Takutai Kāpiti: Coastal hazards adaptation decision-making framework

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Kāpiti Coast District Council

Takutai Kāpiti
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Glossary

Term	Definition
Adaptation Actions	The specific measure taken to reduce or eliminate long-term risk associated with the hazard(s).
Adaptation Area	Five defined areas within the Kāpiti District where adaptation pathways for coastal hazards will be developed by the CAP and consolidated into the Coastal Hazards Adaptation Recommendations Report. The five Adaptation Areas are: Northern Kāpiti; Central Kāpiti; Raumati; Paekākāriki; and Queen Elizabeth Park. Refer to Figure 11 of this report.
Adaptation Options	Overview term used to group adaptation actions which have similar objectives and outcomes. In line with the MfE (2017) *Coastal Hazards Guidance,* Options in this report are termed as: Enhance, Accommodate, Protect, Retreat, Avoid.
CAP	Coastal Advisory Panel
Coastal Hazards Adaptation Recommendations Report	The report produced by the CAP which outlines the recommendation of adaptation pathways for each Adaptation Area in the Kāpiti Coast District
Criteria	A principle, value, or objective by which something can be judged or decided against in a MCDA process. These can be social, cultural, environmental, technical.
DAPP	Dynamic Adaptive Planning Pathways – An approach to planning for sea level rise in the future.
Hazard	Any atmospheric, earth or water related occurrence, the action of which adversely affects or may adversely affect human life, property, social, cultural, economic activities, or other aspects of the environment. A hazard is characterized by its timing, location, scale, intensity, and probability.
Initial preferred pathway	An adaptation pathway chosen by the CAP in Phase 2 which identifies their preferred pathway based on the MCDA analysis and economic analysis, prior to seeking community feedback.
Long-term	50 to 100 years from the present day
Medium-term	30 to 50 years from the present day to align with the life of a building being not less than 50 years, as defined in the Building Act.
MCDA	Multiple Criteria Decision Analysis used as a decision tool to inform assessment of the DAPP process.

Objectives	Goals defined by the CAP for use in the MCDA process and to develop the recommended adaptation pathways based on collective values.
Pathways	A sequence of actions which reduce or eliminate the risk to the hazard(s) over the short, medium, and long term that are the outputs from the DAPP process.
Preferred Adaptation Actions and Pathways	A sequence of actions which CAP has identified as having the most alignment with their values based on scoring in the MCDA analysis, economic analysis, and community feedback.
Relative Sea Level Rise	The combined effect of sea level rise and changes to the elevation of the land surface (i.e., vertical land movement).
Risk Assessment	A systematic approach to identifying the consequences of exposure to hazards, based on the likelihood of the event multiplied by the consequences.
ROA	Real Options Analysis is an economic assessment technique that can help evaluate policy pathways and quantify the investment risk associated with uncertain future outcomes.
Scoring	Quantitatively assessing the expected performance of each adaptation pathway against the MCDA criteria.
Sea Level Rise	An increase in the level of the ocean due to the effects of climate change.
Sensitivity Analysis	An analysis undertaken to enable robust examination of the MCDA results by exploring their sensitivity to weighted changes to different criteria, which is done in a systematic way to assess the effect on results.
Signals	Derived indicator values, monitoring changes in physical, social, cultural, economic, and risk attributes, which provide early warning to signal that a trigger (decision point) is approaching in the near to medium term and should prompt thinking and initial engagement processes on the next steps or any changes to the trigger.
Short-term	0-30 years from the present day to align with Long Term Planning timeframes set under the Local Government Act.
Coastal Strategy (2006)	Kāpiti Coast: Choosing Futures Coastal Strategy (2006). This document was developed by KCDC and provides high level guidance for the management of the coastal environment. It was prepared and adopted four years before the NZCPS.
TAG	Technical Advisory Group

Thresholds	When agreed objectives, community values, risk exposure, or levels of service are no longer being met or start to fail, requiring an alternative adaptation action or pathway to be in place before this occurs. The adaptation threshold is not tied to a particular time – rather it will be a bracketed time window derived using the scenarios in the DAPP processes tolerance for the hazard has been exceeded
Triggers	A derived indicator value(s), which when reached, provides sufficient lead time to cover community engagement, consenting, construction and funding arrangements, to ensure a new pathway or adaptation action can be implemented before the adaptation threshold is reached. The trigger is not tied to a particular time – rather it will be a bracketed time window derived using the scenarios in the DAPP process.
Values	Something considered, either personally or collectively, as being important or beneficial to quality of life.
Weighting	Assigned relatively for each of the criteria to reflect their relative importance to the decision for the objective of the strategy.

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The sole purpose of this report and the associated services performed by Jacobs is to prepare report outlining the coastal adaptation decision-making framework in accordance with the scope of services set out in the contract between Jacobs and Kāpiti Coast District Council ('the Client'). That scope of services, as described in this report, was developed with the Client.

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Appendices

1. Introduction

Through the Takutai Kāpiti project, the Kāpiti Coast District Council (KCDC) have formed a Coastal Advisory Panel (CAP) who are tasked with developing a set of recommendations for how coastal communities and infrastructure within the Kāpiti Coast District should adapt to sea level rise over the next 100 years. **The purpose of this report is to set out the tasks and process that CAP will follow in order to produce their coastal hazard adaptation recommendations.** The recommendations of CAP will help inform the broader coastal strategy and a district plan change that will be developed following the Takutai Kāpiti process.

The recommendations produced by the CAP following the framework described in this report will consist of adaptation pathways for defined 'Adaptation Areas' within the Kāpiti Coast District. The CAP will use various assessments covering social, environmental, cultural, infrastructure, and economic impacts from coastal hazards to inform the selection of the recommended preferred pathways consisting of adaptation actions over a 100-year time frame.

The report produced by the CAP at the end of this process is referred to as the Coastal Hazards Adaptation Recommendations Report. The development of the recommendations will be supported by a Technical Advisory Group (TAG) comprising of specialist consultants, relevant staff from KCDC, and the Greater Wellington Regional Council (GWRC).

1.1 Alignment with Ministry for Environment (2017) Guidance

The decision-making framework outlined in this document aligns with the steps 3-7 of the 10-step decision cycle framework from Ministry for Environment (2017) *Coastal Hazards and Climate Change Guidance for Local Government*, as shown in Figure 1.

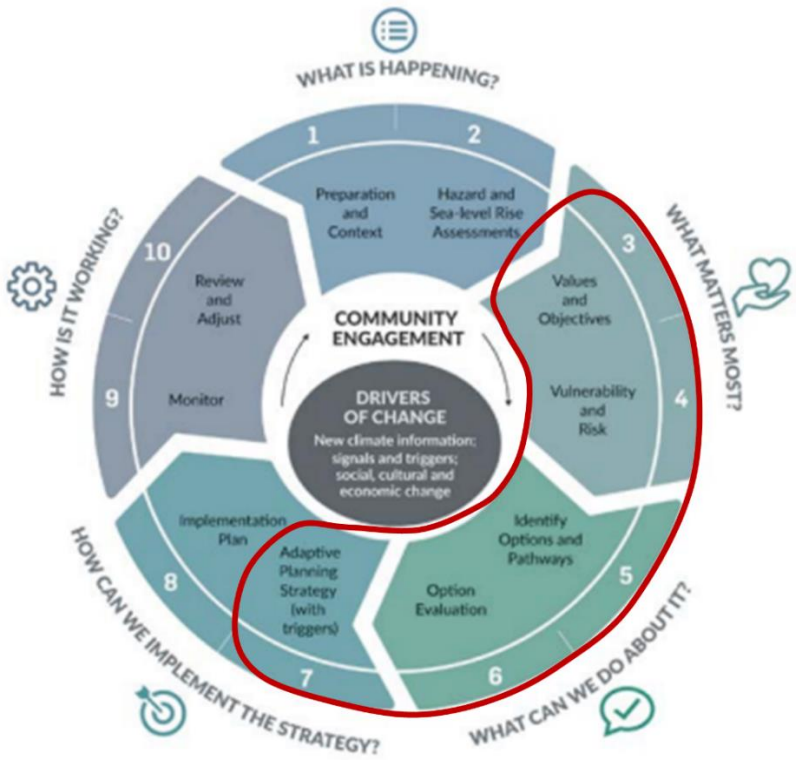

Figure 1: 10-step decision cycle framework from MfE (2017). This report outlines the decision-making framework required to undertakes steps 3-7 of this cycle.

Steps 1-4 of the 10-step decision cycle framework, shown in Figure 1, are used to gather information around the hazards and community values. At the time of writing this report, Steps 1 and 2 have been completed through the development of the Takutai Kāpiti project, and the initial hazard assessment undertaken by Jacobs (2022). This initial hazard assessment identified the coastal hazard susceptibility and vulnerability in

the Kāpiti Coast District under a range of different Relative Sea Level Rise (RSLR) scenarios. This work also included a vulnerability assessment of number or properties and critical infrastructure exposed to coastal hazards

To inform steps 3 and 4 of the decision-making cycle, the following work is being undertaken to collate the relevant information for the CAP:

- Maven Consulting is currently undertaking a Social Impact Assessment (SIA).
- Dr Aroha Spinks is currently undertaking a Cultural Values Assessment (CVA).
- Boffa Miskell is currently undertaking a Natural Character Assessment for planning purposes, but the outputs of the assessment will be used as baseline information for the CAP.
- KCDC are compiling a report of all known ecological values within the Adaptation Areas.
- Further flood modelling of the interaction of coastal, fluvial and groundwater sources is being undertaken by AWA and will be inputted into the project as hazard information as it becomes available.

This information will be delivered throughout the CAPs decision-making process as they work through each Adaptation Area in the form of a risk assessment, as well as baseline information to inform their understanding of cultural, social, and ecological values along the coast.

A decision-making framework (this report) is required to turn what was learned about hazards susceptibility and social/cultural values in Steps 1-4 (Figure 1), into a set of recommendations for coastal hazards adaptation for the district coastline using Steps 5-7 (Figure 1).

Following the CAP recommendation and pending acceptance from councilors, the council will develop an implementation plan (Step 8) to implement the selected adaptation option(s) pathways in a coordinated and planned manner that will provide the best overall outcome for the Kāpiti Coast district, both now and in the future as the risk profiles change. Recommendations on the implementation, monitoring, and review (Steps 8-10 of Figure 1), will form part of the recommendations by CAP in the final report formed from this decision-making framework process.

1.2 Development of this Report

This report has been prepared by Jacobs and Mitchell Daysh Limited in collaboration with other members of the Technical Advisory Group (TAG) (KCDC coastal team, GWRC, and Maven), for presentation and workshopping with the CAP in June 2022.

2. Overview of Decision-making Framework and Tools

In developing a set of coastal hazard adaptation recommendations, several decision-making tools will be used to inform a **DAPP (Dynamic Adaptive Planning Pathways) approach**. These tools are well-established techniques that have been applied both nationally and internationally to form adaptive pathways for coastal communities. The overall approach to adaptation used for the Takutai Kāpiti process is a DAPP approach, in which CAP will be able to identify preferred pathways using Risk Assessment, Multi-Criteria Decision Analysis (MCDA) and Real Options Analysis (ROV) tools, as discussed below.

2.1 Dynamic Adaptive Planning Pathways (DAPP) Approach

The Dynamic Adaptive Planning Pathway approach (DAPP) is recommended in the MfE (2017) Guidance. MfE has adapted this approach from the Dynamic Adaptive Policy Approach developed in the Netherlands (Haasnoot, et al., 2012). For the Takutai Kāpiti process, and in line with several other case studies in New Zealand, we will be adopting the general DAPP approach.

The DAPP approach allows for making decisions in the coastal context where there are dynamic characteristics leading to ever-changing risk profiles, and there is uncertainty around rates and magnitude of changes, especially over the long term. The DAPP approach is built on the notion that decisions are made over time in dynamic interaction with the system itself and cannot be considered independently or pre-determined

The DAPP approach focuses on making transparent what the path dependency is between actions and whether they will result in lock-in of existing risk or create future exposure to hazard risk, while keeping multiple pathway options open for the future. This helps to reduce the risk of irreversible decisions (Kwakkel et al., 2016). Importantly, the DAPP approach does not prescribe a single 100-year solution that is embedded up-front. After the short-term, future options are left for future decisions, provided they lead to the achievement of the stated objectives. This means there is some certainty for the community about what the future possible pathways entails. Longer-term uncertainty can be managed by specifying that the DAPP process be regularly reviewed (e.g., every 10 years).

2.1.1 New Zealand Case Studies using a DAPP approach

The DAPP approach has recently been successfully applied in New Zealand across several regions to address uncertainty over the next 100 years. Some examples of projects which have used the DAPP tool include:

2.1.1.1 Clifton to Tangoio Coastal Hazards Strategy 2120 (Hawkes Bay Coast) 2018

In the development of the Hawkes Bay Clifton to Tangoio Strategy, a DAPP approach was utilised to assess a series of pathways which were informed by other tools (MCDA[1], ROA[2]). The general DAPP approach was used, where pathways were developed for each coastal unit from a combination of hazard response options for short term (0-20 years), medium term (20-50 years) and long term (50-100 years), and a decision for a preferred pathway was determined using the MCDA and ROA tools. An example of how the tools were used to inform the recommendation is shown below in Figure 2. For the final output of the strategy, the community panels recommended a 'preferred' pathway for short-medium-long term options., However, the recommendation report noted that with regular strategy review periods, the recommended pathways for each priority units will be able to be reviewed and may well change in response to new information.

The Hawkes Bay coastal strategy was developed in a similar structure to the Takutai Kāpiti process, with a north and south community assessment panel tasked with defining preferred pathways. Based on the experience of the TAG members and successful experience with the Hawkes Bay process, the decision-making framework developed for the Takutai Kāpiti process is similar to that developed for the Hawkes Bay process.

[1] Multi Criteria Decision Analysis

[2] Real Options Analysis

Unit L: Clifton										
Pathway	Short term →	Medium term →	Long term	MCDA Score	MCDA ranking	Cost + Loss[1] ($m)	Cost + Loss[1] ranking	VFM[2] ($'000/ point)	VFM[2] ranking	Short Term build costs[3] ($m)
PW 1	Renourishment →	Managed Retreat →	Managed Retreat	67	2	12.20	6	173	5	7.12 (0.44 / yr)
PW 2	Renourishment + Control Structures →	Renourishment + Control Structures →	Managed Retreat	59	3	10.47	5	159	4	6.25 (0.40 / yr)
PW 3	Renourishment + Control Structures →	Renourishment + Control Structures →	Renourishment + Control Structures	52	4	9.60	3	156	3	6.25 (0.40 / yr)
PW 4	Renourishment + Control Structures →	Renourishment + Control Structures →	Sea wall	43	6	10.29	4	205	6	6.25 (0.40 / yr)
PW 5	Sea wall →	Sea wall →	Managed Retreat	70	1	8.83	2	110	1	5.23 (0.38 / yr)
PW 6	Sea wall →	Sea wall →	Sea wall	49	5	7.65	1	126	2	5.23 (0.38 / yr)

[1] Cost + loss is equal to the total cost estimate (operational + capital costs) for the full 100 year pathway + residual losses due to events that exceed a 1 in 100-year chance of occurrence.

