Report on: Erosion at Cloherty's Peninsular, Moreton Island

1.0 Introduction

This report has been prepared by the Coastal Management Unit of Environment Planning for Moreton Bay Marine Park Operations to assess the coastal processes affecting the eastern shoreline of Cloherty's Peninsular, Moreton Island. Erosion of this beach has exposed a disused landfill site on a reserve (Lot 51 on SL8794) located east of the Kooringal Township.

The purpose of this assessment is to investigate channel migration and other coastal processes that may be contributing to erosion of the subject beach. The assessment will assess the likely rate of erosion over the short to medium term and provide some advice on the likely long term prospects for this beach.

2.0 Site Description

The study site is the eastern beach of Cloherty's Peninsular, Moreton Island between Mirapool to the north and Reeders Point to the south (refer Figure 1). This beach has a south-easterly aspect and is exposed to waves from the east to north-east sector. The site is protected from the prevailing south-easterly waves by North Stradbroke Island. The site is influenced by the tidal channels within South Passage, the entrance to Moreton Bay between North Stradbroke and Moreton Islands.

South Passage is influenced by two main channels, the Rous and Rainbow Channels. The more dominate Rainbow Channel has a north-south orientation and runs along the western foreshore of North Stradbroke Island and along the eastern foreshore of Moreton Island. The Rous Channel is orientated roughly in an east-west direction and joins the Rainbow Channel approximately halfway between Moreton and North Stradbroke Islands.

This section of coast is highly dynamic due to wave exposure and the magnitude of tidal currents through South Passage. Lateral movement of the Rainbow Channel and changes to the channel configuration through South Passage has resulted in persistent erosion of the foreshore at Amity Point, North Stradbroke Island and the eastern foreshore of Cloherty's Peninsular, Moreton Island.

Erosion along the eastern foreshore of Cloherty's Peninsular does not threaten any freehold land. However, a disused landfill site on a Reserve is located approximately halfway along the subject beach and ongoing erosion has exposed buried waste, primarily car bodies, on the beach. Brisbane City Council has previously undertaken works on a number of occasions through the 1990's and early 2000's to remove waste material from the beach and dunes. The material is currently exposed along a 100m length of beach and it is uncertain how much additional material remains buried in the dunes adjacent to the beach.

2.1 Site Inspection

The study site was inspected on 13 July 2010 with QPWS officers to ascertain the extent of erosion that has occurred in the last 12 months. Figure 2 shows the location of the landfill site and exposed waste in relation to the 2004 and 2009 seaward

vegetation line (assumed shoreline). Figure 3 shows the seaward vegetation extent and edge of exposed landfill measured on 13 July 2010 in relation to the 2004 and 2009 shoreline. Since 2004 the shoreline has eroded at a consistent rate of approximately 10m/year.

Figure 1: Study Site (Aerial Photograph – 2009)

Source: Aerial photograph sourced from Google Earth (2009)

