



**CLIFTON TO TANGOIO  
COASTAL HAZARD  
STRATEGY**

ADAPTATION THRESHOLDS  
DEVELOPMENT REPORT

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SUMMARY REPORT  
13 DECEMBER 2022



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### Report Information

|                      |                             |
|----------------------|-----------------------------|
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# PART A



Adaptation Threshold  
Development Process

# 1 Introduction

The Northern and Southern Cell Assessment Panels (the Panels) for the Clifton to Tangoio Coastal Hazards Strategy (the Strategy) recommended a series of adaptative pathways to respond to coastal hazard risks.

These pathways, summarised in **Table 1**, have been determined by the Panels as being their preferred method for responding to coastal hazard risks for each unit, based on a range of assessment criteria and financial metrics.

In order for these adaptation pathways to be truly adaptive, signals, triggers and adaptation thresholds (STATs) need to be developed that enable changes in coastal areas to be monitored and decisions made before performance measures desired by the community are no longer being met or start to fail.

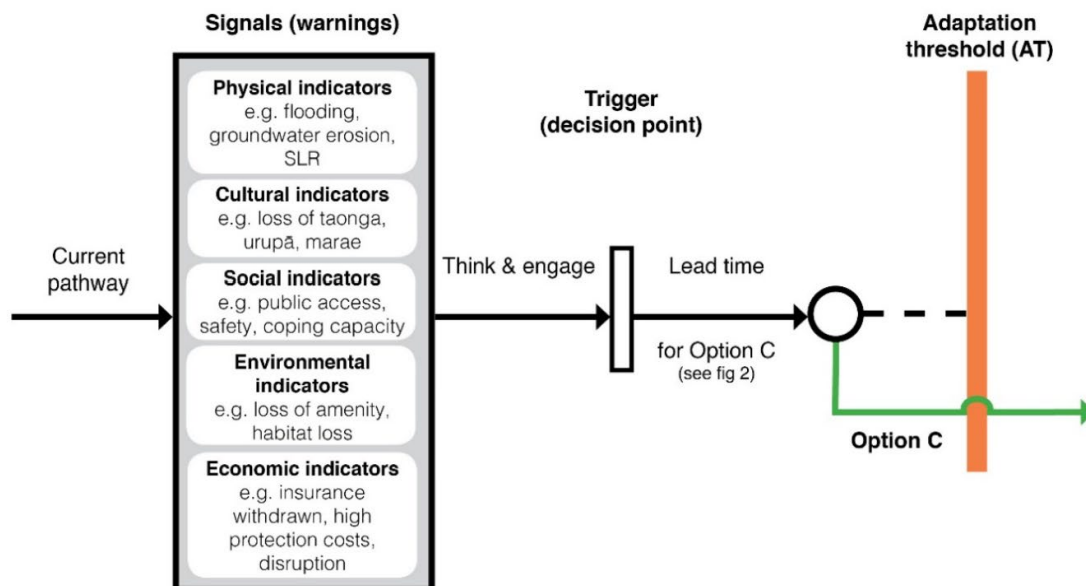
Table 1: Clifton to Tangoio Coastal Hazard's Strategy Recommend Adaptive Pathways: Revised 2021

| Cell          | Unit               | Short term<br>(0 - 20 years) | Medium term<br>(20 - 50 years)     | Long term<br>(50 - 100 years)      |
|---------------|--------------------|------------------------------|------------------------------------|------------------------------------|
| Southern Cell | Clifton            | Status quo                   | Sea wall                           | Managed Retreat                    |
|               | Te Awanga          | Renourishment + Groynes      | Renourishment + Groynes            | Renourishment + Groynes            |
|               | Haumoana           | Renourishment + Groynes      | Renourishment + Groynes            | Managed Retreat                    |
|               | Clive / East Clive | Status quo                   | Renourishment + Groynes            | Retreat the Line / Managed Retreat |
| Northern Cell | Ahuriri            | Status quo                   | Sea wall                           | Sea wall                           |
|               | Pandora            | Status quo                   | Storm surge barrier                | Storm surge barrier                |
|               | Westshore          | Renourishment                | Renourishment + Control Structures | Renourishment + Control Structures |
|               | Bay View           | Status Quo / Renourishment   | Renourishment + Control Structures | Renourishment + Control Structures |
|               | Whirinaki          | Status Quo / Renourishment   | Renourishment + Control Structures | Sea wall                           |

STATs are described below:

- **Signals** are an early warning of change that identifies when a trigger point or adaptation threshold may be approaching.
- **Triggers** are a decision point or points. They are designed to be set to allow sufficient time to take an action, before an adaptation threshold is reached.
- **Adaptation thresholds** describe a situation where performance measures are no longer being met or start to fail. Essentially, adaptation thresholds describe a situation that people/communities don't want to see happen.

Figure 1 illustrates the role of signals, triggers and adaptation thresholds in an adaptive pathway.



Source: Lawrence, J., Bell, R., Blackett, P., Stephens, S., Collins, D., Cradock-Henry, N. & Hardcastle, M. (2020). *Supporting decision making through adaptive tools in a changing climate: Practice Guidance on signals and triggers*. Wellington: Deep South Challenge.

Figure 1 Diagram showing the role of signals, triggers and adaptation thresholds in an adaptive pathway

This report focusses on the process that was used to develop adaptation thresholds for the priority units identified in the Strategy.

## 1.1 Deep South National Science Challenge Guidance

In 2020, the Deep South National Science Challenge released a practice guidance document “*Supporting decision making through adaptive tools in a changing climate – practice guidance on signals and triggers*”. This guidance recommended a 5-Phase, 13-task process to defining thresholds, signals and triggers, monitoring and review (related to Steps 7 – 10 of the MfE guidance process) as illustrated on **Figure 2** below.

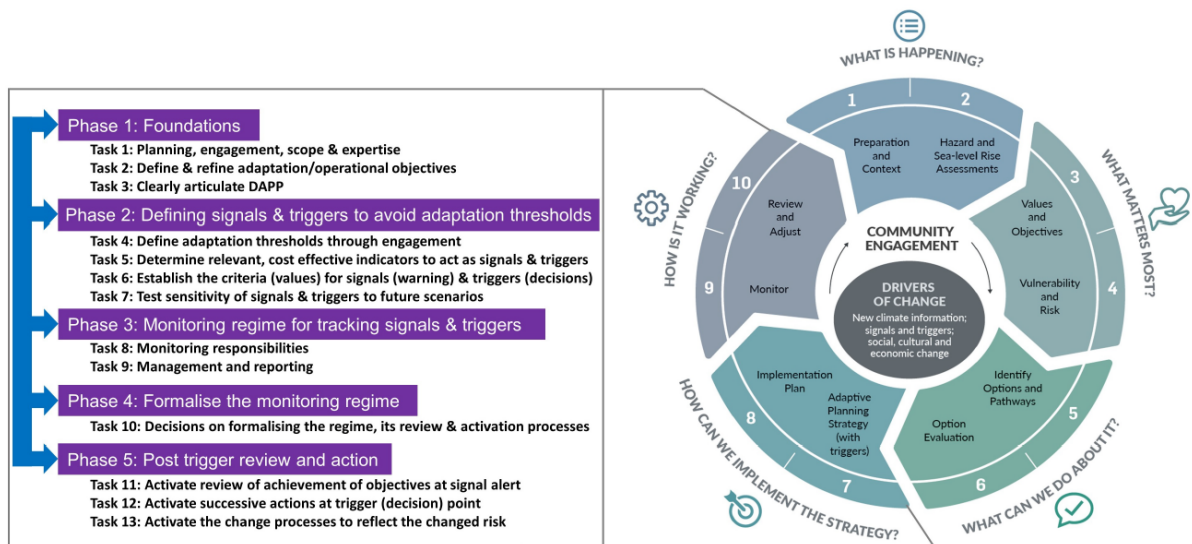


Figure 2 Thresholds, Signals and Triggers – the recommended process (Source: Deep South National Science Challenge)

The approach to developing adaptation thresholds for the Strategy was designed to align with this guidance.

## 2 Literature Review

In the first phase of work, a literature review was undertaken by Tom FitzGerald from Coastal Management Collective to provide guidance on current literature, recent practice and examples of the implementation of STATs.

The review provided a summary of current experience with adaptive planning approaches and STATs development.

It is noted that while some use of trigger points have been documented, at the time the literature review was undertaken there were no examples of STATs being developed and used in practice for natural hazards adaptation.

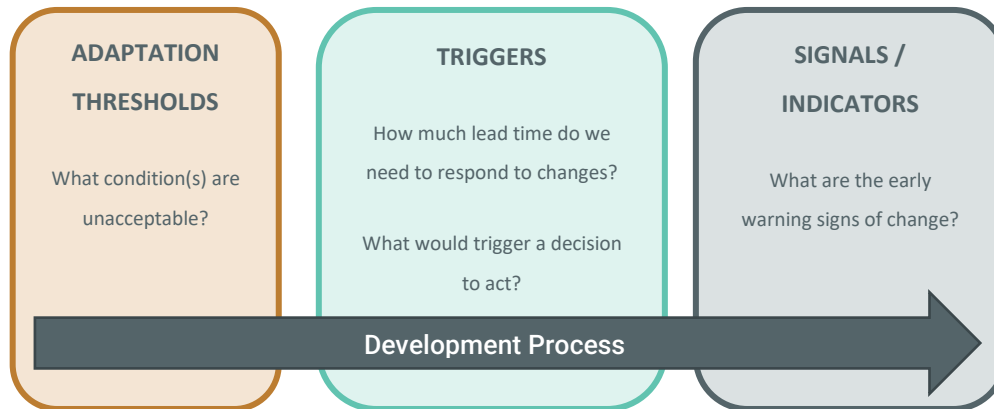
The literature review offers the following recommendations:

- Undertake a Gap analysis – it is important to understand work currently being undertaken by Councils that could be used to monitor, evaluate and report on signals, triggers and thresholds, including environmental, social, cultural, economic and governance areas.
- Community-driven – unsure that STATs are developed collaboratively to reflect a community’s “lived values” of a place.
- Align with existing monitoring and evaluation activities including at a national, regional or area-specific scale.
- Monitoring, Evaluation, Reporting and Learning (MERL) plan – development of a robust, pragmatic and flexible MERL Plan is recommended to support adaptive planning decisions and track progress.

**Appendix 1** contains the literature review in full.

### 3 Development process

The STATs development process was designed to first identify the adaptation thresholds, as illustrated in **Figure 3**.



*Figure 3 Development process of adaptation thresholds, triggers and signals.*

Adaptation thresholds take into account a range of factors that may be influenced as a result of coastal hazards including physical/built environment, social, cultural and economic factors.

In order to develop meaningful and effective adaptation thresholds that span the range of factors, the values of both the community and Councils (in their role as asset managers and emergency management) was considered essential.

This report only covers the adaptation threshold development process. Signals and triggers are currently in development, but necessarily follow the development of adaptation thresholds. Key considerations for signals and triggers include that they are practical and cost-effective to monitor and provide sufficient lead time on the relevant adaptation threshold such that actions can be implemented before the threshold is reached.

## 4 Workshop series

The threshold development process was primarily centred around a series of workshops held with the community and Council asset managers & CDEM team members.

Figure 4 shows the threshold development process and the roles each of the groups played. For clarity, "TAG" in the Figure 4 refers to the Technical Advisory Group established for the Strategy, which is formed by senior staff from each Partner Council and the Chair of the Joint Committee. "Panel" in Figure 4 refers to a working group of community members, primarily formed by former members of the Northern and Southern Cell Assessment Panels but including new members.

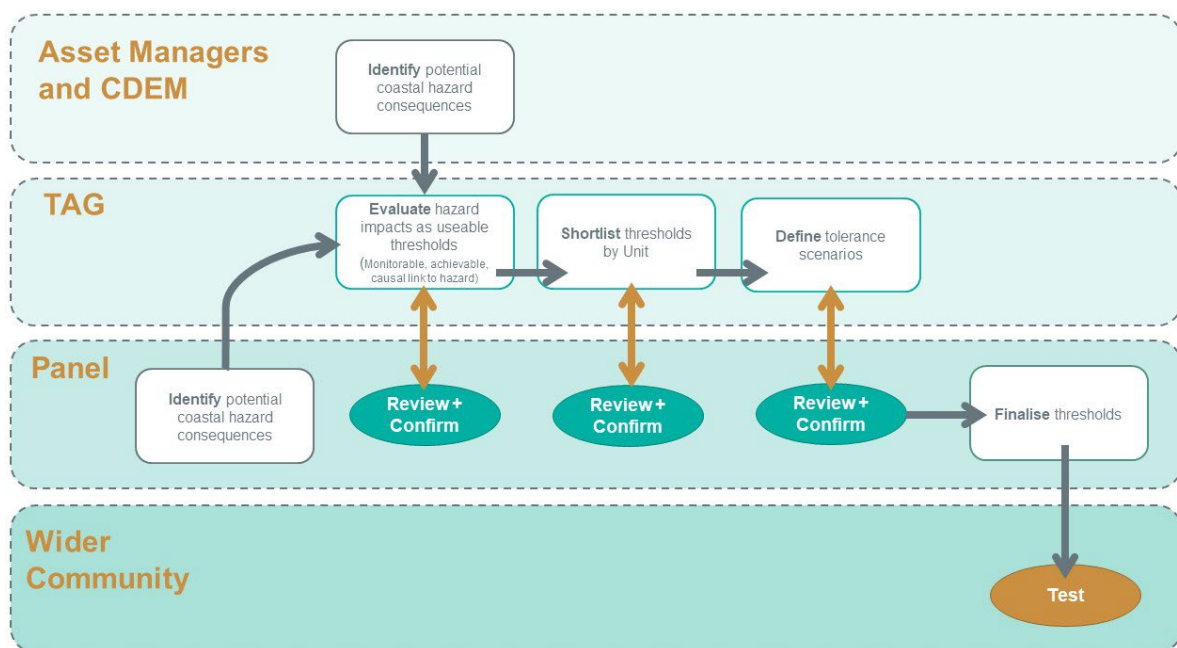


Figure 4 Workshop series

The following sections describe in more detail how proposed adaptation thresholds were developed through the workshop series.

