REPORT

Elements of Byron – Extension to Existing Geobag Coastal Protection Works

Coastal Engineering Assessment

Client: Elements of Byron

Reference: PA3267-IB-RP-221121

Status: Final/00

Date: 29 May 2023

Royal HaskoningDHV
Enhancing Society Together

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1 Introduction

1.1 Background

Coastal protection works in the form of a geobag wall approximately 210m long exist along part of the boundary of Elements of Byron within the entrance area of the Belongil Estuary. These works are located wholly on private land owned by Ganra Pty Ltd (Elements of Byron) and were constructed in March 2015 in response to severe foreshore erosion experienced at the time.

The existing works originally constituted Temporary Coastal Protection Works, placed in accordance with Part 4C of the then *Coastal Protection Act 1979*, Part 3 of the *Coastal Protection Regulation 2011*, and the Code of Practice under the *NSW Coastal Protection Act 1979*. Subsequently, the NSW Coastal Panel confirmed in writing on 18 January 2017 that the existing works are approved to be permanent providing there are no changes to the works and they are appropriately maintained, which is the case. A copy of this letter is included in **Appendix A**.

Recent erosion (February - April 2022) has occurred to the north of the existing coastal protection works and impacted adversely on Elements of Byron assets, public safety, public access and beach amenity.

In response to the recent erosion, Elements of Byron propose to extend the existing geobag coastal protection works to the north by approximately 40m, located wholly on private land. The proposed extension to the existing coastal protection works is permissible with consent. No changes to the existing coastal protection works are proposed.

The proposed life of the extension to the coastal protection works is five (5) years while the Coastal Management Program (CMP) for the Byron Shire Northern Coastline (Cape Byron to South Colden Beach) is completed.

Haskoning Australia Pty Ltd, a company of Royal HaskoningDHV (RHDHV), has been engaged by Elements of Byron to prepare the design and a coastal engineering assessment of the proposed extension to the existing geobag coastal protection works.

1.2 Structure of the Report

The report is structured in the following way:

- Section 2 sets out a brief description of the existing geobag coastal protection works;
- Section 3 provides a description of the recent foreshore erosion;
- Section 4 sets out a description of the proposed extension to the geobag coastal protection works;
- Section 5 sets out a description of key coastal processes and coastal hazards in the subject area;
- Section 6 sets out an assessment of the proposed extension to the geobag coastal protection works in relation to relevant legislation and policies, namely:
  - *Coastal Management Act, 2016*,
  - *State Environmental Planning Policy (Resilience and Hazards) 2021*,
- Section 7 provides a list of References.

2 Description of the Existing Geobag Coastal Protection Works

The existing coastal protection works comprise 0.75m^3 sand filled geotextile containers (geobags) arranged in a stepped profile typically five units high. It is understood the toe level of the geobags is at approximately 0m above Australian Height Datum[1] (0m AHD) and the crest level is at 1.41m AHD. The overall length of the works is approximately 210m. A small return of several metres length was constructed at each end of the works to mitigate the risk of outflanking.

The geobags were filled with sand imported to site from a commercial sand extraction operation at Chinderah. The individual mass of the 0.75m^3 geobags would be expected to be approximately 1.5t based on field measurements of geobags reported in Blacka et al (2007).

The protection works were installed in response to ongoing foreshore erosion in the entrance area to the Belongil Estuary.

Figure 2-1 shows the location of the existing geobag coastal protection works together with land ownership information. As noted earlier, the works are located wholly on private land owned by Ganra Pty Ltd (Elements of Byron).

Photographs taken during construction of the geobag structure in March 2015 are shown in Figures 2-2 to 2-6. A brochure (installation guidelines) for the 0.75m^3 geobags prepared by the supplier Geofabrics Australasia Pty Ltd is included in **Appendix B**.

As noted briefly in the introduction to this report, the existing coastal protection works were placed in accordance with the Code of Practice under the then *Coastal Protection Act, 1979* (Department of Environment, Climate Change and Water [DECCW], 2011). A copy of this Code of Practice is included in **Appendix C**. Some key requirements of the Code of Practice were as follows:

- sandbags comprising the works must be placed and maintained in a manner that minimises the likelihood of the collapse of the escarpment[2];
- excavation of the escarpment for the placement of the works is not permitted with the exception that, when placing sandbags, limited excavation of the beach (other than the escarpment) may be undertaken to enable the bottom layer of sandbags to be placed approximately horizontally. Any excavated sand is to be placed elsewhere on the beach;
- the height of the works must not exceed 1.5m from the base (or toe) of the escarpment;
- the works must be placed against the seaward side of the escarpment and be within 4m of the escarpment;
- the slope of the face of the works must not exceed 34 degrees from the horizontal plane (1 Vertical : 1.7 Horizontal, or 1V:1.7H);
- emergency coastal protection works must not be placed at any location where other coastal protection works (whether lawfully placed or not) exist[3]; and
- works damaged by tides or waves during a storm are to be repaired or removed as soon as practicable after the storm conditions cease.

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[1] Australian Height Datum is approximately the level of Mean Sea Level at present.
[2] The term sandbag in the Code of Practice referred to a geotextile or woven polypropylene fabric bag having a maximum volume of 0.75m^3 when filled. The term is used interchangeably with geobag in this report.
[3] This provision applied to the situation where emergency coastal protection works were to be placed seaward of other coastal protection works. Having said that, the Code of Practice went on to say that this restriction does not apply if a professional engineer has provided a written opinion that the proposed emergency coastal protection works together with the existing coastal protection works will not provide greater erosion protection than the protection that would be provided solely by emergency coastal protection works placed on the land.

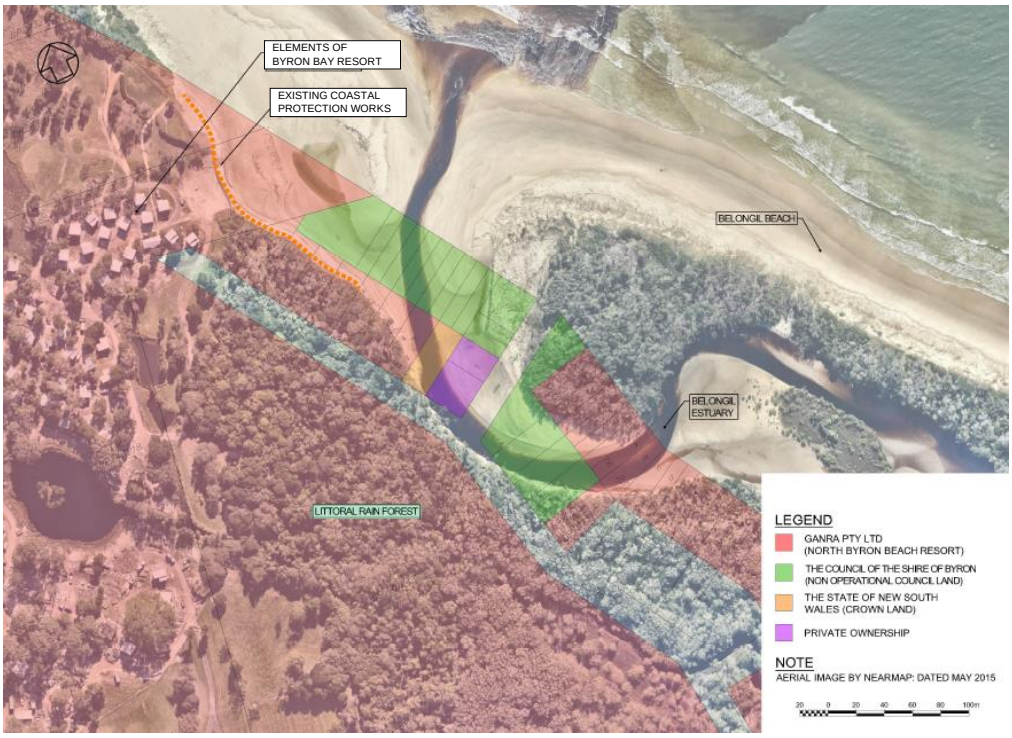

Figure 2-1 Plan showing longitudinal extent of the existing geobag coastal protection works and land ownership

Figure 2-2 Filling geobags with sand from the imported sand stockpile using an excavator (March 2015)

Figure 2-3 View looking southwards during construction showing the prepared foundation for the protection works and the rows of geobags (March 2015)

Figure 2-4 View showing excavator positioning geobags in the structure (March 2015)

Figure 2-5 View of a section of the completed coastal protection works five units high (March 2015)

Figure 2-6 Reshaping and grooming of the beach in front of the protection works at completion (March 2015)

3 Recent Foreshore Erosion in 2022

The erosion of the foreshore which occurred in 2022 is shown in the various images in Figures 3-1 to 3-6 and described in the captions. The damage which is evident to the existing geobag coastal protection works will be repaired as part of the maintenance obligations of Elements of Byron under the approval for these existing works.

An indication of the extent of erosion of private land in recent years can be seen in the comparison of the surveyed land surface (sections) in the area to the north of the existing coastal protection works in Figure 3-7, derived at two times from two survey sources:

- in December 2018 from the ELVIS 'Elevation Information System' online Database managed by Geoscience Australia in which ground levels are determined by LiDAR (Laser Imaging, Detection and Ranging); and
- in November 2022 from a terrestrial laser scanner survey carried out by Bennett & Bennett.

The survey comparison in Figure 3-7 indicates that within 20 to 30m north of the end of the existing geobag coastal protection works there has been a loss of approximately 10m of private land over the period December 2018 to November 2022.

Figure 3-1 Erosion immediately north of the existing geobag structure showing steep dune escarpment and undermining of foreshore assets (20 October 2022)

Figure 3-2 View looking southwards towards the existing geobag structure with erosion escarpment in the foreground (20 October 2022)

Figure 3-3 Close up view of the northern limit of the existing geobag structure and adjacent erosion (25 October 2022)

Figure 3-4 Warning signage 'Danger – Keep Clear of Unstable Bank' near the base of the erosion escarpment north of the geobag structure. The escarpment is at or near the natural angle of repose and is a potential public safety risk to users of the beach (25 October 2022)

Figure 3-5 View of signage 'Danger Zone – Beach Access Closed' at the point of entry to the estuary entrance area from Elements of Byron (25 October 2022)

Figure 3-6 View of restricted access to the crest of the erosion escarpment and facilities due to the safety risk (25 October 2022)

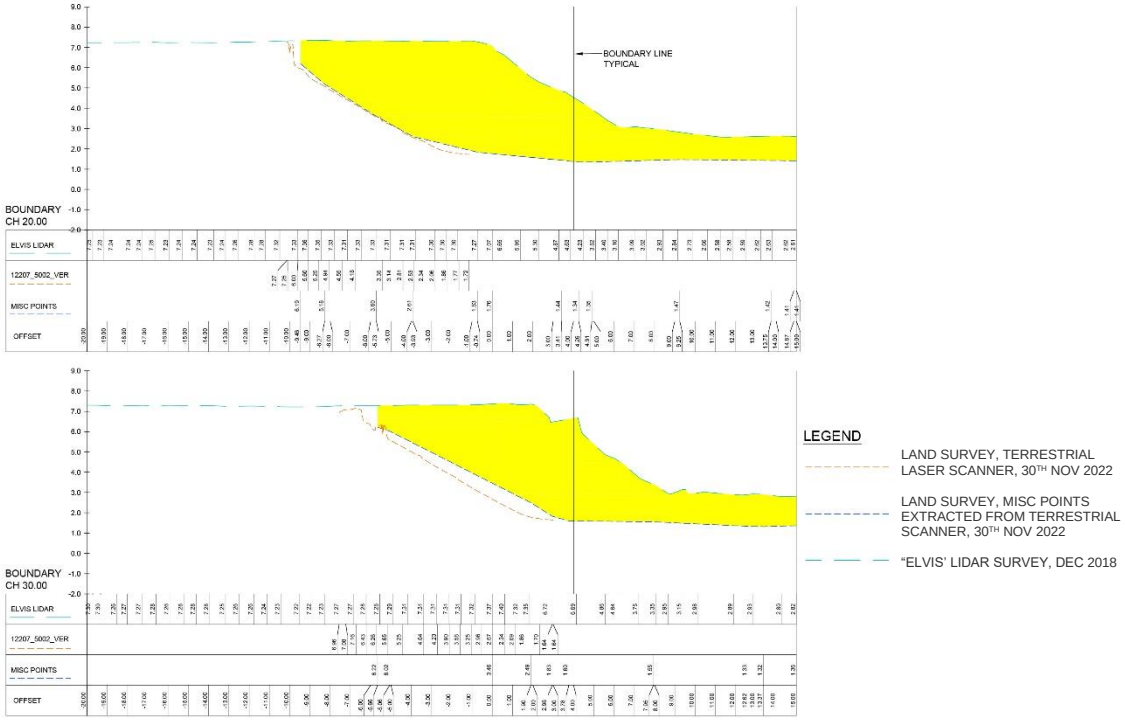

Figure 3-7 Comparison of the December 2018 and November 2022 land surfaces in the area 20m to 30m north of the end of the existing geobag coastal protection works. Difference between surfaces (sand loss) is shaded yellow.

4 Description of Proposed Extension to Geobag Coastal Protection Works

4.1 Design Concept

The extension of the existing geobag coastal protection works is intended to comprise a temporary structure having a proposed life of 5 years while the CMP for the Byron Shire Northern Coastline (Cape Byron to South Golden Beach) is completed. The works are proposed to comply with, as far as reasonably feasible and practicable, the requirements for emergency coastal protection works as outlined in the Code of Practice under the former *Coastal Protection Act 1979* (DECCW, 2011).

The proposed extension to the existing geobag coastal protection works is shown in Drawings 3267-1000, 3267-1101, 3267-1102,and 3267-1103 included in **Appendix D**, and described below.

The extension to the existing geobag coastal protection works would be approximately 40m long and comprise 0.75m^3 geobags arranged in a stepped profile five units high and typically two units wide. The units would be placed in stretcher bond pattern with the long axis parallel to the alignment. The face of the works would have a slope of approximately 1V:1.5H.

Based on an average measured height for the 0.75m^3 geobags of 0.42m (Blacka et al, 2007), the overall height of the works would be approximately 2.1m. The proposed toe level, subject to detailed design, is approximately 0m AHD to match the toe level of the existing coastal protection works. The aim would be avoid or minimise excavation below the water table for placement of the bottom layer. The approximate crest level of the proposed works for a toe level at 0m AHD would be 2.1m AHD.

To reduce the risk of undermining of the toe, it is proposed that an additional geobag would be incorporated in the bottom layer, on the seaward side, encapsulated in geotextile and tied back to the double-layered structure. This is typically referred to as an 'encapsulated self-healing toe'.

The overall design cross section, comprising a double-layer stretcher bond arrangement constructed at a slope of 1V:1.5H and incorporating an 'encapsulated self-healing toe', conforms with the recommendations set out in Coghlan et al (2009) following extensive research on the stability of geocontainer revetments under wave attack, including scale laboratory tests on 0.75m^3 model geocontainers. A similar design cross section was also adopted for recently constructed geobag coastal protection works at Clarkes Beach, Byron Bay (Carley and Flocard, 2021).

Design guidelines for geobag stability under wave attack were published in Coghlan et al (2009) and Hornsey et al (2011) based on the scale laboratory testing. The design curve for 0.75m^3 geobags is shown in Figure 4-1. It shows the significant wave height (H_s) at the structure corresponding to 'Initial Damage' as a function of spectral peak wave period (T_p) for a double-layered structure in a stretcher bond arrangement incorporating an 'encapsulated self-healing toe', for different structure slopes; namely 1V:1H, 1V:1.5H and 1V:2H[4]. 'Initial Damage' was defined as less than 2% of the geobags moving (note that this is not zero damage).

It can be seen from Figure 4-1 that for a T_p value of say 13 seconds and a structure slope of 1V:1.5H, the significant wave height corresponding to initial damage would be approximately 1.2m. It is noted that the

[4] *Significant wave height H_s is defined as the average wave height of the highest one-third of waves in a wave train. It approximates the estimate of wave height recorded by a trained observer from a fixed point at sea. The spectral peak wave period is the wave period associated with the waves of highest energy in a wave train.*

model testing from which the design curve was established involved a fully exposed structure down to the toe level.

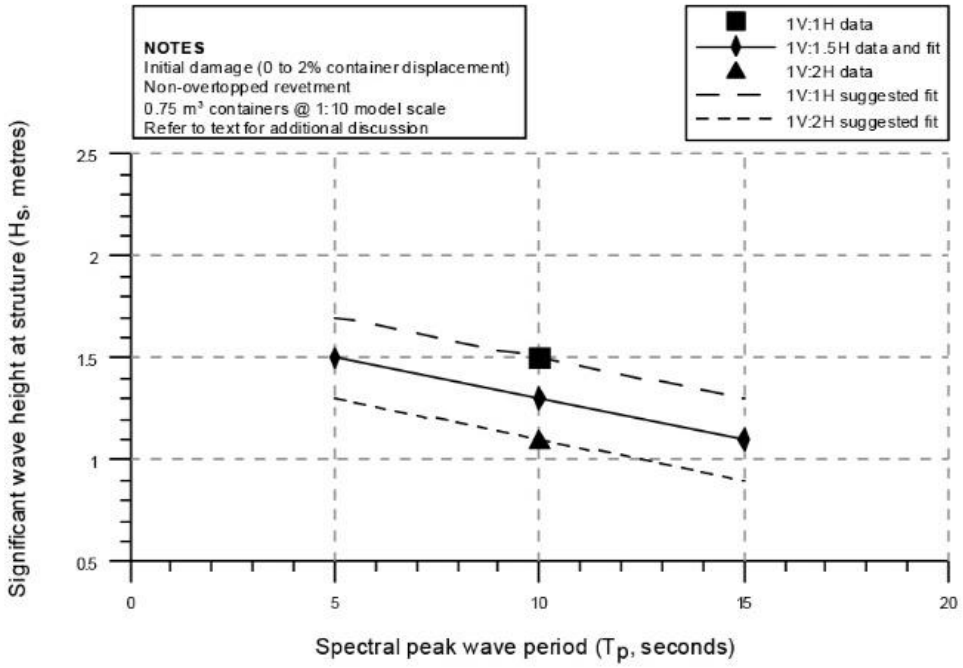

Figure 4-1 Significant wave height for 'Initial Damage' for 0.75m³ geobags as a function of spectral peak wave period

Wave runup levels were also estimated in the scale laboratory testing, from video footage. Runup was found to be relatively high compared to an equivalent rubble mound structure, presumably due to the reduced porosity of the geobag structure. For a structure slope of 1V:1.5H, the wave runup level above still water level, for T_p values in the range 10 to 15 seconds, was 2.5 to 3.5 times H_s (Coghlan et al, 2009).

The hydraulic stability and wave overtopping performance of the proposed extension to the existing coastal protection works are discussed further in Section 6 in the review and assessment of the proposed works in relation to the *Coastal Management Act 2016* and *State Environmental Planning Policy (Resilience and Hazards) 2021*.

The alignment of the proposed extension to the existing geobag coastal protection works is entirely on private land owned by Ganra Pty Ltd (Elements of Byron), as is the case for the existing works. The proposed extension would connect to the northern limit of the existing geobag coastal protection works and extend northwards such that the seaward edge of the encapsulated self-healing toe of the extension structure is located on the private property boundary.

