Vance Boyd

From: Martin Single [beachdr@slingshot.co.nz]
Sent: Friday, May 17, 2024 11:26 AM
To: Vance Boyd
Subject: Re: : Coastal Hazard planning.

Hi Vance,

An interesting issue you have put valuable thought and research into addressing. I am impressed by your comments to the committee and agree that the issue is not adequately addressed in the proposed plan.

I have re-read the proposed plan and the NIWA reports (February 2022 Measures and Rouse; March 2022, Bosserelle and Allis), and although generally familiar with the methods that have been employed in providing a line on a map, I am not sure of what information or data other than the erosion at the old dump site was used to create the map of shoreline changes (Figure 4-34 of the March 2022 report).

I couldn't find, or replicate through a search of the WCRC web site your screen grab (Figure 6 in your comments), but the pattern of abrupt change to the inland boundary of the Coastal Hazard Severe area is similar to what I have seen at other sites where the area between two known data points is extrapolated with straight lines rather than with due consideration of the geomorphology and land-use. To that end, I would ask of NIWA or the drafters of the plan how this was derived with consideration to section 3.1.1 of the NIWA March 2022 report:

3.1.1 Manual review/correction

All the coastal erosion hazard areas were manually reviewed to account for geomorphological features and underlying geology that the hybrid probabilistic approach cannot take into account. For example, when the probabilistic hazard width extends from a sandy beach system to a bedrock feature, the coastal erosion hazard area was manually corrected to the limit of the beach system. The manual-redraw also helped making transition between morphology so that adjacent hazard areas are consistent. Another correction was applied when the hazard area stops short of a significant geomorphological feature (e.g., the area was in a coastal wetland or across an old channel) that may be reactivated during an extreme event, in such situation the hazard areas was extended to cover the geomorphological feature.

If I was approaching this to give advice on coastal hazards for the purpose of a consent application, I would focus on the site in question (for example your empty section) to derive the historical shore change at that site using air photos where possible and ground evidence, the potential inundation using the land levels at the site, and potential mitigation measures to protect the proposed activities (buildings etc).

However, at the level of the proposed plan, I agree with your contention that the uncertainty of the projected erosion presents an onerous burden on landowners, and that although activities being "permitted" would be too generous, the historical land-use and the risk being limited to the existing subdivision suggests that there is scope for special consideration in addressing land-use consents where there is this uncertainty.

I don't think that under the proposed rules that you would get experts arguing as there should be agreement as to how coastal hazards are determined at a specific site. I do agree that those matters are best looked at for a site to site basis, and that the 100 year projection also moves constantly through time, having a 75 year or 50 year line does not really dispense with the requirement to identify the long-term hazards.

I am not sure how that fits in with plans, rules and the "lines" that are drawn on planning maps for the planning purpose, but I do feel that it fits with wise long-term use of the coastal resource.

I hope my comments give you some clarity, although they possibly do not help you resolve your concerns.

Happy to discuss further.

Regards

Martin

Dr Martin Single
Coastal Geomorphologist

ph. 021 790797
ph. 00 64 3 3514041 (hme/wk)

Shore Processes and Management Ltd.
1/15a Lothian St
Christchurch, 8041

e-mail: beachdr@slingshot.co.nz (hme/wk)
e-mail: martin.single@canterbury.ac.nz (UC/wk)

On 15 May 2024, at 5:49 PM, Vance Boyd <rvcnb@xtra.co.nz> wrote:

Hello Martin,

Thanks for talking a short time ago.

I have attached my comments made the Committee considering whether the mapping should be notified in its current 100 year forecast form. I spoke to these comments at a meeting in February.

The Committee is made up of the four West Coast mayors, the Chairman of the regional council and an independent committee chair.

The committee was sympathetic to my arguments but felt obliged to follow the advice of their contract planner that they should only consider 100 year mapping and that the NIWA report was robust. Although they resolved to notify the maps on the basis outlined above I was informally told later that I should provide any new information and they may take a fresh look before notification takes place.