### 4.1 Workshop #1: Consequences & elements at risk

For the first Panel workshop, our objectives were to communicate the role of adaptation thresholds and to get an initial understanding from community members of their experience, knowledge and concerns of the actual and potential consequences of coastal hazards.

To achieve this, we undertook a two-part exercise. We first sought to understand from the community, the consequences of coastal hazards occurring.

We then sought to understand the elements at risk of each of the identified consequences, and what these effects meant for individuals and their wider community. This part of the exercise encouraged participants to consider and identify a range of elements including physical, people (social and cultural) and economic factors.

A few weeks later, we ran an identical workshop with Council asset managers, engineers and CDEM team members to gain insights into Council perspectives on these issues. This workshop started from a clean page and was not shown the previous work by community members.

The information collected from both workshops was collated into a complete set and formed the basis for further workshops and discussions at TAG.

Figure 5 provides an example of the worksheet that was completed in these first workshops.

| Coastal Hazard Consequence |  | Caused by                           |                                     | What would this mean for me & my community?   |  |   |   |
|----------------------------|--|-------------------------------------|-------------------------------------|---|--|---|---|
| Number                     | Description  | Ind.                                | Ero.                                | Economic  | Social   | Cultural  | Environmental   |
| 1.                         | Reduced stability of riverine stopbanks (particularly at mouth)  | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <ul style="list-style-type: none"> <li>Increased costs for funding maintenance (costs passed on to community/beneficiary-pays)</li> </ul>   | <ul style="list-style-type: none"> <li>Stopbanks are decommissioned for recreational uses</li> <li>Compounding hazards if erosion not addressed (e.g. increasing FW flooding risk)</li> <li>Cycleways become disrupted /re-routed</li> </ul> | <ul style="list-style-type: none"> <li>Access to traditional mahinga kai sites/practices affected</li> </ul>                  | <ul style="list-style-type: none"> <li>Compounding impacts on nearby natural processes (e.g. fish spawning, sedimentation of estuaries, meandering river mouths etc)</li> </ul> |
| 2.                         | Access to and along the coastline limited (vehicles and pedestrian), due to steepness of beach escarpments | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <ul style="list-style-type: none"> <li>Recreational commercial activities affected/cease</li> </ul>   | <ul style="list-style-type: none"> <li>Pedestrian safety increasingly vulnerable</li> <li>Local boat launching sites affected/unusable</li> <li>No vehicles on many beaches – a PLUS!</li> </ul>   | <ul style="list-style-type: none"> <li>As above</li> </ul>  | <ul style="list-style-type: none"> <li>positive no vehicles on beaches (esp. sensitive ecosystems)</li> <li>Loss of natural ecosystems with nowhere to go/re-create</li> </ul>  |
| 3.                         | Impact on tourism activities, campsites, freedom camping, use of pathways                                  | <input type="checkbox"/>            | <input checked="" type="checkbox"/> | <ul style="list-style-type: none"> <li>Reduced commercial operators</li> <li>Reduced 'choice' in location and market providers.</li> <li>Impact on HB reputation and marketing as active recreation destination/experience</li> </ul> | <ul style="list-style-type: none"> <li>Multifaceted effect of reduced tourism</li> <li>Reduced amenity/wellbeing from limited recreational activities and coastal sense of place</li> </ul>  | <ul style="list-style-type: none"> <li>Loss of sense of place</li> <li>Disrupted whanau tradition over generations</li> </ul> | <ul style="list-style-type: none"> <li>Inappropriate de-commissioning of assets/infrastructure/built stuff</li> </ul>   |

Figure 5 Worksheet example from Workshop 1

A full summary of Workshop 1 outcomes is provided as **Appendix 2**.

Workshop 1 outcomes were then used to define a set of proposed adaptation thresholds. This was done by assessing the consequences and elements at risk against two criteria to determine their usefulness and applicability as potential adaptation thresholds. The evaluation and selection criteria used were:

1. Coastal hazards are the cause of the threshold being breached; and
2. Data to assess the threshold is available or can readily be collected and interpreted

It became evident through this process that potential adaptation thresholds could be grouped into one of four categories, as presented in **Table 2**. This categorisation shows implications for how the adaptation thresholds can be monitored, and what sorts of signals and triggers would later be required to support them.

Table 2 Threshold types

| Type of threshold        | Description  | Example   |
|--------------------------|--|---|
| <b>Pass/Fail</b>         | The effects of the threshold either are experienced, or they are not   | <i>Coastal Erosion causes overwhelming or damage to/leakage from septic tank(s)</i>   |
| <b>Frequency</b>         | The effects of the threshold are time sensitive and consideration of a duration of the effect and/or the frequency of the effect is needed | <i>Coastal inundation causing loss of road access for the majority of the community.</i><br><br><i>How long: At least 24 hours</i><br><br><i>How often: More than once every 5 years.</i> |
| <b>Subjective</b>        | Subjective thresholds are those that are influenced or determined by people’s feelings or opinions.  | <i>High levels of anxiety within the community regarding coastal hazard risks and impacts.</i>  |
| <b>Objective measure</b> | Objectives thresholds are those that are those based on fact.  | <i>Median house process for coastal properties decline in response to actual or perceived coastal hazard risks.</i>   |

Following this process, and with support from TAG, an assessment of the relevance of each potential adaptation threshold for each coastal unit was undertaken. This was based on spatial knowledge of the units and the assets within them and their risk exposure, including through using the [coastal hazard portal](#). Figure 6 shows an example how this information was captured, with the full results included in Appendix 3.

| Coastal Hazard Consequence<br><small>(Identified through community workshop series + Council asset manager workshops – July &amp; November 2021)</small> | Proposed Threshold<br><small>(Developed with feedback from community workshop series - February 2022)</small>   | Likely source of data?                         | Threshold Evaluation and Selection                               |  |                             | Relevant Unit |        |         |           |          |          |         |           |         |
|--|---|--|--|--|-----------------------------|---------------|--------|---------|-----------|----------|----------|---------|-----------|---------|
|  |   |  | 1. Coastal Hazards are the cause of the threshold being breached | 2. Data to assess threshold is available or can readily be collected and interpreted | 3. Selected as a threshold? | ALL UNITS     | Aburri | Pandora | Westshore | Bay View | Whitnail | Clifton | Te Awanga | Huamona |
| <b>Potential Physical/ Infrastructure Thresholds</b>   |   |  |  |  |                             |               |        |         |           |          |          |         |           |         |
| Loss of Road Access (Community Scale)  | Coastal inundation in [NAME] causing loss of road access for the majority of the community.<br><i>How long: At least 24 hours</i><br><i>How often: More than once every 5 years.</i>    | Observed/ inspected/ reported by asset manager | ✓  | ✓  | ✓                           |               |        | ✓       |           |          | ✓        | ✓       | ✓         | ✓       |
|  | Coastal erosion in [NAME] causing loss of road access affecting the majority of the community.  | Observed/ inspected/ reported by asset manager | ✓  | ✓  | ✓                           |               |        |         | ✓         | ✓        | ✓        | ✓       | ✓         | ✓       |
| Loss of Road Access (Property Scale)   | Coastal inundation in [NAME] causing loss of road access that affects individual properties.<br><i>How long: At least 24 hours</i><br><i>How often: More than once every two years.</i> | Observed/ inspected/ reported by asset manager | ✓  | ✓  | ✓                           | ✓             | ✓      | ✓       |           |          | ✓        | ✓       | ✓         | ✓       |
|  | Coastal erosion in [NAME] causing loss of road access that affects individual properties.   | Observed/ inspected/ reported by asset manager | ✓  | ✓  | ✓                           | ✓             |        | ✓       | ✓         | ✓        | ✓        | ✓       | ✓         | ✓       |

Figure 6 Potential adaptation thresholds identified from workshops

## 4.2 Workshop #2: Draft Thresholds for consideration

The potential adaptation thresholds were presented to the Panel at a second workshop for their consideration, comment and amendment.

At the workshop, we undertook a small groups exercise to test the relevance of the potential thresholds for a specific unit, based on the consequences information from the previous workshops. Each group reviewed and commented on the suggested tolerance measures for each threshold and rated the importance of each potential threshold for the specific unit they were working on. This part of the exercise was designed to support a shortlisting process for final proposed adaptation thresholds for each unit.

Feedback from the group was collated and later worked through with the TAG team to refine and shortlist final proposed adaptation thresholds for each unit.

### 4.3 Workshop #3 Thresholds by unit

At the final workshop, the Panel was presented with a refined set of potential thresholds.

Thresholds were divided into those that applied to all units, and those that only applied to a specific coastal unit.

The Panel first examined the proposed adaptation thresholds to apply to all units. They discussed whether each proposed threshold was suitable to apply across all coastal units and commented on the threshold’s relevance and proposed threshold measures in terms of frequency and duration. **Figure 7** is a portion of the all-unit thresholds identified. The far right column of the table notes the rationale for any changes made as result of feedback in Workshop 3.

| General Proposed Thresholds (apply to all Units)  |   |   |  |
|---|---|---|--|
| Threshold + Threshold Measure   | Primary responsibility for monitoring and reporting to HBRC | Monitoring method/ data source  | Rationale for changes made in response to feedback as a result of community workshop held 22 June 2022   |
| Coastal inundation causing the loss of one or more essential services affecting the majority of the community.<br><i>How long: At least 48 hours</i><br><i>How often: More often than once every 5 years.</i> | HBRC + Relevant TA  | Observations during and following a coastal inundation event, including community feedback.                         | Majority of feedback suggested that in order for the impact to be substantial and therefore act as a threshold, not a trigger, duration should be extended to 48 hrs from 24 hrs   |
| Community-wide coastal inundation causing damage to multiple buildings/service.<br><i>How long: Any duration</i><br><i>How often: More often than once every 5 years.</i>                                     | HBRC  | Observations during and following a coastal inundation event, including community feedback.                         | Some feedback proposed reducing this threshold to 3 years however retained as 5 to have parity with above threshold.   |
| Any serious injuries and/or fatalities that occur as a result of a coastal erosion or coastal inundation event.   | Civil Defence   | CDEM observations during and following a coastal erosion or coastal inundation event, including community feedback. | Extensive debate on this threshold. All agreed that no fatalities are acceptable. Generally agreed that for injuries, threshold should be for serious injuries caused as a result of coastal hazards. Note, there are some standard definitions available. |
| Civil Defence emergency is declared in response to coastal inundation or coastal erosion.<br><i>How often: More often than once every 10 years.</i>   | Civil Defence   | CDEM reporting during and following a coastal erosion or coastal inundation event, including community feedback.    | Feedback suggested moving to 10 years from 5 to reflect that a Civil Defence Emergency is a major event that is not tolerable more frequently.   |

Figure 7 A portion of the whole of coast thresholds

The group then examined the unit specific thresholds. During this process, a number of potential thresholds were removed where they were identified as being better as a trigger due to the scale of the impacts or where there were clear management techniques to address the issue through other means, as shown in **Figure 8**.

| Whirinaki Proposed Thresholds  |   |   |   |
|--|---|---|---|
| Threshold + Threshold Measure  | Primary responsibility for monitoring and reporting to HBRC | Monitoring method/ data source  | Rationale for changes made in response to feedback as a result of community workshop held 22 June 2022  |
| Coastal erosion in Whirinaki affecting Whirinaki Road and/or North Shore Road, causing loss of road access for the majority of the community.  | HDC   | Observed/ inspected/ reported by Council asset managers during/ following coastal erosion or coastal inundation events. | No changes suggested but change made to specifically reference Whirinaki and North Shore Roads as loss of access to either of these roads from coastal erosion would affect the majority of the community.  |
| Coastal erosion in Whirinaki causing loss of road access that affects individual properties.   | HDC   | Observed/ inspected/ reported by Council asset managers during/ following coastal erosion or coastal inundation events. | Feedback suggests that this threshold would be better as a trigger given the individual scale of effects – we have applied this rationale to all individual scale thresholds in all units.  |
| Buildings in Whirinaki are deemed uninhabitable as a result of coastal hazards (e.g. loss of septic tanks, building structural integrity etc). | CDEM/ HDC   | Observed/ inspected/ reported by Council asset managers during/ following coastal erosion or coastal inundation events. | No changes suggested  |
| Rail access is disrupted as a result of coastal hazards.<br>How long: more than 48 hours<br>How often: More often than once annually           | KiwiRail  | Reported by KiwiRail  | Feedback suggested that this could be extended duration as there are alternative options that could be utilised in the event that rail is unavailable. Alternatively, some feedback suggested that this is better as a trigger, as it is not directly a community matter.<br><br>Given the low impact for the wider community as a result of this infrastructure being affected <a href="#">i.e.</a> not a commuter service, it was decided that this threshold was no longer needed. |

Figure 8 Whirinaki example of unit-specific thresholds and the amendments as a result of community feedback.

Appendix 4 provides a summary of the final feedback from the panel.

This feedback was then used to compile a final set of proposed adaptation thresholds, which were later presented and adopted by TAG.

## 5 Final adaptation thresholds for the Clifton to Tangoio Coastal Hazards Strategy

**Table 3** presents the final proposed adaptation thresholds for the Strategy. The following key limitations are noted:

1. Tangata whenua perspectives are not reflected in the draft thresholds. This requires resolution through further engagement.
2. The thresholds have been developed in collaboration with community members and Council staff, but require tangata whenua involvement and testing with the wider community to be legitimatised and confirmed.

