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1 October 2019

Attention: Bill Brown
SARB Investments Ltd
171(a) Victoria Rd,
St. Clair
Dunedin 9012

Project Name: Coastal Hazard Assessment, Thousand Arce Road, Kakanui

Subject: Review of Coastal Erosion Setback Provisions

Dear Bill

As requested this letter reviews the provision of coastal erosion setback provisions for a proposed 25 lot rural lifestyle subdivision along the Beach Road coastal frontage north of Kakanui.

My background to undertake this review is 35 years experience undertaking coastal hazard assessments in my roles as a coastal geomorphologist for local government, universities and consultancies.

District Plan Requirements

In accordance with the Waitaki District Plan (Operative 2010) Natural Hazards Section (4.2.4), a coastal building set-back of 100 m is required based on previous erosion trends to protect building from potential coastal erosion and inundation risks over the next 50 years. However, this section of the District Plan appears to be dated from 2004, with more recent information on erosion trends being available, which may alter the need for this width of building set-back.

Recent NIWA Coastal Hazards Report

In January 2019 Otago Regional Council released the results of a recent NIWA coastal erosion and inundation assessment for the entire Waitaki District, which had as one of its purposes the need to update the Waitaki District Plan and to address the potential effects of sea level rise on coastal hazards as required under the NZ Coastal Policy Statement (2010). As part of the assessment the findings and report were independently peer reviewed for ORC by Tonkin and Taylor. We have undertaken a further independent review of the hazard assessment methods and findings of this report in the context of this consent application on the eroding coast along southern Beach Road, north of Kakanui.

From our review, we found that the methods used to determine coastal erosion hazard zones are acceptable. In summary, for the proposed development coast these methods involved:

- Determining past cliff top position from six aerial photograph dates between 1955 and 2016, and determining cliff erosion rates at 5m interval transects along the coastline. For the calculation of the long-term rate, the rates from 300m running window of transects were

used to remove the contribution of short-term slumps in individual locations. Shoreline detection was undertaken by identifying the vegetation line along beach environments, or the cliff top along cliff-backed shores/beaches.

- Using accepted cliff line erosion model (SCAPE) to evaluate the response of the soft-cliff shoreline to projected sea level rise. Due to a lack of data in the study area to drive the model, this was calculated from model responses for alluvial cliffs north of Oamaru where there is sufficient data.
- Calculation of short-term shoreline change (e.g. storm effects) – due to the lack of data for the study coast, this was based on the averaged value of the maximum absolute shoreline erosion between any two beach profile dates for alluvial cliffs north of Oamaru.
- To allow for uncertainty with the results, use a hybrid-probabilistic approach to mapping the hazard zones, in which the 95th percentile and 50th percentile predicted erosion are presented. The 95th percentile zone (CHZ95) represents only a small chance (5%) of the actual erosion exceeding the hazard width and is considered to be a 'conservative' approach, while with the 50th percentile (CHZ50) that there is 50% change of the actual erosion being greater than the zone width which is considered to be a 'reasonable' approach to calculating the hazard zone.
- All mapping is presented to 100 year time frames.

For coastal inundation, hazard mapping combining the results of extreme water level and wave run-up with updated sea level rise scenarios is only presented for the four most populated areas of the Waitaki coast, which does not include the study area.

We also note that the report did not assess inundation related to tsunamis, ground water flooding, river floods or urban flooding.

Relevant Report Finding for Proposed Rural Lifestyle Development

Our interpretation of the relevant findings of the report in the context of a coastal hazard assessment for the proposed rural lifestyle development include the following. Note that the supplementary material digital maps of the coastal hazard zone widths were not made available, therefore the given estimates of the hazard zone widths are only obtained from the relevant map presented in the report (Figure 3-39, Page 70; Appendix A of this letter). The resolution of these maps is poor, therefore the estimates of hazard zone widths cover the likely range rather than the calculated width.

- Long-term erosion along southern Beach Road at the proposed development site is in the order of 0.38 m/yr.
- The SCAPE modelling found that the acceleration of sea level rise would have little to no effect on cliff erosion rates.
- At a 95% confidence level, short-term erosion is not predicted to exceed 10 m along southern Beach Road.
- Applying a 'reasonable' approach, the CHZ50 coastal hazard zone widths for a 100-year timeframe are between 30-60m along southern parts of Beach Road.

- Applying a 'conservative' approach, the CHZ95 coastal hazard zone widths for a 100-year timeframe are between 40-80m along southern parts of Beach Road.

- The report does not show coastal inundation hazard zones for the proposed development. However, the coastal inundation maps for surrounding areas in Kakanui of a similar land elevation suggest that there is no coastal inundation risk at the proposed development for a 100-year ARI storm with +1.3 m of sea level rise. The only inundation risk in the surrounding area is at the Kakanui River mouth, which this is a significant distance from the proposed location and is not foreseen to be of any risk to the site.

