Kapiti Coast District Council's Coastal Adaptation project: A review of the Coastal Advisory Panel's Analysis

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tailrisk economics
te maha hoki o nga pihikete

About Tailrisk economics

Tailrisk economics is a Wellington economics consultancy. It specialises in the economics of low probability, high impact events including financial crises and natural disasters. Principal Ian Harrison (B.C.A. Hons. V.U.W., Master of Public Policy SAIS Johns Hopkins) and is currently completing a Master of Climate Change science and Policy degree at Victoria University. He has worked with the Reserve Bank of New Zealand, the World Bank, the International Monetary Fund and the Bank for International Settlements. In his time at the Reserve Bank Ian worked extensively on the measurement and reporting of the risks posed by large scale economic and financial crises and has extensive experience in evaluating complex models.

Ian has written extensively on the evaluation of climate change reports (see Tailrisk.co.nz/documents) and has a good understanding of the content of relevant IPCC climate change reports and many of the relevant New Zealand government reports.

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Introduction

The purpose of this paper is to present a preliminary review of the Kapiti Coastal Advisory Panel's (CAP's) analysis of future coastal sea level rise adaptation proposals. It draws on a review of all of the documents produced for and by the CAP; the update provided to the Waikanae Community Board; relevant New Zealand Government reports; the international literature, and the main reports produced by the Council's principle consultants, Jacob's. Jacobs is a large US firm that consults across a range of fields including environmental planning. Jacobs was engaged by the Council and is responsible to it. The CAP also been supported by Council officers, Jacobs and various outside subject specialists.

The CAP members are Council appointees. The CAP did not have a material budget and had a limited capacity to obtain external independent advice. It was lacking in some of the skill sets essential to their task. There were no economics, risk and property specialists on the panel.

Our main conclusion in this report is clear. The CAP's work has been a wasteful and unproductive exercise that has generated some poor advice. They have spent more than two years building what is called a multicriteria decision analysis (MCDA) that did not consider the costs and effectiveness of possible interventions. It was purportedly designing to translate community values, as collected and interpreted by the CAP, into a single numerical score for each adaptation pathway and area. Information on the costs and benefits of the options were withheld from the community and the CAP through this process.

Only at the last minute (at the meeting on 10 April 2024) was the CAP given the economic analysis that did assess costs and effectiveness. This found that the benefit cost ratio (BCR) of the CAP's preferred ultimate response to inundation risk to Waikanae beach (we have used Waikanae beach as an illustrative example in this report), which involved managed retreat, was 0.01. That is, for every dollar spent the benefits were only one cent. Managed retreat was the preferred option in several of the areas and would result in the destruction of several Kapiti communities.

It remains to be seen how the CAP will take the economic information into account. The minutes for the 10 April meeting, where the CAP considered the economics reports, were not available at the time of writing.

It should be obvious that the MCDA methodology, which has been the centre of the CAP's processes and reporting to the community, was fundamentally flawed. It produced results that will be unaffordable and generate very few benefits

It is useful at the outset to distinguish three different related but distinct tasks that the CAP processes will impact.

They are:

1. Physical adaptation.
   How and when the Council physically responds, to sea level rise i.e. by building seawalls or by retreating. This is the primary focus of the CAP. While this will not necessarily require decisions with substantial financial implications in the very short run, the assessments made here can feed through into tasks two and three and have market impacts immediately.

2. Coastal Planning.
   The CAP's assessment of sea level rise risks will affect how the Council restricts development. The CAP is expected to advice on these planning issues.

3. Information provision.
   This involves what information the Council provides on sea level rise risk to third parties, in particular sellers and purchasers of property. It may also affect the price and availability of insurance. This may also have substantial economic impacts in the short run.

This paper is organised as follows:
Part two sets out our key findings.

Part three discusses three critical errors in the CAP analysis, the misuse of an extreme climate change scenario to generate sea level rise assessments; the use of an inadequate methodology called the 'bathtub' approach to calculate inundation impacts; and the assumption that sea walls would not be maintained.

Part four examines the Multiple Criteria Decision Analysis (MCDA) that has provided the analytical basis for the CAP's advice to date.

Part five examines the advice provided to the Waikanae Community Board as a case example.

Part six briefly discusses possible implications for the Council's coastal planning policies and rules, and for the provision of public information on sea-level rise projections and implications

Part seven concludes.

Part two: Key findings

Sea level rise projections driven by extreme assumptions
The projections of future sea level rises were affected by extreme assumptions about future GHG emissions. In particular it was assumed that the Paris Agreement would fail completely and that coal consumption would increase by a factor of six or more by the end of this century. This is extremely unlikely but is represented in the risk calculations as a likely outcome. As a consequence what is probably nearer a 1:1000 probability of inundation is presented as a 1:100 probability. This, in the words of the High Court judgement of the Kapiti Coast District Council's previous effort on representing risk, is neither accurate or fair.

