Proposed Thames-Coromandel

District Plan

THAMES COROMANDEL DISTRICT COUNCIL

Submission Form

Form 5 Clause 6 of the First Schedule to the Resource Management Act 1991

THAMES-COROMANDEL DISTRICT COUNCIL
13 MAR 2014
RECEIVED BY: Taji Wana 12:41

Your submission can be:

Online: www.tcdc.govt.nz/dpr
Using our online submissions form

Posted to: Thames-Coromandel District Council
Proposed Thames-Coromandel District Plan
Private Bag, Thames 3540
Attention: District Plan Manager

Email to: customer.services@tcdc.govt.nz

Delivered to: Thames-Coromandel District Council, 515 Mackay Street, Thames
Attention: District Plan Manager (or to the Area Offices in Coromandel, Whangamata or Whitianga)

Submitter Details

Full Name(s) Catherine Matthews, David Gray, Alison Gray & Robert Gray.

or Organisation *(if relevant)*

Email Address jandcmatthews@xnet.co.nz

Postal Address 43 Tephra Blve, Stonefields
Auckland 1072

Phone no. *include area code* (09) 5210204

Mobile no. 0211116059

Submissions must be received no later than 5 pm Friday 14 March 2014

If you need more writing space, just attach additional pages to this form.

PRIVACY ACT 1993

Please note that submissions are public information. Information on this form including your name and submission will be accessible to the media and public as part of the decision making process. Council is required to make this information available under the Resource Management Act 1991. Your contact details will only be used for the purpose of the Proposed District Plan process. The information will be held by the Thames-Coromandel District Council. You have the right to access the information and request its correction.

Your Submission

The specific provisions of the Proposed District Plan that my submission relates to are:
(please specify the Objective, Policy, Rule, Map or other reference your submission relates to)

Proposed Heritage Building
proposed Heritage site
302 Queen Street, Thames

My submission is:
(clearly state whether you SUPPORT or OPPOSE specific parts of the Proposed District Plan or wish to have amendments made, giving reasons for your view)

I support ☐ *oppose* ☑ *the above plan provision.*

Reasons for my views:

see attached submission

The decision I seek from the Council is that the provision above be:

Retained ☐ *Deleted* ☑ *Amended* ☐ *as follows:*

Proposed District Plan Hearing

I wish to be heard in support of my submission. ☑ *Y* ☐ *N*

If others make a similar submission, I will consider presenting a joint case with them at a hearing. ☑ *Y* ☐ *N*

Signature of submitter [signature] *Date* 12 March 2014

Person making the submission, or authorised to sign on behalf of an organisation making the submission.

Trade Competition

Please note that if you are a person who could gain an advantage in trade competition through the submission, your right to make a submission may be limited by Clause 6 of Schedule 1 of the Resource Management Act 1991.

I could gain an advantage in trade competition through this submission. ☐ *Y* ☑ *N*

If you could gain an advantage in trade competition through this submission please complete the following:

I am directly affected by an effect of the subject matter of the submission that –

a) adversely affects the environment; and

b) does not relate to trade competition or the effects of trade competition. ☐ *Y* ☑ *N*

If you require further information about the Proposed District Plan please visit the Council website ***www.tcdc.govt.nz/dpr***

THAMES-COROMANDEL DISTRICT COUNCIL
Private Bag, 515 Mackay Street, Thames 3540
phone: 07 868 0200 | fax: 07 868 0234
customer.services@tcdc.govt.nz | www.tcdc.govt.nz

THAMES COROMANDEL DISTRICT COUNCIL

SUBMISSION

302 QUEEN STREET – B259 ML NOKENOKE

Proposed Heritage Building – Proposed Heritage Site

We oppose the proposed Historical Heritage Building and Proposed Heritage Site placed on the property without any compensation from Thames District Coromandel Council. This is an infringement on the fundamental rights of a freehold property owner.

We believe the placing of the Heritage label on the site puts an unfair burden on the property owners, now and in the future.

FAMILY BACKGROUND OF PRESENT OWNERS

This property was never purchased to be renovated or preserved. It was only ever purchased to be demolished and the site redeveloped. Our mother purchased the property for its location only. As the property is close to amenities in the town it was seen as an ideal property for a retirement home. If our mother had any idea of what the council are trying to do to the property at present she would never have considered purchasing the property. As our mother became ill and passed away, the retirement property was never built. Her four children have now inherited the property.

We feel that it is not an economical option to restore this house in its present state. As this house was owned by the Women's Club for 45 years then rented until the site was to be redeveloped, little work has been done on the house for many years. Therefore to keep it as a family home, it is in need of a total renovation. To now spend over $100,000 on this house would make it an uneconomical option in Thames for anyone, developers included.

With the Thames District Coromandel Councils Plan to have this house kept and not to be removed. Where does this leave us as owners now?

- The present owners do not live in Thames and therefore will never live in the house.
- A property that no one wishes to purchase as the cost to restore to a comfortable family home would be in the vicinity of over $100,000. Not many would look at this option.
- While this property is zoned High Density, the Heritage overlay takes away any options to remove or redevelop this site.
- While there has been interest from buyers in the property, once potential buyer find out about the Heritage tag, they are not interested for fear of the unknown and the limitations that are now on the property.
- To keep the house tenanted with an ideal tenant for a property like this is not always easy. Most desirable tenants request improvements to the house. We do not want any further damage to the house by unsuitable tenants.

HERITAGE

Is this actually the house that J E MacDonald lived in? There is still confusion within the town to which house J E MacDonald actually lived in.

After extensive research we have not been able to find the name of John Edwin MacDonald on any of the Title deeds or lease agreements.

While mentioned in Toss Hammond Journal the Treasury Journal Volume 4 (2011).

"in those days a small creek ran along the northern side of Richmond St from the foothills. This was the Noke-noke Creek. Just north of the mouth of this creek was a small section that remained not built on for many years. Some said it was a Tapu ground. Immediately north of this vacant section was section with 33 ft frontage and on this was the residence of the well-known solicitor J. E. McDonald."

While these are the recollections of Toss Hammonds father. It was written many years ago and does not contain any street numbers to give any legal clarification to the actual address.

Building the family home – Kate MacDonald

'I returned again to Auckland while the house was being built. It was to be in Pollen Street, facing the beach. The ground went right through to the next street, and later the Volunteer Hall was built at right angles to us, the back of it forming part of our garden fence'.

Once again no street numbers. This section does not show that it went right through from Pollen Street on the old maps.

Local information on 300 and 302 Queen St properties

- The local 'The Treasury' are still quoting the house that J E MacDonald lived in as 300 Queen Street, Thames (see attached). If the Council believed that the correct house was 302 Queen St, Thames, why have they not corrected The Treasury?
- Received by Council "Thames-Coromandel District Council Historic Heritage item No.47" listing 300 Queen St, Thames. Original owner Mr and Mrs McDonald, first Mayor and Mayoress of Grahamstown. (see attached). How does this show the Council is concerned or even interested in who lived in these homes?

ARCHITECTURAL SIGNIFICANCE

Carpenter's Gothic styling.

According to the local Treasury no Carpenter's Gothic were ever built in Thames. As stated in the Historic Heritage item Record Form this house has had significant modifications. If this had originally been a four room home then it has been greatly added to over the years. What part if any are still Carpenter's Gothic today? What part of the house do you wish to protect?

HISTORIC SIGNIFICANCE

45 year tenure of the Thames Womens Club.

While this house had been the Thames Women's Club for 45 years, they had altered the house internally to suit a club. Walls removed, Kitchen as a local hall style, stage in lounge. Little upkeep of the property had been done to the inside of the house. Many of the walls still have scrim.

The current club do not appear to hold great signification to the old club building. No photos appear in the merged club.

The Women's Club was started for the women of Thames for friendship and a place to meet for social events. Our grandmother and mother had been members for many years until their deaths. We are sure that this would not have be the intentions of the members that this house had to remain as it was. Members would not have approved that the property would become a burden for whoever owned it in the future and held accountable by the local council to keep the house on the section.

NOTIFICATION AND SUPPPORT BY COUNCIL

We are appalled at the lack of notification by the Thames Coromandel District Council on the Heritage issue to the ratepayers that are affected.

- Initial letter and map of November 2012
- 17th December 2013

While we presume that the minimum notification will no doubt have been given out, the letters have been very general. Not listing the rate number or legal description of the properties or even the street address. Some people may have a number of properties with parts of the plan affecting their properties. This has made them very easy to disregard. We are shocked at the number of people that don't know what is happening to their properties and the limitations that will affect them in the future. The Council is enforcing these changed upon us. Not us asking for them. Where has there been any care or concern from the Council to work with the individual rate payers on this issue. We as property owners have had to request any information on the property. The website is referred to in these letters but the website is not considered very user friendly.

While this is a large project for the Council it is also a very large concern on individual property owners, it's our property that you are trying to change.

HOW WILL ANYONE BUT THE OWNERS KNOW THAT A SIGNIFICANT PERSON ONCE LIVED AT THIS PROPERTY?

What are the council themselves doing to provide any Heritage awareness in the town other than expecting this to be upheld financially by a few individual ratepayers? How is this fair? While we presume you are hoping to eventually have a large area of Thames with nicely renovated houses for visitors to drive by on their way to the Coromandel beaches what are the Thames Coromandel District Council themselves doing towards it.

As the town appears divided as to the correct house that J E MacDonald lived in, we take it that this issue is not very high on the Councils agenda. Why should we as owners bear the brunt of the financial cost?

The house has external weather board that are not standard size of today's standards so this would all need to be custom made to preserve the history. Decramastic roof added, veranda. Does this affect the council's plans for the heritage aspect of the house, or is it just the look of an old house that the Council want. Rather than who supposedly lived in the house in the past. If this is the case the Council could have picked many other houses in the area that are more pleasing to the eye.

The family do not intent to invest any money in this property. So it will become more in need of repair as time goes by. If we did have the financial means to renovate the house we wouldn't consider it a good finance investment anyway.

We would like to sell this property, yet we have been unable to do so. While there has been interest in the property. Once anyone finds out about the proposed Heritage site they are not interested. As most people are unsure what they will be able to do to the property. If they intend to do any future work, they are scared by the unknown.

As the proposed District Plan is a very long drawn out process by the Council the ratepayers are left to bear the brunt of waiting for a number of years before anything is finalised. How can the town progress until this is all sorted.

The Council have left us with a property that is a liability to the owners. If you are intending to place this tag on the property you must consider it to be of value to you. An asset to you, a liability to us. If it is so important to the Council for the history of the town that this house that J.E. MacDonald supposedly lived in, the council should buy it. You are the people that you are making it into an unsellable property for us. Then you could renovate it back to the original condition the supposedly owner J E MacDonald built and turn it into the museum of the original property's of Thames or Shortland as it was then known. As it is a prime gateway to the Coromandel site. Why should the Thames Coromandel District Council be able to force restrictions like this on our property? We don't own the property because of who lived in the house previously or what Club owned, this appears now to be only a disadvantage. Why should some ratepayers be so disadvantaged? We would like to move on with this property and be able to sell it fairly without these restrictions.

Submitted by

Catherine Matthews

David Gray

Alison Gray

Robert Gray

Topic: 300 Queen Street

Topic Type: Place

Built in the early days of the goldfield (1867-1868) as a single story house by J. McDonald, a lawyer who later became the first democratically elected Mayor.

Unusually, the kitchen was noted as the best room in this dwelling and it is probably that it is here that Sir George Grey, avid supporter of Thames and goldmining, was entertained to dinner.

After McDonald, who service two terms as Mayor, a second storey was added in the 1890s. As the development between Grahamstown and Shortland filled in the town, additions such as the second storey reflect the commercial success of Thames at that time.

THAMES HERITAGE STUDY
ITEM IDENTIFICATION SHEET

REGISTERED ITEM NO. 47

NAME House

ADDRESS
300 Queen Street, Thames

TYPE
Waahi Tapu
Precinct
Building ✓
Group of Bldgs
Structure
Monument
Historic Site
Other

LEGAL DESCRIPTION: PT LOT 260 OF NOKENOKE B SHORTLAND NO 13

OWNER Mr and Mrs K L Morrison
300 Queen Street
Thames

DATE PERIOD
Pre 1800
1800-1840
1840-1870 ✓
1870-1880
1880-1910
1910-1940
1940-1980
Post 1980

ORIGINAL OWNER
Mr and Mrs McDonald, First Mayor and Mayoress of Grahamstown

ARCHITECT/DESIGNER

STATUS

PHOTO REFERENCE
Film:
Neg:
Date:

THEMATIC CONTEXT
Maori
Gold-mining ✓
Engineering & Shipbuilding
Timber Industry
Transport
Rural Servicing
Entertainment ✓
Social and Civic ✓

SIGNIFICANCE
Tangata Whenua
Historic ✓
Architectural ✓
Aesthetic
Scientific
Technological
Archaeological
Townscape

Submission by WILLEM PIETER de LANGE for and on behalf of the Matarangi Future Coastal Protection Line Objection Group

Executive Summary

1 This submission was prepared by Willem Pieter de Lange for and on behalf of the Matarangi Future Coastal Protection Line Objection Group (MFCPLOG) and assesses the methodology and assumptions used to determine the Current Coastal Erosion Line (CCEL) and Future Coastal Protection Line (FCPL) by Dahm and Munro (2002) and FOCUS (2012).

The members of the MPCPLOG are detailed in Appendix 1 and listed in the Attachment 'Matarangi dbase'. This submission is made on behalf of the collective MFCPLOG and the individuals listed in the attachment 'Matarangi dbase'. The nominated point of contact for the MFCPLOG is Graeme Osborne, whose contact details are as follows:

Address: 4i / 118 Gladstone Road
Parnell
Auckland 1052
Mobile: 021 337377
Email: osborne@beachfront.co.nz

PO Box 37-320
Parnell
Auckland 1151

The MFCPLOG submits:

1.1 'There is no sound basis for the Future Coastal Protection Line (FCPL) and we wish it to be removed from the Proposed District Plan along with all related and consequential changes, to include proposed changes to the resource consenting process for existing properties located between the FCPL and the future development of existing properties.

1.2 That the Thames Coromandel District Council (TCDC) honours the development terms and conditions that were applied in good faith when development and resource consents were originally issued for the development of the Omaro Spit.

1.3 That TCDC applies coastal erosion management policies consistently and equitably across all tidal zones within the TCDC jurisdiction.

1.4 That we are opposed to the suggestion of encumbrances (or similar) being registered on individual titles (and therefore TCDC Land Information Memorandum - LIMs) of eastern Coromandel coastal property in relation to the FCPL in the Proposed District Plan. In particular this concern relates to coastal owners on Matarangi Beach (refer Planning Map 12D - Matarangi - Overlay).