Obviously getting some resolution before commissioner hearing stage is an attractive option for us.

If you could advise if you are able to help please.

Kind Regards,
Vance Boyd.

Vance Boyd

From: Rosie Hill [rosie.hill@toddandwalker.com]
Sent: Friday, May 10, 2024 11:10 AM
To: Vance Boyd
Subject: FW: Advice on West Coast Coastal hazards overlay mapping
Attachments: Project-Summary-Wharekawa-Coast(1).pdf

Hi Vance – see below

This a helpful start to get some expert assurance that we are on the right track – shall reach out to Derek Todd below to also get his gut feel?

Equally, I'm happy if you wish to and then feed that back to me

Rosie Hill
Senior Associate
P: +64 3 441 2743 | M: +64 27 460 0243
E: rosie.hill@toddandwalker.com
W: www.toddandwalker.com
TODD&WALKER law
LAWYERS | NOTARY PUBLIC

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From: Terry Hume <terryhume6@gmail.com>
Sent: Friday, May 10, 2024 10:43 AM
To: Rosie Hill <rosie.hill@toddandwalker.com>
Subject: Re: Advice on West Coast Coastal hazards overlay mapping

Good morning Rosie.

The material you supplied sets out clearly what's required. I understand that the requirement in the first instance is for comment on approach/principles that have been applied rather than more site specific comment re the coastal settlement of Hannahs Clearing.

My decision is to pass up on this and recommend another provider.

I consider that it's in your client's best interest to go to a provider who is better resourced than myself in this area. Also, although the focus is on Hannahs Clearing the issues raised here will have ramifications for implementing the PDP along this stretch of coast. I think you need a provider who can be in there for the long haul. That also means someone with better knowledge of West Coast coastal processes than myself.

I suggest you contact Derek Todd of Jacobs. Derek is based in Christchurch and has a knowledge of the west coast and been involved in working with communities on coastal hazards issues.

Derek Todd, Jacobs Christchurch Office. Derek.Todd@jacobs.com . 027 2787439 and 03 940 4981

I personally am in favour of an adaptive coastal hazard strategy informed by science/technical advice. I would agree that the absence of 25, 50 and 75 year mapping severely restricts understanding and limits the ability to consider adaptive change with trigger points. In principle it is acceptable to consider modelling coastal inundation at the same time as coastal erosion although it depends on locality.

I worked on a project that has relevance in approach to the Hannahs Creek situation. The Wharekawa Coast 2120 in the Firth of Thames. Wharekawa Coast 2120 is a community-led plan jointly developed by Regional and District councils and community (summary document attached). Here the major hazard issue is coastal inundation (flooding from the sea) (and the land is sinking), coastal erosion is a lesser and more local issue, but In the long run (decades) the inundation will completely overwhelm the coastal erosion issue. However the two hazards needed to be considered together. The WRC developed a risk assessment approach to address those matters and adaptive management strategies were developed to sequentially address the ramping up for short, medium and long term hazards. The community consultation process had its ups and downs and was time-consuming but good strategies were developed.

The community consultations were led very ably by Simon Bendall of Traverse Environmental

simon@traverse.co.nz 021 918489

Sorry I cannot assist directly in this case but I thrust my thoughts are useful

Kind regards

Terry Hume

Dr Terry Hume
Managing Director
Hume Consulting Ltd
Postal address: 6 Pacific Parade, Surfdale, Waiheke Island 1081
Email: terryhume6@gmail.com
Mob: 027 2267263

On Thu, May 9, 2024 at 1:18 PM Rosie Hill <rosie.hill@toddandwalker.com> wrote:

Terry

Thank you for the time to discuss just now.

In summary – we have a couple of clients interested in challenging the West Coast Regional Council's upcoming notification of a variation to the TTmP to amend the coastal hazards overlay.

The issues are:

WHAREKAWA COAST 2120 - PROJECT SUMMARY

PROJECT RECAP

A jointly developed and community-led plan – Wharekawa Coast 2120.