Methodology for assessing inundation risk inadequate
The consultants used the 'bathtub' method for assessing inundation risk. The bathtub method is known to overstate the risks compared to more sophisticated dynamic methodologies, in topographies like Kapiti's. The consultants were aware of this shortcoming but said that the Council would provide the necessary information before the review was completed. This never occurred so it is likely that inundation risks have been overstated.

Sea wall maintenance assumption unrealistic
It was assumed that existing seawalls would not be maintained and would fail after 10 to 30 years. This may account for much of the projected erosion in areas currently protected by sea walls.

Multicriteria Decision Analysis (MCDA) process not fit for purpose
The MCDA purports to be able to translate community values into a single score that allows a ranking of adaptation pathways. However, the CAP/Council were unable to explain how the process actually works. It is open to biases that favour the Council's preferred outcomes. The MCDA should be scrapped as an adaptation decision metric.

Economic assessments of managed retreat show benefit cost ratios (BCRs) for the large scale managed retreat options identified as the best options by the CAPs Multicriteria Decision Analysis were extremely poor.

The BCR's for Waikanae Beach and Otaki Beach were 0.01 and 0.03 respectively. For every dollar invested there is a return of only one or three cents. This clearly demonstrated that managed retreat does not make economic sense. The Council's consultant, Jacobs, did not produce the economic analysis until the end of the process and then many of the results were obscure.

BCR should be the primary assessment metric

Scrapping the MCDA leaves the BCR as the main metric. As managed retreat is a major investment it should be subject to a robust cost benefit analysis. The BCR is a summary measure of the cost benefit analysis.

Economic analysis should be rerun

The economic analysis considered only the top three pathways identified by the MCDA for each area. It is possible that superior options could have been ruled out at the first stage of the process. The impact of key assumptions need to be clearer and the modelling rerun using more appropriate estimates of sea level rise and impacts/

Part three: Use of extreme scenarios; the bathtub assumption and seawall maintenance

The use of the 'extreme' RCP-8.5 scenario

The CAP has used two assumptions about the amount of future global emissions that drive temperature increases, and hence sea level rises, over different time horizons. The first assumption is what is described as RCP- 8.5[1]. It makes extreme assumptions about the drivers of future emissions. Coal use will increase by a factor of over six or more (when global coal consumption has been more or less stable for around a decade); the world population will increase by another three billion, and there will be faster economic growth than in the mean emissions scenario.

RCP-8.5 is obviously an extreme and highly implausible scenario, but unfortunately it has been misrepresented in the academic and policy literature. It has been frequently described

[1] RCP means Recognised Concentration pathway. The number is a measure of the amount of energy in watts impacting on a sq. metre relative to a preindustrial measure. The RCP descriptor has now been supplanted by the term SSP but they mean more or less the same thing.

as a ‘business as usual ‘ projection and hence interpreted as akin to a mean estimate of future developments.

This representation of RCP- 8.5 is now generally understood (by those who understand the process) to be wrong. In its latest report on the physical science (AR6-WG1) the IPCC conceded that RCP-8.5 was an extreme assumption. As a consequence it reduced its mean forecast of the future temperature increase from 4oC to 2.7oC. It is clear that the lower RCP, say RCP 4.5, should be used to represent the most likely scenario. However, the CAP has primarily focused on RCP-8.5, which means that it is overstating the risk from future sea level rises in the following way.

The probability of an adverse coastal inundation event occurring is described in the material provided to the CAP, as its annual probability of exceedance (AEP). A probability of one event in one hundred years (1:100) is used to divide properties at lower risk, from those where the risk is more appreciable. This is a reasonable dividing line. A 1:100 year event is rare but can be consequential. If the damage to an inundated house is $200,000, then the expected annual cost is $2,000.

The problem with the use of RCP-8.5 for future scenarios is that there are two probabilities in play. There is the probability of an extreme storm event, which is set at 1:100. Then there is the probability that the sea level will rise by a particular amount at a particular future date. To calculate the future probability of a damaging event it is necessary to multiply the two probabilities. So if the probability of a RCP-8.5 outcome is one tenth[2] that of the RCP- 4.5 outcome, the AEP will be 1:1000 (100 X 10), not 1:100. Using RCP-8.5 rather than RCP-4.5 substantially overstates the risk. This is a basic point but it has been missed by the Council’s consultants (and the MfE and many others).

There is nothing necessarily wrong in using RCP-8.5 as an extreme stress test scenario, but the correct AEP of, say, 1:1000 for this scenario must also be presented. Not to do so would present a false and misleading picture and expose the Council to legal risk.

However, the Jacobs reports holds on to using RCP- 8.5, without presenting the adjusted AEP, and presents various arguments for doing so. It appears that Jacobs has drawn from Ministry for the Environment’s (MfE) advice on this matter.