1.5 We oppose any new District Plan provision that creates the need for additional resource management processes including but not limited to additional resource consents, for beach front development between the primary and secondary setback lines at Matarangi Beach. We assert that the Resource Consent context under which the Matarangi beachfront was originally developed should prevail.

1.6 We submit that the Proposed District Plan is not in accordance with Part 2 of the Resource Management Act 1991 (Act) and does not meet the purpose of the Act (s5) by promoting the sustainable management of natural and physical resources. In its present form the Draft Plan does not provide for managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety.

1.7 We propose the following as a preferred approach for addressing the requirements of the NZCPS as it applies to TCDC and the Proposed District Plan:

i. We propose the adoption of a partnered approach to coastal management and beach restoration. A unique opportunity currently exists for TCDC and the Waikato Regional Council (formerly Environment Waikato) and the regions coastal communities to set a new global standard for a principled approach to coastal preservation and management, one that keeps robust science and an agreed value set at the core of a dynamic management model that blends the interests of existing coastal landowners with best practice conservation and management principles, a genuinely partnered approach between landowners, TCDC, WRC, Department of Conservation (DOC).

ii. Site specific monitoring and management: That TCDC/WRC establish a scientifically robust monitoring system (possibly in partnership with either the University of Waikato or the University of Auckland) to gather reliable and robust data series related to storm damage, sea level rise and beach behaviours that can be used to predict 'natural hazard risk' for coastal Coromandel over the next 100 years, with built in decadal (say) comparisons as a preference to adopting global projections that have little local relevance, and as a prerequisite to modelling future erosion lines.

iii. We seek confirmation by TCDC that they already 'own' any responsibilities and liabilities that arise from resource and building consents they have already granted.

iv. TCDC has been presented with a unique and profound opportunity to develop and implement policies and plans to restore and conserve the developed Coromandel coastline; in a calm, reasoned way based on shared values that motivates and encourages co-operative attitudes and combines / aligns the separate forces represented by TCDC / WRC / coastal landowners.

v. The monitoring process suggested above will confirm Coromandel erosion and sea level trends and provide robust inputs into future planning that will inform TCDC management of 'coastal hazards' in a way that reduces the need to rely on loosely formed, debatable and contentious assumptions'.

2 The CCEL and FPCL are uniform setback distances whose extent depends on the type of beach: either a pocket beach, which is short, narrow and relatively steep; or a sand barrier beach, which is long wide and relatively flat. The CCEL represents the sum of a natural dynamic fluctuation term, which represents the maximum historic storm erosion for that type of beach, and a protection dune buffer term, which is intended to provide a residual

dune width between the beach and development following a worst case storm. The FCPL is the sum of the CCEL and the maximum calculated shoreline recession due to sea level rise for that type of beach.

3 The approach used is described as precautionary and does not quantify the probability of coastal erosion occurring, the frequency/magnitude relationships associated with any of the processes that drive coastal erosion, or consider any impacts of climate change other than an assumed sea level rise. The absence of an assessment of climate change impacts contradicts the title of the FOCUS report.

4 Apart from the maximum historic erosion for each type of beach, there is no consideration of historic trends or sediment budgets for any of the beaches. Peer reviewers noted that both, particularly sediment budgets, should have been considered. This is an integral component of the proposed best practice for New Zealand.

5 The shoreline recession due to sea level rise was calculated using the Bruun Rule. This method is not appropriate, and should not have been used. The available observations indicate that shoreline erosion for Matarangi Beach is driven by infrequent storm events and historic sea level rise has had no detectable impact.

6 The projected sea level rise of 0.9 m suggested by MfE (2008) guidelines for consideration was adopted. A range of sea level scenarios was not evaluated, and the maximum calculated recession was adopted as a standard value. This approach does not quantify the probability of the assumed sea level rise occurring, and very likely overestimates the risk of coastal erosion.

7 The methodology adopted does not provide the information required by the New Zealand Coastal Policy Statement 2010 on the risk of coastal erosion, and in particular does not identify areas of high risk. The methodology followed also does not conform to the suggested best practice for determining coastal erosion hazard.

8 Therefore, the proposed FCPL and existing CCEL are not fit for the purpose of informing planning decisions on coastal erosion hazard.

Qualifications and Experience

9 My full name is Willem Pieter de Lange. I hold the degrees of BSc (1981), MSc(Hons) First Class Honours (1983), and DPhil (1989) from the University of Waikato in the fields of Computer Sciences and Earth and Ocean Sciences. My training was in Earth and Ocean Sciences, particularly in sedimentology and coastal processes, and Computer Science, particularly numerical modelling, data analysis and visualisation.

10 I am employed as Senior Lecturer at the University of Waikato within the Department of Earth and Ocean Sciences, Faculty of Science and Engineering, a position that I have held since 1984.

11 During my scientific career I have published some 182 scholarly items, including: 96 peer-reviewed published book chapters and scientific journal papers, mainly in international scientific journals, presented some 11 statements of expert evidence for Hearing / Planning Tribunal / Environment and High Court cases, and published an additional 38 consulting reports. I have been involved in the supervision of 94 MSc/MSc(Tech), 2 MPhil and 20 DPhil/PhD students to completion, mostly in the general area of coastal processes.

12 I am a member of the Coasts, Oceans, Ports and Rivers Institute (COPRI) of the American Society of Civil Engineers (ASCE), the Coastal Education and Research Foundation (CERF), The Oceanographic Society (TOS), and the NZ Coastal Society and NZ Society for Earthquake Engineering technical groups of the Institute of Professional Engineers New Zealand (IPENZ).

13 Since 1984, mostly at the University of Waikato, I have undertaken research into fundamental coastal processes and management pertaining to New Zealand estuaries and the coast. During that time my research has concentrated on coastal hazards, including tsunamis, storm surges, meteo-tsunamis, waterspouts, sea level changes, climate variability, and coastal erosion processes and mitigation.

14 This research has included investigations into the methodologies used to determine coastal hazard zones for a range of different types of coast from sandy beaches to cliffed coasts. I have undertaken determinations of coastal hazard zones, presented expert evidence to the High Court and Environment Court on aspects of coastal zones, and reviewed coastal hazard zone assessments since 1984. I have participated in and reviewed various lifelines vulnerability assessments for major urban areas around New Zealand. I have also been a Technical Commissioner dealing with planning hearings into aspects of coastal development.

Scope of Submission

15 I have prepared this submission at the request of the Matarangi Future Coastal Protection Line Objection Group (Appendix 1). In this submission I will assess the methodology and assumptions used to determine both the Current Coastal Erosion Line (CCEL) and the proposed Future Coastal Protection Line (FCPL). In particular, I will consider the use of the Bruun Rule, the assumed sea level rise projections, possible impacts of climate change, the assumed response of Matarangi Beach to future sea levels and climatic conditions, and finally the risk of coastal erosion

CCEL and FCPL

16 Dahm and Munro (2002) estimated the CCEL and FCPL (Figure 1) as the Primary Development Setback (PDS) and Secondary Development Setback (SDS) respectively. The CCEL included generic values for natural dynamic fluctuation (storm cut and fill cycles) and a protective dune buffer (10 m) to provide a residual dune following a worst-case storm event. No allowance was made for long-term trends in shoreline position as it was assumed that there was no significant source of sediment, and, therefore, no significant trend was present.

Table 1: Development Setbacks (metres) for developed Eastern Coromandel Peninsula Beaches.

	Dune Barrier Beaches	Pocket Beaches
Natural dynamic fluctuation	30 m	25 m
Protective dune buffer	10 m	10 m
Primary Development Setback	**40 m**	**35 m**
Recession due to sea level rise	20 m	15 m
Secondary Development Setback	**60 m**	**50 m**

Figure 1 – Derivation of estimated CCEL (Primary Development Setback) and FCPL (Secondary Development Setback) from Dahm and Munro, 2002).

17 Beaches were grouped into two types, mostly on the basis of beach length (Figure 1): as short, steeper, narrow pocket beaches; or long, flatter, wide dune barrier beaches. The assumed natural dynamic fluctuation was 25 m and 30 m for these respectively. The FCPL included an additional term for the effect of sea level rise over 100 years based loosely on the Bruun Rule as 15 m for steeper pocket beaches and 20 m for flatter dune barrier beaches.

18 Strictly both the dune barrier beaches and pocket beaches are classified as pocket or embayed beaches, where headlands at both ends of the beach system restrict or prevent the exchange of sediment (Horikawa, 1988). Therefore, the distinction between the two groups appears to be predominantly based on the size of the beach and not a true geomorphic classification.

19 The current CCEL and proposed FCPL are not coastal hazard lines as required by the New Zealand Coastal Policy Statement (NZCPS) 2010. This is clear from the briefing paper prepared by Joan Alin (retired Chief Justice of the Environment Court) for the expert panel reviewing the coastal erosion hazard lines adopted by the Kapiti Coast District Council (attached as Appendix 2). The proposed FCPL, in particular, needs to conform with Policy 24, identification of coastal hazards, which states:

"**Policy 24 - Identification of coastal hazards**

(1) Identify areas in the coastal environment that are potentially affected by coastal hazards (including tsunami), giving priority to the identification of areas at high risk of being affected. Hazard risks, over at least 100 years, are to be assessed having regard to:

(a) physical drivers and processes that cause coastal change including sea level rise;

(b) short-term and long-term natural dynamic fluctuations of erosion and accretion;

(c) geomorphological character;

(d) the potential for inundation of the coastal environment, taking into account potential sources, inundation pathways and overland extent;

(e) cumulative effects of sea level rise, storm surge and wave height under storm conditions;

(f) influences that humans have had or are having on the coast;

(g) the extent and permanence of built development; and

(h) the effects of climate change on:

(i) matters (a) to (g) above;

(ii) storm frequency, intensity and surges; and

(iii) coastal sediment dynamics;

taking into account national guidance and the best available information on the likely effects of climate change on the region or district."

20 This policy requires the identification of *risk*, which is defined by the NZCPS as

"Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated likelihood of occurrence (AS/NZS ISO 31000:2009 Risk management - Principles and guidelines, November 2009).

21 Therefore, the NZCPS requires that the FCPL should identify a range of hazards, their likelihood of occurrence, and hence identify areas of *high risk*. In contrast the FOCUS (2012) report used to determine the FCPL considers only coastal erosion for selected beaches on the eastern coast of the Coromandel Peninsula, which represents a limited part of the coastline administered by the Thames Coromandel District Council (TCDC). Further FOCUS (2012) doesn't attempt to calculate the risk; instead stating:

"It is important to appreciate that the estimated erosion is not an existing risk but one which may arise in the future with projected sea level rise".

22 This submission will consider whether the FCPL and the CCEL represent areas of *high risk* of coastal erosion in the future below.

23 The FCPL and CCEL appear to be derived using the same methodology, the difference being the time period over which the coastal erosion is estimated. The only factor that appears to be different between the two lines is the amount of erosion estimated in response to projected sea level rise. It is not clear what allowance has been made for the long-term trends in shoreline position at any of the beaches considered. This submission will consider long-term trends as part of the discussion on shoreline response.

The Bruun Rule

24 Dr Hilton in his peer review of the FOCUS (2012) report stated, “The Bruun Rule has been discredited by the world’s leading geomorphologists”. This is a correct interpretation of the weight of evidence presented in the literature. Tonkin and Taylor Ltd (T&T), argued that the Coromandel beaches meet the requirements for the application of the Bruun Rule, without providing justification, but observed that an assessment of the sediment budget was required. Two studies by Everts (1985) and Zhang *et al* (2004) were cited as support for the applicability of the Bruun Rule. Both studies considered the east coast of the USA, and both studies excluded sites similar to the Coromandel beaches: the studies only considered long straight beaches with a net littoral drift on a tectonically stable coastline, at sites that were not in proximity to tidal inlets or structures, and predominantly sites with a long-term trend of erosion.

25 The Everts (1985) study developed a sediment budget model as an alternative to the Bruun Rule. This study only showed that a negative sediment budget results in erosion trends as predicted by the Bruun Rule. It should be noted that the Bruun Rule can only predict erosion.

26 The Zhang *et al* (2004) study indicates that for the sites examined, the shoreline erosion rate is 50-120 times the rate of sea level rise. In contrast, the FOCUS (2012) report suggests that for the Coromandel beaches it is 19-37 times the rate of sea level rise. The difference arises due to the way the slope of the nearshore zone is determined. Zhang *et al* (2004) in effect estimated the slope that predicted the observed shoreline erosion from the observed sea level rise, assuming that all of the erosion was due to sea level rise. Their ratios of 50-120 are the reciprocals of the gradient of the nearshore zone, and correspond to typical gradients for the continental shelf, even though Zhang *et al* (2004) suggest that the gradient for the Bruun Rule should be determined for depths less than about 10 m.

27 The FOCUS (2012) report bases the Bruun Rule ratios on the slope out to a depth defined by the Hallermeier Limit. There are two different Hallermeier limits: an inner limit that corresponds to the seaward limit of the active surf zone; and an outer limit that corresponds to the seaward limit of the extreme surf zone during storm conditions that are exceeded for

less than 12 hours per year. Interestingly, Zhang *et al* (2004) argue that storm conditions are not a good indicator of long-term shoreline erosion for the sites they considered, which is borne out by their ratios. If the FOCUS (2012) report ratios are valid predictors of shoreline erosion for the East Coromandel beaches, then they indicate that storm processes and not sea level rise dominate coastal erosion.