- Working together with our communities, councils and iwi to look at a range of issues over the next 100 years.
- Using technical expertise to help us understand the issues.
- Planning how we will respond to natural hazard risks in the future, because recognising what we know about these risks may change 10, 20 and 100 years down the track.
- Looking at opportunities for the growth and development of our communities on the Wharekawa Coast.

The project is made up of four parts:

1. *What is happening?*
2. *What matters most?*
3. *What can we do about it?*
4. *What are we going to do about it?*

The following sections outline progress to date on these four parts of the project.

Part 1 - WHAT IS HAPPENING?

This part of the project has provided an understanding of the risks of natural hazards in the area. It covers what the natural hazards are and looks in detail at the major ones (coastal inundation, coastal erosion and river flooding).

Information is provided on what the impacts of these natural hazards are likely to be on social and ecological values, and an assessment has been done on what is at risk from natural hazards.

More work is required on the views of mana whenua/tangata whenua of Wharekawa on potential impacts of natural hazards and climate change.

Natural hazard reports

Reports were prepared and presented on the major natural hazards:

1. Coastal processes report (Dr Terry Hume) – which includes **coastal hazards** (Coastal-processes).
2. Hauarahi Stream rapid flood assessment (WRC) – which looks at **flooding of the Hauarahi Stream** from rainfall events (Hauarahi-Stream-rapid-flood-assessment).
3. Climate driven river flooding (Jonathan Chambers) – which looks at **climate change scenarios and how these effect Hauarahi Stream flooding** risks (Climate-driven-river-flooding).

A brief summary of these reports is provided in Appendix A.

Feedback from the community panel identified that river flooding was an issue at other locations in the area, not solely the Hauarahi Stream. The project team looked into this and realised that they did not have a lot of information on the flooding of other rivers and streams and they sought to prepare a further report on **freshwater flooding across the area**. This is currently being prepared

and is due in June 2021. It is based on researching councils' files and records, and discussions with residents and community panel members.

Other natural hazards in the area include: slips/land stability, tsunami, earthquake and liquefaction, and ground water. A report is also being prepared on **slips/land stability** (in progress), due to information about slips affecting the road in the north of the study area. The remaining natural hazards were identified as minor and will not be considered further at this time.

Impact assessment

The impacts of natural hazards on social and ecological values have been considered. This is to provide a more comprehensive picture of what the effects of natural hazards could look like for local people and the local environment.

Reports were prepared as follows:

1. Natural hazards social impact assessment (Cerasela Stancu) – this looks at the social impact and implications of sea-level rise on communities along Wharekawa coast (Natural-hazards-social-impact-assessment).
2. Ecological values assessment (WRC) – this looks at the future state of the intertidal areas, chenier plains and intertidal vegetation of the area under different scenarios (Ecological-values-assessment).

A brief summary of the findings is in Appendix B.

Tangata whenua study

An important part of this project is to record the views of the iwi, hapū and whānau of Wharekawa (mana whenua/tangata whenua of Wharekawa) regarding actual and potential impacts of climate change (particularly flooding and rising seawater) upon the iwi/hapū/whānau of Wharekawa (including their people, lands, assets, resources and estates).

This work in underway with the scope of this study in progress to be finalised.

Risk assessment

Once the information noted above on natural hazards was considered and refined by the community panel, the next step was to prepare a **natural hazards risk assessment** (Natural-hazards-risk-assessment) which brings together this information and presents the likely impacts of natural hazard scenarios on different categories of things such as homes and properties, rural land, roading and bridges and recreation and tourism.

Due to the size and complexity of the natural hazards risk assessment a **natural hazards risk assessment summary report** (Natural-hazards-risk-assessment-summary) was prepared.

Part of the risk assessment work is to break the project area up into five compartments, with a coastal and inland sub-compartment for each (Compartmental-map).