Table 3: Final Proposed Adaptation Thresholds

|                  | Threshold + Threshold Measure  | Primary responsibility for monitoring and reporting to HBRC (Proposed) |
|------------------|--|--|
| <b>All Units</b> | Coastal inundation causing the loss of one or more essential services affecting the majority of the community.<br><i>How long: At least 48 hours</i><br><i>How often: More often than once every 5 years.</i>                        | HBRC + Relevant TA   |
|                  | Community-wide coastal inundation causing damage to multiple buildings/service.<br><i>How long: Any duration</i><br><i>How often: More often than once every 5 years.</i>  | HBRC   |
|                  | Any serious injuries and/or fatalities that occur as a result of a coastal erosion or coastal inundation event.  | Civil Defence  |
|                  | Civil Defence emergency is declared in response to coastal inundation or coastal erosion.<br><i>How often: More often than once every 10 years.</i>  | Civil Defence  |
|                  | 50% of an affected coastal community consider that a permanent loss of amenity has occurred as a result of coastal erosion or coastal inundation impacts   | HBRC   |
|                  | 50% of the community report actual or perceived property purgatory effects i.e. actual or foreseeable damage to their properties from coastal erosion or coastal inundation and uncertainty about being able to recover their losses | HBRC   |
|                  | 50% of properties are unable to secure building insurance for losses from coastal hazards.   | HBRC   |
|                  | Access to and use of the beach, coastal reserves and/or recreational facilities is prevented as a result of coastal inundation.<br><i>How long: At least 7 days</i><br><i>How often: More often than once every 5 years.</i>         | Relevant TA  |

| Threshold + Threshold Measure                  |   | Primary responsibility for monitoring and 08 reporting to HBRC (Proposed) |
|--|---|---|
| <i>Whirinaki</i>                               | Coastal erosion in Whirinaki affecting Whirinaki Road and/or North Shore Road, causing loss of road access for the majority of the community.   | HDC   |
|  | Buildings in Whirinaki are deemed uninhabitable as a result of coastal hazards (e.g. loss of septic tanks, building structural integrity etc).  | CDEM/ HDC   |
| <i>Bay View</i>                                | Coastal erosion in Bay View affecting Le Quesne Road, causing loss of road access for majority of the community.                                | NCC   |
| <i>Westshore</i>                               | No unit specific thresholds – only Whole Coast Thresholds apply   |   |
| <i>Ahuriri</i>                                 | No unit specific thresholds – only Whole Coast Thresholds apply   |   |
| <i>Pandora</i>                                 | Coastal inundation in Pandora affecting Thames Street and Severn Street causing loss of road access for the majority of the community.          | NCC   |
|  | How long: At least 48 hours   |   |
|  | How often: More often than once every 5 years.  |   |
| <i>East Clive</i>                              | Buildings in East Clive are deemed uninhabitable as a result of coastal hazards (e.g. loss of septic tanks, building structural integrity etc). | CDEM/ HDC   |
| <i>Haumoana</i>                                | Coastal inundation in Haumoana affecting Haumoana and/or Beach Road causing loss of road access for the majority of the community.              | HDC   |
|  | How long: At least 48 hours   |   |
|  | How often: More often than once every 5 years.  |   |
| <i>Te Awanga</i>                               | Buildings in Haumoana are deemed uninhabitable as a result of coastal hazards (e.g. loss of septic tanks, building structural integrity etc).   | CDEM/ HDC   |
|  | Coastal inundation in Te Awanga affecting Clifton Road causing loss of road access for the majority of the community.                           | HDC   |
|  | How long: At least 48 hours   |   |
| How often: More often than once every 5 years. |   |   |
| <i>Clifton</i>                                 | Coastal erosion in Te Awanga affecting Clifton Road causing loss of road access affecting the majority of the community.                        | HDC   |
|  | Buildings in Te Awanga are deemed uninhabitable as a result of coastal hazards (e.g. loss of septic tanks, building structural integrity etc).  | CDEM/ HDC   |
|  | Coastal inundation in Clifton affecting Clifton Road causing loss of road access for the majority of the community.                             | HDC   |
| How long: At least 48 hours                    |   |   |
| How often: More often than once every 5 years. |   |   |
| <i>Clifton</i>                                 | Coastal erosion in Clifton affecting Clifton Road causing loss of road access affecting the majority of the community.                          | HDC   |
|  | Buildings in Clifton are deemed uninhabitable as a result of coastal hazards (e.g. loss of septic tanks, building structural integrity etc).    | CDEM/ HDC   |
|  | Coastal erosion in Clifton affecting Clifton Road causing loss of road access affecting the majority of the community.                          | HDC   |
| <i>Clifton</i>                                 | Buildings in Clifton are deemed uninhabitable as a result of coastal hazards (e.g. loss of septic tanks, building structural integrity etc).    | CDEM/ HDC   |
|  | Coastal erosion in Clifton affecting Clifton Road causing loss of road access affecting the majority of the community.                          | HDC   |
|  | Buildings in Clifton are deemed uninhabitable as a result of coastal hazards (e.g. loss of septic tanks, building structural integrity etc).    | CDEM/ HDC   |

## 6 Signals, Triggers & future monitoring

Work has now commenced on the development of appropriate signals and triggers. These will be designed to provide clear early warnings of change, with sufficient lead-time to enable robust decision making around next steps.

We consider it important to have good knowledge of likely next actions in order to accurately define signals and triggers. For example, if the likely next action in response to a trigger being reached is increased beach nourishment, little lead time (months) will be required in order to take that action to avoid an adaptation threshold being reached. A physical structure in the Coastal Marine Area and its associated consenting and construction process will require significantly more lead time (years). Managed or planned retreat is likely to require 10 years plus lead time. Consideration of lead-time has significant implications for how signals and triggers are defined and monitored for each part of the coast.

A subsequent but necessary step, once the signals and triggers have been identified, is the need to develop a pragmatic monitoring programme.

This programme will provide the mechanism for tracking identified adaptation thresholds, signals and triggers over time. In the development of the monitoring programme, existing monitoring already undertaken by Councils or others will be identified and its efficiency for monitoring signals, triggers and adaptation thresholds evaluated to identify any gaps where additional monitoring is required.

We recommend that a dedicated website or page is developed to provide “live” reporting of signals, triggers and adaptation thresholds once these are in place and being monitored. A simple traffic light system overlaid with an interactive map would be used to graphically show whether signals, triggers and adaptation thresholds are nominal (green), approaching (amber) or reached (red). This would provide a valuable node of communication for community members, Councils and asset owners/managers, and could provide an online forum for self-reporting of monitoring data by community members or others.

# PART B



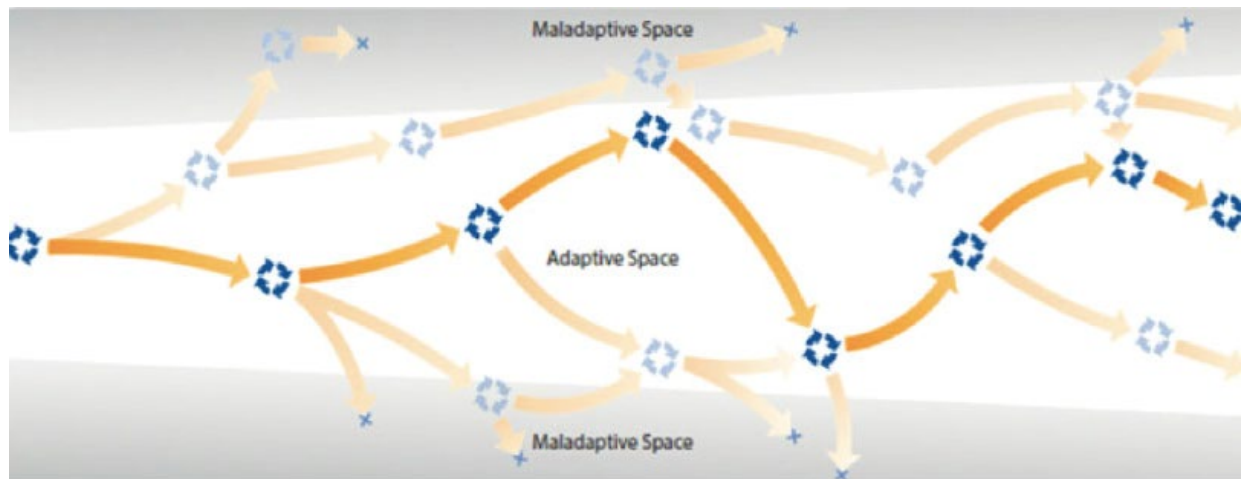
## Appendices

# Appendix 1

## Literature Review

# Supporting Adaptation using Signals, Triggers and Adaptation Thresholds (STATs): a brief review

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Tom FitzGerald, Coastal Management Collective

May 2021

**Cover image:** a diagram showing conceptual adaptation pathways with intermittent decision points and alternative pathways seeking to stay in the adaptive space and avoid maladaptation. Source: [1]

**Date:** 16 May 2021

**Version:** STATs\_brief review FINAL v8.docx

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# 1 Background

## 1.1 This document

This document reviews current literature, recent practice and examples of Signals, Triggers and Adaptation Thresholds (STATs) and provides a basis from which to inform their development as a key part of the next phase of the *Clifton to Tangoio Coastal Hazard Strategy 2120* (the Strategy).

The Strategy was developed as the pilot project of the MfE Guidance [2] but is not yet complete and requires the development of STATs to progress toward implementation whilst ensuring the Strategy is both dynamic and adaptive – as envisaged by the MfE Guidance.

## 1.2 The mandate for adaptive planning

In 2017, the Ministry for the Environment published new guidance setting out an approach to managing for coastal change that takes account of deep uncertainty and ongoing change. Steps in the MfE Guidance revolve around a core of ongoing community engagement and monitoring drivers for change. The 10 steps are founded upon a simple rubric captured by five deceptively simple key questions that form the backbone of a living adaptive planning strategy, they are:

1. *What is happening?*
2. *What matters most?*
3. *What can we do about it?*
4. *How can we do it?*
5. *How do we know it's working?*

Fundamentally, the MfE Guidance [2] places an emphasis on using *dynamic adaptive pathways planning* to deal with uncertainty.

According to the now emergent doctrine of Dynamic Adaptive Pathways Planning (DAPP) an *adaptive planning strategy* (see MfE, 2017) may be conceptualised as a series of actions over time that can proactively account for the uncertainty over future climate change and societal manifestations. Essentially, DAPP enables contingency actions to be

put in place proactively as conditions change. A pathways approach to adaptation planning is about keeping options open (so called 'low regrets' actions) and so avoiding path dependency and lock-in. Under the approach, rather than determining a final outcome or final decision at an early stage, decision-makers are able to build a strategy that will adjust to changing circumstances over time. The approach acknowledges that while not all decisions can be made now, they can be planned, prioritised and prepared for. It is a useful approach for dealing with uncertainty [3], and is the preferred approach set out in the MfE Guidance (2017) (see Figure 1 below).

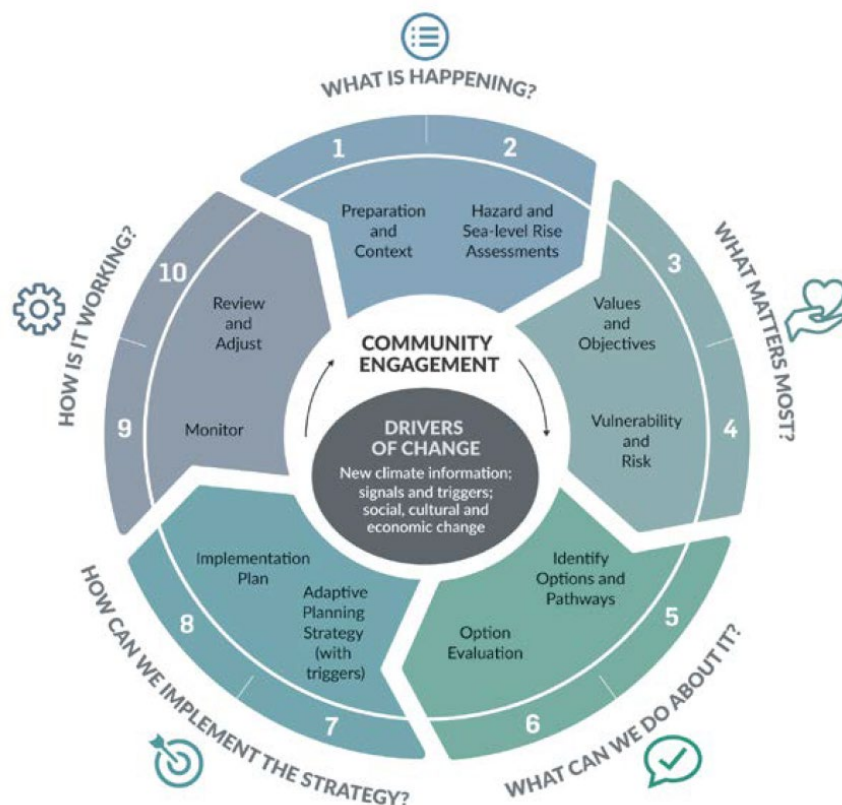


Figure 1 The ten (10) steps and five (5) key questions that fundamentally underpin the mandated approach to coastal adaptation in New Zealand – Dynamic Adaptive Pathways Planning (DAPP) to support an adaptive planning strategy. Source: MfE, 2017.

Characteristics of a DAPP approach include:

- Each decision-point is triggered by some change in context (environmental, economic, cultural or social). In the design of the Adaptive Planning Strategy (see Step 7 above), the steps and the triggers must be identified.
- Each decision-point has a series of identified choices or adaptation responses associated with it.

- Once the decision-point is reached (or triggered), the adaptation responses for that step are 'tested' against plausible futures and the acceptable risk to the community, and a selection is made.
- The selection leads to the next section of the pathway, and in turn to the next decision-point.
- The adaptation responses that are not selected will, if appropriate, be available for selection at the next decision-point. The wide range of options considered, evaluated and left 'on the table' for the future gives decision makers flexibility and allows decisions to be responsive and iterative.

It is this kind of flexibility that is required to deal with an uncertain future. But underpinning our decision-making lies the foundations of monitoring, evaluation, reporting and learning (MERL) [4] and our ability to track adaptation progress.

### 1.3 Monitoring for change: the fundamental premise behind adaptive planning

However, the ultimate success of any adaptive planning strategy and implementation plan is critically dependent on the monitoring, evaluation and adjustments that are allowed for at the back end of this process (*How do we know it's working?*). It enables us to learn from experience, and redesign better solutions iteratively. This is why monitoring for change (by way of signals and triggers) were placed at the very core of the MfE Guidance.

