



APPENDICES MINUTES

**Hui Poari ā-Hapori o Raumati |
Raumati Community Board Meeting**

Tuesday, 30 May 2023

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Comments on Jacobs's Methodology Report (Volume 1)

Coastal Ratepayers United
July 6 2021

Kāpiti Coast
New Zealand

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INTRODUCTION

Jacobs have published *Kāpiti Coast Coastal Hazard Susceptibility and Vulnerability Assessment Volume 1: Methodology* to "update previous coastal hazard assessments undertaken along the Kāpiti Coast District shoreline" to assist the KCDC's "Takutai Kāpiti: Our community-led coastal adaptation project".

The scope was set out in the contract between Jacobs and KCDC and is described in this report.

Coastal Ratepayers United Inc. (CRU)¹ represents the part of the Kāpiti community directly affected by the immediate coastal hazards and has over a decade's experience dealing with the technical issues that arise with assessing these. While Jacobs' Assessment is a significant step forward on previous assessments, in our view a number of professional judgments and technical assumptions made in it detract from the report and its usefulness for KCDC and the community in supporting its stated purpose (1.1), particularly its use for Hazard Assessment under the NZCPS for planning purposes.

Given the amount of time that CRU has had to review Volume 1, we have limited ourselves to identifying the material issues without quantifying their impact in detail or necessarily suggesting what should be done. However, we consider these issues are sufficiently significant that they require either amendment of Volume 1 or comment on the reasons for the choices made and any consequent limitations before proceeding to Volume 2.

We also make clear this in the nature of a review only and should be read in the context of the time and resources available to it. It is possible that these issues stem from misunderstandings or lack of information e.g., key data, raw data and code that has not yet been published.

KEY ISSUES

1. **Pervasiveness of "conservative" Approaches in the Report.**
2. **Relationship between Global MSL and Local SL.**
3. **Trigger Points**
4. **Use of RCP 8.5H+ and de facto Adoption of RCP 8.0 for Sea-Level Rise (SLR).**
5. **Treatment of Vertical Ground-Level Movement.**
6. **Treatment of Accretion when it Outpaces SLR**
7. **Use of Bruun Rule and Lack of Validation.**
8. **Linear Model in Time for Historic Trends.**
9. **Treatment of Options for Sea Walls.**
10. **Uncertainty Distributions and Materiality.**

¹ See Appendix for more information about CRU

1. Conservative Approaches

As a general comment, we have been struck by the pervasiveness of "conservative" approaches presented in the report. A partial list includes the Bruun Rule (section 6.4.3), coastal inlet migration (6.7.3), the bathtub model (7.2.2), extreme sea levels (7.3.1) and groundwater levels (7.3.3).

A strong conservative bias, like any other form of bias, is highly undesirable for planning purposes. By forcing the analyst's own risk preferences on to the decision-makers, it may lead the community to avoid selecting futures that would better accord with the community's own risk preferences.

We strongly encourage Jacobs to review its conservative choices and to balance them with non-conservative estimates wherever possible, even if that must reflect unsupported expert judgement. This is necessary so that the Community Panel can better understand the uncertainties inherent in the analysis. Making a single conservative choice simply hides those uncertainties.

2. Relationship between Global MSL and Local SL.

The Report directly incorporates GMSL projections (adjusted for local relative movements) in its model to project Kāpiti coast's RSL, and from that the shoreline. While MfE (2017)² uses this approach in its Guidance (Section 5.6), its use in any specific location should be tested empirically to ensure that the local historic observations (without local relative movements) are material, are significantly correlated with GMSL³, and the parameters derived from this relationship are robust.

To achieve this the Report depends upon Bell et al. (2018) which is an update of Bell et al. (2012). The latter was subject to a review commissioned by CRU by de Lange⁴ that addressed this specific issue⁵ along with others that have largely been acknowledged in the Jacob's Report. While time has passed since de Lange was written the conclusions still should be addressed by any user of Bell et al. (2018) or MfE (2017).

Primarily de Lange suggests GMSL Projections may not be the dominant driver of Kāpiti coast's RSL and the historic relationship between them is weak.

