## Additional evidence on the evolution of Te Puru fan-delta - WILLEM PIETER de LANGE

### Introduction

1 The Te Puru Group, involving 5 properties at the southern end of the Te Puru fan-delta, agreed to engage in 'without prejudice' discussions with Council.

2 I have previously prepared evidence for the Te Puru Group relating to the nature of the coastal hazards affecting their properties and the location of the CEL. A key finding was that the Te Puru fan-delta (an alluvial fan that is prograding into a water body) is an accretionary landform that is continuing to accrete, primarily in response to episodic events (debris flows). In my opinion, accretion is likely to continue in the future.

3 The Te Puru Group have provided me with a letter to the TCDC, dated 15 September 2016 and marked *Without Predjudice*, which is **attached** as Appendix **A**. I have read this letter, which outlines a number of suggestions to allow specified activities seaward of the CEL by affected landowners.

4 Subsequent to the hearing, additional data have become available on the evolution of the fan-deltas of the Western Coromandel, including Te Puru. This document summarises the additional data and discusses the implications for the potential shoreline changes at the southern end of Te Puru fan-delta pertinent to the suggestions made in the letter.

### Recent research results

5 Longstaff (2014) presents the results of a study involving the University of Auckland and University of Otago, which examined the geomorphology of 6 fan-deltas on the eastern shore of the Firth of Thames. This study included the collection of seismic reflection (CHIRP) and ground penetrating radar (GPR) profiles, LIDAR elevation data, 2 cores at Te Puru, measurement of sediment characteristics, and numerical modelling of bedload transport rates (Figure 1). The thesis also reviewed and incorporated earlier research, primarily conducted by the University of Waikato. One study omitted from the review was the thesis by Gunn (2001) that examined debris flows between Thames and Waiomu, and highlighted the impacts of catchment topography and geology on sediment yields.

6 The two cores obtained from Te Puru (TPFR1 and TPD2) provided some datable material and also showed clear transitions from terrestrial to marine to terrestrial deposition (Figure 2). The deepest core material was interpreted as alluvial fan deposits that were buried by marine deposits as sea level rose. The dates indicate a marine environment at ~6000 BP, which was inferred to coincide with a sea level high-stand approximately 2 m above the present MSL, which has been identified at other locations around the Firth of Thames

(Dougherty and Dickson, 2012). A terrestrial environment involving chaotic debris-flow deposits commenced ~3100 BP, when sea level is inferred to have been approximately at the present elevation.

7 The offshore CHIRP profiles for Te Puru, combined with offshore core data from Naish (1990), indicate that older fan-delta features formed at lower sea level still-stands. Finer marine sediments bury these features. The data do not show any significant remobilisation of coarse fan-delta sediments (medium to coarse sands, gravels and boulders) by marine processes, but do not exclude possible reworking of fine sediment (muds and fine sands).