It's not an overstatement to suggest that appropriate monitoring and evaluation frameworks should be the bedrock underpinning any adaptive planning strategy. After all, if we haven't been able to define 'success' then there would be no reason to change course - any possible future would represent success and make the notion of adaptive planning redundant. Monitoring and evaluation are a critical component of understanding whether success as it has been defined, has been or is being achieved. Furthermore, as adaptive planning strategies seek to oversee and guide decision-making for the next 100+ years – being able to point to indicators that are suggesting onset of adverse conditions and then making decisions to avoid the worst of those adverse conditions becomes increasingly invaluable.

The DAPP approach focuses on keeping multiple pathways open into the future to deal with greater uncertainty over longer timeframes. It's all about flexibility. It's an iterative process requiring ongoing support from decision-makers and the community. Critical to this process is the underlying premise that adaptation actions (whether they be for example: policy decisions, structural solutions, or natural defences) can only ever have a finite life in the face of continual change (whether climate change or community change). In order to maintain the flexibility to change tack, or employ an alternative adaptation solution, monitoring and review of current actions for their efficacy is fundamental.

CoastAdapt ([www.coastadapt.com.au](http://www.coastadapt.com.au)) identifies three key elements of how regular monitoring and evaluation can help track adaptation progress, by:

1. Tracking the performance of activities during the development of an adaptative planning strategy (e.g. a survey about community engagement).
2. Tracking previously identified indicators pointing to approaching adaptation thresholds, signals and key decision points (or triggers).
3. Determining whether outputs and outcomes have been achieved.

In 2020, to provide additional support to the MfE Guidance (2017) and under the auspices of the Deep South National Science Challenge, Lawrence et al [5] published practice guidance on signals and triggers and proposed an approach to developing STATs to enable proactive decision-making (see Figure 2 below). The practice guidance sets out thirteen key tasks to be undertaken in developing STATs, as set out below:

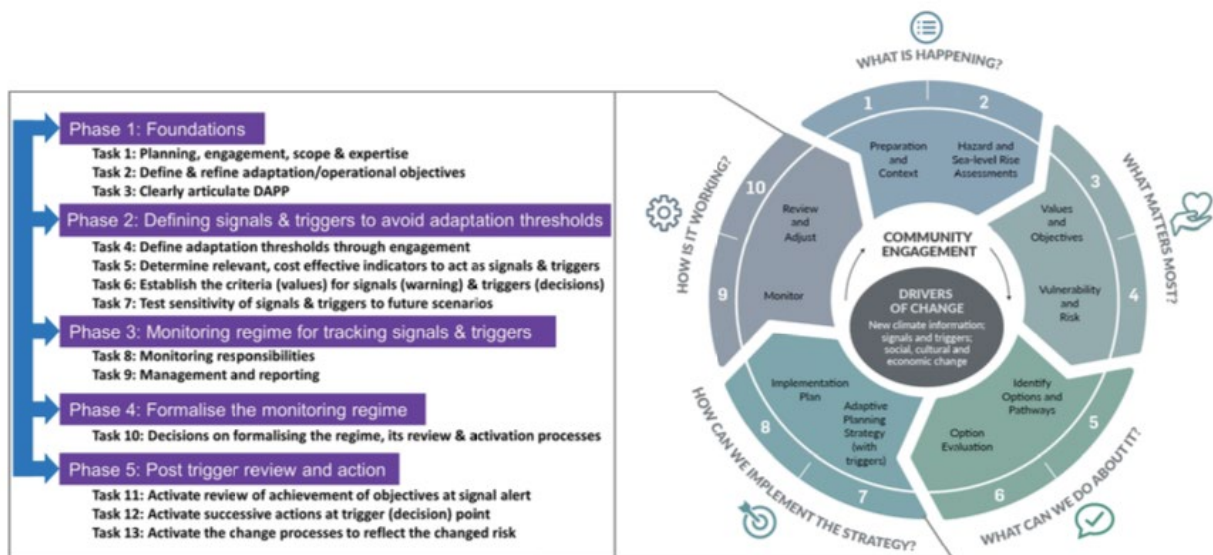


Figure 2 The proposed process for developing STATs as part of broader coastal adaptation process recommended by MfE (2017) – the 10-step decision cycle.

With that in mind, this review sets out the context and considerations for the development of STATs to support the implementation, monitoring and review of actions identified in the *Clifton to Tangoio Coastal Hazard Strategy 2120* and to help ensure its ongoing success as a truly adaptive planning strategy.

## 2 Signals, Triggers and Adaptation Thresholds (STATs)

Signals, triggers and adaptation thresholds (STATs) are first and foremost defined in the MfE Guidance, but for convenience they are summarised here:

- **Signals** – an early warning that identifies when a trigger point or adaptation threshold may be approaching<sup>1</sup>.
- **Triggers** – the decision point(s), allowing sufficient time to take an action prior to an adaptation threshold being reached.
- **Indicators** - individual or combined metrics or qualitative values that can pick up changes or trends and be used to monitor for both signals and triggers. Indicators should be salient, credible and legitimate for decision-makers and the community (see Lawrence et al, 2020).
- **Adaptation Thresholds** – the conditions to be avoided by taking a new action i.e. what people do not want to happen.
- **Adaptation Pathway** - an approach designed to schedule adaptation decision-making: it identifies the decisions that need to be taken now and those that may be taken in future. The approach supports strategic, flexible and structured decision-making<sup>2</sup>. It allows decision-makers to plan for, prioritise and stagger investment in adaptation responses.

The below diagram (Figure 3) illustrates the relationships between the above described terms:

---

<sup>1</sup> In some cases it may be possible, or more practical, to combine signals and triggers into one point in time – see Section 3.2 of Lawrence et al, 2020. This may be due to the differences between the two being insignificant, or not significant enough e.g. the difference between 'minor' and 'moderate' or 'likely' and 'very likely' – this is particularly relevant for quantitative physical indicators like flooding and high sea level events.

<sup>2</sup> See CoastAdapt - <https://coastadapt.com.au/pathways-approach>

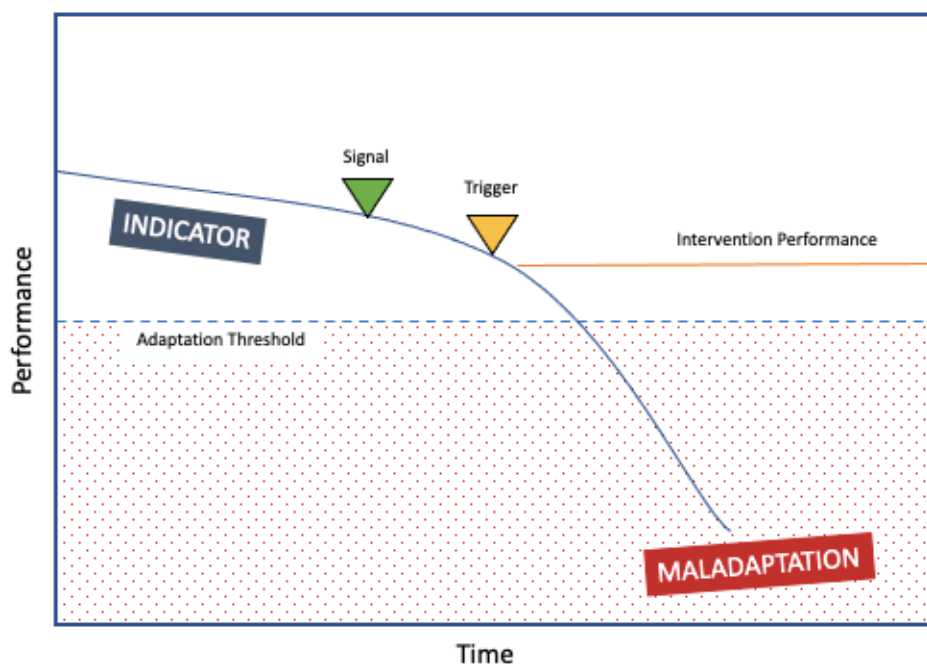


Figure 3 Conceptual diagram of the sequence and interaction between indicators, signals, triggers (decision point) and adaptation thresholds. Note that signals and triggers are identified at an earlier time than when the adaptation threshold is reached – this is to ensure sufficient lead time is built into the process to allow a new pathway (or intervention) to be planned and implemented. Note also that 'Performance' on the Y-axis could be described by reference to levels of risk, levels of service, metrics around community wellbeing etc. A dynamic adaptive pathways planning approach should guide decisions away from maladaptation, or negative outcomes.

The blue line in the diagram above represents an indicator of the status quo i.e. if nothing was done the indicator would trend down dipping below a known/unknown adaptation threshold (dashed line) and resulting in maladaptation. The yellow line represents an intervention (or adaptation response) designed to at least maintain performance for a specified period of time e.g. a seawall designed to withstand a 1 in 50 year event under a high sea level scenario.

Maladaptation in this diagram describes a space where interventions (or adaptation responses) result in an undesired state. This may also include lack of adaptation response.

Further detail, examples (Boxes 1-4) and commentary on STATs is provided in Sections 2.1 and 2.2 below.

## 2.1 Starting with Adaptation thresholds

The identification of adaptation thresholds (ATs) is a question fundamentally about risk tolerability. This is directly related to what people value, their objectives (including those set by policy or regulation) and how those values interact with the potential frequency and magnitude of coastal hazards. But really it is about asking the question: what you don't want to experience and why? [5] What is the breaking point?

According to Stephens et al [6], an *adaptation threshold* occurs “...when the status quo is no longer effective in meeting objectives and a new action or pathway becomes necessary. Adaptation thresholds are associated with performance of the system of concern, for example storm-tide flooding becoming too frequent for a viable community to function or, when beach nourishment or a sea wall is no longer effective due to technical, economic, or social limitations.” CoastAdapt (2021) differentiates between two kinds of AT (1) a threshold of the system being managed, or tipping point, and (2) a threshold related to the adaptation responses being considered. For example, the second type of AT might be described by a point in time when a seawall is overtopped by rising seas.

As well as being defined by changing environmental conditions ATs can also be socially, culturally or economically defined and may be framed in terms of coping capacity, adaptive capacity, disruption to activities, or disconnection from special (highly valued) places (or other similar measures, see Figure 4). Community engagement is a central mechanism employed to unravel how an individual’s or a group’s values (framed as objectives) may be impacted by coastal hazards, and help determine acceptable, tolerable or otherwise intolerable levels of risk.

Community engagement does not have to be in person or undertaken through traditional mediums, it can also be done virtually. For example, novel US research has used social media (e.g. Twitter remarks) to help identify nuisance flooding thresholds. Researchers developed a ‘remarkability metric’ that implicitly considered risk consequences e.g. a flood that blocks an important roadway will generate more commentary than a similar event over less used, less populated land. Also of interest is that the remarkability of increasingly common events was noted to diminish over a period of 2-8 years as events become less and less surprising [7].

However a key difficulty with community engagement in longer-term planning has been in an individual’s or community’s inability to engage beyond the immediate planning horizon, or the temporal scale of the personal impact [8]. This has often resulted in a preference for hard coastal protection structures as an ‘interim’ or first step. Grace and Thompson [8] surmise about the short-sighted thinking in preferences for hard coastal protection structures and point to an inevitability about retreat as an ultimate endpoint:

*“Engineered structures are designed to withstand a specified storm event, and have a design life after which they no longer offer viable protection. It is important for stakeholders to understand the temporary nature of protection*

*measures. In the long term, the size and extent of engineering structures required to withstand sea level rise and more intense storm events will necessarily become larger, increasing their cost and impact. The logical conclusion is that the feasibility and cost of continuing protection will become untenable, and eventual retreat from the vulnerable land is therefore inevitable."*

### **BOX 1: LAKES ENTRANCE, VICTORIA (AU)**

One of the pioneering approaches to adaptation pathways in Australia was at Lakes Entrance on the East Coast of Victoria [9, 10]. The below diagram summarises the triggers (and implied ATs) identified and the possible steps to be taken. The triggers (derived through interviews, focus groups and surveys<sup>3</sup>) were identified as illustrating a marked departure from 'normal' experience with discernible social impacts for local business, employment, access, disadvantaged groups and the costs of living<sup>4</sup>. Importantly, they found that triggers of change that have social impacts are salient to local communities and help build consensus around adaptation decisions, essentially acting as collective expressions of risk tolerability and providing windows of opportunity to enact policy change (or change path). Descriptions of likelihood and physical environmental parameters can then be worked backward from there e.g. a once in 20 years flood event (1:20 yr flood) leads to flooding of the main road through the town.

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<sup>3</sup> Further information on the methods used to derive triggers based on lived values is provided in Barnett et al (2014):  
10. Barnett, J., et al., *A local coastal adaptation pathway*. *Nature Climate Change*, 2014. **4**(12): p. 1103-1108.

<sup>4</sup> For further work on 'lived values' undertaken by Sonia Graham at UNSW Sydney, see:  
11. Graham, S., et al., *Local values for fairer adaptation to sea-level rise: A typology of residents and their lived values in Lakes Entrance, Australia*. *Global Environmental Change*, 2014. **29**(0): p. 41-52, 12. Graham, S., et al., *The social values at risk from sea-level rise*. *Environmental Impact Assessment Review*, 2013. **41**(0): p. 45-52, 13. Graham, S., et al., *Towards fair local outcomes in adaptation to sea-level rise*. *Climatic Change*, 2014. **130**(3): p. 411-424.

