaving; coastal management activities; Landcare, wildlife and habitat rehabilitation groups.

4 Common shoreline erosion management options

Figure 4.1: from top: dune restoration; beach nourishment; groyne and seawall

This section provides a brief overview of the common shoreline erosion management options and the associated likely advantages and disadvantages. All options presented in the SEMP include coordinated shoreline monitoring. Common shoreline management options can be generically categorised as *soft* or *hard* options. Refer to Table 4.1 for an overview of the common options.

4.1 Soft options

Soft Options restore and/or preserve the natural character, behaviour and values of the coastal system, including natural coastal processes and values, and include:

- dune management – restoration (including dune building using accretion fencing) and revegetation;
- beach nourishment, sand relocation and scraping, and
- regulatory and planning instruments that manage activities in erosion prone areas and sensitive coastal environments (e.g. protected areas, vehicle/boating use restrictions and development controls).

4.2 Hard options

Hard options involve construction of works to:

- alter the natural processes to change the way in which the beach behaves (usually options include groynes and artificial reefs), and
- form a barrier to natural coastal erosion to protect land or other infrastructure (usually options include revetments, seawalls and breakwaters).

4.3 Hybrid options

Hybrid options involve a combination of both hard and soft options and are often most suited to situations where existing high value or strategically significant land or other infrastructure lies within the erosion prone area of a high utilisation beach. For example, sea walls may be combined with ongoing beach nourishment to minimise or mitigate impacts on natural processes and social and economic (human use) values.

Table 4.1 Overview of common shoreline erosion management options

Option	Advantages	Disadvantages	Comments
Maintain Existing Arrangements (with additional coordinated monitoring only)	(a) Beach continues to behave naturally (in the absence of hard infrastructure) (b) No additional expenditure on protective options (c) Monitoring informs future decisions	(a) Land and infrastructure may be subject to erosion impacts (b) Existing infrastructure may negatively affect natural processes	This approach is most appropriate in low risk scenarios and must consider any existing protection works. Existing infrastructure can have a negative impact on coastal processes and resources and may require mitigation works.
Dune Management-Building and Restoration (Soft Option)	(a) Larger well vegetated dunes trap more sand (b) Improves dune habitat and resilience	(a) Ongoing cost and commitment to achieve well established dune vegetation; subject to cross shore erosion	General low cost and prudent option to maintain existing dune buffer in low risk scenario; provides natural and social values.
Beach Nourishment (Soft Option)	(a) Increases beach buffer width and therefore increases land and infrastructure protection (b) Can improve natural and human use values of beach	(a) Sources of nourishment sand not always close to nourishment site (b) Ongoing cost; subject to cross shore erosion	Appropriate for low to moderate risk scenarios and as part of hybrid options to mitigate adverse effects of hard options. May delay the need for hard options.
Groynes (Hard Option)	(a) May be effective in building beach on up drift side (b) Effective channel training structures	(a) Interferes with coastal processes. Does not prevent erosion – merely transfers it (b) High level of maintenance	Useful in conjunction with beach nourishment or if erosion on down drift side is acceptable; can be used to train tidal channels.
Artificial Reef (Hard Option)	(a) May be effective in building up beach on up drift side (b) Shelters beach from storm attack (c) May offer recreational opportunity (e.g. surfing)	(a) Cost is usually prohibitive. Lack of consensus on benefits. (b) Interferes with coastal processes - results in erosion on down drift side	Cost can be cost prohibitive and special design requirements apply.
Seawalls, revetments and breakwaters	(a) Commonly used as last line of defence for protection of land and infrastructure	(a) Cost is usually high.	Should only be used as *planned* last line of defence for strategically significant assets in moderate to high

Option	Advantages	Disadvantages	Comments
(Hard Option)	(b) Provides direct land and infrastructure protection	(b) Interferes with coastal processes, can increase erosion of beaches in front and at edges of wall.	risk scenarios. Locks up sand behind the wall. Results in turbulence and reflects wave energy; increasing erosion.

5 The SEMP preparation method

The preparation of the SEMP and evaluation of management options was broadly undertaken in three steps as outlined below.

5.1 Step 1 – Background Study

The SEMP is informed by a significant body of work, known as the Background Study. The *Legislative Framework and Generic Shoreline Management Options* (BMT WBM 2013a), and the *Coastal Processes Study for the Sunshine Coast* (BMT WBM 2013b), serve as the foundations of the Background Study.

In addition, the Background Study includes further specialist advice and stakeholder input, all of which underpin a sound understanding of local coastal process and values and an informed position on the utility of various erosion management options.