A westward return would be included at the northern limit of the extension to mitigate the outflanking risk. As the alignment returns westward the toe level of the structure would rise upwards such that at the northern limit of the extension the toe level would be approximately 1m AHD.

Due to the alignment of the property boundary relative to the erosion escarpment, the extent of the earthworks required to construct the extension work would vary along the alignment of the extension. This is discussed further in Section 4.2.

The estimated total number of 0.75m^3 geobags required to construct the approximately 40m long extension is 200. There are already some 300 0.75m^3 geobags that are filled and stockpiled near the northern limit of the extension ready to be installed. This stockpile of geobags is visible in the aerial photograph within the 'Location Plan' on Drawing 3267-1000 (refer **Appendix D**).

The geobags within the stockpile were filled with sand from the commercial sand extraction operation at Chinderah. No sand was used from the beach or dune system.

A volume of sand would also be imported to the beach to assist in re-establishment of the dune profile on private land, as shown in Drawings 3267-1104, 3267-1105 and 3267-1106 in **Appendix D**. The volume of sand would be approximately 800m^3 and would be sourced from the commercial sand extraction operation at Chinderah. The volume of imported sand would also address the volume of sand 'locked up' behind the extension to the geobag coastal protection works, as discussed further in Section 6.

4.2 Construction Methodology

4.2.1 General

The following sections set out a description of the anticipated construction methodology for the proposed extension to the existing geobag coastal protection works. The final construction methodology would be the responsibility of the Contractor but would not be expected to differ significantly to that described below.

In general, the Contractor would be required to carry out the works in accordance with the manufacturer's installation guidelines for 0.75m^3 geobags, a copy of which is included in **Appendix B**.

A summary of the various earthworks volumes is provided in Section 4.2.8.

4.2.2 Pre-Planning activities, installation of environmental controls and temporary works

A staging area for delivery of materials would be established landward of the proposed alignment of the works, in the northern area of the site. This area is visible in the aerial photograph on the 'Location Plan' of the works (Drawing 3267-1000) and already contains stockpiled filled geobags, as noted earlier.

Fencing would be incorporated around the construction works on the landward side to prohibit unauthorised access. Star pickets with bunting/flagging or the like would be utilised on the beach to manage access, coupled with observers employed by the Contractor.

Erosion and sediment controls would be installed in accordance the 'Blue Book'(Landcom, 2006), as required, to manage the potential effects of land disturbance activities on the Belongil Estuary.

All equipment utilised on site would be clean prior to mobilisation on site. Spill kits would be kept on site.

It is anticipated the Contractor may construct a temporary bund on the beach seaward of the works to provide a level of protection to the works from wave action and tides during the construction phase. The bund would be constructed from sand scraped locally from the dry beach berm or excavated for the works, and/or by stacking geobags (noting that the number of existing stockpiled filled geobags, some 300, is well

in excess of the required number to construct the extension, approximately 200). No other materials would be permitted in the construction of the bund.

The bund would be removed at the completion of the works and the beach reshaped and groomed to a natural beach profile as was the case for construction of the existing geobag coastal protection works (refer Figure 2-6).

4.2.3 Excavation for the coastal protection works

Excavation of the beach berm and dune would be required to install the geobags to the proposed level and alignment. The Contractor would be responsible for ensuring temporary excavation slopes are stable. The slopes are likely to be approximately 1V:2H and may be benched in the dunal area in the north.

The excavation volume would be variable along the alignment, increasing as the alignment enters the dune, as shown in the Drawings in **Appendix D**. The estimated total quantity of excavation is 1,200m^3. All excavated material would be temporarily stockpiled and reused in the restoration/reshaping of the beach and dune profile. No excavated sand would be removed from the beach and dune system.

As noted earlier, the aim of the excavation would be to place the geobags as low as possible in the sand profile while avoiding or minimising the need for excavation below the water table, which would otherwise affect buildability and the quality of construction. In the event it became necessary to remove any groundwater or wave washover from the excavation, this would be pumped to a nearby depression (sump) created in the beach berm to allow natural infiltration. The groundwater would not be pumped directly to the estuary or to the sea.

4.2.4 Filling of the geobags

As noted earlier, a total of some 300 0.75m^3 filled geobags are already stockpiled for use in construction of the extension. No additional filling of geobags is required.

4.2.5 Placement of the geobags

The geobags would be transported from the staging area to the placement area by a posi-track loader and placed by longreach excavator. The placement of the geobags would be supervised by a suitably experienced Coastal Engineer. Particular care would be taken in the installation of the ‘encapsulated self-healing toe’ to ensure the geotextile encapsulation of the third geobag in the bottom layer is suitably tied to the double-layer main section of the works.

4.2.6 Backfilling, restoration and revegetation

Where the extension of the coastal protection works is located seaward of the existing erosion escarpment, the area between the crest of the works and the escarpment would be backfilled and battered back at a stable slope of not steeper than approximately 1V:1.5H. The two geobags at the crest would be left exposed to facilitate alongshore pedestrian access unless the crest level is below the existing beach berm level at the time of construction.

Where the extension to the coastal protection works is located wholly within the dunal system, the works would be completely backfilled. The net sand volume excavated to install the works would be placed on

the seaward side of the works and the dune slope reestablished to a stable slope of not steeper than approximately 1V:1.5H.

At the completion of the works, vegetation of the dune areas would be undertaken using suitable species as set out in the Landscape Plan.

4.2.7 Duration of the works

The works would be carried out during normal construction working hours Monday to Friday. No work would be undertaken on weekends or Public Holidays. Approval may be sought to extend working hours during Monday to Friday to take advantage of tide levels and weather conditions, to reduce the construction period.

The total duration of the works from establishment on site to completion of restoration and revegetation would not be expected to exceed 4 weeks.

4.2.8 Summary of volumes

A summary of the various volumes involved in the proposed works is set out below:

- volume of excavation, approximately 1,200m^3;
- volume of sand within the approximately 200 0.75m^3 geobags, 200 x 0.75m^3 = 150m^3;
- volume of excavated sand available for backfill and restoration, 1,200m^3 (full volume);
- net increase in volume of the beach and dune system after construction of the geobag extension and backfill with excavated material = 150m^3 (volume of geobags);
- volume of imported sand 800m^3;
- net increase in volume of the beach and dune system after construction of the geobag extension, backfill with excavated material, and importation of sand = 150m^3 + 800m^3 = 950m^3.

5 Key Coastal Processes and Coastal Hazards

5.1 General

The proposed extension to the existing geobag coastal protection works is located within the entrance area of the Belongil Estuary. The estuary is an intermittently closed and open lake/lagoon (ICOLL). To manage flood risk within the catchment the estuary mouth is mechanically opened by Council, under licence from NSW Crown Lands, when the water level in the estuary at the Ewingsdale Road bridge gauge reaches a level of 1m AHD. The estuary may also break out naturally to the sea in heavy rainfall.

The current long-term Belongil Creek Entrance Opening Strategy was adopted by Council on 27 February 2020. The version on Council's website is dated December 2021 and incorporates recommendations endorsed by Council at the 25 November 2021 meeting, Resolution 21-547, following revisions by Council staff. The strategy document has a Council reference (Belongil Creek Entrance Opening Strategy and EMP-Resolution 21-547 – December 2021 (Revision 1.0)) and also an Alluvium reference (P418043_Belongil_Creek_Entrance_Opening_Strategy_Draft_V01)[5].

The proposed entrance opening locations in the current Entrance Opening Strategy are shown in Figure 5-1. The adopted location at any time is dependent on whether it is the breeding season for shorebirds (Aug-Dec) and whether the prevailing swell and wind direction is from the north:

- during the breeding season, the centreline of the excavated channel is located approximately 10m north of any authorised bird protection fence, subject to any significant site constraints (the red line in Figure 5-1); and
- when the predicted prevailing swell and wind direction is from the north to north-east, a more northern opening location is adopted to minimise impacts on the bird nesting area (the yellow line in Figure 5-1).

Figure 5-1 also shows the access route to site for the machine used to mechanically excavate the channel, which is from Bayshore Drive along the designated walkway to the beach and then along the beach berm.

It is noted that both of the entrance opening locations are located to the south of the proposed extension to the geobag coastal protection works.

[5] *Alluvium and Salients prepared the original document (September 2019). Revisions to the 2019 document were made by Council staff following a 2-year review of the Entrance Opening Strategy and EMP.*

Figure 5-1 Entrance opening locations and access route to the site from Bayshore Drive (source: Entrance Opening Strategy – Revision 1.0, December 2021 – Figure 9)

The assessment of the coastal, estuary and catchment conditions and processes that supports the Entrance Opening Strategy and EMP are documented in the Belongil Creek Entrance Opening Strategy – Initial Findings Report (Alluvium, 2018). A summary of the processes understanding as set out in this report is included in Section 5.2.

RHDHV (2016) also set out a description of the coastal and estuary processes in the entrance area of the Belongil Estuary. This was based on review of previous studies and an assessment of the movement/migration of the Belongil Estuary channel and surrounding foreshore through examination of available historical vertical aerial photography covering the period 1947 to 2015. This information is summarised in Section 5.3.

Additional comments on the key coastal processes and coastal hazards, and potential options to address the hazards, are included in Section 5.4.

5.2 Belongil Creek Entrance Opening Strategy - Initial Findings Report (Alluvium, 2018)

This report made the following main points in relation to coastal and estuary processes in the entrance area of the estuary:

- long term recession of the Byron coastline is occurring due to differences in longshore transport rates along the coast and direct losses off Cape Byron, with long term recession rates in the range 0.05 to 0.45m/yr;
- due to long term recession there is a risk that Belongil Creek may eventually break through the spit south of its current location, as a result of continued erosion and wave overtopping at low dune sections;
- the northward transport of sand and erosion of the spit elongates and pushes the entrance channel further north. This behaviour is illustrated in Figure 5-2 which shows the 2018 creek shoreline/vegetation line in the entrance area (in blue) superimposed on earlier aerial photography including a 1986 and a 1965 vertical aerial photograph;

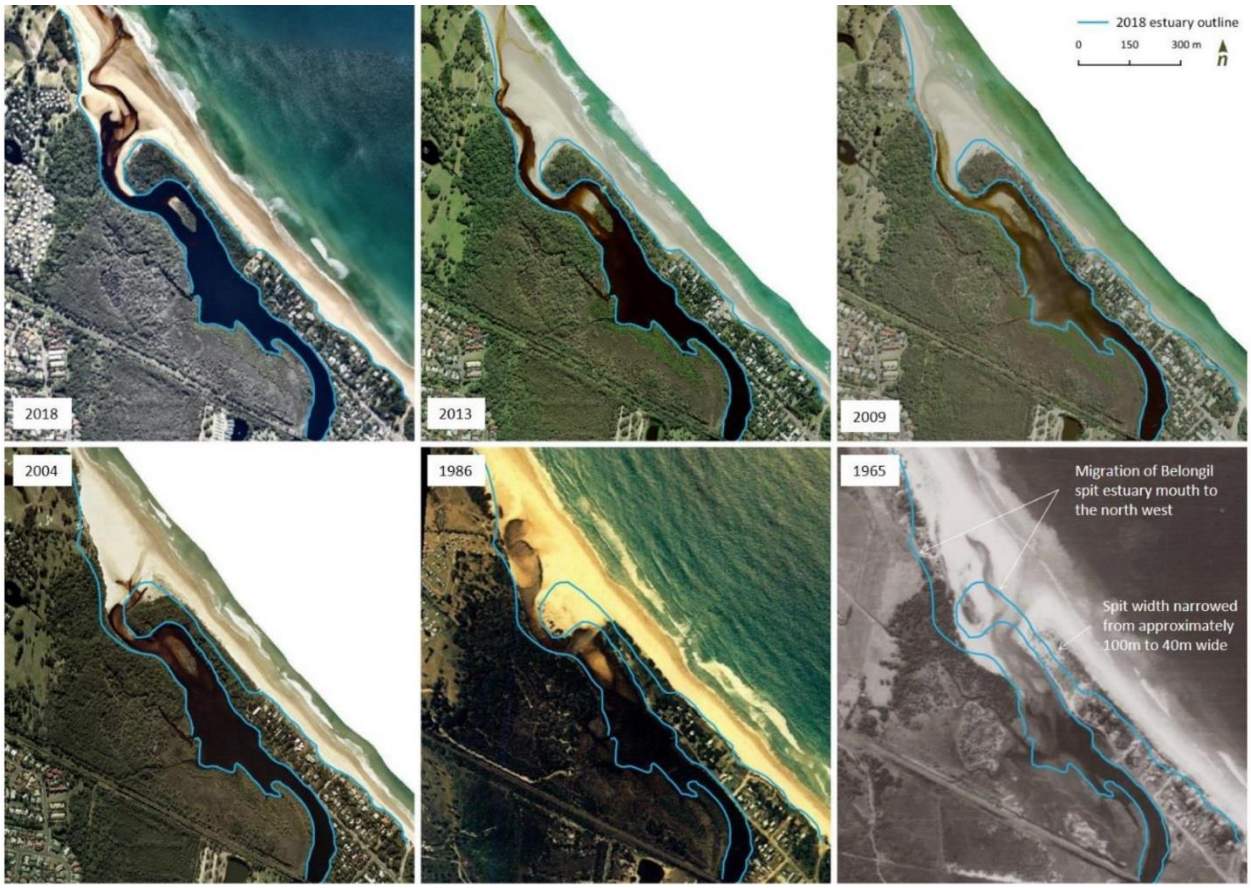

Figure 5-2 Historical aerial imagery comparison in the entrance area of the Belongil Estuary, with 2018 creek and vegetation outline shown in blue (source: Entrance Opening Strategy – Revision 1.0, December 2021 – part Figure 12)

- the Belongil Estuary is prone to closure at any time of the year through build-up of the sand barrier (berm) at the ocean entrance. The berm formation is primarily driven by surf and tidal sediment transport through the entrance channel, followed by swash sediment transport. Onshore winds can also influence berm formation. The berm provides natural protection to the back-shore region and dunes from storm wave action;
- the estuary opens naturally following periods of heavy rainfall and subsequently closes, often rapidly, during dry periods;

- the morphodynamics of the entrance breakout behaviour are driven mostly by the difference in water levels across the entrance berm, ie. between the estuary and the ocean;
- during storms, storm surge and wave setup in combination with high tides will periodically overtop the entrance berm and significantly impact entrance dynamics;
- rainfall in Byron Bay is high compared to other coastal areas in NSW, with an average annual rainfall based on 60 years of records of 1,737mm. Rainfall is notably seasonal, peaking in late Summer/early Autumn, typically caused by ex-tropical cyclone rain depressions moving from north to south along the coast lasting for 2 to 3 days. Rainfall events strongly influence entrance openings (both artificial/mechanical and natural) as most openings are preceded by a rainfall event in the local catchment;
- the development of an effective and persistent breakout channel is strongly controlled by having a reasonable head difference (water level difference) across the sand berm, ie. high water levels in the estuary and low water levels in the adjacent ocean;
- the current entrance opening trigger level of 1.0m AHD is 'very low' and the current management strategy encourages opening at a falling or low tide. These approaches do not optimise development of a strong entrance channel scour and the potential for greater longevity of an open system. However, this is intentional, as part of the aim of the entrance management is to reduce the 'rapid flushing' of sand from the entrance leading to rapid drainage of poor water quality from the upper catchment of the estuary. Managing the entrance in this manner means that, occasionally, the attempt at breaking out the entrance is not very effective;
- when the entrance is open and water from the catchment has drained, the estuary is subject to tidal influence. At such times the mean water level in the estuary is elevated above mean sea level, at a level of approximately 0.2m AHD[6]; and
- tidal currents in the estuary entrance area when the entrance is open have been measured at up to approximately 0.5m/s.

5.3 Coastal and Estuary Processes – Belongil Estuary Entrance Area (Royal HaskoningDHV, 2016)

Note: The text in the following Sections 5.3.1 and 5.3.2 has been taken from RHDHV (2016). A minor update has been made in the form of referring to the subject private land as Elements of Byron resort rather than North Byron Beach resort.

5.3.1 General

The coastal and estuary processes in the entrance area of Belongil Estuary have been considered in a number of previous studies, eg. BMT WBM (2013), BMT WBM (2015) and WRL (2016). The area is highly dynamic and complex, with significant interaction between coastal and estuary processes. For these reasons, erosion hazard lines presented in recent coastline hazard assessment studies and coastline management plans for the Byron Bay coastline are discontinuous at the Belongil Creek entrance (BMT WBM, 2013; WRL, 2016).

[6] *This superelevation of mean water level in the estuary would be due to so-called 'shallow water effects' on tidal propagation and, to some extent, frictional effects. In simple terms, the tidal wave is more efficient in entering the estuary as the tide rises (flood tide, greater water depth) than it is leaving the estuary as the tide falls (ebb tide, shallower water depth). The mean water level becomes 'perched' above mean sea level so that the volume of water entering and leaving the estuary, when averaged over time, is equal. Another feature of the tidal response within the estuary is a shorter flood tide duration than ebb tide duration.*

Erosion of the foreshore of Elements of Byron resort land and land owned by others including the Crown and Byron Shire Council has been an issue for many years. The erosion has resulted in the loss of assets and Littoral Rainforest. The erosion is a result of two main processes:

- erosion caused by undercutting of the left hand bank (looking downstream) of the Belongil estuary during high creek flows; and
- erosion caused by waves propagating over the low lying entrance zone of the estuary during ocean storms.

The extent of the erosion by both estuary flows and ocean storms is exacerbated by the tendency for the estuary entrance to meander following opening.

5.3.2 Belongil Estuary Entrance Management and Behaviour

Following an opening of the estuary, there is a tendency for the entrance to typically migrate northwards due to the net northerly littoral drift of sand on this section of the coast. Examples of the northerly migration are shown in Figure 5-3 and Figure 5-4. Such migration can exacerbate erosion of the Littoral Rainforest and the Elements of Byron land. This is due to several factors:

- the estuary ‘hugs’ and undercuts the left hand bank for a longer distance before entering the sea;
- the alongshore migratory behaviour creates a wider entrance zone, comprising a low lying sandy berm, which can be overtopped by waves during ocean storms;
- the migratory entrance channels deplete the beach sand volume available to combat the storm erosion demand; and
- the remnant pools at the base of the erosion escarpment allow wave attack at a lower elevation in the dunal profile and also potentially allow some partial wave reformation before reaching the back beach erosion escarpment.

Figure 5-3 Entrance channel migration northwards and erosion of the dunal profile prior to construction of the existing coastal protection works

Figure 5-4 Evidence of historic entrance channel migration northwards (now a 'blind' channel) together with an existing channel further south

Erosion in the entrance area over the period 2006-2012 (prior to the existing coastal protection works), represented by movement of the vegetation line, is shown in Figure 5-5, taken from a handout prepared by the then North Byron Beach Resort. A number of 'Fast Facts' are included in the Figure including reference to a total movement of the erosion escarpment over the period 2006-2012 of some 20 to 30m.

