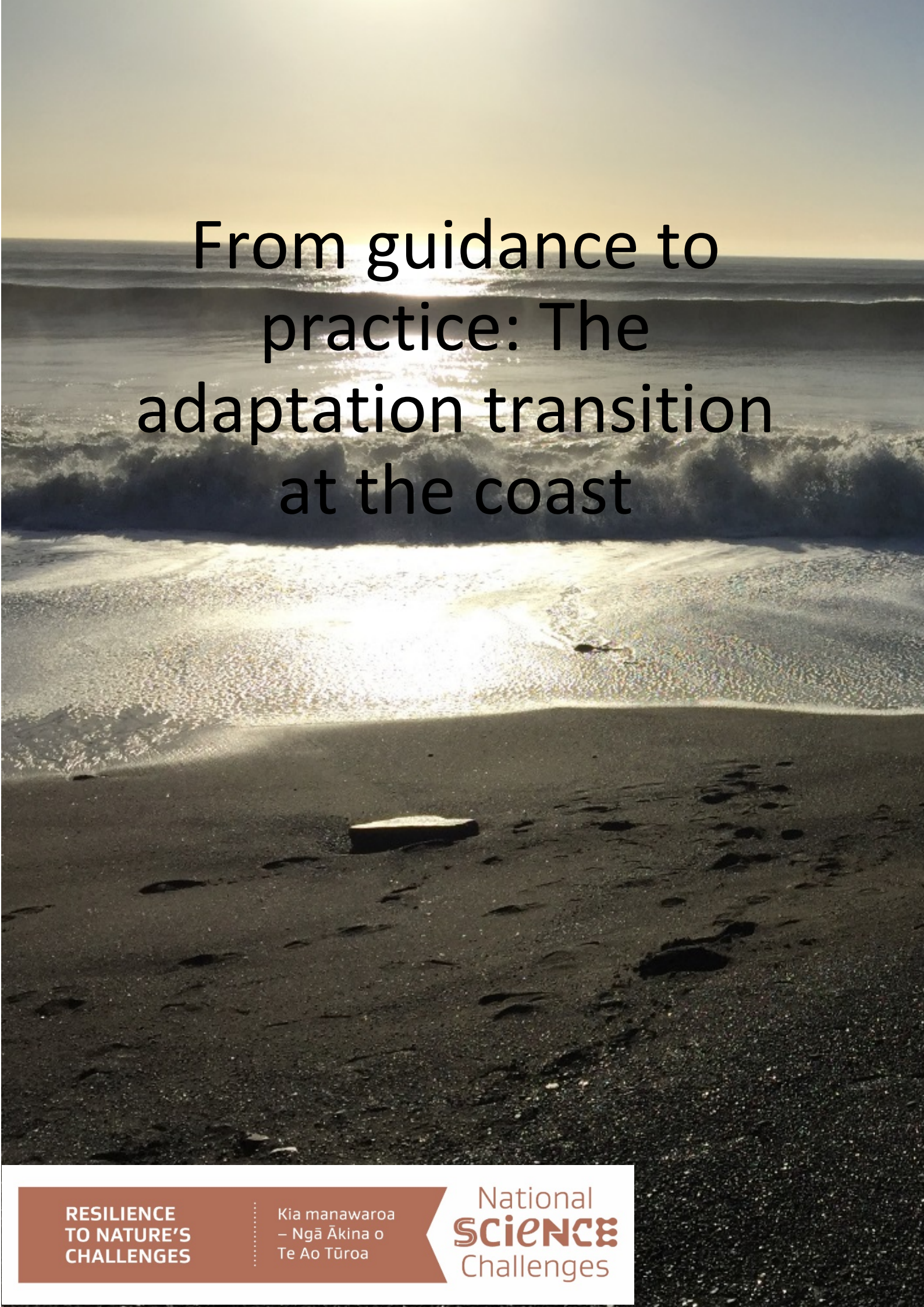

From guidance to practice: The adaptation transition at the coast

RESILIENCE TO NATURE'S CHALLENGES
Kia manawaroa – Ngā Ākina o Te Ao Tūroa
National SCIENCE Challenges

From guidance to practice: The adaptation transition at the coast

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Introduction

In 2014 local government in Hawke's Bay committed to preparing the Clifton to Tangoio Coastal Hazards Strategy 2120[4] (*Strategy*). Several factors aligned in 2016 that, together with the development of this *Strategy*, offered a significant coastal management learning opportunity: the 2017 revision of the Ministry for the Environment (MfE) (MfE 2017) national guidance on coastal hazards and climate change for local government (*Guidance*), the Department of Conservation guidance on the implementation of the New Zealand Coastal Policy Statement (NZCPS) (Department of Conservation, 2017) and the 2016-2019 funding of the Resilience to Nature's Challenges National Science Challenge *'Living at the Edge'* research programme (the Edge), aimed at improving the resilience of coastal communities to coastal hazards. The Edge researchers were invited to collaborate in the *Strategy* development process as 'critical friends'[5] providing independent technical advice and support on adaptation options, assessment methodologies and engagement processes.

This discussion paper accompanies a shorter practice brief published in the September 2019 edition of the New Zealand Planning Quarterly. Here, we discuss the lessons learned from applying the approaches set out in the *Guidance* in the *Strategy* development, in order to inform the ongoing use by practitioners of the *Guidance* in addressing coastal hazards and risks in New Zealand.

Coastal risk and planning context in New Zealand

Low-lying coastal communities face intensification and acceleration of coastal hazard and financial/insurance risks from ongoing sea-level rise (SLR) (Rouse et al., 2016). A high-level assessment of coastal risk exposure by the Parliamentary Commissioner for the Environment (PCE, 2015; Bell et al., 2015) identified substantial exposure of buildings, people and infrastructure on land less than 1.5 m above mean high water spring tide. A recent, more-detailed national assessment starting with present storm-tide levels (a 1% annual exceedance or 1/100 year event) and adding on increments of SLR up to 3 m, has shown much of New Zealand's risk is in the first metre of SLR, with 125,602 buildings and population of 177,646 potentially exposed to extreme storm-tide water levels once a 1 m SLR is reached (Paulik et al., 2019).