In preparing the SEMP, the Background Study has been considered in the broader context of Council's Corporate Plan and strategies and the public interest. While the Background Study, particularly the coastal processes investigation, has considered multiple planning horizons (up to a 50 year horizon), the SEMP considers a 10 year planning horizon.

5.2 Step 2 – Screening for coastal erosion threats

Prior to checking for coastal erosion threats, the coastline was categorised into **4 shoreline management zones** made up of **28 beach management units**. The boundaries for these zones and localities were based on physical features that affect coastal processes such as rocky headlands and river entrances. Detailed maps of the 4 management zones and 28 beach units are given in Appendix A.

Once boundaries were established, the dominant coastal processes and the social, economic and environmental values were identified for each zone and beach management unit.

Following this, the *defined erosion prone area* (erosion event of approximately 1% Annual Exceedance Probability) was applied to screen for threats to Council controlled infrastructure within each zone and beach management unit. Where significant Council assets were identified as being subject to erosion or at threat from being in the erosion prone area, the site was considered an erosion management priority.

5.3 Step 3 – Selection of preferred erosion anagement responses

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

An internal reference group was established to review the relevant coastal values and to ensure the interests of all areas of Council and the community were represented during the option evaluation process. A decision making process (see the overview provided as Figure 5.1) was followed to assist in the identification of appropriate management responses.

The decision making process formalises the statutory requirements of the QCP and the policy requirements of the *Waterways and Coastal Management Strategy*, and is consistent with the Council's draft Coastal Management Policy (Public Lands), in that it seeks to maintain:

- Coastal processes – (e.g. currents, long-shore and cross-shore sand transport);
- Economic values – (e.g. tourism, existing development, roads and other infrastructure networks);
- Natural values – (e.g. areas of High Ecological Significance, Significant Dunes, Fish Habitat Areas), and
- Social Values – (e.g. open space, community facilities, cultural heritage, utilisation of the coastal environment).

The decision making process enforces a key constraint of the legislative and policy framework: that is, that natural processes and resources are given precedence over land and infrastructure unless there is a compelling case for intervention. Generally, a compelling case will involve establishing that a specific

landuse or infrastructure item is strategically significant and/or an overriding public/strategic interest exists to the extent that the cost and impacts of an erosion management response is justifiable.

When applying the decision making process, and considering which of the erosion management options is most suitable for a particular site, a range of factors were considered including:

- community values – social economic and environmental;
- significance of the asset/infrastructure;
- objectives of the erosion management works;
- physical attributes/constraints of the site; and
- capital and operational costs of preferred options.

Implementation of the decision making process

Where existing infrastructure is located within the defined erosion prone area, it should only be protected where it is in the strategic interests of the community to do so. Such a case may include where resilience cannot be built into the structure and the infrastructure cannot be reasonably relocated or abandoned. Such protection works need to be fit for purpose - that is, they need to be capable of the addressing the specific erosion threat and be cost effective. They also need to be appropriate within the context of the local values. Depending on specific situations, it may be appropriate to identify trigger points for action, such as identifying a breach of a minimum buffer distance to a particular asset as the trigger to implement a course of action. Such scenarios should have approvals and designs in place or significantly prepared in advance. It may also be appropriate to stage the implementation of more complicated or hybrid options to integrate an element of flexibility through observing the response of the dynamic coastal environment to particular stages and, where appropriate, adjust the course of action accordingly.

Where intervention to protect land, infrastructure or other human use value is deemed in the interest of the community, the relevant statutory and policy positions require the avoidance or minimisation of adverse impacts. This results in a preference for lower impact and more adaptable soft options (e.g. beach nourishment, beach scraping) over hard options (e.g. seawalls, groynes). There may be situations where hard options are deemed necessary to protect land and other infrastructure. Specifically, where the protection offered by soft options does not adequately protect the asset against the defined erosion threat. Therefore, a preference for soft options tends to be most appropriate for the protection of existing adequate buffers; beach amenity (including with respect to mitigating adverse impacts of hard protection options); dunes; and, land-based infrastructure with respect to smaller storm related events, or for use in otherwise low risk scenarios.

Where hard options such as groynes and seawalls are likely to result in significant adverse impacts, hybrid options that include beach nourishment may be required to minimise these impacts. However, where soft and hybrid options are not viable, it may still be appropriate to implement hard options such as in cases where infrastructure values are sufficiently significant to outweigh potential adverse impacts. All of these impacts are subject to very close scrutiny under approvals processes.