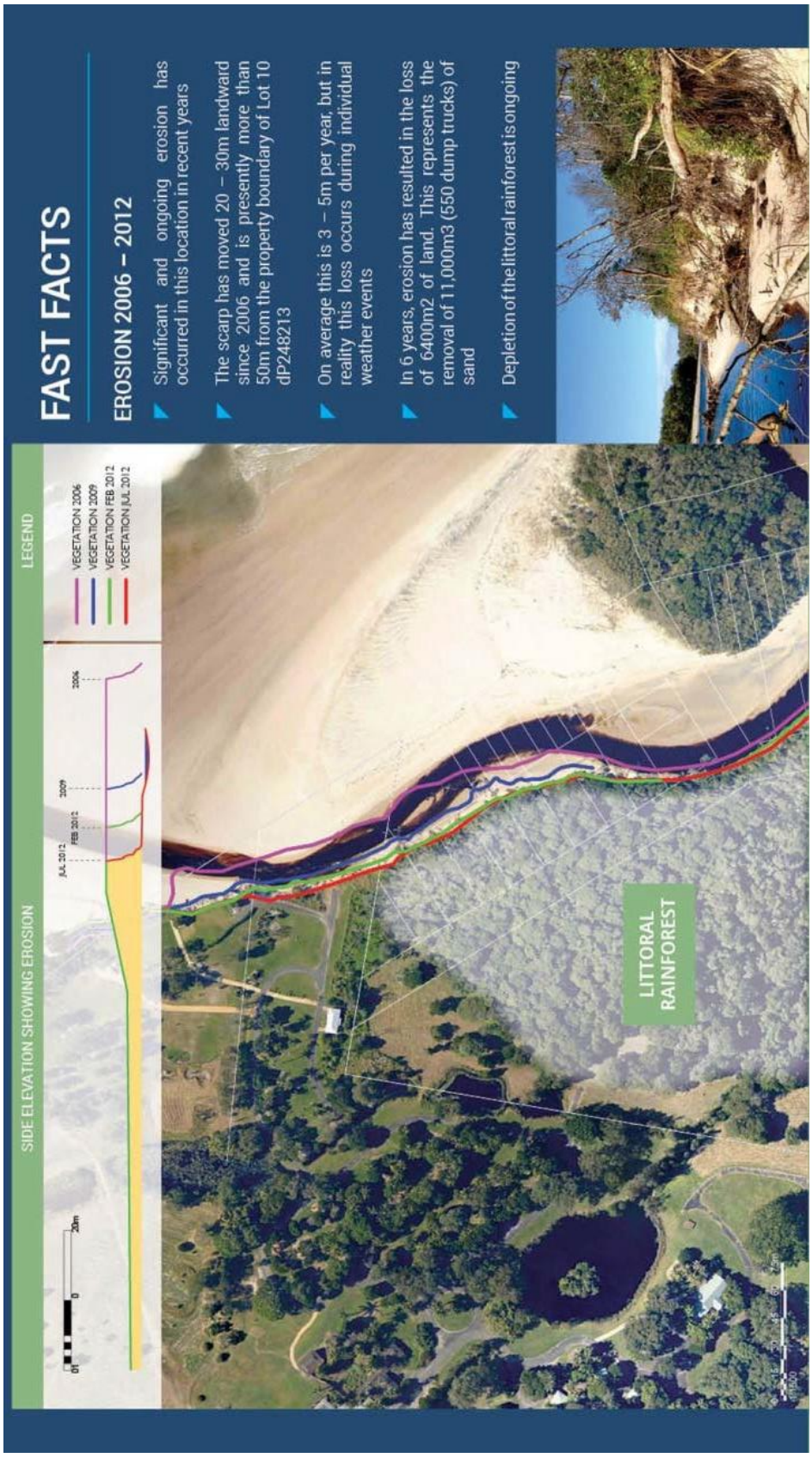

Figure 5-5 Erosion over the period 2006-2012

RHDHV has also undertaken an assessment of the movement/migration of the Belongil Estuary channel and surrounding foreshore based on examination of available historical vertical aerial photography. This assessment covered the 68 year period 1947 to 2015.

A summary of the assessment is provided below by reference to Figure 5-6 and Figure 5-7 (noting the end date of the assessment is 2015). These figures show the movement of the sand/vegetation interface in the vicinity of Belongil Estuary entrance over the periods 1947-1991 and 1991-2015 respectively. The following is evident, with reference to the areas denoted A to H in these figures.

- recent recession of Belongil Spit in the A to B area (since about 1997);
- consistent northward migration of the end of Belongil Spit (near C) since 1947, at an average rate of about 5m/year since 1991;
- formation of a recurved spit, stabilised with vegetation, at the northern end of Belongil Spit (near C) since 1991, growing in volume over time;
- relative stability near D;
- recession of the bank of Belongil Estuary near E at an average rate of about 0.7m/year since 1966 and 1.5m/year since 1997;
- recession near F at an average rate of about 0.4m/year since 1966;
- relatively large recession near G at an average rate of about 4m/year since 2004, after being relatively stable from 1977 to 2004; and
- recent recession near H, since 2004.

A significant factor in the estuary behaviour has been the formation of the recurved spit at the northern end of Belongil Spit and its continued vegetative stabilisation and growth in volume. This feature has forced the estuary to be diverted westward between D and F causing erosion of the bank and loss of Littoral Rainforest. Coupled with this behaviour has been the formation of the vegetated island east of D; as a consequence the dominant channel now flows to the east of the island causing the estuary to take a sharp ninety degree bend at the recurved spit to flow westwards directly towards the bank between D and E.

The impact of the estuary behaviour on foreshore erosion extends further northwards beyond D and E, to the area of F and G, in concert with the coastal processes (such as wave action) which become more dominant in this area. It is very likely estuary behaviour contributed to the observed recession of the foreshore near G since 2004.

Ongoing erosion of the bank of the estuary between D and F and further northwards, with continued loss of Littoral Rainforest, can be expected with the further growth of the recurved spit, fed by a net northerly littoral drift along Belongil Beach.

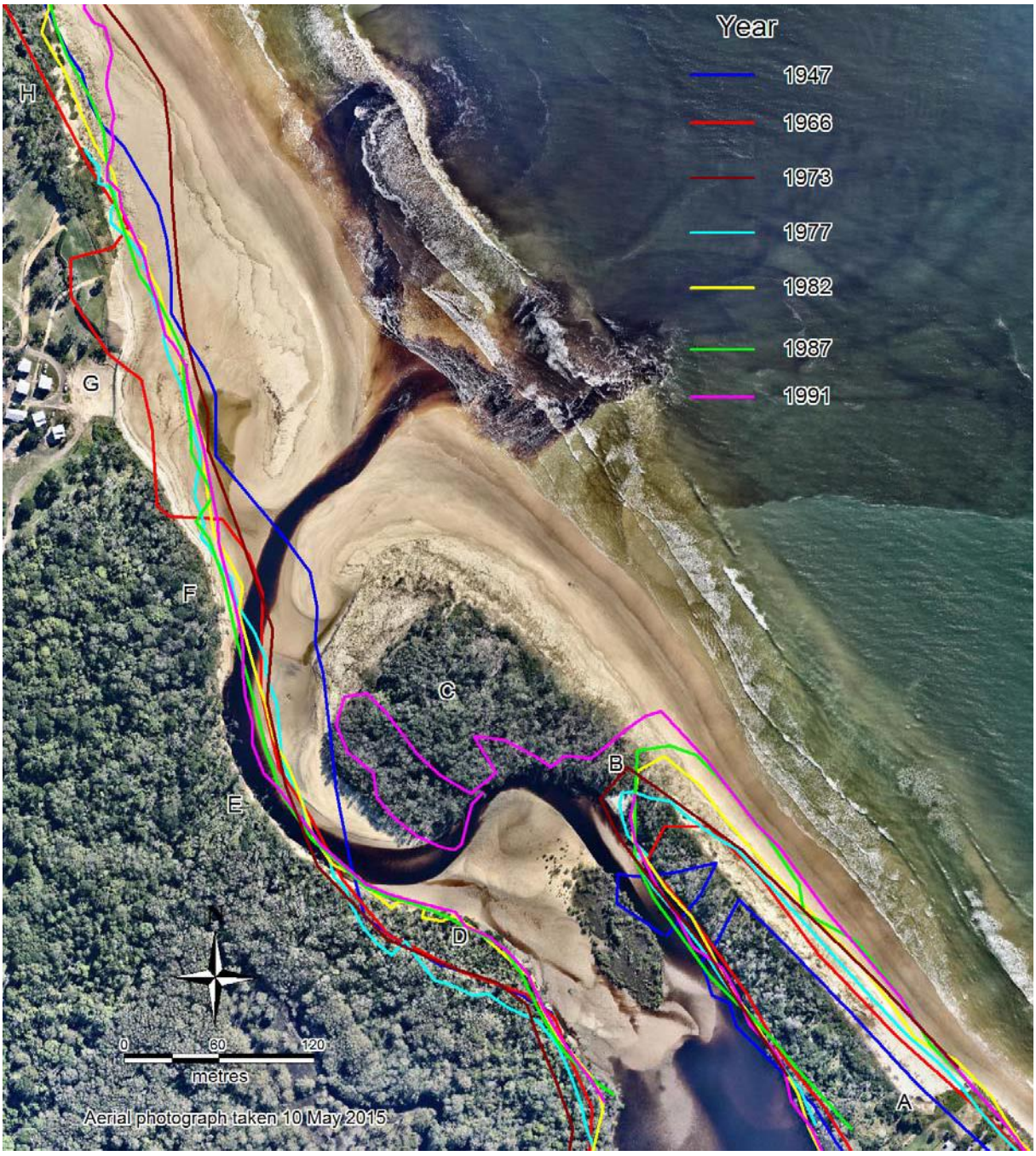

Figure 5-6 Movement of sand/vegetation interface in vicinity of Belongil Estuary entrance from 1947 to 1991

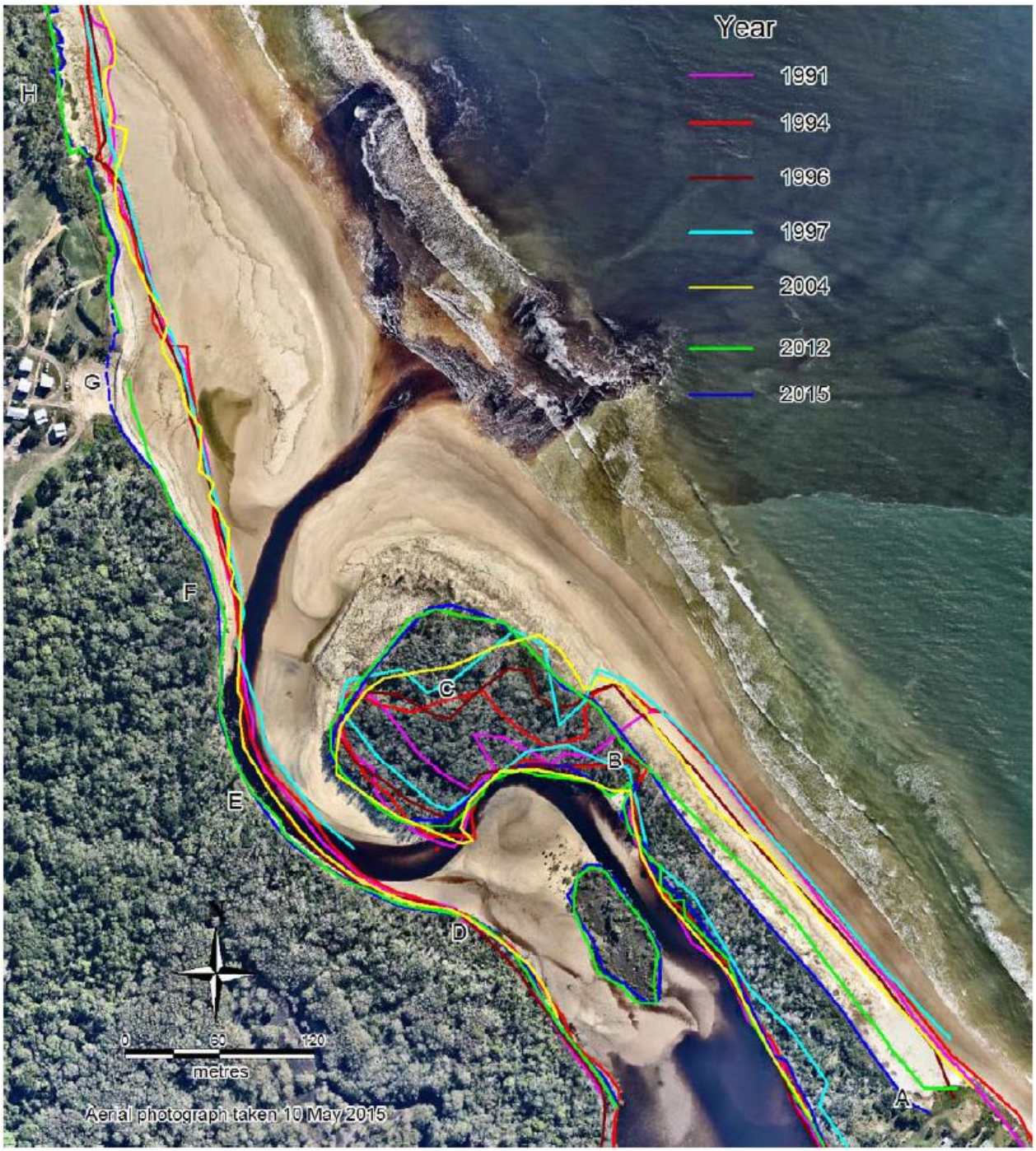

Figure 5-7 Movement of sand/vegetation interface in vicinity of Belongil Estuary entrance from 1991 to 2015

5.4 Additional Comments

5.4.1 Elevated water levels and wave action at the estuary entrance

It has been noted previously in Section 5.3.1 that one of the main processes that causes foreshore erosion in the entrance area is waves propagating over the low lying entrance zone during ocean storms.

This process has been observed on site and is evident in the damage suffered at times by the existing geobag coastal protection works since their construction in 2015. The outcome can also be predicted from knowledge of the elevated ocean water levels at times of ocean storms and sand levels which can occur across the entrance area, as noted below.

In the SMEC (2009) flood study for Belongil Creek, the 100 year ARI ocean water level including wave setup was estimated to be 2.42m AHD. In the BMT WBM (2014) flood study for Belongil Creek the 10 year ARI ocean water level including wave setup was estimated to be 2.0m AHD.

In the November 2022 terrestrial laser scanner survey carried out by Bennett & Bennett, sand levels across the entrance area seaward of the eroded escarpment varied from around 1.2m AHD to 1.6m AHD. At times these sand levels would be lower, particularly depending on the entrance channel location.

It is evident that even in a 10 year ARI event with sand levels comparable to those surveyed in November 2022, breaking waves in the order of 0.5 to 0.8m could occur against the erosion escarpment. The fact that damage has occurred to the existing geobag coastal protection works in the 8 years since 2015, necessitating repair and maintenance, is indicative that wave heights at the back of the beach have exceeded 1.2m at times, having regard to the design guidelines for geobag stability under wave attack discussed in Section 4.1 (initial damage for wave height at approximately 1.2m, refer Figure 4-1).

5.4.2 Longer term management options at the entrance to the Belongil Estuary

The current Belongil Creek Entrance Opening Strategy (Final report (Revision 1), December 2021) acknowledged that as the spit elongates more to the north and Littoral Rainforest is further eroded, some management response in the entrance area is warranted, noting that the bank retreat in the area is currently occurring at the rate of 3 to 5 m/yr.

In terms of a management response, it was stated that a tripper wall or some shorter, shore normal buried groynes, beach scraping and protective works, could help protect the Littoral Rainforest community and the Elements of Byron foreshore (Final Report (Revision 1), December 2021, Section 4.4). The Final Report went on to say that the necessary planning and investigations for the above options should begin now (late 2021) under the NSW Coastal Management Framework, ie as part of the development of a CMP covering the Belongil Estuary.

RHDHV had also earlier in 2015 considered management responses in the entrance area of Belongil Estuary to address erosion of the Littoral Rainforest and Elements of Byron foreshore. The preferred management response comprised of a number of main elements:

- a southern spur wall, having the primary aim of training the outlet position of the Belongil Estuary (a form of tripper wall);
- a northern spur wall, aimed at mitigating the risk of the entrance breakout channel returning (meandering) toward the resort foreshore immediately north of the southern spur wall;
- retention of the existing geobag coastal protection works;
- periodic beach scraping in response to beach conditions; and
- estuary foreshore protection works along the left hand bank (looking downstream) extending upstream from the southern spur wall to prevent further erosion of the Littoral Rainforest and outflanking landward of the southern spur wall.

The southern and northern spur walls were proposed to comprise sand filled containers, either mega containers or 2.5m^3 geocontainers.

The RHDHV proposal including a concept design plan and sections was set out in advice to the then North Byron Beach Resort and could be a consideration in the development of a CMP covering Belongil Estuary.

6 Coastal Engineering Assessment of Proposed Extension Works

6.1 General

This section sets out a review of the proposed extension to the existing geobag coastal protection works, from a coastal engineering perspective, in relation to the *Coastal Management Act, 2016* and the *State Environmental Planning Policy (Resilience and Hazards) 2021*.

Prior to the review, Section 6.2 sets out a brief discussion of construction versus operational impacts.

6.2 Construction versus Operational Impacts

It is reasonable to consider that the most significant potential impacts on the environment of the proposed extension to the existing coastal protection works are operational as opposed to construction impacts.

Construction impacts are relatively short term, localised, and can generally be suitably mitigated by standard construction phase controls in relation, for example, to noise, traffic, access, erosion and sediment control, and the like.

One aspect of construction that warrants closer attention is the potential impact of a temporary bund which might be constructed on the beach by the Contractor to provide a level of protection to the works from wave action and tides during the construction phase. Such temporary bunds are a typical feature of construction activity on a beach in order to reduce the risk of storm damage to the partially completed works and to maximise effective construction hours.

In certain situations, depending on the relative exposure of the construction site to coastal processes, the bund may include materials other than sand, eg. rock or concrete barriers. In such cases it is necessary to ensure that these materials are not mobilised by wave action and become strewn over the beach and in the surf zone, causing adverse impacts for beach amenity, beach safety and coastal processes.

For the subject proposed works, it is proposed that no materials other than sand and geobags would be employed in the formation of the bund. Sand for the bund would be obtained from adjacent beach scraping or from the excavation for the works. There are ample 0.75m3 filled geobags already stockpiled onsite for use in a temporary bund. The bund should be removed at completion of the works and the beach reshaped and groomed to a natural beach profile as was the case for construction of the existing geobag coastal protection works (refer Figure 2-6).

The remainder of the discussion in the following sections relates to potential operational impacts.

6.3 Coastal Management Act 2016

The relevant section of the *Coastal Management Act 2016* is Section 27 within Part 5 Miscellaneous. This Section is reproduced below followed by a discussion. As noted in Section 1.1, the proposed life of the extension to the coastal protection works is 5 years.

