

Managing and adapting to coastal erosion at Cobden Beach

Prepared for West Coast Regional Council

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Prepared by:
Michael Allis

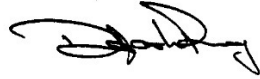


For any information regarding this report please contact:

Michael Allis
Coastal Engineer
Coastal and Estuarine
+64-7-856 1714
michael.allis@niwa.co.nz

National Institute of Water & Atmospheric Research Ltd
PO Box 11115
Hamilton 3251

Phone +64 7 856 7026

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	Reviewed by:	Doug Ramsay
	Formatting checked by:	Alison Bartley
	Approved for release by:	Murray Hicks

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Executive summary

This report has been prepared for West Coast Regional Council (WCRC) to aid the decision-making processes associated with management of Cobden Beach. The investigations undertaken as part of this assessment includes a site visit, review of aerial photographs and recent literature. WCRC requested advice on 1) the likely implications of recent in-situ coastal protection works, and 2) recommendations for effective and feasible options that allow long-term management and protection of infrastructure and properties along the Cobden Beach foreshore.

Overall, Cobden Beach is not experiencing current long-term and widespread erosion and is relatively healthy and well-stocked with a wide gravel beach and vegetation between the beach face and road infrastructure or private property. The northern 5 km of the beach is wider and remains in an accreting phase, with evidence of 50 m or greater accretion in the previous 30 years. The southern 1 km of the beach has also accreted since the 1980s but to a lesser extent. Despite the general trend of accretion over the last 30 or so years, episodic storms or spates of storms can cause overwashing and short-term cut back of the seaward gravel berm along the entire frontage.

Future trends in the Cobden Beach shoreline position relate principally to continued sediment bypassing from Blaketown Beach around the river training works. Further extensions to the tipheads are unlikely, thus it is anticipated that the supply of sediment to Cobden Beach will continue in the foreseeable future in a similar manner as has been occurring over the last 30 or so years. This suggests that the shoreline along the Cobden frontage will in general be relatively stable or accretionary in the long-term, but episodic, short-term natural cycles of accretion and erosion (consequential on river floods, storm events and sequencing and wave climate variability) should still be expected. These natural cycles are expected to cause smaller changes to the Blaketown and Cobden Beaches compared to the historic changes that resulted from the construction of the river training walls.

There is no requirement for any erosion management interventions over the northern 5 km of the beach (north of Monro Road) as this section of the beach appears wide and stable, is expected to withstand storms and can absorb tens of metres of shoreline retreat before the road or private assets are threatened. However, it is imperative that no development or new infrastructure is permitted on the seaward side of the road along this section. Monitoring in the form of regular cycles of aerial photographs from WCRC, Grey District Council (GDC) and Google Earth should be conducted to capture ongoing shoreline changes and provide early warning of any developing risks.

The coastline along the southern 1 km section of the beach near Jellyman Park will continue its unstable fluctuations as the defences surrounding the car park continue to interfere with natural beach processes. The fundamental issue is that the car park and associated infrastructure have been located too close to the active shoreline and do not provide for sufficient beach crest buffer to accommodate the cycles of storm-related erosion that are experienced. It is recommended that:

1. The Cobden community and both Councils (WCRC and GDC) discuss their values, objectives and expectations for the carpark, and its future as an amenity or coastal defence buffer.
2. Consideration be given to relocating the car park and its access further landward and a minimum 10 m beach crest vegetated buffer reinstated (ideally this would be wider and closer to the 30 – 40 m width occurring along much of Domett Esplanade).

1 Introduction

Coastal erosion is an issue facing several communities on the West Coast. This report is one of several recent reports by NIWA assessing coastal issues for the West Coast Regional Council (WCRC). This report assesses coastal erosion at Cobden Beach, situated immediately north of the Grey River mouth and part of the wider Greymouth community.

Cobden Beach is a popular recreational area that has experienced a number of recent erosion events affecting the beach and seaside infrastructure. Attempts have been made to rebuild and repair eroded sections of the beach and protect the infrastructure using rock riprap and other various ad-hoc methods.

WCRC is concerned that these coastal protection methods may have unintended detrimental effects on Cobden Beach and has requested advice on 1) the likely implications of the recent works, and 2) recommendations for effective and feasible options that allow long-term management and protection of infrastructure and properties along the Cobden Beach foreshore. The advice provided in this report is intended to support WCRC, the Cobden community and recreational users of the beach.