These compartments are based on river catchments, communities of interest, elevation and coastal processes (methodology Memo-compartment-methodology). This helps determine which areas are experiencing the greatest impacts of natural hazards and where to concentrate work on options to mitigate these impacts.

Another important part of the risk assessment is to consider what makes the area and the community vulnerable to the impacts of natural hazards. These are factors which make people more susceptible to the impacts of natural hazards, such as: many properties replying on one road for

access to their homes and wider services, being reliant on individual septic tank systems which may become inundated by groundwater or seawater, having less services available locally without travelling, more older people who are generally less mobile and more physically vulnerable.

The next step in the risk assessment is the identification of the **community risk thresholds**. These thresholds are the frequency at which the community can no longer tolerate the impacts of the described scenario (or event) happening e.g. every 50 years.

The thresholds can then be used to figure out how much time is available to implement adaptation actions to reduce the natural hazard risk to the community. They can also be used to prioritise sub-compartments and impact categories where the impacts will become intolerable sooner.

The community panel have volunteered to go out and ask people individually to determine their risk thresholds, which can then be averaged to provide a community threshold range. This work is underway with the booklets being finalised for trial by the community panel in May 2021 and surveying the community by June 2021.

A wider community session is planned for June 2021 for the panel to share what they have learned about natural hazards and to present information on what's important to the community (including the themes and goals work from section 2 below).

Part 2 - WHAT MATTERS MOST?

This part of the project is about identifying what's important to the community, and what is of value to them.

To do this a community workshop was held in 2018 and people were asked in groups to identify what they love, what they want to see more of or less of, and what they are concerned about. This exercise was also done with the community panel in 2021. The results were plotted spatially on a map, listed and then collated into word clouds.

Using this information the community panel came up with the following themes and goals for what matters most.