27 Granting of development consent relating to coastal protection works

(1) Development consent must not be granted under the *Environmental Planning and Assessment Act 1979* to development for the purpose of coastal protection works, unless the consent authority is satisfied that—

(a) the works will not, over the life of the works—
  (i) unreasonably limit or be likely to unreasonably limit public access to or the use of a beach or headland, or
  (ii) pose or be likely to pose a threat to public safety, and

(b) satisfactory arrangements have been made (by conditions imposed on the consent) for the following for the life of the works—
  (i) the restoration of a beach, or land adjacent to the beach, if any increased erosion of the beach or adjacent land is caused by the presence of the works,
  (ii) the maintenance of the works.

(2) The arrangements referred to in subsection (1) (b) are to secure adequate funding for the carrying out of any such restoration and maintenance, including by either or both of the following—

(a) by legally binding obligations (including by way of financial assurance or bond) of all or any of the following—
  (i) the owner or owners from time to time of the land protected by the works,
  (ii) if the coastal protection works are constructed by or on behalf of landowners or by landowners jointly with a council or public authority—the council or public authority,

(b) by payment to the relevant council of an annual charge for coastal protection services (within the meaning of the *Local Government Act 1993*).

(3) The funding obligations referred to in subsection (2) (a) are to include the percentage share of the total funding of each landowner, council or public authority concerned.

Note. Section 80A (6) of the *Environmental Planning and Assessment Act 1979* provides that a development consent may be granted subject to a condition, or a consent authority may enter into an agreement with an applicant, that the applicant must provide security for the payment of the cost of making good any damage caused to any property of the consent authority as a consequence of the doing of anything to which the consent relates.

Table 6-1 Coastal Management Act 2016 – Comments and Assessment

Coastal Management Act 2016 Section 27	Comments/Assessment
(1) Development consent must not be granted under the *Environmental Planning and Assessment Act 1979* to development for the purpose of coastal protection works, unless the consent authority is satisfied that:	
(a) the works will not, over the life of the works:	
(i) unreasonably limit or be likely to unreasonably limit public access to or the use of a beach or headland, or	Access to the beach by the general public is provided by an existing accessway located approximately 160m to the north of the northern limit of the proposed extension works, leading from Bayshore Drive. End effects attributed to the proposed extension of the existing coastal protection works are unlikely to unreasonably limit this public access to the beach over the design life of the extension works of 5 years for a number of reasons:

Coastal Management Act 2016 Section 27	Comments/Assessment
	• the design life of 5 years may not be sufficient time for an end effect to fully develop; • overtopping of the relatively low crest level of the extension works (approximately 2.1m AHD) would deliver sand to the end effect area; • in a severe event that causes damage to the extension works, additional sand from below and/or behind the extension works would be delivered to the end effect area; and • the observed end effect to date from the existing geobag coastal protection works, which are approximately 210m long, is limited to approximately 60m. Having said the above, noting the complexities of the coastal and estuary processes in the entrance area, and the potential for cumulative impacts, it is recommended that satisfactory arrangements be made (by conditions imposed by the consent), for the life of the extension works, for restoration of the beach and land adjacent to the beach, including the public accessway to the north (if required), if any increased erosion is caused by the presence of the works (refer also to (b)(i) below) The proposed works would be located on private land. As such, the works would not be expected to unreasonably limit use of the beach. In the event the estuary entrance channel is located adjacent to the works, or the beach has eroded back to the works, the design form of the works would facilitate alongshore beach access by pedestrians (walking along the crest of the works). The access to the beach from Elements of Byron resort, which is currently closed (refer Figure 3-5), would be reinstated as part of the works. As such, existing access to the beach by members of the public staying at the resort would be improved by the works.
(ii) pose or be likely to pose a threat to public safety.	The proposed works, over the life of the works would not be expected to pose or be likely to pose a threat to public safety, for the following reasons: • the proposed geobag coastal protection works have been designed in accordance with accepted coastal engineering practice and design guidelines to maximise stability; and • the proposed works would be subject to monitoring and maintenance in the event of any damage (refer also to (b)(ii) below). The proposed works would include regrading and re-establishment of the dune profile which would improve public safety.
(b) satisfactory arrangements have been made (by conditions imposed on the consent) for the following for the life of the works:	

Coastal Management Act 2016 Section 27	Comments/Assessment
(i) the restoration of a beach, or land adjacent to the beach, if any increased erosion of the beach or adjacent land is caused by the presence of the works,	Firstly, it is necessary to consider whether any increased erosion of the beach or adjacent land would be caused by the presence of the works. This can be considered under several topics: • additional scour/erosion immediately seaward of the works; • end effects on immediately adjacent land; and • consequences due to 'locking up' of sand behind the coastal protection works. <u>Additional scour/erosion immediately seaward of the works</u> Research has shown that concerns that seawalls cause additional scour/erosion immediately seaward and greatly delay post-storm beach recovery are probably false, as there are no known data or physical arguments to support these concerns (US Army Corps of Engineers, Coastal Engineering Manual (CEM), pp V-3-28, V-3-32). Accordingly, the proposed works would not be expected to cause any increased scour/erosion immediately seaward of the works, noting also that at times of severe storms the erosion escarpment within the dune system can be near-vertical and thus steeper than the geobag works. Furthermore, the low crest height of the proposed works (approximately 2.1m AHD) would limit any reflective behaviour. <u>End effects on immediately adjacent land</u> Increased erosion of immediately adjacent land, particularly to the north of the works, is predicted to occur due to end effects, caused by the presence of the works. An underlying assumption for assessing the extent of the end effect is that the volume of sand 'locked up' behind the coastal protection works and which would otherwise be available to meet the storm erosion demand is offset within the end effects. As noted earlier, the extent of the end effect due to the proposed works is not expected to reach the public accessway located some 160m north of the northern limit of the works over the life of the works of 5 years, however there is some uncertainty in this prediction. Since some increased erosion would be caused by the presence of the works, to meet the requirements of the *Coastal Management Act 2016*, satisfactory arrangements would need to be made (by conditions imposed on the consent) for restoration of the increased erosion for the life of the works. It is recommended such a condition is imposed. <u>Consequences due to 'locking up' of sand</u>

Coastal Management Act 2016 Section 27	Comments/Assessment
	There are two potential consequences of 'locking up' sand behind the coastal protection works: • additional localised erosion to meet storm erosion demand. This has been considered in the above discussion of end effects; and • impact on long term shoreline recession. An assessment of the second point has been made by considering the volume of sand that could be potentially 'locked up' behind the coastal protection works as the shoreline recedes. Based on RHDHV (2019) it is considered reasonable to adopt a long term average shoreline recession rate due to net sediment loss (underlying recession) of 0.5m/yr and a shoreline recession due to sea level rise over the next 5 years of 1.8m (0.008m/yr x 5 years x 45 [Bruun Factor]). This would give a total shoreline recession over the next 5 years of 4.3m. If the proposed works, with a crest level of approximately 2.1m AHD, restricted the entire active height of the dune of 7m from recession, the volume of sand 'locked up' over 40m for 5 years would be approximately 1,200m^3. If, on the other hand, the proposed works only locked up the sand to a height equivalent to the crest level of the works, on the basis that the dune above the crest level would be able to recede, the volume of sand 'locked up' over 40m for 5 years would be approximately 400m^3. The volume of 1,200m^3 is considered an overly conservative estimate. However, in order to introduce some level of conservation it is considered that an average of the above two estimates, or approximately 800m^3, could be adopted. As it happens, in order to re-establish the dune profile on the private land, it is proposed to import approximately 800m^3 of sand to site for this purpose. This would account for the adopted estimate of the 'locked-up' volume of sand for 5 years. There is also the recommendation, as noted above, that a condition of consent be imposed to address Section 27 (1)(b)(ii) of the *Coastal Management Act* 2016. Hence it is considered that satisfactory arrangements have been made.
(ii) the maintenance of the works.	It is recommended that a suitable condition of consent be imposed for the maintenance of the works, for the life of the works.
(2) The arrangements referred to in subsection (1) (b) are to secure adequate funding for the carrying out of any such restoration and maintenance, including by either or both of the following:	

Coastal Management Act 2016 Section 27	Comments/Assessment
(a) by legally binding obligations (including by way of financial assurance or bond) of all or any of the following—	The Applicant is prepared to enter into a legally binding obligation in relation to the arrangements referred to in subsection (1)(b).
(i) the owner or owners from time to time of the land protected by the works,	Refer above.
(ii) if the coastal protection works are constructed by or on behalf of landowners or by landowners jointly with a council or public authority—the council or public authority.	Not Applicable.
(b) by payment to the relevant council of an annual charge for coastal protection services (within the meaning of the *Local Government Act 1993*).	Refer above.
(3) The funding obligations referred to in subsection (2) (a) are to include the percentage share of the total funding of each landowner, council or public authority concerned.	Not applicable. The Applicant proposes to meet the full cost of any restoration and maintenance.

6.4 State Environmental Planning Policy (Resilience and Hazards) 2021

6.4.1 General

The relevant part of the State Environmental Planning Policy (Resilience and Hazards) 2021 is Part 2.2 Development controls for coastal management areas. Within this Part there are four relevant Divisions as follows:

- Division 2 Coastal vulnerability area
- Division 3 Coastal environment area
- Division 4 Coastal use area
- Division 5 General

The following sections consider each of these Divisions in turn.

6.4.2 Division 2 Coastal Vulnerability area

As yet no Coastal Vulnerability Area Map has been prepared and therefore no coastal vulnerability area has been identified. On the one hand it could be considered that due to the absence of a Map the matter of development within a coastal vulnerability area does not apply. However, it is clear that the proposed works would be located within a coastal vulnerability area once mapped, hence consideration is given to this matter below. The relevant Clause 2.9 is reproduced followed by comments and assessment in Table 6-2.

2.9 Development on land within the coastal vulnerability area

Development consent must not be granted to development on land that is within the area identified as "coastal vulnerability area" on the *Coastal Vulnerability Area Map* unless the consent authority is satisfied that—

(a) if the proposed development comprises the erection of a building or works—the building or works are engineered to withstand current and projected coastal hazards for the design life of the building or works, and

(b) the proposed development—
  (i) is not likely to alter coastal processes to the detriment of the natural environment or other land, and
  (ii) is not likely to reduce the public amenity, access to and use of any beach, foreshore, rock platform or headland adjacent to the proposed development, and
  (iii) incorporates appropriate measures to manage risk to life and public safety from coastal hazards, and

(c) measures are in place to ensure that there are appropriate responses to, and management of, anticipated coastal processes and current and future coastal hazards.

Table 6-2 Coastal Vulnerability Area - Comments and Assessment

SEPP Clause 2.9	Comments/Assessment
Development consent must not be granted to development on land that is within the area identified as "coastal vulnerability area" on the *Coastal Vulnerability Area Map* unless the consent authority is satisfied that:	
(a) if the proposed development comprises the erection of a building or works—the building or works are engineered to withstand current and projected coastal hazards for the design life of the building or works	The proposed works have been engineered to conform with design recommendations established following extensive research on the stability of geocontainer revetments under wave attack, including scale laboratory tests on 0.75m^3 model geocontainers. The possibility exists that the proposed works may suffer some damage over the 5 year design life of the works. It has been recommended that a suitable condition of consent be imposed to ensure maintenance of the works over their design life. The Applicant is prepared to enter into a legally binding agreement to this effect.
(b) the proposed development: (i) is not likely to alter coastal processes to the detriment of the natural environment or other land	The proposed works are not likely to alter coastal processes to the detriment of the natural environment or other land in respect of additional scour/erosion immediately seaward of the works or due to 'locking up' of sand behind the works. The possibility exists that end effects could occur as a result of the works. In the event end effects were to occur, the condition of consent referred to above in relation to Section 27 (1)(b)(i) of the *Coastal Management Act 2016* would be triggered to restore the land as a result of increased erosion caused by the presence of the works.

	It is noted here that the wording of sub-clause 2.9 (b)(i) in *State Environmental Planning Policy (Resilience and Hazards) 2021* is somewhat at odds with sub-clause 27 (1)(b)(i) in the *Coastal Management Act 2016* which specifically anticipates that coastal protection works may increase erosion but that this is only acceptable if conditions can be imposed to restore it. It is understood that if there is any inconsistency between the Policy and the Act, the Act would override the Policy.
(ii) is not likely to reduce the public amenity, access to and use of any beach, foreshore, rock platform or headland adjacent to the proposed development	Consideration of rock platforms and headlands is not relevant as these features are remote from the proposed works. Public amenity, access to and use of the beach and foreshore, would not be likely to be reduced since: • the proposed works would improve access to the beach by members of the public staying at the resort, allowing reinstatement of the currently closed beach access (refer Figure 3-5); • the proposed works are located wholly on private land at the back of the beach; • end effects attributed to the proposed extension to the existing coastal protection works are unlikely to unreasonably limit public access to the beach from the existing public accessway leading from Bayshore Drive, for reasons outlined earlier in the response to Section 27 (1)(a)(i) of the *Coastal Management Act 2016*; • a volume of 800m^3 of sand would be imported to the site which would account for any 'locking up' of sand over the life of the works; • satisfactory arrangements would be made (by conditions imposed on the consent), for the life of the works, for restoration of the beach, or land adjacent to the beach, if any increased erosion of the beach or adjacent land is caused by the presence of the works, and • satisfactory arrangements would be made (by conditions imposed on the consent), for the life of the works, for maintenance of the works.
(iii) incorporates appropriate measures to manage risk to life and public safety from coastal hazards	The proposed works would include the regrading of the existing steep erosion escarpments which are potentially unstable (refer Figure 3-4) and pose some risk to life and public safety. This action would have a positive impact on risk to life and public safety. The proposed works have been designed in accordance with accepted coastal engineering practice and design guidelines to maximise stability. The proposed works would be subject to monitoring and maintenance in the event of any damage.
(c) measures are in place to ensure that there are appropriate responses to, and management of, anticipated coastal processes and current and future coastal hazards	Such measures would be expected to be in place as a consequence of a condition of consent imposed on restoration of the beach or land adjacent to the beach, if any increased erosion of the beach or adjacent land is caused by the presence of the works, and a

	condition of consent imposed for maintenance of the work.

6.4.3 Division 3 coastal environment area

The relevant clause is reproduced below followed by comments and assessment in Table 6-3.

2.10 Development on land within the coastal environment area

(1) Development consent must not be granted to development on land that is within the coastal environment area unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on the following—

(a) the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment,
(b) coastal environmental values and natural coastal processes,
(c) the water quality of the marine estate (within the meaning of the *Marine Estate Management Act 2014*), in particular, the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1,
(d) marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms,
(e) existing public open space and safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,
(f) Aboriginal cultural heritage, practices and places,
(g) the use of the surf zone.

(2) Development consent must not be granted to development on land to which this section applies unless the consent authority is satisfied that—

(a) the development is designed, sited and will be managed to avoid an adverse impact referred to in subsection (1), or
(b) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or
(c) if that impact cannot be minimised—the development will be managed to mitigate that impact.

(3) This section does not apply to land within the Foreshores and Waterways Area within the meaning of *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005*.

Table 6-3 Coastal Environment Area - Comments and Assessment

SEPP Clause 2.10	Comments/Assessment
(1) Development consent must not be granted to development on land that is within the coastal environment area unless the consent authority has considered whether the proposed development is likely to cause an adverse impact on the following:	

SEPP Clause 2.10	Comments/Assessment
(a) the integrity and resilience of the biophysical, hydrological (surface and groundwater) and ecological environment	Not a coastal engineering consideration. However, it can be stated that the purposed works would not cause an adverse impact to surface and groundwater.
(b) coastal environmental values and natural coastal processes	The relevant coastal engineering consideration is natural coastal processes. The proposed works would not be likely to cause an adverse impact on coastal processes directly seaward of the works based on the landward position of the works and the research documented in the US Army Corps of Engineers, Coastal Engineering Manual (CEM), pp V-3-28, V-3-32. Any potential for 'locking up' of sand over the life of the works would be addressed by the importation of 800m3 of sand as part of the proposed development. The proposed works have the potential to impact on natural coastal processes to the north of the works due to end effects. These impacts would be mitigated by restoration works carried out as a condition of consent to address Section 27 (1)(b)(i) of the *Coastal Management Act 2016*.
(c) the water quality of the marine estate (within the meaning of the *Marine Estate Management Act 2014*), in particular, the cumulative impacts of the proposed development on any of the sensitive coastal lakes identified in Schedule 1	The proposed works would not be likely to cause an adverse impact on water quality of the marine estate since: • during the construction phase, erosion and sediment controls would be established, and any groundwater that was pumped out from the site to allow construction in the dry would be directed to a depression (sump) created in the beach berm to allow natural filtration; and • the geobags are made of materials (staple-fibre polyester and polyester/polypropylene blends) that do not cause water quality issues when in contact with groundwater, surface water or ocean waters. The proposed works do not impact on any sensitive coastal lakes listed in Schedule 1.
(d) marine vegetation, native vegetation and fauna and their habitats, undeveloped headlands and rock platforms	Not a coastal engineering consideration.
(e) existing public open space and safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability	The proposed works are not likely to cause an adverse impact on existing public open space and safe access to and along the foreshore or beach, noting that the proposed works are located wholly on private land, and for the reasons outlined in the responses to Sections 27 (1)(a)(i), 27 (1)(a)(ii), 27 (1)(b)(i) and 27 (1)(b)(ii) of the *Coastal Management Act 2016*, and Clause 2.9 (b)(ii) of the *State Environmental Planning Policy (Resilience and Hazards) 2021*.
(f) Aboriginal cultural heritage, practices and places	Not a coastal engineering consideration.
(g) the use of the surf zone	The proposed works would not be expected to cause an adverse impact on use of the surf zone as the works

SEPP Clause 2.10	Comments/Assessment
	are located wholly on private land well landward from the normal surf zone. The works would only interact with the surf in storms, at which time use of surf zone by beachgoers would not be expected or would not be as far landward as the works.
(2) Development consent must not be granted to development on land to which this section applies unless the consent authority is satisfied that:	
(a) the development is designed, sited and will be managed to avoid an adverse impact referred to in subsection (1), or	It is considered that the proposed works have been generally designed, sited and will be managed to avoid an adverse impact in respect of items (a), (c) and (g) in subsection (1).
(b) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or	In the case of items (b) and (e) in subsection (1), where the impacts cannot be reasonably avoided, it is considered the development has been designed, sited and will be managed to minimise and mitigate the impacts by way of: • being located wholly on private land; • the importation of 800m^3 of sand; • regrading of unstable slopes; • imposing a condition on restoration if any increased erosion is caused by the presence of the works, for the life of the works; • imposing a condition for maintenance of the works, for the life of the works.
(c) if that impact cannot be minimised—the development will be managed to mitigate that impact.	Refer to response under (b) immediately above.

6.4.4 Division 4 Coastal use area

The relevant clause is reproduced below followed by comments and assessment in Table 6-4.

2.11 Development on land within the coastal use area

(1) Development consent must not be granted to development on land that is within the coastal use area unless the consent authority—

(a) has considered whether the proposed development is likely to cause an adverse impact on the following—
(i) existing, safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability,
(ii) overshadowing, wind funnelling and the loss of views from public places to foreshores,
(iii) the visual amenity and scenic qualities of the coast, including coastal headlands,
(iv) Aboriginal cultural heritage, practices and places,
(v) cultural and built environment heritage, and

(b) is satisfied that—

(i) the development is designed, sited and will be managed to avoid an adverse impact referred to in paragraph (a), or
(ii) if that impact cannot be reasonably avoided—the development is designed, sited and will be managed to minimise that impact, or
(iii) if that impact cannot be minimised—the development will be managed to mitigate that impact, and

(c) has taken into account the surrounding coastal and built environment, and the bulk, scale and size of the proposed development.