Since 2012 the evidence has increased that other factors (e.g., tectonic processes) are even more significant and uncertain at Wellington. Consequently, if these factors are not being appropriately identified then analysis of the historic relationship of the residue (local absolute SLR) with GMSL will be unreliable, as is noted by the various references when discussing the statistical significance of this relationship. This then will impact on the parameters used in the projections of Kāpiti coast's RSL.

A particular aspect of this problem is that the historic time series of estimated absolute local SLR can have models other than a simple linear relationship with a particular breakpoint fitted to it. The breakpoint analysis used in Bell et al. (2012) is not particularly sophisticated in the face of known regime changes whether natural (IPO, ENSO) or man-made (measurement techniques).

² References are to the corresponding reference in the Jacobs' report Volume 1.

³ The problems of downscaling Global MSL projections to regional projections are well understood e.g., IPCC (2013a).

⁴<https://researchcommons.waikato.ac.nz/bitstream/handle/10289/9662/Comments%20on%20GWRC%20DCCS.pdf>

⁵ We note that Bell et al. (2018) does not reference the issues raised by de Lange or his report itself.

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This issue is potentially material and should be discussed in the Report to justify the judgements made, and with that, the parameters and error estimates used in the assessment of the Kāpiti coast's RSL.

3. Trigger Points

When managing hazard risks from an evolving process there are two distinct ways of identifying when a vulnerability might occur.

One is the use trigger points of physical events such as a particular amount of sea-level rise. This is encouraged by MfE (2017) and focuses on triggering actions to manage a risk by the physical proximity to the hazardous event. We strongly endorse it for this use, particularly where triggering regulatory action is involved. Residents can typically assess what is happening over time and by using that can judge the consequences and how far off they might be. It also gives greater certainty because the regulations do not need to change depending on the actual pathways that evolve.

But equally, interested parties want to understand the likely future risks with only today's knowledge. Risk assessment, particularly the consequences, is tightly tied up with estimates of how long before they will occur. They are interested in where the envelope of likely pathways ends up over a particular period, and over time which pathways are being eliminated (or added). In this case the trigger points for adaptive management have become the pathway that is evolving. This approach allows people to test the sensitivity of investment decisions to the pathways, and even to delay investment to achieve a better understanding of the pathway that is occurring.

So, both needs should be accommodated in any assessment (as per the caption of Figure 3.2).

Focusing scenario runs around the fixed shoreline triggers alone, as appears to be happening in Sections 4.2 and 6.1, runs the risk of losing information about the dynamic that is unfolding — the likely pathways, and the uncertainties that will get resolved by time. It is easy enough to derive physical trigger points from scenario-based pathway analysis, but more difficult the other way around, so we recommend this be the former be the used in the risk assessment (see next section).

4. Use of RCP 8.5H+ and de facto Adoption of RCP 8.0 for Sea-Level Rise

The NZCPS Policy 24 requires hazard identification and assessment to be done "taking into account national guidance and the best available information on the likely effects of climate change" i.e., it is to be based on the likely effects, and the usefulness of any guidance/information is constrained by this requirement⁶.

This requirement to be "likely" informs the remaining Policies including Policy 27 (1) and Policy 27 (2) (b) that references "the expected effects of climate change," back-referencing to the requirement to be "likely". Significantly, Policy 25's "In areas potentially affected by coastal hazards over at least the next 100 years ...", is defined by Policy 24, that is in turn based on the "likely effects of climate change". Thus MfE (2017)'s view that Policy 25 requires the use of more extreme, i.e., "potential", effects is based on a misinterpretation of the law.

SLR is the primary effect of climate change considered by the Report.

RSLR projections from IPCC (2019) and MfE (2017) are given in Table 3.1. These are adjusted by the extremes of VLM to give Table 3.2, then rounded to give a series of RSLR projections in Table 3.3. These are then added to the estimated extreme sea levels based on a 1% AEP to give the input (Table 4.2) into calculations of impact on shoreline giving "SL" that is used in the probabilistic assessments.

⁶ See, Allin "The Kapiti Fiasco" <https://www.kapiticoast.govt.nz/media/29153/chapter-3-allin-appendix-1-allin-crozier-gwrc-pnpr-submission-received-14-july-2016-2.pdf>

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This methodology uses an RSLR projection from RCP 8.5H+ as the upper scenario, RCP 2.6 median as the lower, and de facto uses figures similar to RCP 8.5 for the 2120 "Intermediate Projection".