Proposed Subdivision Overview Development Plan

The overview development plan for the proposed 25 lot subdivision development supplied by terramark (Appendix B of this letter) shows proposed Lot boundaries are setback 180m (southern end) to 100m (northern end) from the cliff top edge where the coastal hazard zone was calculated from in the NIWA (2019) study. It is noted that the cliff line at the time of the base photograph is shown as being a further 5 m east of the property boundary.

The setback distance of the individual Lots boundary along the coastal fronting edge of the subdivision are therefore an additional 20-80m beyond the conservative 80m wide 100-year coastal erosion hazard zone determined from the NIWA (2019) report.

Conclusion

Based on our review, we can make the following conclusions regarding set-backs along the proposed development site:

1. Recent NIWA coastal hazards assessment indicates that the existing 100m setback provision of the Waitaki District Plan is adequate to provide protection to buildings for a period considerably longer than 50 years.
2. The Overview Development Plan supplied by terramark shows that the Lot boundaries are setback an additional 20-80m beyond the conservative 100 year erosion zone from NIWA, and therefore the proposed Lot boundaries are an adequate distance from the coast over a 100 year planning timeframe.

Yours sincerely

D. Todd.

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Appendix A:

Figure 3.39 (P70) from NIWA 2019: Waitaki District Coastal Hazards. Report prepared for Otago Regional Council