(2) This section does not apply to land within the Foreshores and Waterways Area within the meaning of *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005*.

Table 6-4 Coastal Use Area - Comments and Assessment

SEPP Clause 2.11	Comments/Assessment
(1) Development consent must not be granted to development on land that is within the coastal use area unless the consent authority:	
(a) has considered whether the proposed development is likely to cause an adverse impact on the following:	
(i) existing, safe access to and along the foreshore, beach, headland or rock platform for members of the public, including persons with a disability	The proposed development is not likely to cause an adverse impact on this matter. Refer to response under Clause 2.10 (1)(e) in Table 6-3.
(ii) overshadowing, wind funnelling and the loss of views from public places to foreshores,	Not a coastal engineering consideration.
(iii) the visual amenity and scenic qualities of the coast, including coastal headlands	Not a coastal engineering consideration.
(iv) Aboriginal cultural heritage, practices and places	Not a coastal engineering consideration.
(v) cultural and built environment heritage	Not a coastal engineering consideration.
(b) is satisfied that:	
(i) the development is designed, sited and will be managed to avoid an adverse impact referred to in paragraph (a), or	The only relevant coastal engineering consideration in (a) above is (a)(i). It is not considered possible for the proposed works to be designed, sited and managed to avoid an adverse impact in respect of (a)(i), principally due to the potential for end effects to occur to the north of the proposed works. However, it is possible to minimise and mitigate the impact in respect of (a)(i), as noted below.
(ii) if that impact cannot be reasonably avoided—the development is designed,	It is considered the development has been designed, sited and will be managed to minimise and mitigate the

sited and will be managed to minimise that impact, or	impacts by a number of means – refer to the response in Clause 2.10 (2)(b) in Table 6-3.
(iii) if that impact cannot be minimised—the development will be managed to mitigate that impact	Refer to response under (ii) immediately above.
(c) has taken into account the surrounding coastal and built environment, and the bulk, scale and size of the proposed development	The proposed works are of similar, modest, vertical scale, to the existing approved permanent geobag coastal protection works located immediately to the south, but are considerably less in length (about 20% of the length of the existing works). The proposed works are also temporary in nature.

6.4.5 Division 5 General

The relevant clause is reproduced below followed by comments and assessment in Table 6-5.

2.12 Development in coastal zone generally—development not to increase risk of coastal hazards

> Development consent must not be granted to development on land within the coastal zone unless the consent authority is satisfied that the proposed development is not likely to cause increased risk of coastal hazards on that land or other land.

Table 6-5 General – Comments and Assessment

SEPP Clause 2.12	Comments/Assessment
Development consent must not be granted to development on land within the coastal zone unless the consent authority is satisfied that the proposed development is not likely to cause increased risk of coastal hazards on that land or other land	The proposed works are likely to cause increased risk of coastal hazards on land to the north due to potential end effects caused by the works. Measures are proposed to minimise and mitigate the risk, including imposing a condition on restoration if any increased erosion is caused by the works, for the life of the works, and the importation of 800m^3 of sand as part of the development proposal. It is noted here that the wording of Clause 2.12 in *State Environmental Planning Policy (Resilience and Hazards) 2021* is somewhat at odds with Section 27 (1)(b)(i) in the *Coastal Management Act 2016* which specifically anticipates that coastal protection works may increase erosion but that this is only acceptable if conditions can be imposed to restore it. It is understood that if there is any inconsistency between the Policy and the Act, the Act would override the Policy.

7 References

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Appendix A Letter from NSW Coastal Panel to Planners North dated 18 January 2017

NSW GOVERNMENT | NSW Coastal Panel

Planners North
Received 31.1.17 1315
Project
☐ to be returned
☐ reviewed
☐ approved for use
☐ noted, file - no action required
☐ approved for payment ledger # .....
☐ action as follows

Ms Kate Singleton
Planners North
P.O Box 538
Lennox Head, NSW, 2481

Our reference: DOC17/26490
Contact: Marc Daley, (02) 4927 3103

Dear Ms Singleton

I am writing to you concerning the Development Application (DA) lodged by you on behalf of Jeremy Holmes for the proposal to make Temporary Coastal Protection Works (TCPW) permanent at Lots 10 and 11 DP243218 and Lots 16-23 Section 6 DP1623 Bayshore Drive, Belongil. This DA was received by the NSW Coastal Panel on 9 January 2017.

As was discussed with you via telephone on 17 January 2017, the works which you are seeking development consent for constitute existing TCPW placed in accordance with Part 4C of the *Coastal Protection Act 1979*, Part 3 of the *Coastal Protection Regulation 2011* and the Code or Practice under the *NSW Coastal Protection Act 1979*.

As the TCPW are located on private land, they are not limited to the 2 year (maximum duration) period imposed for TCPW located on public land. Provided that there are no proposed changes to the works that would otherwise make them inconsistent with the requirements for TCPW, then development consent for the existing works is not required as the works are already permissible under the *Coastal Protection Act 1979*. Please note, there remains the ongoing requirement to ensure that works are maintained in accordance with the maintenance requirements for TCPW as defined in the *Coastal Protection Regulation 2011*.

Can you please confirm the receipt of this letter and that the submitted DA does not propose changes to the TCPW by 20 January 2017. Once this confirmation has been received the furnished DA and application fees will be returned to you (on behalf of your client).

If you have any further questions please do not hesitate to contact the Coastal Panel Secretariat Dr Marc Daley. He can be contacted on (02) 4927 3103 or by email marc.daley@environment.nsw.gov.au.

Yours sincerely

M Daley

MARC DALEY
Secretariat
NSW Coastal Panel

18 January 2017

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www.environment.nsw.gov.au

Appendix B Installation Guidelines for 0.75m^3 Sand Containers

ELCOROCK®

Installation Guidelines

0.75m³ Sand Containers

Quality - Support - Expertise

GEOFABRICS®

ELCOROCK® Installation Guidelines

Please read the important notice at the end of this brochure

Contents

These guidelines are general in nature. Site or project specific conditions may require them to be altered or amended to ensure effective installation. Please follow the guidance of the consulting or site engineer.

1.0 INTRODUCTION

ELCO**ROCK**® engineered sand containers offer excellent performance in durability, robustness and usability. ELCO**ROCK**® sand containers offer the designer, contractor and end user a range of benefits over traditional rock or hessian bag type structures; including more consistent physical properties, a well structured installation process and an amenable, user-friendly end product.

ELCO**ROCK**® 0.75m³ sand containers are designed to be used in rivers and protected coastal revetments, with larger 2.5m³ sand containers being preferable for more exposed conditions and applications. Constructed from staple-fibre polyester and polyester/ polypropylene blends, the ELCO**ROCK**® product is capable of withstanding some of the harshest conditions on the planet ranging from prolonged exposure to extreme ultra-violet radiation to abrasion due to sand and wave action.

The installation of the ELCO**ROCK**® 0.75m³ sand containers is a structured process that has been developed to ensure it is capable of delivering rapid construction times. This document provides a detailed outline of the procedure that should to be followed in order to correctly store, fill and install ELCO**ROCK**® 0.75m³ sand containers.

Standard Occupational, Health and Safety guidelines should be followed as per normal site operations. Site safety and safe work practices are the responsibility of the consultant and/or contractor.

2.0 PACKAGING, TRANSPORT AND UNLOADING ON SITE

ELCO**ROCK**® 0.75m³ sand containers are supplied wrapped in waterproof, UV resistant, opaque plastic stretch-wrap on a pallet. For quantities of sand containers per pallet refer to Table 1. Transportation of sand containers is usually by flatbed truck or similar and unloading should be conducted on the pallet as a whole, leaving the protective wrap in place until such time as the sand containers are required for filling. Unloading from the pallet should take place as required and remaining sand containers should be covered with the plastic wrap to prevent water ingress or exposure. Failure to do this may lead to saturation of the bags, making them heavy and difficult to handle.

Table 1: Packaging

Geotextile	Number of containers per pallet
Standard	50
Vandal deterrent	25

3.0 ON SITE STORAGE

All deliveries of ELCO**ROCK**® sand containers should remain in as-delivered protective wrapping until filling and placement commences. Ideally, sand containers should be stored in a location that offers protection from the elements, particularly for longer storage periods.

4.0 INSTALLATION REQUIREMENTS

The following are the minimum requirements to ensure a good filling and placement rate of 0.75m³ ELCO**ROCK**® sand containers;

- 2 Filling frames,
- 0.75m³ J-Bin. Ensure compatibility of excavator quick hitches,
- 13 tonne excavator for filling sand containers,
- 20 tonne excavator for placement of sand containers,
- 3 labourers plus excavators operators,
- 2 Sewing machines,
- Generator,
- Personal protection: hats, steel cap boots, sunglasses, sun screen and long sleeve shirts.

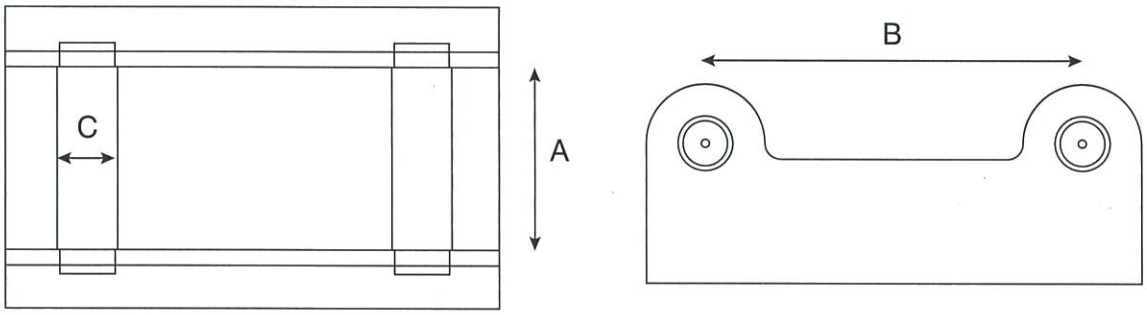
5.0 EQUIPMENT COMPATIBILITY

The J-Bins have been designed to accept a wide range of different excavators by means of an interchangeable quick hitch attachment. If the equipment available does not match the standard quick hitches available (refer to Table 2), project specific hitches can be manufactured to suit. The contractor should allow at least one month for the manufacture of new quick hitch attachments.

Table 2: Standard Quick Hitch Dimensions

Code	A Spread	B Pin Centres	C Pin Diameter
QH 141	221mm	407mm	65mm
QH 201	320mm	440mm	80mm
QH 301	350mm	515mm	90mm
QH 351	420mm	585mm	100mm

Figure 1: Quick Hitch Dimensions



6.0 INSTALLATION TEAM

Before installing ELCO**ROCK**® sand containers this guideline should be read thoroughly by all installation personnel. The installation team should be aware of their individual roles in ensuring a quality installation. Any questions raised by the installation team which cannot be answered by this document should be referred to the supplier.

7.0 SITE AND SUBGRADE PREPARATION

Depending on the size of the project and the number of units to be filled, planning of the site layout and logistics regarding filling and placement will enhance productivity and minimise the need for excessive handling or travelling.

The site must be prepared such that there is no debris and the filling area is level and firm. Failure to ensure a level and firm construction area may lead to damage or instability of the filling apparatus.

8.0 WEATHER CONDITIONS FOR INSTALLATION

ELCO**ROCK**® installations can be sensitive to climatic conditions including tides, waves, rain and wind. Tidal variations may influence the availability of fill material, ability to place and the area available to work and store raw materials and equipment. For safety reasons, strong or severe wave action can have an effect on the ability to work within an exposed coastal region. Rain and wind can present hazardous situations in and around the work site, particularly where electricity is present. All of the above factors must be taken into account when planning an installation.

9.0 FILLING

The 0.75m³ ELCO**ROCK**® sand containers are filled using a product specific filling frame. The filling frame is designed such that a container can be filled and the frame released and moved on to the next container filling point, reducing delays in production.

The following guidelines should be followed to ensure an efficient and effective work rate:

1. Ensure a sufficient stockpile of sand and an adequate supply of fuel for the generator.
2. Remove one ELCO**ROCK**® sand container from the pallet and place it in a filling frame, following these steps.
3. Insert the sand container up from the inside of the fixing ring and fold over the fixing ring.
4. Pull the sand container down until between 250 to 300mm overhang is achieved.

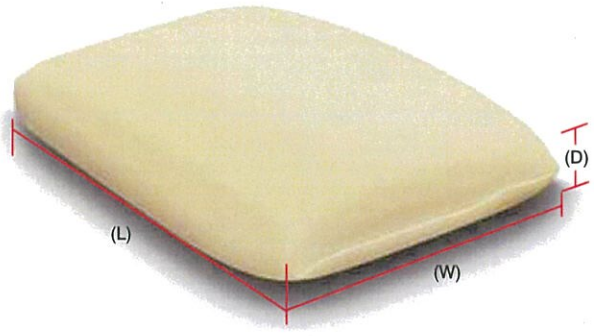
   Note: When using vandal deterrent geotextiles, the top 250mm of the sand container should be folded over prior to insertion into frame, as this simplifies the task.
5. The bottom of the sand container must hang approximately 25mm above the ground.

   Note: The empty sand container should be hanging uniformly in the filling frame. This prevents the container from folding or creasing during the filling operation. This will limit the fill volume and reduce the stability of the sand container.
6. Secure the container using the clamping ring supplied. The clamping ring must lock in below the rim of the fixing ring.
7. Fill the sand container with sand to within 300mm of the top of the fixing ring (refer to Figure 2).

   Note: The first load of sand should be dispensed slowly so that the possibility of the sand container folding along the base is limited and the sand container can be manhandled to free up any folds.
8. Using great care, release the sand container from the frame by removing the lock ring.
9. Push excess sand into the corners of the sand container and pull the two faces of the sand container together. Approximately 75mm vertical surface is required to allow a sewn closure to be facilitated.

   Note: 1. If more than 100mm of material is available for sewing, the sand container is under filled and more sand should be added.

   2. If less than 50mm of material is available for sewing, remove sand from the sand container as the limited depth will restrict the movement of the sewing machine and may cause it to jam.
10. Slide the filling frame forward and repeat the procedure.



Dimension Range	
Depth (mm)	350-400
Width (mm)	1200-1500
Length (mm)	1600-1800

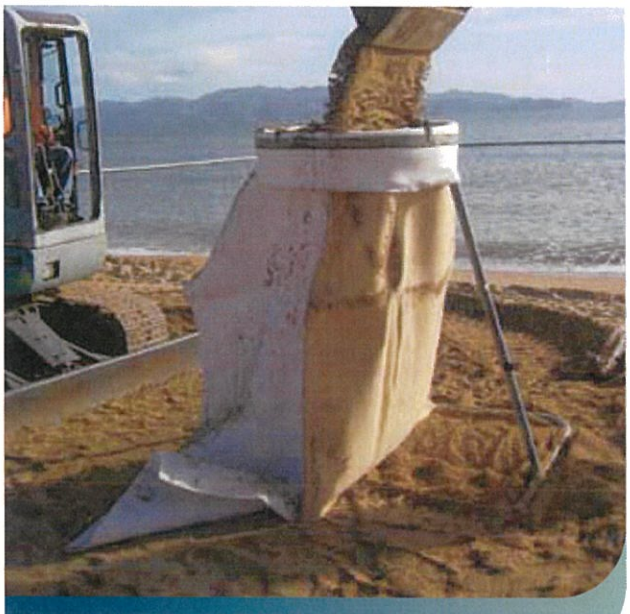


Figure 2. Filling sand container

10.0 CLOSURE

Only sewing machines and sewing yarn supplied by Geofabrics Australasia should be used for this operation. Use of other materials may compromise the longevity of the structure and the speed of the closure operation.

The hand held sewing machines require special attention and details regarding their operation are provided below.

Sewing machine operation:

1. The sewing machine must be threaded correctly in accordance with factory diagrams. Minor errors in threading are sufficient to create a faulty seam.
2. Ensure that the yarn/thread is not tangled or caught around any components as it dispenses from the spool. This may occur between STOP/START of sewing, laying down of the machine, on windy days or after unpacking.
3. Ensure the machine is clean and free of sand or dirt. Compressed air is an effective means of cleaning around needle/looper end feeds.

   Note: 1. Compressed air is dangerous when not used safely,
   2. Check for yarn/thread tangles after blowing clean.
4. The sewing machine relies on 240v AC current. When operating in the field, ensure that a suitable earth leakage protection device is utilised.
5. Never continue sewing if the machine has snagged and is not progressing forward. Follow this procedure:
   - Unplug power supply,
   - Turn drive assembly over to relieve foot pressure on the fabric,
   - Cut tangled thread to clear machine.
6. Always ensure fabric is clear of debris such as shells, sand or small stones.

The sewn closure consists of two full sewn runs and locked off corners, as described below.

Sewing:

1. **First seam - Straight line**

   Start sewing at the factory seamed edge and sew across the top of the sand container towards the folded edge. Ensure there are no folds in the fabric as this will jam the sewing machine or cause the machine to go out of alignment.

2. **Second seam - "Sine Wave"**

   Start sewing at the factory seamed edge (refer to Figure 3) and sew across the top of the sand container towards the folded edge, crossing first seam at least 5 times (refer to Figure 4 and Figure 5).

3. **Locked corners - Diagonal locks to sewn seams**

   Sew downwards from the top of the sand container, lock off corners twice;

   Note:
   - Always apply light forward pressure to the sewing machine to assist travel over the geotextile. If the sewing machine is allowed to pull itself over the geotextile it may become jammed,
   - Slow the machine when sewing off the edge of the geotextile. Sewing off at high speed may cause the machine to go out of alignment,
   - The machine can be stopped or started at any time during sewing. It is better to stop sewing to clear a fold or potential jam than trying to continue sewing despite obstacles.

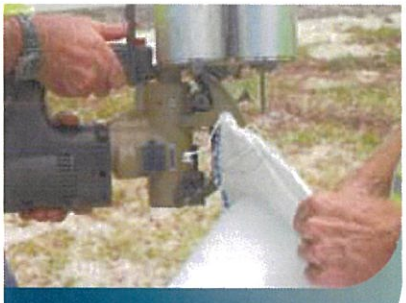


Figure 3.

Figure 4.

Figure 5.

11.0 HANDLING AND PLACEMENT

The 0.75m³ sand containers must be handled using purpose made J-Bins supplied by Geofabrics Australasia. The J-Bins limit the stress on the geotextile during handling and allow accurate placement. A simple quick-hitch attachment on the sand container allows 13 to 35 tonne excavators to rapidly deploy sand containers. Modified rock grabs are not suitable for use as they place the container under high levels of stress, which can stretch the fabric out of shape, or even cause a failure of the seam.

The sand containers should be stored on a soft, sand surface and not stacked. This is to ensure the J-Bin can easily dig under the container and lift it as shown. Failure to do this may lead to lost production or damage to the sand containers.

The placement of the sand container should be completed in such a way that the site closed seam is buried/hidden from exposure.