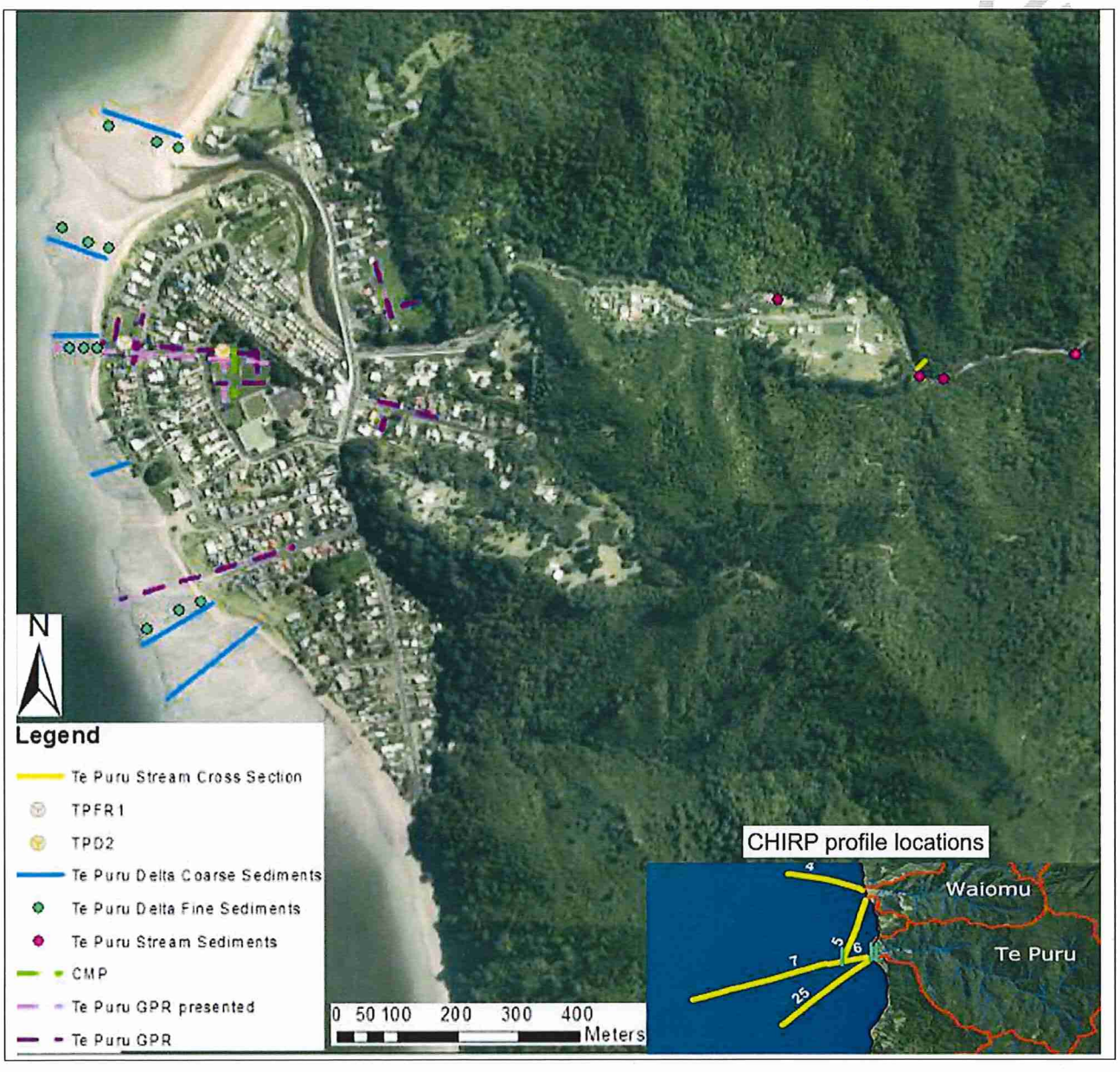


*Figure 1. Locations of measurements discussed by Longstaff (2014). After Figures 4.3 and 4.8 of Longstaff (2014).*

8 Longstaff (2014) determined the volumes of the fan-deltas by combining LIDAR, CHIRP and GPR data. Offshore core data from Naish (1990), and the two Te Puru cores (Figures 1 and 2) was used to constrain the thicknesses of the fan-deltas. Average thicknesses for

geomorphic zones identified from LIDAR data were used to estimate the total volume of Holocene terrestrial deposition. Te Puru was found to have the largest volume at 9.26 x $10^7$ $m^3$, which corresponds to an accumulation rate of ~3 x $10^4$ $m^3.y^{-1}$ over the last 3 ka. Te Puru is also the thickest fan delta with the thickest sub-tidal delta front (Longstaff, 2014).

9 LIDAR data was used to create a DTM of the Te Puru fan-delta (Figure 3). This indicates that it has a classic alluvial fan shape. However, there are two clear lobes evident in the intertidal area. The northern lobe is associated with the present-day Te Puru Stream outlet, while the southern lobe is a relict feature associated with a former southern outlet. It is also evident that the two cores (Figure 2) were obtained from lower elevation, and hence thinner, areas of the fan-delta.