Figure 2: Shoreline Erosion between 2004 and 2009

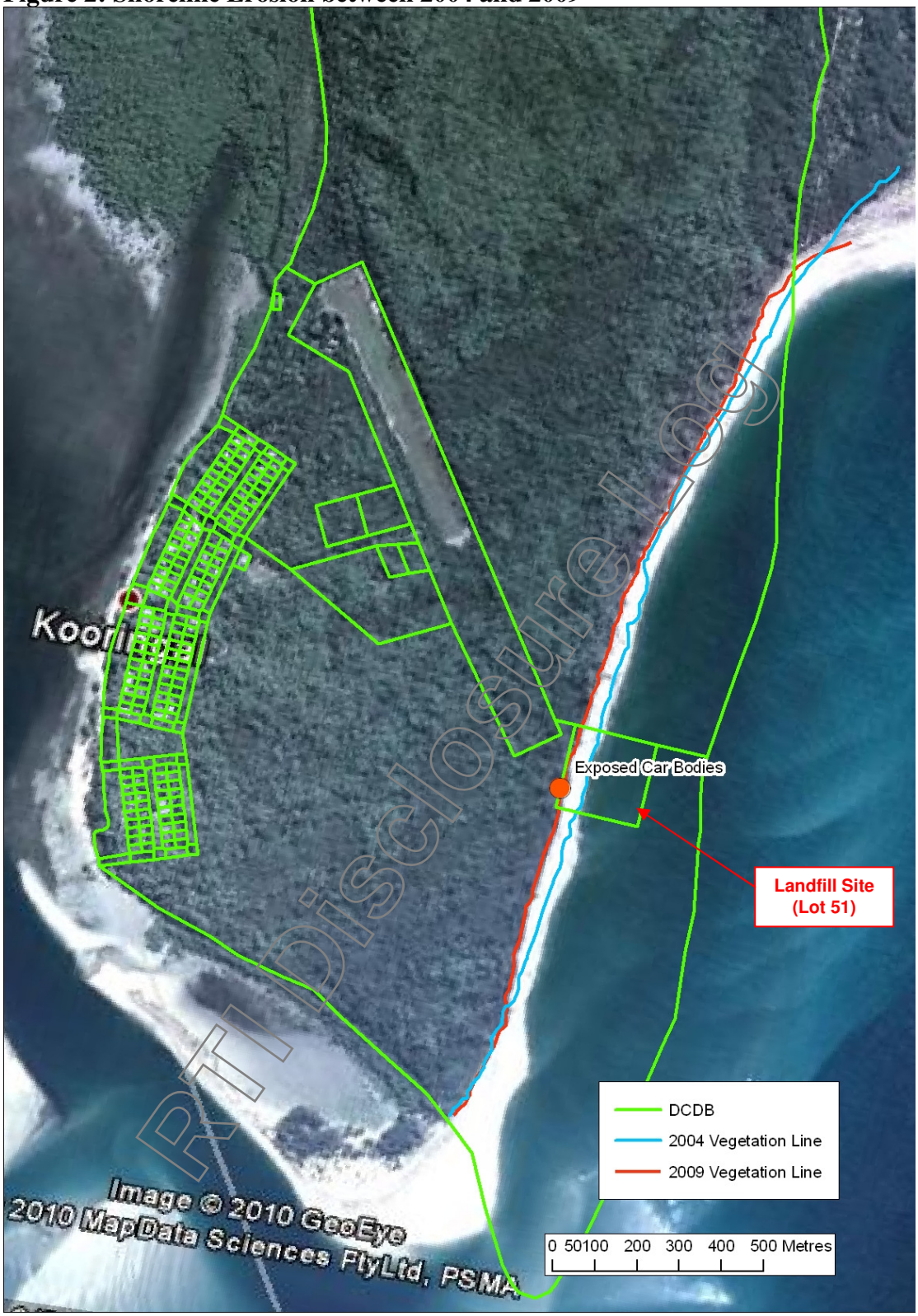


Figure 3: Shoreline Erosion and Extent of Exposed Landfill

3.0 Description of Coastal Processes

This is a highly dynamic section of coast due to the influence of large tidal flows through South Passage between North Stradbroke Island and Moreton Island, and exposure to ocean waves. The purpose of this section is to describe the coastal processes that are important to sediment transport within the study site. These processes include:-

- waves; and
- tides and associated currents.

3.1 Waves

DERM records deepwater wave conditions from a buoy located south-east of Point Lookout on North Stradbroke Island (refer Figure 4). Wave heights and periods have been recorded at this site since 1976 and wave direction since 1998. Figure 5 shows the deepwater wave climate for this section of coast is dominated by waves from the southeast quadrant with a significant wave height (H_S) typically between 1.5 to 2.5m.

Wave transformation processes occur as waves encounter obstructions and travel into shallower water. Along this section of coast the southeast offshore waves bend towards the coast (i.e. refract) as the relative water depth reduces and diffract as they pass Point Lookout. The rapid reduction in water depth across the South Passage Bar causes further refraction, shoaling and breaking of the waves. As such the wave climate at the study site will be significantly different to the offshore wave climate.

Due to the wave transformation processes the wave climate along the southeast foreshore of Moreton Island (including the study site) would be dominated by waves from the east to northeast. Moving north along Moreton Island the dominate wave direction swings around to the southeast as the influence of Point Lookout and the South Passage Bar reduces.