The MfE was guilty of misleadingly representing the RCP-8.5 metric as a ‘business as usual’ scenario in its ‘First National Climate Change risk assessment (2020)’. The Ministry appears reluctant to admit to its mistake and in its 2024 ‘Coastal hazards and climate change: Guidance for local government’ it makes the case for retaining RCP- 8.5. This is argued in box 3 ‘Should the high end SSP- 8.5 be used in coastal planning’.

[2] One tenth is a conservative assumption. It could well be one twentieth in which case the AEP would be 1.:2000

It concludes that RCP- 8.5 should continue to be used to 'allow high-end stress testing of adaptation options and pathways'. As noted above stress testing is fine as long as the AEP is appropriately calculated. However, the MfE missed this critical proviso in its discussion.

The MfE also argued that because sea levels are expected to keep on rising for some time the sea level predicted by RCP-8.5 for 2120 will be hit using the RCP-4.5 assumption but later, say, by 2200. But using the RCP-8.5 result is still misleading. It presents a 2200 result not a 2130 result. If the MfE wanted Councils to produce a mean sea level assumption for 2200 then it should have said so directly, not misleadingly present what is a 2200 estimate as a 2120 estimate.

In its stage two report Jacobs presented a similarly misleading argument. For a given RCP the IPCC modelling presents a range of temperature outcomes reflecting different results from the dozens of modellers that contribute to the IPCC's future temperature projection process. This reflects scientific uncertainty about the impact of greenhouse gases on temperature. Jacobs argue that because the most extreme of these models using RCP - 4.5 can produce as high a temperature as some of the lowest RCP-8.5 results it is 'appropriate' to use RCP-8.5. The problem with this argument is that the probability of the most extreme model forecast being right, and hence overlap with the RCP-4.5 projection is very low. Hence we are in the same position as we were with the RCP scenarios. A low probability event is being misrepresented as a mean scenario.

There is also an issue with Jacobs' assumptions on vertical land movements (VLM), which increases the effective sea rise projections. Sean Rush (Is Wellington Sinking) suggests that the science basis for the VLM assumptions is insecure and that should be set aside.

Inundation methodology

The key problem here is that Jacobs and hence the CAP have used a simple model, the bathtub model, to calculate inundation AEPs, rather than a more sophisticated and appropriate dynamic model. The bathtub method works by assuming that any land that is below the assumed maximum sea level rise during the 1:100 year event will be inundated. A dip in the land even distant from the coast with no pathway to the sea is assumed to instantly fill with water. Which of course is obviously wrong. If this methodology were applied to the Netherlands then a significant part of its built environment would be underwater.

Many of the houses identified as being subject to a 1:100 year inundation risk would not be captured by the more appropriate dynamic methodology, which takes account of flow pathways and the time available for the sea to inundate properties. The peak sea level rise

takes place at the highest level of the tide and will naturally drop after a few hours in most cases.

In their part one document Jacobs made the following statement:

The dune ridges along the Kāpiti Coast District shoreline are generally higher than current estimates of extreme sea levels including allowances for SLR over the next 100 years. Therefore, depending on shoreline erosion characteristics, the dunes will continue to provide a barrier to direct inundation by the sea along the majority of the coast.

And Jacobs said that their use of the bathtub method was just provisional.

However, it should be noted that new flood models being developed by KCDC are expected to become available during the course of the project. These new models will allow a more detailed simulation of the combined flooding from coastal storms, pluvial and fluvial events and can be used to further support the development of adaptation pathways as required.

The Council's report has not been forthcoming but Jacobs does not appear to have backed off its bathtub driven advice.

The difference between the bathtub and dynamic methodologies is illustrated in an Otago Regional Council assessment of sea level rise impacts on Dunedin South. Figure one shows inundation depths using the bathtub method. Serious inundation is indicated. Figure two shows inundation using a dynamic model. The sea level rise problem substantially disappears and can be mitigated by improved drainage.

Figure one: Bathtub assessment Dunedin South

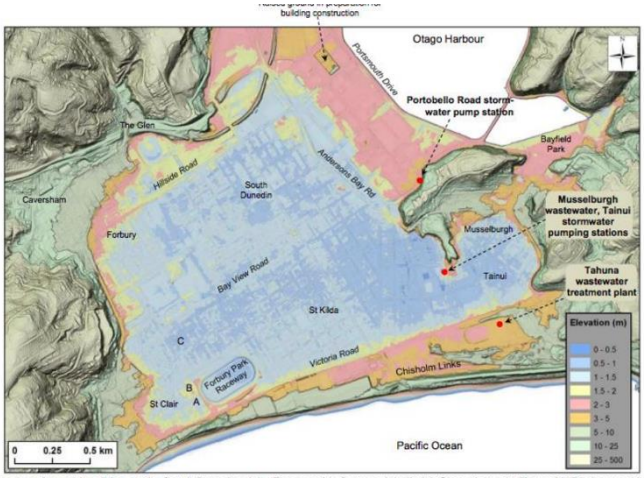

Figure 3. Topography and localities on the South Dunedin plain. Topographic features labelled A-C are shown in Figure 20. Background image is Dunedin City LiDAR, flown 2009, and coloured according to elevation. Elevation is in metres above MSL (mean sea level).