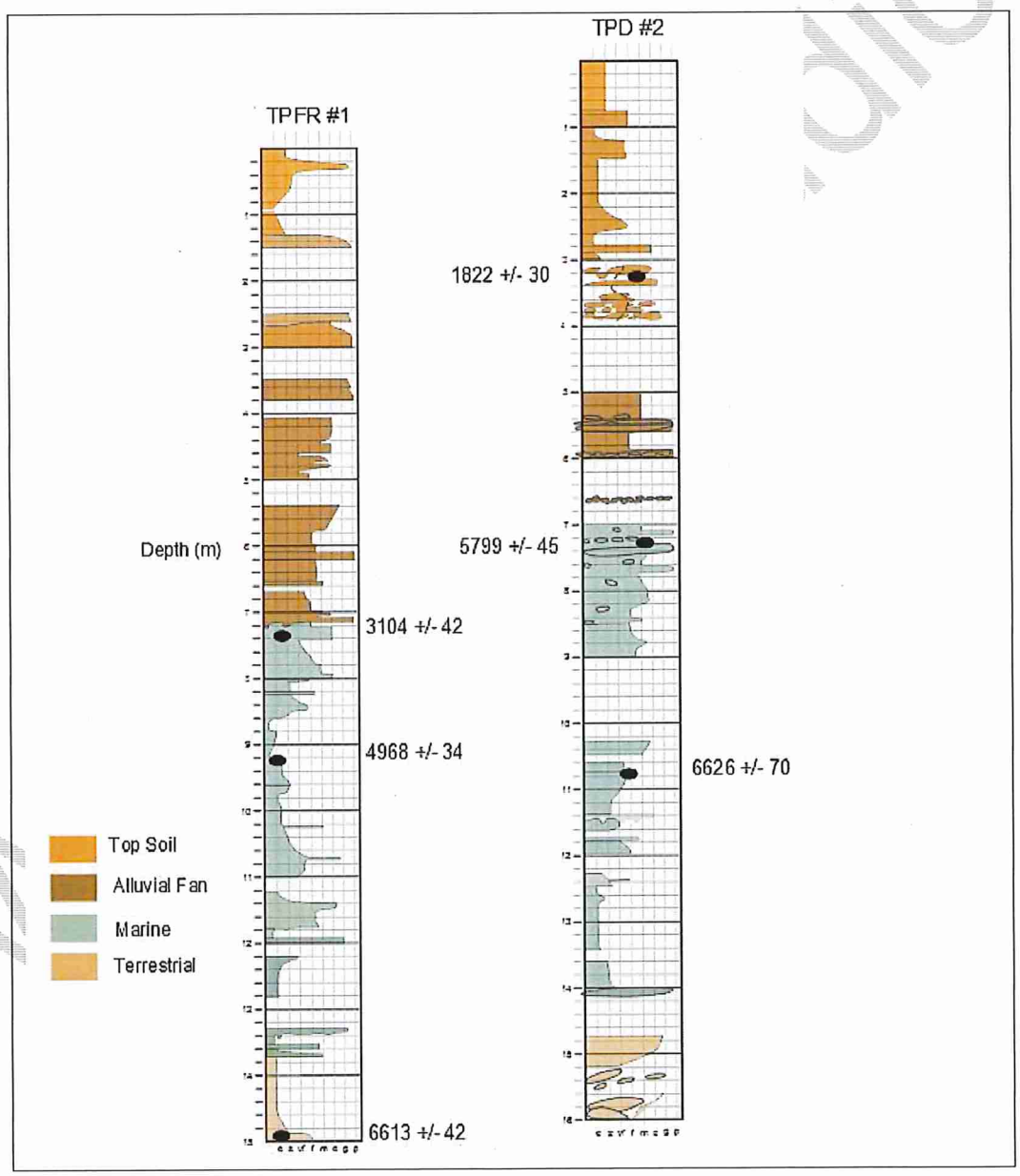


*Figure 2. Core logs for two cores obtained at Te Puru at either end of West Crescent: TPFR1 – Foreshore reserve; TPD2 – Te Puru Reserve (Figure 6.10, Longstaff, 2014)*

10 Longstaff (2014) also estimated the bedload sediment yield using a simple numerical model. For Te Puru the estimated volume delivered over the last 3 ka was 2.92 x $10^7$ $m^3$, which corresponds to an accumulation rate of ~1 x $10^4$ $m^3.y^{-1}$. As noted by Longstaff (2014), the volume occupied by the Te Puru fan-delta is approximately 3 times larger than would be expected from the estimated sediment supply. She attributed this to the effects of episodic debris flows. However, it is also possible that the higher and thicker inland region of the fan-delta was partly deposited at a higher elevation during the high-stand before 3000 BP.