This exposure can result in significant losses and disruption to property owners, wider communities and associated services and have flow-on effects across the economy into cultural, social and financial domains. This affects the ability of our governance systems to address the uncertainty of risk from climate change (especially SLR) and the funding of adaptation and disaster recovery (Boston & Lawrence, 2018; Lawrence, Blackett, Cradock-Henry, & Nistor, 2018). Higher premiums and withdrawal of insurance from property owners in areas of foreseeable risk are the first signals that risk is being embedded into our institutions (Storey & Noy, 2017). These signals will flow quickly to the banking sector and could precipitate home loan defaults due to the maturity mismatch between residential insurance and mortgages (Storey et al., 2017) and limit access to finance for purchasers.

SLR is ongoing and is thus a different type of problem to extreme, discrete events (e.g. a storm

[4] https://www.hbcoast.co.nz/

[5] The 'critical friend' role was fashioned on the *amicus curiae* role in a court of law

or inundation event). SLR creeps up on communities and is compounded by rising groundwater and the impacts of coastal storm events, affecting property and infrastructure including stormwater and wastewater systems (White et al., 2017). We already see the effects of the rise during king tides in many low-lying coastal and estuarine locations around the country e.g. Tamaki Drive (Auckland) and Marine Drive (Eastbourne). Damage and losses from such coastal hazards are not covered by the Earthquake Commission (except land damage from storms), and local authorities and their insurers could increasingly find themselves facing large liabilities and potential court proceedings for inaction on adaptation (Hodder, 2019). The case for an anticipatory fund for climate change adaptation to address the foreseeable rising risk and uncertainties in coastal areas has been mooted (Boston & Lawrence, 2018), since access to funding has been identified as a significant barrier to adaptation (CCATWG, 2017, 2018).

Local government and financial stakeholders will need to promote adaptive risk reduction to minimise further exposure and plan over long timeframes, as the rate and scale of climate change impacts will increase (Reisinger et al., 2014). Box 1 sets out the existing statutory context for coastal adaptation in New Zealand. This ongoing and escalating risk exposure for coastal areas (Paulik et al., 2019) will pose substantial challenges to our planning, insurance, funding and infrastructure processes, as well as to residents and iwi/hāpu, who live with significant coastal place-based attachment.

Box 1: Statutory context for coastal adaptation

Coastal hazards management and planning in New Zealand is governed through the objectives and principles in the Resource Management Act 1991 (RMA) alongside several other statutes—the Local Government Act 2002 (LGA), the Local Government Official Information and Meetings Act 1987, the Building Act 2004 and the Civil Defence Emergency Management (CDEM) Act 2002. The statutory New Zealand Coastal Policy Statement (NZCPS, 2010) and guidance on the implementation of its policies (Department of Conservation, 2017), together with the national *Guidance,* direct and frame how coastal hazards can be managed and implemented through policies, plans and rules set by regional and district councils through their Regional Policy Statements, Regional Coastal Plans, District Plans, Long Term Plans, Infrastructure and Asset plans and CDEM Group Plans.

The RMA embeds natural hazard management requirements as part of sustainable management. Thus councils must address management of significant risks from natural hazards as a "matter of national importance" [s6(h) RMA] including "the effects of climate change"[s7(i) RMA]; on current and future generations (s5 RMA). The RMA has provisions for Māori values, traditions and culture in the management of natural and physical resources to guide council decision-making with Māori as Treaty partners. Statutory requirements for stakeholder and community consultation are set out in the LGA and define responsibilities for resilience in the face of natural hazard risks and long-term infrastructure plans.

There are gaps and misalignment in enabling statutes for adaptation to anticipate and control further developments in at-risk coastal areas (CCATWG, 2017, 2018; Stephenson et al., 2018), creating uncertainty of mandate between levels of government and a mismatch between planning timeframes, ability to address ongoing and changing risk and how to implement managed retreat. Regional inconsistencies in coastal hazard management and adaptation exist as a consequence. A National Risk Assessment, National Adaptation Plan and independent monitoring and reporting is included in the Climate Change Response (Zero Carbon) Amendment Bill 2019.

Box 2: Updated central-government *Guidance*

The *Guidance* (MfE, 2017) has community engagement at the core of coastal adaptation planning and implementation. The *Guidance* contains adaptive tools for working with widening uncertainty and changing risk, improved hazard and risk/vulnerability assessment methods that include community values and recommends use of four SLR projections alongside dynamic adaptive policy pathways planning and monitoring of signals and triggers. The *Guidance* is framed around an iterative 10 step decision cycle (Figure 1) and includes case studies, case law, hazard factsheets and a summary document: *Preparing for Coastal Change.*

Complementary guidance on the NZCPS implementation for coastal hazards management (Department of Conservation, 2017) highlights several precautionary approaches for coastal hazard management and SLR. For example, Objective 5 (NZCPS) directs new developments away from risk prone areas; considers responses, including managed retreat, for existing development; and promotes protecting or restoring natural defences to coastal hazards. Policy 24(1) (h) (NZCPS) sets a timeframe of "at least 100 years" for identification of coastal hazards and climate change effects, taking into account national guidance and best available information. Policy 25 (NZCPS) focuses on avoiding increasing risk and encouraging land use change, including managed retreat, to reduce the risk of adverse effects and discourages hard protective structures, while encouraging use of natural defences. Policy 27(1) (e) (NZCPS) highlights the need to identify and plan for transition mechanisms and timeframes to move to more sustainable approaches. Figure B-1 shows how the NZCPS policies determine the type of adaptation to climate change at various junctures.

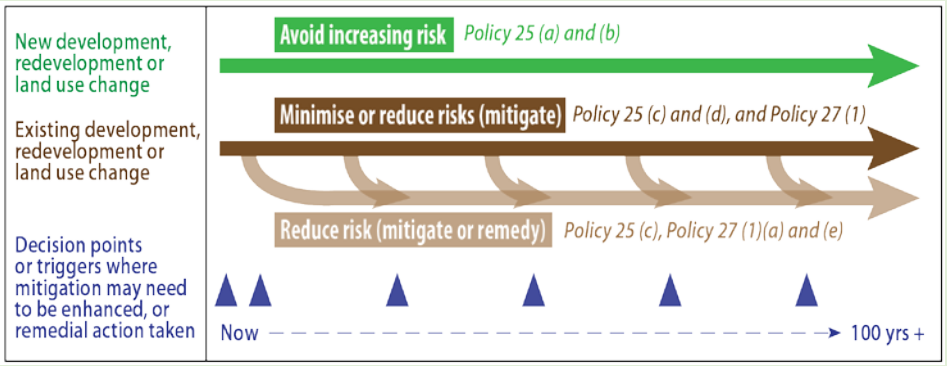

Figure B-1. New Zealand Coastal Policy Statement 2010 decision context for coastal areas exposed to coastal hazards and climate change. Note: uses terminology from RMA 1991 s 5(2)(c).