The assumed minimums and maximums applied to SL (or its components) in the probabilistic assessment are not given — they will not be published until Vol. 27.

These scenarios and the projections derived from them are unlikely⁸, and all the probabilistic analysis will give is the likely range of unlikely futures. This will not be particularly useful in any application of the NZCPS.

MfE (2017) is explicit about the function of RCP 8.5H+ — it is only there for the "purposes of stress-testing adaptation plans where the risk tolerance is low and/or future adaptation options are limited, and for setting an SLR for green-fields development where the foreseeable risk is to be avoided" (p. 100).

Hence RCP 8.5H+ clearly is not "national guidance ... on the likely effects of climate change". It is only going to be of use for cities like Wellington where a major port and much of the CBD might be at risk. Its application to Kāpiti is difficult to see.

In respect of the suggestion that it gives better coverage of ice sheet melt, IPCC (2019) postdates MfE (2017) and is a much broader-based review than it. Section 4.2.3.3.1 explicitly discusses the weaknesses in the alternative methods such as Kopp (2014) used by MfE (2017), and even MfE (2017) acknowledges this issue (Section 5.4.3)⁹.

IPCC (2019) explicitly says its projections are designed to capture the "likely range of RSL" (Section 4.2.3.3.4) with the implication that Kopp (2014) and other more recent contributions based on similar methodologies do not.

RCP8.5 is de facto used as approximately the 2100 intermediate projection. For that to be useful under the NZCPS, RCP8.5 would need to be a "likely" scenario, able to inform the "likely effects" of climate change.

A series of papers in Climate Change 109 (2011) describe the RCP scenarios and their construction, including an overview¹⁰ and RCP8.5¹¹. RCP8.5 is the highest of what was designed as the reference scenarios i.e., no policy action. It gives an upper bound on these (i.e., "Compared to the scenario

⁷There is some curious language in Section 6.1 that says the probability distributions for PFSP arise from "pre-determined increments of SLR" possibly implying that Table 4.4 is applied deterministically i.e., its uncertainty is excluded from the probabilistic calculations. This seems highly unlikely since the timing of any hazard arising is central to its management. The community will need to have this uncertainty quantified as best as possible, and this is essential for setting any triggers/adaption thresholds in adaptive planning. Regardless the problems of using "unlikely" RCP scenarios still apply.

⁸MfE (2017) is incorrect to state likelihoods cannot be assigned to these scenarios (5.7.1). They are a product of the assumptions that go into them, and assessments can be made of their likelihood. The lie to MfE (2017)'s assertion occurs with it saying in the next breath: "It will be challenging, however, to achieve the lowest RCP2.6 M scenario as described earlier, because of the rapid and large reductions in emissions required globally".

⁹Ironically CRU had raised the same objections citing similar literature when commenting on a draft of MfE (2017) but these were put aside by the authors.

¹⁰<https://link.springer.com/article/10.1007%2Fs10584-011-0148-z>

¹¹<https://link.springer.com/article/10.1007/s10584-011-0149-y>

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literature RCP8.5 depicts thus a relatively conservative business as usual case ..."). For a fuller discussion see a recent article by Zeke Hausfather¹²

RCP8.5 assumes no policy interventions and along with other assumptions each of which is in the nature of "possible" not "likely". Jointly they become highly unlikely.

In fact, if countries reduce their emissions in line with the Paris targets, then there is no possible future in which the climate changes in accordance with RCP 8.5.

It would be remiss of Jacobs not to draw the inconsistency to the attention of the Community Panel and to provide the Panel with sea-level estimates which are consistent with plausible expectations of the future path of global emissions. This is not to say that such scenarios are the only ones that should be presented, but they should be emphasised as the "likely" future and as such should legally be the ones that inform our District Plans.

RCP6.0¹³ includes a reference scenario based on "no-climate-policy" (and further, assumes any existing policies are retired when they expire). This scenario only reaches 7 Wm⁻² and would better represent the no-policy intervention scenario, although given the various international processes and agreements since AR5 (e.g., Paris) a reversion to "no policy" and 7 Wm⁻² by 2100 would be regarded by most as unlikely. This is particularly so considering technological innovations over the last decade¹⁴ — these will not be rolled back. Thus RCP6.0 is a reasonable representation of an upper limit for likely emissions.