Finally, having considered the advantages and disadvantages of potential options, a *preferred* management response is recommended for each beach management unit. Each response is considered viable, cost effective and in the strategic interests of the Sunshine Coast Community. Most options require approvals and permits from State and Local authorities, and some may trigger federal interests. These approval processes will require the preparation of detailed designs and more in depth assessment of values, potential impacts and mitigation requirements. Further information on the assessment of each beach unit is provided in Section 6.

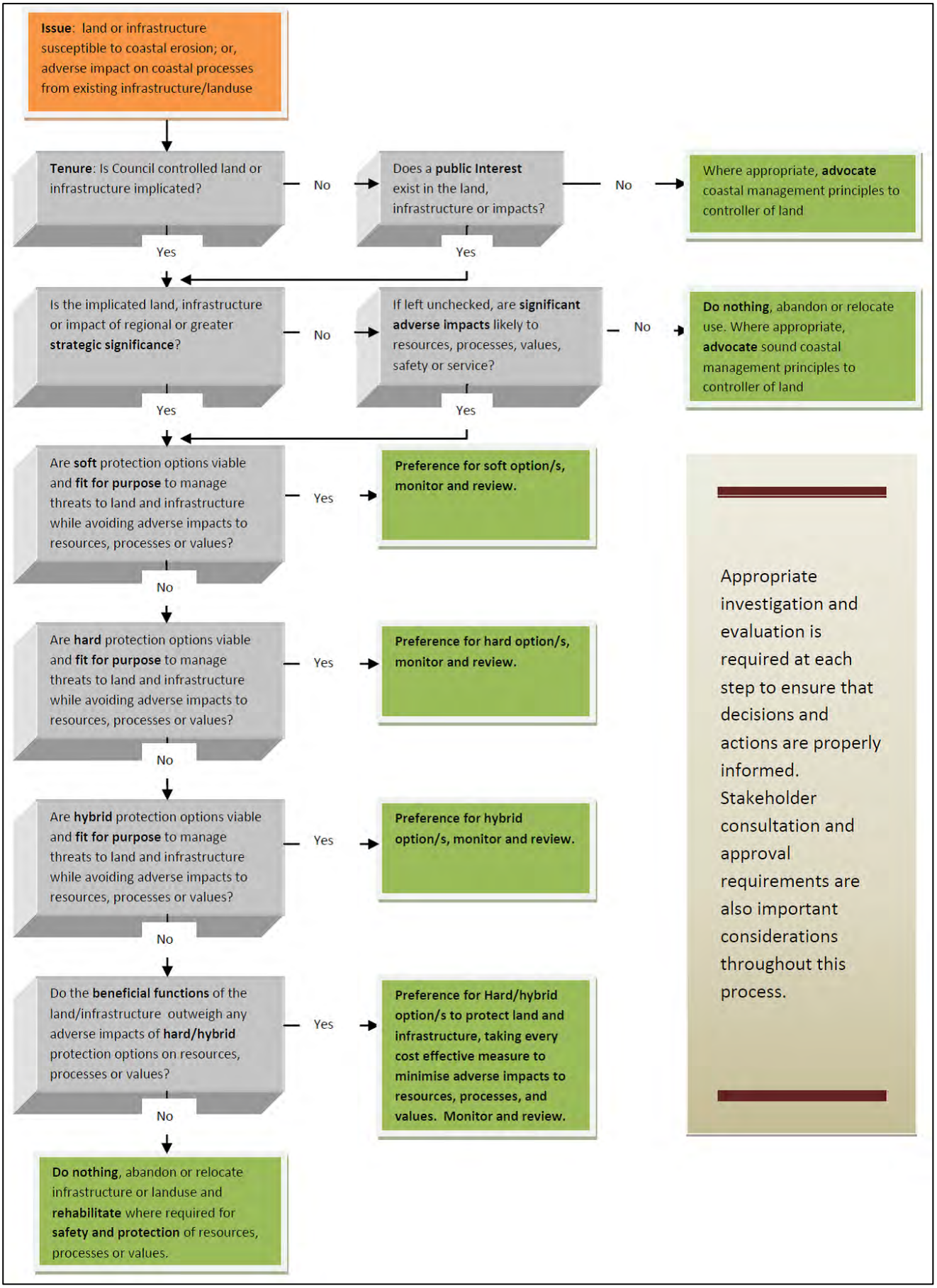


Figure 5.1: Decision making process to identify appropriate shoreline erosion management measures