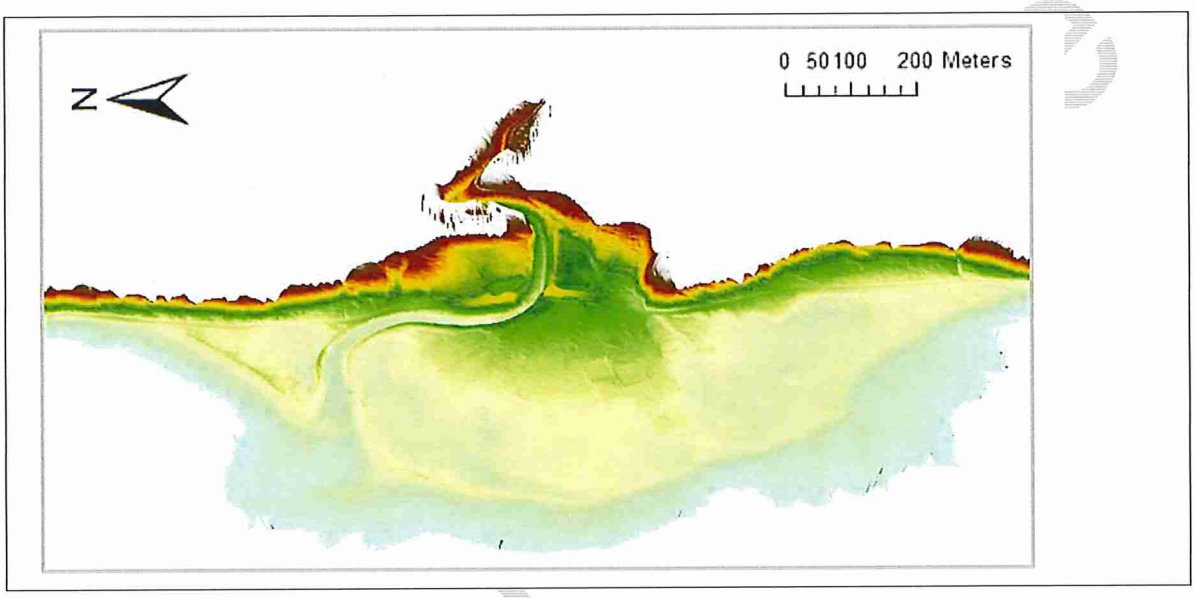


*Figure 3. DTM of Te Puru fan-delta (After Figure 6.5, Longstaff, 2014).*

11 It is evident from the results presented by Longstaff (2014) and Gunn (2001) that the 6 fan-deltas of the Western Coromandel differ significantly. There are a range of factors that contribute to this, including differences in the catchment characteristics and intensity of coastal processes. Longstaff (2014) highlighted that higher proportion of steep slopes and Gunn (2001) noted a higher tendency for slope failures within the Te Puru catchment. Both studies noted that the topography resulted in the direct delivery of material from slope failures into the stream channel, which contributes to an increased potential for debris flows during heavy rainfall events.

12 Further, each fan-delta shows a wide variation in longshore morphological stability depending on a range of factors including sediment texture, proximity to the fluvial channel, exposure to waves and the effects of anthropic modifications.

**Interpretation and implications**

13 Te Puru, consistent with the other fan-deltas and chenier plain around the Firth of Thames coastline is mostly likely to have developed by punctuated accretion. This involves episodic storm events supplying sediment to the delta from the catchment, primarily through debris

flows, followed by lengthy periods of sediment reworking and redistribution. The recent evidence indicates that Te Puru developed over a shorter time frame (~3 ka *cf.* 6-7 ka) than previously assumed. The recent evidence suggests that the reworking and redistribution at Te Puru largely involves the fine fraction of the bedload delivered, and that overall little sediment is lost from the system.

14 There is no evidence to indicate that Te Puru rapidly accreted initially due to sea level rise, and the rate of accretion has dropped to essentially zero at present. Instead, the evidence indicates that if the rate of sea level rise is sufficiently slow the fan-delta continues to accrete (as demonstrated by historical trends). If sea level rise is sufficiently fast the fan-delta is inundated and buried in finer marine sediments. A subsequent reduction in the rate of sea level rise would result in the development of a new fan-delta, as indicated by the CHIRP data offshore from Te Puru.