Based on this IPCC (2019) then gives projected SLRs that take account of more recent information on ice sheet melt, and its published likely ranges gives a distribution based on multiple different climate model runs (and hence climate sensitivities to GHGs)¹⁵. There seems no good reason to move from this for the purposes of applying the NZCPS.

However, there is good reason to expect a more aggressive policy response, and this will be increasingly likely as pathways consistent with RCP6.0 unfold.

Faced with this situation and the use of an adaptive framework, further scenario runs that cover the "likely" outcomes are needed. CRU would expect at least two runs, one based on RCP6.0¹⁶ and another RCP4.5 (broadly as recommended by MfE (2017). The probability distributions of the CED that result will show the likely (P66) and P90 extent of hazard vulnerability conditional upon the "likely" assumptions of SLR over the period.

This is the minimum required to allow the outputs to be used to give effect to the NZCPS in the District Planning processes.

This change will impact any of the other coastal hazards' assessment where SLR is treated as an input e.g., inundation.

¹² <https://www.carbonbrief.org/explainer-the-high-emissions-rcp8-5-global-warming-scenario>

¹³ <https://link.springer.com/article/10.1007%2Fs10584-011-0150-5>

¹⁴ E.g., unanticipated PV and wind generation cost reductions, LEDs, better batteries/EVs.

¹⁵ Note the IPCC gives a distribution for SLR and we would expect that to be used instead of the simple triangular assumption.

¹⁶ The issue of the IPCC sea-level projections ending at 2100 can be addressed in a variety of ways using IPCC projections.

5. Treatment of Vertical Ground-Level Movement.

The local VLM is independent of sea level rise. If the subsidence is 1-3mm/year, the expected effect is to raise the median RSLR by about 2mm/year. Since plate tectonics and climate change are uncorrelated, the effects on the upper and lower limits of RSLR will be less than the additional +/- 1mm/year, and should be estimated by simulation. The figures given in Table 3.2 are accordingly not correct.

6. Treatment of Accretion When it Outpaces SLR.

Section 6.8 makes the comment:

For this mapping product, only the 'hazard' has been mapped, so that where accretion was projected to occur over a specified time frame (i.e., if the long term accretion rate is higher than the effect of SLR) then only the 'present day' hazard (short term and dune stability) has been mapped.

It is unclear if this implies the reducing risk from the "present-day" hazard is not recognised as the shoreline progressively moves seaward over time. If so, any such projection will be incorrect.

7. Use of Bruun Rule and Lack of Validation.

Despite all the warnings about the Bruun rule not applying to accreting, eroding or protected shorelines (i.e., the Kāpiti coast) this is used as if it has the status of a physical model i.e. that with some adjustments it can independently (i.e., a priori) project the impact of sea-level rise on the coastline.

Given the nature of the Kāpiti coastline, this is most unlikely, particularly given the sediment movement on the coast. As the report correctly notes, referencing Morton (2003), sediment budgets are inherently hard to measure. However, the longshore movements are a critical example of the kind of thing that needs to be estimated to apply a physical model.

In light of this, the minimum CRU would expect is some empirical validation of the results from the Bruun analyses by way of hind-casting. This will raise the issue of separating the impacts of longshore sediment movements from sea level rise in the historic records. Doing this is an important issue that is concealed by the current methodology.

We make some suggestions for how to address this in the next section.

We would add that the Bruun rule and adjustments end up with a linear model with multiple parameters and assumptions. This model appears hard to justify based on the level and quality of information available. A simpler model should also be tested perhaps along the lines suggested below, or even simpler still where just the slope of the beach is fitted to the historic record for each transcript within each cell.

8. Linear Model in Time for Historic Trends.

The past long-term rates of shoreline movement are derived from analysis using DSAS to derive annual rates of movement at 50m spaced transcripts using the endpoints and the linear trend in time¹⁷.

These are used to derive parameters for the long-term trends.

¹⁷There is an inherent bias in using the vegetation line for measurement — it responds immediately for erosion, but with a lag for accretion. This should be tested and corrected for if significant.

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An alternative approach that could be used within each of the coastal cells (Fig. 6.6) is to test a simpler but still physical-based model of the change in shoreline position (known independently) being based on a linear combination of (1) longshore addition/subtraction over each time period (not known independently), (2) the accretion/erosion impact of SLR (known independently) at each transept, and a residue covering the processes that are independent of these.