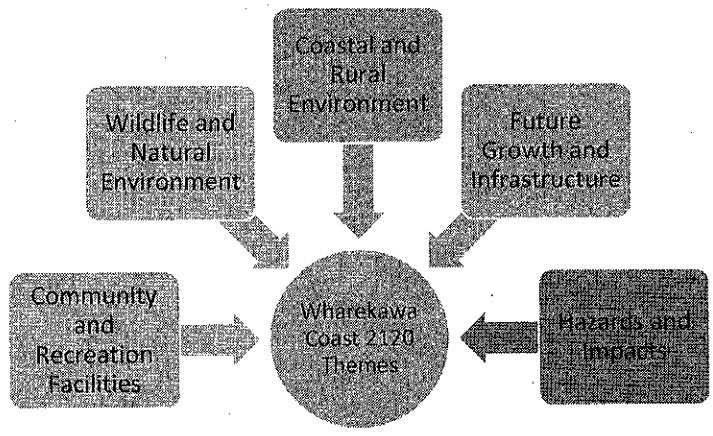

Figure 1: Wharekawa Coast 2120 key themes

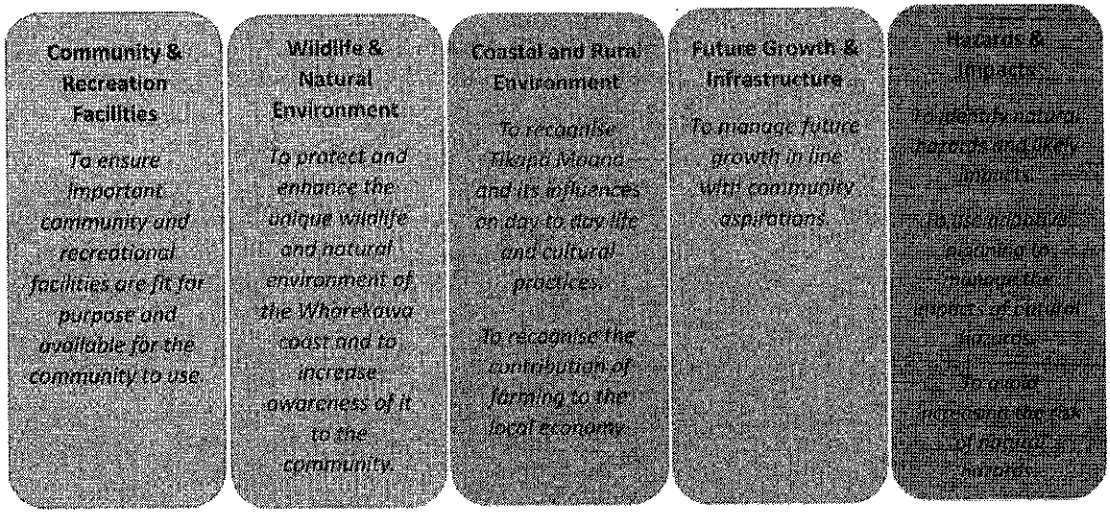

Figure 2: Wharekawa Coast 2120 goals

Part 3 - WHAT CAN WE DO ABOUT IT?

This part of the project identifies options for responding to what's happening with natural hazards and climate change and evaluates those options, keeping in mind the community goals identified in what matters most above.

This is where the project is currently up to (as well as completing the outstanding matters mentioned above). Five workshops (May- Aug 2021) with the community panel are scheduled to identify the options, come up evaluation criteria and then evaluate them. A wider community session is also planned to present the options to the community and seek their feedback on these.

Part 4 - WHAT ARE WE GOING TO DO ABOUT IT?

This part of the project also has five workshops (Sept- Nov 2021) scheduled for the community panel to work through and determine our response.

The workshops will involve selecting the preferred options for responding to natural hazards and putting them together with other short term actions the panel identify (e.g. improving maintenance of drains). This will result in a final report which will go to the councils for their consideration. From this will emerge the Wharekawa Coast 2120 community plan which will be released to the wider community for feedback and then adopted by the councils.

APPENDIX A – BRIEF SUMMARY OF HAZARD REPORTS

1. Coastal processes and hazards report
2. Climate driven impacts on Hauarahi Stream flooding report
3. Hauarahi Stream flood report

1. Coastal processes and hazards report

Coastal inundation

Coastal inundation is the major threat to the Wharekawa coast. The coastal plain lies at a level at or below mean sea level and the low and narrow coastal barrier ridge provides little protection against overtopping by the sea.

Under the status quo coastal inundation events will, as they have in the past, continue to threaten.

Inundation events will be the largest and most extensive when storm tides coincide with high tide and king tides and when these conditions are maintained for several days. Flooding will be further exacerbated during heavy rainfall that is commonly associated with storms.

Sea water flooding up rivers and drains prevents the escape of flood waters to the sea and causes water levels to rise to higher levels and further inland and the land remains inundated for longer periods of time. While large events are infrequent, the coastal plain is so low in places that any one of those events occurring alone can cause lesser amounts of inundation. Coastal inundation will be widespread along the shoreline with the extent dictated by the topography, proceed rapidly and little can be done at the time to mitigate the effects.

Coastal erosion

Coastal erosion is less of a hazard than coastal inundation. However, the low gravel ridge barrier, unlike large dunes on a sandy coast, provides little buffer against erosion as they contain only a small volume of sediment and receive only a meagre supply of sand and gravel. Shoreline stability is very dependent on a continued supply of sand and gravel from the rivers and shell material from the tidal flats offshore.

The variety of structures constructed along the coast to prevent coastal erosion including rock walls, wooden groynes, dumped concrete and concrete pipes are in various states of disrepair and some are of questionable effectiveness and may in some instances be detrimental to coastal processes and be contributing to the erosion rather than preventing it. Coastal erosion will be local, proceed slowly, the scale will be dictated by how well the beach is built up with sediment prior to a storm event and can be mitigated at the time by various actions.

Climate change

Climate change and associated sea level rise will exacerbate the threats and the risk to assets from coastal inundation and erosion because these are predicted to 'ramp up' in both magnitude and frequency.