15 Assuming that episodic high intensity rainfall events will continue to occur in the future, it is unlikely that there will be a significant reduction in the sediment supplied by debris flows to the Te Puru fan-delta. Therefore, it is likely to continue to accrete. However, in the unlikely event that the sediment supply is reduced, possibly due to channelization as suggested by Allison (2014) for Te Mata fan-delta, the evidence indicates that there will be little erosion of the sediments forming the Te Puru fan-delta.

16 In my opinion, due to the variability of morphological stability between and within the fan-deltas along the eastern side of the Firth of Thames, there should not be a single assumed factor for the shoreline response to extreme events. In other words, the CEL should reflect the coastal hazard risk at specific sites. The evidence presented previously, and the results form the recent research, all indicate that the risk of coastal erosion at the southern end of the Te Puru fan-delta is lower than elsewhere along the Te Puru shoreline.

17 Therefore, in this particular case, the available evidence indicates the properties requesting exceptions for specified activities seaward of the CEL can be reasonably considered to differ from the majority of coastal properties along the western Coromandel coastline.

18 Given that the modern shoreline is seaward of the property boundaries and is likely to continue to accrete, in my opinion a CEL coincident with the property boundaries would be reasonable to manage the existing erosion hazard. However, if the TCDC prefers to maintain the CEL in the current position, it is also my opinion that the suggested amendments put forward by the Te Puru Group would not increase the coastal hazard for the affected properties, and would allow the TCDC to meet its' obligations under the relevant policies.

## References


Allison AE (2014) Morphodynamics on an armour-layered fan delta, Te Mata, Coromandel. MSc Thesis, University of Auckland, Auckland.

Dougherty AJ, Dickson ME (2012) Sea level and storm control on the evolution of a chenier plain, Firth of Thames, New Zealand. *Marine Geology* 307-310:58-72.

Gunn WJ (2001) Assessment of mass movement mechanisms in the Thames-Waiomu Region, Coromandel Peninsula, New Zealand. MSc Thesis, University of Waikato, Hamilton, 210 pp.

Longstaff KA (2014) Geomorphic variation of Thames Coast fan-deltas, Coromandel, New Zealand: A sediment budget approach. MSc Thesis, University of Auckland, Auckland, 123 pp.

Naish TR (1990) Late Holocene mud sedimentation and diagenesis in the Firth of Thames: Bentonites in the making. MSc Thesis, University of Waikato, Hamilton, 154 pp.

"A"

HARRIS TATE
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15 September 2016

Bruce Baker and Leigh Robcke
Thames Coromandel District Council

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**leigh.robcke@tcdc.govt.nz**

**WITHOUT PREJUDICE**

Dear Bruce and Leigh

**APPEAL AGAINST TCDC DISTRICT PLAN - TE PURU GROUP**

1. We refer to our without prejudice meeting of 30 August 2016.

2. At the meeting, we expressed our clients' strong preference for the removal of the Current Coastal Erosion Line ("CCEL") from the proposed District Plan ("the Plan"). However, given the Council's position in respect of the presence and location of the CCEL, we also considered alternative approaches to the issues raised by our clients' appeal.

3. At the end of the meeting, our understanding was that you would approach the Council's District Plan Appeals Panel ("the Panel") with a proposal to see whether it was open to re-classifying certain activities in the Plan that affect our clients' Te Puru properties.

4. In advance of the Panel meeting on 19 September 2016, we agreed to supply you with a list of the types of activities that our clients may wish to undertake on their properties. We also agreed to provide you with some suggestions for criteria over which the Council may exercise its discretion.

5. We have broken down our response into 3 parts; activities that we consider should be permitted seaward of the CCEL; activities which we consider may require a permit seaward of the CCEL; and a suggested framework under which the Council may exercise its discretion.

**A. Permitted activities seaward of the CCEL:**

6. The following activities are those we consider to be permitted activities under the Plan. We would welcome your clarification that our interpretation aligns with the Council on these matters.