On this approach, longshore changes for any period would be a function of the distance into the cell, and the sea level affects a function of the shape of the transept.

Such a linear model could be fitted to test if it is possible to partial out the two effects on these assumptions and to test the parameters derived from the Bruun Rule.

9. Treatment of Options for Sea Walls.

The assignment of likelihoods to the options for the future of sea walls is inappropriate. It is quite wrong to simply assume that existing structures will be abandoned at the end of their useful lives. That is a possible decision, but for many of the structures being considered, it is not at all a likely one. (Consider, for example, KCDC's current work to renew the Paekakariki seawall.)

These are decisions that will need to be taken and potentially planned for. The consequences of each for the hazard risks need to be understood, along with the options analysis envisaged by Policy 27 of the NZCPS. CRU would therefore expect all three to be modelled to allow the NZCPS to be given effect.

10. Uncertainty Distributions and Materiality.

The minimum, mean and maximum values used to determine the distribution of the parameters in the projections of the CED are yet to be published. An important issue for hazard management is the materiality of each of the uncertainties in the analysis i.e., their contribution. These need to be reported.

FINAL NOTE

The report suffers from poor proofreading. Inadvertently repeated passages of text, spelling errors and the like raise concerns in the reader's mind about whether some aspects of the analysis may also contain inadvertent errors. Generally, the errors do not impair the reader's ability to understand what is being said, except that on pp. 57-58 the authors twice say "perpendicular" when what they seem to mean is "parallel".

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APPENDIX

Coastal Ratepayers United, Inc (CRU) is an incorporated society, most of whose members are ratepayers living on the Kāpiti Coast. CRU was incorporated in 2012, in response to coastal hazard provisions of Kāpiti Coast District Council's (KCDC's) Proposed District Plan (PDP) and the imposition of alarmist and unsupported risk statements which KCDC had decided to place on the LIMs of coastal properties. The Objects of CRU are set out in its Rules:

- a) Take whatever steps are necessary to have reviewed the imposition of hazard lines on LIMs or any other documents;
- b) Make representations to Councils concerning the coastline, including the rights and interests of property owners along or near the coastline;
- c) Undertake scientific, engineering, legal and other research relating to the coastline and provisions to govern activities along or near the coastline;
- d) Make representations, gather evidence and make submissions and appeals concerning any consultative or statutory document, including any Regional/District Plan or draft or proposed Regional/District Plan;
- e) Take any appropriate legal or other action required to further the objectives of the Society;
- f) Do anything necessary or helpful to the above purposes.

Legal action supported by CRU was successful in getting the LIM information fixed. Legal and political action succeeded in getting KCDC to appoint scientific and planning panels to review the PDP and its processes. The science panel found that the coastal hazard information used for the PDP and the LIMs was not fit for purpose, and the planning panel advised that the PDP was so flawed that it was nearly a toss-up whether to withdraw it and start again or try to fix it through the hearings process.

KCDC then withdrew all coastal hazard provisions from the PDP, with a promise to develop suitable new provisions by way of variation to the proposal by 2020 (a promise which was not honoured).

Regarding submissions on the PDP, a case was taken to the Environment Court about the way in which coastal hazard matters were being dealt with, and an appeal against the final approved version, all led to significant other improvements in the Plan.

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Addendum to:

“Comments on Jacobs’s Methodology Report (Volume 1)”

Consequent upon the publication of:

IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change August 2021

**Coastal Ratepayers United
September 2021**

**Kāpiti Coast
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INTRODUCT IO N

In July 2021 Coastal Ratepayers United Inc. (CRU) prepared a review (the “CRU Review”) of a report by Jacobs NZ Ltd for the Kapiti Coast District Council: *Kāpiti Coast Coastal Hazard Susceptibility and Vulnerability Assessment Volume 1: Methodology*. The Jacobs Report was to "update previous coastal hazard assessments undertaken along the Kāpiti Coast District shoreline" to assist the KCDC's "Takutai Kāpiti: Our community-led coastal adaptation project".

The *CRU Review* addresses a number of professional judgments and technical assumptions made in the report that detracted from its usefulness for KCDC and the community in supporting its stated purpose (1.1), particularly its use for Hazard Assessment under the NZCPS for planning purposes.

