Coromandel East Coast Beaches:

Future Coastal Erosion Setback, Response to Peer Reviews

Prepared for Thames Coromandel District Council

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focus
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Report prepared for:

Thames Coromandel District Council

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Introduction

Coastal hazard setback recommendations for eastern Coromandel beaches currently incorporate two coastal erosion setbacks, which are taken from Dahm & Munro (2002), Dahm & Gibberd (2009) and Dahm & Gibberd (2012):

- The Current Coastal Erosion Line (CCEL) (formerly known as the Primary Development Setback or PDS), which provides for the maximum likely erosion associated with existing coastal processes,
- The Future Coastal Protection Line (FCPL) (formerly known as the Secondary Development Setback or SDS), which identifies the further erosion that could occur over the next 100 years due to projected sea level rise.

The FCPL was initially presented in Dahm & Munro (2002), and reviewed and updated by Dahm & Gibberd (2012), based on more recent sea level rise predictions. The update did not include any further detailed investigations or new methodology, but simply recalculated the likely impact of sea level rise on erosion based on more recent sea level rise projections.

The Thames Coromandel District Council ("Council") has since commissioned two peer reviews of the methodology used to calculate the FCPL. One peer review was undertaken by Dr Tom Shand from Tonkin & Taylor Ltd, experienced practitioners in coastal hazard assessment, having developed coastal setbacks for a number of district and regional councils, and successfully defended these in the Environment Court. The second review was completed by Dr Mike Hilton, a senior lecturer from the University of Otago.

This report is a response to these peer reviews, including clarification of some of the issues raised in the reviews.

Assessment Methodology and Sea Level Rise Values

Dr Shand notes that the assessment uses a methodology that is consistent with good practice and uses recommended and accepted sea level rise values. He does, however note that the value of 0.8 m is deemed appropriate to the 2090s (i.e. midpoint 2095), meaning that a further 20 years (i.e. to 2015) is required to achieve a 100 year planning period, which is required by the NZCPS (2010).

He therefore recommends it would be prudent to increase the 100 year sea level rise value from the 0.9 m used in our assessment to 1.0 m. We believe that the 0.9 m figure we have used is reasonably precautionary, but accept that 1.0 m is justifiable. We are happy to make this change if Council decide that this precautionary approach is warranted, though we note that it would increase our draft FCPL setback by just over 10%. For instance, at Matarangi, the calculated setback would increase by about 3.5 m.

Bruun Rule

Dr Hilton criticises the use of the Bruun Rule as a method to calculate shoreline erosion in response to sea level rise. He refers to the Bruun Rule as having been "discredited" and an "overly simple method derived long before and understanding of how beaches and dunes work".

We do not agree that the Bruun Rule has been "discredited", and note that there are a wide range of views by leading coastal scientists and engineers that differ from the views of the authors quoted by Dr Hilton. Moreover, Dr Hilton quotes Cooper and Pilkey (2004) as noting that *"because the Bruun Rule ignores various important geological and oceanographic principles, it does not and cannot predict shoreline retreat due to sea-level rise accurately"*.

We note that the assumptions guiding the application of the Bruun Rule clearly identify the geological and oceanographic conditions where the method is applicable. In our view, the assumptions of the Bruun rule (as outlined in our report and by Dr Hilton) do broadly apply to the beaches of the eastern Coromandel, as:

- The beaches are largely discrete systems, without significant sand exchange between them (i.e. no significant longshore inputs or losses).
- The beaches are finite coastal systems, with little to no ongoing sediment supply, and this situation is not likely to change with sea level rise.
- The majority of the beach systems are in equilibrium with existing coastal processes, out to at least the closure depth, and do not have the nearshore geological controls discussed by Cooper and Pilkey (2004).
- The sediment landward of the beach typically comprises erodible sand with characteristics similar to those of the nearshore (and our calculations provide for modification of the FCPL where this is not the case).

Accordingly, the beaches are likely to adjust to sea level rise by sediment transfers within the beach system, and the Bruun rule is the most appropriate of the available shoreline response methodologies to provide an indication of the erosion that could accompany this adjustment. We accept that the method (like all available methods) does not pretend to provide accurate predictions, and the figures are best regarded as indicative. However, Council is required by the NZCPS (2010) to consider the effects of climate change over at least 100 years, and it is not appropriate to simply ignore this requirement because of the limitations of existing methodologies. We believe that the Bruun Rule is the best of the available methods for eastern Coromandel beaches and note that Dr Hilton does not suggest any viable alternatives.

Our position is supported by the Tonkin and Taylor Ltd (Dr Shand) review. As noted earlier, Tonkin and Taylor are very experienced in coastal hazard assessment and have developed setbacks for a number of Councils including use of the Bruun Rule – with successful defence at the Environment Court. Dr Shand notes that "eastern Coromandel beaches generally fulfil the requirements for application of the Bruun rule and it is a suitable method provided any long-term erosion or accretion (if any) is evaluated and included in predicted recession distance". We cover the issue of long term erosion and accretion in a later section of this response.