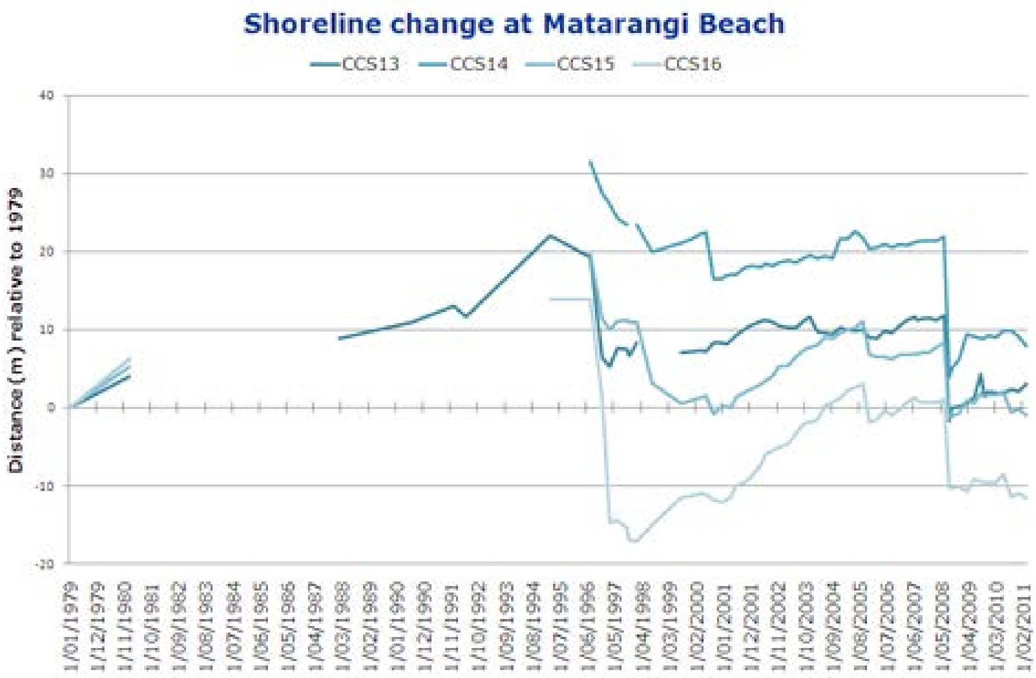


Figure 2 – Shoreline change at Matarangi Beach between 1979 and 2011

(http://www.waikatoregion.govt.nz/Environment/Environmental-information/Environmental-indicators/Natural-hazards/Coastal-hazards/co16-report/)

28 There is sufficient data to undertake an analysis similar to Zhang *et al* (2004) for the East Coromandel beaches. Wood (2010) has partially done such an analysis, although it was primarily based on beach volume and not shoreline erosion. The key findings of this study were presented by Wood et al (2009), and indicate that beach volume is influenced primarily by storm events. Dahm and Gibberd (2009) suggest that coastal erosion for these beaches is the result of the cumulative effect of several storms. However, Wood (2010) suggests that the East Coromandel beach volume changes are predominantly the consequence of isolated storm events, separated by general beach recovery. This is consistent with the findings of Healy, Dell and Willoughby (1981) based on aerial photographs between 1945 and 1978, and the summary of shoreline changes for Matarangi based on beach profiles between 1979 and 2011 posted by the Waikato Regional Council on their website (Figure 2).

29 The maximum sea level rise between 1979 and 2009 based on Auckland tide gauge records (Hannah *et al*, 2010) was 13 cm (sea level peaked in 2001 over this time interval). Therefore, the estimated shoreline erosion due to sea level rise for Matarangi Beach based on the Bruun Rule is 3.77-4.81 m. From Figure 2, it is clear that storm events have

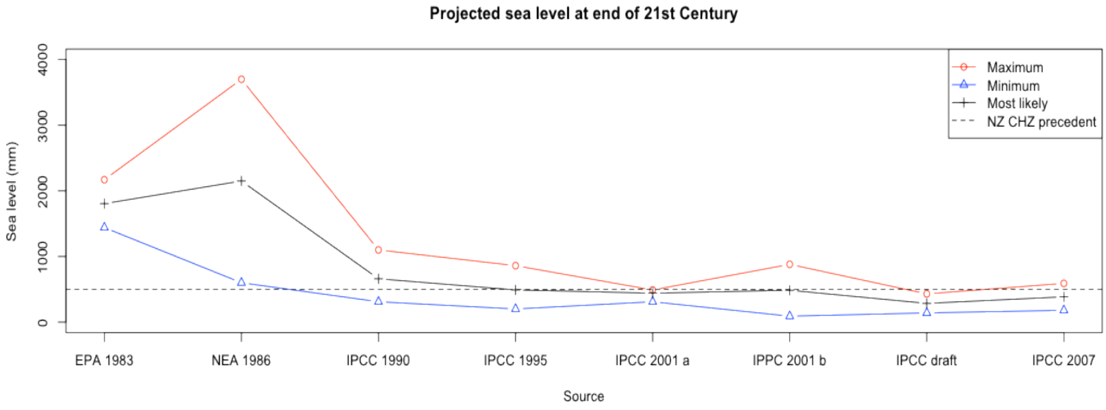
significantly larger impacts than sea level rise over the 32 years of record. Further, the sites not affected by the tidal inlet (CCS13 and CCS14) display an underlying trend of accretion and not erosion. However, the time series starts after a severe storm induced erosion event in 1978, so it is possible the observed accretion is solely due recovery following the storm if there are no additional sources of sediment. Likely additional sediment sources are discussed below.

30 In summary, the available evidence for the East Coromandel beaches indicates that shoreline erosion is predominantly driven by storm events, and, therefore, assessment of coastal erosion risk should be based on a sediment budget approach. The Bruun Rule is not an appropriate method to assess the sea level rise component of shoreline change, and as noted by the T&T, should only be applied when sediment budgets are accounted for. This was not done by the FOCUS (2012) report, and no evidence was provided to support the assertion that the Bruun Rule is suitable for the purpose of determining the FCPL for East Coromandel Beaches.

Sea level rise projections

31 The FOCUS (2012) report assumes a sea level rise of 0.9 m over the next 100 years based on the MfE (2008) guideline for planning purposes of 0.8 m by AD 2100 and an additional 0.1 m by AD 2110. For Matarangi Beach this equates to 26.47 m of erosion based on the Bruun Rule (approximately 10 times the erosion that should have occurred between 1979 and 2009). FOCUS (2012) increased the value to 30 m to allow for uncertainty and “fairness”. It was argued that the 0.9 m value does not represent an upper level or worst-case sea level. This assertion is incorrect.

32 Prior to MfE (2008) a value of 0.5 m per century was generally adopted for sea level rise (As in Dahm and Munro, 2002) following the setting of a legal precedent in a case at Ohope Spit involving the Whakatane District Council in 1984. This case involved the determination of a coastal hazard zone that I undertook. At that time 0.5 m was the accepted flood freeboard for the Whakatane District and I included it in the coastal hazard zone because the location involved was inside the estuary. It was included in addition to a predicted sea level rise of 0.25 m per century based on observed rates of sea level rise. Following the High Court decision, the 0.5 m flood freeboard was treated as a sea level rise factor, even though it was only about 25% of the EPA (1983) most likely sea level projection (Figure 3). Further, the predicted 0.25 m sea level rise was omitted, resulting in an overall reduction in assumed future water level increase from 0.75 m to 0.50 m.



Source	Sea level rise by 2100 (mm) Minimum	Maximum	Most likely
Hoffman *et al* ((1983) - US EPA	1440	2170	1805
Hoffman et al (1986) - NEA	600	3700	2150
IPCC 1990	310	1100	660
IPCC 1995	200	860	490
IPCC 2001 – most likely	310	490	440
- extremes	90	880	485
IPCC 2007 – all scenarios	180	590	385 ?
Historic global rate			174
Historic NZ rate	130	170	140

Figure 3 – Ranges of predicted and projected sea level rise by AD 2100 from EPA and IPCC sea level assessments. Also tabulated are naïve predictions based on observed 20th Century sea level rise.

33 Coincidentally the 0.50 m sea level value corresponded to the most likely projected sea level by AD 2100 of 0.49 m for the IPCC Second Assessment Report in 1995 and 0.44-0.485 m for the IPCC Third Assessment Report in 2001 (Figure 3).

34 The MfE (2008) Guidance Note changed from the most likely projected sea level used previously, to the maximum sea level projected by the IPCC AR4 report in 2007 (0.59 m) plus an additional 0.20 m to allow for ice sheet dynamic collapse, and 0.01 m of rounding. Subsequent research indicated that the 0.20 m for ice sheet dynamic collapse was not justified, but it is still incorporated in the 0.8 m of the MfE (2008) sea level rise by AD 2100.

35 Hannah *et al* (2010) suggest that the absolute sea level rise projections for the UK are an appropriate proxy for projecting sea level rise for the Auckland Region (Figure 4). These projections indicate that the MfE (2008) value of 80 cm is an extreme value lying beyond the upper 95% value for the worst-case emission scenario.

Table 3: UK **absolute** time mean sea level change (cm) over the 21st century, including ice melt, under three different scenarios, with 5th to 95th percentile confidence intervals. The changes are given for the period 1980–1999 to 2090–2099.

	5th percentile	Central estimate	95th percentile
High emissions	15.4	45.6	75.8
Medium emissions	13.1	36.9	60.7
Low emissions	11.6	29.8	48.0

Figure 4 – Projected sea level by AD 2090-2099 with 90% confidence limits from Hannah et al (2010)

36 FOCUS (2012) note that some sea level projections are higher than 0.9 m as reported by RSNZ (2010). All of the higher projections cited by RSNZ (2010) are based on semi-empirical methods that attempt to scale sea level directly from projections of global temperature. Gregory *et al* (2012) in their review of 20th Century sea level rise evaluated these projections and concluded that the methods “depend on the existence of a relationship between global climate change and the rate of GMSLR [*Global Mean Sea Level Rise*], but the implication of the authors’ closure of the budget is that such a relationship is weak or absent during the twentieth century.” In other words, there is not a strong cause and effect relationship between global temperature changes and the rate of sea level rise (or fall) at centennial time scales.

37 The IPCC AR5 assessment in 2013 also concluded that there is no consensus on the reliability of semi-empirical methods that project higher sea levels and assigns low confidence to their projections. The methodology for assessing the ranges of sea level projections was changed for the AR5 assessment, which makes it difficult to directly compare the 2013 projections (Figure 5) with the earlier values (Figure 3). Importantly, the mid-point rise is now quoted instead of the most likely or median rise. Since the distribution of values for each scenario is asymmetrically distributed (most projections cluster towards the minimum rise in the range), the mid-point rise is higher than both the mean and median. Further, the IPCC AR5 projections are based on emission scenarios and not economic activity scenarios. However, for the purposes of comparison, the most likely sea level rise is consistent with emission scenario RCP2.6, showing a further reduction in the projected sea level rise by AD 2100.

SCENARIO	Minimum rise (cm)	Maximum rise (cm)	Mid-point rise (cm)
SRES A1B	36	59	47
RCP2.6	26	55	40
RCP4.5	32	63	47
RCP6.0	33	63	48
RCP8.5	45	82	63

Figure 5 – IPCC AR5 2013 sea level projections for different emission scenarios (RCP), compared to the IPCC AR4 2007 SRES A1B scenario used to set the MfE (2008) planning sea level projections

38 RSNZ (2010) and Hannah *et al* (2010) both report that the rate of sea level rise around New Zealand has decelerated over the 20th Century and has continued to do so this Century. This is consistent with the findings of Gregory *et al* (2012) who report a global slowing in the rate of sea level rise, leading in part to the poor relationship between global temperature and sea level rise, and Chen *et al* (2014), who found that despite decadal scale fluctuations in the rate of sea level rise, the rate of sea level rise has continued to slow in the 21st Century. A reduction in the projected sea level rise by AD 2100 is consistent with the observed slowing in the rate of sea level rise.

39 The IPCC sea level projections are preferentially based on deterministic modelling of assumed processes contributing to sea level rise based on the global temperature projections produced by models based on radiative forcings derived directly from emissions scenarios (AR5) or indirectly from economic scenarios (earlier assessments). The results are referred to as projections because they strictly do not have any associated likelihood of occurrence, which is inherent to predictions. There are several issues that arise from the dependence of projecting sea level rise on the projected global temperature.

40 The review by Gregory *et al* (2012) found a poor relationship between global temperature and sea level that results in *low confidence* in semi-empirical models that directly predict sea level from global temperature. The same problem arises for deterministic models, although it is argued that there is higher confidence in process-based deterministic modelling. It is clear from the published literature that there is ongoing disagreement between different studies about the relative magnitude of different contributions to observed sea level rise (Gregory *et al*, 2012), which in part accounts for the range of sea level projections for any particular emissions scenario.

41 Meyssignac *et al* (2012) analysed sea level trends for the tropical Pacific Ocean and found no signal that could be linked to greenhouse gas forcing. Instead they attributed all the observed sea level trends to natural variability. Chambers *et al* (2012) reported a consistent 60-year cycle in sea levels, albeit with different timings in the major ocean basins, which indicates a strong internal variability driving sea level. This is consistent with the observed PDO signal in sea level data from Auckland (Bell *et al*, 2000). This pattern is not accounted for in sea level projections, particularly the semi-empirical methods that have used the 30-year rising part of the cycle as the basis of their projections. The lack of a clear greenhouse-forcing signal also raises doubts about the use of greenhouse gas projections to drive sea level rise in deterministic models.

42 There is a growing deviation between projected and observed global temperatures; with models projecting greater warming than has been observed over the last 2 decades (Fyfe *et al*, 2013; Fyfe and Gillett, 2014; Santer *et al*, 2014; Schmidt *et al*, 2014). This suggests that the projected temperatures based on the models, and hence projected sea levels derived by deterministic models, are too high. This was demonstrated by Houston (2013), who compared observed sea levels between 1993 and 2012, as measured by satellite altimetry, with the IPCC AR4 projections for the same period, and found that by 2012 observed sea level fell within the lowest 50% of the projections.

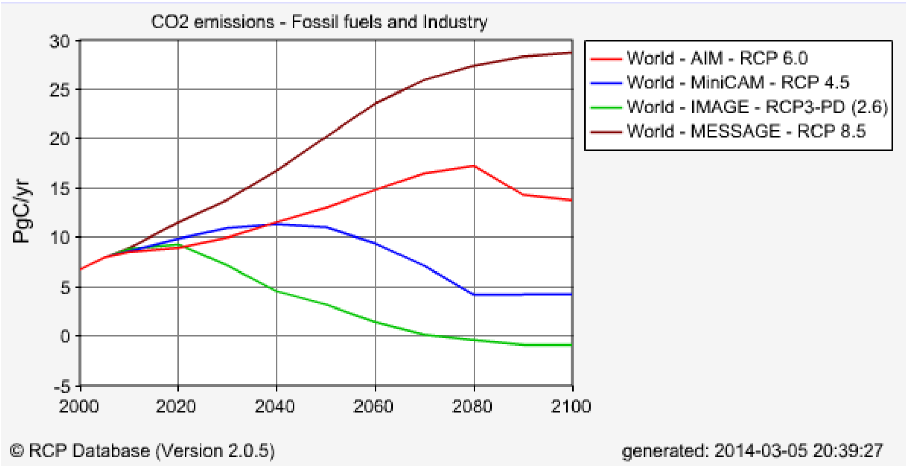


Figure 6 – Summary of CO2 assumed CO2 emissions from fossil fuels and industry for Representative Concentration Pathways (RCPs) considered in Figure 5.