[2] Value for Money measure – how much it costs to "purchase" each MCDA point based on the MCDA score and total cost estimate (operational + capital) of each 100 year pathway

[3] Mid-point cost scenario (including operational costs) for the first stage of each pathway (i.e the short term option). Numbers in brackets are the annual rating cost of the short term option over 20 years.

Figure 2: Output from the DAPP approach for the Clifton to Tangoio Strategy (Mitchell Daysh, 2018).

2.1.1.2 Hutt River City Centre Upgrade Project (Greater Wellington Regional Council) 2015

As part of a study by Greater Wellington Regional Council in 2015 of long-term options for managing flood risks in the Hutt Valley, a DAPP approach was used to assess the various option pathways available to the community (including economic analysis) to determine scenario-based timeframes for when changes to the current actions may be required. The final output of the plan is presented below in Figure 3 and sets out a pathways map for a range of options over time developed for that study.

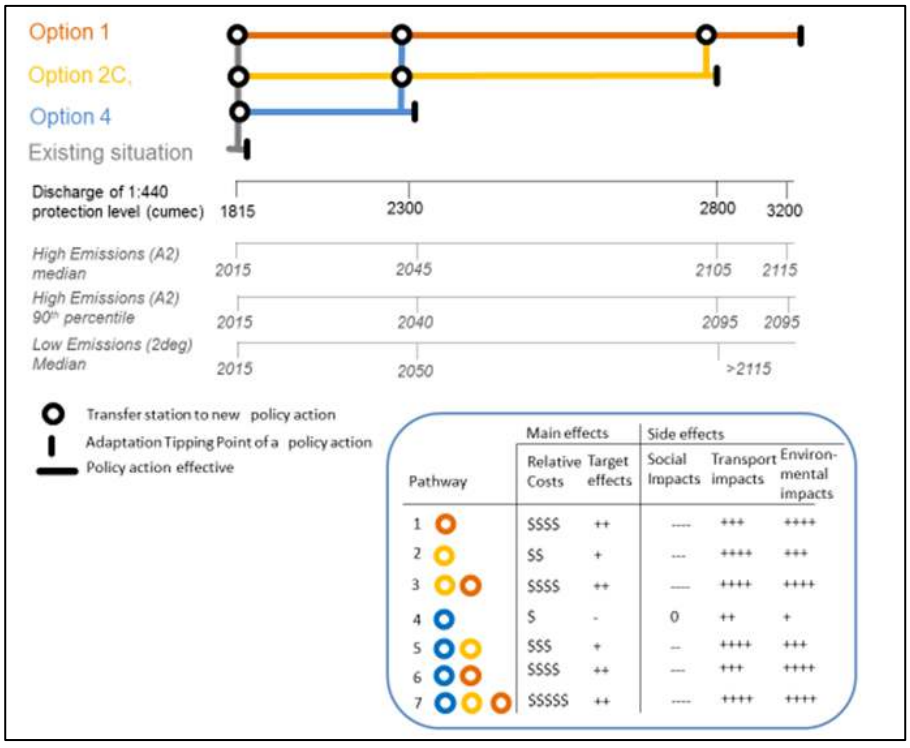

Figure 3: Adaptation Pathways Mapped developed for the Hutt River Centre Upgrade Project (GWRC, 2015).

2.1.1.3 St Clair to St Kilda Coastal Plan (Dunedin City Council) 2022

Dunedin City Council has used the DAPP approach to develop future pathways for the St Clair to St Kilda coastline within their district. This plan developed site-specific adaptive plans for each area of the study, which showcased a variety of potential management options informed by community engagement. These plans highlighted relative timeframes for when these changes may need to occur, and where a change in action was required. The plan identified a series of short-term actions which were already scheduled and budgeted to take plan over the next 3 years and highlighted longer term shortlisted pathways. An example of a site-specific DAPP is shown in Figure 4.

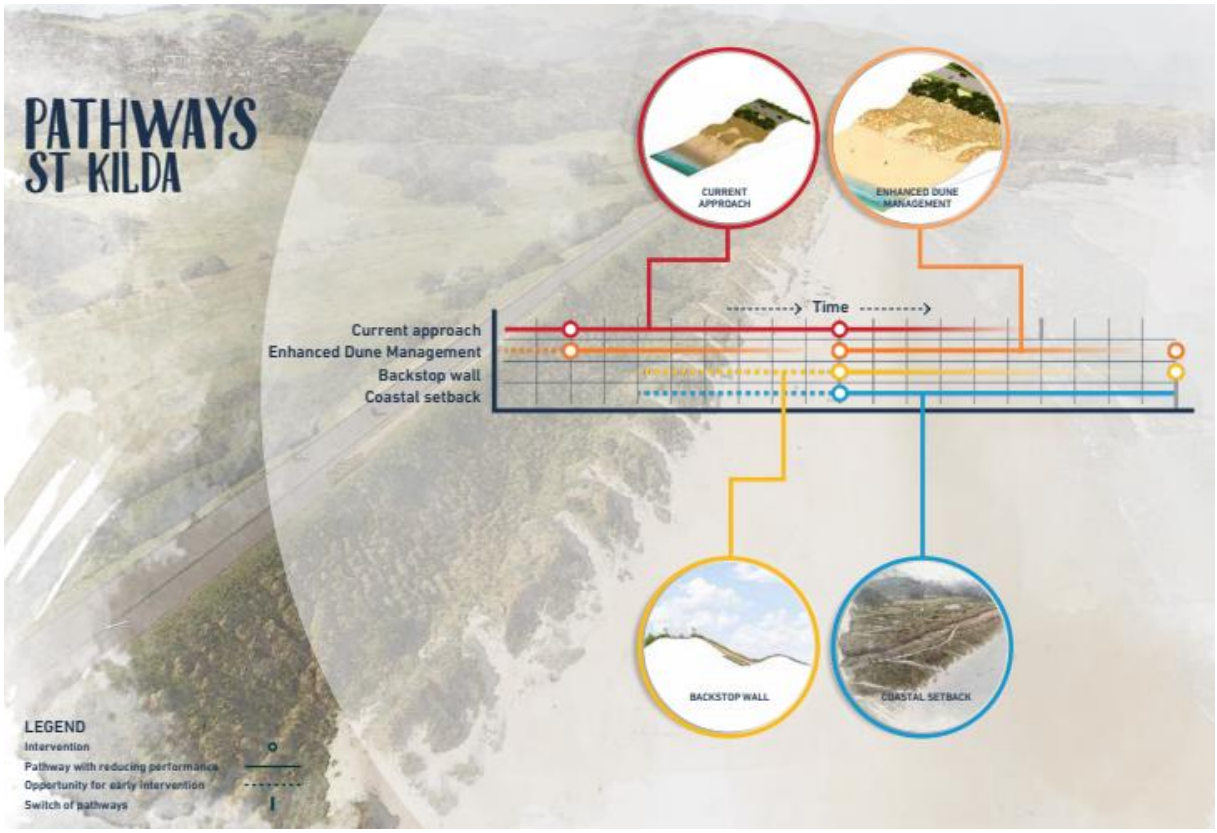

Figure 4: Site specific dynamic adaptive pathway map from the St Clair to St Kilda Coastal Plan (DCC, 2022).

2.1.1.4 Shoreline Adaptation Plan: Whangaparāoa Pilot (Auckland Council) 2022

Auckland Council (AC) used the DAPP as a tool to provide a 'roadmap' for changing coastal management strategies over time. In developing the pathways, AC used four overarching adaptation strategies to define the high-level strategy developed for each coastal stretch over the short (0-20 years), medium (20-60 years), and long (60 years +) term, with an indication of how these choices reflect the escalating risk, considerations of infrastructure providers, and the values and objectives of mana whenua and the local community. An example of one shoreline adaptation plan is shown in Figure 5. AC applied these high-level strategies to 35 'coastal stretches' based on a number of considerations. It is assumed that similar to the Hawkes Bay strategy, the pathways would be reviewed, and pathways could be adapted in the future in light of new information.

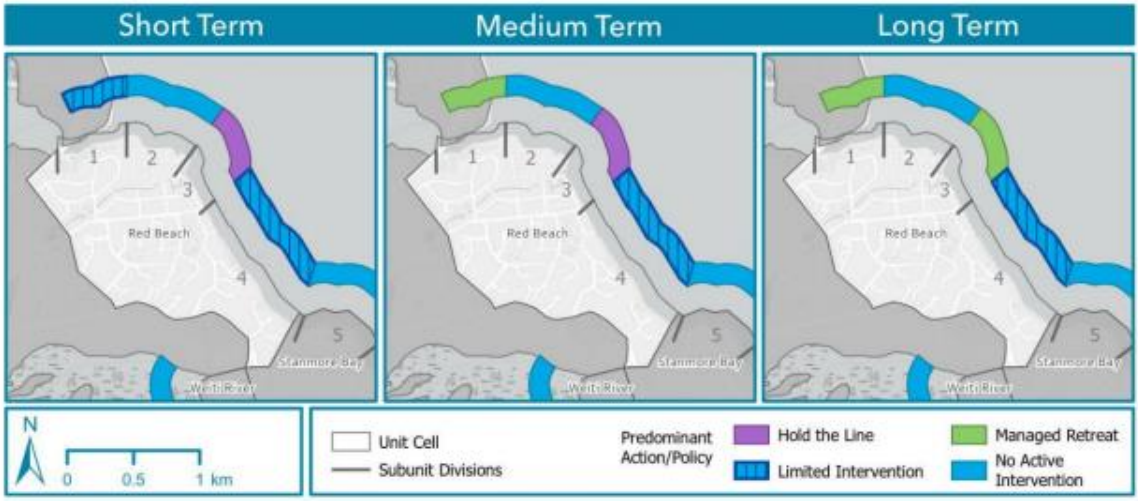

Figure 5: Example for Auckland Councils Shoreline Adaptation Plan: Whangaparāoa Pilot (Howe et al, 2022).

2.2 Risk Assessment

Risk is defined in the MfE (2017) coastal hazards guidance as *"a combination of likelihood and consequence"*, with a Risk Assessment being a technique to collate, intercept, and interpret all the information on likelihood of the hazard and the consequences of the hazard to both the physical assets/infrastructure and social, cultural, and environmental values.

The above definition is embedded in standards documents and consequent practice worldwide. However, in some international standards risk is also defined as "*the effect of uncertainty on objectives*". For SLR, the '*likelihood*' side of the risk equation changes with time, with uncertainty over the magnitude and timing that it will occur. Therefore, there will be emergence of increasing risk and increasing uncertainty. As a result, the likelihoods around risk in the MfE (2017) *Coastal Hazards Guidance* are expressed as "*a bracketed time period of emergence of risk for an increment in SLR, or an increased frequency of a coastal hazard event for a specified SLR or range"*. The MfE (2017) Guidance also notes that "*in an asset management context, a risk assessment needs to also incorporate the risks to levels of service as well as physical damage to the component parts"*.

The MfE (2017) Guidance presents a three-level risk assessment process as follows:

- A first pass screening of the climate change related exposure using readily available datasets. The Takutai Kāpiti Volume 2 report "*Coastal Hazards Susceptibility and Vulnerability*" (Jacobs, 2022) satisfies this level of screening.
- A second-pass risk assessment taking a standard risk-based approach using appropriate national, regional, and local data on hazard exposure for various SLR scenarios, asset attributes, demographics, and expert knowledge on non-physical and environmental values. It enables the identification of how climate change may compound existing risks or the emergence of new ones. The volume 2 "*Coastal Hazards Susceptibility and Vulnerability*" (Jacobs, 2022) report only partially meets the requirements for this standard of assessment, as expert opinion on cultural, social, and environmental factors were not available at the time, and therefore the full range of consequences of the hazards could not be accurately depicted.
- A third pass (detailed) risk assessment involves further investigation testing of response options and actions to reduce risks, and identify what conditions and bracketed time periods these will remain effective. This third pass detailed risk assessment is satisfied by the development of adaptation pathways using the DAPP approach.

The methodology for the development of the second pass risk assessment for each Adaptation Area is presented in section 4.3.1.

2.3 Multi-Criteria Decision Analysis (MCDA)

Multi-Criteria Decision Analysis (MCDA) is a tool that is used to assist decision-making by people able to consider a number of different criteria, including both qualitative and quantitative. The objective of the MCDA is to provide an overall ordering of options from the most preferred to the least preferred option. It is used in a number of contexts to help provide analysis of different options and outcomes, and how they compare to one another.

The UK Manual (2009) summarises the MCDA approach as follows:

"MCDA is both an approach and a set of techniques, with the goal of providing an overall ordering of options, from the most preferred to the least preferred option. The options may differ in the extent to which they achieve several objectives, and no one option will be obviously best in achieving all objectives. In addition, some conflict or trade-off is usually evident amongst the objectives; options that are more beneficial are also usually more costly.

MCDA is a way at looking at complex problems that are characterised by any mixture of monetary and non-monetary objectives, of breaking the problem into more manageable pieces to allow data and judgements to be brought to bear on the pieces, and then of reassembling the pieces to present a coherent overall picture to decision makers. The purpose is to serve as an aid to thinking and decision-making, but not to take the decision."

The Hawkes Bay Clifton to Tangoio Coastal Hazards Strategy 2120 used the MCDA tool to assess different adaptation pathways against one another. The Community Assessment Panels developed assessment criteria to be used in the MCDA process with an accompanying scoring guide. The assessment criteria were split into 'Technical assessment criteria' (e.g., the efficiency of the option) and 'Impact assessment criteria' (e.g., the impact of implementing the option). The MCDA was carried out for each short-listed pathway against weighted criteria, and pathways were then assigned a 'ranking'. There is no criteria included to consider the economic aspects of a given pathway (such as affordability). It was a deliberate decision of the Community Assessment Panels to complete economic analysis as an extra task in the assessment process, that was separate to but complemented the MCDA outcome. The MCDA Process is outlined diagrammatically in Figure 6.