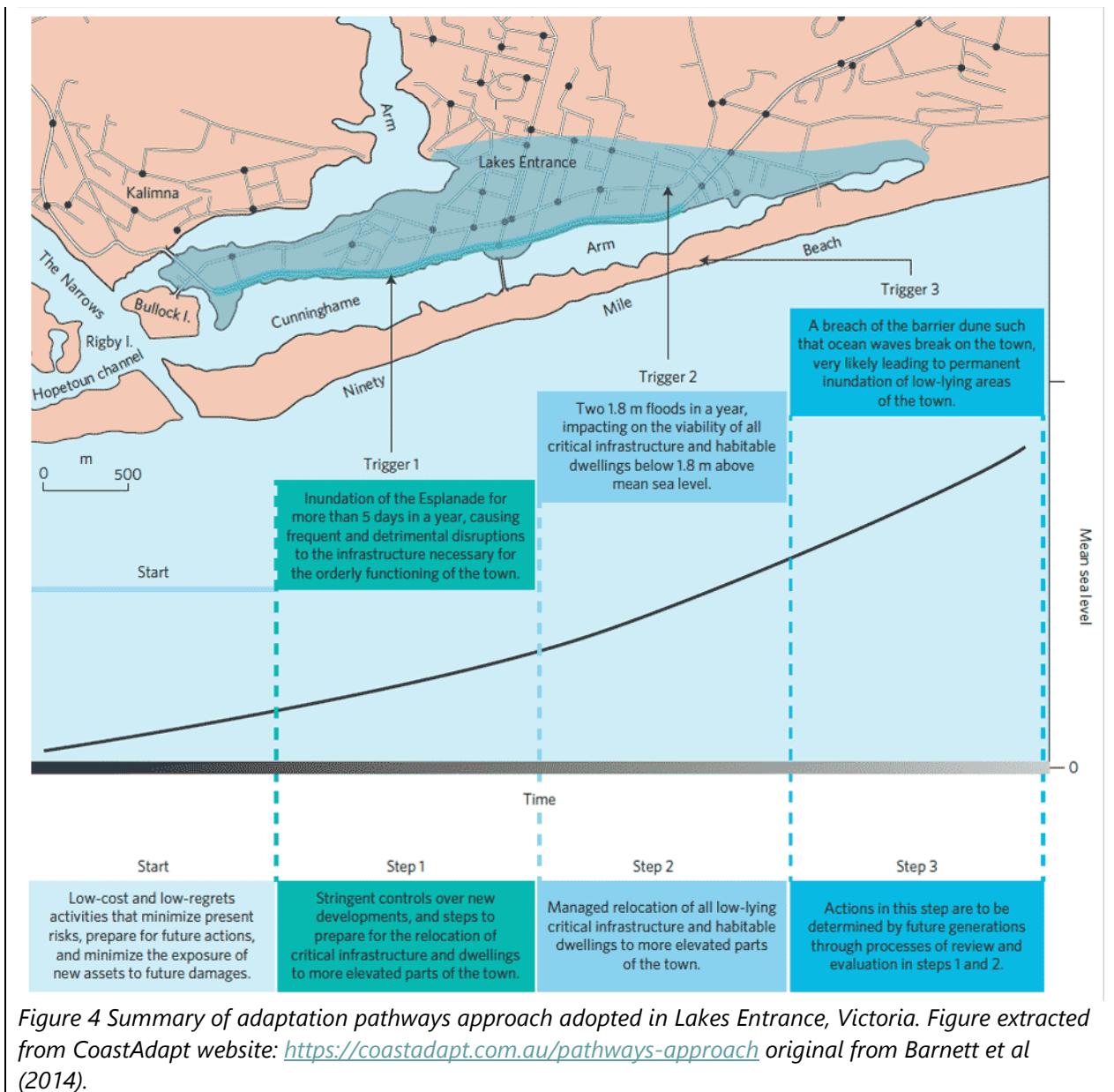


Figure 4 Summary of adaptation pathways approach adopted in Lakes Entrance, Victoria. Figure extracted from CoastAdapt website: <https://coastadapt.com.au/pathways-approach> original from Barnett et al (2014).

### Adaptation thresholds, acceptable risk and limits to adaptation

Another way of contemplating an adaptation threshold is to frame the observation or decision in terms of risk tolerability. For human society, a risk is largely a social construct driven by natural hazards [14-16] determining STATs requires social and political judgments to be made regarding acceptable, tolerable and intolerable levels of risk in each circumstance. As each adaptation response involves some degree of residual risk<sup>5</sup>

<sup>5</sup> The risk that remains (and may continue to change unmanaged) after risk management measures and adaptation policies have been put in place (National Climate Change Risk Assessment: Method Report, 2020).

(i.e. the risk that remains after the adaptation response is in place), then this risk is either tolerated or accepted by the local community.

To provide a local example, in Westshore (Hawkes Bay) this might mean (for example) that every now and then a larger than anticipated storm will come along and overcome the protection afforded by the renourished beach in the short-term. This is because there is typically no 100% guarantee of success provided by any particular adaptation response. Therefore another way to frame the question for identifying the adaptation thresholds is to ask “*what level of risk would you consider to be intolerable?*”. These can be very personal, subjective and qualitative assessments that will differ person to person, place to place, and over time.

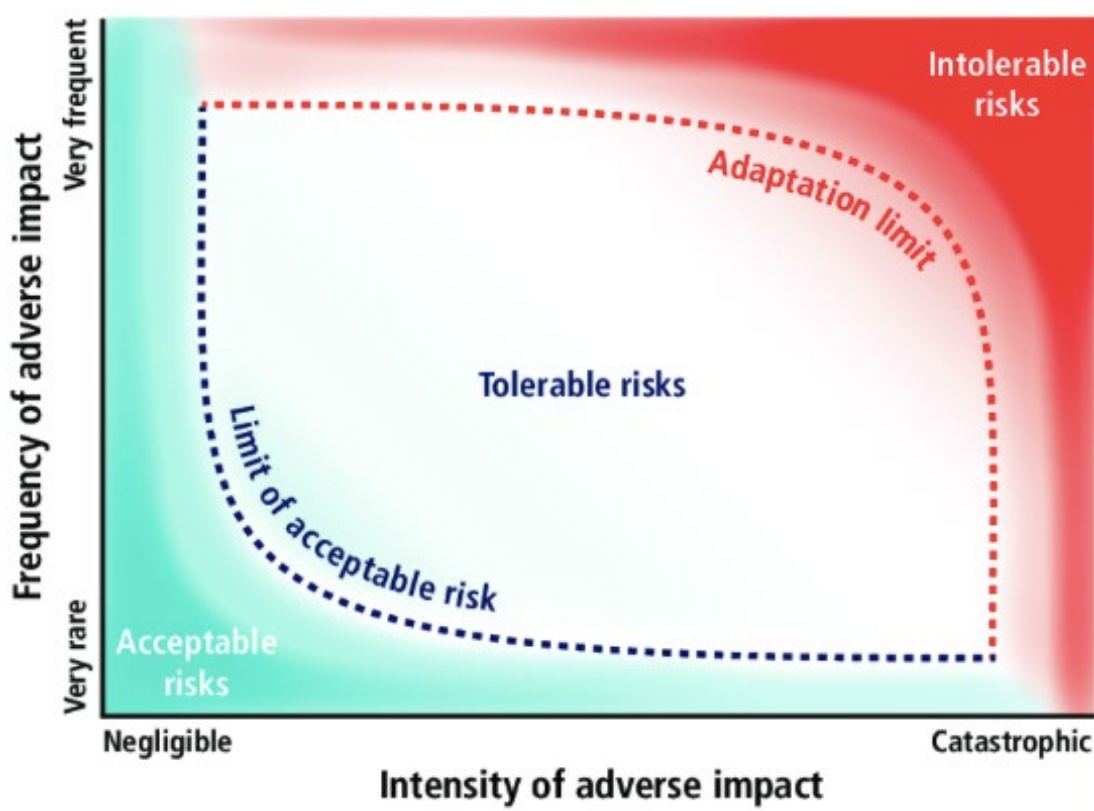


Figure 5 Conceptual model of the determinants of acceptable, tolerable, and intolerable risks and their implications for limits to adaptation [17-19]. In this conceptual diagram, adaptation efforts are seen as keeping risks to objectives within the tolerable risk space. The dotted lines indicate that individual or collective views on risk tolerance with respect to the frequency and intensity of climate-related risks are not fixed but may vary and change over time. In addition, the shape or angle of the lines and the relative area in each section of the diagram are illustrative and may themselves change as capacities and attitudes change.

Community perceptions of risk tolerability can be a very useful way of determining practical, useable ATs. However, there are also quantitative ways of determining when ATs have been reached that can complement and support community driven ATs. Technical, quantitative work could include identified levels of service, engineering design

or building standards and or consented performance standards, monitoring requirements or consent lapse/expiry dates.

Notably in Figure 5 above, the idea of 'limits to adaptation' are introduced. These can be defined as "*when adaptation efforts are unable to provide an acceptable level of security from risks to the existing objectives and values and prevent the loss of the key attributes, components or services of ecosystems*" [20]. There is large diversity in this literature and 'limits to adaptation' have also been described as "thresholds", "regime shifts", "tipping points", "dangerous climate change", "reasons for concern", "planetary boundaries" etc. They can also be described as being *hard* i.e. limits that will not change, or *soft* i.e. limits that can change depending on preferences and time.

### ***BOX 2: PETONE, WELLINGTON (NZ)***

Kool et al [21] applied the DAPP approach to stormwater and wastewater infrastructure in Petone, Wellington. The case study was chosen due to the criticality of infrastructure serving communities who may also be exposed to rising sea levels and changing coastal hazards, but also due to the fundamental problem of gravity-reliant systems (mostly) needing to rely on sufficient space to discharge at the ocean – space that will only be reducing as seas rise and begin to block discharge outlets.

For this study, ATs were identified by a combination of modelling and expert elicitation, and limited to the identification of physical consequence parameters such as regular ponding or overflows (stormwater and wastewater) delineated by sea level rise (SLR) increments e.g. 0.3m, 0.5m, 0.8m above current (see Figure 6).

It is notable that ATs were defined without community input, instead using a proxy of "unacceptable" Level of Service as defined by projected asset/system failure conditions. Due to the complex system nature of the stormwater and wastewater network, Kool et al [21] identified that a number of different adaptation responses that would be required at different times (largely dependent on SLR projections and elevation) and for different geographical areas. Interestingly, rules and policies in land use plans and strategies were also identified as potential signals for eventual retreat. It is also worth noting that the sensitivity of the systems was only investigated with regard to changing sea level conditions, and not changing land use patterns over the next 100 years – a much more

volatile set of scenarios, but something that is now possible to investigate using tools such as RiskScape.

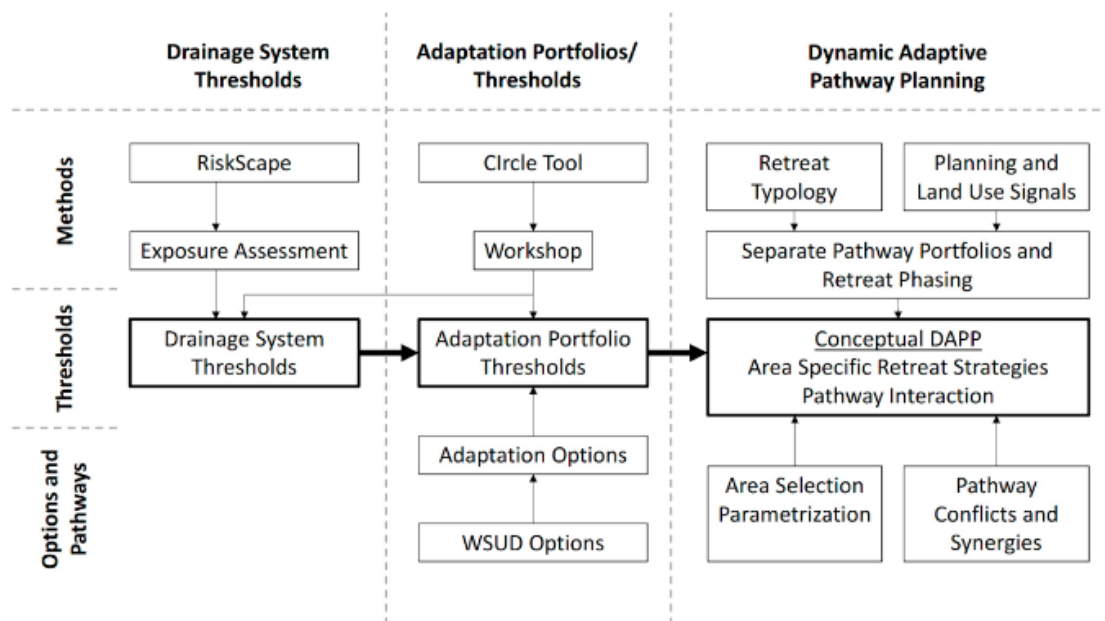


Figure 6 Method for applying a DAPP approach to stormwater and wastewater systems

Involving the community in investigating the adaptation threshold conditions (e.g. asking what is an unacceptable disruption to the function performed by stormwater and wastewater networks?) would have allowed a more nuanced and ground-truthed approach to decision-making that would likely engender greater support.

## 2.2 Monitoring using Indicators (Signals and Triggers)

Indicators are metrics or descriptors that are used to monitor change. In that sense, triggers and signals represent points in time somewhere along that continuum of change that are identified, described and selected by the relevant community. Therefore, in this report signals and triggers form a subset of indicators.

Stephens et al (2018) noted that identifying, evaluating and using indicators to develop STATs for climate adaptation is a relatively unexplored area in the scientific literature. Monitoring for signals and triggers is also more commonly used in other domains; such as ecological management, infrastructure planning [22] and transport policy, and water management [23]; and in other countries. It has also been used in coastal locations in Australia (see work in Lakes Entrance, Victoria [9, 10] and Cockburn, Western Australia

[8]), and is increasingly being applied in coastal guidelines for sea level rise across Australian jurisdictions [24].

## *TRIGGERS AND SIGNALS*

In 2014, the use of triggers and adaptive pathways was an emerging field for coastal management and adaptation [23]. Designed to help deal with uncertainty and the identification of risk tolerability thresholds and key decision points (or triggers), they seek to recognise and account for dynamics in a changing environment and a changing socio-economic and cultural context, and therefore a changing risk profile [5].

Signals are intended to function as an 'early warning' notice that if things carry on as is, agreed community objectives and standards may be breached, signalling that planning, scoping and engagement should begin for the next set of possible pathways.

Ideally, well designed signals and triggers provide decision-makers advance notice allowing preventative actions to be undertaken thereby avoiding frequent damaging impacts that may be considered intolerable by the community. Critically, they help reduce uncertainty and make tangible the effects of climate change by using events rather than time horizons as decision points (CoastAdapt, 2021).

The idea of proactive decision-making is not new, but its practice could always be better. The author has observed and noted in numerous jurisdictions that decision-making is much more expedient in times of emergency, with big coastal storms often acting to create political impetus and triggering reactive decisions. It's this sort of reactive management that has blighted many parts of New Zealand's coastline for as long as humans have attempted to intervene in coastal processes. Wainui Beach is one such example.