1. Connect the excavator to the J-Bin quick hitch.
2. Push the container over onto its side, ensuring the longitudinal factory seam is parallel to the ground.
3. Pick up the sand container with the J-Bin (refer to Figure 6).
   a. Push the nose of the J-Bin down into the sand until the upper bar touches the top of the container.
   b. Rotate the J-Bin upwards to lift the container.
4. Shake the J-Bin from side to side to remove sand trapped below the container (refer to Figure 7).
5. Walk the excavator into position and place the sand container (refer to Figure 8). A slight backwards and forwards shaking movement of the J-Bin may be required to assist in allowing the sand container to slide forward out of the J-Bin. Ensure site seam is placed so that it is not exposed.
6. Press down on the top of the container using the back of the J-Bin to achieve desired height.

Figure 6.

Figure 7.

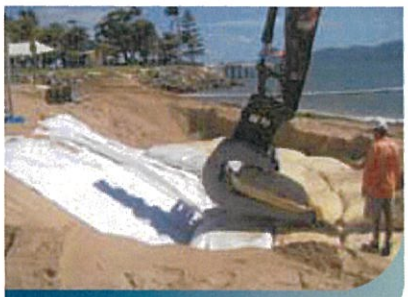


Figure 8.

12.0 MAINTENANCE

It is the responsibility of the owner to adequately maintain the structure once complete. This will require regular inspections to identify and repair any damage that may have occurred to the structure. It is important to note that where sand containers are located in submerged or intertidal zones the sand retained within the container can be removed rapidly due to wave and current movements and it is imperative that repairs be carried out as soon as any damage is identified.

If the ELCO**ROCK**® sand container is allowed to lose fill material to a point where the geotextile can flap, the geotextile will tear along the fatigue lines created by the flapping action and catastrophic failure of the container is likely to occur.

The following general guidelines are recommended: walk over the structure once a month; identify sand containers with damage or showing signs of deterioration: ensure all sand containers are inspected; patch or repair damaged containers immediately as per details provided in section 13.

13.0 REPAIRS

While the geotextile used to manufacture ELCO**ROCK**® sand containers is extremely tough and durable, the material can be damaged by boat impact, vandalism or other factors. An effective method has been developed to patch the sand containers both above and below the waterline.

1. **Patch preparation**
   a. The patch should extend at least 300mm beyond the edge of the hole,
   b. Ensure all corners of patch are rounded 100mm radius minimum,
   c. 5mm holes should be burnt (using a hot soldering iron) at 100mm centres along the edge of the patch and 50mm in from the edge.
2. **Surface preparation**
   a. Scrub the area with a coarse brush to remove all algae growth,
   b. Shake the geotextile to dislodge the sand trapped in the outer layer of the geotextile, it will not be possible to remove all sand but the more porous the surface the better the bond between the patch and the sand container.
3. **Patch placement**
   a. Place the patch over the hole and punch a hole in the sand container using a sharpened screw driver,
   b. Screw first screw into place, continue process around the patch,
   c. Ensure a thick layer of Silastic 732 adhesive/sealant is applied to the surface of the sand container to ensure a good bond between patch and container,
   d. After all screws are in place, press down firmly on patch to ensure the adhesive is forced into the geotextile and squeezes evenly out along the edge of the patch,
   e. Where adhesive does not extrude out from under the edge of the patch extra adhesive must be applied to the area by pushing the nozzle under the patch.

Contact Geofabrics Australasia for advice on any unusual repairs or maintenance requirements.

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Fax: (03) 8586 9186	Fax: (02) 9821 3670	Fax: (02) 4950 5895	Fax: (02) 6653 5706	Fax: (08) 9249 5447	Fax: (08) 8177 2044
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M156-06/11

Appendix C Code of Practice under the Coastal Protection Act 1979

NSW GOVERNMENT
Environment, Climate Change & Water

Code of Practice under the *Coastal Protection Act 1979*

Cover photographs (clockwise from main photograph):
Lennox Head, Lake Ainsworth in the foreground (DECCW); sandbags at Byron Bay (M. Sharpin/DECCW); sandbags at Byron Bay (M. Sharpin/DECCW); and coastal revegetation (Bruce Coates/DECCW).

Published by:
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DECCW 2011/0223

March 2011

Contents

Explanatory notes

Note: These explanatory notes do not form part of the Code of Practice and are provided for guidance only.

The primary purpose of this document is to detail requirements related to the following sections of the *Coastal Protection Act 1979*:

- placement of material that forms part of emergency coastal protection works under the provisions of section 55P(2)(f)
- maintenance of emergency coastal protection works under the provisions of section 55R(1)(d)
- removal of emergency coastal protection works under the provisions of section 55Y(1)(b)
- removal of certain material and structures unlawfully placed on beaches under the provisions of section 55ZA(3)(b)
- restoration of land, including public land, under certain circumstances under the provisions of section 55ZC(5)(b).

These requirements are to be read in conjunction the *Coastal Protection Act 1979* and the Coastal Protection Regulation 2011, which are available at www.legislation.nsw.gov.au.

Definitions

The following is a list of definitions for terms used in this Code of Practice.

AS: Australian Standard

Beach, coastal protection works, emergency action subplan, emergency coastal protection works and **public land:** have the same meaning as in the *Coastal Protection Act 1979*

Escarpment: the vertical or near-vertical drop in the profile of a beach caused by tidal or storm erosion

Professional engineer: a person belonging to a class of persons recognised as being qualified to be registered or registered as a professional engineer in the civil engineering area of practice by the National Engineering Registration Board, or under the Queensland *Professional Engineers Act 2002*, with expertise in coastal engineering

Sandbag: a fabric bag that can be filled with sand which meets the requirements under the *Coastal Protection Act 1979*, including the Coastal Protection Regulation 2011 and this Code

Storm conditions: a period during which a severe weather warning for large waves or damaging surf issued by the Bureau of Meteorology applies

The Act: the *Coastal Protection Act 1979*

Works: emergency coastal protection works.

1 Safety requirements for placing, maintaining and removing works

These requirements relate to sections 55P(2)(f), 55R(1)(d) and 55Y(1)(b) of the *Coastal Protection Act 1979*.

1.1 General requirements

(i) Before any works are placed, maintained or removed, a temporary safety fence must be erected around the area where works are to be placed or are located and any additional area used by earthmoving equipment or other vehicles for the purpose of placing, maintaining or removing the works. The safety fence is to be removed after the placement, maintenance or removal of the works is completed.

(ii) In addition to the requirements under (i), if the escarpment concerned exceeds 1 metre in height, an additional temporary safety fence must be erected before any works are placed, maintained or removed. The safety fence must be erected on the landward side of the escarpment at a distance of at least 2.5 times the greatest height of the escarpment. For example, if the escarpment is 2 metres high at its highest point, then a safety fence must be erected 5 metres from the escarpment on its landward side. The area between the safety fence and the escarpment must not be used during the placement, maintenance or removal of the works. The safety fence is to be removed after the placement, maintenance or removal of the works is completed.

(iii) Sand or sandbags comprising the works must be placed and maintained in a manner that minimises the likelihood of the collapse of the escarpment. Should a collapse of the escarpment occur, an authorised officer may require the landowner to obtain, before continuing with placing the works, a written opinion from a professional engineer that the placement of the works does not present a significant safety risk. This opinion must be kept by the landowner until the works are removed.

(iv) Subject to item 2.4 below, excavation of the escarpment for the placement of the works is not permitted.

(v) Routine maintenance or removal of the works or restoration of land following removal of works is not to be undertaken during storm conditions. Emergency repairs to the works may be undertaken where the landowner has obtained a written opinion from a professional engineer that the repairs to the works do not present a significant safety risk. This opinion must be kept by the landowner until the works are removed.

1.2 Safety requirements under storm conditions

Works are not to be placed during storm conditions unless the landowner obtains a written opinion from a professional engineer that the placement of the works under these conditions does not present a significant safety risk. This opinion must be kept by the landowner until the works are removed.

2 Placement of works

These requirements relate to section 55P(2)(f) of the *Coastal Protection Act 1979*.

2.1 Permitted locations for placement of works

Material for works may only be placed at a location specified in the schedule. Any associated vehicular access to a beach at this location must be by the access points nominated in the schedule.

2.2 Requirements for placement of works

2.2.1 General requirement

Works may only be placed where the most landward part of an escarpment is within 20 metres of the most seaward wall of a building. Note that section 55P(2) of the Act specifies the requirements of a building in relation to placing works.

2.2.2 Placement and maintenance of sandbag works

Works comprising the placement of sandbags must meet the following requirements:

(a) the height of the works must not exceed 1.5 metres from the base (or toe) of the escarpment

(b) the works must be placed against the seaward side of the escarpment and be within 4 metres of the escarpment

(c) the slope of the face of the works must not exceed 34 degrees from the horizontal plane

(d) no voids on any exposed faces of the works, or between the works and the escarpment, of a size that may present a public safety risk.

2.2.3 Placement and maintenance of sand works

Emergency coastal protection works comprising the placement of sand must meet the following requirements:

(a) the sand must be placed against the escarpment on the seaward side

(b) the slope of the face of the works must not exceed 34 degrees from the horizontal plane.

2.2.4 Placement of works when other coastal protection works exist

Emergency coastal protection works must not be placed at any location where other coastal protection works (whether lawfully placed or not) exist. This restriction does not apply if a professional engineer has provided a written opinion that the proposed emergency coastal protection works together with the existing coastal protection works will not provide greater erosion protection than the protection that would be provided solely by emergency coastal protection works placed on the land. This opinion must be kept by the landowner until the works are removed.

2.3 Material requirements

2.3.1 Sand requirements

(i) The sand used in the works is to comply with the following requirements:

(a) the sand must not contain a proportion of heavy metals or other toxic contaminants that exceeds the criteria set out in the *National Environment Protection (Assessment of Site Contamination) Measure 1999.* This requirement does not apply to quarried sand.

(b) the main constituent of the sand is to be silica (in the form of quartz)

(c) the median sieve size (d50) of the sand is to be 0.15 to 0.5 millimetres to AS 2758

(d) the fines content of the sand (<75 μm) is to be 5% or less to AS 2758

(e) the colour of the sand is to be similar to the colour of the sand of existing dunes within the vicinity of the works.

(ii) If sand used in the works is obtained from a sand supplier, the landowner must obtain and keep (for the life of the works) a written statement from the supplier certifying that the sand meets these requirements.

2.3.2 *Sandbag and geotextile fabric requirements*

(i) Sandbags used in the works are to be manufactured from geotextiles or woven polypropylene fabric and have a maximum volume of 0.75 cubic metres when filled.

(ii) Geotextiles used for these sandbags is to be non-woven, staple fibre and needle-punched. The geotextile is to have a minimum tensile strength of 21 kN/m (tested to Australian Standard 3706.2) and a minimum California bearing ratio burst strength of 5400 N (tested to Australian Standard 3706.4). Woven polypropylene fabric is to have a minimum tensile strength of 3 kN/m (tested to Australian Standard 3706.2). The landowner must obtain and keep for the life of the works a written statement from the supplier of the sandbags certifying that the fabric meets these requirements.

2.4 Additional construction requirements

(i) An exception to item 1.1(iv), when placing works comprising sandbags, limited excavation of the beach (other than the escarpment) may be undertaken to enable the bottom layer of sandbags to be placed approximately horizontally. Any excavated sand is to be placed elsewhere on the beach.

(ii) All sandbags used in the works are to be sewn or tied closed before placement.

3 Maintenance of works

These requirements relate to section 55R(1)(d) of the *Coastal Protection Act 1979*.

(i) Works comprising sandbags that do not meet the requirements under the Act (note this includes requirements under the Coastal Protection Regulation 2011 and this Code) are to be relocated to the correct location or removed from the beach as soon as practicable. This includes sandbags located elsewhere on the beach which were originally placed as part of the works.

(ii) Works damaged by tides or waves during a storm are to be repaired or removed as soon as practicable after the storm conditions cease.

4 Removal of works and restoration of land

These requirements relate to sections 55Y(1)(b) and 55ZC(5)(b) of the *Coastal Protection Act 1979*.

4.1 Removal of sandbag works

Sandbags used in the works are to be opened and the sand distributed on the beach, resulting in a reasonably even beach terrain. Emptied sandbags are to be removed from the beach.

4.2 Restoration of land

(i) In relation to the removal of works (whether in accordance with section 55Y of the Act or an order under section 55ZC), areas disturbed during the placement, maintenance and removal of the works are to be restored to a condition as close as is reasonable to the condition that existed before the works were placed. Sand that has fallen from the escarpment to the beach is to be distributed on the beach, resulting in a reasonably even beach terrain.

(ii) In relation to the alteration or repair of emergency coastal protection works in accordance with an order under section 55ZC of the Act, if any area that was disturbed during the placement or maintenance of the works is no longer covered by or under the works, that area is to be restored to a condition as close as is reasonable to the condition that existed before that part of the works was placed.

(iii) Restoration of damaged dunes is to be carried out in accordance with the document entitled *Coastal Dune Management: A manual of coastal dune management and rehabilitation techniques*, published by the NSW Department of Land and Water Conservation in 2001. Dune escarpments should be restored in accordance with this document to the extent to which this is reasonable for the particular escarpment.

5 Restoration of land after order to remove illegal material or structure

These requirements relate to section 55ZA(3)(b) of the *Coastal Protection Act 1979*.

(i) Areas disturbed by the deposit of the material or the erection of the structure concerned are to be restored to a condition as close as is reasonable to the condition that existed before the material was deposited or structure was erected. Sand that has fallen from a dune escarpment to the beach is to be distributed on the beach, resulting in a reasonably even beach terrain.

(ii) Restoration of damaged dunes is to be carried out in accordance with the document entitled *Coastal Dune Management: A manual of coastal dune management and rehabilitation techniques*, published by the NSW Department of Land and Water Conservation in 2001. The dune escarpment should be restored in accordance with this document to the extent to which this is reasonable for the particular escarpment.

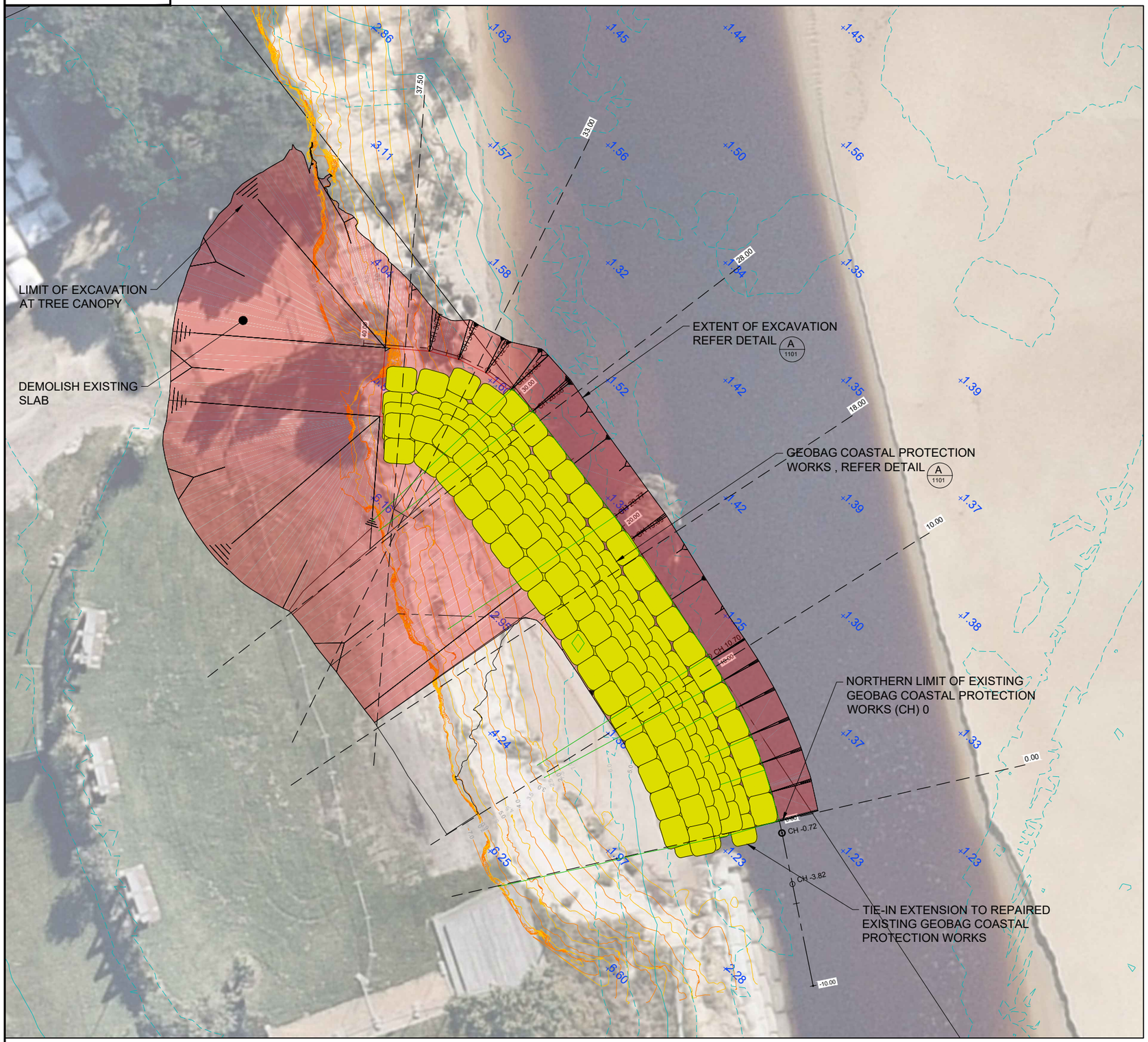
Schedule – Authorised locations for placing works and associated beach access

Authorised locations for placing works	Authorised beach access
Basin Beach, Mona Vale	Beach access track from corner of Surfview Road and Basset Street (alternate access – adjacent to Mona Vale Surf Life Saving Club, Seabeach Avenue)
Belongil Beach, Byron Bay	Childe Street; Manfred Street; Don Street
Bilgola Beach, Bilgola	From north end of Allen Avenue (alternate access – Bilgola Avenue at Allen Avenue)
North of outlet from Cakora Lagoon and east of Ocean Street, Brooms Head	Track from Ocean Street (south of bridge)
Collaroy Beach, Collaroy	Collaroy Beach carpark (opposite Jenkins Street), Frazer or Stuart Streets
Hargraves Beach, Noraville	Elizabeth Drive (north end)
Narrabeen Beach, Narrabeen	Wetherill or Mactier Streets, adjacent to Narrabeen or South Narrabeen Surf Life Saving Clubs, Birdwood Park carpark or Clarke Street
North Entrance Beach, The Entrance (North)	Curtis Parade
Mollymook Beach, Mollymook (between Donlan Road and Mollymook Creek)	Mitchell Parade
Cabbage Tree Harbour Beach, Norah Head	Bald Street boat ramp area
Old Bar Beach, Old Bar	Pacific Parade at Rose Street or adjacent to the Taree Old Bar Surf Club, Ungala Road
Pearl Beach, Pearl Beach	Coral Crescent; Pearl Parade; Gem Road
Wamberal Beach, Wamberal	Adjacent to Wamberal Surf Life Saving Club, Dover Road
Wooli Beach, Wooli	Wooli Road (South Terrace)