Dr Hilton also argues that many Coromandel Beaches are not in dynamic equilibrium with existing coastal processes due to the effects of coastal structure and dune construction and management. We firmly disagree with this.

In regard to coastal structures, there are certainly some limited areas (parts of Buffalo Beach, eastern end of Cooks Beach, southern end of Hahei) where shoreline adjustment is constrained by rock sea walls. However, our Bruun Rule calculations used beach profiles that are not modified by coastal structures and where the cross-sectional form reflects present day natural coastal processes. Accordingly, these concerns raised by Dr Hilton are not relevant to our calculations.

Dune restoration and management at locations such as Whangapoua have not disrupted the ability of any of the eastern Coromandel beach systems to naturally adjust in response to natural coastal processes. The primary role of dune management on the eastern Coromandel Peninsula is in fact to restore natural dune function and vegetation on dunes that have previously been extensively modified and/or degraded by human activities. The work at Whangapoua involved simple repair of a severely eroded dune by pushing sand up from the adjacent beach, mimicking the natural transfer of wind-blown sand. In most cases, dune repair is left to natural processes, and this approach (at Whangapoua) was only adopted so that permanently damaging works (e.g. seawalls) were not required to protect threatened houses. The works did not fundamentally alter the natural sediment dynamics of the beach, and monitoring indicated that natural beach conditions were restored very soon after the works (Eco Nomos, 2011).

Closure Depth

While Dr Shand agrees that the Bruun rule is appropriate for the eastern Coromandel beaches, he suggests that further work could be done to validate the closure depth used in our calculations. He notes that our calculated setbacks are relatively low compared with values typical of open coast sandy beaches. For instance, he notes values of between 50 m and 100 m are typically adopted in New South Wales, compared with our values of 20 m and 30 m.

As outlined in our report, our calculations were largely based on the offshore surveys available at the time. We believe the approach that we have used is appropriate but agree there is further work that could be done to better confirm closure depth. We believe the use of field data is most appropriate in this respect as opposed to some of the more empirical techniques (e.g. Hallermeier, 1981 & 1983). In our experience, the empirical techniques often tend to over-estimate closure depth (certainly as relevant to the Bruun Rule) and this can result in very large setbacks being estimated. We believe it would be difficult to justify these larger values given the existing survey data used in our report.

If Council wish to undertake further work, we believe that additional offshore profile surveys and associated offshore sediment investigations would provide the most reliable assessment of closure depth. We agree with Dr Shand that any increase in closure depth would likely increase the width of the calculated FCPL, as profile slopes tend to decrease with distance from shore.

Probabilistic vs. Deterministic Approaches

Dr Hilton notes that probabilistic, rather than deterministic (single value) estimates of coastal recession are now required as we develop new risk management approaches to coastal management. We concur and note that we are joint authors of recent national guidelines referred to by Dr Hilton (Ramsay, Gibberd, Dahm and Bell, 2012), which highlight the potential of probabilistic approaches in the management of coastal hazard risk.

It is important however to appreciate that the CCEL and FCPL setbacks are used for specific purposes which require definition of the maximum likely area that may be impacted by coastal erosion for defined circumstances, namely:

- **CCEL:** Storm cut erosion up to at least 100 year return period for existing sea level – including potential slope adjustment of the eroded dune face plus a safety factor. This setback is used by Council to assess safe locations (for existing sea level) for new dwellings.
- **FCPL:** An estimate of the additional erosion that could arise with sea level rise of 0.9 m - added to the CCEL. This setback is used to provide a reasonable worst likely estimate of the additional area that might potentially be affected by erosion given projected sea level rise. It is used by Council for purposes such as managing subdivision.

These conditions represent what we have assessed to be reasonable but precautionary erosion scenarios for the next 100 years based on existing best information for eastern Coromandel beaches and future sea level rise. We accept that future sea level rise over the next century may be higher, as noted by Dr Hilton, but would note that it may also be lower. As outlined in our earlier report, we have followed the available national guidelines in identifying the most appropriate sea level rise scenario for the next century - as required by the NZCPS (2010).

Probabilistic techniques estimate the range of possible shoreline changes that could occur based on probability distributions for the various erosion parameters. These techniques can for example be used to assess the likelihood of various levels of erosion (e.g. as a percentage likelihood of occurring) for given planning periods and sea level rise scenarios as outlined by Ramsay et al., (2012).

Dr Hilton suggests that Council might adopt multiple FCPL setbacks associated with a range of sea level rise scenarios. However we note that it would be very difficult to apply multiple lines for the specific management purposes relevant to the CCEL and FCPL.

We nonetheless believe that probabilistic techniques do have a range of other applications. For instance, the techniques are potentially very useful in providing greater transparency in terms of the uncertainty associated with predicting future shoreline change. We also believe these approaches have potential application in the development of detailed hazard management recommendations and strategies for individual sites.