(https://www.wmo.int/pages/themes/climate/emission_scenarios.php)

43 The largest rise in sea level is associated with RCP8.5, and the maximum value for this scenario is the closest to the MfE (2008) planning guideline of 0.80 m. The RCP8.5 emissions scenario is based on the assumption that fossil fuel and industrial emissions of CO_2 will steadily increase to 28 PgC.y^{-1} by AD 2100 (Figure 6). However, an analysis of potential CO_2 emissions from these sources by Tans (2009) found that emissions associated with known reserves peak at 11.1 PgC.y^{-1} by AD 2029, and inclusion of estimated unconventional resources results in emissions peaking at 16.1 PgC.y^{-1} by AD

2044. This suggests that the RCP8.5 emissions scenario significantly overestimates the available CO_2 resources, and hence exaggerates the potential radiative forcing in the future.

44 Therefore, the 0.9 m sea level rise adopted by FOCUS (2012) is an extreme value, and the higher values suggested by the peer reviewers are even more so. Note that for a risk-based assessment it is not appropriate to argue that this is reasonable because sea level may continue to rise for centuries. It would be equally valid, and unreasonable, to argue that it is likely that sea level will fall some time in the future due to the onset of the next glacial period. Such an argument is purely speculation. Suggested best practice is to consider a range of sea level scenarios, and not select a single value (Ramsay *et al*, 2012).

45 It should also be noted that sea levels around the New Zealand coastline over the last 8000 years have been higher than the projected future sea levels. Clement et al (2010) combined an earlier reconstruction of Holocene sea levels by Gibb (1986) with additional data, primarily from northern New Zealand, to produce a revised sea level curve (Figure 7).

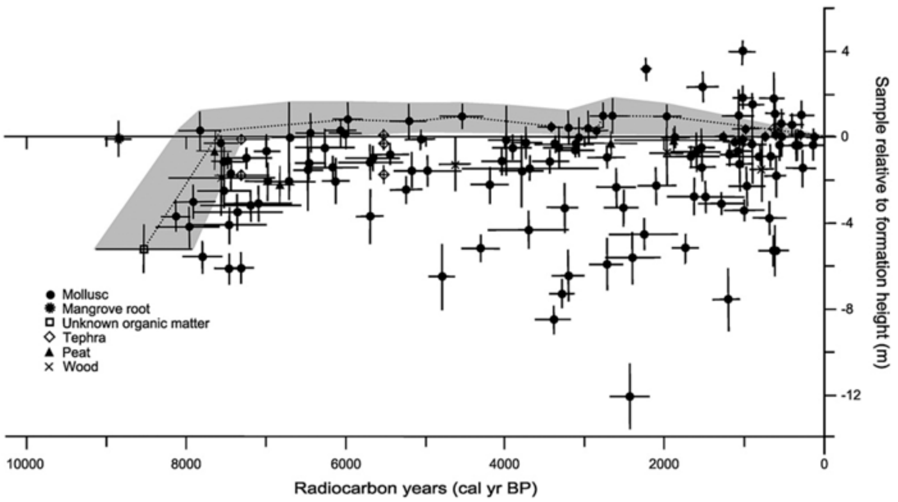


Figure 7 - Revised New Zealand Holocene sea level curve (Clement et al., 2010).

46 The revised curve (Figure 7) indicates that sea level may have reached approximately the present position up to 1000 years earlier than Gibb (1986), but most of this difference is due to a revision of the ^{14}C dates since 1986. Clement et al (2010) also indicate that the eustatic sea level was likely 0.3 m higher than indicated in Figure 7 around 7500 BP. This would make the New Zealand curve consistent with the Zone V (most of Southern Hemisphere) eustatic sea level curve of Clark and Lingle (1979), the recent assessment of the Australasian eustatic sea level curve (Lewis et al, 2013), and the thermosteric sea level behaviour implied by recent reconstructions of Holocene Australasian ocean heat content (Rosenthal et al., 2013).

47 Dougherty and Dickson (2012) re-examined a key site used for sea level reconstructions at Miranda in the Firth of Thames. They found that sea level was approximately 2 m higher than the present 4000 years ago, which is higher than the reconstruction in Figure 7. Sea level then fell to approximately the present level about 1000 years ago, which is in agreement with Figure 7. They also found that the development of the coastal plain at Miranda was largely controlled by variations in storm activity, although falling sea levels influenced the development of shell ridges (*cheniers*), probably due to the reduction of sediment supply.

Projected climate change

48 NZCPS 2010 requires that the identification of high-risk coastal areas consider the impacts of climate change on coastal processes and sediment dynamics. Dr Hilton correctly pointed out in his review that the FOCUS (2012) report ignores a range of processes that affect coastal erosion, and ignores the impact of future climate change. As pointed out by T&T in their review, and in the discussion above, shoreline response in terms of erosion and accretion is dependent on the sediment budget, with long-term erosion being associated with a negative budget.

49 Zhang and Leatherman (2004) point out that sea level rise by itself does not cause erosion, because there is insufficient energy associated with sea level rise to drive the transport of sediment. Therefore, while a higher sea level may facilitate erosion, other processes are necessary for erosion to occur. If climate changes, then these processes may be affected.

50 In his peer review, Dr Hilton summarised projected climate changes for the north east coast of New Zealand from the OPMSAC (2013) report as:

i) Average precipitation will be up to 5% lower by AD 2040;

ii) Easterly winds will be more frequent;

iii) Temperatures will be hotter, with at least 40 extra “hot” days >25°C by AD 2100;

iv) An increase in extreme rainfall events; and

v) An increase in droughts.

51 Unfortunately, the OPMSAC (2013) report does not explain the methodology used to derive these projected changes except that it is based on numerical models and selected scenarios. If they are derived from the global climate models that also drive global sea level projections, then the same issues discussed above arise.

52 In terms of the coastal erosion hazard for the East Coromandel beaches, the projected increase in easterly winds and extreme rainfall events are likely to influence coastal processes driving erosion. For this coast, onshore winds (easterly) tend to transport

sediment offshore over the inner continental shelf, whereas offshore winds (westerly) tend to transport sediment onshore (de Lange, 2001). Therefore, an increase in easterly winds associated with a decrease in westerly winds will tend to facilitate coastal erosion. An increase in easterly winds may also increase the mean wave height, which will result in a change in surfzone dimensions. Since the FOCUS (2012) use the seaward limit of the surf zone as the closure depth, changes in surfzone width due to increasing easterly winds should affect their results.

53 Intense rainfall events in the catchments leading to the East Coromandel Coast are typically associated with flooding. The floodwaters transport sediment to the estuaries and continental shelf. As will be discussed below, there is evidence that sediment is added to East Coromandel beaches as a consequence of flooding. Therefore, an increase in intense rainfall events may increase the rate of sediment supply to the beaches, and offset losses due to other factors.

54 Overall, the projected climate changes that are relevant to coastal erosion hazard are smaller in magnitude than observed interannual and decadal variations. Key drivers at these timescales include the El Niño-Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO) (de Lange, 2001). The PDO is also referred to as the Interdecadal Pacific Oscillation (IPO) in Australia and New Zealand (Power *et al*, 1999), but it affects the whole Pacific Ocean and was first defined as the PDO in the Gulf of Alaska (Mantua *et al*, 1997).

55 Wood *et al* (2009) demonstrate that changes in beach volume for East Coromandel beaches are in phase with the climate variations associated with the PDO. These changes are manifest as beach rotation in response to changes in dominant wave approach direction, and severity of storm impacts. All East Coromandel beaches were found to respond in phase with the PDO, but the magnitude of the responses varied with beach morphology and the length of the beach. Matarangi and Pauanui Beaches showed the strongest response.

56 The projected climate changes over the next 25 years outlined above are consistent with the cool phase of the PDO, and as noted by OPMCSA (2013) the projected climate changes for this period will be difficult to distinguish from natural climate variability. Beyond that, the projected climate variations are inconsistent with the PDO variations. Natural climate oscillations, such as the PDO, are not simulated by the global climate models (Goddard, 2014), and there is growing evidence that deviation between projected climate change and observed change is due to neglecting these oscillations (Kosaka and Xie, 2013). Dowdy *et al* (2014) report that downscaling of 18 global climate models predicts a reduction in the frequency and intensity of major extratropical storms for the east coast of Australia due to global warming, resulting in a reduction in severe wave events. The same

type of storms are associated with coastal erosion for the east coast of the North Island (Hay et al, 1991; Dunn, 2010), and these results that there may also be a reduction in storm activity driving coastal erosion for the East Coromandel beaches.

57 The climate projections summarised by OPMCSA (2013) suggest that as a consequence of global warming the influence of the PDO will reduce, which would also imply a reduction in the frequency of severe coastal erosion for the East Coromandel beaches (*viz* de Lange, 2001). There is no long-term record of the PDO for New Zealand, but proxy records of storm activity provide an indication of PDO behaviour. These records are also a useful indication of storm activity changes for the Coromandel Peninsula.

58 Lake Tutira, Hawkes Bay, provides a record of North Island storm activity for the last 7200 years (Page *et al*, 2010), which was found to be a useful proxy for the discharge of sediment from the Waipaoa River catchment into Poverty Bay (Upton *et al*, 2013). The sediment discharge from the Waipaoa River was simulated over the last 5,500 years, and found to correlate well with continental shelf sedimentation determined by coring, and indicated that centennial to millennial scale precipitation fluctuations were the primary driver of changes in sedimentation rates. As noted by OPMSCA (2013) extreme precipitation is one of only 2 climate indicators that show a weak relationship with observed global warming for some areas of Earth.

59 Figure 8 shows the Lake Tutira storm activity measured as years between storm event deposits within the lake, climate proxy data derived from carbon (precipitation) and oxygen (temperature) isotopic ratios in speleothems from Waitomo, the dune phases preserved at Te Horo on the Kapiti Coast, and the ages of palaeotsunami deposits found on Kapiti Island by Goff *et al* (2000). Page *et al* (2010) identified 25 periods of increased frequency of major storms over the last 7,200 years, of which 9 were of at least 100 years duration (shaded bands in Figure 8). Dougherty (2013) reported 25 palaeo-beachfaces representing major erosive events preserved within Omaha Spit (which includes the 1978 event). Omaha Spit is similar to Omaro Spit (Matarangi Beach), although it is located further north, and is more sheltered from open ocean storm waves.

60 Page *et al* (2010) found no relationship between storm activity and ENSO (3-7 year) climatic variations, and speculated that storm behaviour may be influenced by the interaction of ENSO, PDO (50-60 year fluctuations) and the Southern Annular Mode (SAM). They also noted that, as is evident in Figure 8, Holocene climate for New Zealand has involved multiple periods of rapid change, particularly in terms of storm activity.

61 Gomez et al (2011) examined the Lake Tutira data in conjunction with climate proxy data from Ecuador, the Western Pacific Warm Pool, and Central Antarctica, in order to assess

the combined role of ENSO and SAM climatic variations. They argue that La Niña (positive) conditions and a positive SAM both enhance rainfall and the incidence of extratropical storms and strong easterly to northeasterly winds for the eastern North Island. Hence, the storm activity record from Lake Tutira represents the relative phase of ENSO and SAM, with maximum storm activity occurring when both are positive. Although the data showed some support for this interpretation, it was also evident that the strength of the coupling between ENSO and SAM varied throughout the last 7,200 years. The variation in coupling was linked to the seasonal contrast in solar insolation, and therefore the precession component of Milankovitch Cycles, resulting in amplified responses around 5000 and 2000 BP.

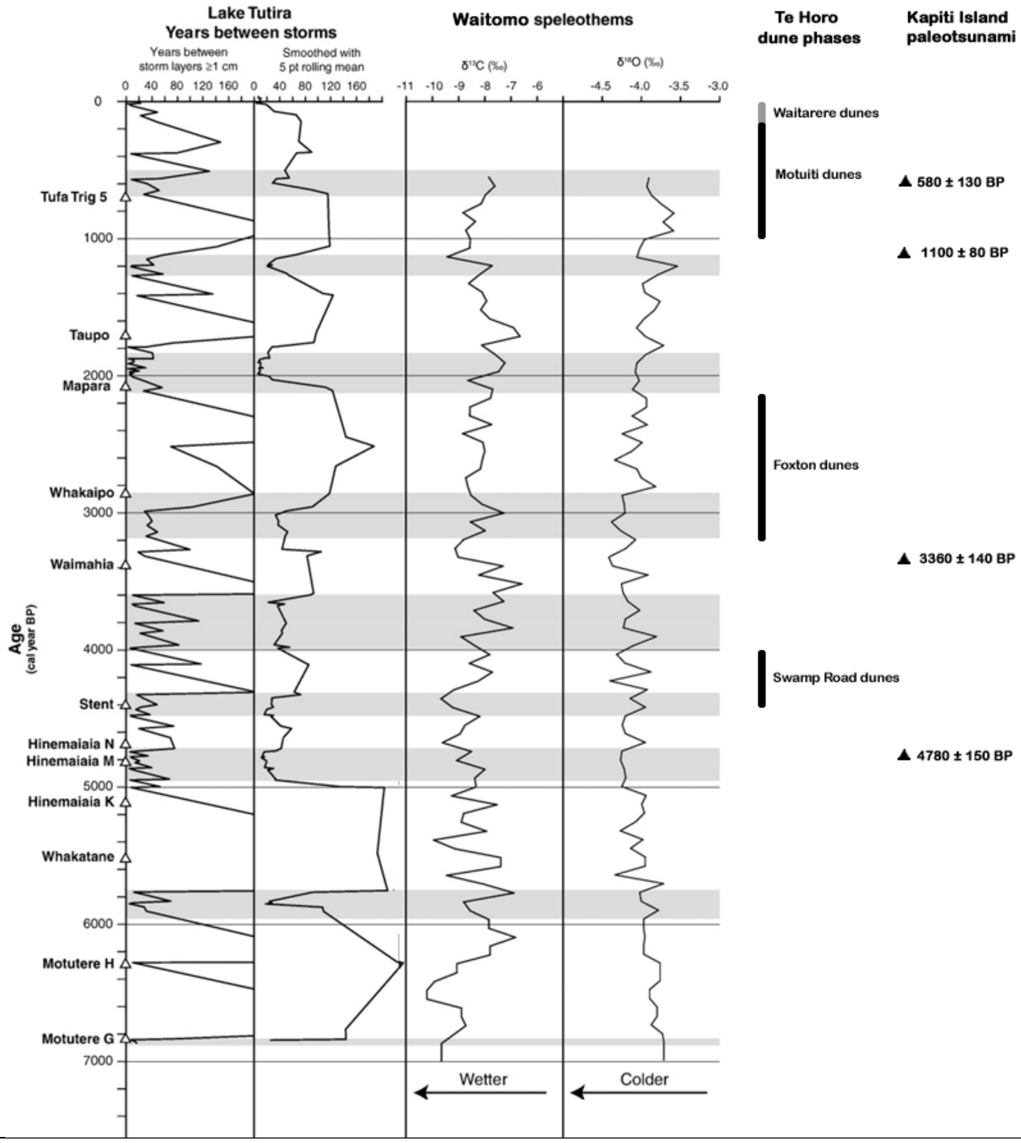


Figure 8 - Comparison between storm intensity at Lake Tutira (indicated by years between storms), precipitation and temperature proxy data from Waitomo, the dune phases at Te Horo, and palaeotsunami deposits on Kapiti Island. Open triangles on the vertical axis summarise key tephra markers (After Page et al., 2010; Hawke and McConchie, 2006; and Goff et al, 2000).