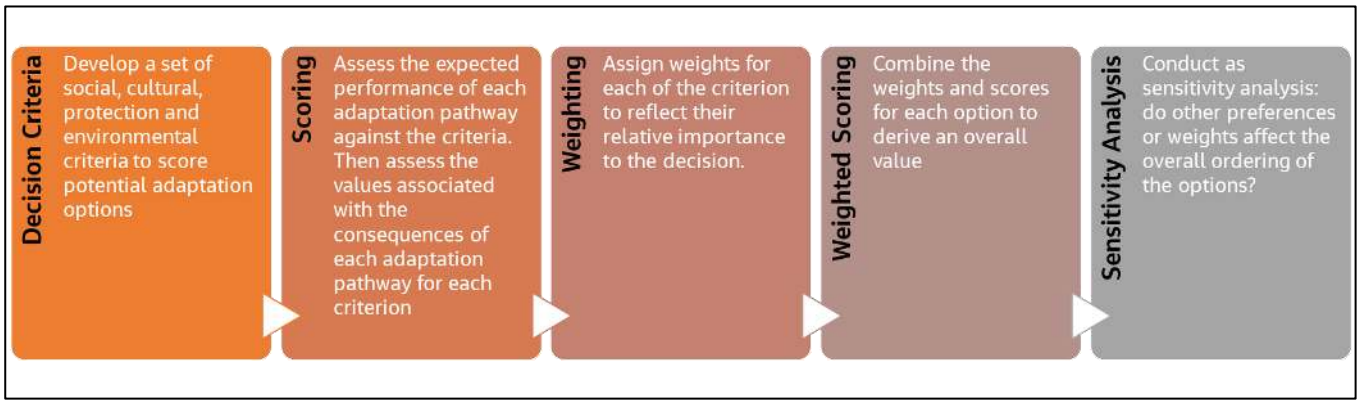

Figure 6: Overview of the MCDA Process (adapted from Mitchell Daysh, 2017).

One of the key points the UK Manual makes is the analysis can be framed in different ways, some more directly supporting the eventual decision, and some less so. The MCDA might be structured to:

- Show the decision maker the best way forward;
- Identify the areas of greater and lesser opportunity;
- Prioritise the options;
- Clarify the differences between the options;
- Help the key players to understand the situation better;
- Indicate the best allocation of resources to achieve the goals;

- Facilitate the generation of new and better options;
- Improve communication between parts of the organisation that are isolated (e.g. finance, engineering, environmental); or
- Any combination of the above.

The application of the MCDA tool in the Takutai Kāpiti Process is described in Sections 4.2.2 and 4.3.5-4.3.6.

2.4 Real Options Analysis (ROA)

Real Options Analysis (ROA) is an economic assessment technique that can help evaluate policy pathways and quantify the investment risk associated with uncertain future outcomes. Traditional investment decisions are often informed by a cost-benefit analysis (CBA), but CBA approaches do not account for uncertainty inherent in a changing climate or the flexibility needed to address a changing climate (Dawson et al, 2018). ROA can enable economically efficient adaptation investment decision-making both now, and at future decision points.

The ROA approach assesses whether it is better to invest now or to wait – and whether it is better to invest in options that offer greater flexibility in the future (Watkiss et al. 2013).

ROA considers:

- the flexibility over the timing of the capital investment.
- the flexibility to adjust the investment as it progresses over time, i.e., allowing a project to adapt, expand or scale-back in response to unfolding events.
- the value of waiting for more information before an expensive and possibly irreversible investment is undertaken, and whether an alternative investment might suffice in the meantime.

These decision-making elements are important considerations when valuing adaptation options and pathways that are exposed to changing hazard risk profiles. Unlike in CBA, the ROA approach can support multiple decision points and be updated as information changes. The ROA approach will also help ensure that decisions taken today do not create further risks which are costly to reverse in the future.

The ROA process will provide two specific metrics:

1. A **'Cost + Loss'** metric which is derived from two elements:
    - A total cost estimate (Capital and Operational) for the design, construction, and maintenance of all elements in the full 100-year pathway sequences (this will be a discounted value).
    - A residual loss calculation – reflecting there may still be impacts due to uncertainties in climate science and engineering design. This could be a calculated loss figure from damage caused by events that exceed a 1 in 100-year chance of occurrence used in the hazard assessment.
2. A **Value for Money (VFM)** measure for each pathway. This compares the total cost estimate for each 100-year pathway sequence against its MCDA results (the weighted scores) to provide the cost of each MCDA point.

The robustness of MCDA results can be checked by comparing the MCDA results with the ROA incremental investment cost differences between the various flexible pathways. In this way, the MCDA results can be meaningfully compared with ROA results on value for money.

As such, MCDA and ROA are complementary assessment tools that have been shown to support application of the Dynamic Adaptive Planning Pathways framework. Examples of successful application of this approach include:

- Greater Wellington Regional Council for the Hutt River upgrade project for valuing pathways and to test the sensitivity of options to climate scenario, discount rate, decision review date and costs and losses (Greater Wellington Regional Council, 2015)

- Hawke's Bay Regional Council Real Options Analysis of Strategies to Manage Coastal Hazard Risks (Infometrics, 2017)

This approach used in the Hawke's Bay was reviewed by Lawrence et al (2019) and a number of lessons learned from that review have been used to steer the development of this Takutai Kāpiti Coastal Adaptation Strategy Decision-making Framework.

3. Relationships, Roles, and Responsibilities

3.1 Coastal Advisory Panel (CAP)

The Coastal Advisory Panel (CAP) was established in November 2021. The project scope, make-up and role of the panel was co-designed by Council and a working group of iwi partners, Coastal Ratepayers United, North Otaki Beach Residents Group, Waikanae Estuary Care Group, and GWRC staff. Seven members of the panel were appointed through a recruitment agency to form a representative group, with another six representatives to be appointed by iwi. The terms of reference for the CAP are provided in Appendix A.

The purpose of the Takutai Kāpiti Coastal Advisory Panel (CAP) is to develop the Strategy for KCDC consideration. The CAP is the formal mechanisms through which wider community input and indigenous knowledge are used to develop a set of recommendations for coastal hazards adaptation for council's consideration.

Panel members have full decision-making rights involving the scoring of the MCDA analysis, development of adaptation pathways based on this scoring and making recommendations to Council on the preferred pathways to be followed in each Adaptation Area.

3.1.1 CAP Objectives

As per the terms of reference, the CAPs objectives are:

- *To facilitate engagement with the broader community, affected persons, and other stakeholders in relation to coastal hazard risks and associated coastal hazard response options.*
- *To develop coastal hazard response options through consideration of the practicality, affordability, scientific, cultural, and social values (technical expertise provided externally) of a range of options, based upon agreed trigger points.*
- *To determine, in consultation with the wider community, the preferred option(s) and provide Council with recommendations regarding:*
    - *Priority areas for action;*
    - *Preferred coastal hazard response options; and*
    - *Programming, implementation and monitoring of effectiveness.*
- *To prepare a report detailing the evaluation process and recommendations of the Panel. KCDC resources will be available to assist with the editing, compilation, and publication of the report.*

3.1.2 CAP Meetings and Workshops

The CAP will meet regularly (i.e., monthly) at the agreed scheduled meetings to discuss new information and hear from technical experts of various relevant subject matter. The meeting and workshop schedule at the time of this report is presented in Figure 7, however this is subject to change as information and timelines evolve.

Throughout the Takutai Kāpiti process, CAP will have access to relevant technical expertise through the Technical Advisory Group (TAG). The CAP may also request additional technical experts in other subject matters where they see fit. It is through these meetings and workshops that additional experts will present their information to the CAP for discussion. Following these meetings, relevant reports and presentation slides will be circulated to the CAP.

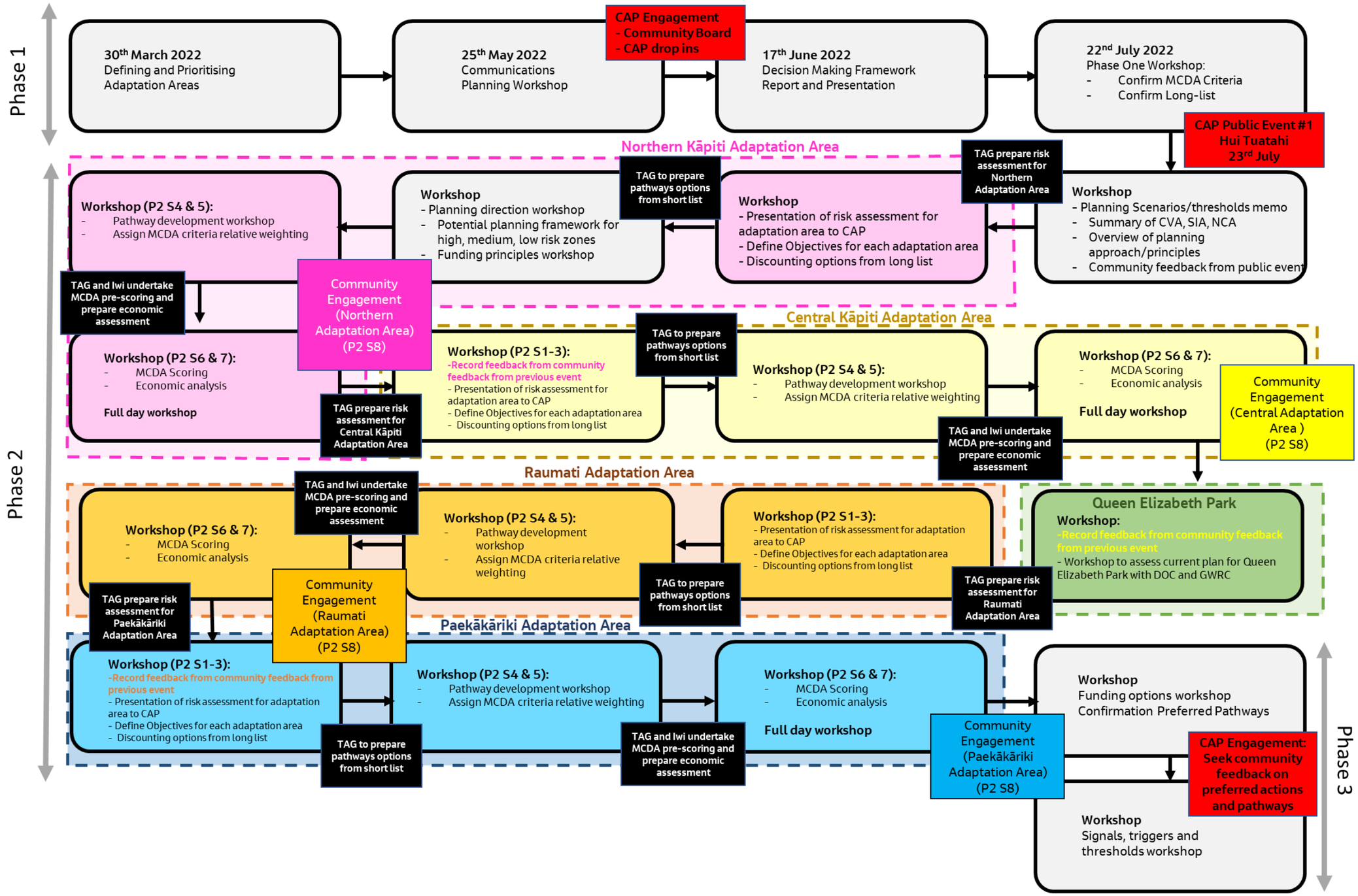

Figure 7: CAP workshop schedule.

3.1.3 CAP Outputs and Deliverables

The primary output of the CAP will be a Coastal Hazards Adaptation Recommendation Report to Council outlining the process they have taken, and final set of recommended Adaptation Pathways for each Adaptation Area. The facilitator will work with the CAP to develop this report, and additional administrative support will be provided by the Council project team and the TAG to consolidate the information into a single document. Further information about the detailed outputs required for the report are described in Section 4.4 (Phase 3).

3.2 Technical Advisory Group (TAG)

The TAG is a group of internal KCDC and external technical experts that provide technical support to the CAP. The TAG has been split into two groups: (1) 'Core' TAG; and (2) 'Wider' TAG. The structure and parties involved in these two groups is shown in Figure 8, and a detailed breakdown of individuals involved in the TAG is presented in Appendix B.

The role of the TAG is to assist the CAP with their delivery of their recommendations, with key responsibilities including:

- Preparing and facilitating the key information required for the CAP to inform their decision-making;
- Providing on-hand technical advice to the CAP to assist their decision-making; and
- Coordination and facilitation of CAP workshops to help develop the final recommendation report.

The 'wider' TAG group is made up of a broader range of subject matter experts who are providing input of key information into the CAP process, as well as key KCDC staff who's workstream may overlap with the outputs of the recommendations being developed by the CAP. The wider TAG will generally meet monthly to provide updates on the various workstreams feeding into the strategy development process with CAP.

The TAG is made up of KCDC staff, GWRC staff and external consultants set out in Appendix B and will adjust in accordance with the CAPs request for further information.

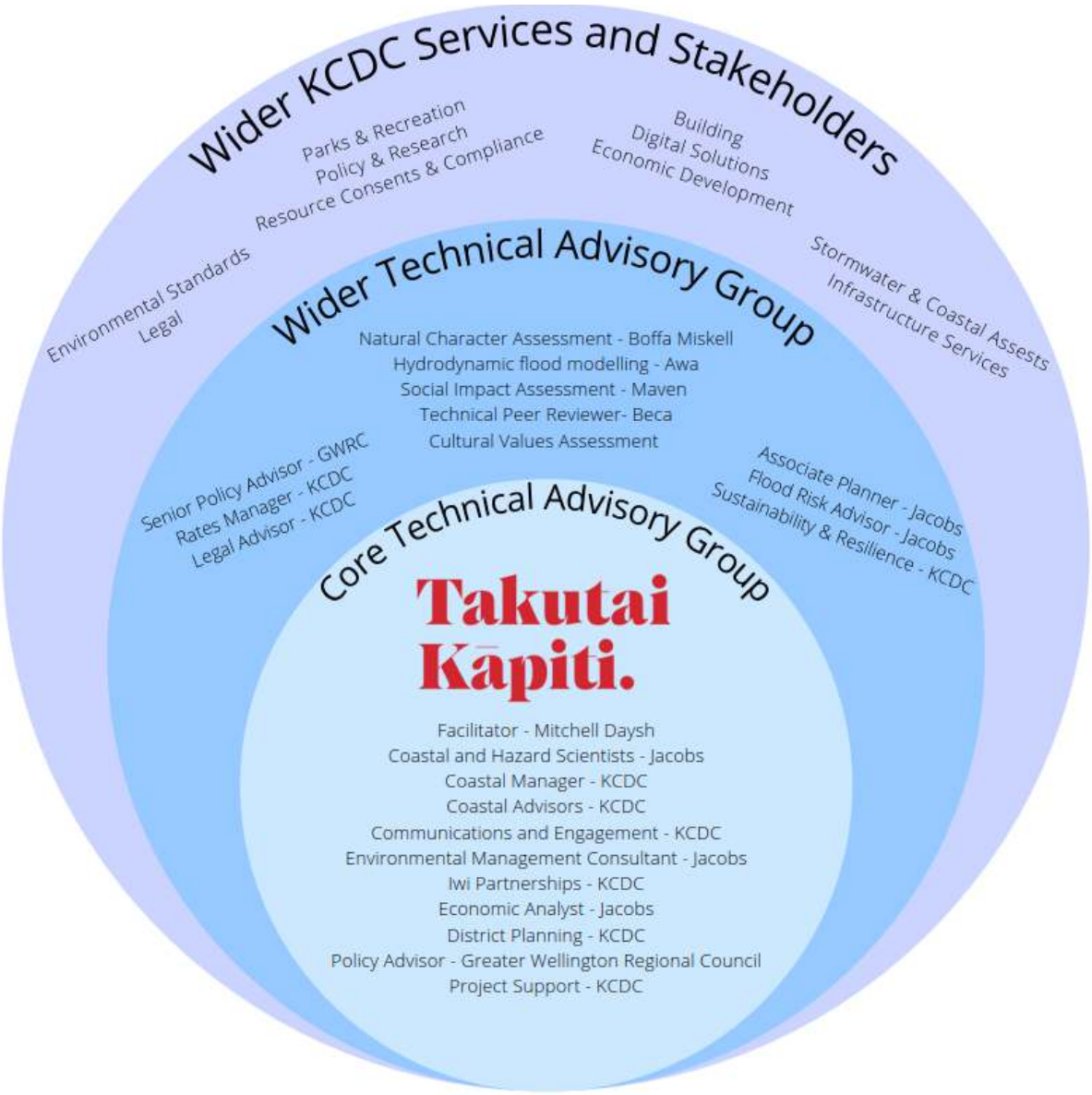

Figure 8: Overview of TAG members and wider TAG structure.