Source: (MfE, 2017)

Lessons learned during development of the *Strategy*

The 10-step decision cycle in the *Guidance* (MfE, 2017) is grouped around five questions (Figure 1) and forms the framework for our discussion of lessons learned from the Hawke's Bay *Strategy* development process. This analysis is intended to help others conducting similar processes elsewhere, at different spatial scales, using the recommended practice from the *Guidance*. Each section introduces the importance of the question, describes how the *Strategy* has addressed it to date, and identifies lessons learned through the process.

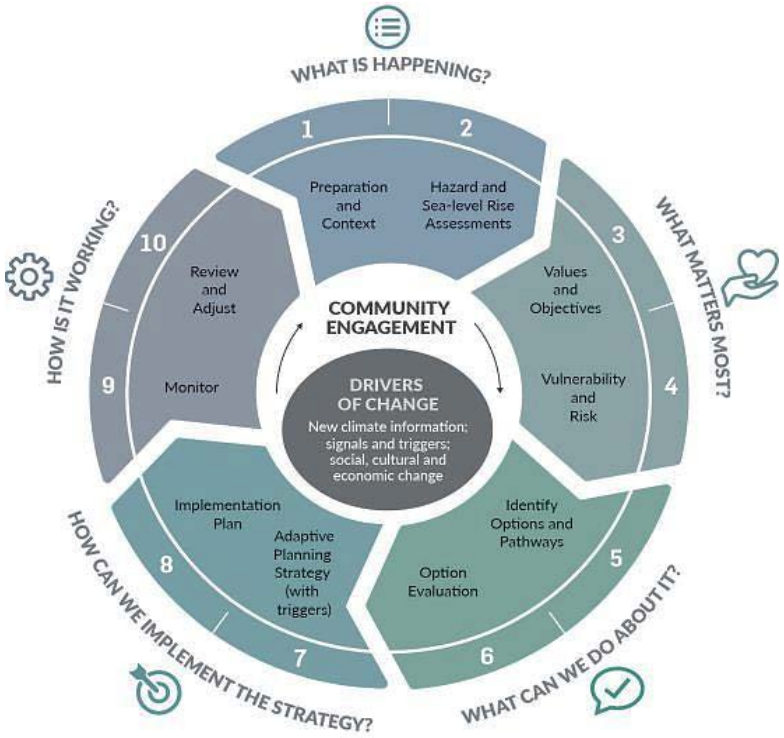

Figure 1 The 10 step decision-cycle formed around five key questions (Source: MfE, 2017)

Q1 What is happening?

What is included and why

This question covers *Step 1 Preparation and context,* which includes understanding the physical hazard context and influence of future changes and uncertainties, assembling a multi-disciplinary team, understanding local community context, deciding how the team will engage with communities, iwi/hapū and stakeholders, framing the overall planning approach and mobilising resources. At *Step 2 Hazard and SLR assessments* are deemed more robust if they use appropriate assessment tools that explicitly incorporate uncertainties. The *Guidance* advises using probabilistic approaches where there is little, or statistical uncertainty, and the use of four SLR scenarios for hazard and SLR assessments for unknown or unknowable future conditions (refer Figure 44 of the *Guidance*). This enables the most appropriate hazard/risk assessment methods to be used and to tune the level of resourcing depending on the scale of the situation.

Being well-prepared means that appropriate governance arrangements, skills and knowledge are available at the start of the process and can provide resources for the assessments. Planning the governance arrangements and engagement early, ensures that the appropriate people are involved and can be briefed, and thus start with an understanding of the hazardscape and the adaptation process. Understanding the different levels of uncertainty will help in deciding the most appropriate assessment method and the level of complexity of hazard assessments (Stephens et al., 2017). Preparation also builds trust, and providing a 'safe space' for discussion is essential to the success or failure of the decision process.

How the Strategy addressed Q1

After its inception in 2014, the *Strategy* was led by Hawke's Bay Regional Council, Hastings District Council, Napier City Council, Maungaharuru-Tangitū Trust, Mana Ahuriri Incorporated and He Toa Takitini, via a Joint Committee. The Joint Committee was supported by a Technical Advisory Group comprising staff from the three councils and engineering and planning consultants. In 2016, the Joint Committee was supplemented by the Edge research team in a 'critical friend' and advisory role alongside the *Strategy* process, which brought specialist knowledge from a range of disciplines and observed the process as it unfolded. The *Strategy* comprised four stages: 1) Define the problem; 2) Framework for decisions; 3) Develop responses; and 4) Respond (Corbett & Bendall, 2019).

A decision-making framework was developed for the *Strategy* process setting out the methodology, the approach for making decisions on options and pathways for adaptation, how the community would be involved, the priority coastal units, roles and responsibilities, terms of reference, and meeting schedule. This pre-defined governance legitimised the community panel decision-making process.

The community was involved via two community panels (comprising participants predominantly from coastal communities including mana whenua representatives, and from the wider community, business, recreational and other interested groups), which explored, confirmed and assessed the options for each priority coastal unit (using multi-criteria decision analysis, augmented with a modified dynamic adaptive policy pathways approach). The panels recommended preferred sequences of actions to the Joint Committee. The wider community was engaged through social media and public meetings during the course of the *Strategy* development. To support the work of the panels, a cultural advisor undertook a cultural values assessment as input to the assessment process (Ropiha, 2017).