62 Therefore, although there is good evidence that there are fluctuations in storm intensity over centennial to millennial time scales, there does not appear to be a simple relationship

between global climate and the frequency and magnitude of storm events for the North Island. In particular, the projected pattern of climate change based on global warming summarised by OPMSCA (2013) is inconsistent with past warming events as observed at Lake Tutira.

63 In relation to Matarangi Beach, climate oscillations clearly affect beach volume and therefore should be considered within an analysis of coastal erosion hazard, but this was not done for either the CCEL or FCPL. Further, projected climate changes based on climate models do not appear to be consistent or reliable for the purposes of the FCPL, and certainly do not have any meaningful probability of occurrence.

Response of Matarangi Beach to climate change and sea level rise

64 As discussed above, there is clear evidence that potential drivers of shoreline erosion for the East Coromandel beaches have varied over the last 8000 years. Further, the projected changes for the next 100 years are within the range of the past changes. Therefore, the behaviour of Omaro Spit (and hence Matarangi Beach) over this time period should provide a reasonable guideline to the potential response to future changes in sea level and climate.

65 Marks and Nelson (1979) report on an investigation into the sedimentology and evolution of Omaro Spit. They concluded that the spit initially formed by rollover of a pre-existing barrier as sea level rose during the Holocene Transgression, and that a spit had formed by 4000 years ago when sea levels were at least 2 m higher than present. Woods (2012) reports a similar mechanism of initial spit formation for the Whitianga Barrier south of Omaro Spit. The Omaro Spit progressively prograded seaward as sea level generally fell towards the present level.

66 Marks and Nelson suggest that the observed decrease in dune ridge elevation towards the sea (Fugure 8) reflects the fall in sea level. However, most of the height decrease occurs between the two landward-most dune ridges. Therefore, the increased height of the initial dune may reflect the higher availability of sediment associated with the rollover of an existing barrier during sea level rise forming the initial spit. The composition of the dune sediments suggests that the Omaro Spit is largely derived from local sediment sources; so progradation seawards would be dependant on the erosion of the catchment areas.

67 Woods (2012) examined the development of the estuarine deposits of the Whitianga Harbour. She found that most of the infilling of the estuary behind the barrier spit occurred shortly after the formation of the spit. If the same occurred for the Whangapoua Harbour, then there would be a hiatus in spit progradation, with the subsequent progradation limited by the rate of sediment supply.

68 The soil development within the dunes indicates a relatively steady rate of progradation. However, based on the data from Omaha Spit (Dougherty, 2013) it is likely that the progradation was punctuated by major storm events that would reset soil development. If the interpretation for Omaha Spit is correct, then ^{14}C dates of material within the spit would given misleading indications of the extent of the spit.

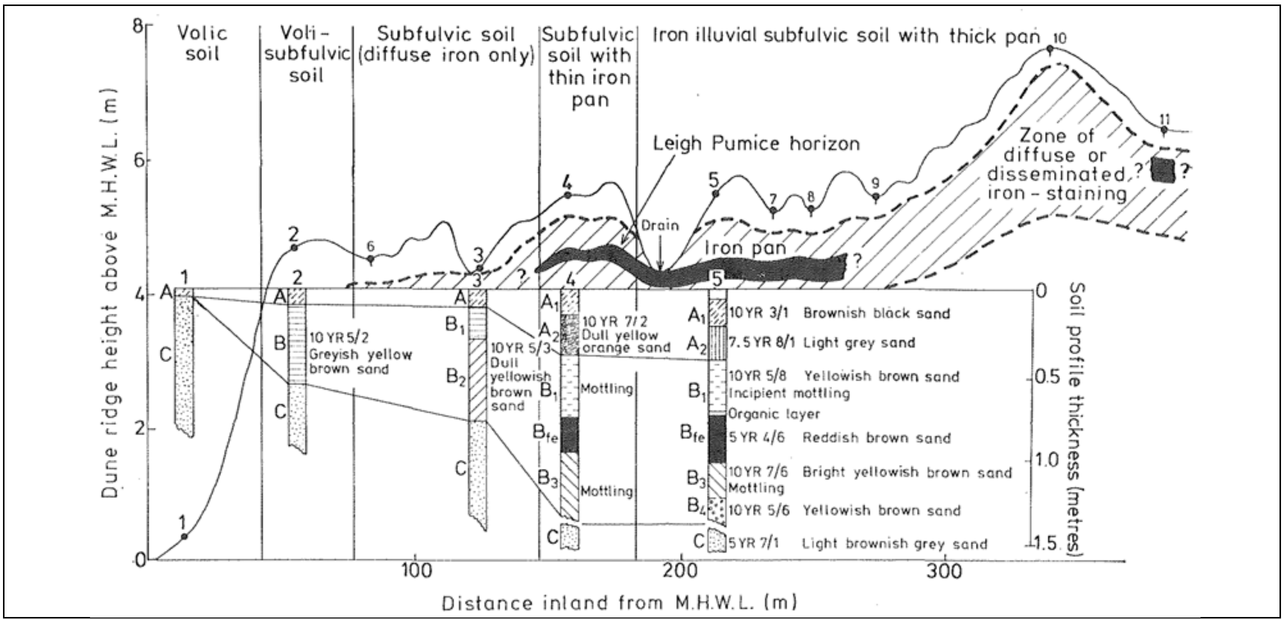


Figure 9 – North-south cross-section through Omaro spit showing the reduction in dune ridge height seawards, and the associated decrease in depth and extent of soil formation (Figure 23, Marks and Nelson, 1979).

69 Marks and Nelson (1979) also identified a problem with the use of soil development for determining the evolution of Omaro Spit. A horizon of sub-angular grey pumice was identified 170 m inland from the mean high tide mark, which was identified as the Leigh Pumice deposited about 2000 years ago. The pumice is associated with soils that were estimated to be 3000-4000 years old, leading Marks and Nelson to suggest (1979) that there had been a period of erosion. However, Pullar *et al* (1977) indicated that it was not possible to reliably date the Leigh Pumice, and Froggatt and Lowe (1990) recommend that the Leigh Pumice not be used as a stratigraphic marker.

70 However, the work of de Lange and Moon (2007) demonstrates that sub-angular pumices are most likely primary overwash deposits of sea-rafted pumice deposited by an extreme event such as a tsunami, rather than a secondary beach deposit as assumed by Marks and Nelson (1979). The composition of the pumice reported by Marks and Nelson (1979) is consistent with pumice erupted by the Denham Caldera, Raoul Island around 2200 years ago (Worthington *et al*, 1999). An eruption from the Mt Healy caldera is associated with the deposition of primary Loisels Pumice around the North Island around 600 years ago. Bell *et al* (2004) report the presence of a tsunami deposit associated with the Loisels Pumice, and an older deposit around 2500 years old at Otama Waihi Beach and Waihi Beach.

Therefore, the deposit along Omaro Spit may represent the landward extent of tsunami inundation associated with this eruption.

71 Although it would be useful to obtain better data for Omaro Spit using new technology such as ground-penetrating radar, the available data suggest that Omaro Spit prograded relatively steadily over the last 6000 years, but progradation was punctuated by occasional erosion associated with major storm events and possibly tsunami.

Figure 10 – Comparison of the shoreline at the eastern end of Omaro Spit (Matarangi Beach) between 1973 (Photo: Graeme Marks) and 2014 (Photo: Graeme Osborne). The white arrow marks the corresponding house between photos. The beach state in 2014 corresponds to a ridge-runnel intermediate beach condition, indicating active onshore movement of sediment.

72 Historic evidence indicates that Omaro Spit has continued to accrete up to the present, although with occasional erosion associated with major storms. Figure 10 compares a photo of the eastern end of Omaro Spit taken by Graeme Marks for his MSc research in 1973, with a recent photo taken by local property owner Graeme Osborne in 2014. A steep

dune scarp was present in 1973 due to a recent storm. This dune scarp is still evident in 2014, along with a prograded area of new foredune seaward of the scarp. The area shown in the photos include the coastal erosion survey site CCS13 in Figure 2, which indicates that between the two photos there has been at least 2 major erosion events due to storms.

73 Further, the sea level data from Hannah et al (2010) indicate a maximum sea level rise of 13.3 cm during this period. However, the sea level rise was not constant: consisting of periods of sea level rise and periods of sea level fall, with the largest sea level rises tending to occur during transitions from the warm to cool phase of the PDO (Bell *et al*. 2000), the sea level data indicate that the 3 major erosion events identified between 1945 and 2009 all occurred during periods of 3-5 years of stable to falling sea level (Figure 11). Further. The periods of rising sea level were associated with shoreline accretion. This contradicts the assumption that rising sea level necessarily results in shoreline erosion.

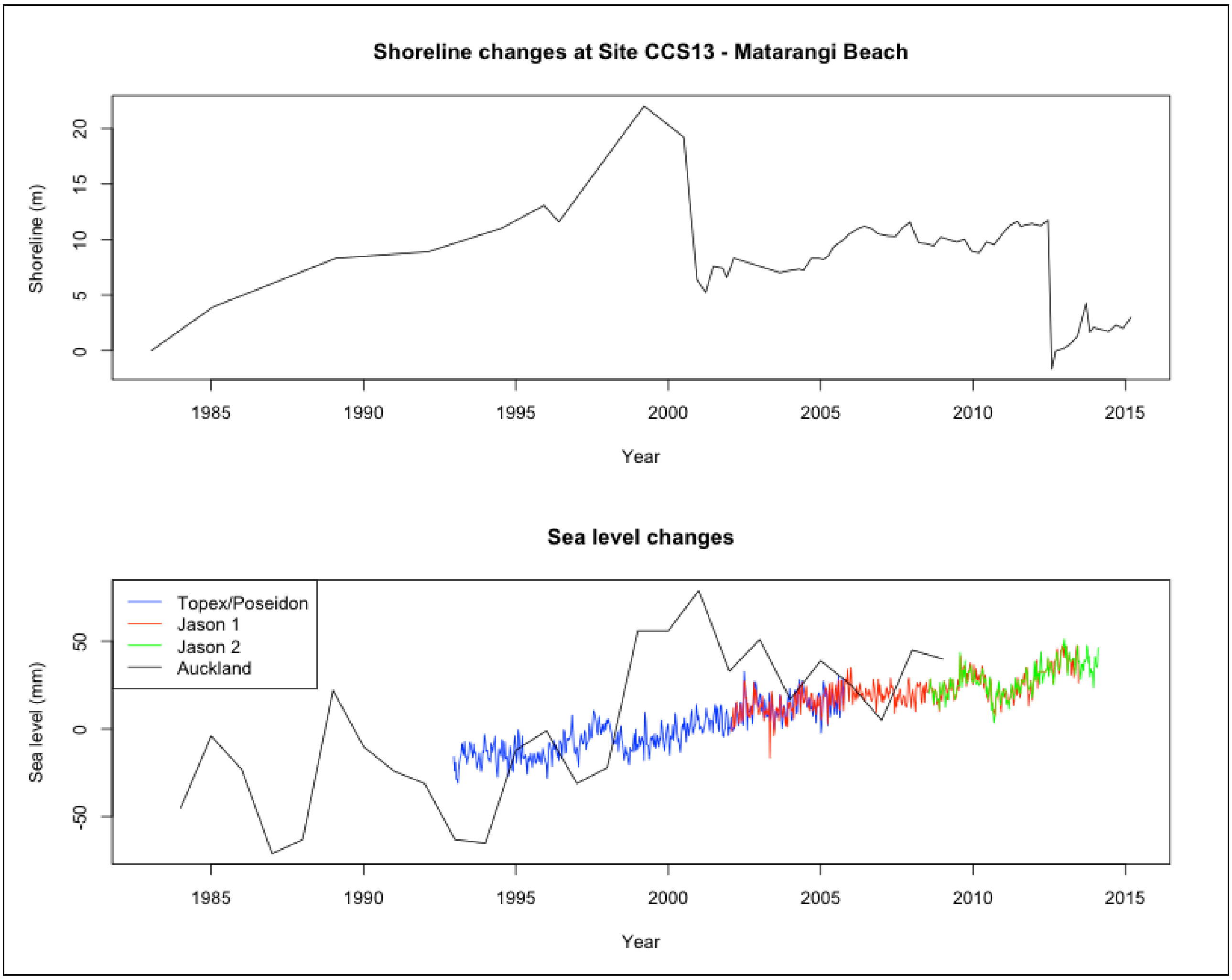


Figure 11 – Shoreline changes measured at site CCS13 on Matarangi Beach (Data from Waikato Regional Council), and observed sea level changes from the Auckland Tide Gauge (Hannah et al, 2010) and satellite altimetry of the Pacific Ocean (NOAA Laboratory for Satellite Altimetry).

74 de Lange (2001) suggested that the cool phase of the PDO was associated with an increased risk of coastal erosion for the northeast coast of New Zealand, due to a higher

incidence of storm events and associated storm surges (de Lange and Gibb, 2000). The available data for Matarangi indicates that the main episodes of severe erosion have occurred during the cool phase of the PDO between 1948 and 1978, and the current cool phase that appears to have begun around 1998-2001.