Appendix D Design Drawings for Extension to Existing Coastal Protection Works

DRAWING No.
PA3267-RHD-00-XX-DR-ME-1000

DO NOT SCALE



GENERAL ARRANGEMENT PLAN
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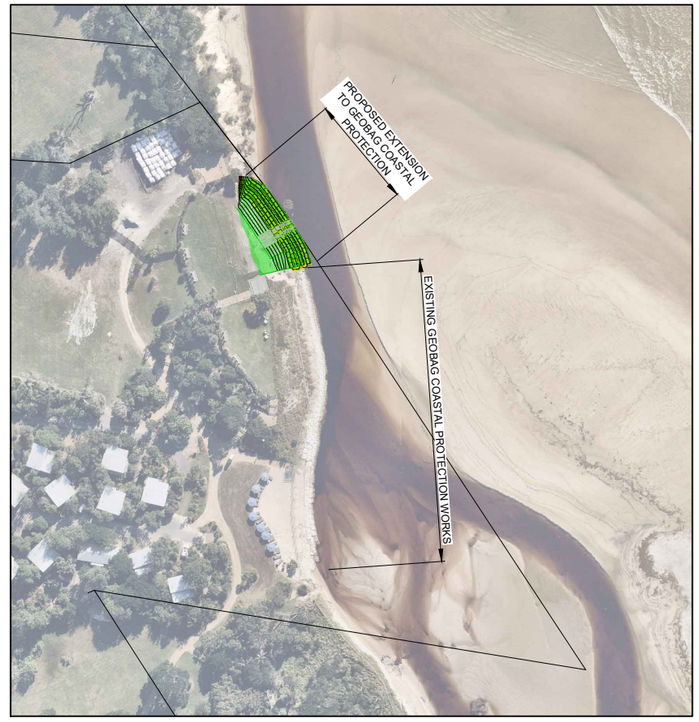

LOCATION PLAN
1:1000

NOTES

1. CONCEPT DESIGN , SUBJECT TO DETAILED DESIGN
2. TIE IN EXTENSION WITH EXISTING GEOBAG COASTAL PROTECTION WORKS
3. REMOVE ANY DELETERIOUS MATERIAL FROM FOOTPRINT OF GEOBAGS PRIOR TO PLACEMENT
4. ALL LEVELS ARE IN METRES REDUCED TO AUSTRALIAN HEIGHT DATUM (AHD)
5. AIR PHOTO BY NEARMAP DATED 16/07/2022
6. REFER TO DRAWINGS 1104 - 1106 FOR RE-ESTABLISHMENT OF DUNE PROFILE

LEGEND

- LAND SURVEY, TERRESTIAL LASER SCANNER, 30th NOV 2022
- LAND SURVEY, MISC POINTS EXTRACTED FROM TERRESTRIAL SCANNER, 30th NOV 2022
- "ELVIS" LIDAR SURVEY, DEC 2018
- EXTENT OF EXCAVATION

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NOT FOR CONSTRUCTION

AUSTRALIAN HEIGHT DATUM

REV	DATE	DESCRIPTION	BY	CHK	APP
P02	29.05.2023	ISSUED FOR DA	SGB	GWB	
P01	31.03.2023	ISSUED FOR INFORMATION	SGB		

REVISIONS

CLIENT

ELEMENTS OF BYRON

PROJECT
ELEMENTS OF BYRON
EXTENSION TO EXISTING COASTAL PROTECTION WORKS

TITLE
GENERAL ARRANGEMENT AND LOCATION PLAN

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PA3267-RHD-00-XX-DR-ME-1000	S0	P02

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DRAWING No.
PA3267-RHD-00-XX-DR-ME-1101

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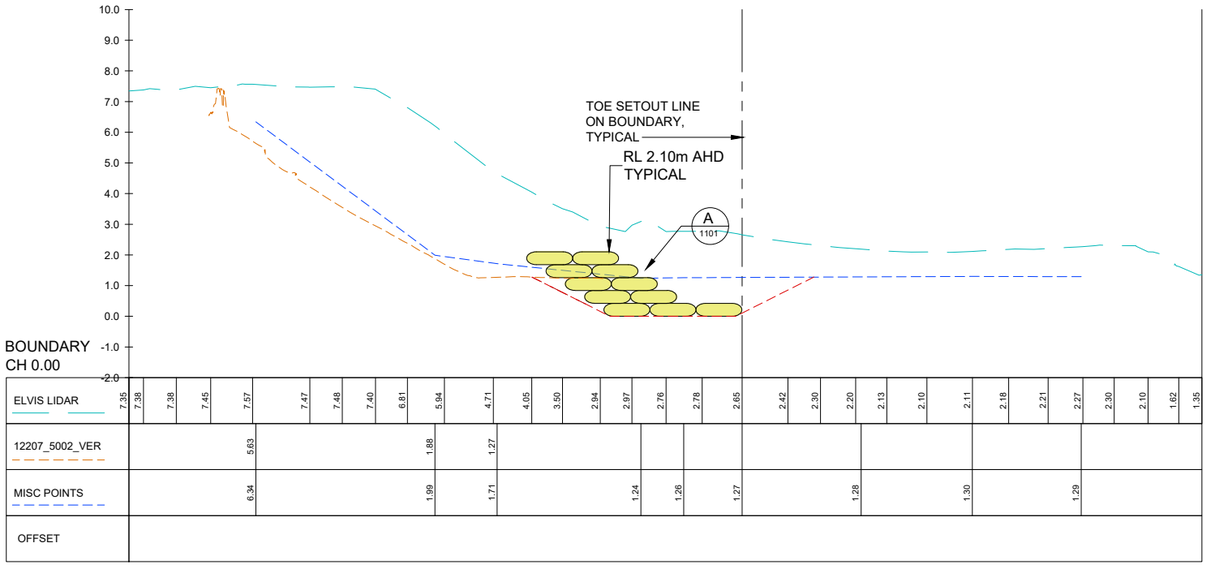

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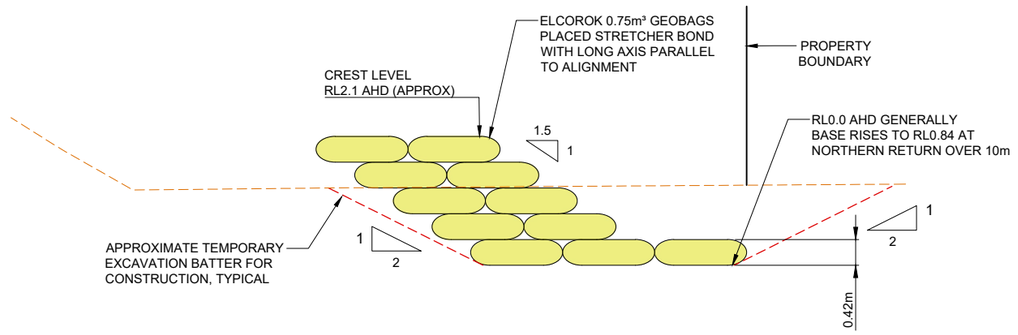

DETAIL A
AS SHOWN

LEGEND

- LAND SURVEY, TERRESTIAL LASER SCANNER, 30th NOV 2022
- LAND SURVEY, MISC POINTS EXTRACTED FROM TERRESTRIAL SCANNER, 30th NOV 2022
- "ELVIS" LIDAR SURVEY, DEC 2018

AUSTRALIAN HEIGHT DATUM

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REV	DATE	DESCRIPTION	BY	CHK	APP
P02	29.05.2023	ISSUED FOR DA	SGB	GWB	
P01	31.03.2023	ISSUED FOR INFORMATION	SGB		

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ELEMENTS OF BYRON

PROJECT
ELEMENTS OF BYRON
EXTENSION TO EXISTING COASTAL PROTECTION WORKS

TITLE
CROSS SECTIONS
SHEET 1

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DRAWING No.
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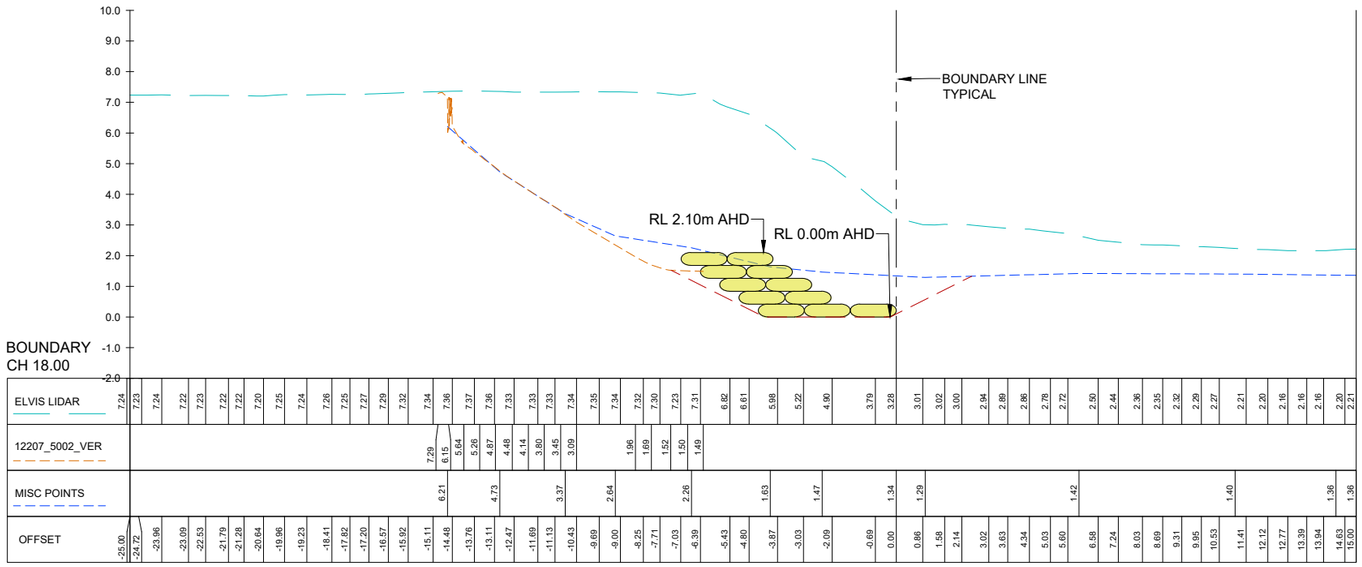

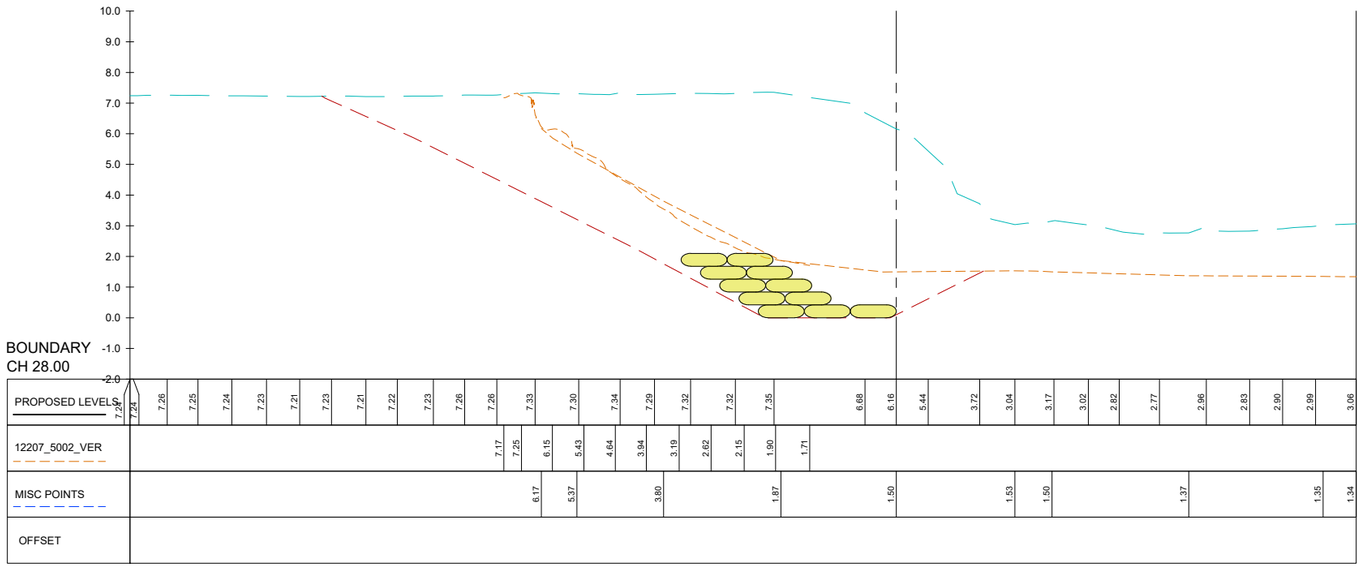

NOTES

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ELEMENTS OF BYRON

PROJECT

ELEMENTS OF BYRON
EXTENSION TO EXISTING COASTAL PROTECTION WORKS

TITLE

CROSS SECTIONS
SHEET 2

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DRAWING No.	SUITABILITY	REVISION
PA3267-RHD-00-XX-DR-ME-1102	S0	P02

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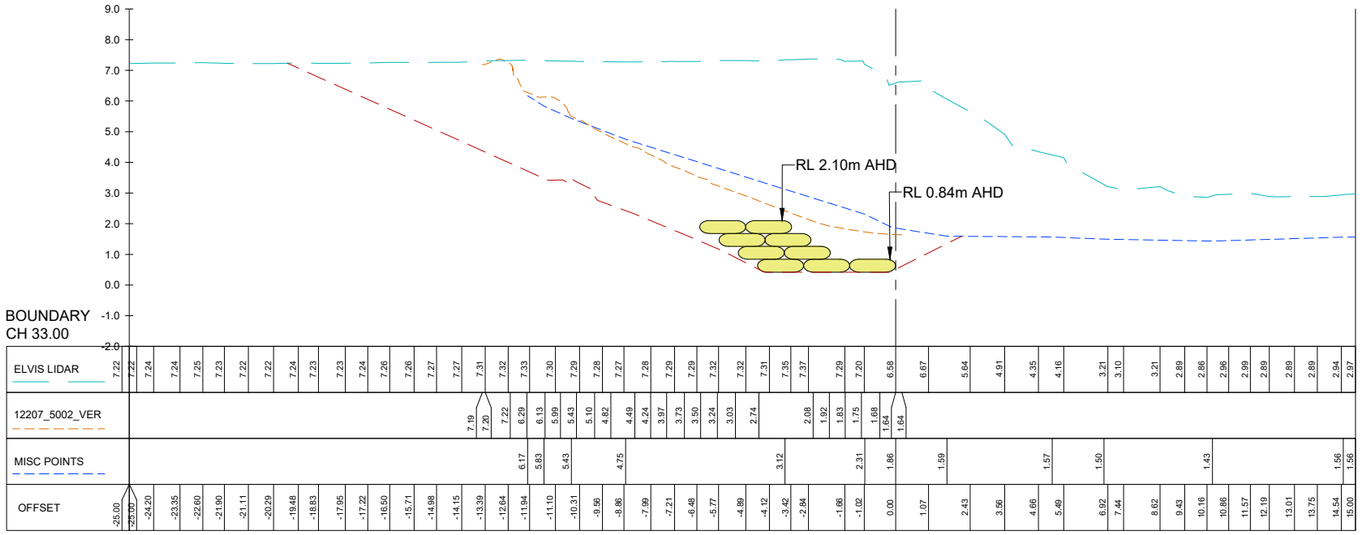

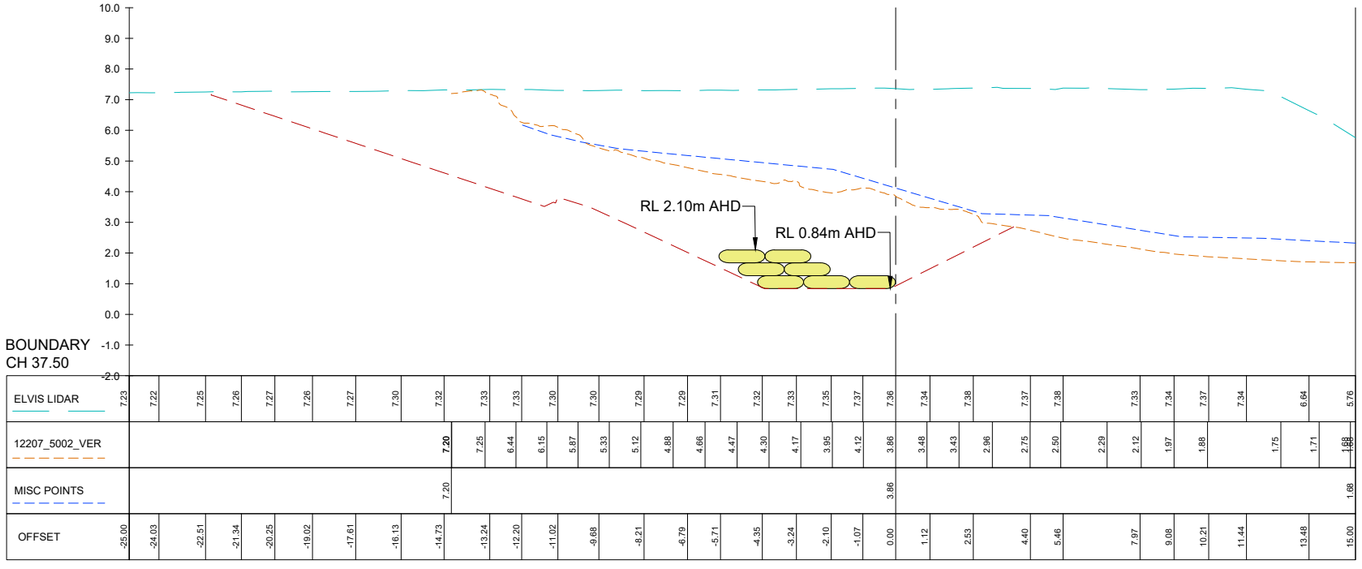

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P01	31.01.2023	-	SGB		

REVISIONS

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ELEMENTS OF BYRON

PROJECT
ELEMENTS OF BYRON
EXTENSION TO EXISTING COASTAL PROTECTION WORKS

TITLE
CROSS SECTIONS
SHEET 3

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SCALE	REF:		
AS SHOWN	PA3267-RHD-00-M3-ME-0001B		

DRAWING No.	SUITABILITY	REVISION
PA3267-RHD-00-XX-DR-ME-1103	S0	P02

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DRAWING No.
PA3267-RHD-00-XX-DR-ME-1104