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Directors Katrina Hulsebosch
Grant Harris
David Foster (Notary Public)
Oliver Moorcroft

a. Attaching an awning to the house front;

The definition for a building excludes structures that are no greater than 0.3 m wide (maximum horizontal dimension), and no higher than an additional one third of the maximum permitted height or Height in Relation to Boundary standard in the applicable rule. As such, provided the structure holding the awning up is less than 0.3m in width and meets the permitted height limits, then we consider it is permitted seaward of the CCEL.

b. Placement of sun shade sails;

The definition for a building excludes structures that are no greater than 0.3 m wide (maximum horizontal dimension), and no higher than an additional one third of the maximum permitted height or height in relation to boundary standard in the applicable rule. As such, provided the structure holding up the sun shade sail is less than 0.3m in width and meets the permitted height limits, then we consider it is permitted seaward of the CCEL.

c. Building a fence.

The definition for a building excludes fences that are no higher than 2 metres from the lowest adjoining ground level. Provided any fence meets this definition, then we consider it is permitted seaward of the CCEL.

d. Garden work or landscaping;

It is noted that Rule 10 (Earthworks) of the Plan specifies that earthworks that are a permitted, controlled or restricted discretionary activity in the underlying zone and district-wide rules retain their activity status provided:

i. They are commissioned by the Waikato Regional Council; or

ii. They are for domestic gardening; or

iii. They are to install a consented or permitted building, structure or coastal defence.

Given that the underlying Plan Residential Zone rules permit earthworks up to a maximum of 100m3 over an area of 250 m2, garden work or landscaping, which is considered, in our opinion, to be domestic gardening, are permitted seaward of the CCEL.

e. Building a boatshed or similar:

If a boatshed or similar structure is less than 10m2 in area and is no higher than 3.5m in height, then it is unlikely to meet the definition of a building and therefore, in our opinion, could be considered to be permitted seaward of the CCEL.

f. Building a deck;

We do not consider a deck would meet the definition of a building and therefore, in our opinion, could be considered to be permitted seaward of the CCEL.

g. Adding a pool or spa;

We do not consider a pool or spa meets the definition of a building and therefore, in our opinion, could be considered to be permitted seaward of the CCEL.

**B. Activities requiring permits:**

7. In addition to the above activities, we have also identified the following activities which may be undertaken seaward of the CCEL but for which we consider a consent may be required. This is the activity for which we are proposing a restricted discretionary classification.

a. House renovations extending beyond the current footprint of the property;

b. Demolishing an existing structure and building a new property that crosses the CCEL; and

c. Building a deck, swimming pool, spa boatshed or similar that meets the definition of a building.

**C. Framework for restricted discretionary activities:**

8. On the basis that the above activities may be considered restricted discretionary, we put forward the following framework (and amendments to existing rules) as a starting point for inclusion within section 34.1 of the Plan. We have been assisted by a planner in putting together this framework.

***Rule 9 - Permitted Activities***

*9. The following are Permitted Activities:*

*a. Maintenance, replacement or alteration of any lawfully established building or structure inside the envelope and footprint of the existing building or structure.*

***Rule 9A - Restricted Discretionary Activity***

*10. The following are Restricted Discretionary Activities:*

*a. Additions to or the replacement of any lawfully established building or structure that is proposed to exceed the existing building or structure envelope or footprint.*

*b. Demolition of a building or structure.*

*c. New buildings or structures (not otherwise listed).*

*d. Any fence along the common boundary and the Coastal Marine Area that is:*

*i. Greater than 1.2 metres in height; or*
*ii. Is constructed out of materials that are not timber and left to weather naturally.*

***Restricted Discretionary Activities shall comply with the following standards and terms:***

11. *Additions to, or the replacement of, any existing lawfully established building or structure within the CCEA that is proposed to exceed the building envelope or footprintof the existing building or structure, provided that:*

    a. *The additional gross floor area (GFA) at ground level does not exceed 20m2 (as measured from the floor area existing at 13th December 2013) unless accompanied by a report from a Coastal Processes Engineer that has regard as set out in the information requirements in Appendix XXX: Information Requirements (within the CCEA);*

    b. *The addition or replacement project no further seaward than the existing external surfaces of the building or structure (as measured from the floor area existing at 13th December 2013) unless accompanied by a report from a Chartered Professional Engineer that has regard as set out in the information requirements in Appendix XXX: Information Requirements (within the CCEA).*

***Restricted Discretionary Activity - Matters of Discretion for Additions to, or the Replacement of, any Lawfully Established Building or Structure within the CCEA.***