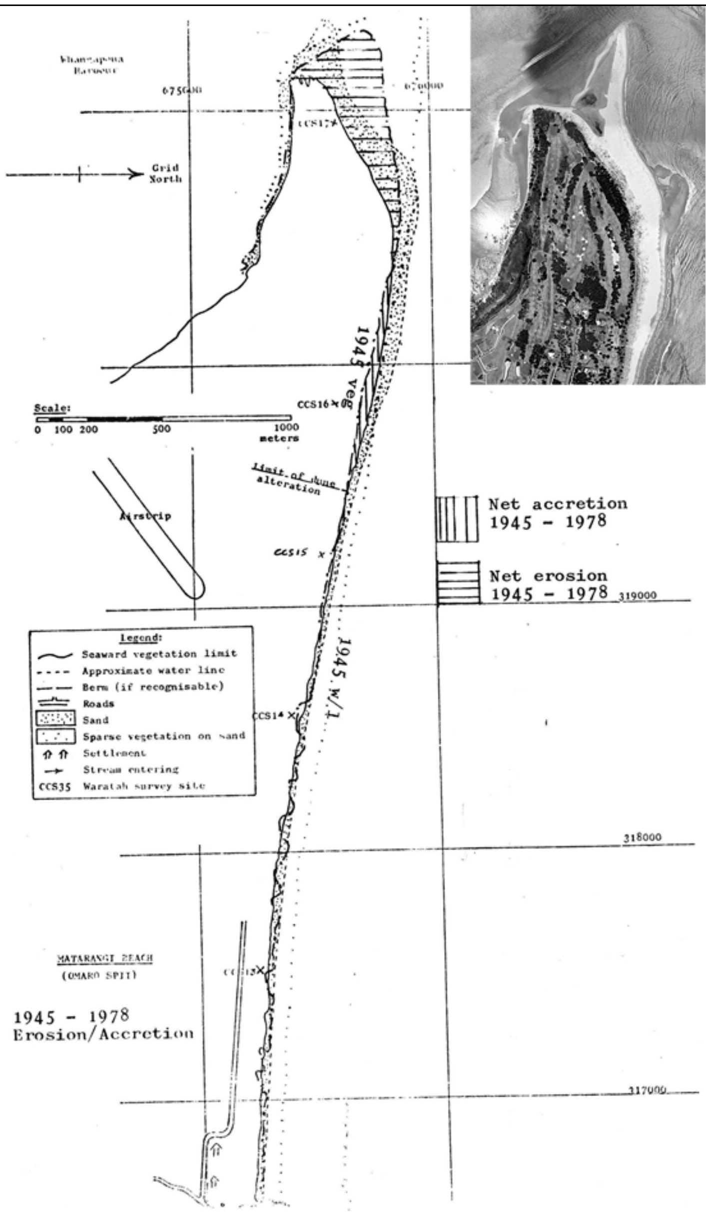


Figure 12 – Shoreline change for Omaro Spit (Matarangi Beach) between 1945 and 1978 (Figure 36, Healy et al, 1981). Inset is the 2014 image of the spit tip from Google Earth for comparison to the 1945 and 1978 shorelines.

75 The shoreline changes reported by Healy *et al* (1981) indicate that the erosion was more severe between 1948 and 1978 (Figure 12), than observed so far this century. However, the data are based on estimated dune toe locations derived from aerial photographs and not beach profile data as summarised in Figures 2 and 11. This makes quantitative comparisons unreliable. Most of the observed erosion occurred at the tip of the Omaro Spit, and may have been a consequence of the Chilean Tsunami in 1960 and the Alaskan Tsunami in 1964, which caused similar erosion of spits around the Bay of Plenty (de Lange

and Healy, 1986). The inset in Figure 12 shows the Omaro Spit tip at the start of 2014, and indicates that the tip is accreting back to the 1945 configuration, but vegetation has not established much beyond the 1978 shoreline.

76 Harris (1977 in Healy et al, 1981) in a report to the Hauraki Catchment Board expressed concerns about the rate of shoreline erosion at Matarangi Beach and recommended that the setback distances be increased for future development, and that the spit tip be left undeveloped. This is now reflected in the greater setback for Cordyline Crescent, Corokoia Place, Puka Crescent, and Totara Place, compared to Kenwood Drive and Pacific Parade. The Town and Country Planning Appeal Board imposed the 100 m setback to accommodate the expected coastal erosion over the next 100 years (an average rate of 1 $m.y^{-1}$). Further, the Appeal Board required that dwellings 100-200 m back from the shoreline should be capable of being relocated if erosion exceeded the predicted values (Healy and Dean, 2000).

77 The findings of Wood *et al* (2009) indicate that the East Coromandel beaches may be better distinguished by their predominant beach state: whether they are mostly dissipative (wide and flat beach), intermediate, or reflective (narrow and steep beach). The beach state determines the nearshore gradient, and also appears to influence the response of the beaches to storm events. The results of Wood (2010) also indicate that the different beach states may also influence, or be a consequence of, the extent to which the beach is affected by beach rotation: the exchange of sediment between opposite ends of an embayed beach in response to variations in mean wave approach direction.

78 Therefore, the East Coromandel beaches clearly have different coastal erosion risks depending their location and beach state, as suggested by Wood *et al* (2009). Hence, the constant values used to derived the CCEL and FCPL (Figure 1) are unlikely to provide a useful measure of the relative risk and will not identify areas of high risk.

79 Figure 13 represents a portion of the coastal hazard zone map for Matarangi Beach that accompanied Dahm and Munro (2002) as provided by the Waikato Regional Council website. Based on the FOCUS (2012) report, the proposed FCPL lies 30 m further inland from the FCPL indicated by the dotted white line. There are a couple of obvious inconsistencies displayed by the CCEL and FCPL lines in terms of the risk of coastal erosion. First the eastern end of Matarangi Beach is identified as having the greatest landward extent of coastal erosion, despite this area being the least affected by shoreline erosion since 1945 (Figures 2 and 11). Based on the cadastral information and vegetation evident in Figure 13, there appears to be no justification for the southwards dip in the lines approaching Bluff Road.

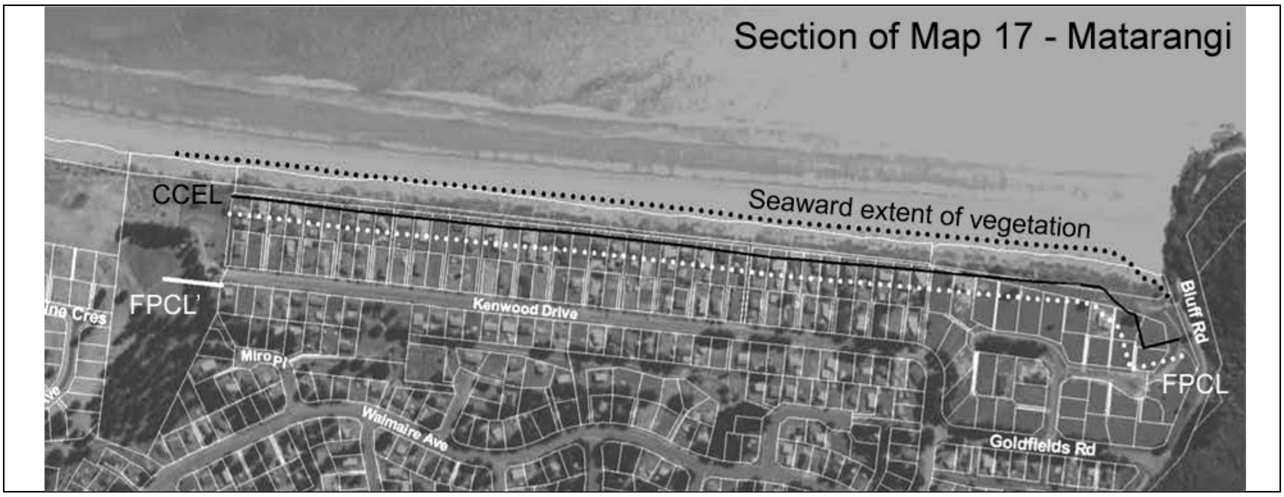


Figure 13 – Section of the setback map for Matarangi Beach produced by the method of Dahm and Munro (2002). Note that this is the only part of Omaro Spit that was identified as having an erosion hazard on the Matarangi map.

80 At the western end of the area marked with setback zones a solid line indicates the "no development" FCPL. This area is in fact developed with parking facilities evident at the end of Kenwood Drive, and I assume has been set aside as a reserve. There is no scientific basis to suggest this area will experience more coastal erosion than the adjacent properties on the seaward side of Kenwood Drive. Figure 11 also indicates that other parts of Omaro Spit are subject to erosion hazards, but these have been ignored.

81 As mentioned above, the determination of CCEL and FPCL by Dahm and Munro (2002) and FOCUS (2012) ignores historic trends, and assumes that the shoreline is in dynamic equilibrium, essentially due to a zero sediment budget. The main evidence presented to support this by Dahm and Munro (2002) is a series of ^{14}C dates based on cores at 8 East Coromandel beaches (Figure 14). The transition from dune sand to active beach face was identified within the core and dated. Dahm and Munro (2002) do not provide information on the magnitude of dating errors due to both the dating technique, and the time lag between the stranding of the active beach face and burial by advancing dune sands. Further, it is not possible from the core data to determine where on the former active beach face the core sample is located.

82 More importantly, as demonstrated by Dougherty (2013), major storm events reset the clock for the marker layer used by Dahm and Munro (2002). Figure 9 demonstrates the reduction in dune higher at the coast and weaker soil development, reflecting more recent erosion and profile disturbance than the higher inland dunes. The "clear" slowing down reported by Dahm and Munro (2002) and shown in Figure 14, is due to the use of a single point derived by a different measurement to define the present shoreline. More sophisticated techniques, such as ground penetrating radar, that provide a more complete image of the structure within the sand deposit indicate a more consistent rate of continued

accretion over the last 4-6000 years (Dougherty and Dickson, 2012; Woods, 2012; Dougherty, 2013).

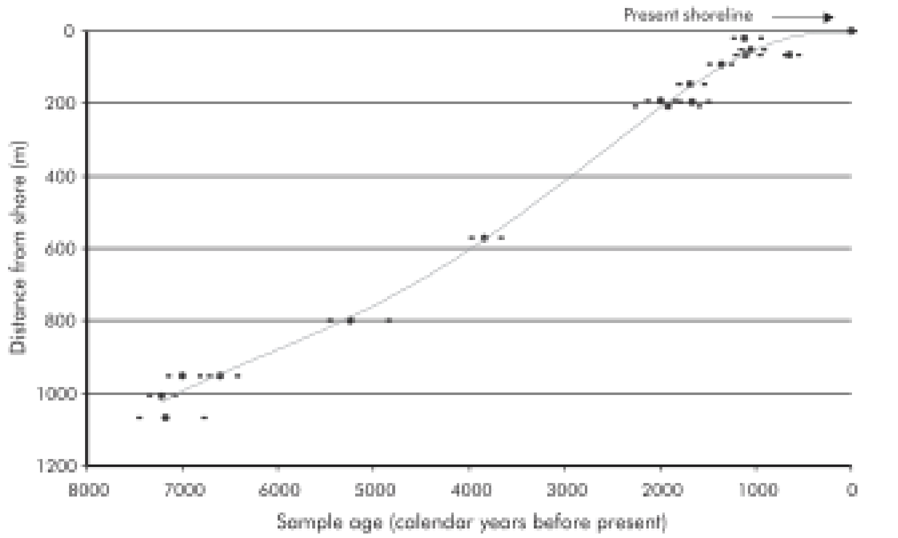


Figure 13: *Results from dating of dune core material at Whangamata Beach. This graph shows that the rate of dune movement towards the sea at Whangamata was rapid from 7000 years ago until about 1000 years ago when it slowed considerably. Rates of seaward movement appear to have averaged only about 4 cm per year over the last 1000 years.*

Figure 14 – Figure 13 from Dahm and Munro (2002), which was used to infer dynamic equilibrium.

83 As discussed earlier, beach profile data for Matarangi Beach indicate accretion between occasional storm events (Figures 2 and 11). Some of the sediment involved represents the slow recovery of beach volume following the storm (*viz*. Hilton and Hesp, 1996). The important question is whether additional sediment is available and being added to the beach volume.

84 It is evident from studies that examined coastal sediment budgets for the northeast coast of New Zealand that sediment is still moving onshore from the inner continental shelf (Healy and de Lange, 2014). For example, Bear *et al* (2009) report an average onshore flux of 2.6 $m^3m^{-1}y^{-1}$ for the western end of Waihi Beach. In this area, the dunes were removed following sand mining during World War II, so the sand involved does not appear to represent a long term recovery of sand transported offshore by recent storm events. Bradshaw *et al* (1994) demonstrated that a significant quantity of sand is present offshore from East Coromandel beaches, within both the nearshore Holocene sand wedge, and the surficial Pleistocene deposits of the inner continental shelf. Therefore, it is probable that sediment is still being added to beaches from the inner shelf.

85 Woods (2012) examined the development of the Whitianga barrier system. They noted that the Whitianga Estuary was a mature estuary with a large proportion of intertidal flats within the estuary. As a consequence, particularly during flood events, a significant proportion of

the sediment discharged from catchments around the estuary bypasses the estuary and is transported to the open coast (Woods, 2012).

86 The Whangapoua Harbour enclosed by Omaro Spit is similarly a mature estuary. Marden et al (2006) reported that storm-initiated landslide events are the most important hillslope process responsible for the generation of sediment and its delivery to streams for catchments around Whangapoua Harbour. They found one sub-basin of the Waitekuri Stream contributed 228 t of sediment to the stream channel over 1 year of monitoring, 72% of which was attributed to storm-initiated landsliding and the rest to forestry activities.

87 Gibbs (2006) examined sediments within Whangapoua Harbour in order to identify the sediment sources, assuming that the ^{13}C ratios in the sediment associated with variations in vegetation reflected the proportion of sediment from different sources. This study demonstrated that the streams around Whangapoua Harbour do discharge sediment into the estuary, and a proportion of the sediment eventually bypasses the estuary and is discharged to the open coast. McKnight (1969) linked the observed mortality of benthic shellfish at a depth of 22 m off Kennedy Bay to heavy rainfall in the Whangapoua Harbour catchments, and others further north, at the end of January 1962.

88 Although the Gibbs (2006) study focussed on mud-sized sediment, which contains the organic markers used to track the sediment, it is reasonable to expect that during major flood events sand sized sediment will also be discharged to the open coast during ebb tides. This would also provide a source of sediment for ongoing accretion, and one that is proportional to the frequency and magnitude of storm events.

89 Therefore, in my opinion, the assumption of dynamic equilibrium associated with negligible accretion is unjustified, and hence the long-term trend should be considered in any hazard determination. In particular, it is necessary to consider the overall sediment budget for Matarangi Beach, and the potential impacts of changing climate on the processes driving sediment transport, and the sources and sinks of sediment.