Figure 4: Brisbane Waverider Buoy Location

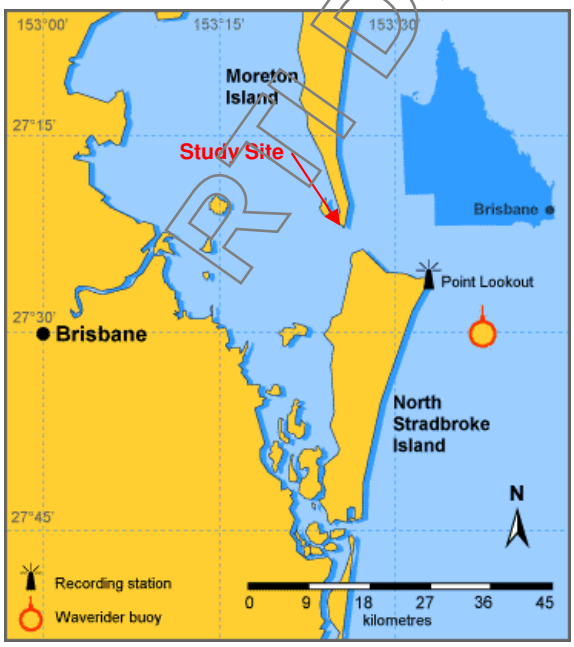
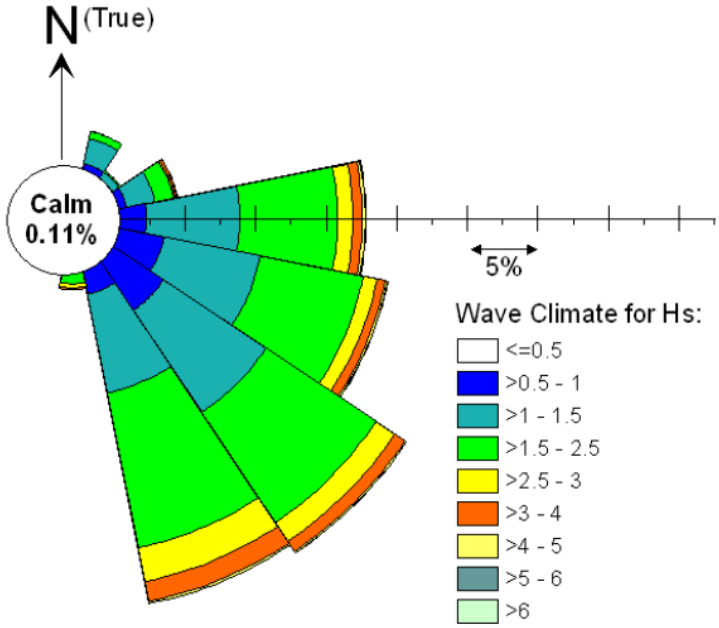


Figure 5: Direction Wave Rose for Brisbane Buoy (March 1998 to April 2010)



Source: Coastal Unit, Queensland Climate Change Centre of Excellence

3.2 Tides

South Passage, adjacent to the study site, is part of a highly dynamic tidal delta and the tidal currents through South Passage drive significant sediment transport processes. This in combination with the wave climate contributes to the erosion rate of 10m/year observed at the study site in recent years.

Tides are caused by the relative motion and gravitational attraction of the Earth, Moon and Sun. While the vertical tidal fluctuations are generated as a result of these forces, the distribution of land masses, bathymetry and Coriolis force determine the local tidal characteristics and currents.

Tides in southeast Queensland are semi-diurnal, that is, there are normally two high and two low tides each day. There is also a difference between successive high and successive low tides (diurnal inequality). Table 1 presents the tidal planes for sites in the vicinity of South Passage.

Table 1: Tidal Planes (Maritime Safety Queensland, 2010)

Place	Tidal Plane (m AHD)						
	HAT	MHWS	MHWN	MSL	MLWN	MLWS	LAT
Amity Point	1.22	0.76	0.44	0.07	-0.40	-0.72	-1.02
Dunwich	1.40	0.85	0.46	-0.08	-0.55	-0.93	-1.30
Rous Light*	1.52	0.96	0.57	0.00	-0.45	-0.84	-1.21

* Levels estimated from Mean Sea Level

Amity Point is located in close proximity to the study site at South Passage and the tides at these two locations would be similar. Amity Point has a tide range of approximately 1.5m at spring tides.

Dunwich is located at the southern extent of the Rainbow Channel and Rous Light is located at the western extent of the Rous Channel. These two sites have a tide range of approximately 1.8m at spring tides. The greater tide range within Moreton Bay in comparison to South Passage is due to amplification of the tide within the Bay.

There is also a time lag between the tide in Moreton Bay and the ocean. At Dunwich there is a lag of approximately 50 minutes for high tide and 70 minutes for low tide when compared to Amity Point. Similarly, the tides at the Rous Light lag behind Amity Point by approximately 49 minutes for high tide and 60 minutes for low tide. The longer lag time for low tide indicates the tide in these two channels is asymmetrical. The tidal asymmetry results in the magnitude of the flood (incoming) tide being much greater than the ebb (outgoing) tide. This would therefore drive a higher sediment transport rate on the flood tide.