Figure two: Dynamic inundation: Dunedin South

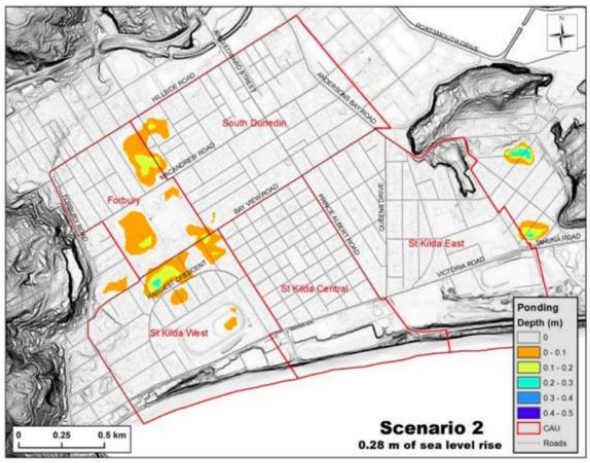

Figure 41. Above-ground ponding for 0.28 m of mean sea level rise, relative to the 2003-2015 average

Dunedin South is a more pronounced case of the difference between the bathtub and dynamic assessments. Figure 3, which shows the differences for Gisborne, may be a better guide for Kapiti. The figure on the left, the dynamic assessment, shows that there would be a limited incursion into Gisborne City. With the bathtub method (on the right) it is much more pronounced.

Figure three: Bathtub and dynamic method comparison. Gisborne.

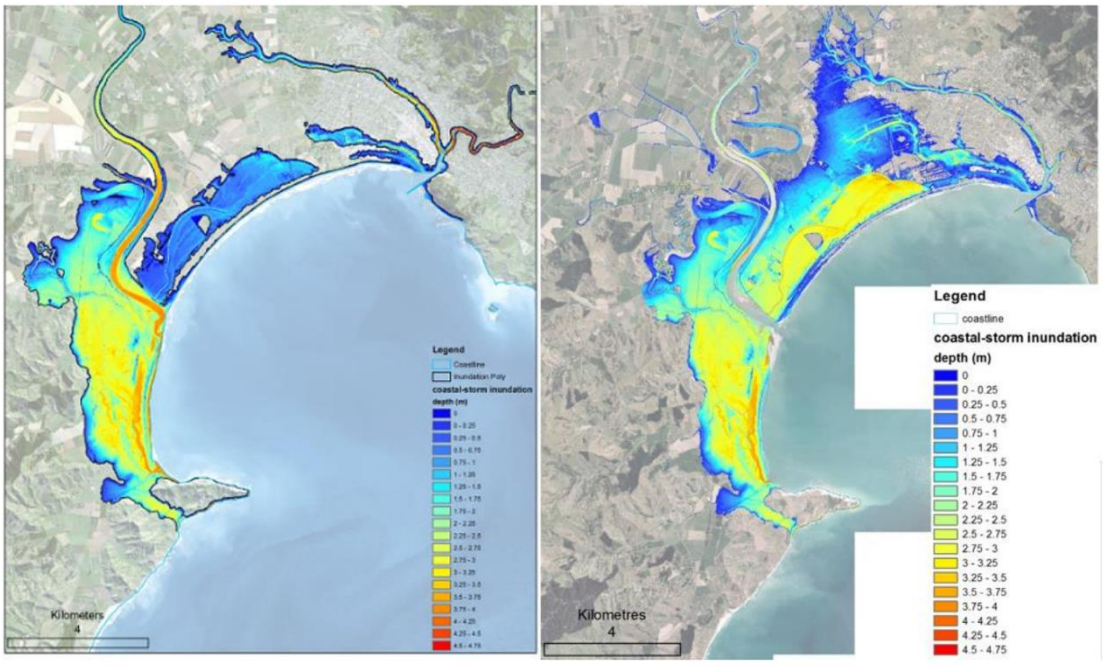

Figure 2-6: Comparison of coastal inundation in Poverty Bay (Gisborne District) estimated from dynamic (left) and bathtub models (right). Note the larger coastal inundation extent created by the bathtub model. Source: Stephens et al. (2015b).

There are other issues with the CAP's presentation of the risk. First, the expression 'inundation' can be misleading. It can give the impression that houses will be fully or significantly under water. What it actually means that for houses on the AEP boundary line will just be touched at the bottom of their foundations and then most likely just for a few hours.

Second, it is assumed that all houses are built flat to the ground, which obviously is not true. In our opinion the risk assessments of impacted houses should have assume a standard foundation of, say, 300mm. We note that a partial adjustment for this was made in the Economic report when assessing damage, but this was not done in the earlier reports that estimated the number of houses at risk.