Risk of coastal erosion

90 As highlighted above, the NZCPS 2010 requires the identification of the risk of coastal hazards, particularly any high-risk areas. Further, risk is defined to be a combination of both the magnitude of the hazard in terms of the potential impact, and the frequency of occurrence or the probability that a hazardous event of a given magnitude will occur within the specified time period.

91 The FOCUS (2012) report does not consider the probabilities of occurrence, following on from the method of Dahm and Munro (2002), which also ignores probability. Given that the

FOCUS (2012) report is stated to be an update of Dahm and Munro (2002), it should have considered the requirements of the NZCPS 2010 beyond including a higher projected sea level than assumed earlier.

92 The methodology used, which classifies beaches into two types and applies uniform CCEL and FPCL setback distances to all beaches, does not discriminate between different levels of risk. More importantly, it does not identify areas of high risk. Figures 2 and 12 demonstrate that at Omaro Spit and Matarangi Beach the risk is not uniform. Figure 13 implies that the risk is greater for the location with minimal infrastructure (FCPL') between Kenwood Drive and Cordyline Crescent, than for the more intensely developed area seaward of Kenwood Drive. Since the impact of coastal erosion for the area of minimal development is clearly less, a higher risk would require a greater frequency of occurrence, which is nonsensical.

93 The FOCUS (2012) report adopts what is claimed to be a precautionary approach. This does not meet the requirement to identify the risk, as discussed by retired Justice Joan Alin in Appendix 2. As discussed above, the chosen projected sea level curve for the 21st Century is currently higher than observed sea level rise for Auckland (which is considered a good proxy for the East Coromandel beaches (Hannah and Bell, 2012). This sea level curve assumes an accelerating rate of sea level rise, while observations confirm the rate of sea level rise has been decelerating. Finally, as noted by Hannah *et al* (2010) and shown in Figure 4, the chosen sea level exceeds the 95th percentile of the most extreme high emission scenario projections.

94 Therefore, in my opinion the probability of reaching the projected sea level rise is likely to be very low, if not negligible.

95 The use of the Bruun Rule to estimate of the shoreline response, apart from being an inappropriate methodology, is very likely to have over-estimated shoreline erosion. Firstly, the method has ignored the ongoing accretion evident in the beach profile measurements. Secondly, comparison of predicted trends of erosion during historical sea level rise with the observed shoreline response demonstrates the method incorrectly predicts historic behaviour.

96 The Dahm and Munro (2002) method of selecting the maximum calculated values for the components in their Table 1 in Figure 1 and applying for all sites also is likely to over-estimate the shoreline response. This is due to the observed variation in shoreline response for East Coromandel beaches reported by Wood *et al* (2009), and the spatial variation within beach systems evident from survey data such as presented by Healy *et al* (1981). The FOCUS (2012) report suggests that it would be "unfair" to have a range of

values. However, the NZCPS 2010 requires the identification of high-risk areas, and this approach classifies all areas of a particular beach type as having the maximum effective risk. In my opinion, the approach used by Dahm and Munro (2002) and FOCUS (2012) reports exaggerate the hazard and do not provide useful information on the levels of risk along the coast.

Concluding remarks

97 The approach used by Dahm and Munro (2002), and subsequently by the FOCUS (2012) report for the FCPL does not meet the requirements of suggested best practice as set out by Ramsay *et al* (2012). In particular, Ramsay *et al* (2012) state the following on page 69, which particularly relevant to the FCPL:

> "In selecting, using and applying an approach to incorporate sea-level rise considerations for shoreline change, the following must be clearly considered and communicated:
>
> A range of sea-level scenarios need to be assessed and the sensitivity of the model predictions ascertained.
>
> The methodologies selected need to be informed by a conceptual understanding of how the beach system may change with sea-level rise and climate change.
>
> Where appropriate a range of methodologies should be investigated and applied the variability in response considered.
>
> What assumptions are being made, limitations, range of validity and uncertainties there are for the methodologies used and associated impacts on the intended use of the approaches."

98 As a consequence, the CCEL and FCPL setbacks defined for the East Coromandel beaches merely indicate areas of urban development that have an unknown probability of experiencing coastal erosion over the next century. This is a rather trivial outcome, and should not be the basis of planning measures to address natural hazards. In particular, the lack of a proper risk assessment precludes against the use of the CCEL and FCPL to notify purchasers of potential hazards through Land Information Memoranda.

References

Bear, A.L., Healy, T.R., and Immenga, D.K., 2009. Coastal erosion and sedimentation processes at Waihi Beach, New Zealand. *Journal of Coastal Research Special Issue* 56: 1721-1725.

Bell, R.G., Goring, D.G., and de Lange, W.P., 2000. Sea-level change and storm surges in the context of climate change: *IPENZ Transactions*, 27: 1-10.

Bell, R.G., Goff, J., Downes, G.L., Berryman, K.R., Walters, R.A., Chagué-Goff, C., Barnes, P.M., and Wright, I.C., 2004. *Tsunami hazard for the Bay of Plenty and Eastern Coromandel Peninsula: Stage 2*: Hamilton, Environment Waikato Technical Report 2004/32, 70 pp.

Bradshaw, B.E., Healy, T.R., Nelson, C.S., Dell, P.M., and de Lange, W.P., 1994, Holocene sediment lithofacies and dispersal systems on a storm-dominated, back-arc shelf margin: the east Coromandel coast, New Zealand: *Marine Geology*, 119, 75-98.

Chen, X., Feng, Y., and Huang, N.E., 2014. Global Sea Level Trend during 1993-2012: *Global and Planetary Change*, 112: 26-32.

Clark, J.A., and Lingle, C.S., 1979 Predicted relative sea-level changes (18,000 Years B.P. to present) caused by late-glacial retreat of the Antarctic ice sheet. *Quaternary Research* 11, 279-298.

Clement, A.J.H., Sloss, C.R., and Fuller, I.C., 2010. Late Quaternary geomorphology of the Manawatu Coastal Plain, North Island, New Zealand. *Quaternary International* 221(1–2): 36–45.

Dahm, J., and Munro, A., 2002. *Coromandel Beaches: Coastal Hazards and Development Setback Recommendations*. Environment Waikato Technical Report 02/06,180 pp.

de Lange, W.P., 2001. Interdecadal Pacific Oscillation (IPO): a mechanism for forcing decadal scale coastal change on the northeast coast of New Zealand: *Journal of Coastal Research, Special Issue* 34: 657-664.

de Lange, W.P., and Gibb, J.G., 2000. Seasonal, interannual and decadal variability of storm surges at Tauranga, New Zealand: N*ew Zealand Journal of Marine and Freshwater Research*, 34: 419-434.

de Lange, W.P., and Healy, T.R., 1986. New Zealand tsunamis 1840-1982: *New Zealand Journal of Geology and Geophysics*, 29: 115-134.

de Lange, W.P., and Moon, V.G., 2007. Tsunami washover deposits, Tawharanui, New Zealand: *Sedimentary Geology*, 200: 232-247.

Dougherty, A.J., 2013. Extracting a record of Holocene storm erosion and deposition preserved in the morphostratigraphy of a prograded coastal barrier: *Continental Shelf Research*, http://dx.doi.org/10.1016/j.csr.2013.10.014

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

Dowdy, A.J., Mills, G.A., Timbal, B., and Wang, Y. 2014. Fewer Large Waves Projected for Eastern Australia due to Decreasing Storminess. *Nature Climate Change* advance online publication (March). http://dx.doi.org/10.1038/nclimate2142.

Dunn, A.S., 2010. *Coastal storm activity along the Eastern North Island of New Zealand - East Cape to Wellington*: PhD Thesis, Hamilton, The University of Waikato, 217 pp.

Everts, C.H., 1985. Sea level rise effects on shoreline position: *Journal of Waterway, Port, Coastal and Ocean Engineering*, 111: 985-999.

FOCUS, 2012. *Coromandel East Coast Beaches: Potential impacts of projected climate change on coastal erosion over the next century and review of future coastal erosion setback*: Report prepared for Thames Coromandel District Council by the Focus Resource Management Group, November 2012, 9 pp.

Froggatt, P.C., and Lowe, D.J., 1990. A review of late Quaternary silicic and some other tephra formations from New Zealand: their stratigraphy, nomenclature, distribution, volume, and age: *New Zealand Journal of Geology and Geophysics*, 33: 89-109.

Fyfe, John C., and Nathan P. Gillett. 2014, Recent Observed and Simulated Warming: *Nature Climate Change*, 4(3): 150–51.

Fyfe, J.C., Gillett, N.P., and Zwiers, F.W., 2013, Overestimated global warming over the past 20 years: *Nature Climate Change*, 3: 767-769.

Gibb, J.G., 1986. A New Zealand regional Holocene eustatic sea-level curve and its application to determination of vertical tectonic movements. *Royal Society of New Zealand Bulletin*, 24: 377-395.

Gibbs, M., 2006, *Whangapoua Harbour sediment sources*: Hamilton, Environment Waikato Technical Report 2006/42, 55 pp.

Goddard, L., 2014. Heat hide and seek: *Nature Climate Change*, 4: 158–161

Goff, J.R., Rouse, H.L, Jones, S.L., Hayward, B.W., Cochran, U., McLea, W., Dickinson, W.W., and Morley, M.S., 2000. Evidence for an earthquake and tsunami about 3100-3400 years ago, and other catastrophic saltwater inundations recorded in a coastal lagoon, New Zealand. *Marine Geology* 170(1-2): 231-249.

Gomez, B., Carter, L., Orpin, A.R., Cobb, K.M., Page, M.J., Trustrum, N.A., and Palmer, A.S., 2012. ENSO/SAM Interactions During the Middle and Late Holocene. *The Holocene* 22(1): 23–30.

Gregory, J.M., White, N.J., Church, J.A., Bierkens, M.F.P., Box, J.E., van den Broeke, M.R., Cogley, J.G., Fettweis, X., Hanna, E., Huybrechts, P., Konikow, L.F., Leclercq, P.W., Marzeion, B., Oerlemans, J., Tamisiea, M.E., Wada, Y., Wake, L.M., and van de Wal, R.S.W., 2012. Twentieth-century global-mean sea-level rise: is the whole greater than the sum of the parts?: *Journal of Climate*, 26(13): 4476–4499

Hannah, J., and Bell, R.G., 2012. Regional sea level trends in New Zealand: *Journal of Geophysical Research*, 117: C01004-C01004.

Hannah, J.; Bell, R.; Paulik, R., (2010). Sea Level Change in the Auckland Region. Prepared by Otago University for Auckland Regional Council. Auckland Regional Council Technical Report 2010/65, 36 p.

Hay, D.N., de Lange, W.P., and Healy, T.R., 1991, Storm and oceanographic databases for the Western Bay of Plenty, *in* Bell, R.G., Hume, T.M., and Healy, T.R., eds., *Coastal Engineering - Climate for Change: 10th Australasian Conference on Coastal and Ocean Engineering*, Volume 21: Auckland, New Zealand, Water Quality Centre, p. 147-151.

Healy, T.R., and Dean, R.G., 2000. Methodology for delineation of coastal hazard zones and development setback for open duned coasts, *in* Herbich, J.B., ed., *Handbook of coastal engineering*, 19.1-19.30.

Healy, T.R., and de Lange, W.P., 2014. Reliability of geomorphic indicators of littoral drift: Examples from the Bay of Plenty, New Zealand: *Journal of Coastal Research*, 30(2): 301-318.

Healy, T.R., Dell, P.M., and Willoughby, A.J., 1981. *Coromandel Coastal Survey: Volume 1 basic survey data*. Hauraki Catchment Board Report No 114, 233 pp.

Hilton, M.J., and Hesp, P., 1996. Determining the limits of beach-nearshore sand systems and the impact of coastal sand mining: *Journal of Coastal Research*, 12: 496-519.

Horikawa, K., 1988. *Nearshore dynamics and coastal processes: Theory, measurement and predictive models*: Tokyo, University of Tokyo Press, 522 pp.

Houston, J., 2013. Global Sea Level Projections to 2100 Using Methodology of the Intergovernmental Panel on Climate Change: *Journal of Waterway, Port, Coastal, and Ocean Engineering*, 139: 82-87.

Kosaka, Y., and Xie, S-P., 2013. Recent Global-Warming Hiatus Tied to Equatorial Pacific Surface Cooling: *Nature* 501(7467): 403–407.

Lewis, S.E., Sloss, C.R., Murray-Wallace, C.V., Woodroffe, C.D., and Smithers, S.G., 2013. Post-glacial sea-level changes around the Australian margin: a review: *Quaternary Science Reviews* 74: 115-138.

Mantua, N.J., Hare, S.R., Zhang, Y., Wallace, J.M., and Francis, R.C., 1997. A Pacific interdecadal climate oscillation with impacts on Salmon production: *Bulletin of the American Meteorological Society*, 78: 1069-1079.

Marden, M., Rowan, D., and Phillips, C., 2006, Sediment sources and delivery following plantation harvesting in a weathered volcanic terrain, Coromandel Peninsula, North Island, New Zealand: *Soil Research*, 44: 219-232.

Marks, G.P., and Nelson, C.S., 1979. Sedimentology and evolution of Omaro Spit, Coromandel Peninsula: *New Zealand Journal of Marine and Freshwater Research*, 13: 347-372.

Meyssignac, B., Salas Y Melia, D., Becker, M., Llovel, W., and Cazenave, A., 2012, Tropical Pacific spatial trend patterns in observed sea level: internal variability and/or anthropogenic signature?: *Climate of the Past*, 8: 787-802.

MfE, 2008: *Coastal Hazards and Climate Change. A Guidance Manual for Local Government in New Zealand*: 2nd edition Revised by Ramsay, D., and Bell, R. (NIWA), Wellington, Ministry for the Environment.

McKnight, D.G., 1969. A recent, possibly catastrophic burial in a marine molluscan community: *New Zealand Journal of Marine and Freshwater Research* 3(1): 177–79.

OPMSAC, 2013, New Zealand's changing climate and oceans: The impact of human activity and implications for the future. Office of the Prime Minister's Science Advisory Committee (OPMSAC), Auckland, New Zealand, 20 p.

Page, M.J., Trustrum, N.A., Orpin, A.R., Carter, L., Gomez, B., Cochran, U.A., Mildenhall, D.C., Rogers, K.M., Brackley, H.L., Palmer, A.S., and Northcote, L., 2009. Storm frequency and magnitude in response to Holocene climate variability, Lake Tutira, North-Eastern New Zealand. *Marine Geology* 270(1-4): 30-44.

Power, S., Casey, T., Folland, C., Colman, A., and Mehta, V., 1999, Inter-decadal modulation of the impact of ENSO on Australia: *Climate Dynamics*, 15: 319-324.