There were many technical reports available on Hawke's Bay coastal hazards for informing the process given the longstanding coastal erosion and flooding problems. These were brought together with the help of consultants, as maps and presentations for briefing the Joint Committee and the community panels. The current and future hazard and risk assessments, and the basis on which they were conducted (e.g. using the then current 2008 coastal guidance), were completed before the Edge researchers joined the *Strategy* process (Tonkin & Taylor, 2016 a, b). The new recommendation in the 2017 *Guidance* on the use of four SLR scenarios was brought to the attention of the councils and their consultants by the Edge, since only one scenario (RCP 8.5) was used for coastal flood hazard and applied at 2065 (0.5 m) and 2120 (1.0 m). The status quo was maintained to limit the cost of re-doing additional scenarios, as the process was already underway. A wider range of SLR scenarios was, however, used for coastal erosion assessments.

Lessons learned

Effective governance of the process was essential to give mandate, political commitment and oversight. The collaboration of the three councils and the role of mana whenua groups on the Joint Committee was a critical part of this.

Early partnering with mana whenua is essential to ensure that Te Ao Māori perspectives are appropriately integrated into the short and long term planning efforts, recognising different perspectives on stewardship and duty of care (manaakitanga) of land and water (kaitiakitanga). Early engagement and consideration of Māori values throughout the asessment process can also help avoid delays at the statutory implementation phase (e.g. consideration of potential impacts of beach renourishment on valued offshore reefs and kaimoana).

Having trusted and independent advisors (across multiple disciplines) alongside the process (e.g. the Edge researchers, independent peer reviews and independent consultants) gave credibility to the knowledge used, which gave the community panels confidence that the science was robust and well supported by a range of experts.

The preparation and context building stage enabled trust and respect to be built between the councils and the community.

The use of only one SLR scenario for coastal flooding constrained the stress-testing of options later in the process. Using the four SLR scenarios would have enabled candidate options to be consistently evaluated in reducing risk and communicating residual risk, and how the shelf-life of different actions/options fits with planning timeframes (Lawrence et al., 2019).

While the hazard assessments for the Strategy were completed in 2016, the Guidance (Section 6.5) now recommends mapping coastal flooding and erosion using increments of SLR. Such an approach better informs questions around adaptation thresholds (e.g. at what SLR) for consideration of shelf-life of short-term actions (e.g. seawalls, re-nourishment), which were not easily resolved in the Strategy development process. The issue of how to integrate new science on SLR (a rapidly developing field) and how to address compound hazards such as rainfall, groundwater and storm-tide into existing assessments and into engineering design requires further research and guidance.

Q2 What matters most?

What is included and why

Defining what matters most should reflect community values and council objectives (*Step 3*) and bound vulnerability and risk assessments (*Step 4*). To begin to understand these values and objectives, those who contribute community knowledge should be identified, along with methods to capture their values and objectives (e.g. existing information, surveys, interviews, workshops).

For risk assessments (hazard-exposure-vulnerability), the first task is to scope the scale and information needs required and to determine sensitivity and coping capacity of the physical and human systems to climate change — noting that vulnerability includes both fragility of assets and the adaptive capacity of people, organisations and institutions (the legal frameworks and rules and governing norms). Before beginning risk/vulnerability assessments, the level of assessment method (from screening to detailed) and who will be engaged with must first be decided. Methods must also note the way uncertainty and changing risk are incorporated.

How the Strategy addressed Q2

The values and objectives driving the *Strategy* process were encapsulated in the Decision Framework (DF) document (Daysh, 2017), which was augmented by input from the Edge research team. The DF was subsequently endorsed by the Joint Committee, the TAG and the community panels. The DF comprised the *Strategy* development methodology, the decision-making process involving two community panels and its modus operandi (participation, consensus approach, terms of reference, priority coastal units, meeting process, schedule and outputs required) and draft evaluation methodologies.

Coastal hazard risk was assessed for present, 2065 and 2120, providing the foundation for identification of the *Strategy's* priority coastal units (Tonkin & Taylor, 2016b). Vulnerability was

subsequently identified in several ways, reliant primarily on a 2016 coastal risk and exposure assessment (Tonkin & Taylor, 2016b) and demographic information. The risk assessment identified total losses for each hazard for four main risks - human, economic, social/cultural, environmental/ecological - for coastal units using a six-level scale from negligible to very high risk. This provided both asset fragility and high level social and environmental implications. Social impacts were assessed by consultants (Maven, 2017) through a social impact and valuation assessment in 2017. This detailed what coastal communities valued about the coast and how they perceived the risks based on semi-structured interviews of at least 80 potentially affected coastal community members. The basis of these interviews was discussion of the status quo scenario for the next 5-10 years for coastal erosion and inundation, with minimal examination of 10 years and beyond, given that it was found to be difficult to accurately test and explore individual perceptions of events and impacts much beyond a 10 year horizon. From this assessment, a valuation of the social cost was calculated and reported to the community assessment panels and the public at wider community meetings that were conducted at intervals during the *Strategy* process. The *Strategy* simultaneously undertook both the values and objectives scoping with the social costing and limited the values assessment to a relatively short timeframe. This meant that the social costing could not be easily integrated with the later assessment of the suite of long-term adaptation options (refer Q 3 below).

An additional survey of the wider Hawke's Bay community was conducted in 2017 by the Edge team (Becker et al., 2018) to include perceptions of those living beyond the priority coastal units to balance the views of those who had a direct interest in the *Strategy* outcome.

A Māori cultural values assessment was undertaken by an independent researcher (Ropiha, 2017) and the results presented to the whole *Strategy* team, including all panel members, the TAG, and consultants. This was supplemented with a cultural values 'hikoi' along the coastline for all panel members. The cultural assessment was used to inform the options, pathways and their evaluation. The evaluation of the cultural indicator later in the assessment process was done first by a sub-group of mana whenua representatives and discussed and finalised by the panels.

Lessons learned

A social impact and vulnerability assessment should be fit-for-purpose for application in climate change adaptation decision making for slowly evolving impacts like SLR. The assessment of community values, vulnerability and potential future social impacts approached in a stepwise additive way is recommended in the Guidance. Values and vulnerability can be then combined to underpin the social impact assessment for each suite of adaptations to ensure transparency through the pathway evaluation process.