3.3 Other Parties

Climate change portfolio holders for GWRC and KCDC, and KCDC community board members can be present to observe the CAP meetings and workshops, and can participate in the discussion, at the discretion of the Chair.

3.4 Relationship between CAP, TAG, and Council

The relationship structure between the CAP, the TAG, KCDC staff, elected council, and the community is outlined below in Figure 9. The CAP, as the community representative group, is tasked with making recommendations to Council on behalf of the community. Throughout the process, CAP will engage both independently and in facilitated environments to gauge community feedback on the development of the preferred pathways. The CAP acts as the conduit and community voice for input into the Coastal Hazards Adaptation Recommendation Report to council.

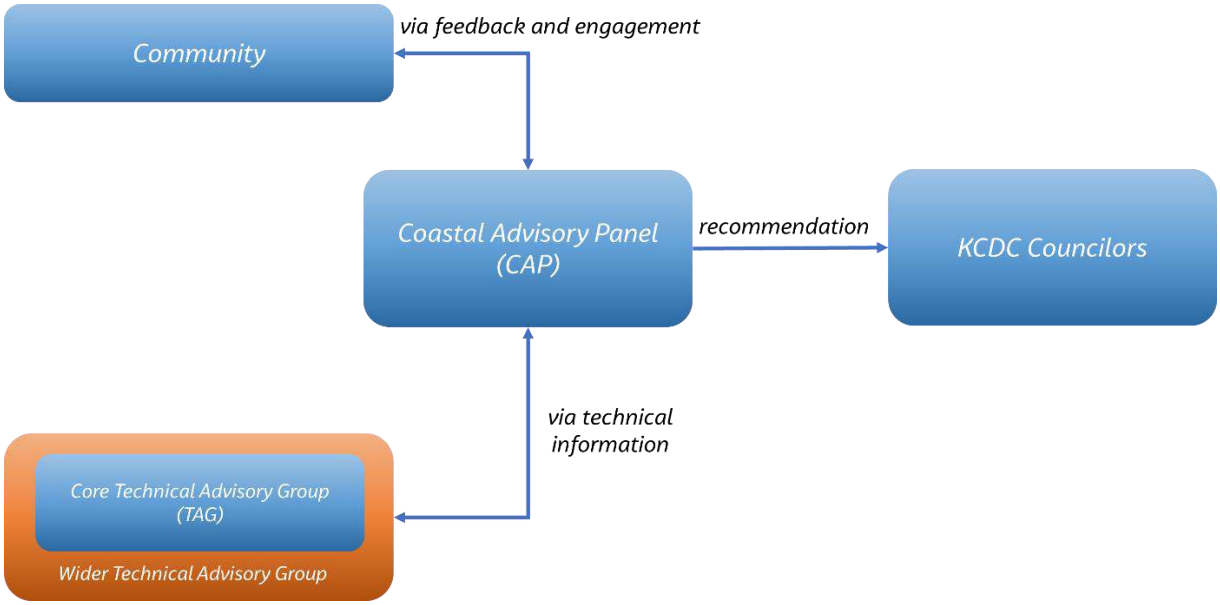

Figure 9: Relationship structure for the development of the Coastal Hazards Adaptation Recommendations Report

3.5 Consensus Approach to decision-making

A consensus decision-making approach will be adopted to the decision-making process for the CAP.

As per the CAP Terms of Reference (Appendix A):

> *20 A consensus decision-making model will be used in formulating Panel recommendations.*
>
> *21 If a consensus cannot be reached on any specific recommendation in the final report, the reasons for disagreement will be noted in the report.*
>
> *22 The Panel's preference is to achieve consensus. If at any stage a Panel member feels that they are regularly in a position of disagreeing with proposals, or are regularly compromising, i.e., making agreements that they 'may not entirely agree but can live with', this should be noted by that member as soon as it is realised.*
>
> *23 Mandated Panel iwi representatives will seek decisions through their respective rūnanga boards and present outcomes at the following Panel meeting.*

During the important MCDA weighting and scoring phases of the process, the facilitator (Stephen Daysh) will apply a "negotiation" approach for the establishment of the weighting (of the criterion as between the various criteria) and scoring of the options (against the criteria). This approach engenders reasoning needing to be explained for the outcomes (which is also written down in the process to clearly explain the differences between the defined weightings and scoring). In past experiences, this negotiation/discussion/recording process is usually successful at arriving at an agreed weight/score (without the need for any voting process).

4. Decision-making framework for the development of Takutai Kāpiti Coastal Hazards Adaptation Recommendations

4.1 Overview of Decision-making Process for CAP

The decision-making process for the Takutai Kāpiti Adaptation Strategy is outlined in Figure 10, and is discussed is more detailed methods in Sections 4.2-4.4 below.

The decision-making framework is split into three key phases:

- **Phase 1:** Defining and Confirming
- **Phase 2:** Assessment of Pathways for Adaption Area (repeated for each Adaptation Area)
- **Phase 3:** Synthesis and Final Recommendations

Phase 1 will involve a series of tasks to help set the baseline criteria for undertaking the assessments and developing recommendations of actions and pathways in each Adaptation Area. This information defined in Phase 1 can be carried through for use across each Adaptation Area. This will involve:

1. Defining the 'Adaptation Areas' within the Kāpiti Coast District based on the relevant information provided to them by the TAG; and defining the approach to addressing each area (i.e., looking at the areas in parallel or in sequence). The selection and prioritization of the Adaptation Areas is covered in section 4.2.1.
2. Confirming the MCDA criteria to be used in the MCDA analysis in Phase 2 to score each of the shortlisted adaptation pathways. So that the CAP does not start with a 'blank sheet', the MCDA criteria will be developed by the TAG, which will be discussed and further refined with the CAP where required (Section 4.2.2)
3. Confirming the 'long-list' of adaptation options which could be applied to the Kāpiti Coast, which will then be further refined into shorter more appropriate lists of adaptation actions to form pathways for each Adaptation Area in Phase 2 (Sections 4.2.3).

Phase 2 consists of eight key tasks which CAP will repeat for each Adaptation Area in order to develop the recommended adaptation pathways within each area. These tasks involve:

1. Presentation by the TAG of the relevant Risk Assessment information for the Adaptation Area, which will provide a baseline scenario for CAP to measure the success of their proposed adaptation actions against (Section 4.3.1).
2. Define the coastal hazard management objectives for the Adaptation Area. These objectives will be based on the values highlighted in the cultural values assessment and social impact assessment, along with the experience and views of the CAP as community representatives (Section 4.3.2).
3. Discount from a long list of potential adaptation options and actions (Appendix D) which ones would not be appropriate for the Adaptation Area, based on objectives developed in Phase 2 Task 2 (Section 4.3.3).
4. From the remaining options which were deemed as potentially appropriate for the Adaptation Area, CAP will develop a short list of potential pathways for the Adaptation Area (Section 4.3.4).
5. Define the MCDA criteria weightings for the Adaptation Area (Section 4.3.5).
6. Undertake a MCDA analysis on the short-listed pathways for the Adaptation Area using the weightings defined in Phase 2 Task 5. CAP will use this analysis to select an initial preferred pathway (Section 4.3.6).
7. Following the MCDA analysis, the TAG will present an economic assessment to CAP to understand the cost implications of each short-listed pathway for the Adaptation Area, and how funding principles

may apply to the different pathways. CAP will use this information to update their initial preferred pathway (Section 4.3.7).

8. The CAP will then communicate the process they have undertaken to the community and seek feedback on their initial preferred pathways for the Adaptation Area. This feedback will then be incorporated into the final preferred pathways presented in the district wide Coastal Hazards Adaptation Recommendation Report in Phase 3 (Section 4.3.8).

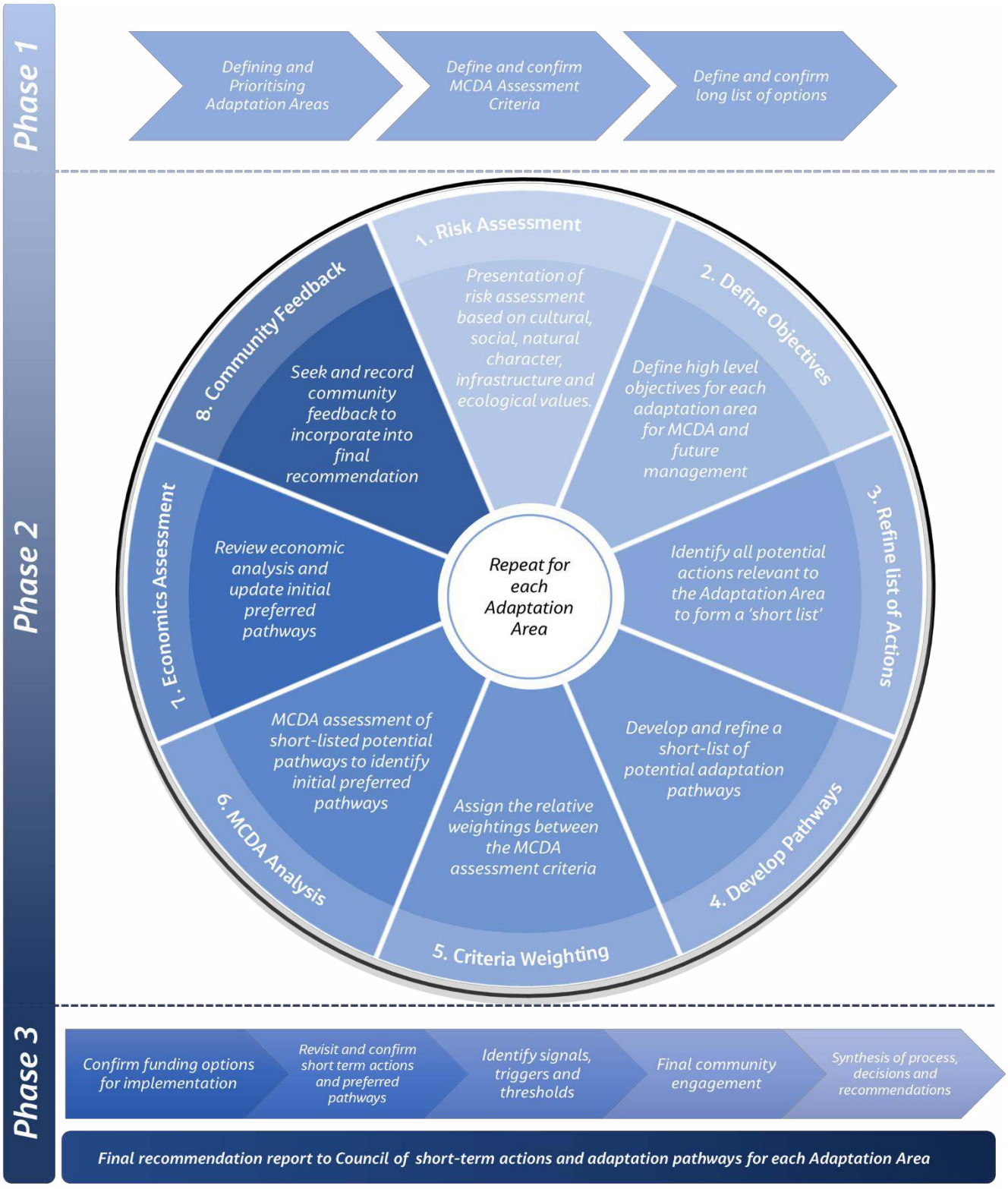

Figure 10: Overview of decision-making framework for the CAPs Recommendation Report.

These eight tasks will be undertaken for all Adaptation Areas, except the for the Queen Elizabeth Park Adaptation Area. Queen Elizabeth Park is owned by GWRC and managed under the Toitū Te Whenua Parks Network Plan 2020-2030, and therefore a bespoke approach will be undertaken to have input to the future plans for the park. It is anticipated that a workshop will be held with the CAP, GWRC and Department of Conservation to determine an outcome for Queen Elizabeth Park Adaptation Area.

Phase 3 consists of the CAP synthesising the results of Phases 1 and 2, to produce a recommendation on coastal hazard adaptation pathways across all Adaptation Areas to Council. Phase 3 is made up of 5 key tasks which will take place over a series of workshops with the CAP and the TAG:

1. The TAG will present CAP with the funding information, which will identify how short-term actions and medium to long term pathways across all Adaptation Areas could be funded (e.g., public vs private).
2. Using the funding information along with the feedback from the community in Phase 2 Task 8, the CAP will revisit and confirm their preferred pathways for each Adaptation Area.
3. With the assistance of the TAG, the CAP will then identify signals, triggers, and thresholds to define when the initiation of the short-term adaptation actions with be required, and to move from the short term to the medium-term adaptation actions.
4. Seek further community feedback on the preferred adaptation pathways; signal, triggers, and thresholds; and fundings arrangements for the short-term adaptation options
5. Using the decisions made in Phase 3 Tasks 1-4, and the feedback from the community, with assistance from the TAG, CAP will synthesise the results of the process they have undertaken and prepare a report to council which outlines:
    - A documentation of the decisions CAP made at key points in the decision-making process;
    - Final recommendation on the preferred short-term actions for each of the Adaptation Areas, along with appropriate potential pathways of adaptation actions over the medium to long term.
    - A series of recommendations to inform steps 8-10 of the MfE (2017) decision cycle in Figure 1, including recommendations on funding; implementation; and monitoring.