Events that are rare today (decadal or longer) will be increasingly common (weekly) in the distant future. Storm tides will cause increases in water levels (over and above the level of predicted tides) caused by storm conditions that last from hours to days. This will cause an increase in the magnitude

and frequency of coastal inundation. In storms it will result in higher water levels and waves closer to the shore resulting in rollback of the beach ridge system and overall coastal erosion and shoreline retreat.

2. Hauarahi Stream flood report

March 2017 event

The Hauarahi Stream has a history of significant flood events, with the most recent occurring in March 2017 (colloquially known as the Tasman Tempest), which also affected a wider area. The event is recorded as over a 1% (annual exceedance probability) which is equivalent to a 100-year ARI (average recurrence interval) for 6, 12, and 24-hour time intervals. The persistence of the rainfall throughout the week played a significant role in worsening impacts, with short gaps not allowing for full clean-up or any significant channel clearing work.

The event caused a significant amount of disruption to infrastructure such as roading, power networks and water supplies. Kaiaua was isolated due to flooding on roads from the early hours of the morning until just before midday on 8 March. Several houses were inundated and farmland damaged.

Flood modelling

The results of the hydraulic modelling show that even a 2-year ARI (50% AEP) flood event in the Hauarahi Stream will cause some flooding of rural property and potentially residential property.

As the magnitude of the event increases (and frequency decreases), the flood hazard progressively increases, for both farmland and residential.

When the projected effects of climate change are considered, an increase in rainfall intensity alone does not cause a substantial increase in the severity of flooding (though there is an increase in flood hazard to residential land on the northern side of Hauarahi Stream). However, with 1m of projected sea level rise the increase in flood hazard is such that the majority of Kaiaua Township may be inundated.

Here it is important to note that much of the flooding in the lower reaches is the result of sea level rise causing coastal inundation, rather than as a result of river flooding. This highlights the importance of considering the effects of river flooding in conjunction with those of coastal inundation, particularly when assessing mitigation options.

3. Climate driven impacts on Hauarahi Stream flooding report

Flood Dynamics in North Kaiaua

Flooding in North Kaiaua is driven by overtopping flows from the true left bank of the Hauarahi Stream at the intersection of Puriri Ave and Pohutukawa Ave. Runoff ponds behind the East Coast Road intersection, atop the landward side of the storm berm, and spills into remnant valleys in the north. The northern valleys pond to the same level in more extreme events, causing runoff to spill over East Coast Road and onto the beach.

Flood Dynamics in South Kaiaua

The relative proximity of Puriri Ave to the Hauarahi Stream floodplain and minimal associated depression storage causes properties in North Kaiaua to flood up to 30 minutes sooner than properties in South Kaiaua.

Flooding in South Kaiaua is driven by overtopping flows from the true right bank of the Hauarahi Stream to the west of Puriri Ave. A large proportion of the overtopping flow is attenuated in local depressions north of Lipscombe Road or conveyed towards the coast via the local roads. The remainder of the flow enters Lipscombe Road adjacent the Kaiaua Community Hall, running along Kowhai Ave and discharging into the southern coastal plain some 800 metres downstream of its diffluence from the Hauarahi Stream.

Climate change impacts

The projected impacts of climate change will increase the severity and frequency of flooding in the town by increasing the likelihood of elevated coastal water levels, bringing more intense rainfall events, and saturating the coastal plain. From 2050 onwards, coastal inundation will be a significant contributing factor to the apparent hazards impacting most flood-prone properties in Kaiaua under Mean High Water Springs (MHWS).

Both future climate pathways assessed in this study are projected to significantly increase flood hazards to existing dwellings in Kaiaua.