Seawall maintenance assumption

It was assumed that existing seawalls would not be maintained and would fail after 10 t0 30 years. The coast reverts to its natural profile after a relatively short period. This assumption may account for much of the projected erosion in areas currently protected by sea walls. This is an unlikely assumption. Property owners are unlikely to systematically give up maintaining or enhancing their seawalls at a time when risk is increasing. There was no discussion of why this assumption was adopted nor were alternative assumptions suggested.

Part four: The MCDA framework

The logic of the Multi-Criteria Decision Analysis (MCDA) is to produce a quantified assessment of community 'values', CAP judgements, and 'expert' inputs. A single number is produced i.e. 64 (with high being good) for each option and area. The pathways can then be ranked from low to high, with only the top three being selected for an economic evaluation.

At this point the costs of the options do not enter into the evaluation. Jacobs explanation for the two step process is.

There is no cost-based decision included in the MCDA assessment. This allows for the non-monetary elements of different short-listed potential pathways to be assessed separately without financial bias, prior to a separate economic analysis being undertaken of the short-listed pathway.

It is considered that allowing for the CAP to explore all options from a core values perspective, before factoring in the realities of funding, is beneficial to the decision-making process as it will ensure pathways are not discounted initially from a cost perspective, allowing the consideration of significant benefits across a realm of criteria which the community may be willing to pay for.

In our view this two stage process makes little sense. It makes for a preliminary focus just on the elements that are just likely to be a minor part of the decision making process and which are typically assessed subjectively and opaquely. It is distinctly odd to spend two years analysing the impacts of climate change without any regard to the costs of preferred actions. Taking account of costs at an early stage of a process is not a bias, it is just good sense.

The reality is that the climate change response will largely come down to costs. Once a good cost benefit analysis is put before the public it will largely drive the decisions.

The economic analysis, which we discuss below, shows just how off-beam the MCDA process was. As noted in our introduction the top MCDA assessment produced generated benefits that were just one percent of the costs. The CAP will probably argue that the economic analysis does not account for other factors that the community values such as recreation, ecology and landscape. However the CAP would then have to explain how these factors would offset the billions of dollars of costs and many years of neighbourhood blight caused by managed retreat.

Jacobs discusses how this process went when the Hawkes Bay went through a two-step process.

When the overlay of the economic assessment tools from the ROA (Cost + Loss; and Value for money) was made in that process, most of the Adaptation Areas were well aligned in terms of MCDA ranking and the ranking from the economic tools. However, there were a small number of Adaptation Areas where the economic factors were so significant that the Hawkes Bay CAPs moved from their initial preferred pathways to a different pathway, as this recognised that the community could not afford the initial preferred option.

This description of the Hawkes Bay outcome is misleading. Most of the adaptation area decisions (as measured by the number of affected properties) were reversed when their community consultation groups became aware of the costs and benefits.

Further, the Hawkes Bay process was only applied (except for a couple of small areas of Napier) to the thinly populated ribbon coastal developments to the north and south of

Napier. It seems to have been taken as a given that Napier city would not be abandoned. By contrast the Kapiti CAP is at least contemplating managed retreat for large parts of Kapiti.

MCDA information sheet

Very recently the CAP released a public information sheet on the MCDA
The steps in the process are described as follows.

Step 1: Develop decision criteria.

They are:

(i) *Community, social and economic wellbeing values.*
How the pathway options will impact the community and social cohesion.

Logically this criteria does not fit with the separation of 'values' from the elements in the cost benefit analysis. A good cost benefit analysis should at least capture economic wellbeing.

(ii) *Ecology*
How the pathway impacts the habitat of indigenous or other species

(iii) *Landscape*
Impact on natural character and landscape.

(iv) *Public access and recreation*
Impact on public's ability to access the coast and carry out recreation activities

(v) *Te Ao Maori values*

(vi) *Effectively manage the risk of coastal erosion*

(vii) *Effectively manage the risk of coastal inundation*

(viii) *Regulatory consenting and policy risk:*

Step 2: Assign weights to the criteria.

The weights reflect the CAPs opinion on whether the criterion is important (weighting of 1), very important (2), or critical (3)

This allows only a limited recognition of the differences in importance. Obviously effective management of the risk of coastal erosion and inundation is extremely critical. Indeed it is the point of the exercise. But this criterion can only be assigned, at most, three times the weight of much lesser concerns.

Importantly the weights assigned to the decision criteria are not disclosed in this presentation. However, there is more, and apparently inconsistent, information in the develop pathways section presented to the Waikanae Community Board. Of the 7 criteria 5 were rated 3, which is a neutral rating; one (landscape) was rated a 2 (undesirable); and one (consenting and risk) was rated a 1 (highly undesirable). We were unable to make sense of this information.