Pullar, W.A., Kohn, B.P., and Cox, J.E., 1977. Air-fall Kaharoa Ash and Taupo Pumice, and sea-rafted Loisels Pumice, Taupo Pumice, and Leigh Pumice in northern and eastern parts of the North Island, New Zealand: *New Zealand Journal of Geology and Geophysics,* 20: 697-717.

Ramsay, D.L., Gibberd, B., Dahm, J. and Bell, R., 2012. *Defining coastal hazard zones and setback lines. A guide to good practice*. National Institute of Water & Atmospheric Research Ltd, Hamilton, New Zealand. 91 pp.

Rosenthal, Y., Linsley, B.K., and Oppo, D.W., 2013. Pacific Ocean heat content during the past 10,000 years: *Science* 342(6158): 617–621.

RSNZ, 2010. *Sea Level Rise: Emerging Issues*: Emerging Issues paper produced by Royal Society of New Zealand (RSNZ), September 2010.

Santer, B.D., Bonfils, C., Painter, J.F., Zelinka, M.D., Mears, C., Solomon, S., Schmidt, G.A., Fyfe, J.C., Cole, J.N.S., Nazarenko, L., Taylor, K.E., and Wentz, F.J., 2014. Volcanic Contribution to Decadal Changes in Tropospheric Temperature. *Nature Geoscience* 7(3): 185–189.

Schmidt, G.A., Shindell, D.T., and Tsigaridis, K., 2014. Reconciling Warming Trends. *Nature Geoscience* 7(3): 158–160.

Tans, P., 2009. An accounting of the observed increase in oceanic and atmospheric CO2 and an outlook for the future: *Oceanography*, 22(4): 26-35.

Upton, P., Kettner, A.J., Gomez, B., Orpin, A.R., Litchfield, N., and Page, M.J., 2013. Simulating post-LGM riverine fluxes to the coastal zone: The Waipaoa River System, New Zealand. *Computers & Geoscience* 53: 48-57.

Wood, A., 2010. Episodic, Seasonal, And Long Term Morphological Changes Of Coromandel Beaches: MSc Thesis, Department of Earth and Ocean Sciences, The University of Waikato.

Wood, A; Bryan, K R; Smith, R K; Coco, G and Pickett, V., 2009. Indicator beaches on the Coromandel Peninsula, New Zealand. Proceedings of Coasts and Ports 2009: In a Dynamic Environment. Engineers Australia: 224-230.

Woods, J.L.D., 2012. The evolution of a Holocene estuarine barrier on the Coromandel Coast, New Zealand: *Geographical Research,* 50(1): 89-101.

Worthington, T.J., Gregory, M.R., and Bondarenko, V., 1999. The Denham Caldera on Raoul Volcano: dacitic volcanism in the Tonga-Kermadec arc: *Journal of Volcanology and Geothermal Research*, 90: 29-48.

Zhang, K., Douglas, B.C., and Leatherman, S.P., 2004. Global warming and coastal erosion: *Climatic Change*, 64: 41-58.

Appendix 1 – Matarangi Future Coastal Protection Line Objection Group (refer attached spreadsheet for full list of submitters).

Appendix 2 – The Science and the Law

Submission to the Kapiti Coast District Council by retired Chief Justice of the Environment Court, Joan Alin.

THE SCIENCE AND THE LAW[1]

1. Because the work of the Panel, and the Coastal Systems Limited (CSL) report, occurs within a legal framework, it is relevant for scientists to understand the legal framework and their role within that framework.

2. This brief paper explains:
   I The law that applies:
   - the Resource Management Act 1991, including district plans, the New Zealand Coastal Policy Statement and the Regional Policy Statement which are all prepared and implemented under the RMA;
   - other statutory provisions, other than the Resource Management Act, for which science is relevant;

   II The contribution of science in a legal framework;
   III The role of scientists, decision-makers, and others in that legal framework.

I THE LAW THAT APPLIES

Resource Management Act 1991

3. The Resource Management Act 1991 (RMA) is the principal piece of legislation in New Zealand that governs the use of land, air and water.

4. Part 2 (ss 5-8) sets out the purpose and principles of the RMA.

5. The purpose of the RMA is set out in s 5(1):

> "to promote the sustainable management of natural and physical resources".

6. Sustainable management is defined in s 5(2). Sustainable management:

> "means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while -
> (a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and
> (b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and
> (c) avoiding, remedying, or mitigating any adverse effects of activities on the environment."

[1] This paper was prepared by Joan Allin, a submitter and former Environment Court judge. The paper has been reviewed and approved by Simpson Grierson for the Council as being an accurate and helpful guidance note and statement of the legal framework relevant to coastal hazards.

7. So, sustainable management means:
   - managing the use, development, and protection;
   - of natural and physical resources (a defined term);
   - in a way, or at a rate;
   - which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety;
   - while sustaining the matters in (a), safeguarding the matters in (b) and avoiding, remedying, or mitigating the matters in (c).

8. Section 6 identifies matters of national importance, section 7 sets out other matters, and section 8 refers to the Treaty of Waitangi. The matters set out in these sections are required to be addressed by persons exercising functions and powers under the RMA (eg Councils, the Environment Court). The requirements are there to enable the purpose of the RMA to be achieved.

9. Various other sections in the RMA bring the focus back to the s 5 purpose of the RMA and therefore reinforce its primacy.

10. District plans, the New Zealand Coastal Policy Statement 2010 and the Regional Policy Statement, which are all prepared and implemented according to legal requirements in the RMA, are discussed under the following sub-headings:
    a District plans
    b New Zealand Coastal Policy Statement 2010
    c Regional Policy Statement.

a District plans

11. Territorial authorities, like Kapiti Coast District Council, prepare district plans under the RMA. The purpose of district plans is to assist territorial authorities to carry out their functions in order to achieve the purpose of the RMA (s 72).

12. The RMA sets out the functions of territorial authorities (s 31) for the purpose of giving effect to the RMA. The functions include "the control of any actual or potential effects of the use, development, or protection of land, including for the purpose of … the avoidance or mitigation of natural hazards…"

13. The process for preparing a district plan is set out in the RMA. Once various steps have occurred:
    - a proposed district plan is publicly notified;
    - any person can make a submission or a further submission to the Council;
    - there can be pre-hearing meetings or reports prepared, which is the stage that the Kapiti proposed plan has reached;
    - the Council holds hearings and issues decisions;
    - any person who made a submission or further submission can appeal to the Environment Court;
    - there can be Environment Court mediation or a hearing and the Environment Court issues a decision;
    - the proposed district plan becomes a district plan.

14. The Kapiti proposed district plan (PDP) includes Coastal Hazard Management Areas based on the CSL report, with accompanying objectives, policies and rules restricting what can be built in the Coastal Hazard Management Areas.

15. The matters to be considered in preparing (or changing) a district plan are set out in s 74 and include the territorial authority's functions under s 31, the provisions of Part 2 (which includes the purpose of the RMA), and an evaluation of alternatives, benefits and costs[2].

16. The RMA (s 75(3)) states that a district plan must give effect to:
    - any New Zealand coastal policy statement; and
    - any regional policy statement.

17. So, for Kapiti's PDP, the New Zealand Coastal Policy Statement 2010 and the Regional Policy Statement for the Wellington region are relevant. They are to be given effect to through the district plan.

18. In the RMA decision-making process for a proposed district plan, a wide range of matters are considered by the Council (or the Environment Court).

b Zealand Coastal Policy Statement 2010

19. The purpose of a New Zealand coastal policy statement is to state policies in order to achieve the purpose of the RMA in relation to the coastal environment of New Zealand (s 56).

20. In 2010, the provisions of the previous New Zealand Coastal Policy Statement 1994 were replaced, with significant differences being introduced, including a new policy (Policy 24) relating to the identification of coastal hazards.

21. The New Zealand Coastal Policy Statement 2010 (NZCPS) states: "This NZCPS is to be applied as required by the [RMA] by persons exercising functions and powers under the [RMA]." (page 7). So, the NZCPS is to be applied:
    - as required by the RMA, which means that all the relevant objectives and policies are considered by the Council (or the Environment Court) as part of the RMA decision-making process; and
    - by persons exercising functions and powers under the RMA - the Council (or the Environment Court).

22. The NZCPS includes numerous relevant objectives and policies. Two of them are referred to in the terms of reference for the Panel[3].

---

[2] In relation to the s 32 evaluation of alternatives, benefits and costs, the Resource Management Amendment Act 2013 introduces a number of amendments in Part 2 of the Amendment Act that come into force in December 2013. However, clause 2 of the new Schedule 12 of the RMA effectively provides that for the Kapiti PDP (where further submissions have ended), the further evaluation must be undertaken as if Part 2 had not come into force. So, effectively, the existing s 32 continues to apply.

[3] Policy 24 in the terms of reference is set out incorrectly, which affects interpretation. The last part of Policy 24 should be out to the left margin as it applies to all of Policy 24, and not just (h).

23. The role of coastal scientists is particularly relevant to Policy 24, identification of coastal hazards. Policy 24 states:

> "**Policy 24 - Identification of coastal hazards**
>
> (1) Identify areas in the coastal environment that are potentially affected by coastal hazards (including tsunami), giving priority to the identification of areas at high risk of being affected. Hazard risks, over at least 100 years, are to be assessed having regard to:
> (a) physical drivers and processes that cause coastal change including sea level rise;
> (b) short-term and long-term natural dynamic fluctuations of erosion and accretion;
> (c) geomorphological character;
> (d) the potential for inundation of the coastal environment, taking into account potential sources, inundation pathways and overland extent;
> (e) cumulative effects of sea level rise, storm surge and wave height under storm conditions;
> (f) influences that humans have had or are having on the coast;
> (g) the extent and permanence of built development; and
> (h) the effects of climate change on:
> (i) matters (a) to (g) above;
> (ii) storm frequency, intensity and surges; and
> (iii) coastal sediment dynamics;
>
> taking into account national guidance and the best available information on the likely effects of climate change on the region or district."

24. Scientific information enables the Council (or the Environment Court) to assess management responses, and appropriate provisions that should be included in a district plan. In terms of the NZCPS, that would include eg Policies 3, 25 - 27 and whatever provisions the decision-makers decide to include in a district plan in relation to identification of coastal hazards under Policy 24.

25. Various policies in the NZCPS (including Policy 24) refer to "risk". This is defined in the NZCPS as:

> "Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated likelihood of occurrence (AS/NZS ISO 31000:2009 *Risk management - Principles and guidelines*, November 2009).[4]

[4] There is an unusual footnote to risk in Policy 25, but it seems that the defined term applies more widely than just to that policy.

c ***Regional Policy Statement***

26. As noted above, the RMA also requires the district plan to give effect to the Regional Policy Statement (RPS).

27. The RMA states that the purpose of a regional policy statement is "to achieve the purpose of the [RMA] by providing an overview of the resource management issues of the region and policies and methods to achieve integrated management of the natural and physical resources of the whole region" (s 59).

28. Again, there are a number of objectives and policies in the RPS and the RPS is applied in the context of the RMA.

29. Objective 19 in the RPS is:

> "The risks and consequences to people, communities, their businesses, property and infrastructure from natural hazards and climate change are reduced."

30. Section 4.1 of the RPS sets out policies that direct district plans. Policy 29, which is entitled "Avoiding inappropriate subdivision and development in areas at high risk from natural hazards" requires district plans to:

> "(a) identify areas at high risk from natural hazards; and
> (b) include polices [sic] and rules to avoid inappropriate subdivision and development in those areas."

31. Section 4.2 of the RPS sets out policies that are to be given particular regard when progressing a proposed district plan. These include Policies 51 (Minimising the risks and consequences of natural hazards) and 52 (Minimising adverse effects of hazard mitigation measures).

32. There are also Explanations under the various policies providing comment about the policies and what is meant.

33. Again, all of these matters are to be addressed in the context of the RMA process, with decisions being made by the Council or the Environment Court.

34. The RPS includes a definition of risk, which is:

> "A combination of the probability of a natural hazard and the consequences that would result from an event of a given magnitude. Commonly expressed by the formula: risk = hazard x vulnerability."

35. It also includes a definition of residual risk, which is:

> "The risk to a subdivision or development that remains after implementation of risk treatment or hazard mitigation works."

Other statutory provisions for which the science is relevant

36. While the CSL report was prepared in the context of changing the district plan and the provisions of the district plan will be addressed in the context of the RMA, there are other statutes that the CSL report is being used for.

37. The Local Government Official Information and Meetings Act 1987 requires councils to put certain material relating to individual properties into a land information memorandum. Section 44A(2) states:

> "The matters which shall be included … are -
>
> (a) information identifying each (if any) special feature or characteristic of the land concerned, including but not limited to potential erosion…, being a feature or characteristic that -
>
> (i) is known to the territorial authority; but
>
> (ii) is not apparent from … a district plan…".

38. The Building Act 2004 (ss 71-74) provides for notices on titles of land if certain building work is carried out and if the land "is subject or is likely to be subject" to one or more natural hazards.

II THE CONTRIBUTION OF SCIENCE IN A LEGAL FRAMEWORK

39. As noted above, in terms of the PDP, the RMA is the governing statute. District plans must give effect to the New Zealand Coastal Policy Statement 2010 and the Regional Policy Statement and the decision-maker must decide that the outcome is in accordance with all the relevant provisions of the RMA, including the s 5 purpose of the RMA.

40. Science and scientists play a crucial role in providing the range, and type, of objective scientific information that enables decision-makers to make decisions in the relevant statutory context.

41. The science helps to identify the geographical areas where there are coastal erosion hazard risks, and the related uncertainties.

42. That enables the decision-makers to decide where to focus their attention, to consider management approaches, alternatives, etc and to decide what lines or zones, and provisions, to include in the district plan.

43. The science also helps submitters to participate in the process in a meaningful way.

III THE ROLE OF SCIENTISTS, DECISION-MAKERS, AND OTHERS IN THAT LEGAL FRAMEWORK

44. It is relevant that each player in the legal process has a different role.

45. The scientist provides the science to enable people to participate in the process and decision-makers to make decisions within the statutory framework.

46. So, in this context, the science provides appropriate objective scientific information.

47. The policy and legal decisions are made by others.

48. The scientific information goes into the mix of all the other relevant matters that need to be considered by the Council (or the Environment Court). After considering submissions, evidence and all the matters required to be considered in the RMA, the Council (or the Environment Court) will make the policy and legal decisions about what (if any) geographical areas should be identified in the district plan and what objectives, policies and rules should apply to those areas.