The investigation included a site visit to Cobden by Drs Michael Allis and Murray Hicks on the 21st of November 2017 and review of literature including the West Coast Coastal Hazard Assessment (NIWA, 2012).

This investigation and report has been funded by an Envirolink Small Advice Grant (ref No 1740: C01X1627).

2 Site description

Cobden Beach stretches about 6 km north from the mouth of the Grey River. The southern limit of the beach is the north bank of the Grey River which is fixed in place by a rock training wall (locally known as the 'tiphead'). The northern extremity of the beach is near to Point Elizabeth where it is replaced by the cliffed shoreline formed by the 12 Apostles Range (Figure 2-1). The beach is sometimes referred to as North Beach (e.g., North Beach Road).

Except for the northern extremity near Point Elizabeth, the Cobden Beach hinterland is backed by low lying areas composed of reclaimed tidal lagoons, creek mouths and former channels of the Grey River. Remnants of these are still present, namely Cobden Lagoon, Cobden Island and Lake Ryan (Figure 2-1).

Cobden Beach is mainly composed of mixed sand and gravel. It is typical of coarse grained beaches in that it is relatively steep and narrow (over the present-day active beach foreshore) compared to fine-grained (sand) beaches.

The primary driver of coastline change at Cobden Beach is the supply of sediment to/from the beach by the nearshore littoral drift. Along this coastline the littoral drift trend is bi-directional, i.e., moving sediment along the beach in both a northerly and southerly direction. The northerly drift direction is dominant, being driven by the predominant W-SW wave and wind direction at a net rate somewhere between 10,000 m³/year and 100,000 m³/year (Phaflert 1984).



Figure 2-1: Cobden Beach location diagram. Key site inspection locations shown, Scale: 1 km squares. [Credit: Topo NZ, LINZ].

2.1 Shoreline trends

The Grey River training works, constructed over 100 years ago, extend approximately 1 km from the 1884 shoreline (see Figure 2-2), and they significantly altered the coastline by modifying sediment supply to the adjacent beaches. To the south of the river (Blaketown and South Beach), since constructed massive accretion occurred as the northerly littoral drift was trapped against the river training works. Conversely, to the north of the river at Cobden, significant historical erosion occurred as the beach was starved of the sediment that had been trapped on the south side of the river training works (Gibb 1978, Pfahlert 1984, Benn & Todd 2003).

Mapping of the coastline position from aerial photographs and cadastral maps showed that from 1884 to 1981 Blaketown beach prograded (advanced seaward) about 300 m at a rate of 2.9 m/year, while the southern part of Cobden Beach retreated about 130 m at a rate of 1.35 m/year (Pfahlert 1984).



Figure 2-2: Changes to the coastline at Greymouth 1875-2014. [Credit: West Coast New Zealand History¹].

This rate of sediment trapping at Blaketown was expected to reduce in time with a concomitant increase of sediment bypassing around the river training works and onto Cobden Beach. Pfahlert calculated that more than half the original volume of sediment that accumulated on Blaketown Beach (south of the Grey River) in 1884 (about 18,000 m³/year) was bypassing onto Cobden Beach at a rate of about 9,000 m³/year as at 1984. It was also suggested that if this trend continued (assuming a linear trend and no change in sediment supply), Blaketown Beach would eventually stop prograding in 2067 and all sediment would bypass onto Cobden Beach.

¹ <http://westcoast.recollect.co.nz/nodes/view/18234#idx24171>

Subsequently, Benn and Todd (2003) updated the observations of coastline change with new aerial photographs and found that the southern 1.2 km of Cobden Beach (Bright Street to Kettle Street) had ceased its widespread retreat and had prograded about 30 m from 1981 to 2001 at a rate of about 1.4 m/year. Their investigation did not comment on changes to the northern 4 km of Cobden Beach. The more recent coastal hazard assessment (CHA) prioritised Cobden as a medium hazard area due to threats to North Beach Road and houses at the North of Cobden township (NIWA 2012, updated 2015). It appears the hazard was based on reports of wave overwash causing nuisance inundation along Domett Esplanade, and the prior installation of a small bund alongside the road to manage the overtopping. Photos from the CHA confirmed the widespread accretion along the beach.