Selected pathways

Three selected pathways were presented to the Waikanae Community Board on 2 April 2024. But no information was provided on the MCDA score for Waikanae Beach. As this is the flagship result of the process and Waikanae Beach is a large population centre , this was a bad omission.

Step three: Scoring pathways

This is meant to explain how the scoring works.

"During the MCDA scoring process each pathway is given a scoring of between 1 and 5 for each management unit within the adaptation area. The higher the score the better the option is. But the pathways are not just given the overall score, they are scored against how beneficial each pathway is for each of the decision of the decision criteria.

The scores that have been given to each pathway are then adjusted according to the weighting assigned as done in Step 2 of the MCDA process.

We were unable to understand from this description how the overall scores were calculated. There is no description of how and why each pathway was assigned a rating of between 1 and 5. At the least a worked example would have helped.

Finally there is an explanation of why the MCDA is a good process.

How does CAP know which pathway is best for each of the criteria.

*CAP is supported by a Technical Advisory Group(TAG) which include (*sic*) a group of subject matter experts in each of these areas who advise CAP on how each of the criteria will be negatively or positively impacted by the pathways. TAG provided pre-scoring commentary for CAP to consider. The technical criteria are scored by TAG and mana whenua score the te ao Maori values criterion and CAP score the remaining criteria.*

This description should not give much confidence. From our reading of the 'expert' advice provided to the CAP much of it appeared to be simply made-up and in some cases obviously wrong.

It appears that the CAP, at least initially, was uncertain as to how the process would work. From the minutes of one of their meetings there is:

There was discussion among the room on how the scoring is arrived to, and how the social aspects are given numerical values. It was emphasised that in previous processes this has come to the forefront naturally and this is a process which needs to first be undertaken to get to the point of scoring.

And the CAP was assured that:

the science has been peer reviewed by Beca and Greater Wellington Regional Council, is robust, best practice and fit for purpose.

This was misleading. Beca and the Regional Council did not review the MCDA.

Our reading of the relevant material did not give us confidence that the process has produced meaningful results.

Part five: Application to Waikanae Beach

In this part we walk through how the methodology was applied to inundation risk for Waikanae Beach.

Define objectives
The starting point were a set of questions designed to explore community values.

For the Central Adaptation Community the questions were:
1. What do you value most about living here?
2. How important is our coastline to you and why?
3. How concerned are you about coastal hazards and why?
4. How do you think our coastline should be protected?

The next step was to translate the answers into objectives. How this was done was not explained. This leaves plenty of room for the CAP to insert its own (and the Council's) values and predispositions into the process.

For the Central Adaptation Area: the objectives were:

Plan and implement sensible adaptation solutions that recognise the natural and relaxed coastal community feel as the coastline evolves over time by:

- *Protecting the mana of the coast, dunes, biodiversity and river and wetland areas*
- *Utilising natural solutions where practical*
- *Adapting our public recreational assets and services*
- *Keeping the community informed and involved about the types of solutions and associated costs*

These objectives were so general that it is difficult to see how they could be translated into practical decision making.

Further the CAP appears to be biased, less concerned about faithfully translating what people want than presenting some CAP's members' opinions. The minutes in one meeting read:

Jim commented that many of the CAA community's themes are about retaining status quo and the whole exercise of the CAP is about changing the current status quo. Stephen agreed with Jim, and people need to understand the science to realise that things are going to change. Bringing the community along on the journey is an important part of the CAP's community engagement and feedback events.

Far from keeping the community informed of the costs, the CAP, effectively controlled by the Council, have kept the community in the dark on costs for as long as possible.

Risk assessments

Here we discuss inundation risk for Waikanae Beach.
The risk assessments were conducted for SSP-4.5 and SSP-8.5.
A colour coded table (green, yellow, orange and red) represents the risk for a number of categories: built environment; ecological; human and natural character. These categories are broken down into a number of subcategories. The human category, for example, includes: displacement; inequities; health, and daily routines.

The inundation risk assessments are presented as extreme (red) for roads and bridges, and ecological sites and health even under RCP 4.5. The assessments were implausible. The economic report said that risks to roads and bridges were generally low because they would not be subject to fast flowing water and were designed to be inundated for a short period of time.

And the idea that community health is at extreme risk because once every 100 years some people will be subject to some nuisance flooding and some will face more serious damage, obviously does not make sense.

Part of the problem here is that the 'experts' have followed MfE (2020) guidance on risk assessment, which is not necessarily intuitive or helpful, if not interpreted carefully. We will expand on this point in a later full scale report.

The other information provided is a map showing the inundation hazard (but only for SSP5-8.5) and a table which shows the number of affected properties. The map with marked blue inundation areas, without a careful explanation, presents the risk that the map will be interpreted as meaning that the blue areas will be permanently under water, when it just means that it will be subject to a 1:100 inundation risk. Further the inundation risk assessment used the 'bathtub method', which as discussed above, likely substantially overstates the number of houses at any material risk of serious flooding.