The output of Phase 3 will form the Coastal Hazards Adaptation Recommendations Report and will be presented to the Council by the CAP for consideration at a special meeting.

4.1.1 Technical information provided to CAP

At the time of writing this report, the following technical assessments have been provided to the CAP:

- Jacobs (2021) Kāpiti Coast Coastal Hazard Susceptibility and Vulnerability Assessment Volume 1 Methodology Report
- Jacobs (2022) Kāpiti Coast Coastal Hazard Susceptibility and Vulnerability Assessment Volume 2 Results Report

The following information will also be available for input into the Risk, MCDA, and economic assessments for each Adaptation Area:

- Social Impact Assessment (Maven)
- Cultural Values Assessment (Dr. Aroha Spinks)
- Natural Character Assessment (Boffa Miskell)
- Coastal Hazards District Planning Assessments (Jacobs)
- Ecological values (KCDC)

The delivery of these reports within the broader project timeframe is presented in Figure 11. These assessments will be required for the CAP to consider and include in the development of preferred actions and pathways. It is important to note that the CAP can request further information and assessments from the TAG as they feel is required for their evaluation role

Takutai Kāpiti Project

Stage	Phase One 2020 Project launch. Jacobs team commissioned	Phase Two: 2021-2023 Coastal Advisory Panel (CAP) and Technical Advisory Group (TAG) formed						Phase Three: 2024 Recommendations to Council and implementation planning.	
Delivery of technical advice	Volume 1 Takutai Kāpiti	Volume 2 Takutai Kāpiti	Volume 3 Takutai Kāpiti							
	Methodology	Hazard and Susceptibility Assessment	Decision Making Framework Report	Planning framework relevant to coastal hazards memo	Social Impact Assessment	Cultural Values Assessment	Natural Character report	Ecology report	Recommendation Report from CAP to Council	Officer's Report from Takutai Kāpiti Team to Council
			Risk assessment completed for each adaptation area based on input from various technical experts, the community and discussions with the Takutai Kāpiti Team, Council, CAP and TAG: - Northern Kāpiti Adaptation Area Risk Assessment - Central Kāpiti Adaptation Area Risk Assessment - Raumati Adaptation Area Risk Assessment - Paekākāriki Adaptation Area Risk Assessment							

Figure 11: Summary of delivery of technical advice throughout the course of the Takutai Kāpiti Project.

4.2 Phase 1: Pre-Assessment Defining and Confirmation

Phase 1 is about confirming the district wide approaches and information that is required for the Phase 2 assessments in each Adaptation Area. Phase 1 Task 1 (Defining and prioritising adaption areas) has already been undertaken by CAP at the time of writing this report but is included for completeness of the decision-making process.

It is anticipated that Tasks 2 and 3 of Phase 1 will be undertaken in one workshop (July 2022) with the CAP and relevant core TAG members in order to get final confirmation of the MCDA criteria and long-list of options for the whole district.

4.2.1 Task 1: Defining and Prioritising Adaptation Areas

4.2.1.1 Defining Adaptation Areas

Given the likely different potential adaptation pathways that will be needed along the Kāpiti Coast, the district needed to be divided into Adaptation Areas of similar coastal morphologies, processes, hazard exposure and current management practices. From this approach, relatively uniform preferred adaptation pathways could then be developed for each Adaptation Area.

Potential Adaptation Areas were drafted by Jacobs, and were based on the following factors:

- Similarities in the susceptibility and vulnerability to coastal hazards
- Similarities in local processes occurring (e.g., sediment supply, sediment transport)
- Density of population and infrastructure
- Present day coastal management practices (e.g., structured/non-structured)
- Limit of coastal influence on flooding and groundwater levels
- Common catchments

The draft Adaptation Areas are shown in

Figure 12 and were presented to CAP on 30/03/2022 for confirmation of use. At this meeting CAP were presented with technical details on how these areas were developed.

CAP accepted the Adaptation Areas were appropriate for use in developing adaptation pathways.

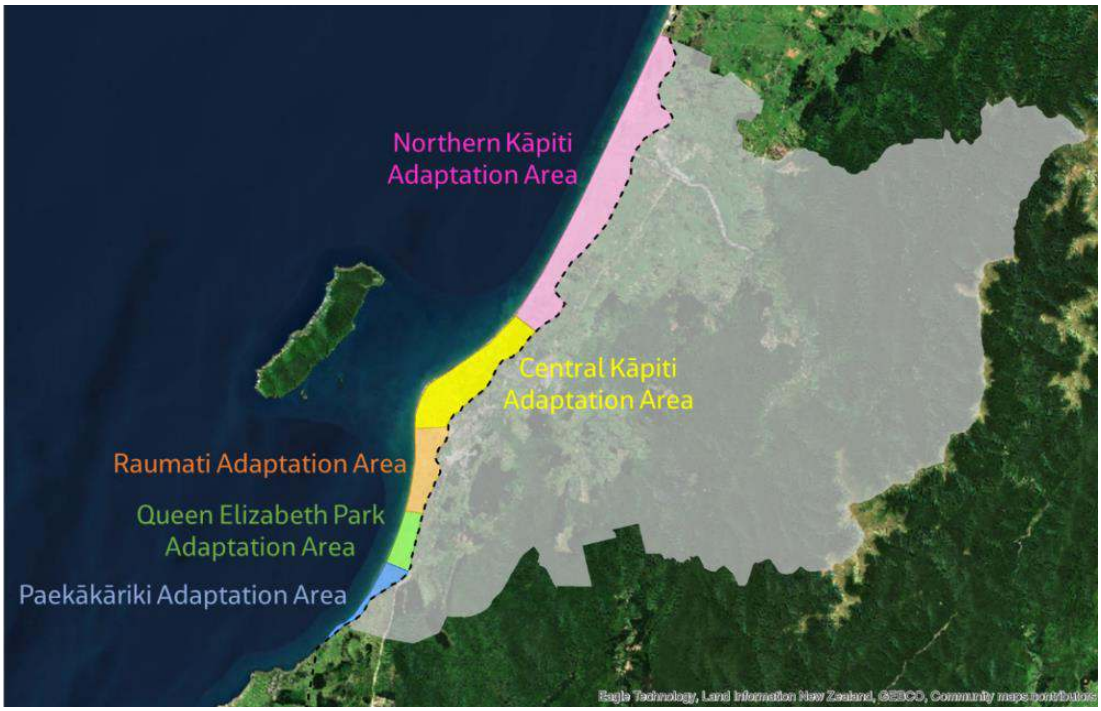

Figure 12: Adaptation Areas confirmed by CAP at meeting on 30/03/2022.

4.2.1.2 Prioritising the Assessment of Adaptation Areas

At the same CAP meeting on the 30/03/2022, CAP were presented with information about options for how to approach the assessment. The first decision made by CAP was whether Adaptation Areas needed to be worked through in parallel or sequential:

- Parallel – No cells would be prioritized, the tasks described in Phase 2 would be carried through at each adaptation cell at the same time; or
- Sequential – All tasks described in Phase 2 would be undertaken for one adaptation cell before working through all tasks for the next Adaptation Area.

CAP confirmed at this meeting that they wanted to work through the Adaptation Areas using a sequential approach.

Following this, CAP were then tasked with deciding which Adaptation Area to start with, and how they would prioritise this. CAP were presented with information around possible prioritization options, including:

- Addressing cells by Vulnerability (e.g., most at risk is addressed first)
- By availability of existing information
- By difficulty/reverse difficulty (e.g., complex interactions with infrastructure and populations)
- Availability of community resource and iwi support

CAP discussed these options and decided that they would begin with the Northern Kāpiti Adaptation Area due to the complexities of issues being less than that perceived in other Adaptation cells.

At the CAP meeting on 25 May 2022, CAP confirmed that their preference would be to work through the Adaptation Areas from north to south, but would look at Queen Elizabeth Park prior to Raumati to ensure they had a good understanding of what was planned for the park and how it could be affected by future adaptation in Raumati and Paekākāriki. Whilst this sequence may be subject to change as CAP work through the process, the order that the Adaptation Areas will be worked through at the time of this report is as follows:

1. Northern Kāpiti
2. Central Kāpiti

3. Queen Elizabeth Park
4. Raumati
5. Paekākāriki

This order is reflected in CAP workshop and meeting schedule presented earlier in Figure 8.

Kāpiti Island was not included in the initial hazard assessment undertaken by Jacobs as it is outside of the scope of this assessment. Adaptation pathways for Kāpiti Island will not be developed in the Takutai Kāpiti processes. However, consideration for Kāpiti Island will be taken into account in the Central Kāpiti Adaptation Area to ensure that any adaptation actions and pathways identified would not have a negative impact on the Island.

4.2.2 Task 2: Confirm MCDA Assessment Criteria and Scoring Guide

Development of the district wide MCDA criteria and scoring guide is required for the CAP to be able to undertake the MCDA assessment in Phase 2 Task 6 for each Adaptation Area. An example set of MCDA criteria used in the Hawkes Bay Strategy is presented in Appendix C. This example criteria prepared for Hawkes Bay and accompanying scoring guide will be further developed by the TAG to align with the Kāpiti Coast, and will be reviewed by the CAP in the Phase 1 workshop (July 2022) for use in the MCDA assessment for each Adaptation Area. Details of the final MCDA criteria will be included in the Coastal Hazards Adaptation Recommendations Report to council (Phase 3).

There is no cost-based decision criteria included in the MCDA assessment. This allows for the non-monetary elements of different short-listed potential pathways to be assessed separately without financial basis, prior to a separate economic analysis being undertaken of the short-listed pathway (Section 4.3.7). This two-step process is considered important as it ensures that potential pathways can be thoroughly tested in terms of the coastal hazard management objectives without cost factors dominating the MCDA evaluation.

As in the Hawkes Bay example (Appendix C), a simple five-point scale to 'score' the outcome of the identified pathways against each criteria is proposed as follows:

5. Highly desirable
4. Desirable
3. Neutral
2. Undesirable
1. Highly undesirable

As well as scoring, reasons need to be recorded as to why certain scores have been assigned.

Based on Mitchell Daysh's experience in Hawkes Bay, pre-scoring is to be undertaken by the TAG and relevant technical experts before the CAP workshop. The recommended scores and rationale would be presented to the CAP in a workshop and they will debate/confirm the scoring and change where they felt was required. This pre-scoring is discussed further in Phase 2 Task 6 (Section 4.3.6).

4.2.3 Task 3: Defining and confirming the long list of adaptation options and actions

The terms 'adaptation options' and 'adaptation actions' is defined as:

- **Options** is the broader term used to identify the general approach to adaptation, and overarches a number of 'actions' which all have similar objectives/outcomes. The Options proposed for use in the adaptation strategy are those presented in the MfE (2017) coastal hazards guidance, being as follows:

- **Enhance – "We keep doing what we are doing, and we do it better"**
  Enhancement as an option builds on the current actions that are underway along the Kāpiti Coast, and utilises the existing environment to provide protection.
- **Accommodate – "We adapt where we are and learn to live with the hazard"**
  Accommodating as an option looks at adapting our current assets and infrastructure where they currently are in order to become more resilient to the hazard.
- **Protect – "We protect ourselves from the hazard"**
  Protection as an option looks to use soft or hard engineering options in order to slow the retreat, hold the line, or retreat the line (e.g., setting back future protection structures from their current position).
- **Retreat – "We move to safer ground"**
  Retreat as an option looks to move assets, infrastructure, or communities to safer ground which has a lower risk profile.
- **Avoid – "We avoid developing in places we know will be at risk in the future"**
  Using Avoid as an option ustilises land use and infrastructure planning tools to help ensure that we do not increase the risk profile by controlling the placement or extension of new assets, infrastructure, or services in areas at risk from coastal hazards. It also involves the control of activities that could exacerbate the exposure to hazards by adversely impacting current natural buffers or protection structures. It is anticipated that **Avoid** is a district wide option that will form pathways across all Adaptation Areas in conjunction with other options.

- **Actions** is the term used to define the measure that is required to execute the Option. For example, the *Option* could be to protect; and the *action* would be to build a hard engineering structure such as a rock revetment, or to undertake a soft engineering solution such as beach nourishment.

A draft 'long-list' of potential adaptation options and actions has been prepared by the TAG, and is presented in Appendix D, with further descriptions of options provided in Appendix E. This draft list has been compiled from examples both nationally and internationally of actions that have been undertaken to adapt to coastal hazards. It is important for the process to start as broadly as possible in identifying options because any options chosen will have implications for different people and parts of the study area, and all will have implications for the future as well. Following appropriate options being identified for each timeframe for each Adaptation Area, then specific actions can be identified for the short-list pathway development.

The draft long-list of adaptation actions presented in Appendix D will be presented to CAP in the Phase One workshop (22 July), with CAPs task being to refine and confirm the long-list for use in Phase 2. This will involve:

- Discounting further any adaptation actions which they consider to not be suitable on the Kāpiti Coast under any circumstances in the future.
- Adding any additional adaptation actions they think are relevant for the Kāpiti Coast which have not been included.

Once CAP has confirmed their acceptance of the long list, it will be used for building dynamic adaptive pathways for each Adaptation Area in Phase 2.

4.3 Phase 2: Assessment of Pathways for Adaption Area

In Phase 2, Tasks 1-8 (Figure 10) will be repeated for each Adaptation Area in order to develop the adaptation pathways of actions for each area. From the CAP workshop schedule presented in Figure 7, it is anticipated that each Adaptation Area will take approximately 3 workshops over a 3-month period to work through these tasks. This sequence includes:

- Tasks 1-3 (Risk assessment; defining objectives; and refining list of actions) being undertaken in one workshop;
- The TAG will then prepare potential pathways options from the short list of adaptation actions

- Tasks 4-5 (Develop pathways; and criteria weighting) can then be undertaken in one workshop;
- The TAG will then prepare additional information based on the CAPs decisions (Economics assessment and MCDA pre-scoring). This is estimated to take 4-6 weeks.
- Tasks 6 and 7 (MCDA analysis; and economic assessment) can then be undertaken in one full day workshop
- Task 8 (community feedback) will be done through public engagement sessions with the CAP and community. Short listed pathways considered by CAP along with their initial preferred pathway and reasons for the selection will be presented to the community. Following the community engagement, feedback and any changes to the initial preferred pathway will be recorded in the next CAP workshop, with the resulting preferred pathway being incorporated in the final recommendation report to council.

These tasks are detailed below.