4.0 Sediment Transport Processes

South Passage is a high dynamic system and sediment transport processes are very complex. Figure 6 shows some of the main features associated with the sediment transport processes through South Passage determined from the most recent aerial photography.

As previously discussed there is a southeast dominated wave climate in this region. However, along the southeast foreshore of Moreton Island waves are transformed by Point Lookout and the South Passage bar resulting in an east to northeast dominated wave climate driving a southern longshore transport of sand. Further north along Moreton Island the effect of Point Lookout and the South Passage bar on the wave climate reduces and wave are predominately from the southeast and the longshore transport is to the north. There is a transition point along the eastern foreshore on Moreton Island where the beach is often eroded back to coffee rock deposits.

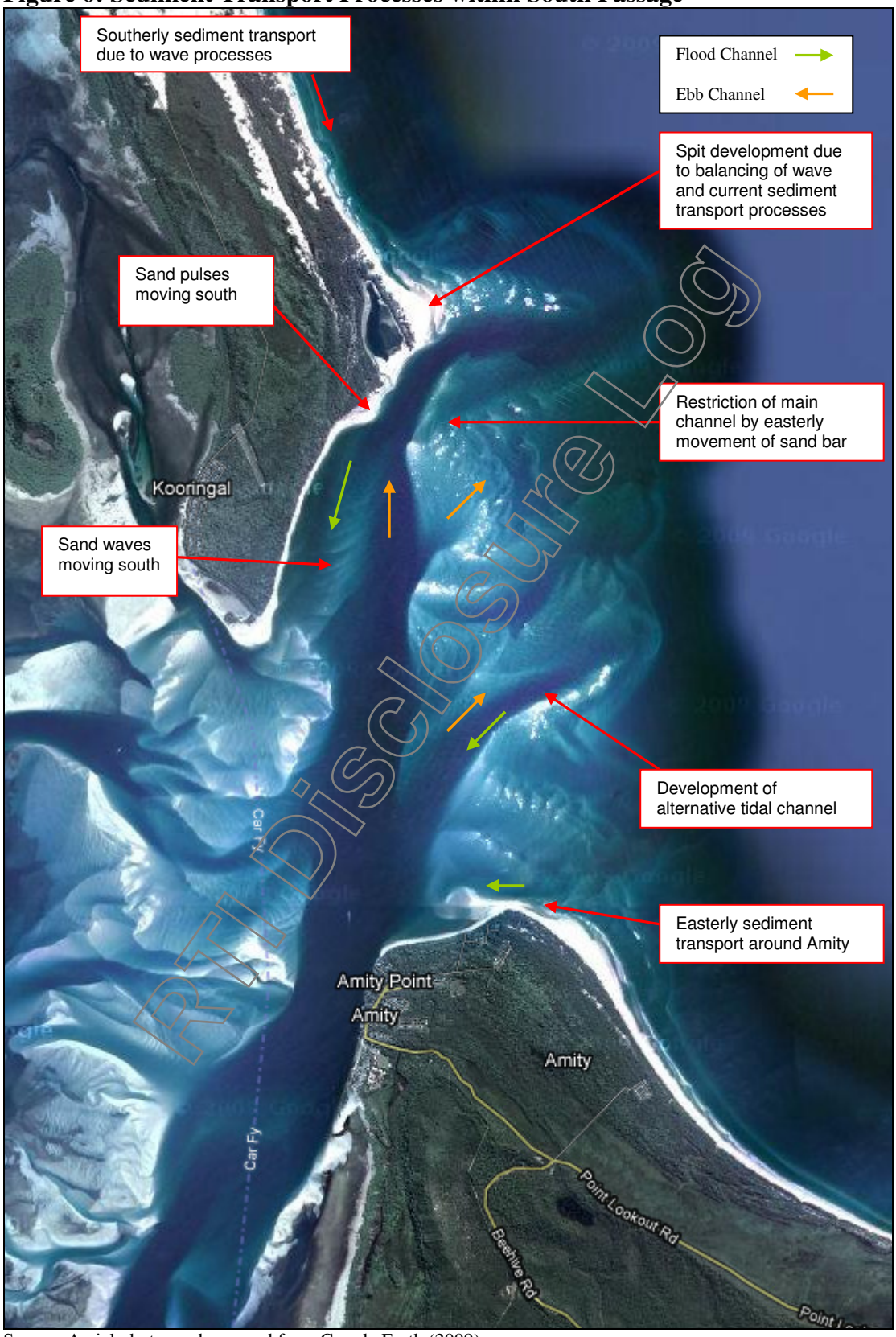
The 2009 aerial photograph shows that South Passage consists of a complex network of channels and sand banks dominated by the north-south orientated Rainbow Channel. The magnitude of the flood tide current through this channel is greater than the ebb tide current due to the local tide characteristics. This drives a southern transport of sand along the southeast foreshore of Moreton Island south of Mirapool. Sand pulses immediately south of Mirapool and the orientation of sand waves within the channel adjacent to the foreshore indicate this southerly sand transport.