The social impact assessment had a short timeframe (5–10 years) with a focus on the current community context only, which constrained consideration of the long-term issues and of future flexibility of options today. At an individual level, community members found it difficult to consider the social impact of events occurring longer than 10 years into the future. Serious games have been used elsewhere in New Zealand (Lawrence and Haasnoot, 2017) *and broaden the outlook and experiences of citizens and decision makers through simulations bounded by a widening uncertainty and underlying change (e.g. SLR).*

The initial risk assessment put high level costs on the social and environmental values, focusing primarily on the fragility of assets and potential causalities, and were not informed by the granularity of the social values information and their subsequent valuation. Because of this and the lack of a clear national methodology for integrating fragility and social/cultural/ environmental aspects into a broader vulnerability assessment, inadequate weight may have

been given to social and cultural vulnerability.

Additionally, integration of Māori *values with broader social vulnerability issues may prompt other stakeholders to consider options differently.*

While community newsletters and other communication tools were actively used, focusing attention mainly on affected parties at the coast through the assessment panel process meant that the wider community was less well informed. This is likely to be a risk at the implementation stage of the Strategy when funding options are considered and the broader community is consulted on different rating options, which may involve some element of general rating contribition .

Q 3 What can we do about it?

What is included and why

Options and possible pathways to manage risks are developed (*Step 5*) and evaluated (*Step 6*) at this stage. To do this, the most appropriate evaluation tools need to be used to enable consideration of changing risk over time. This involves monitoring to identify adaptation triggers prompting shifts in risk management strategies. The *Guidance* recommends the Dynamic Adaptive Policy Pathways (DAPP) approach because it enables uncertain futures to be considered by retaining flexibility, rather than by prescribing a single sequence of actions (Haasnoot, Kwakkel, Walker, & ter Maat, 2013). This is achieved by identifying short-term actions that do not foreclose a shift to longer term options, if the objectives can no longer be achieved by the short-term actions (i.e. an adaptation threshold is reached). The use of serious games as highlighted in the *Guidance* can be used at this stage so evaluators can instantly experience feedback on decisions and choices on actions or options at various junctures during the simulation, with widening uncertainty over time.

How the Strategy addressed Q3

The option evaluators were the two community panels representing areas north and south of Napier Port, aided by technical support from TAG. Before the options were defined, the TAG received a briefing from the Edge about decision making under uncertainty, and undertook a serious game facilitated by the Edge to experience making decisions over a 100 year timeframe.

The options were first identified by the panels as discrete, single options for responding to coastal hazards risks. This was a “blank page” exercise where no option could be purposefully left out and creative thinking was encouraged. TAG also assisted at this stage to ensure that a full suite of possible options were considered. This produced an initial list of 18 discrete options, which determined the scope of the adaptation options across the main types already embedded in the DF (Corbett & Bendall, 2019) — do nothing, defend, accommodate or retreat. These 18 options were then combined by TAG and technical consultants in various permutations to develop six possible pathways for each priority unit. The pathways were tailored to each priority unit (so an option was not included where it would not provide a benefit or could not be practically implemented in that unit) and were structured to cover the range from do nothing, soft engineering, hard engineering and retreat responses.

Pathways sequences of nominal short (20 years), medium (20-50) and long term (50-100) were selected for each priority coastal unit for comparison. It was stressed that short- medium- and long-term may be shorter (if no longer effective) or longer than the nominal timeframe

depending on rates of change. Pre-defined triggers (decision points) would be established in Stage 4 (Respond) of the *Strategy* to determine the conditions for switching to the next option in the sequence or a shift to an entirely new pathway.

The initially proposed assessment tool, Multi-Criteria Decision Analysis (MCDA), was not well-suited on its own to address changing risk over a 100 year planning timeframe, as required by the NZCPS 2010 for coastal areas. Accordingly, the Edge advised DAPP to be used alongside MCDA to introduce consideration of future uncertainties, ongoing changing hazard and risk (refer *Guidance* Steps 5 and 6) and to explore the long-term efficacy of different pathways under changing conditions (Lawrence et al., 2019).

To include uncertainty and changing risks over time, additional criteria were added to items assessed by MCDA. These included: managing risk through reduced exposure to coastal flooding and erosion; meeting objectives over long timeframes; ability to adapt to increasing risks; including flexibility measures to support future adjustments; transferring risk to others along the coast and to future generations.

Real Options Analysis (ROA) (Infometrics, 2017) was used to assess relative costs of the six pathway sequences in each coastal unit after the sequences were converted to a DAPP structure (Lawrence et al., 2017). The ROA process added two additional measures—a Cost + Loss figure and a Value for Money measure for each pathway. This costing information for each pathway was augmented by a measure of the rating (property tax)[6] impact of each pathway based on an assumed public/private cost allocation, as a proxy for affordability.

The outcome of the year-long panel process was one preferred pathway for each coastal unit, which was passed on to the Joint Committee in a report (Mitchell Daysh, 2018) and through a verbal briefing.

Lessons learned

Having a clearly defined process and rules of engagement from the start legitimised a transparent assessment process where participants generally felt they were heard.

A comprehensive set of adaptation options/actions on the table is important so that nothing was ruled out initially, including managed retreat.

The focus of the development of options was primarily on 'hard' and 'soft' structural options in the short-term. Had the vulnerability assessment been focused on the longer term, the emergence of SLR impacts for low-lying areas in the next few decades and their potentially existential outcomes in some areas could have been considered in greater depth. In particular, managed retreat as a pathway complete with near-term decisions and actions that enable staging and retreat in an orderly and least disruptive manner could have been explored. The lack of a clearly defined methodology for implementing retreat in New Zealand made this difficult.

The notional timeframes used (a single linear sequence of short/medium/long term actions compared with the DAPP process as outlined in the Guidance) "unlocked" important discussions about managed retreat that were otherwise difficult to have. However, the linear sequencing of options resulted in the panels focusing on the immediate threats (particularly in areas being impacted currently by coastal hazards) and on hard protection. Such an approach can foster a false sense of security, encouraging further development with expectations of ongoing protection. Such short-term actions, even to "buy time", need to carefully consider the

[6] Rating refers to the funding contributions from the direct and indirect community beneficiaries for implementing the actions

consequences of near-term residual risk (e.g. breaches or overtopping) and risk exposure when the structures or scheme fail to meet the risk reduction objectives, which could be earlier if SLR is faster than envisaged.

The modification of pathways into single linear sequences also runs the risk that future councils will not understand that short-term actions may be followed by a range of different options and pathways, leaving options open and avoiding path dependency to achieve the objectives of the Strategy as the future unfolds.