Since then then the IPCC, has published *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* August 2021, providing a major update on the climate related aspects of the Kapiti coastal processes.

We have therefore reconsidered the *CRU Review* in light of the IPCC AR6 WG1 report and have prepared this brief addendum addressing two areas where AR6 provides additional insights¹:

- 2 **Relationship between Global MSL and Local SL.**
4. **Use of RCP 85H+ and de facto Adoption of RCP 80 for Sea-Level Rise (SLR).**

This addendum should be read in conjunction with the *CRU Review*. In particular, we draw attention to the disclaimers made in the *CRU Review* that also apply to this addendum.

2. Relationship between Global MSL and Local SL.

The *CRU Review* drew attention to the weaknesses in Bell et al. (2018) as used by the Jacobs Report for adjusting the Global MSL rise to give the Wellington Relative SLR. This is needed to assess the impact of GMSL rise on the Kāpiti coast.

The Jacobs Report used Bell et al, 2018 to estimate an average historic rate of RSLR from 1900 to 2017 at 2.28 ± 0.15 mm/yr, compared with a global average rate of rise of 1.7 ± 0.2 mm/yr from 1901 to 2010 (IPCC, 2014). This would suggest applying an adjustment of ~ 0.6 mm/yr to GMSL projections to get an estimate of Wellington RSL projection, but Jacobs instead applies 1 to 3 mm/yr adjustment into the future, not carrying forward several sources of local change on the basis that they are unpredictable.

Jacobs therefore overstates projected RSLR by using the worst case possible.

IPCC AR6 WG1 (2.3.3.3) revisits its estimates of the 1901 to 2010 global average rate of SLR adopting 1.5 ± 0.1 mm/yr (Table 2, Palmer et al (2021)², the basis for IPCC's revision). This change would marginally increase the adjustment to AR6 projections needed to give RSLR at Wellington (~ 0.8 mm/yr). This is slightly closer to what Jacobs assume, but it still overstates the projections rather than incorporating the uncertainty into the overall projection uncertainty.

Denys et al. *Sea Level Rise in New Zealand: The Effect of Vertical Land Motion on Century-Long Tide Gauge Records in a Tectonically Active Region* (2020)³ gives a more extensive analysis of these issues than Bell et al. (2018), and Table 6 shows closure across the country (1891–2013) to within the margin of error of the IPCC AR6 global average 1901 to 2010 rates of increase. This would argue for the use of an average adjustment of only ~ 0.6 mm/yr (2.18 mm/yr less 1.56 mm/yr) to ASLR projections, and also provide the basis for

¹ Carrying forward the *CRU Review* numbering on the two points.

² <https://doi.org/10.1088/1748-9326/abdaec>

³ <https://doi.org/10.1029/2019JB018055>

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estimating the uncertainties for use of this adjustments in the Monte Carlo simulations as set out in the *CRU Review*.

4. Use of RCP 8.5H+ and de facto Adoption of RCP 8.5 for Sea-Level Rise

The CRU Review made the point that the use of RCP 8.5H+ and de facto adoption of RCP 8.5 for Sea-Level Rise did not give effect to NZCPS Policy 24 because these scenarios didn't represent the "likely effects" of climate change. Our comments were based on the literature describing the AR5 RCP scenarios and their construction, and more recent comment along the same lines from Zeke Hausfather.

This has been further reinforced by IPCC AR6.

AR6 has developed the scenarios further, adding different socio-economic development pathways (SSP) to the earlier representative concentration pathways (RCP). Where AR5 had been silent on issues around scenario likelihood AR6 now explicitly addresses it (1.6.1.4). It states:

"In general, no likelihood is attached to the scenarios assessed in this Report. ...

"... However, the likelihood of high emission scenarios such as RCP8.5 or SSP5-8.5 is considered low in light of recent developments in the energy sector (Hausfather and Peters, 2020a, 2020b)⁴. ..."

This is further discussed in Section 4.2.2 where it notes:

"... The high-end scenarios RCP8.5 or SSP5-8.5 have recently been argued to be implausible to unfold (e.g., (Hausfather and Peters, 2020); However, where relevant we show results for SSP5-8.5, for example to enable backwards compatibility with AR5, for comparison between emission-driven and concentration-driven simulations, and because there is greater data availability of daily output for SSP5-8.5. When presenting low-likelihood high-warming storylines we also show results from the high-end SSP5-8.5 scenario.