The Rainbow Channel is being restricted at the northern end by the development of the Mirapool spit and the western migration of offshore sand bars. In the long-term the restriction of the main channel may lead to the development and increased dominance of another channel. The 2009 aerial photograph shows an alternative tidal channel is forming further to the south and under favourable conditions may become the more dominant channel over time with the progressive abandonment of this channel.

In the long-term a switch in dominance of tidal channels through South Passage would reduce the erosion pressure on the study site. Under such a scenario the sand banks southeast of Mirapool would continue to migrate westward and eventually lead to the accretion of the beach at the study site. Such processes operate over a very long

cycle in the order of decades. Sand transport southward from Mirapool would also assist in channel closure and dune rebuilding.

Figure 6: Sediment Transport Processes within South Passage



Source: Aerial photograph sourced from Google Earth (2009)

5.0 Discussion

The coastal process affecting sediment transport along the eastern foreshore of Cloherty's Peninsular have been investigated to assist in managing an exposure of buried landfill waste by sea erosion.

The coastal processes in the vicinity of the study site are very complex and dominated by tidal currents through the channels of South Passage. The wave climate along this section of coast is affected by South Passage and North Stradbroke Island causing sand to be transported southward into the tidal delta. There has been ongoing erosion of the subject beach due to tidal channel migration and since 2004 the beach has eroded at a rate of up to 10m/year. The disused landfill site has now been almost entirely eroded away exposing waste, primarily car bodies, on the beach.

The beach erosion trend of 10m/yr is expected to continue over the next 2 to 4 years at a rate at least comparable to the current erosion rate and there is a strong possibility that the erosion rate will accelerate as the westward migration of offshore sand bars forces the channel closer to the shoreline. As such continued exposure of buried material within 30 to 50m of the present day coast can be expected over the next 3 years.

The coast remains vulnerable to wave erosion from severe storm events and it is likely that sudden erosion episodes could occur and increase the overall extent of recession in this period in the order of 10m.

In the longer term the westward migration of sand shoals and sand delivery southward from Mirapool will progressively restrict tidal flow and increase the likelihood of another tidal channel to the south developing and becoming dominant over time. Meandering and switching of channel dominance is part of the normal coastal processes within tidal entrances over decadal time periods. If this scenario develops the erosion rate will slow and stop over a 5 to 15 year period. However, this is not anticipated to assist in managing the landfill exposure in the short term.

6.0 Management Options

There is a high certainty that erosion of the beach is expected to continue at current rates and a shoreline recession of up to 50m is expected within the next 3 years. Waste buried in this zone will be exposed on the beach and will be deposited within the Rainbow Channel within 5 years. The following summarises the available management options:

- ***Do nothing*** –
  The waste material would be allowed to be dispersed in to the channel and reburied by channel migration processes. This option is highly dependent on the characteristics of the waste (quantity, contaminants, dispersibility of the material) and likely environmental harm. Depending on the nature of the waste material this option may be inconsistent with DERM waste policy and could only be considered for a relatively small waste mass that poses minimal risk of environmental harm.

- ***Remove waste on the shoreface as progressively exposed –***
  This option will involve regular monitoring and possibly frequent cleanups operations. An assessment of the waste material is required for this option at it is only suitable if contaminated waste is not present and the waste is not readily dispersed from the site. It is likely that access to the beach to collect waste material will be limited by the tides.

- ***Pre-emptive landfill waste removal –***
  This option involves identification of buried waste locations within a 20-50m zone and excavation and removal of the waste. The removal operation can be staged depending on resources, with staging of the operation based on monitoring to track the actual erosion rate. There is limited access on the beach at high tides but there is sufficient space available on the dunes to provide a clear all tide work and stockpile area. Given the rapid erosion rates the removal of vegetation and excavation of landfill material would not have any significant adverse long term impact on the coastal processes.

- ***Works to halt erosion –***
  Engineering works could be undertaken to protect the landfill site. The construction of a seawall is the only possible action but is considered cost prohibitive and inconsistent with the Queensland coastal management policies and the zoning of the adjacent marine park.

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