The November 2016 site visit (see Section 2.2) confirms the advance and stabilisation of the Cobden Beach coastline. Physical evidence on the rearmost gravel berms suggests 30-40 years have elapsed since that beach material was deposited by wave action on the beach face. This timing aligns with aerial photographs, suggesting that the 1970s-1980s decades mark the transition from erosion to accretion along Cobden Beach. This beach accretion is most prominent further north along the beach, with the beach now well stocked with gravel and the beach face now 60-70 m distant from the road.

The 1980s transition from erosion to accretion at Cobden Beach reflects the increasing volume of sediment bypassing the river training works resulting in the long-term supply of sediment to the southern part of Cobden Beach now exceeding sediment losses from the southern part of the beach alongshore to the north. It can be expected this rate of bypassing would continue to increase as Blaketown Beach intercepts less sediment each year.

The future of sediment supply to Cobden Beach relies on continued bypassing from Blaketown Beach around the river training works, and ongoing flood-flow supply from the Grey River. Further extensions to the tipheads are unlikely, thus it is anticipated that the supply of sediment to Cobden Beach will continue in the foreseeable future in a similar manner as has been occurring over the last 30 or so years. This suggests that long-term shoreline changes along the Cobden frontage will be relatively stable or accretionary but with episodic, short-term natural cycles of accretion and erosion consequential on river floods, storm events, storm event sequences and wave climate variability. These natural cycles are expected to cause smaller changes to the Blaketown and Cobden Beach systems compared to the historic changes that stemmed from the construction of the river training walls.

2.2 Walkover inspection

NIWA and WCRC staff performed a walkover inspection of Cobden Beach on 21st November 2016 (12 pm to 2 pm). Low tide was about 11:09 am for the Grey River mouth, offshore significant wave height was approximately 1.5 m from the west, and winds were light (< 10km/h) and from the west.

The beach was accessed at multiple locations along North Beach Road (see Figure 2-1). Distances referenced below represent distance alongshore (north) from the tiphead. In the following description, the beach has been divided into three separate areas.

2.2.1 Tiphead to Jellyman carpark (0 km - 0.6 km)

This beach is predominantly medium-coarse sand, with minor gravel and cobbles. Due to it being in the wave shadow of the tiphead, sheltered from the prevailing south-westerly waves, the beach is sandy in composition and relatively flat-sloping.

The former Cobden landfill is nestled behind the active beach, adjoining the tiphead wall. The landfill is located on (and forms) reclaimed land and is separated from the sea by a broad low beach crest. A floodway 'cut' channel (mechanically excavated to allow flood flows to exit Cobden Lagoon) separates Jellyman Park and carpark from the tiphead. Aerial photographs show there is sometimes a low-tide bar in the nearshore surf zone close to the tiphead - possibly related to pulses of sediment delivered to the beach during Grey River flood events. The landfill crest is about 5 m above beach crest level, with its sides and toe armoured by building rubble.

The carpark occupies the broad crest of the beach, with the car park surface approximately 1.5 m above the beach level (Figure 2-3). The seaward edge of the carpark is protected by a rock revetment composed of small-medium granite rocks (0.3-0.7 m diameter) at a slope of 1:1.5 to 1:2. We understand that the rocks were added when the carpark was resized in 2015, resulting in the seaward edge of the carpark being pushed further over the beach. No geotextile underlay is apparent beneath the rocks. The crest of the revetment is only one rock wide (0.5 m), and it sits nearly flush with the carpark elevation (Figure 2-3). The carpark now protrudes onto the active beach face 3-5 m from the adjacent vegetation lines and adjacent beach crest. There is no vegetation on the beach in front of the carpark. The seaward edge of the carpark has been repaired several times after storm erosion has undermined the rubble revetment (pers. comm. P. Birchfield). The carpark remains a popular overnight stop for freedom campers.