Thus, the Jacobs' projections are "implausible", and they are basically only used by the IPCC for comparative reasons.

Further Section 1.6.1.4 then goes on to say:

"... SSP3-7.0 and SSP5-8.5 are explicit 'no-climate-policy' scenarios (Gidden et al., 2019; Cross-Chapter Box 1.4, Table 1), assuming a carbon price of zero. These future 'baseline' scenarios are hence counterfactuals that include less climate policies compared to 'business-as-usual' scenarios – given that 'business-as-usual' scenarios could be understood to imply a continuation of existing climate policies.... Studies that consider possible future emission trends in the absence of additional climate policies, such as the recent IEA 2020 World Energy Outlook 'stated policy' scenario (International Energy Agency, 2020), project approximately constant fossil and industrial CO2 emissions out to 2070, approximately in line with the medium RCP4.5, RCP6.0 and SSP2-4.5 scenarios (Hausfather and Peters, 2020b) and the 2030 global emission levels that are pledged as part of the Nationally Determined Contributions (NDCs) under the Paris Agreement (Section 1.2.2; (Fawcett et al., 2015; Rogelj et al., 2016; UNFCCC, 2016; IPCC, 2018))."

The world is likely to see more serious emissions mitigation efforts in the future, and so the likely future pathways will be below the current 'business-as-usual'. Thus, adaptation planning should consider SSP2-4.5 as the upper limit of what is likely. While higher scenarios are not impossible, they are very far from

⁴ References as per AR6 WG1 Report.

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being likely, and should not be central to adaptation planning. Thus, based on IPCC AR6 WG1, the high end of the “likely effects” of climate change would be best represented by the SSP2-4.5 scenarios.

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IN THE MATTER OF Resource Management Act 1991,
Subpart 6 concerning Intensification
Streamlined Planning Process

AND

IN THE MATTER of Plan Change 2,
Proposed plan change to the Kāpiti
Coast District Plan under
The Resource Management Act 1991,
Schedule 1 Subpart 6.

**STATEMENT OF EVIDENCE OF
SEAN EDWARD RUSH
REGARDING THE PROPOSED CQMP**

**On behalf of
COASTAL RATEPAYERS UNITED Inc**

March 2023

Coastal Ratepayers United Inc.

Introduction

1. My full name is Sean Edward Rush.
2. I qualified as a lawyer in 1992 and have spent most of my career advising clients in the petroleum industry.
3. I obtained a Masters Degree in Petroleum Law and Policy in 2012, with distinction, studying post-graduate geology in the process, and was the Todd Group's asset manager for the Maui pipeline which exposed me to soil movement analysis and technology.
4. In 2019 I went back to University full time to study climate science, which included the physical science, adaptation and mitigation strategies, and post-graduate legal training on the Resource Management Act 1991 which supplemented my working knowledge of planning rules gained whilst at the Todd Group.
5. I graduated with a Masters Degree in Climate Change Science and Policy from Victoria University of Wellington ("VUW"), with merit, in 2021 and was an Expert Reviewer for the IPCC, contributing to the recent Sixth Assessment Report (Working Group 1, The Physical Science Basis) ("IPCC 2021" or "AR6").
6. In 2019 I was elected to the Wellington City Council and was the Chair of its Infrastructure Committee, portfolio lead for Low Carbon Energy and its representative for several committees and trusts. Due to my climate studies, I familiarized myself with climate reports prepared by the likes of NIWA, GNS and the MfE regarding the Wellington region and regularly corresponded with experts regarding such reports. I took a particular interest in the sea-level literature and measurement techniques affecting the Wellington region.
7. I did not stand for re-election.
8. In preparation for this Statement of Evidence, I have read aspects of the following dealing with sea-level rise and vertical land movement:
 - i. Kāpiti Coast Coastal Hazard Susceptibility and Vulnerability Assessment Volume 1: Methodology (**Jacobs 1**);
 - ii. the *Kāpiti Coast Coastal Hazards Susceptibility and Vulnerability Assessment Volume 2: Results* report (**Jacobs 2**);
 - iii. the Ministry for the Environment's July 2022 *Interim guidance on the use of new sea-level rise projection* (**MfE, 2022**);
 - iv. the New Zealand Coastal Policy Statement 2010 (**NZCPS 2010**);
 - v. the Coastal Erosion Hazard Assessment for the Kāpiti Coast: Review of the Science and Assessments Undertaken for the Proposed Kāpiti Coast District Plan 2012 (**Shand Review**);
 - vi. the Kāpiti Coast coastal hazard assessment, Dr Willem de Lange, Department of Earth and Ocean Science, the University of Waikato, (November 2013) ("**De Lange 2013**");