The information on the number of properties affected is as follows.

Table one: Properties affected

Sea level rise	Flooding		Erosion	
	SSP2- 4.5	SSP5-8.5	SS2-4.5	SSP5-8.5
Current	107	107	0	0
0.2 c. 2050	210	210	27	27
0.35 - 0.45 c. 2070	332	398	27	27
0.85 -1.25 c. 2130	721	928	30	107

There is no explanation of what 'property affected' means. We assume that it means that it is exposed to a 1:100 year risk of being inundated or subject to erosion. Here caution needs to be adopted in interpreting the data. A property might be at risk but not the house if it is set back from the seaward boundary. Notable there are no substantial differences between the SSP2-4.5 and SSP5-8.5 assumptions until 2130.

What is probably driving the appearance of a serious emerging problem (928 houses 'at risk' by 2130) is the use of the bathtub assumption. As noted above if a proper assessment of the risks due to a combination of drainage issues and sea level rise had been done then some of the problem might go away. Certainly the nature of the problem and its solution would change. It becomes when and where to supplement gravity drainage with pumps, use shutoff flaps for stormwater drains. Dykes and floodgates will have an important role in the later years.

Determine options and actions.
This page just presents a menu of possible actions. What will be appropriate and what in order can only be determined by a consideration of costs benefits and efficacy.

Multicriteria decision analysis (MCDA rating) weightings and analysis
Application to Waikanae Beach (inundation).
Only pathways 3, 4 and 5 are evaluated. Pathway three involves the long term decision to elevate or flood proof buildings. 4 and 5 involve retreat in the long term. For the reasons discussed above these conclusions are a costly and unnecessary over reaction. This becomes very clear when we consider the results of the economic analysis below

Part six: The economic analysis

The economic analysis is complex and provides a substantial amount of information. Our review of the modelling is provisional until we have had the opportunity to obtain answers to several questions about the detailed methodologies and input assumptions. In general, however, the modelling structure appears to be reasonably robust and we have taken the results as given by the purposes of our review. We focus on the benefit cost ratio (BCR), which is a standard way of summarising the results of a cost benefit analysis, which should be a necessary part of the assessment of investment proposals of this magnitude.

The economic analysis is spread over four papers making it more difficult to absorb the economics. The CAP was given only two hours and five minutes to consider the reports.

The four documents are:

- A list of BCR results by the area and damage type codes. It was very difficult to interpret because a key to the codes was not provided.
- A comparison table of the top MCDA and BCR results. The top MCDA number by area was presented, but not the BCRs. It did not allow a ready comparison of the MCDA with the BCR for the same pathway. Again it was difficult to interpret the results.
- An economic analysis of the pathways. This covered the main assumptions and modelling structures, and a description of decision/information metrics. The main output is a table of results set up to allow comparisons. The BCR was not included in the table. The BCRs were relegated to a separate table at the bottom of the report.

- A methodology manual. Many of the assumptions presented in the manual would have been critical to the results.

In table two we present the significant area results for the erosion and inundation costs and benefits. The costs and benefits are additional to continuing the status quo (the baseline). The following are our key take-outs:

- With respect to erosion costs and benefits the Council's interventions increase rather than reduce net costs. The present value baseline costs for the five areas presented here are about $730 million. The costs with intervention are about $1340 million. Good policy interventions should reduce not increase those costs. The BCR ratios are all below 1 (the breakeven point where the costs match the benefits).

  There were some areas, not reported below, where there are some minor net benefits.

- With the inundation costs and benefits there is a huge difference between the status quo and the policy interventions. The climate change costs increases for the non-intervention strategies total under $100 million. The interventions have a present value cost of over $1.9 billion. This was driven by the four cases where the preferred MCDA option was managed retreat.

- Note that the numbers presented in the table are present values. Future values have been heavily discounted to the present because a high discount rate (5 percent) has been used. The actual future costs, given Jacobs assumptions, are likely to be well in excess of $5 billion. The BCRs clearly show just how bad the retreat policies are. The BCRs for Waikanae and Peka Peka were 0.01. That is, for a $1 investment the return is one cent. The 'best' BCR outcome was 0.03.

Table two : Significant economic outputs

	Long term Option	**MCDA**	**Total costs and losses**	**BCR**
Erosion			**$m**	
Peka Peka PW-5				
Baseline		87	13.1	
Option	Retreat		73.6	0.05
Raumati Nth PW-				

Baseline			188.7	
Option	Replenishment	53	337.6	0.41
Raumati Sth PW4				
Baseline			377.4	
Option	Re-establish the line with a setback seawall and dune reconstruction	57	561.5	0.54
Paekakariki Nth. PW3				
Baseline			53	
Option	Re-establish the line with protection structure	64 tied	206.4	0.17
Paekakariki Sth. PW3				
Baseline			97.1	
Option	Enhance Seawall		168.9	0.43
Inundation				
Otaki - PW3				
Baseline			46.1	
Option	Retreat	83	757.4	0.03
Te Horo -PW3				
Baseline			9.2	
Option	Retreat	83	84.4	0.02
Peka Peka-PW3				
Baseline			7.6	
Option	Retreat	85	90.5	0.01
Waikanae PW5				
Baseline			17.5	
Option	Retreat	62	938.5	0.01