An assessment of individual buildings in the catchment identified a minimal number of dwellings that are influenced by coastal inundation at MHWS prior to 2050, increasing to a balance of dwellings by 2080, and a majority of dwellings by 2120. Refer to figure 18 below:

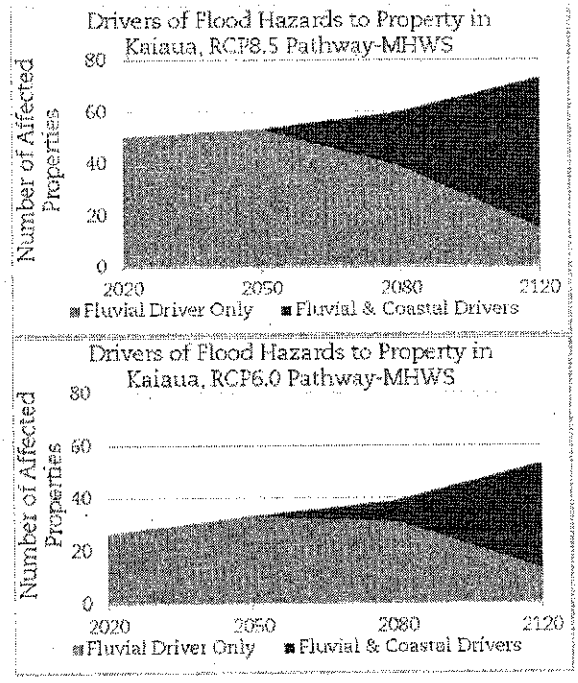

Figure 18 Proportion of flood-impacted dwellings in Kaiaua experiencing at least 200 mm flooding above finished ground level.

The severe influence of projected sea-level rise means that relative to an optimistic coastal boundary at MHWS, the depth of flooding experienced by many existing dwellings during a 50% Annual Exceedance Probability (AEP) rainfall event in 100 years' time will exceed the depth of flooding experienced during a 1% AEP rainfall event in the present climate.

Climate change is driving an exponential increase in beach ridge barrier overtopping and streamflow retarding events in Kaiaua which may culminate in the equivalent of a 0.5% AEP storm surge which devastated the community in 2018 occurring on a monthly basis by 2120.

A new home insurance model and a coordinated transformative adaptation plan will be required in the next thirty to sixty years to avoid residents losing their homes.

APPENDIX B – FINDINGS FROM SOCIAL AND ECOLOGICAL IMPACT REPORTS

1. Natural hazards social impact assessment for Wharekawa
2. Ecological values impact assessment

1. Natural hazards social impact assessment for Wharekawa

Main social and community issues

A number of issues have been frequently raised during interviews as social concerns for the area. These issues and concerns are described below:

- Relationship with Council
- Isolation and access to services (especially in times of emergency)
- Action and capability of local authorities for planning and respond to flooding
- A sense of being trapped
- Mobility and immobility of residents
- Pressure on local infrastructure from tourism
- Social cohesion
- Young people leaving the area
- Uncoordinated efforts to adapt and mitigate future risks
- Ambivalence or reluctance to change
- Social gathering places exposed to flooding risk
- The social area of influence is wider than the area affected.

Community perception of natural hazards

Many of those interviewed are highly concerned about natural hazards, either coastal or from on-land. Previous experience with coastal inundation has caused direct damage and severely impacted their livelihoods e.g. farm productivity lost due to saltwater killing off pasture, homes inundated and damaged, insurance premiums increased and too costly to pay.

A smaller group of 'Doubters' question the risks coastal hazards pose. They doubt that climate change is driving changes in coastal hazards and question whether any planning should be done, as these events occur all the time. This group disassociates the previous events, such as the 2018 flooding event, with climate change and believe that the risks of such an event occurring again remain the same, i.e. rare.

A 'Denial' group is formed of those who believe that the issue is exaggerated and that nothing will change. This group also consists of those who feel that another event will not happen in their lifetime. They believe that they won't have to deal with the impacts of coastal hazards.

A 'Neutral' group perceives coastal hazards very differently to the rest of the groups. They readily accept that hazards exist but are either not directly impacted by them or believe that this is the natural progression of things, i.e. that it is better to work with nature than against it, and that adaptation is meant to occur.