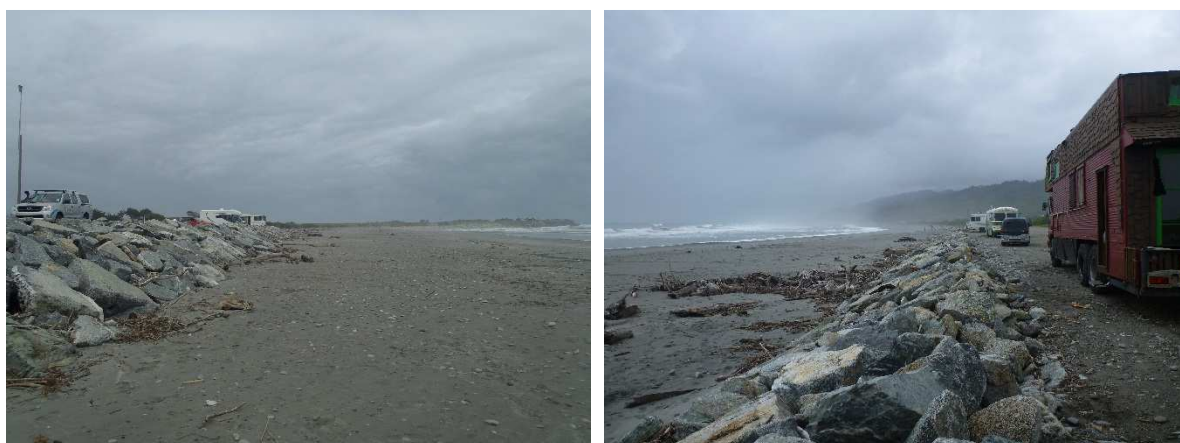


Figure 2-3: Jellyman Park rock protection and beach front. Left: view south to tiphead from northern end of structure. Right: view north towards Point Elizabeth from southern end of structure. [21 Nov 2016. Credit: M. Allis (L), M. Hicks (R)].

To the north and south of the carpark, the beach shows evidence of wave/gravel overwash and vegetation dieback. Immediately north of the carpark, retreat of the beach crest has caused vegetation dieback (gorse/flax, see Figure 2-5). This retreat is likely due to overwashing events, with overwashed gravels reaching 5 m inland from the beach face and up to 10 m inland at access paths. There is also vehicle access at the northern end of the carpark structure, with wheel rut disturbances to sediment and vegetation (Figure 2-4).



Figure 2-4: Cobden Beach at 0.6 km from the tiphead, (at carpark), looking north towards Point Elizabeth. Note vehicle tracks past the end of carpark protection rocks [Credit: M. Hicks, 22/11/2017].



Figure 2-5: Cobden Beach at 0.7 km from the tiphead (100 m north of carpark), looking north toward Point Elizabeth. [Credit: M. Allis, 22/11/2017].

2.2.2 Jellyman Carpark to Monro Road (0.6 km - 1.4 km)

Between Jellyman Park and Monro Road the beach has been recently exposed to large waves (either a single storm or series of storm events), with driftwood/gravels being cast into and onto the vegetated beach crest (Figure 2-5). The vegetation dieback indicates there may be some short-term shoreline retreat. There remains at least 20-30 m of vegetated setback to Domett Esplanade.

Closer to Monro Road, there are historic protection works alongside North Beach Road (Figure 2-6), however, these have been buried by more recent accretion and growth of the beach. At present, the inner gravel is elevated 1.5-2 m above the roadway, with one or two storm-berms (terrace-like ridges parallel to the shoreline). Vegetation and lichen (slight discoloration on gravel) have colonised the gravel berms (Figure 2-6), suggesting that these gravels have not been re-worked for over 30 years (other than vehicle and foot traffic – see Figure 2-6).



Figure 2-6: Cobden Beach at 1.4 km from the tiphead (opposite Monro Road) looking south. Note dark-grey lichen growth on gravel outside vehicle tracks, and note historic rock protection alongside roadway [Credit: M. Hicks, 22/11/2017].

2.2.3 Monro Road to end of road (1.4 km - 5 km)

The width of beach gradually increases with distance north from Monro Road, widening from 30-40 m in the south to 60-70 m at the end of North Beach Road, as seen in the sequence of photographs in Figure 2-7 to Figure 2-9.

This section of the beach typically has three storm-berms (terrace-like ridges parallel to the shoreline). Collectively, these ridges represent a recent accretionary phase, with sufficient sediment available to create a berm during storms and then to build-out the beach face during benign conditions. A fourth berm may be forming at present. Stranded driftwood, lichen growth and advancing vegetation all indicate that this accretionary phase has been of the order of 30 years or more.