4.3.1 Task 1: Presentation of Risk Assessment

In Phase 2 Task 1, the CAP will be presented with a risk assessment for the Adaptation Area they are focusing on. This risk assessment will be a consolidation of all the technical assessments to date, which will provide maps of the intersection of the hazard exposure with the spatial location of elements which are at risk of damage or loss from the hazards (e.g. land parcels, land-uses, infrastructure, community services, areas of significant cultural, social and environmental uses), and commentary on the consequence of hazards to both spatial and non-spatial social, cultural, and environmental values (e.g. loss of ability to access the beach).

The presentation of this risk assessment will bring the CAP up to speed on all of the consequences of coastal erosion and inundation hazards in the Adaptation Area they are focusing on, and will provide a baseline case for the consequences of failing to address SLR in order to test the success of their potential pathways against for the MCDA assessment (e.g., the 'do-nothing' option). The methodology that will be used to inform the Risk Assessment is outlined below.

4.3.1.1 Risk Assessment Methodology

Likelihood

To inform the likelihood part of the risk assessment for each Adaptation Area, the TAG will utilise the current mapped hazard positions from the webviewer that accompanies the "*Coastal Hazards Susceptibility and Vulnerability*" (Jacobs, 2022) report, that recognises the emergence of increasing exposure and uncertainty with time. This hazard mapping is already in the following timeframes which correspond to current, short-term (up to 30 years), medium term (up to 50 years), and long-term (up to 100 years) required for the adaptation pathways.

Consequence

To inform the consequence part of the risk assessment, the TAG will overlay on the above hazard susceptibility maps the spatial data on infrastructure, assets, community services, commercial activities, land parcels and land-uses; as well as high recreational, cultural, social, environmental, and agricultural values. Some of this information is included in the "*Coastal Hazards Susceptibility and Vulnerability*" (Jacobs, 2022) report (e.g., roads and three waters infrastructure, community services – schools, hospitals, medical centres, land parcels), and some will be provided by the other cultural, social, and environmental assessments. However, some additional datasets may have to be interrogated from council databases (e.g., land-uses, commercial activities, high agricultural values).

From this spatial mapping of the intersection of the exposure and location of the above elements, the TAG will provide a qualitive assessment of the nature of the risk for each of the above elements, indicators of economic impact, and commentary on the risks to non-site specific social, cultural, and environmental values for the Adaptation Area.

The final outputs of the risk assessments will be a series of short reports tailored to each adaptation area which will provide commentary about what values and assets are at risk from coastal hazards, and what the consequences would be should the level of hazard eventuate without any intervention.

The report will provide commentary around the risk to values which cannot be spatially identified. The relevant spatial layers used to inform the assessment will also be uploaded to the web viewer for use and interrogation by the CAP and public of the results.

4.3.2 Task 2: Define the objectives for Coastal Hazard Adaptation for the Adaptation Area

Following the presentation of the risk assessment to the Adaptation Area in Task 1, the CAP will be tasked with setting the coastal hazard management objectives for the Adaptation Area they are addressing. These objectives should be aligned with the community values (protection, cultural, social, environmental) and the risks to that community of failing to address increased and emerging hazard exposure with future RSLR within that Adaptation Area. As well as their own knowledge of the Kāpiti Coast, and the "*Coastal Hazards Susceptibility and Vulnerability*" (Jacobs, 2022) report, CAP will be able to use the social values assessment, the cultural impact assessment, the natural character assessment, and the ecological values review to help inform the objectives. These objectives will be used to assess potential pathways against for their success.

These objectives should be set with a focus on "what are we trying to achieve?". It is recognised that the objectives could vary between Adaptation Areas, as they will be based on the different nature of the current shoreline; the different exposure to hazards; the different assets, infrastructure, and property at risk; and the different social, cultural and environment values in each of the Adaptation Areas. The CAP should consider having tangible objectives that can be measured so they can clearly determine whether the pathway is meeting the objective in full, in part, or not at all.

Some examples of objectives from other adaptation projects around the New Zealand include:

- Manage our communities' exposure to coastal hazard risks
- Provide flexibility to respond to increasing hazards as they change over time
- Maintain a natural coastline that continues to provide for our community values
- Ensure that the coast and inland area are resilient to the effects of coastal hazards and climate change and that resilience is achieved through sustainable practices
- Work with nature to create a long-term solution that benefits natural landscapes and wildlife - fostering a culture of care.
- Create connected, accessible public spaces and encourage recreational use in safe and appropriate ways.
- Pro-actively protect and enhance coastal dunes, wetlands, habitats, and biodiversity
- Preserve and enhance the natural environment and ecosystems that support biodiversity
- Shoreline management options provide added benefits to amenity and coastal access

Defining these objectives will be done in a collaborative workshop environment with the CAP and with some assistance from the TAG.

4.3.3 Task 3: Discounting from long-list of actions

Using the long list of options confirmed by the CAP (drafted in Appendix D), CAP will be tasked with discounting any adaptation options and actions that would not be suitable for the Adaptation Area under consideration. This will be done in a workshop environment where CAP, along with technical advice from the TAG, will determine where an action is not practical for the Adaptation Area, and therefore should be discarded. Reasons for discarding the action from the long list should be recorded. For simplicity of record against the long list, the following reasons for discounting should be considered and recorded where appropriate for discounting. If there are reasons other than these, then they should also be recorded:

A. Will not provide for the objectives defined by CAP

B. Does not have a good track record of being successful in this environment

C. Insufficient or limited space to implement the action

D. Not suitable for the environment is it being applied to

E. It is not a practical solution

F. Limited benefits

G. Other

The remaining actions deemed relevant for application within the Adaption Area by the CAP will form the 'short list' of actions, which can then be used to form adaptation pathways.

4.3.4 Task 4: Pathway Development of Potential Options.

The short-listing process described in Task 3 will produce a number of potential actions which could be applied within the Adaptation Area, and when combined will form a large number of potential pathways, both concurrently and through time.

In a workshop environment, CAP will be split into smaller groups (with TAG members) and tasked to 'map out' where actions from the short list could be used to form adaptation pathways. This will be done visually using printed maps of the Adaptation Area, with the overlays of the hazards as well as, where practicable, the spatial location and extent of values and assets.

CAP will be tasked to identify potential pathways of actions which address both inundation and erosion hazards; meet the objectives formed in Task 2; and should be further assessed in the MCDA and economic assessments.

CAP should aim to remove actions that have limited benefit, and ensure that any action being included in a pathway is;

- Technically feasible;
- Practical to implement;
- Realistic; and
- Has maximum adaptability.

The smaller groups will report back to the wider group with their findings and present justification for their proposed actions for the pathways.

It is anticipated that this exercise will produce a series of possible pathways by the CAP, which will then be carried forward as a short list for analysis using the MCDA and Economic analysis tools. This list of actions and pathways will be finalized in the workshop by CAP and the TAG, then used by TAG to develop the inputs required for CAP to carry out Tasks 6 and 7 in the following workshops.

4.3.5 Task 5: Defining MCDA Weightings

Task 5 will be undertaken in the same workshop as Task 4, following the finalisation of the list of potential actions and pathways.

Before the scoring process for each pathway is undertaken in the MCDA, each criteria needs to be weighted to reflect its comparative importance in assessing the pathways. The weighting should reflect which criteria the CAP, representing the broader community, consider to be critical, important, or merely relevant in deciding which actions will be ultimately put forward as a recommendation for implementation to council.

Relative weightings will be applied to each assessment criteria to determine the relative importance of that criteria to achieving the objective. All criteria will be weighted on a scale of 1 to 3:

3 - Critical

2 – Very important

1 – Important

These weightings will help reflect that while all criteria are important, they do not have equal importance for defining an adaptation pathway.

TAG will record the outcomes from this discussion with the CAP and use them in preparing the technical pre-scoring for the next workshop. Where a single weighting value cannot be agreed for a criteria, then majority view will be used in the MCDA, with reasons for the contrary views being recorded.

4.3.6 Task 6: MCDA Assessment and Scoring

4.3.6.1 Pre-scoring

Using the confirmed set of criteria, criteria weightings, and short-listed pathways for assessment, the TAG will meet ahead of the MCDA assessment workshop to develop recommended scores for the 'technical' criteria.

In a similar process, it is identified that particular expertise is required to develop scores for each pathway against cultural impact criteria. It is anticipated that the iwi representatives on the CAP will liaise with their iwi Rūnanga and members, supported by Kahu Ropata (KCDC Iwi Partnerships), will undertake this pre-scoring process through a series of wānanga.

The recommended scores from the TAG and iwi members, together with a rationale for those scores, will be presented back to the CAP in the workshop for consideration.

Ultimately, the CAP must decide whether to accept the recommendations of the TAG or not, but in the Hawkes Bay evaluation, the pre-scoring and then further consideration by CAP proved both effective and efficient. Some of the pre-scoring was changed by the CAP in that process after questioning and further clarification by TAG (Stephen Daysh, Facilitator of Hawkes Bay Coastal Strategy, personal communication, 8th June 2022).

4.3.6.2 CAP Scoring

Through a facilitated workshop, the CAP will then debate the recommendations from the pre-scoring and can ask questions directly of the Technical Team. The CAP will develop (with consideration of the recommended scores) their final MCDA scoring for each short-listed pathway in the Adaptation Area, and importantly, the reasons for each score are to be recorded.

4.3.6.3 Sensitivity testing of MCDA assessment

Sensitivity testing will then be undertaken to determine whether the outcomes of the MCDA assessment vary drastically when the criteria weightings are adjusted. This testing will involve systematically changing the weighting of all criteria to explore the sensitivity of the MCDA scores to weighted changes in the different criteria.

4.3.7 Task 7: Incorporation of Economic Assessment

In the Hawkes Bay Adaptation Strategy, the decision not to include economic criteria in the MCDA allowed the CAP to develop and assess the best outcomes from a core values perspective when developing their initial preferred adaptation pathways for the Adaptation Areas. When the overlay of the economic assessment tools from the ROA (Cost + Loss; and Value for money) was made in that process, most of the Adaptation Areas were well aligned in terms of MCDA ranking and the ranking from the economic tools. However, there were a small number of Adaptation Areas where the economic factors were so significant that the Hawkes Bay CAPs moved from their initial preferred pathways to a different pathway, as this recognised that the community could not afford the initial preferred option.

This approach of bringing the economic tools in to the process after the MCDA analysis has been completed will also be adopted for the Takutai Kāpiti process. It is considered that allowing for the CAP to explore all options from a core values perspective, before factoring in the realities of funding, is beneficial to the decision-making process as it will ensure pathways are not discounted initially from a cost perspective, allowing the consideration of significant benefits across a realm of criteria which the community may be willing to pay for.

The ROA economic assessment complements MCDA and the application of the DAPP approach. Following the MCDA analysis the ROA economic assessment involving the determination of the Cost + Loss and Value For Money metrics will be available to the CAP to understand the cost implications of all short-listed pathways.

The ROA will be used to evaluate whether the initially identified pathways (from Task 4) is also the preferred pathway from an economic perspective and to identify whether there are any additional pathways that are worth considering on economic grounds. This may require a further iteration of the MCDA to provide additional weighted scores for any new pathways identified.

The economic metrics that will be provided are:

- Cost + Loss value
- Cost + Loss ranking
- Value for Money measure
- Value for Money ranking
- Short term build costs

At this stage, the CAP will also be presented with information of how funding principles could be applied to the different pathways. These funding principles will be based on a recommendation from the Senior Leadership Team at KCDC. The inclusion of information on funding at this stage of the process is for CAP to have an understanding of how the implementation of pathways (in particular short term actions) would be funded between public vs private; and for KCDC to have indicative costs of pathways for inclusion into the 2024 Long Term Plan.

In a workshop environment, the TAG will provide the CAP with:

- An overview of district wide funding principles and requirements;
- TAG assessment of public/private benefits – including baseline assessments for each action and detailed assessments for each Adaptation Area; and
- A Financial model showing indicative rating impacts

Examples of how this information was presented to the CAP for the Hawkes Bay Strategy (presentation 17th November 2017) is included in Appendix E.

4.3.7.1 Treatment of social impacts and benefits

The focus of the economic assessment is to identify the economic costs and avoided losses associated with the built environment. Although other cultural or environmental impacts can potentially be valued in economic terms, these elements are included as criteria within the MCDA. This will provide greater transparency on how these benefits are valued to a range of decision makers.

4.3.8 Task 8: Consideration for Community Feedback

Through an engagement session with the communities of the Adaptation Area, the CAP will seek feedback on their initial preferred short-term actions, and initial preferred medium to long term pathways. At these engagement sessions, the CAP should aim to:

- Provide context to the community of the process they have gone through in Phases 1 and 2
- Provide information around the initial preferred pathway, with reasons as to how they arrived at this point.
- Be able to outline to the community what other pathways they considered and why they are not the initial preferred pathway.
- Seek feedback from the community on whether their preferred actions and pathways are aligned with the community's values and expectations, including:
    - Impacts of the pathway on levels of protection and social, cultural, and environmental values
    - Expectations around how the pathway would be funded

The feedback from the community will be recorded and discussed in the next CAP workshop following the engagement, with the CAP having to decide whether the initial preferred pathway needed to be reconsidered in light of the community feedback.

4.4 Phase 3: Final Recommendations to Council

In Phase 3, with the assistance from the TAG and KCDC staff, CAP will synthesise the results of Phases 1 and 2, to identify their preferred short-term actions; preferred medium-long term adaptation pathways for each Adaptation Area; identify signals, triggers, and thresholds; and produce their final Coastal Hazards Adaptation Recommendation Report to Council. Phase 3 is made up of 5 key tasks which will take place over two final workshops with the CAP and the TAG, and a final engagement session with the community.

4.4.1 Task 1: Confirm funding options for implementation

A key element of Phase 3 will be to establish a sound methodology for how coastal hazard responses will be funded with particular focus on the fundability of the preferred short-term actions.

In Phase 2 Task 7, the CAP would have been provided with information around the funding of various pathways based on principles recommended by the Senior Leadership Team at KCDC, which included:

- TAG assessment of public/private benefits – including baseline assessments for each action and detailed assessments for each Adaptation Area
- Financial model showing indicative rating impacts

Phase 3 Task 1 will revisit this information provided for each adaptation area, and confirm that these funding mechanisms are suitable and consistent across the district.

Based on the information, the final report will:

- Identify suitable funding proposals against local government acts (i.e., Local Government Act 2002 (LGA) & Local Government (Rating) 2002 Acts (LGRA)
- Ensure consistency of funding requirements with local authority's Revenue & Financing policy (RFP) and Funding Impact Statement (FIS). (Section 101 (3) LGA sets the process and considerations a local authority must consider it developing its funding approach)
- Document the assumptions employed in the build-up of baseline public/private funding splits
- Identify preferred funding options for targeted rates for the private good (including fixed per rating unit, land value, capital value, area)
- Ensure there is a broad understanding of longer-term funding requirements for medium- and long-term actions that can be kept in place over a very long timeframe (100 years) and are robust to political cycles
- Discuss a framework for providing funding certainty for the community

Outputs from this task will focus on clear recommendations for funding mechanisms to inform the implementation of adaptation pathways, and a monitoring plan for identifying when signals, triggers, and thresholds are reached.