The economic cost criterion was excluded from the MCDA assessment because it would have diverted attention to who pays, rather than focusing on assessing the risks. However, affected communities' interests were reflected in their preference to remain in place and thus to protect their assets regardless of the cost. Cost of options was introduced as a separate consideration at the evaluation phase. However, earlier high level feasibility costings, conducted when options were being chosen for assessment, could have changed the values between protection/accommodation and retreat options in the initial scoring.

Some of the more technical criterion were more easily assessed by the TAG (e.g. environmental criterion) rather than by a community panel, but the combination of both worked well and both gained knowledge in the process.

The exclusion of assessing consent-ability of actions and options from the assessment criteria, meant that relevant statutory considerations that could have influenced the candidate options and preferred pathways were not considered. The NZCPS directs councils to avoid increasing risk, while generally discouraging (but not debarring) hard engineering options in areas of existing development. This could have altered the scoring for some hard options early and thus reduced expectations of the feasibility of continuing to maintain hard protection as seas continue to rise. Consent-ability will be tested against the NZCPS in the implementation stage through plan changes and consents for the options.

The Strategy process can be applied at any scale, but there are advantages of overlaying a regional scale to ensure actions in one area do not detrimentally affect the adjacent areas and also to get broad regional buy-in to decision making prior to the implementation stage.

Q4 How can we implement the *Strategy*?

What is included and why

An adaptive plan is ineffective unless it reduces coastal hazard risk over the long term, thereby giving effect to the NZCPS. This necessitates an implementation plan. Implementation starts with developing the adaptive planning strategy and the early signals and triggers (*Step 7*) for subsequent decisions before reaching thresholds prompting adaptive actions or path changes.

This is followed by developing the implementation plan (*Step 8*) by exploring how the strategy can be implemented. This involves deciding the types of plan and planning processes available to councils that can help manage coastal hazard risks – e.g. the balance between non-statutory and statutory plans in both the LGA, the RMA and other legislation. The choice of planning methods and techniques will be determined by the degree to which significant changes from protection to accommodation or retreat will be required over time. Plans and processes (see Figure B-1 and Department of Conservation guidance on the NZCPS) will need to be transparent and developed collaboratively with the community, iwi/hapū and stakeholders, while maintaining alignment with the NZCPS and regional policy statements before an

implementation strategy is drafted. This ensures timeframes, monitoring framework, integration into plans and development of long-term financing are flexible.

How the Strategy addressed Q4

After the *Strategy* was agreed in-principle by the Joint Committee, the report went back to their respective councils for their in-principle agreement. There was a delay before all councils came on board after further briefing of council members who had not been directly involved in the *Strategy* development process. The Joint Committee then drew up an implementation plan spanning the next four years. It has five workstreams– regulatory, governance, funding, design and costings and triggers for monitoring. Wider community consultation, approvals and pathway implementation then follow.

A costing model for allocation of costs across the community and options for a contributory fund are being developed in parallel with the *Strategy* development, anticipating the need for a mechanism that could pay for the implementation of the *Strategy*. As part of the implementation stage of the *Strategy*, the Joint Committee have recommended the establishment of a Coastal Contributory Fund to offset the future cost of implementing actions. The details of and how the fund will operate will be consulted on in 2020.

Lessons learned

The implementation stage should not be underestimated. To mandate options and pathways requires careful thought and participatory engagement before moving into the statutory planning process, which will require wider public engagement under the LGA on how the monitoring programme is linked to the plans, the design of funding mechanisms and more detailed costings. This takes time.

The delay in endorsing the Strategy recommendations from the community panels to the Joint Committee highlighted the need for ongoing engagement with councillors and senior management in the councils regularly through all stages of the Strategy development.

Keeping the community at all levels abreast of the Strategy and new information as it arises will require the various council responsibilities to be identified and a process for updates set up.

Q5 How is it working?

What is included and why

This question includes monitoring, review and adjustment of the adaptation plan (*Step 10*). Regular monitoring enhances understanding of how the risks are changing over time and enables timely commencement of actions that anticipate future levels of risk.

A monitoring framework includes the design of early signals and triggers that can alert the responsible agency to review pathway performance and activate successive actions at trigger points. Review and adjustment includes whether to commence, alter, cease, or expand actions in response to monitoring information and a review of appropriateness of signals and triggers given the new information. This then leads to consideration of the flow-on effects for the statutory plans and effects associated with activating the change in processes, including shifting to the next pathway sequence (or alternative pathway) required to reflect the changing risk.

Effective assessment of how an adaptive plan is working also necessitates decisions around who is responsible for the monitoring (both which organisation and who in the organisation), the methods for monitoring, auditing the veracity of the findings and distribution of monitoring results for further decisions to be made on adaptation actions.

How the Strategy addressed Q5

The *Strategy* has not yet reached this point in the process. The implementation plan being developed by the Joint Committee has identified the development of a monitoring framework and plan as a key action. To date, two workshops (run by Edge researchers) have been held with the TAG and the community panel members. This has familiarised them with how to approach development of signals and triggers for the implementation phase of the *Strategy*. The second phase of the Coastal project in the Resilience Science Challenge is continuing research into DAPP, statutory planning and costing approaches for adaptation implementation.

Lessons learned

The importance of having a monitoring framework was deemed essential for making decisions over time to enable councils to adjust their Strategy as the risks change. The ability to monitor the chosen options against the objectives sought in the Strategy is the critical part of the application of a DAPP approach. A successful pathways approach relies on anticipating actions required to continue to achieve the objectives ahead of more frequent damaging events and coping thresholds and to switch to another pathway if necessary, with sufficient lead time before the threshold is reached. To do this, an agency needs to be responsible for the monitoring of the signals and triggers and must have the authority to alert the responsible agencies that a decision point is approaching. How these triggers can be effectively actioned under the current RMA and LGA legislative frameworks and monitored over time requires further research.

The need for Guidance on how to develop signals and triggers and how to manage a monitoring system over time was also deemed necessary. The ability to share practice examples so learning can continue between councils across New Zealand was given priority by the Strategy team, noting that the Strategy process has had wide exposure already.