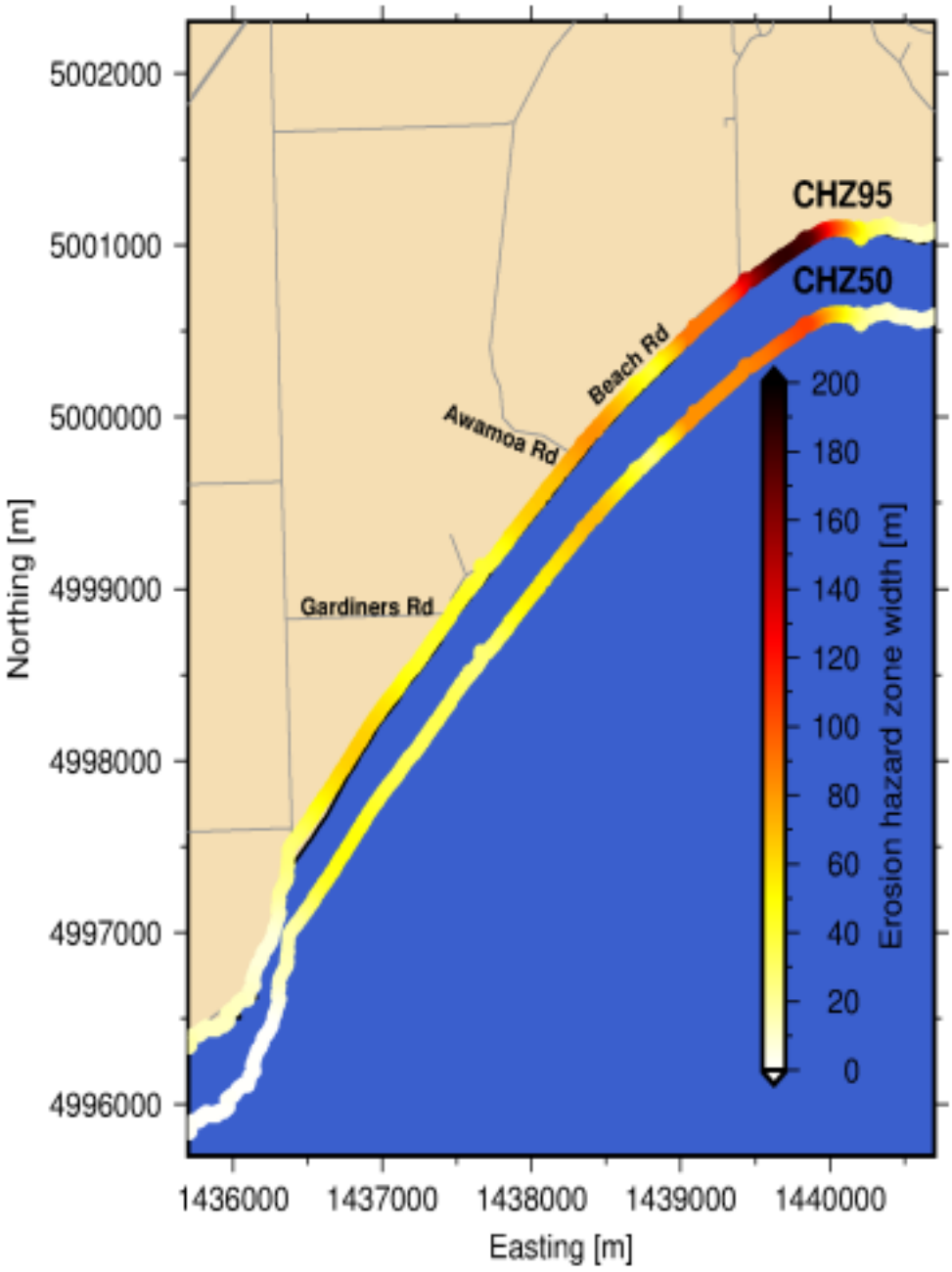
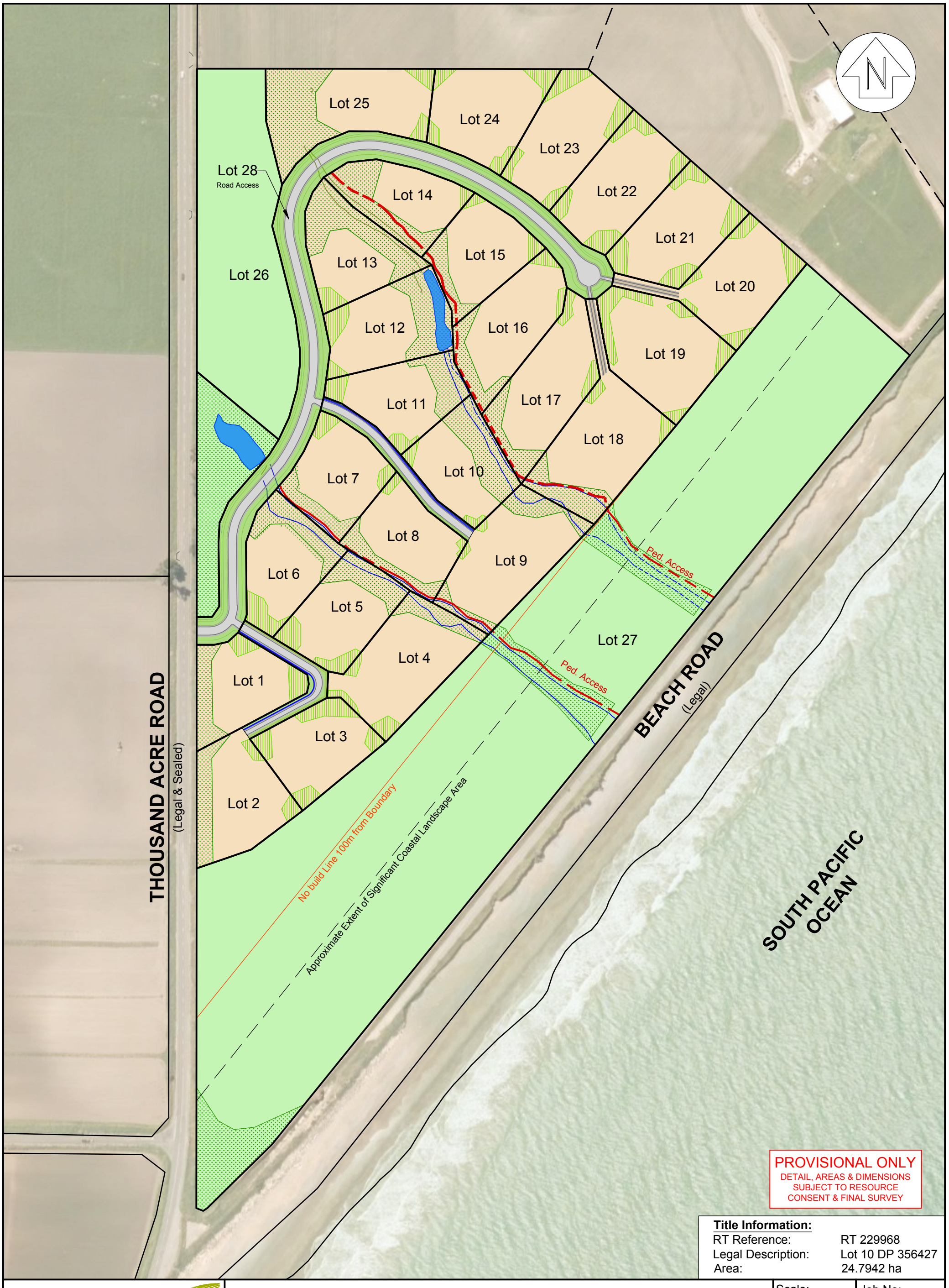


Figure 3-39: Coastal hazard zone width for 95th percentile (CHZ95) and for 50th percentile (CHZ50) for 100-year prediction for Beach Road. Note the CHZ50 points are offset to the south.

Appendix B: Terramark Plans for subdivision (August 2019)



PROVISIONAL ONLY
DETAIL, AREAS & DIMENSIONS SUBJECT TO RESOURCE CONSENT & FINAL SURVEY

Title Information:

RT Reference:	RT 229968
Legal Description:	Lot 10 DP 356427
Area:	24.7942 ha

terramark
setting new boundaries
Surveying, Resource Management & Engineering
Dunedin 03-4774783 Mosgiel 03-4897107 Balclutha 03-4180470

Overview Development Plan
Thousand Acre Road, Kakanui

Scale: 1:2500 @ A3	Job No: D6633
Date: August 2019	Plan No: D6633/201/1