### *BOX 3: WAINUI BEACH, GISBORNE (NZ)*

The *Wainui Beach Erosion Management Strategy 2014* (WBEMS) identifies 'trigger points' to mark consideration or implementation of a change or continuation of management approach, in either the medium term (20-30 years) or the longer term (next 100 years).

Table 1 Identified triggers for each Management Area contained within the Wainui Bech Erosion Management Strategy 2014.

| Management Area                            | Trigger  |
|--|--|
| 1 - <del>Tuahine</del> Point               | Any future proposal for a dwelling or residential development on the seaward side of the ridgelines should trigger consideration of landslide hazard and appropriate action to mitigate this risk (e.g. consideration of change from pastoral to forested land uses).  |
| 2 - <del>Tuahine</del> Crescent            | The trigger for considering alternative treatments such as relocation/removal is linked to expiry of resource consents for existing structures in this section [assumed 2042].   |
| 3 - Murphy Road South                      | In view of the fact that some houses are relatively close to the shoreline, consider appropriate action (e.g. reinstatement of the bluff face using a beach push-up or relocation/removal of the asset) if the top landward edge of any new erosion scarp extends to within 8m of a dwelling.  |
| 4 - Wainui Stream                          | Landward replacement of existing coastal protection structures if severe damage precludes ongoing maintenance and/or that adverse environmental effects (e.g. beach narrowing) become sufficiently serious.<br><br>If the top landward edge of the erosion scarp lies within 8m of a dwelling after a major erosion <u>event</u> then appropriate action should be considered. |
| 5 - Pare Street and <del>Wairoa</del> Road | The 8m setback from the crest of the erosion scarp is required to trigger consideration of appropriate treatments will be required. The most appropriate action will generally be either reinstatement of the eroded dune using sand push-ups or landward relocation of the dwellings on the property.   |
| 6 - <del>Hamangatus</del> Stream           | The 8m setback from the crest of the erosion scarp is required to trigger consideration of appropriate treatments will be required. The most appropriate action will generally be reinstatement of dune using push-ups or landward relocation of surf club   |
| 7 - Northern Wainui Beach                  | Reconfigure car parks if the seaward edge is threatened by future coastal erosion. Consider undertaking this work where the seaward edges of car parks are within 10m of the top landward edge of historic erosion scarps.   |
| 8 - <del>Makorori</del> Point              | None   |

The triggers identified above all relate to the distance of an erosion scarp from an element identified as being at risk e.g. a car park, home etc. In the case of Management Areas 3-6 they appear to have been designed regarding Earthquake Commission (EQC) coverage limitations and to provide sufficient space to relocate a dwelling after a major erosion event.

The WBEMS was forward-thinking and sought to include triggers as a means of creating an adaptive management approach<sup>1</sup>. However, FitzGerald and Hume [25] concluded that their usefulness was hampered in a number of ways: the indicators and signals leading up to the triggers were not identified, tolerability thresholds were not specifically detailed, and potential actions at each trigger point were not set out and stress tested, effectively rendering the triggers redundant.

The lack of effort to track performance of coastal management or adaptation strategies is not unique to Wainui Beach. Many other jurisdictions have gone down the same path and invested heavily in the development of a Plan only to neglect its implementation – a kind of ‘adaptive management lite’ (Frohlich et al, 2019). There can be a multitude of reasons for this: a lack of funding or resourcing to advance specific actions, legal, political or policy barriers, reprioritisation of activities and budgets, changing roles and responsibilities of Council staff, lack of a ‘champion’ to advocate for the Strategy, changing community perspectives etc. There are significant opportunities in this space to improve tracking and reporting, but also to engage people, educate people and encourage local stewardship/kaitiakitanga through citizen science initiatives like CoastSnap (see [www.coastsnap.com](http://www.coastsnap.com)).

#### ***BOX 4: COCKBURN, WESTERN AUSTRALIA (AU)***

Grace and Thompson [26] highlight a flexible adaptation pathway approach undertaken for the Cockburn Sound Coastal Alliance (CSCA) south of Perth. As with, NZ’s MfE Guidance (2017) the approach identifies that using ‘likelihood’ measures associated with sea level rise will increasingly tend toward certainty, or inevitability. Thus using likelihood descriptors (like 1 in 100 yr flood) is not that helpful in conveying the real long-term risk.

They used a series of spatially explicit coastal setback lines (for erosion and inundation) derived from State Coastal Planning Policy that acted as proxies for levels of risk (see Figure 7 and Table 2 below). For erosion, setbacks are based on (1) current risk of storm erosion e.g. 1% AEP (2) historic shoreline movement trends (3) future sea level rise; for storm surge inundation a 0.2% AEP level is used. Those lines were then translated into risk contours on maps using different time periods and sea level rise scenarios i.e. erosion risk over 100 years would be identified as Y100, over 50 years as Y50 etc., and ultimately applying different planning rules.

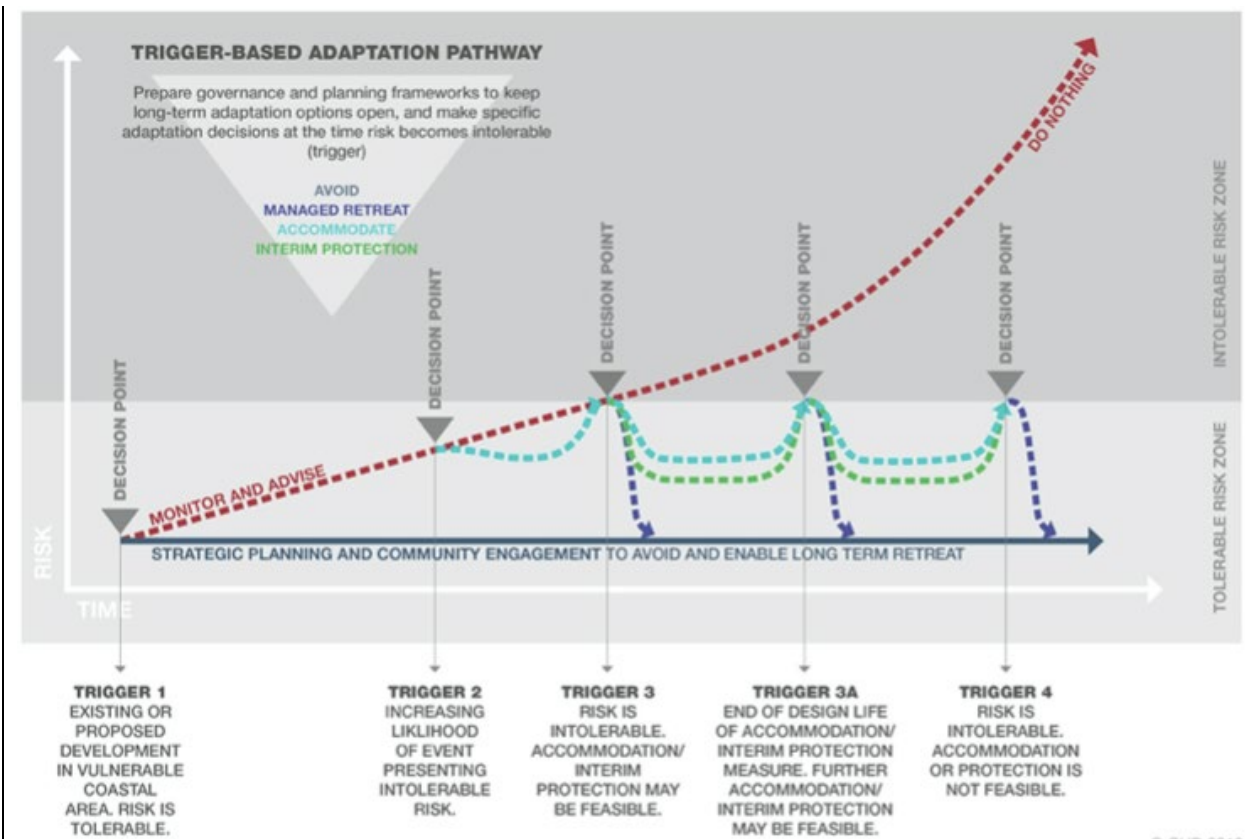


Figure 7 Example of a trigger based long-term adaptive pathway used for coastal planning in Cockburn Sound, Western Australia.

This approach represents incorporates adaptive planning explicitly into spatial and strategic planning – effectively with different coastal hazard zones acting as signals, triggers and adaptation thresholds for the use of different rules and assessment criteria. It relies on community engagement under the relevant planning system and operates on a presumption that the lines demarcating coastal hazard zones will change over time.

Table 2 Triggers, risk levels and actions identified in Cockburn Sound adaptive pathways approach.

| TRIGGER   | RISK LEVEL                                      | LOCATION OF MOST SEAWARD ASSET/VALUE AT RISK | ACTION   |
|---|---|--|--|
| 1 – assets or values in coastal zone reach high risk level                                | Tolerable                                       | Between Y100 and Y50                         | <ul style="list-style-type: none"> <li>• Avoid through strategic planning measures</li> <li>• Ongoing monitoring</li> </ul>  |
| 2 – assets or values in coastal zone will reach extreme risk level during planning period | Increasing likelihood of Intolerable            | Between Y50 and Y15                          | <ul style="list-style-type: none"> <li>• Accommodate through asset or area specific measures.</li> <li>• Ongoing monitoring</li> </ul>   |
| 3 – assets or values in coastal zone reach extreme risk level                             | Intolerable. Interim protection may be feasible | Seaward of Y15                               | <ul style="list-style-type: none"> <li>• Evaluate whether Interim Protection is justifiable on social, environmental, and economic grounds.</li> <li>• Where interim protection is justifiable, determine the nature of the works based on social, environmental and economic grounds.</li> <li>• Where interim protection is not justifiable, Retreat.</li> </ul> |
| 4 – assets or values in coastal zone continue at extreme risk level                       | Intolerable. Protection is not feasible.        | Seaward of Y15                               | Actively plan for retreat in a coordinated manner  |

In New Zealand, summary examples of how triggers are used under the *Resource Management Act 1991* are also provided in Appendix 1 of Lawrence et al (2020). In summary, the mandate for monitoring of the environment, natural hazards and climate change which includes the *RMA*, *Local Government Act 2002* and *Civil Defence and Emergency Management Act 2002*. However, the newly amended *Climate Change Response Act 2002* has not been included and sets out the national level risk and adaptation monitoring and reporting requirements, including their application to local government:

## 5ZW Minister or Commission may request certain organisations to provide information on climate change adaptation

- (1) The Minister or the Commission may, in writing, request that a reporting organisation provide all or any of the following information:
- a description of the organisation's governance in relation to the risks of, and opportunities arising from, climate change;
  - a description of the actual and potential effects of the risks and opportunities on the organisation's business, strategy, and financial planning;
  - a description of the processes that the organisation uses to identify, assess, and manage the risks;
  - a description of the metrics and targets used to assess and manage the risks and opportunities, including, if relevant, time frames and progress;
  - any matters specified in regulations.

Lawrence et al (2020) provide a useful list of potential triggers across different domains that could be explored in the Hawkes Bay context. These are provided in Figure 8 below:

| Precursors   | Hazards   | Risk  | Social/psychological  | Financial/economic  | Cultural   | Environmental   | Governance/institutional  |
|--|---|---|---|---|--|---|---|
| Average New Zealand 7-station air temperature reaches X degree C                                     | Riverbank erodes to within X m of house(s), levee, or other infrastructure                            | Event causing >\$XM damage (or insured losses)  | Measure of concern/anxiety or wellbeing   | Insurance withdrawn or no new build insurance for a section of a community      | Taonga or sites (e.g., urupa) begin to be inundated or are regularly inundated | X% loss of wetlands/marshes/bird numbers/riparian habitat | Regional or district plan controls for further development      |
| Mean annual precipitation across the region or catchment reaches X mm/yr                             | When X flood events, exceeding Z% AEP or Y m <sup>3</sup> /s (historical), occur in a 10-year period. | Levels of service for a utility or infrastructure dip below a minimum agreed level (or for X times)               | Health indicator arising from dampness, e.g., number of child hospital admissions for respiratory illnesses                                       | Premium excesses >\$X   | Disruption of cultural events (incl. tangi, hui, celebrations)                 |   | Reduction in LoS, e.g., flood control, wastewater, water supply |
| Peak storm intensities or durations reach X mm/hr or mm/storm, both annually and during flood season | After X events flood an important road (or access road) preventing vehicle access (or worse)          | Greater than X% of a defined area or town flooded or X times main access to a suburb closed for more than X hours |   | Bank mortgages difficult to secure  | Access to mahinga kai limited or lost  | Sediment supply for gravel extraction is depleted         | Central control taken by national level government              |
| Mean soil moisture levels during the flood season rise to X% of field capacity                       |   | Stopbanks damaged or breached X times   | Aesthetic, e.g., river views – once protection works reach X m high   | Small business, services and agriculture disrupted X times or for Y days/year   |  | % loss of riverbank area for recreation                   | Room made for river   |
| Mean annual hurricane intensity (Pacific Ocean; Southern Hemisphere) reaches X                       | The 20-year Mean Annual Flood reaches X m <sup>3</sup> /s   | The next catastrophic flood (define risk/impact, extent)  | Tolerance measure, e.g., sense of community is threatened; people start moving out or cannot move because cannot afford to (resale value too low) | Maintenance costs exceed \$X pa for protection works                            |  |   | A managed retreat strategy begins                               |
| Mean precipitation over the flood season reaches X mm  | Maximum flood extent reaches an agreed extent   | A critical or significant facility is threatened, e.g., school, hall, fire station, rest home                     | Coping capacity measure   | Council withdraws maintenance funding for access road when unsustainable at \$X |  |   | Central government roading support withdrawn                    |
| Global air temperature reaches X degrees C   | After X floods overtop flood protection or land use assets  |   | Specific societal objective is no longer met  | Median property valuations dip below \$X  |  |   | Central government adaptation law changes                       |
| Global CO <sub>2</sub> concentration reaches X ppm   | When sediment damage to water intakes exceed \$X or becomes uneconomic to maintain                    |   | Resident population of an area drops below X  | Sediment deposited from flood flows exceeds \$X clean-up                        |  |   |   |

Figure 8 Selection of possible triggers for use in the NZ DAPP context. Source: Lawrence et al (2020).