Conclusions

The opportunity for researchers to work alongside a real-life hazard assessment and decision process gave us a unique opportunity to observe how a coastal hazards *Strategy* could be developed using the approaches in the revised 2017 *Guidance*. As researchers and critical friends, we were able to reflect upon the practice and draw out lessons for how others can apply the *Guidance* – what worked, what didn't, and how such a process can be scaled for different coastal settings and communities.

Overall the *Strategy* took on board most of the new approaches in the *Guidance*, albeit modified for community panels to undertake the options assessment. While the process undertaken in the Hawke's Bay with the community was conducted over a period of twelve months, such processes can be scaled to suit the particular local context and undertaken in part or in whole with community panels. Nevertheless, community processes provide a vehicle for gaining community trust and buy-in, which is fundamental for addressing coastal hazard risk at any location and these processes will take time if they are to be effective.

A consensus was reached on preferred pathways sequences and the councils agreed in principle to proceed to the implementation stage. While community interests yielded short-term

'protect' options that looked like business as usual (in a New Zealand context) these near-term options form part of a recognised long-term set of pathways that enable movement beyond protection, to accommodate and to retreat in some cases over the longer term. Thus, the Hawke's Bay coastal community is primed with a little time bought and prepared for ongoing coastal hazards, despite more work to be done regarding the wider community understanding of the risks and despite expenditure choices yet to be made. More could have been done to engage fully with the wider community, but a start has been made and lessons learned along the way.

Lessons for others embarking on coastal hazards and climate change adaptation strategies using the *Guidance* have been highlighted in an effort to 'test' the ability to shift practice toward the new areas recommended in the *Guidance*. In particular:

- The critical importance of governance arrangements prior to starting strategy development;
- The value of a regional/local government partnership for coastal strategy development;
- The value of engaging collaboratively with communities by providing a 'safe space' for deliberation, resulting in social learning about the practical issues around resilience efforts;
- The need for wider community engagement;
- The importance of early partnership with mana whenua to weave in Te Ao Māori perspectives;
- The importance of considering a longer (at least 100 years) timeframe for the vulnerability and risk assessments (using narratives and scenarios) and distilling the emergence of adaptation thresholds;
- Understanding how hazard and coastal flooding assessments and the options assessment process can be scaled, depending on the level of uncertainty and the planning situation;
- The value of an adaptive pathways approach for shifting thinking from short-term protective strategies to a longer term focus on the ongoing changing risks;
- Not to underestimate the time needed for developing the implementation plan that includes regulatory, governance, funding, design and costings, triggers for monitoring and review.

While the research underpinning this paper was developed through a unique alignment of circumstances and leadership by three councils in Hawke's Bay, with the Edge researchers as a 'critical friend', the *Strategy* process has enabled generic lessons to be identified that can inform similar coastal hazards adaptation strategy processes, at different scales or scopes, using the *Guidance*.

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REFERENCE LIST

Becker, J., Patel, P., Ryan, E., Blackett, P., Schneider, P. & Robichaux, L. (2018). *Understanding community perspectives on coastal issues: Hawke's Bay Coastal Survey 2017*. Lower Hutt (NZ): GNS Science. 36 p. + Appendices (GNS Science miscellaneous series 113). doi:10.21420/G25D2J.

Bell, R.G., Paulik, R. & Wadwha, S. (2015). *National and regional risk exposure in low-lying coastal areas: areal extent, population, buildings and infrastructure,* NIWA report prepared for the Parliamentary Commissioner for the Environment, 270 p. https://www.pce.parliament.nz/media/1384/national-and-regional-risk-exposure-in-low-lying-coastal-areas-niwa-2015.pdf.

Boston, J., & Lawrence, J. (2018). Funding climate change adaptation: the case for a new policy framework. *Policy Quarterly, 14*(2), 40-49. https://ojs.victoria.ac.nz/pq/issue/view/582.

CCATWG. (2017). *Adapting to Climate Change in New Zealand: Stocktake Report from the Climate Change Adaptation Technical Working Group*. Available at: https://www.mfe.govt.nz/climate-change/climate-change-and-government/adapting-climate-change/climate-change-adaptation.

CCATWG. (2018). *Adapting to climate change in New Zealand: Recommendations from the Climate Change Adaptation Technical Working Group*. Accessible at: https://www.mfe.govt.nz/climate-change/climate-change-and-government/adapting-climate-change/climate-change-adaptation.

Corbett, E., Bendall, S. (2019). Clifton to Tangoio Coastal Hazards Strategy 2120, Hawke's Bay, New Zealand. In: *Responding to rising seas: OECD country approaches to tackling coastal risks*, Chapter 6, p. 137–154, OECD Publishing, Paris. Available at:https://www.oecd.org/environment/responding-to-rising-seas-9789264312487-en.htm.

Daysh, S. (2017). *Clifton to Tangoio Coastal Hazards Strategy 2120 Stage Two Report: Decision Making Framework*, unpublished report, Mitchell Daysh Limited, 21 p.

Department of Conservation. (2017). *NZCP 2010 Guidance Note: Coastal Hazards Objective 5 and Policies 24.25.26.& 27*. Available at: https://www.doc.govt.nz/Documents/conservation/marine-and-coastal/coastal-management/guidance/policy-24-to-27.pdf.

Haasnoot, M., Kwakkel, J., Walker, W., & ter Maat, J. (2013). Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world. *Global Environmental Change, 23*(2), 485-498. Available at: http://www.sciencedirect.com/science/article/pii/S095937801200146X.

Hodder, J. (2019). *Climate change litigation- who's afraid of creative judges?* Available at: https://www.lgnz.co.nz/our-work/publications/climate-change-litigation-whos-afraid-of-creative-judges/.

Infometrics. (2017). *Real Options Analysis of Strategies to Manage Coastal Hazard Risks: Northern Units B-E & Southern Units J-L.* Reports for Hawke's Bay Regional Council November 2017. Available at: https://www.hbcoast.co.nz/assets/Document-Library/Other-documents/Real-Options-Analysis-of-Strategies-to-Manage-Coastal-Hazard-Risks-Northern-Units-B-E.pdf . https://www.hbcoast.co.nz/assets/Document-Library/Other-documents/Real-Options-Analysis-of-Strategies-to-Manage-Coastal-Hazard-Risks-Southern-Units-J-L.pdf.