4.4.2 Task 2: Confirmation of preferred short-term actions and medium-long term pathways

A summary of information developed Phase 2 will be collated by the TAG and provided to the CAP. For each Adaptation Area this will summarise:

- Scores of the MCDA analysis for each pathway explored;
- MCDA rankings against other pathways;
- Results of the economic analysis;
- Economic ranking against other pathway options;
- Funding options; and
- Feedback from the community

Based on this information, CAP, with assistance from the TAG, will identify any cross-boundary inconsistencies and issues with the preferred pathways, which would require in alterations to the pathways for any part of an Adaptation Area.

The CAP will then confirm for each Adaptation Area:

1. Their preferred short-term actions together with the reasoning for (a) selection of their preferred action; and (b) discounting of other short-term actions.
2. A preferred pathway over the medium and longer term together with the reasoning for (a) selection of this pathway, and (b) discounting of other pathways.

These actions and pathways will form the basis of the Coastal Hazards Adaptation recommendation report to council. The emphasis of the recommendations will be on the short-term actions, with an understanding of how that would impact future potential actions across potential medium to longer term pathways, and how these actions and pathways may be funded. With assistance from the TAG, the CAP will produce an adaptation pathway plan per Adaptation Area to put forward into the final recommendation. An example of how this may be presented is shown in Figure 13.

An example of a preferred pathway for an Adaptation Area is presented in Figure 12, with the preferred short-term pathway clearly identified by the solid black line, and the preferred medium-long term pathway identified with less certainty by the thick black dotted line. The output will differ in each Adaptation Area, depending on the actions shortlisted for the area, and the impact of the short-term decisions on future potential pathways. Actions may be grouped into 'packages' if there are two or more actions that would be taken together, and there may be several adaptation pathways plans per Adaptation Area to address variations in hazards, risks, and values at different locations within the area (e.g., cross boundary).

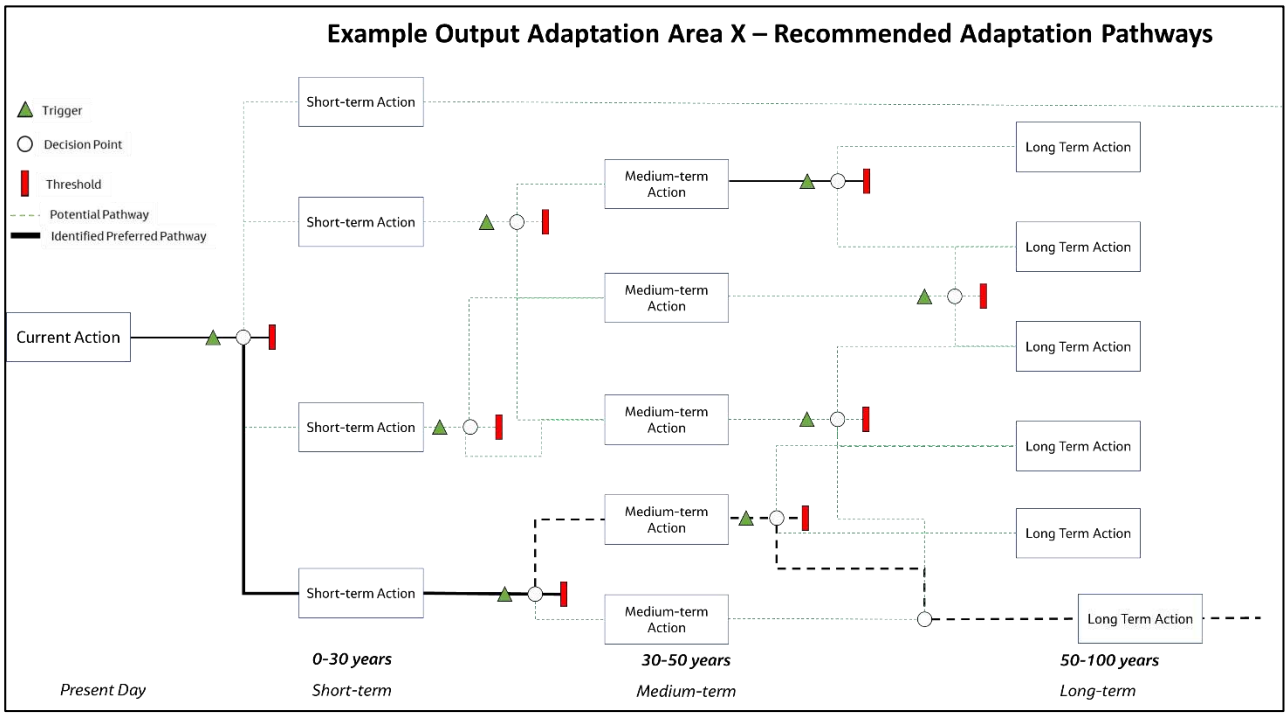

Figure 13: Example Adaptation Pathway Plan.

4.4.3 Task 3: Development of Signals, Triggers and Thresholds

In a workshop environment with the CAP and TAG, the CAP will be tasked to identify these signals, triggers, and thresholds to then include as part of the final recommendation report. It is important for transparency that CAP can communicate what changes to the physical environment, level of risk, or loss of values indicators would trigger a change in adaptation action.

Given the identification of the preferred short-term action, CAP should define **at least** two sets of signals, triggers, and thresholds:

- when there is a change needed from the current action to the short-term action
- when there is a change needed from the identified short-term action to a new medium-term action.

The definition of these terms, as per the MfE (2017) guidance, is as follows:

- **Signal** - Derived indicator values, monitoring changes in physical, social, cultural, economic, and risk attributes, which provide early warning to signal that a trigger (decision point) is approaching in the near to medium term and should prompt thinking and initial engagement processes on the next steps or any changes to the trigger.
- **Trigger** - A derived indicator value(s), which when reached, provides sufficient lead time to cover community engagement, consenting, construction and funding arrangements, to ensure a new pathway or adaptation action can be implemented before the adaptation threshold is reached. The trigger is not tied to a particular time – rather it will be a bracketed time window derived using the scenarios in the DAPP process.
- **Threshold** - When agreed objectives, community values, risk exposure, or levels of service are no longer being met or start to fail, requiring an alternative adaptation action or pathway to be in place before this occurs. The adaptation threshold is not tied to a particular time – rather it will be a bracketed time window derived using the scenarios in the DAPP processes tolerance for the hazard has been exceeded

Signals, triggers, and thresholds can be defined through several different mechanisms:

- Physical Responses, for example:
    - Beach response (e.g., shoreline erosion by 'X' m, beach lowering by 'X' m)
    - Water levels overtopping stopbanks or beach ridges 'X' times per year
    - Certain amount of RSLR has occurred
- Social and Cultural factors, for example:
    - Ability to walk along the beach reduces to 'X' hours above/below low tide
    - Access to public services (e.g., school, hospitals) or properties is restricted for 'X' days a year
    - Likelihood of damage to cultural or ecologically significant sites/locations/activities exceeds acceptable level
- Economic factors, for example:
    - Cost of maintenance (of structures or infrastructure) exceeds $X per year.

The CAP will work through the following steps for identifying a set of signals, triggers, and thresholds:

1. Define threshold for the current action – Based on the social and cultural values or physical factors, CAP should identify at what point the current action being undertaken would not meet the objectives of the strategy.
2. Define approximately how much lead in time would be required to implement the preferred short-term action (include consideration of consultation, engagement, design and consenting (if required))
3. With consideration for the lead in time required for the short-term action to be implemented, identify a measure at which a change in action would be required as a result of the trigger being met.
4. Identify a measure which would signal that change was occurring (but the risk is still tolerable).

4.4.4 Task 4: Final Community Engagement

Through community engagement sessions, the CAP will seek feedback on their final preferred short-term actions, preferred medium to long term pathways; signals, triggers, and thresholds; and funding options. At these engagement sessions, the CAP will seek feedback from the community on whether their preferred actions and pathways are aligned with the community values and expectations around how the pathway would be funded. At this engagement, CAP will also communicate the benefits of the preferred actions and pathways to the community, relative to the other options which were short-listed.

The feedback from the community will be recorded and discussed in the next workshop following the engagement, and be incorporated into the final recommendation report as considered appropriate by CAP.

4.4.5 Task 5: Coastal Hazards Adaptation Recommendation Report

The CAP will prepare a final recommendation report to the Council which summarises their journey, key decisions, and recommendations. It is anticipated that this final recommendation report will cover the following:

- An overview of the CAP process and the methodology they have used to arrive at their decision
- A summary of the key decisions made at each step of the process
- Outcomes of the community engagement and feedback in Phase 2 Task 8 and Phase 3 Task 4
- The final recommendation of:
    - Preferred short term actions for each Adaptation Area;
    - Signals, triggers and thresholds for the short-term actions and movement to medium term action;
    - Identified preferred pathways in the medium-long term for each Adaptation Area.
- Recommendations of what monitoring should be undertaken to inform (a) our understanding of the environment; (b) when signals and triggers are being approached.
- Recommendations of when to review the pathways (e.g., 5-10 year basis) based on the monitoring data, trigger points being reached, and new information.
- Recommendation of review of economics and funding of pathways.
- Any other recommendations that the CAP would like to make to the Council in regards to the management of coastal hazards.

This report will be presented to the Council by the CAP for acceptance. Recommendations made by the CAP will be used to inform the implementation of coastal hazards adaptation pathways and a monitoring plan in stages 8-10 of the MfE (2017) decision cycle (Figure 1).

5. References

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Appendix A. Coastal Advisory Panel Terms of Reference

Appendix B. Technical Advisory Group (TAG)

Organisation	Role	Person
Kāpiti Coast District Council	Coastal Team	Lyndsey Craig Ashlyn Gallagher Yvonna Chrzanowska Heather Wright
	Iwi Partnerships	Kahu Ropata
	Biodiversity and Landscapes	Andy McKay
	District Planning	Jason Holland
	Communications and Engagement	Elspeth McIntyre Moko Morris
	Assets and Infrastructure	Sean Mallon
	Rates and funding manager	Vicky Silk
	Sustainability and Resilience	Neinke Itjeshorst
	Legal	Tim Power
Mitchell Daysh	Facilitation	Stephen Daysh
Jacobs New Zealand	Coastal Hazards	Derek Todd Damian Debski Kate MacDonald
	Planning	Tim Hegarty Devon Alexander
	Economics	Neil Blazey
Dr Aroha Spinks	Cultural Impact	Dr Aroha Spinks
Maven Consulting	Social Values	Cerasela Stancu
Boffa Miskell	Natural Character/Values	Rhys Girvan Andrew Banks
Awa Environmental	Hydrodynamic Modelling	Craig Martell
Beca	Technical Peer Reviewer	Connon Andrews
GWRC	Climate change policy and coastal science	Iain Dawe
	Natural Character	Tim Blackman

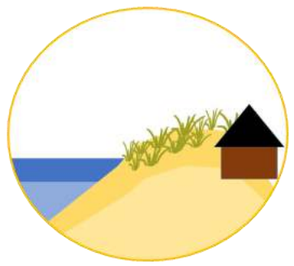
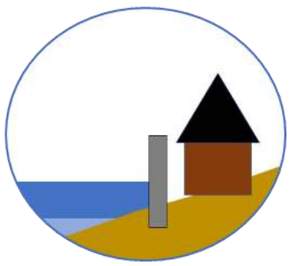
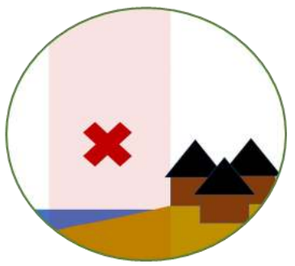
Appendix C. Hawkes Bay Strategy MCDA Criteria

Criteria		Description	Scoring Guide
Technical Assessment Criteria	Manages the risks of storm surge inundation	> Reduced exposure to risks from storm surge inundation > Meets objectives over long timeframes > Proportionate to the scale and nature of risk	5 – High / Good 4 – 3 – Mid 2 – 1 – Low / Bad
	Manages the risks of coastal erosion	> Reduced exposure to risks from coastal erosion > Meets objectives over long timeframes > Proportionate to the scale and nature of risk	5 – High / Good 4 – 3 – Mid 2 – 1 – Low / Bad
	Ability to adapt to increasing risks	> Readily responds to uncertain climate outcomes > Includes measures to support future adjustments	5 – High / Good 4 – 3 – Mid 2 – 1 – Low / Bad
	Risk transfer	> Exacerbation of hazard risk in other areas > The transfer of risk to others, including future generations	5 – Low / Good 4 – 3 – Mid 2 – 1 – High / Bad

Impact Assessment Criteria	Socio-economic Impacts	> Social effects e.g.
		  > Effects on community safety
		  > Loss of amenity value
		  > Decline in recreational values, community facilities
		> Indirect economic / industry impacts (e.g. tourism, fishing)
			5 – Low / Good
			4 –
			3 – Mid
			2 –
			1 – High / Bad

	Relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga	> Impacts on any cultural sites of significance > Maintains access to, and enables the carrying out of, customary activities	5 – Low / Good 4 – 3 – Mid 2 – 1 – High / Bad
	Natural Environments Impacts	> Impacts on natural coastal ecosystems > Impacts on the natural character of the coastal environment	5 – Low / Good 4 – 3 – Mid 2 – 1 – High / Bad

Appendix D. Draft long-list of Options

OPTIONS	ENHANCE	ACCOMODATE	PROTECT	RETREAT	AVOID
	We keep doing what we are doing, and do it better	**We adapt where we are and learn to live with the hazard**	**We protect ourselves from the hazard**	**We move to safer ground**	**We avoid developing in places we know will be at risk in the future**
					
ACTIONS	Dune reconstruction and regeneration Wind trap fencing Coastal wetlands and riparian management and creation Manage access (walkways and ramps) Maintain and strengthen existing structures Increase community education and risk awareness Emergency management Environmental monitoring	Flood-proofing buildings and infrastructure Adaptable and relocatable buildings Elevate floor levels of buildings	Soft engineering: • Renourishment • Beach scraping • Beach drainage Hard engineering: • Vertical sea walls • Rock revetments • Groynes • Stopbanks • Storm surge barriers • Culverts • Breakwaters • Flood gates • Gabion Baskets • Buried terminal walls	Land Acquisitions Buy outs Land swaps Leasebacks Future Interest Conservation easements Transferable development rights	Zoning Trigger-based or time limited land use consents Setback controls Building design – Adaptable, Relocatable, minimum floor levels Reducing intensification or development