Overall, Cobden Beach is not experiencing current long-term and widespread erosion and is relatively healthy and well-stocked, with a wide gravel beach and vegetation between the beach face and road infrastructure or private property. The northern 5 km of the beach is wider and remains in an accreting phase, with evidence of 50 m or greater accretion in the previous 30 years. The southern 1 km of the beach has accreted also since the 1980s but to a lesser extent. Despite the general trend of accretion over the last 30 or so years, episodic storms or spates of storms can cause overwashing and short-term cut back of the seaward gravel berm along the entire frontage.

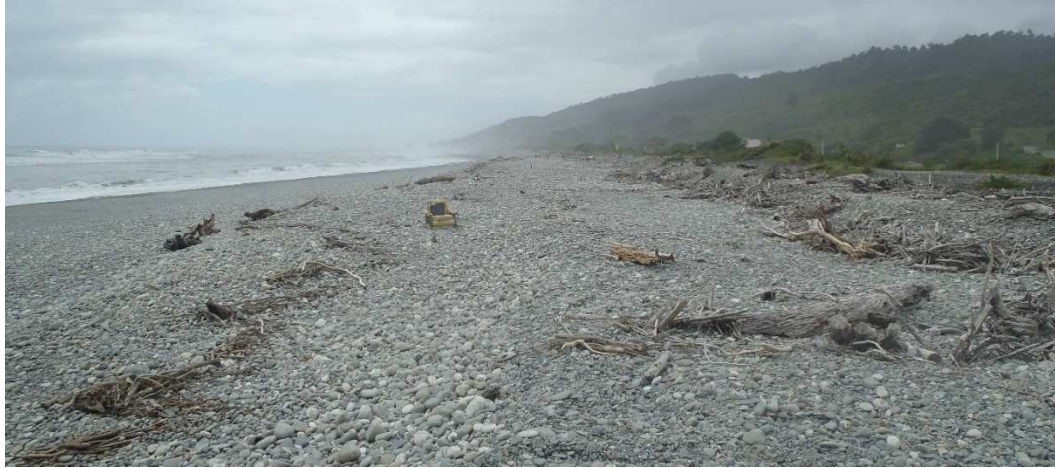


Figure 2-7: Cobden Beach at 1.4 km from tiphead (opposite Monro Road) looking north towards Point Elizabeth. [Credit: M. Allis, 22/11/2017].



Figure 2-8: Cobden Beach at 2.9 km from tiphead (opposite 162 North Beach Road) looking north towards Point Elizabeth. [Credit: M. Hicks, 22/11/2017].



Figure 2-9: Cobden Beach at 5 km from tiphead (end of North Beach Road) looking north towards Point Elizabeth. [Credit: M. Allis, 22/11/2017].

3 Implications of protection works

The Jellyman Park carpark (Hill Quay) occupies the seaward edge of Jellyman Park, as shown in Figure 3-1 (red shading). The carpark acts as both a vehicle carpark, freedom camping site, and coastal defence for the Cobden community and Jellyman reserve. The carpark stretches approximately 200 m along the shoreline between from Cobden Cut (a mechanically-managed channel for drainage of the Cobden Lagoon during high rainfall or river floods) and connects to Hill Quay.

We understand the carpark was previously² a narrow gravel extension to Domett Esplanade positioned on the vegetated gravel barrier. This has been gradually enlarged, with the vegetation lost (either through vehicular trampling or deliberate removal)³ so the gravel barrier berm no-longer had the capacity to accommodate natural fluctuations in shoreline position due to storm events. We understand that the seaward rock protection was added when the carpark was resized in 2015.



Figure 3-1: Jellyman Park, Cobden. Background photograph dated 2013. [Credit: WCRC Westmaps].

The carpark runs parallel along the top of the beach crest and protrudes onto the active beach face 3-5 m further than the adjacent beach crest and vegetation lines to the immediate north and south. Wave action appears to reach the base of the carpark revetment on most high tides.