Lawrence, J. and Haasnoot, M. (2017). What it took to catalyse a transition towards adaptive pathways planning to address climate change uncertainty. *Environmental Science and Policy*. http://dx.doi.org/10.1016/j.envsci.2016.12.003.

Lawrence, J., Bell, R.G., & Stroombergen, A. (2019). A hybrid process to address uncertainty and changing climate risk in coastal areas using Dynamic Adaptive Pathways Planning, Multi-Criteria Decision Analysis and Real Options Analysis: A New Zealand application. *Sustainability, Special Issue: Policy Pathways for Sustainability*, 11:406, 18 p, doi:10.3390/su11020406, https://www.mdpi.com/2071-1050/11/2/406.

Lawrence, J., Blackett, P., Cradock-Henry, N., & Nistor, B. J. (2018). *Climate Change: the cascade effect. Cascading impacts and implications for Aotearoa New Zealand*. Available at https://www.deepsouthchallenge.co.nz/projects/climate-change-cascade-effect.

Maven (2017). Cape Coast Coastal Hazards Social Impact Assessment and Valuation. Available at: https://www.hbcoast.co.nz/assets/Document-Library/Cape-Coast-Area-Coastal-Hazards-Social-Impact-Assessment-and-Valuation.pdf.

Ministry for the Environment (2017). Coastal hazards and climate change: Guidance for local government. Bell, R.G.; Lawrence, J.; Allan, S.; Blackett, P.; Stephens, S.A. (Eds.), Ministry for the Environment Publication No. ME 1292. 284 p + Appendices. Available at: http://www.mfe.govt.nz/publications/climate-change/coastal-hazards-and-climate-change-guidance-local-government.

Mitchell Daysh (2018). *Report of the northern and southern cell assessment Panels. Final Report, Clifton to Tangoio Coastal Hazards Strategy 2120*. Available at: https://www.hbcoast.co.nz/assets/Document-Library/Assessment-Panel-Report-FINAL-28.2.18-reduced-size.pdf.

New Zealand Coastal Policy Statement (2010). Available at: https://www.doc.govt.nz/about-us/science-publications/conservation-publications/marine-and-coastal/new-zealand-coastal-policy-statement/new-zealand-coastal-policy-statement-2010/.

Reisinger, A., R.L. Kitching, F. Chiew, L. Hughes, P.C.D. Newton, S.S. Schuster, A. Tait, and P.Whetton, 2014: Australasia. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1371-1438.

Ropiha, A. (2017). Assessment of cultural values report: Coastal hazards Strategy 2120 Clifton to Tangoio. Mai Te Matau a Māui ki Tangoio. Prepared for the Hawke's Bay Regional Council, Napier City, Hastings District Council. June 2017. Available at: https://www.hbcoast.co.nz/assets/Document-Library/Cultural-Values-Report-Clifton-to-Tangoio-Coastal-Hazards-Strategy-212.-.pdf.

Rouse, H.L., Bell, R.G., Lundquist, C.J., Blackett, P.E., Hicks, D.M. & King, D.N. (2016). Coastal adaptation to climate change in Aotearoa-New Zealand. *NZ Journal Marine and Freshwater Research 51*: 183–222, doi:10.1080/00288330.2016.1185736.

Parliamentary Commissioner for the Environment (PCE) (2015). *Preparing New Zealand for rising seas: certainty and uncertainty,* 92 p. Available at: : www.pce.parliament.nz.

Paulik, R., Stephens, S.A., Wadhwa, S., Bell, R.G., Popovich, B. & Robinson, B. (2019). Coastal flooding exposure under future sea-level rise for New Zealand. NIWA Client Report 2019119WN prepared for the Deep South Science Challenge, June 2019, 76 p. https://www.deepsouthchallenge.co.nz/projects/national-flood-risks-climate-change.

Stephens, S.A., Bell, R.G. & Lawrence, J. (2017). Applying principles of uncertainty within coastal hazard assessments to better support coastal adaptation. *Journal of Marine Science and Engineering 5(3)*: 40; doi: 10.3390/jmse5030040.

Stephenson, J., Orchiston, C., Saunders, W., Kerr, S., MacMillan, A., McKenzie, L. & Willis, S. (2018). *Communities and climate change: Vulnerability to rising seas and more frequent flooding. Motu Note # 29* Deep South Science Challenge Dialogue 21p. Available at: https://motu.nz/our-work/environment-and-resources/climate-change-impacts/communities-and-climate-change-vulnerability-to-rising-seas-and-more-frequent-flooding/.

Storey, B., & Noy, I. (2017). Insuring property under climate change. *Policy Quarterly, 12*(4). Available at: https://ojs.victoria.ac.nz/pq/article/view/4603. doi:https://doi.org/10.26686/pq.v13i4.4603.

Storey, B., Noy, I., Townsend, W., Kerr, S., Salmon, R., Middleton, D. & James, V. (2017). *Insurance, housing and climate adaptation: Current knowledge and future research Motu Note #27.* Deep South Science Challenge Dialogue, 12 p. Available at: https://motu.nz/our-work/environment-and-resources/climate-change-impacts/insurance-housing-and-climate-adaptation-current-knowledge-and-future-research/.

Tonkin & Taylor (2016a). Clifton to Tangoio Coastal Hazards Strategy 2120 Coastal hazards Assessment. May 2016. Available at: https://www.hbcoast.co.nz/assets/Document-Library/Technical-Documents/Coastal-Hazard-Assessment.pdf.

Tonkin & Taylor (2016b) Clifton to Tangoio Coastal Risk Assessment. May 2016. Available at: https://www.hbcoast.co.nz/assets/Document-Library/Technical-Documents/2015.SHAF.Risk-Assessment-Report.R5-print-version.pdf.

White, I., Storey, B., Owen, S., Bell, R., Charters, F., Dickie, B., Foster, L., Harvey, E., Hughes, J., Kerr, S., Lawrence, J., Morgan, K., Palmer, G., Roberts, N., Stroombergen, A., Zammit, C. (2017). *Climate change and stormwater and wastewater systems.* Motu Note #28, Deep South Science Challenge Dialogue, 15 p. Available at: https://www.deepsouthchallenge.co.nz/news-updates/new-zealands-water-systems-particularly-vulnerable-climate-change.