Climate Change Effects

Dr Hilton notes that our report only addressed the sea level rise component of climate change, and that "*the impacts of other climate change processes, including an increase in the frequency and intensity of coastal storms and reorientation of shorelines in responses to changes in wave climate are not examined*". Dr Hilton feels that there would be benefit in addressing these and other potential effects such as changes in groundwater elevation and salinity, precipitation and extreme weather events.

We agree with Dr Hilton that there are many other effects of climate change that may also impact on coastal erosion processes in the future, including changes in storm frequency, intensity and duration and wave climate. However, there is no reliable information on the likely nature of these changes along the eastern Coromandel. Moreover, even if these effects were able to be reasonably quantified, there are no methods presently available to reliably predict the resulting shoreline change. The methods that are available (e.g. numerical modelling) are subject to numerous assumptions of their own, which assumptions have significant bearing on the results obtained. They are also very expensive and have considerable data requirements.

We agree that it is desirable to conduct further research into the nature of changes that may be experienced along the New Zealand coast in response to projected global warming, and the development of methods that could be applied to reliably estimate consequent coastal change. However it is presently not practical to reliably quantify shoreline response to climate change factors other than sea level rise.

Dr Hilton notes that the impact of climate change will in some large measure depend on the incidence of storm events, and the coincidence of circumstances (e.g. tidal conditions). It is important to note that previous work (Dahm & Munro, 2002; Dahm & Gibberd, 2009) has separately estimated the worst case erosion likely to arise from severe coastal storms, based on shoreline change and other morphologic data. This hazard area is defined by the CCEL, which also includes various safety factors to ensure it is reasonable and precautionary. As noted above, the FCPL simply defines the <u>additional</u> erosion that could occur in response to projected sea level rise of 0.9 m.

Undeveloped Sites

Dr Shand notes that a previous report (Dahm & Munro, 2002) adopted a 100 m hazard setback for Greenfield sites, and that our recent report provided no setback recommendations away from residential areas.

We agree and note that in our view the earlier 100 m setback recommendation for undeveloped areas should continue to apply except near estuary and stream entrances, where the setback may need to be larger. Ideally, any application for new development in Greenfield

areas will be accompanied by site specific assessment of setback requirements. We note that the protection of natural character is a significant issue for undeveloped sites and that a development setback for this purpose may need to be wider than a setback based on hazards alone.

Coastal Management

Dr Hilton expresses the view that the FCPL lines should only be applied where there is no intention of protecting existing infrastructure or private property. He notes that there seems little point in these setbacks where "*the decision to protect property has already been made or is inevitable*".

We would agree that is a valid approach where structures have been designed and consented as a long term solution to coastal erosion that might arise as a consequence of sea level rise. There are however no such sites on the eastern Coromandel. Our calculations have therefore not taken into account any existing structures and have not assumed long term erosion protection is inevitable. Dr Shand concurs with this approach.

We note that any assumption that the beaches will be protected with structures would have serious implications for the natural and amenity values of Coromandel beaches and would require a long term commitment to major and ongoing expenditure by the ratepayers of the District. Any decision to hold the shoreline in the face of projected sea level rise would therefore need detailed consultation with affected stakeholders and the wider community. To simply assume that such protection is inevitable and therefore fail to identify and plan for future erosion is not responsible and is inconsistent with the very clear statutory duties of Council. It could also expose Council and its ratepayers to serious liability issues in the future.

Erosion Resistant Materials

Dr Shand notes that the 10 m setback applied for erosion resistant material may or may not be sufficient, depending on the competence of the materials. For instance, he notes that this figure may be insufficient if the material is weakly consolidated or highly weathered. We agree. However, we are reasonably familiar with the eastern Coromandel Coast and are not aware of any locations where rapid cliff retreat has occurred and therefore believe our figure is likely to be sufficient.

Nonetheless, we concur with Dr Shand and believe that it would be useful to conduct further work to confirm that the value we have adopted is adequately precautionary for all relevant sites. This could be achieved relatively easily, and would be preferable to simply adopting a larger value that may unnecessarily increase the setbacks.

Stream Mouth Erosion

Dr Shand notes that setbacks have not always been mapped around stream entrances. We have mapped the influence of streams at most sites, but agree that there are a few sites where this work is still required. Further field work would be required to address these sites and we agree that this work is appropriate.

Accretion

Dr Shand notes that predictions of future shoreline change should incorporate any long term trend for accretion. We are not aware of any reliable evidence for ongoing long term accretion at any of the Coromandel beach sites. Investigations of the age structure of Coromandel beach systems and available information on shoreline change over the last century indicates that the seaward advance that occurred earlier in the Holocene has now largely ceased (Dahm and Munro, 2002). Nonetheless, if reliable information were to arise in the future indicating that some beaches are experiencing long term net accretion, then this accretion could be incorporated into the calculations.