While useful as a ready guide at the outset of any STAT development process, a scan of the table of coastal triggers identified above reveals a slant towards domains that are

not well established, not explicit and not necessarily considered by many regional and/or district councils. For example, the *Hawkes Bay Science Strategy 2020-2025* explicitly identifies a lack of expertise and capacity in social science, economics, knowledge translation and science communication. Many of the triggers identified above would require bespoke Monitoring, Evaluation and Reporting plans to be drawn up, whether or not they were able to take advantage of existing data being collected.

An additional type of trigger not identified in the table above relates to how coastal adaptation can (or in most cases doesn't) link to emergency management. Involving emergency managers as key stakeholders in the development of appropriate STATs is critical. This would help make explicit the link between the 4 R's of emergency management (reduce Risk, Readiness, Response and Recovery) and longer-term adaptation actions. An example of an indicator of relevance to coastal hazards might be the number of activations of the Civil Defence Emergency Management coordination centre, or the number of warnings sent out over a particular time period.

Perhaps unsurprisingly, tracking adaptation progress is a relatively immature field globally [4]. However Monitoring, Evaluation and Reporting (MER) frameworks are not. Councils and agencies have a multitude of functions currently that require them to track progress, sometimes those functions are explicit (e.g. State of Environment reporting), other times they are explicit but not necessarily reported in a coordinated, strategic way for a purpose beyond compliance (e.g. consent reporting) or forward programming (e.g. asset levels of service). Using a 'lived values' approach with community panels will help draw out implicit measures of what needs to be avoided, what are the unacceptable or intolerable risks? Those discussions will help frame objectives, identify adaptation thresholds and generate metrics that can be tracked over time. This will facilitate ongoing learning and adaptation as the world we live in changes.

The *Clifton to Tangoio Coastal Hazards Management Strategy 2120* therefore provides an opportunity to develop an integrated, forward looking Monitoring, Evaluation, Reporting and Learning (MERL) framework that can be used to track adaptation progress against.

## 3 Adaptive pathways for the Hawkes Bay coast

### 3.1 Strategy Development

The *Clifton to Tangoio Coastal Hazard Strategy 2120* (the Strategy) represents a coordinated approach to identifying and responding to coastal hazards, risks and vulnerabilities taking account of the influence of climate change and sea level rise over at least the next 100 years. It was the first Strategy in New Zealand to try and 'operationalise' the MfE Guidance.

The Strategy has been developed through a Joint Committee formed by representatives from the Hawke's Bay Regional Council, the Napier City Council, and the Hastings District Council alongside representatives of the Maungaharuru-Tangitū Trust, Mana Ahuriri Trust and Heretaunga Tamatea Settlement Trust.

The Strategy covers the area between Clifton to Tangoio on the Hawke Bay coast (see Figure 9 below), looks out to a planning horizon of at least the next 100 years<sup>6</sup>, assesses the risks posed by coastal erosion and coastal inundation, and adds climate change as a key driver for changing risk. The vision of the Strategy is "*that coastal communities, businesses and critical infrastructure from Tangoio to Clifton are resilient to the effects of coastal hazards*".

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<sup>6</sup> As required by the New Zealand Coastal Policy Statement 2010.

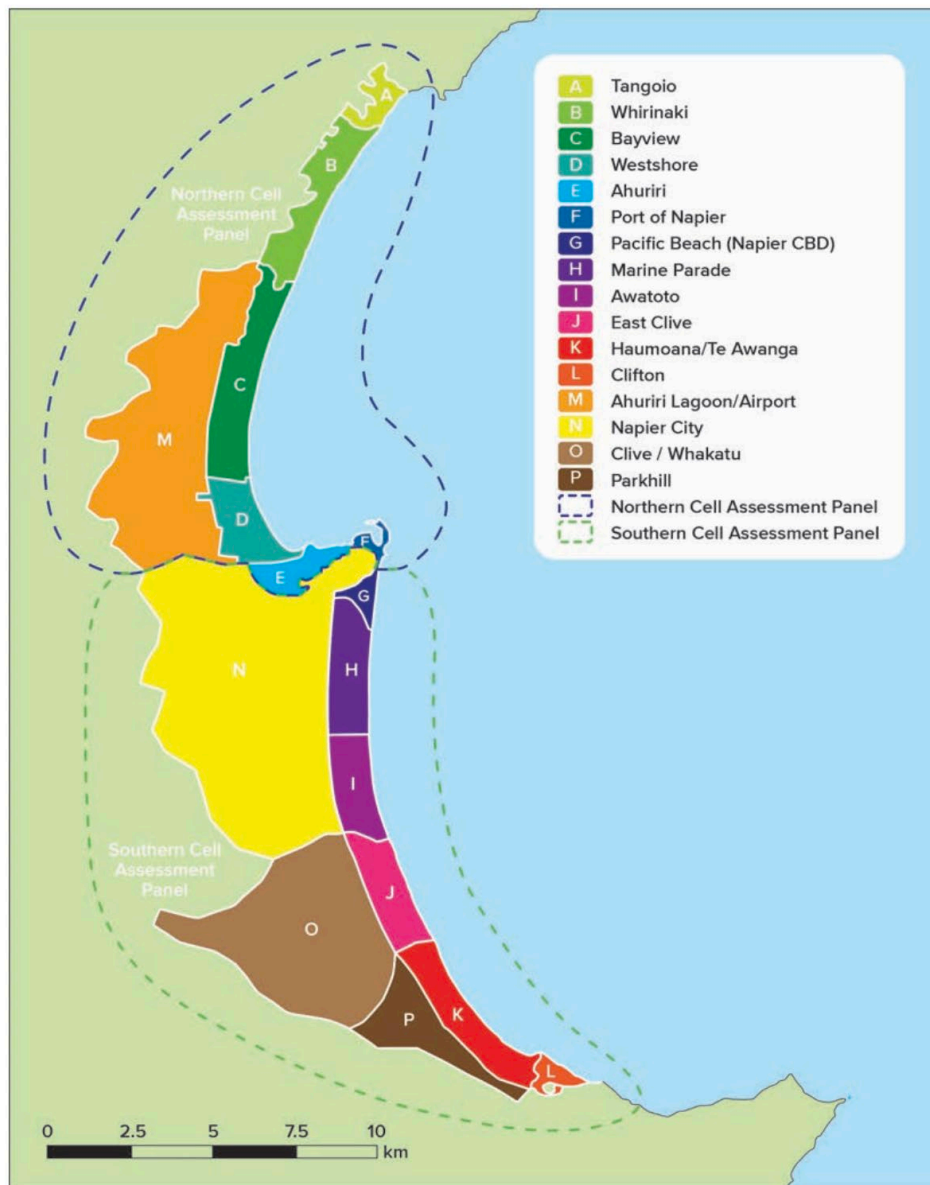


Figure 9 16 coastal units across two cells - Northern and Southern define the spatial extent of the Clifton to Tangoio Coastal Hazard Strategy 2120.

Initially 16 coastal units were identified across two cells (Northern and Southern – see Figure 9), however this was reduced to 9 priority units based on a vulnerability assessment undertaken in Workshop 4 [27]. Using a sequence of workshops with a Northern Assessment Panel and a Southern Assessment Panel, adaptive pathways were developed using nominal timeframes of short (0-20 years), medium (20-50 years) and long-term (50-100 years) [27] for each of the priority units. This represented a simplified process that did not yet answer the key question promoted in the DAPP approach of “under what conditions will the relevant adaptation response fail?”. As discussed previously, adaptive pathways seek to identify how sensitive adaptation responses are

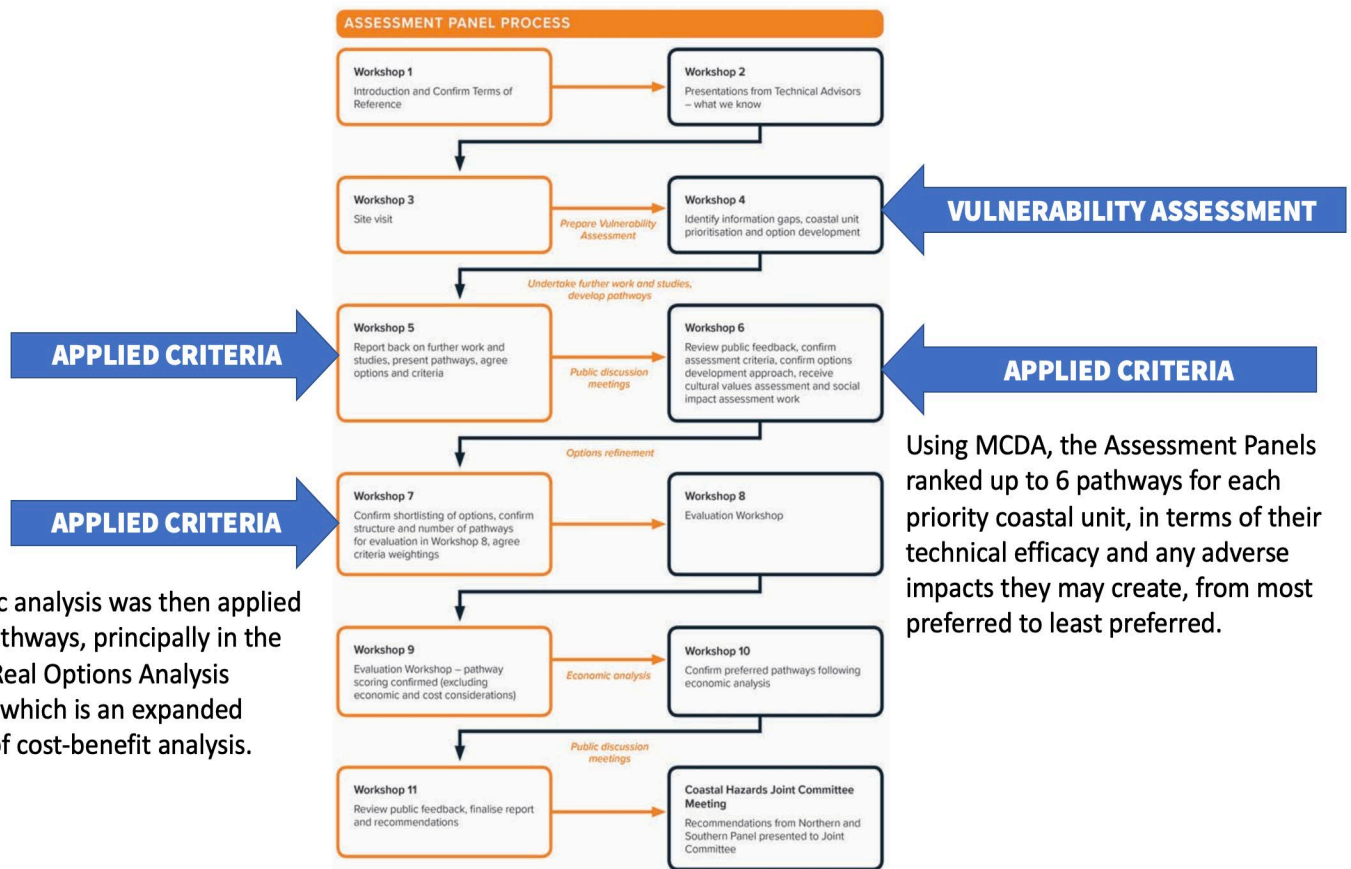
to a changing climate or socio-ecological system, rather than adopting nominal timeframes that may imply a guaranteed efficacy [28].

## 3.2 Approach taken to date and assumptions made

Throughout the Strategy development process a number of layers of decision-making were employed that implicitly or explicitly acted (through application of criteria) to filter and prioritise action – across and within units. For example, when undertaking the vulnerability assessment practitioners made expert judgements about the vulnerability of particular units – this resulted in identification of 9 priority units, with the default residual action for other units being to ‘review in 10 years or earlier if trigger is reached’. This 10-year timeframe in effect acts as an early warning signal for units that have not been prioritised at this stage of Strategy development <sup>7</sup>.

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<sup>7</sup> Note that Port of Napier (F) was excluded as it is entirely privately owned land.



Economic analysis was then applied to the pathways, principally in the form of Real Options Analysis (“ROA”), which is an expanded version of cost-benefit analysis.

Using MCDA, the Assessment Panels ranked up to 6 pathways for each priority coastal unit, in terms of their technical efficacy and any adverse impacts they may create, from most preferred to least preferred.

Figure 10 Sequence of 11 workshops undertaken by both the Northern and Southern Assessment Panels to derive the adaptive pathways for each of the 16 coastal units in the Clifton to Tangoio Coastal Hazards Strategy 2120. Blue arrows note activities that applied some form of decision-making criteria

The application of the Multi Criteria Decision Analysis and Real Options Assessment tools at Workshops 6 and 7 (see Figure 10 above) used social, cultural, environmental and economic reports to assess the performance of adaptation responses. This expert-led, technocentric approach in some ways acted as a kind of proxy for the ‘lived values’ approach as described by Barnett et al (2014) in the Lakes Entrance case study.

However, it may be also be useful to match community identified adaptation thresholds with explicitly defined community objectives set for each unit. At this stage this would include a specific consideration of the question “What is it that we wish to avoid?”. This would also include, for example, delineation and community agreement about the point in time at which the initial preferred adaptation response would need to be transitioned/swapped for the secondary adaptation response. These decisions would be based on the performance of the initial adaptation response, recognising that the fundamental premise of DAPP is that initial adaptation responses/decisions have a shelf life (see [29] and [5]).