² As in 2004 aerial photograph (not shown)

³ As in 2013 aerial photograph (not shown)

Despite the accretion that has occurred along this section of coast, the carpark and associated infrastructure has been placed too close to the active beach to accommodate episodic storm events that can cause beach crest overwashing and beach crest cutback. No natural beach crest buffer width has been maintained to enable these short-term erosion events to be accommodated. As such, the carpark suffers from common issues with rock protection placed on beaches. These being the process of lowering of the beach level in front of the structure (a reduction in beach elevation caused by loss of sediment from wave reflections off the structure face) and edge effects eroding around the flanks of the structure (caused by waves wrapping around the structure).

The key issues identified during the site inspection were:

- Immediately north of the carpark, edge effects have contributed to retreat of the beach crest, with overwashing of the gravel storm berm and vegetation dieback (gorse/flax) evident. There was evidence of recent overwash gravels reaching 5 m inland from the beach face and up to 10 m inland at access paths. The out-flanking erosion is also exacerbated by vehicle access to the beach from the carpark itself, preventing vegetation growth, disturbing beach sediment and lowering beach levels.
- In front of the carpark the beach is lowering (relative to adjacent beach sections), with gravel being stripped from the beach face rather than being deposited on the upper part of the beach crest. Any driftwood is also swept past the revetment, piling up downdrift of the structure (which was the north side during the site visit).
- To the south of the carpark structure, the edge effects are less pronounced, perhaps due to increased wave sheltering from the tiphead. However, GDC have extended the rock protection at the Lagoon Cut (Figure 3-2) to prevent waves eroding the cut and entering the lagoon (pers. comm. P. Birchfield). The rock protection has a slope from 1:1.5 to 1:2 and is comprised of small (<0.4 m diameter) rocks.

The overwash and retreat around the carpark flanks are principally due to the abrupt rectangular shape of the carpark and its protrusion onto the beach face. The steep face of the structure and protrusion onto the beach are causing the increased wave reflections off the structure face, causing the beach to lower in front of the carpark.



Figure 3-2: Rock extension south of the carpark to protect the Lagoon Cut entrance. [Credit: M. Hicks, 21/11/2017].

4 Future management options

Future trends in the Cobden Beach shoreline position relate principally to continued sediment bypassing from Blaketown Beach around the river training works. It is anticipated that this will continue in the foreseeable future in a similar manner as has been occurring over the last 30 or so years (especially as further extensions to the tipheads are unlikely). This suggests that long-term shoreline changes along the Cobden frontage in general will be relatively stable or accretionary but with episodic, short-term natural cycles of accretion and erosion. These natural cycles (e.g., river floods, storm events and sequencing and wave climate variability) are expected to cause smaller changes to the Blaketown and Cobden Beaches compared to the historic changes that stemmed from the river training walls.

There is no requirement for any erosion management interventions over the northern 5 km of the beach (north of Monro Road), as this section of the beach appears wide and stable, is expected to withstand storms and can absorb tens of metres of shoreline retreat before the road or private assets are threatened. However, it is imperative that no development or new infrastructure is permitted on the seaward side of the road along this section. Monitoring in the form of regular cycles of aerial photographs from Councils (WCRC and GDC) or Google Earth should be conducted to capture ongoing shoreline changes and provide early warning of any developing risks.

The southern section of the beach near Jellyman Park will continue to change as the defences surrounding the car park continue to interfere with natural beach processes. With no intervention the outflanking erosion will continue to affect the adjacent beach (particularly to the north). The small size of rock armour used to construct the revetment and likely continued beach lowering in front of the carpark revetment will affect the defence performance and seaward parts of the car park (depending on the rock embedment depth). These processes are expected to continue, requiring a frequent commitment of maintenance of the revetment and seaward edge/surface of the car park. However, the size, position and construction mean the carpark structure is not expected to withstand large storm events without damage. If no mitigation works are undertaken then larger rock armouring is likely to be required to ensure the defence provides an adequate level of protection over the long term. Placing a properly constructed revetment may result in further detrimental environmental effects.

The fundamental issue is that the car park and associated infrastructure have been located too close to the active shoreline and so do not provide for sufficient beach crest buffer to accommodate the cycles of storm-related erosion that are experienced. It is recommended that:

1. The Cobden community and council discuss their values, objectives and expectations for the carpark, and its future as an amenity or coastal defence.
2. Consideration be given to relocating the car park and access further landward and a minimum 10 m beach crest vegetated buffer reinstated (ideally this would be wider and closer to the 30 – 40 m width occurring along much of Domett Esplanade).

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