12. *The Council restricts the exercise of its discretion to:*

    a. *Any recommendations contained within the report provided by a Coastal Processes Engineer.*

    b. *The extent to which the proposed activity will be able to be relocated or removed from the site with minimal disturbance to the foredune, the site or adjacent sites;*

    c. *The degree to which the proposed activity is likely to:*

        i. *Accelerate, worsen or result in further damage to the subject site, other land, or structures or buildings caused either directly or indirectly by coastal erosion or inundation.*
        ii. *Be subject to damage from erosion and inundation;*
        iii. *Compromise the natural buffering ability of the foredune system;*
        iv. *Reduce the nett risk of coastal erosion and inundation hazards;*

    d. *The on-going provision of access to a minimum width of 3 meters to ensure that buildings can be practicably removed;*

    e. *The matters to which any report from a Coastal Processes Engineer is to have regard as set out in the information requirements in Appendix XXX: Information Requirements (within the CCEA);*

    f. *The provision for a review of conditions being required under section 128 of the Resource Management Act 1991. This review would be initiated where defined hazard risk circumstances occur on the site, particularly:*

        i. *When the crest of the foredune or the top of any dune scarp recedes to a point within 10 meters or less from the nearest part of the building;*

ii. *The review will enable the actual risk to be considered at that time, and appropriate mitigation measures implemented through changed consent conditions, should this be deemed necessary, including, but not limited to, requiring the relocation of any building, structure or other works to the alternative building site and/or further monitoring*

g. *Requiring that, on relocation, all materials used in constructing the building, including foundations, be removed from the CCEA and that the site within the CCEA be reinstated, to maintain the natural shape of the foredune by reference to the existing natural shape of the dune in the vicinity of the reinstatement works. As a minimum, the volume of sand between the CCEL boundary and the toe of the foredune (per meter of frontage) is not reduced to less than that existing before reinstatement works were required;*

***Appendix XXX: Information Requirements (within the CCEA)***

a. *In addition to any other information requirements in the Plan, an application for consent for development within the CCEA shall include:*

i. *Written confirmation, within the application and plans, sections and elevations attached to the application, from a Chartered Professional Engineer confirming that the proposed structure, or extension to, any building or structure, on the land, is not likely to accelerate, worsen or result in material damage to that land, other land or any structure, through inundation or erosion.*

b. *Applications for new structures, extensions to any building or structure or additions to structures shall include confirmation from a Chartered Professional Engineer and/or a house removal company that the building (or the addition/extension) is able to be relocated.*

c. *If the applicant considers the location of the CCEA boundaries to be different to those boundaries defined on the District Plan Maps, then the Council may require the Assessment of Environmental Effects, submitted with the application, to include additional information to determine the location of these boundaries in the context of the application.*

d. *The information submitted in support of the application shall include the most recent data, which shall be made available from Council's Geographic Information System, as to the location of the CCEA boundaries.*

***NOTE:***

*Any application for a resource consent made under Rule 9A – Restricted Discretionary Activity Rules shall not be notified, or served on affected persons.*

***Rule 9B - Any other activity***

13. *Any other activity not included in Section 34.11 that:*

a. *Erects or relocates a new permanent building in the Current Coastal Erosion Area Overlay; or*

b. *Is an addition to an existing permanent building where the addition is in the Current Coastal Erosion Area Overlay*

c. *Any activity that does not comply with the Rule 9A – Restricted Discretionary Activity - Standards and Terms*

*is a non-complying activity.*

14. The suggested framework is a means of demonstrating to the panel that such activities could readily be incorporated into the Plan whilst allowing the Council to comply with its regulatory and statutory responsibilities.

15. We understood from the planning consultant that other Councils have adopted similar proposals.

16. However, this proposal is not to be considered as an offer capable of acceptance but rather an invitation to treat that could form the basis of further discussions if the Panel is willing to allow further negotiations on this matter.

17. Our clients have seen this form of words but, given the timeframes, we have not had the opportunity to discuss them in depth with our clients. There may be other suggestions that our clients may have or additional terms or activities to consider.

18. We trust this information is helpful and we look forward to hearing from you shortly concerning the Panel's decision on whether this approach is a possibility.

Yours sincerely

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