Appendix E. Glossary of Options and Actions

Option	Action	Description	Hazard
Accommodate	Adaptable and relocatable buildings	Adaptable buildings are designed to respond to an environmental change while avoiding structural damage. Buildings can also be relocatable to move away from the hazard.	Erosion/Inundation
Accommodate	Building Design – Raising minimum floor levels of existing buildings	Raising the floor levels of existing properties which are at risk from inundation.	Inundation
Accommodate	Flood proofing buildings	Flood proofing measures are best applicable to coastal areas with a small inter-tidal range and where flood depths are low. This involves wet-proofing or dry proofing a building: Wet proofing – allowing water to enter the structure but minimizing the structural damage through using flood resistant materials or elevating structures. Dry proofing – making buildings water-tight so that water cannot enter,	Inundation
Accommodate	Flood proofing infrastructure	Flood proofing infrastructure such as wastewater, stormwater and drinking water infrastructure, telecommunication infrastructure, and roads may involve modifying existing infrastructure or designing new or replacement infrastructure to withstand coastal hazards.	Inundation
Avoid	Building design – Raising minimum floor levels of new builds	Planning provisions in place for potentially affected areas to ensure floor levels area above design flood levels for new builds.	Inundation
Avoid	Reducing further intensification or development	Planning restrictions to reduce further development or intensification within settlements that are likely to be affected by hazards in the future.	Erosion/Inundation
Avoid	Setback controls	Restricting new development and land use in high-risk areas through the imposition of building setback controls. Setbacks are building restrictions that establish a distance from a predetermined point that factors in future erosion rates where landowners are prohibited from building structures, or they establish a minimum elevation for development that factors in sea level rise and coastal inundation	Erosion/Inundation
Avoid	Trigger-based or time limited land use consents	Trigger based or time limited land use consents include conditions linked to hazards such as sea level rise or erosion rates that create a finite term for a particular land use. The land use consents allow development or redevelopment with the expectation that such uses can only continue until specified trigger points are reached or for a specified time period.	Erosion/Inundation

Option	Action	Description	Hazard
Avoid	Zoning	▪ Allowing increased development density in lower risk areas ▪ Creating areas where new development is not permitted ▪ Changing future land uses in at-risk areas from low resilience to high resilience (e.g., from residential to public space) ▪ Using planning policy and rules (Regional and District) to prohibiting hard shoreline protection structures and promoting natural shoreline protection measures that support inland ecosystem migration.	Erosion/Inundation
Enhance	'Top up' existing structures	Add material to existing structures to increase the level of protection (from both inundation and erosion).	Erosion/Inundation
Enhance	Access steps and ramps	Structures that provide pedestrian and/or small boat access to the coast.	Erosion/Inundation
Enhance	Coastal wetlands, riparian management and living shorelines	Enhance coastal wetlands and riparian corridors are vegetated areas that act as a buffer to inundation and erosion, while also providing new habitats and environmental benefits. Installing or enhancing coastal marshes and wetland areas to dissipate wave energy and reduce inundation risk.	Erosion/Inundation
Enhance	Continue emergency management	Emergency management, including the creation of hazard maps, evacuation plans, civil defence emergency management, and temporary accommodation and protection measures continues.	Erosion/Inundation
Enhance	Continue environmental monitoring	Environmental monitoring may include topographic and bathymetric surveys, shoreline mapping, storm events, ecological surveys, structural assessments, and morphological change assessments	Erosion/Inundation
Enhance	Continue to increase community education and risk awareness	Education is an essential element of the global response to climate change. As people build an understanding of the impacts of climate change it is seen to encourage changes in their attitude and behavior, and helps them adapt to climate change. Education and awareness also allow people to make informed decisions and play a role in both climate change mitigation and adaptation. This can be done through organized events, engagement with schools, updating and sharing online resources.	Erosion/Inundation
Enhance	Dune reconstruction and regeneration	Building wind trap fences on the seaward side of an existing dune to trap sand and promote dune growth, and vegetation planting to stabilise dunes. Make artificial dunes.	Erosion/Inundation
Enhance	Enhance existing inundation protection	Increase existing/install new stop banks to provide greater protection from storm surge inundation. Incorporate SLR and higher intensity events into the design of stormwater management when it is being upgraded.	Inundation

Option	Action	Description	Hazard
Enhance	Maintain current infrastructure systems	Current infrastructure systems such as wastewater, stormwater and drinking water infrastructure, telecommunication infrastructure, and roads will be maintained to restore the present-day level of service	Erosion/Inundation
Enhance	Private owners' responsibility	Through planning tools (district and regional), Council allows for owners of private structures to own and maintain their own structures.	Erosion/Inundation
Enhance	Strengthen existing structures (i.e., concrete walls)	Strengthen and patch existing vertical walls. Could involve removal of top unstable wall sections and retention of lower more stable sections.	Erosion/Inundation
Protect	Beach drainage	Mild upper beach and dune erosion can be controlled by beach drains. Beach drainage (also referred to as coastal drainage or beach dewatering) involves the placement of drains parallel to the shoreline, under the exposed beach face, which are connected to a well so that water which enters the system can be pumped out. Beach drainage lowers the water table and therefore increases the depth of the unsaturated zone under the ground. This lowering of the ground water table also encourages sediments to be deposited on the beach and reduces the sea-ward transport of sediment and therefore accretes sediment at the shore	Erosion
Protect	Beach scraping	Redistribution of sediment across a beach profile to increase the dune/crest elevation on the beach.	Erosion/Inundation
Protect	Buried Terminal wall	A buried wall (concrete, rock, gabion baskets, timber) at the landward limit of where it is acceptable for the beach to retreat to at some time in the future. Normal beach processes would continue in the intervening years, with the wall slowly becoming exposed until it was acting as a fully functional protection structure holding the shoreline in place.	Erosion
Protect	Concrete Mattress system (revetment)	Concrete mattress or interlinked concrete blocks placed on design slope on estuary edge to provide required crest height to prevent overtopping and prevent erosion.	Erosion
Protect	Control weirs on culverts at lagoon/ small river mouth openings	Adjustable gates on culverts which control the elevation at which water can flow in or out of a waterway opening. Generally, at the settlement's inundation can occur from both fluvial and coastal sources, with a weir being used to prevent high seas entering a coastal lagoon/waterway, but being opened to allow high fluvial flows to discharge.	Inundation
Protect	Controlled/ planned mouth openings of lagoons and rivers	Controlled openings of lagoons and stream mouths which naturally close with beach sediment building up across the mouth. Planned opening of the mouths will allow water to flow out to the sea/ lagoon in large fluvial events and reduce water backing up in tributaries further upstream.	Inundation
Protect	Culvert outfalls and flap gate valves at smaller inlet	Construction of culvert outfalls with flap gate valve at the entrance of a small inlet which would allow water to flow out of the inlet, but not in from the sea.	Inundation

Option	Action	Description	Hazard
Protect	Detached breakwaters and artificial reefs	The purpose of detached breakwaters are to reduce the wave energy that is reaching the shore through the dissipation, reflection and diffraction of oncoming waves. This creates a low-energy environment close to the shore that encourages the deposition of sediment and therefore the build-up of a wider beach.	Erosion
Protect	Flood gates	Adjustable gates used to prevent storm surges from entering existing waterways, in turn preventing up-stream overtopping and flooding.	Inundation
Protect	Geotextile Sand Containers	Stepped solid barrier along shoreline which prevents the passing of water and sediment between the hinterland and the estuary	Erosion
Protect	Groynes	A groyne (or artificial headland) is a structure built perpendicular to the shoreline out into the sea to catch sediments that are transported along the coast by longshore drift, to reduce coastal erosion. Can be built out of rock, timber, concrete.	Erosion
Protect	Interlocking pre-caste concrete block seawall	Solid vertical barrier constructed by interlocking concrete shapes normally constructed within the beach footprint to 'hold' the shoreline in a fixed location and prevent further shoreline retreat for a considerable timeframe depending on design and cross shore location. Depending on height, it could also reduce/eliminate wave overtopping in storm events, hence also provide protection from coastal inundation. The differences of the interlocking shapes from the vertical seawalls is the ability for variation in the front face and to have a tiered structure.	Erosion/Inundation
Protect	Reno Mattress	Sloping wire basket filled with cobble sized boulders. Placed at steeper slopes to protect the edge and at lower slopes below the edge to prevent lowering of the beach/upper intertidal nearshore.	Erosion
Protect	Retreat the line	Primary defence line retreated inland providing a high standard of inundation protection to properties behind the new defence. (Situation unchanged for those in front)	Erosion/Inundation
Protect	Rock Revetment	Large sized rock placed on design slope on estuary edge to provide required crest height and mass to prevent overtopping or movement of individual rock units that would expose edge to erosion.	Erosion
Protect	Shoreline Renourishment (sand, gravel, cobbles)	Adding sediment to the beach system, either onshore or in the nearshore. Build up natural beach with placement of introduced sand to a design slope.	Erosion
Protect	Stopbanks along settlement boundaries	Engineered stopbanks (most likely earth bunds), along the settlement boundaries to allow surface flooding to occur on the low-lying land around the settlement, but not allowing it to enter into the settlement. Crest height of the stopbanks would be informed through a design level for a specified flood frequency from both coastal and fluvial sources.	Inundation

Option	Action	Description	Hazard
Protect	Stopbanks and bunds	Continuous elongated structure designed to protect low-lying areas from inundation. Bunds are similar physical structures when compared to stopbanks and serve a similar purpose to reduce flood risk, they can be quickly built and generally use local materials, and only involve minor foundation preparations.	Inundation
Protect	Storm surge Barriers	Storm surge barriers are hard engineered structures that are primarily designed to prevent inundation due to storm surges in tidal inlets, rivers and estuaries, while also decreasing reliance on other flood defences inland of the barrier	Inundation
Protect	Vertical Gabion wall	Porous structure (wire basket filled with cobble sized boulders), which allows water to pass into and potentially through the structure with sediment movement being restricted by the use of geotextile fabric behind the gabion basket.	Erosion
Protect	Vertical permeable sill	A structure within the gravel beach that dissipates wave energy, reducing erosion losses through backwash and longshore drift and promotes the retention of gravel behind the structure.	Erosion
Protect	Vertical sea walls (concrete, timber, sheet piles)	Solid vertical barrier along shoreline which prevents the passing of water and sediment between the hinterland and the sea.	Erosion/Inundation
Retreat	Buyouts	Land buyout programs involve the government acquiring land in at-risk areas by agreement, to reduce vulnerability to hazards. Buyouts involve the transfer of title to land and are typically only used in very high risk areas due to the cost associated with them	Erosion/Inundation
Retreat	Conservation easements	A conservation easement (also referred to as conservation agreements or conservation restrictions) is a legal agreement under which permanent limitations are placed on land use in order to sustain an area's natural function. These agreements can manage hazards such as sea level rise and erosion by prohibiting further development in some areas. Conservation easements can be used to proactively plan for sea level rise by tailoring agreements to the areas current and future risk, suitability for industry, and values.	Erosion/Inundation
Retreat	Future Interests	The acquisition of a future interest involves the purchase of a right to acquire land in specified circumstances in return for an agreed upfront fee. For example, it may be agreed upon that once a certain height of sea level rise has been reached, the holder of the future interest (usually a government agency) has the right to acquire the land.	Erosion/Inundation
Retreat	Land Acquisition	Land acquisition can occur through the purchase of land in fee simple or involve the purchase of development rights to an entire land parcel or part of it.	Erosion/Inundation

Option	Action	Description	Hazard
Retreat	Land Swaps	During a land swap, landowners in a hazard zone are given the opportunity to swap their title to land for a comparable sized parcel in a lower risk area. The land that has been swapped then acts as a buffer against coastal hazards	Erosion/Inundation
Retreat	Leasebacks	Leasebacks involve the acquisition of at-risk land with provision for it to be leased back to the former owner or a third party with terms and conditions that facilitate the management of hazards. The former owners or third party, now the lessee, pays rent and uses the land in accordance to the terms of the lease, but no longer owns the land	Erosion/Inundation
Retreat	Transferable development rights	Transferable development rights (TDR's) are a market-based mechanism that can be used to increase development potential in areas where development is desired, and decrease or eliminate the potential in areas that should be preserved, without requiring public investment. Areas that have been identified for preservation are called 'sending areas'. Development rights are separated from the land and are transferred from the sending parcel to land in an area where development is considered appropriate or is even desired, which are called 'receiving areas'. TDR's from the sending area can either be sold to a landowner or developer in the receiving area, or they can be transferred directly if both parcels of land are under common ownership.	Erosion/Inundation

Appendix F. Example of key outputs of funding options information from Hawkes Bay Strategy Funding Assessment (Presentation 7th November 2017)

Funding principles

1. Intergenerational
   - Consideration of the length of loan
2. Expenditure, allocation between:
   - Private good – targeted rates including lump sum
   - Public good – general rates

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Private/Public Split

Base Case Recommendations

Option	Private	Public
Status Quo	0%	100%
Renourishment	50%	50%
Renourishment + control structures	60%	40%
Sea wall	80%	20%
Inundation Protection (Pandora)	80%	20%
Retreat the Line	90%	10%
Managed Retreat	0%	100%

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Private/Public Split

Ahuriri Recommendations

	Base Case		Ahuriri		
Option	**Private**	**Public**	**Private**	**Public**	
Status Quo	0%	100%	0%	100%	No rationale to do different than base case
Renourishment	50%	50%	30%	70%	Only benefits small part of unit as existing sea wall is in place, very popular beach, substantial public benefit to maintain
Renourishment + Control Structures	60%	40%	40%	60%	Only benefits small part of unit as existing sea wall is in place, very popular beach, substantial public benefit to maintain
Sea Wall	80%	20%	60%	40%	Only benefits small part of unit as existing sea wall is in place, very popular beach, substantial public benefit to maintain
Retreat the Line	90%	10%	90%	10%	No rationale to do different than base case

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Ahuriri – pathway 1

Summary of programme			
Years	Short Term 0 to 20 years 20	Medium Term 20 to 50 years 30	Long Term 50 to 100 years 50
	Status Quo	Retreat the line	Managed Retreat
Cost Midpoint			
Capital	42,800	963,750	
One off			TBC
Annual Maintenance	12,200	4,800	
Intergenerational			
Loan period	20 years		
		TAG Group	
Private benefit	0%	0%	
Public benefit	100%	100%	

	Share of private benefit	No. Properties	Total (incl public good) ex GST	
Area 1	0%	87	$0.28	
Area 2	0%	246	$0.28	
Area 3	0%	834	$0.28	
Local		26,000		
Regional	100%	56,200	$0.28	$15,781
National	0%			
	100%			**$15,781**

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