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NOTES

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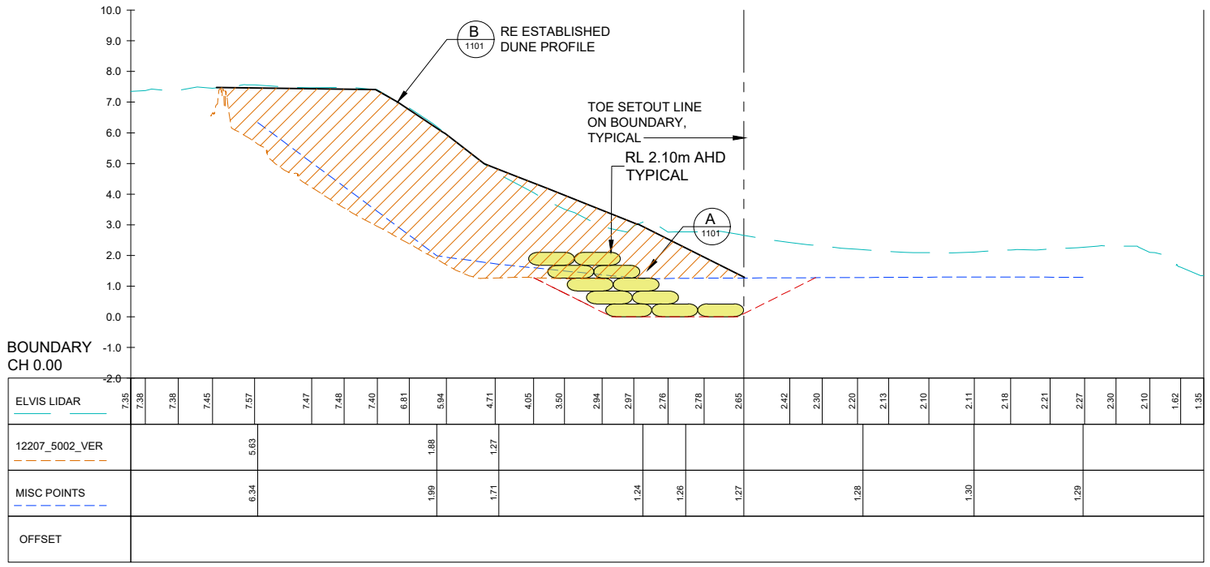

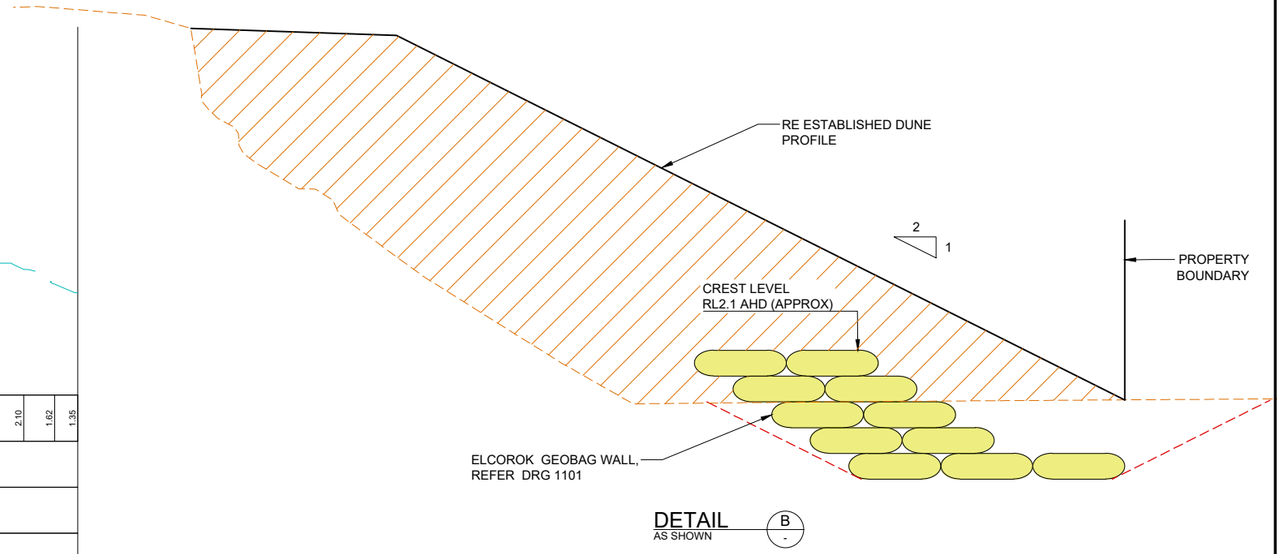

DETAIL B
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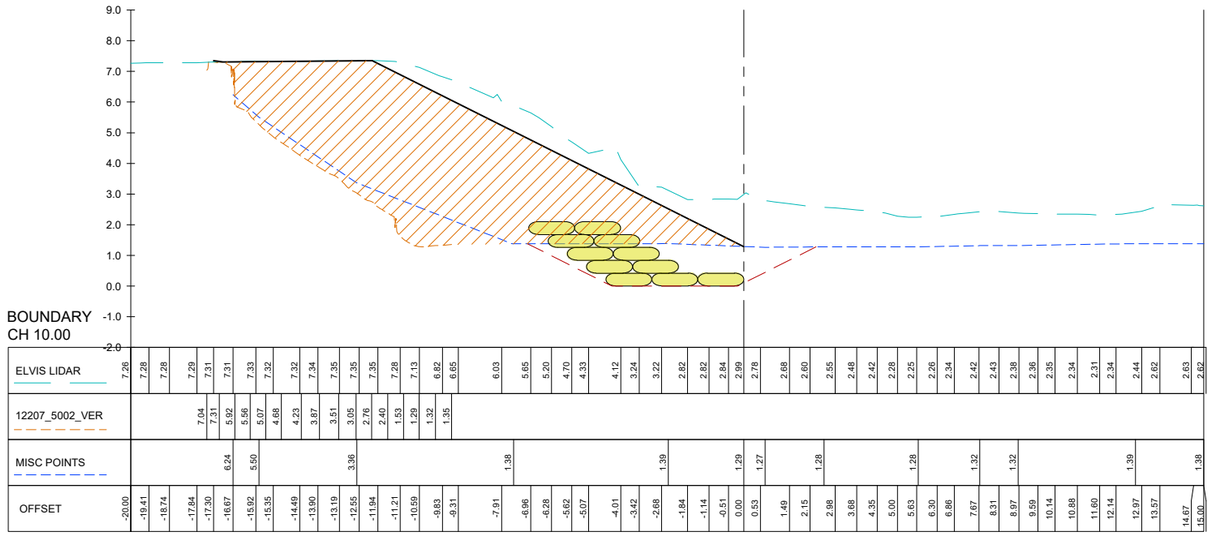

LEGEND

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- "ELVIS" LIDAR SURVEY, DEC 2018
- RE-ESTABLISHED DUNE PROFILE

AUSTRALIAN HEIGHT DATUM

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2 0 2 4 6 8 10m
1:200 (A3) 1:100 (A1)

REV	DATE	DESCRIPTION	BY	CHK	APP
P01	29.05.2023	ISSUED FOR DA	SGB	GWB	

REVISIONS

CLIENT

ELEMENTS OF BYRON

PROJECT
ELEMENTS OF BYRON
EXTENSION TO EXISTING COASTAL PROTECTION WORKS

TITLE
RE-ESTABLISHMENT OF DUNE PROFILE SHEET 1

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DRAWING No.	SUITABILITY	REVISION
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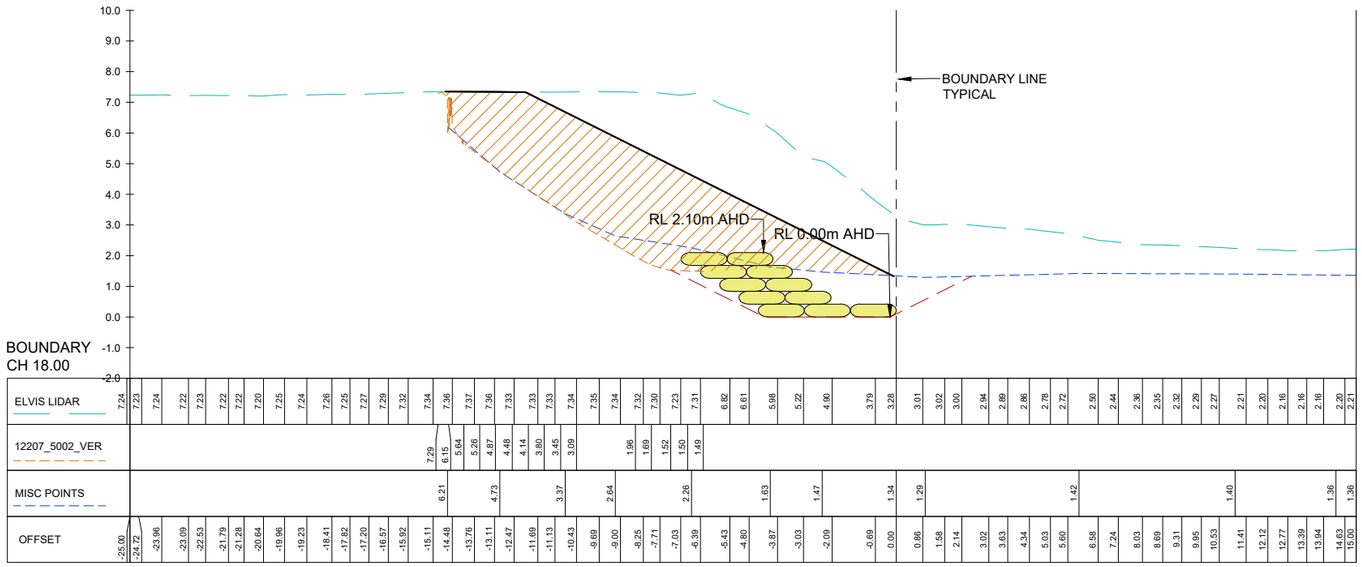
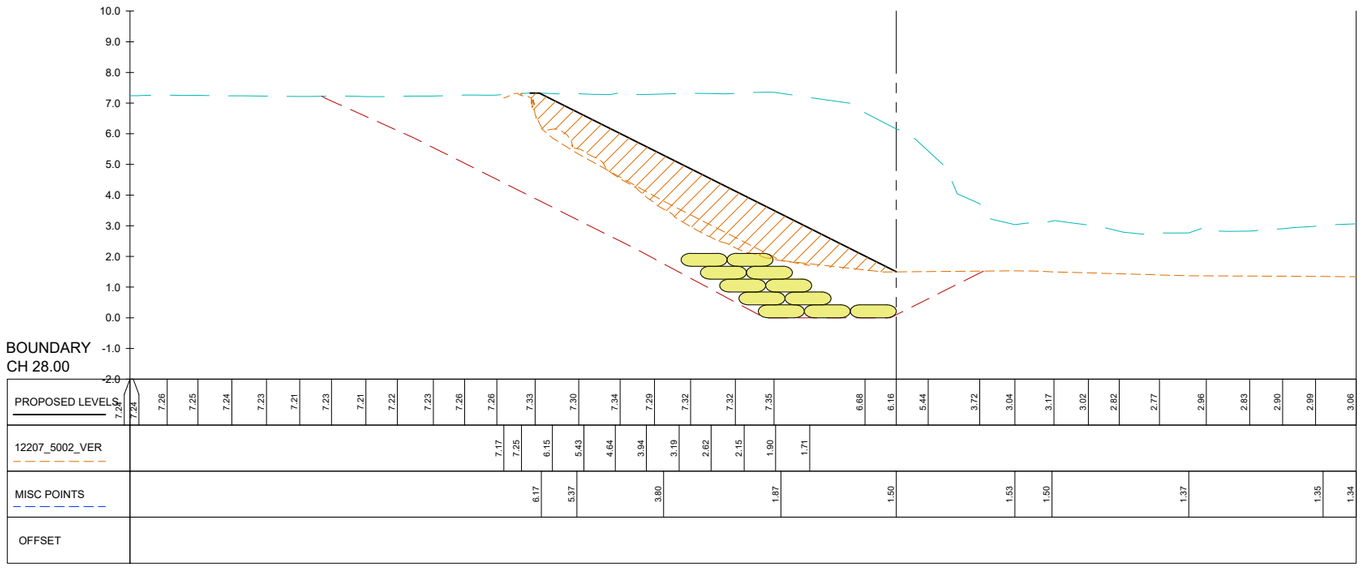
DRAWING No.
PA3267-RHD-00-XX-DR-ME-1105

DO NOT SCALE





NOTES

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2 0 2 4 6 8 10m

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CLIENT

ELEMENTS OF BYRON

PROJECT

ELEMENTS OF BYRON
EXTENSION TO EXISTING COASTAL PROTECTION WORKS

TITLE

RE-ESTABLISHMENT OF DUNE PROFILE SHEET 2

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Royal HaskoningDHV
Enhancing Society Together

DRAWN	COORD. SYSTEM	DATUM	DATE
SGB	GDA 2020	AHD	29.05.2023
SCALE	REF.		
AS SHOWN	PA3267-RHD-00-M3-ME-0001B		

DRAWING No.	SUITABILITY	REVISION
PA3267-RHD-00-XX-DR-ME-1105	S0	P01

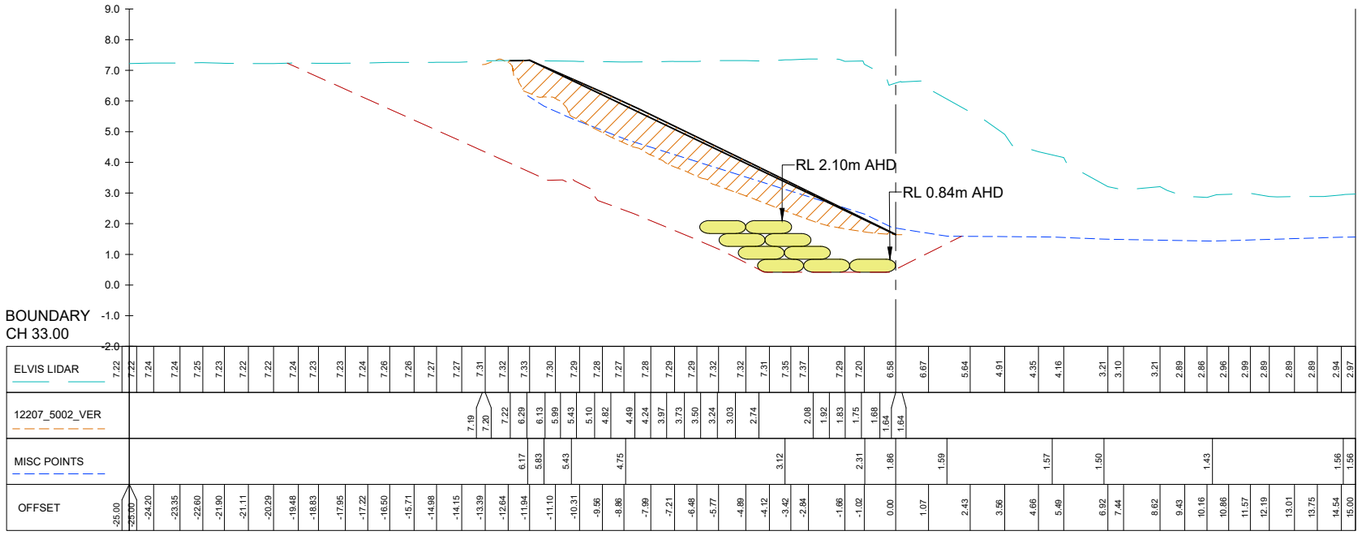
C:\USERS\220000\ROYAL HASKONINGDHV\PROJECT-PA3267-ELEMENTS-OF-BYRON - WIP\CAD\WORKING DRAWINGS\PA3267-RHD-00-M3-ME-0001B

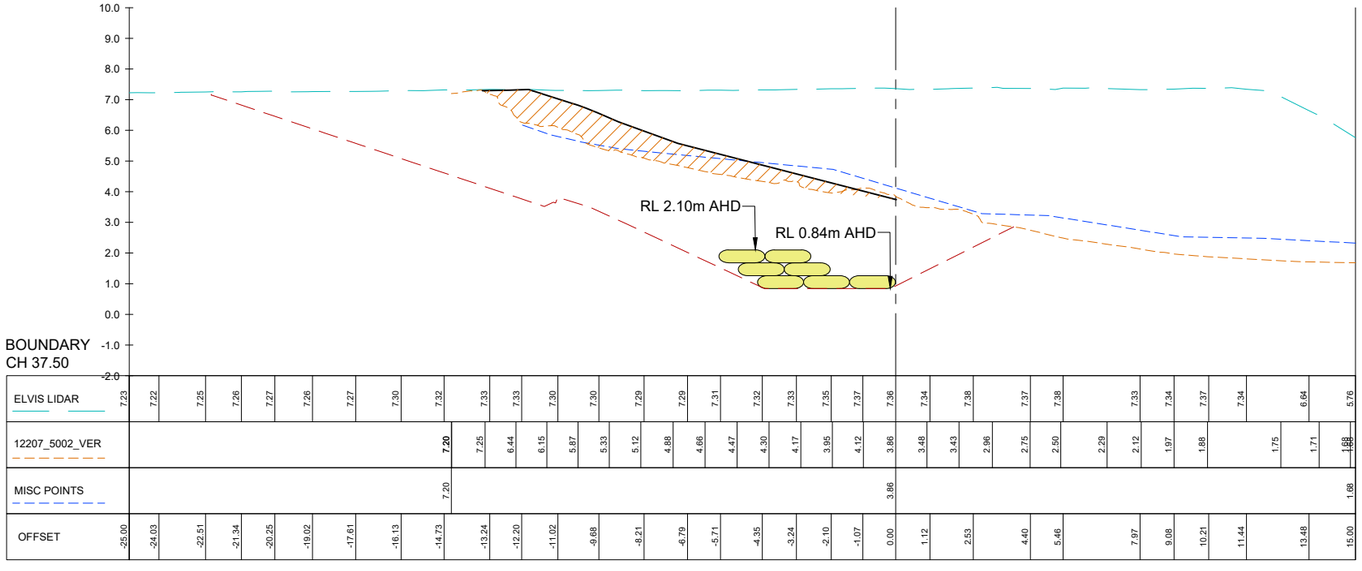
DRAWING No.
PA3267-RHD-00-XX-DR-ME-1106

DO NOT SCALE

NOTES

1. CONCEPT DESIGN , SUBJECT TO DETAILED DESIGN
2. TIE IN EXTENSION WITH EXISTING GEOBAG COASTAL PROTECTION WORKS
3. REMOVE ANY DELETERIOUS MATERIAL FROM FOOTPRINT OF GEOBAGS PRIOR TO PLACEMENT
4. ALL LEVELS ARE IN METRES REDUCED TO AUSTRALIAN HEIGHT DATUM (AHD)





LEGEND

- LAND SURVEY, TERRESTIAL LASER SCANNER, 30th NOV 2022
- LAND SURVEY, MISC POINTS EXTRACTED FROM TERRESTRIAL SCANNER, 30th NOV 2022
- "ELVIS" LIDAR SURVEY, DEC 2018
- RE-ESTABLISHED DUNE PROFILE

AUSTRALIAN HEIGHT DATUM

NOT FOR CONSTRUCTION

2 0 2 4 6 8 10m
1:200 (A3) 1:100 (A1)

REV	DATE	DESCRIPTION	BY	CHK	APP
P01	29.05.2023	ISSUED FOR DA	SGB	GWB	

REVISIONS

CLIENT

ELEMENTS OF BYRON

PROJECT
ELEMENTS OF BYRON
EXTENSION TO EXISTING COASTAL PROTECTION WORKS

TITLE
RE-ESTABLISHMENT OF DUNE PROFILE SHEET 3

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