Paraparaumu PW3				
Baseline			15.7	
Option	Accommodation	62	56.3	0.40

The Jacobs economic reports also introduced a novel decision metric which it calls 'value for money'(VFM). It divides the total "cost + loss" estimate for each pathway sequence by the total MCDA score to provide the cost of each MCDA point. A high dollar score is bad. We have never seen this metric before and Jacobs did not cite literature to support its use in decision making. In our view the 'value for money' metric mixes different concepts and at the least is difficult to interpret. Our advice would be to ignore the VFM results and focus on the BCRs.

Where to from here with the economic modelling

We would need a more detailed understanding of the models to provide a full list but the following present themselves.

- The inappropriate sea level rise and impact assumptions should be replaced with the best expected values.
- The economic analysis should be re-run for all of the plausibly effective pathways. The CAP may have selected out some of the more effective pathways with their MCDA scoring process.
- Some key assumptions should be addressed.
    - The cost of retreat looks to be too high. It was set at 2.5 times the value of a house, because this was the number used in the Hawkes Bay exercise. But that was for a small scale retreat. There could be 'economies of scale' for the large scale destruction of communities such as Waikanae Beach.

    - It is assumed that owners do not maintain their seawalls and that they cease to become effective over 10-30 years. The logic of this assumption and its impact on coastal erosion needs to be clarified and the assumption changed if appropriate to reflect the reality that people will be more inclined to protect their properties as the threat grows.

    - The assumptions on the timings of managed retreat needs to be clarified. There will be dates in the model but they are not disclosed.

Part six: Coastal planning and providing information

In this part we briefly discuss coastal planning and the provision of information on sea level rise hazards by the Council.

On coastal planning the CAP was informed by a Council officer that they were expected to provide advice on coastal planning. This did not appear to be the CAP's mandate and the CAP does not have the skill set to do even a brief advisory job. The concern here is that the Council might argue that coastal planning has already been consulted on during the CAP process and that it does not have to consult anew.

The more substantive concern is that the Council will use the prospect of managed retreat to justify draconic constraints on building work within the 'hazard' areas. The Council's logic might be that the properties are to be abandoned in the future so adding to their value will only add to the cost of retreat.

There is probably little objection to constraints on large scale subdivisions and critical infrastructure investments. But constraints on alterations and additions and pepper potted new developments, and on the nature of developments (i.e. must be removable) are a different story. There is a risk that unreasonable Council controls will impact on property rights and reduce property values.

With respect to the provision of information, particularly on LIMs, the Council does have a legal obligation to provide information from its hazard assessment. But that information in the words of the Justice Williams in the Weir v Kapiti District Council case, 'must be accurate and state the position fairly'. The information relied on by the CAP and likely to be used by the Council, does not meet this test. The CAP and the Council were aware from the Jacobs report, that the bathtub methodology overstated the risks, sweeping in many properties that did not meet the AEP 100 test. The Council undertook to provide the information that would provide a more comprehensive assessment, but failed to so.

Some people might also rely on the Greater Wellington Regional Council's storm surge inundation mapping tool (https://mapping1.gw.govt.nz/GW/SLR/). This tool does not meet the Court's requirement to provide an accurate and fair representation of sea level rise impacts. It does not obviously explain that the water height lines presented are for a 1:100 year event. Many people would have the impression that their homes will be permanently inundated. Second the GWRC did not explain that they were using the bathtub method which can substantially overstate the extent of inundation in many circumstances.

Conclusion

It seems clear that the main role of the CAP was to provide 'consultation cover' for the Council to press ahead with a pro-managed retreat agenda. But it is equally clear that this does not make economic sense. The two large managed retreat proposals for Waikanae Beach and Otaki Beach have BCRs of .01 and .03 respectively. It is obvious why the Councils' 'premature evacuation' strategy does not work. It ignores the value provided by property in the time before retreat does become necessary because defensive structures lose their effectiveness (if that occurs at all over a reasonable time horizon). An additional 50 years of occupancy value represents most of the value of a house, so it does not make sense to abandon a house too early.

It also appears that the CAP evaluation process has been structured and managed to direct attention away from the above economic reality. The CAP spent more than two years on a MCDA process that did not produce transparent and robust results. The economic analysis was delayed as long as possible and presented in a way to make it more difficult to see and understand the BCR information.

In our view the MCDA analysis should be largely scrapped and attention should focus on the BCR results. More information should be provided on the economic analysis and the economic processes rerun to ensure that the best adaptation time paths are being identified and evaluated.

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