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Code of Conduct

9. I have read the Code of Conduct for expert witnesses in the Environment Court Practice Note 2023 and I have complied with it when preparing this evidence. Except when I state that I am relying on the advice of another person, this evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.
10. I am not a member of CRU, I do own a coastal property in Otaki but have not submitted on PC2. My property is within the proposed CQMP although this was only communicated to me after I agreed to provide this evidence. I support the use of natural hazard mapping and adaptive management within hazard zones. However, for reasons I will outline in my evidence, I am of the view that the Jacobs 2 report does not provide a sound basis for the proposed CQMP.

Scope of Evidence

11. My evidence covers the following areas:
- i. A review of relative sea-level rise (**RSLR**) over the 20th century shows there has been no acceleration of RSLR across the 20th century. NIWA scientists previously confirmed that rising sea levels in New Zealand, as assessed by tide gauges, showed no statistically significant acceleration through to the early 21st century, although more recent literature suggests otherwise;
 - ii. A review of Jacobs 1 leads to my view that the authors have not looked closely at some of the peer-reviewed literature, relied on some literature that has been superseded, and have underestimated the uplift associated with the vertical land movement (**VLM**) component of relative sea-level rise (**RSLR**) and accordingly over-estimated the likely RSLR projections;
 - iii. How the use of representative concentration pathway¹ 8.5 (RCP 8.5) (and its 83rd percentile derivative RCP 8.5H+) should not be used to predict coastal hazard lines, because it is now described as not a likely or plausible scenario by the latest IPCC report (AR6);
 - iv. A critique of MfE 2022 is the interim coastal guidance that is underpinned by the "SeaRise"² project's satellite estimates of vertical land movement. In particular, how the SeaRise team's work has not passed the peer review process, was fast-tracked into policy anyway and has caused controversy amongst the geoscience community;
 - v. A response to the Statement of Evidence of Derek John Todd.

¹ Representative concentration pathways are an estimate of the amount of emissions that would occur given certain assumptions around fossil fuel and other high emitting activities. The numeric value is the amount of warming in 'watts pe square metre, so RCP 8.5 denotes an expected increase in warming of 8.5 watts per square metre.

² The SeaRise project is led by Victoria University scientists with others from GNS and other NZ and international institutions. The project used satellite data between 2003-2011 to measure land uplift and subsidence around the NZ coastline. This work has been incorporated into MfE 2022 as the vertical land movement component of sea-level rise projections.

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12. My main conclusions are that Jacobs 1:
 - i. does not utilise the best available information on the likely effects of climate change (per NZCPS Policy 24) on the region or district;
 - ii. omits reference to the latest science about important aspects of coastal planning relating to vertical land movement and tide gauge measurements;
 - iii. is inconsistent with IPCC 2021; and
 - iv. utilises conservative and in my view, unlikely scenarios that, when aggregated, have a compounding effect on the likelihood of their occurrence;

13. My evidence relates to the spatial extent of the “**Coastal Qualifying Matter Precinct**” proposed by the Council under Proposed Plan Change 2 (Intensification) (**PPC2**) to the Operative Kāpiti Coast District Plan 2021. The spatial extent of the “**Coastal Qualifying Matter Precinct (CQMP)**” was informed by the methodology set out in Jacobs 1. As explained in my evidence this report did not incorporate the latest, best available information, including guidance on the likely effects of climate change, with the result that, in my opinion, Jacobs 2 overestimates the inland extent of coastal erosion and inundation over the planning time horizon of 100 years compared with what is required by the NZCPS Policy 24 when assessing coastal hazards under the RMA.

14. Consequently, in my view, Jacobs 2 does not provide a sound basis for determining the location and extent of likely coastal erosion in Kapiti and is therefore unsuitable as a basis for determining the proposed CQMP.