Conclusions

- A broad range of key social outcomes have been identified related to community wellbeing.

- The exposure to direct impacts from coastal hazards changes along the coast. Perceptions around the 'when, how and what' coastal hazard impacts would be, differed amongst the interviewees.
- Despite the different perspectives, the individual and community experience with the 2017/18 events helped built a common level of knowledge and determination to seek sensible solutions to natural hazards.
- Interviewees who have experienced direct impacts were more likely to identify the key social outcomes for the community that are linked to coastal hazards, such as:
    - Decreased wellbeing (anxiety and stress) associated with concerns as a result of damage to (own) property, personal safety, increased insurance costs or insurance exclusion, lack of access to mortgage finance, falling resale values or non-saleability and other
    - Disruption to business activities and farming, loss of revenue and increased insurance costs/exclusion, lack of access to (business) finance, falling resale value (of farm, land etc.)
    - Loss of sites of value and amenities as foundations for community identity, cohesion and growth.

2. Ecological values impact assessment

The Wharekawa coast encompasses significant ecological values associated with extensive intertidal flats and associated wetlands. Habitats and feeding grounds, including Mānawa/mangrove and intertidal flats, support vast numbers of resident and migratory birds, including nationally critical, declining and vulnerable species. Roosting sites for large numbers of shorebirds are provided by the nationally and globally rare chenier formations.

Coastal habitats are threatened by a broad range of contemporary stressors and will be threatened in the future by stressors. Values in the future will be affected by the legacy of human activities in addition to the activities of the time. Future pressures on coastal habitats may include stressors, or combinations of stressors, that are yet to be identified. All stressors will be modified by changes in the physical-geochemical conditions associated with the changing climate. Climate change may have direct effects but will also modify the severity of all other stressors.

Future stressors associated with climate change include ocean acidification, changes to temperature, sea level rise, increases in the frequency of storm surge and changes to the wave climate.

Intertidal flats

Under future scenarios in which the intertidal area becomes muddier, there are likely to be changes in ecosystem functioning and macroinvertebrate community structure e.g. possible loss of several bivalve species. If the intertidal area were to reduce in extent but not change in granulometry, certain negative impacts may be tempered.

The greatest negative effects on intertidal flats would occur if the intertidal extent were to reduce in size and sediments become muddier.

Predicting future outcomes for birdlife is difficult. Management of contemporary issues e.g. predator control, will play a key role in determining the future state of bird populations.

Cheniers

If cheniers were to be inundated or erode, this would substantially reduce levels of protection provided to the shoreline, resulting in greater impacts from storm and wave action, affecting the persistence of fringing coastal vegetation. There would be significant disruption of species that utilise chenier ridges.

Intertidal vegetation

Intertidal vegetation could theoretically migrate landwards until constrained by either rising topography, coastal defence structures or the East Coast Road. Once constrained the viability of the intertidal vegetation depends on a sufficient fine sediment supply and a depositional hydrodynamic regime to accrete vertically.

The intertidal vegetation north of Miranda also depend on the continued existence of the cheniers, if these cheniers break down or migrate landwards at a rapid rate the intertidal vegetation will either become exposed or not establish.

Conclusions

It is presently difficult to predict with certainty the ecological changes that will occur as the Wharekawa coastline responds to a changing climate.

Management action is needed: firstly, to consider different future scenarios and the impacts of possible intervention, and secondly, to address the range of contemporary issues and disturbances that are impacting ecological values today. There are still many issues that require pressing attention, including continued habitat loss and degradation, drainage and infilling human induced disturbances, water quality and invasive marine species.

Focusing efforts on maintaining and restoring the coastal area and minimising stressors may serve as the best insurance for facing an uncertain future.

Under all of the scenarios, the intertidal environment will eventually be constrained by existing coastal defences and the East Coast Road unless these structures are abandoned or modified, and the foreshore is given opportunity to retreat. Over the long-term, the differences between the scenarios will thus be timing, onset and rate of change.