The following diagram summarises all preferred adaptive pathways for each priority unit in the Strategy:

| Unit                  | Short-term<br>(0-20 years) |   | Medium Term<br>(20-50 years)       |   | Long Term<br>(50-100 years)        |
|-----------------------|----------------------------|---|------------------------------------|---|------------------------------------|
| <b>Northern Panel</b> |                            |   |                                    |   |                                    |
| Ahuriri               | Status quo                 | + | Sea wall                           | + | Sea wall                           |
| Pandora               | Inundation Protection      | + | Inundation Protection              | + | Inundation Protection              |
| Westshore             | Renourishment              | + | Renourishment + Control Structures | + | Renourishment + Control Structures |
| Bay View              | Status Quo / Renourishment | + | Renourishment + Control Structures | + | Renourishment + Control Structures |
| Whirinaki             | Status Quo / Renourishment | + | Renourishment + Control Structures | + | Sea wall                           |
| <b>Southern Panel</b> |                            |   |                                    |   |                                    |
| Clifton               | Sea wall                   | + | Sea wall                           | + | Managed Retreat                    |
| Te Awanga             | Renourishment + Groynes    | + | Renourishment + Groynes            | + | Renourishment + Groynes            |
| Haumoana              | Renourishment + Groynes    | + | Renourishment + Groynes            | + | Managed Retreat                    |
| Clive / East Clive    | Status Quo                 | + | Renourishment + Groynes            | + | Retreat the Line / Managed Retreat |

Figure 11 All adopted pathways for each priority unit under the Clifton to Tangoio Coastal Hazard Strategy 2120.

Having gone through the sequence of workshops to develop the adaptation pathways above, community panels have identified a single pathway for each unit. Each of those pathways relies on a number of assumptions and implicit choices made throughout the development process.

EXAMPLE: Unit D - Westshore

How assumptions have been embedded in the process and outputs to date can be illustrated using Unit D – Westshore as an example (see Figure 12 below). The arrows identify the point in time at which a change of adaptation response was deemed necessary. But the key question to ask is, *how will we know when the short-term adaptation response (renourishment) is no longer meeting the objectives of the Unit (and therefore the community)?*

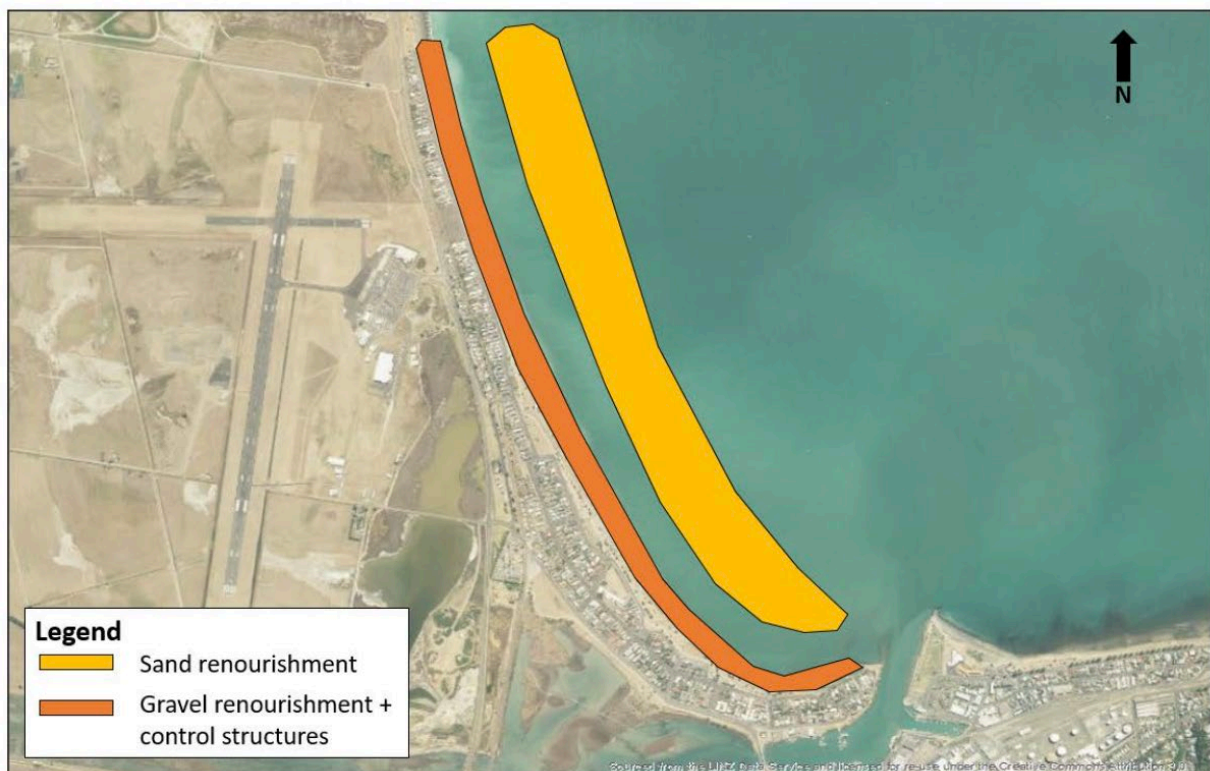
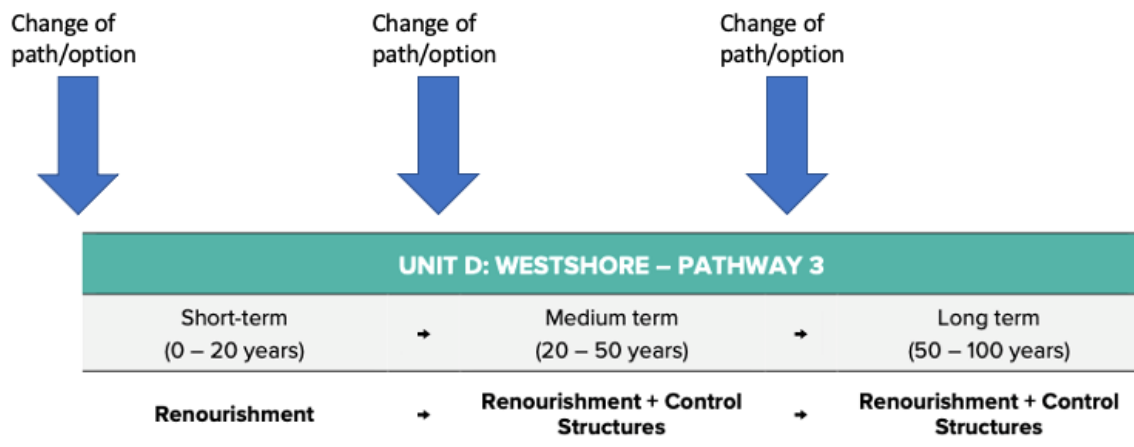


Figure 12 Map of area (LOWER) and preferred adaptive pathways (UPPER) developed for Unit D – Westshore in the Northern Assessment Panel area. The arrows show a point in time at which a change of pathway (or a different adaptation response) is necessary.

While not necessarily intended - the diagram as it stands implies that we already know that after 20 years we will need to swap from the preferred short-term adaptation response (nourishment) to the medium-term adaptation response (nourishment and control structures) to a satisfactory level. Built into this nominal change set to occur 20 years from now is the implicit assumption that nourishment will no longer be effective on its own to meet the objectives for Unit D – Westshore, and that the addition of control structures will be required to continue to meet the objectives of the area. Furthermore, there is also a position taken that the current (Year 0) nourishment activities on Westshore are inadequate (e.g. those already being undertaken and consented to) and need to be scaled up significantly<sup>8</sup> to see out the next 20 years [30].

Technical investigations for consentability for Westshore [30] confirm the requirement for immediate action noting that the current resource consent for nourishment of the beach contains insufficient allowance and inadequate guarantee to implement the short-term adaptation response. The consent also expires in 2027 so there is already a need to get a replacement consent in train in order to transition from the status quo situation [30]. Other assumptions and conceptual standpoints are also made in that report about design aspects for the purposes of assessing consentability, such as the necessary width and height of the gravel barrier to meet an assumed objective. A key criterion is to ensure sufficient space between the ocean and property/assets is available to construct the barrier, noting that approximately 5m of space is required between the landward edge of the gravel barrier and the property boundary. This is more important in the northern part of this Unit where property boundaries and the road are closer to mean high water and the beach.

### 3.3 Previous workshops on STATs in the Hawkes Bay

Previous research on STATs has already been undertaken in Hawkes Bay as part of the *Clifton to Tangoio Coastal Hazard Strategy 2120* (the Strategy), by researchers acting as 'Critical Friends' to the process [5]. A series of three workshops was held with community

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<sup>8</sup> From currently allowed 50,000m<sup>3</sup> per year to 850,000m<sup>3</sup> in the first year followed by 100,000m<sup>3</sup> per year thereafter.

members, technical staff and experts and others involved in the process. Participants were organised into groups of 4-5 people supported by a council officer and a researcher and large blank sheets and pre-prepared cards with examples of signals, triggers, and thresholds were provided. However it is unclear what the outputs of those workshops were, and if any records exist or are publicly available.

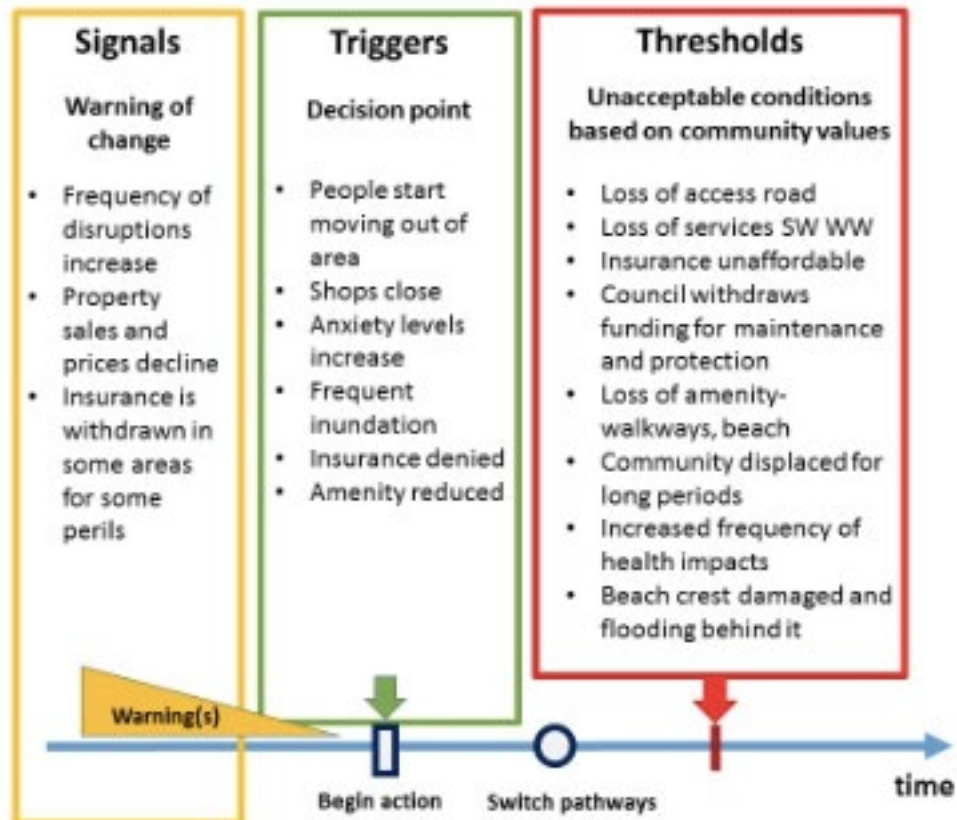


Figure 13 Example of workshop materials from previous Hawkes Bay workshops.

The workshop process began by asking participants the following questions:

1. What do you not want to experience and why?
2. What would trigger a decision to change pathway?
3. What would give you a warning that a trigger is approaching?

The above process enabled elicitation of community values that were key drivers of decision-making. In effect, asking people what sort of conditions or experience they wanted to avoid led to a fruitful discussion and refinement of objectives and risk tolerability (Lawrence et al, 2020). For example, outputs of the three workshops in the Hawkes Bay included an identification of road access as being an important consideration:

*“In Hawke’s Bay...road access was identified by the three groups as being a ‘robust’ signal across a number of scenarios. Reduced access – due to more frequent flooding or increased erosion – was a strong environmental signal that the effects of climate change were accelerating and impacting local communities; however, it was also a strong social and economic signal. Reduced road access might prevent people from getting to/from employment, for example. Regular disruption, in turn, was a warning of an impending threshold: complete loss of road access. By monitoring the signals, actions could be taken in advance (initiated at the pre-determined trigger) to limit further development and explore mitigation solutions. Furthermore, the signal was easily understood and directly relevant to local concerns because road access would also have effects on tourism and livelihoods.”*

- Lawrence et al, 2020 p.51

The results of these workshops should be used as a starting point for the next iteration of community engagement on STATs.

## 4 Conclusions and Recommendations

This review has highlighted the current state of experience of adaptive planning approaches and employment of STAT-based methods across a number of locations. It has also looked at the DAPP process undertaken to date in the Hawkes Bay and the implicit considerations therein. While not definitive, nor exhaustive, the review can be used to help inform the next stage of the process in the Hawkes Bay and found an adaptive planning strategy on useful, measurable metrics that will enable better decision-making. Tracking adaptation progress is an emerging field and so there exists opportunities for Strategy partners to innovate and lead.

Adaptive planning strategies like the *Hawkes Bay Coastal Hazard Strategy 2120* only represent a snapshot in time and must be iterative, and funded and resourced to be reviewed, evaluated, reported on and updated over time.

A number of recommendations have emerged from the literature reviewed and the author's own observations and experience.

### 4.1 Gap analysis: What STAT information exists already?

Councils should undertake an analysis of current monitoring, evaluation and reporting activities. This should not only be restricted to the environmental domain, but instead cover social, cultural, economic and governance domains. It should be noted that it is entirely possible that community panels may devise new metrics that are more suitable to act as STATs for their local coastal environment. These metrics may reflect the particular objectives of each area.

It is suggested that organisations party to the development of the Strategy undertake a review of relevant data sets, and identify existing information that may be relevant to the adaptation pathways chosen for each unit, and the Strategy in general. Data sets provided in Figure 8 may provide a useful starting point.

### 4.2 Community-driven STATs

A key recommendation from this literature review is to ensure that the deliberative process with community panels explicitly ties a community's 'lived values' [11-13] with

the technical work to identify and monitor STATs. Those lived values may be expressed in a number of different ways that the facilitators, recorders and decision-makers must pay close to attention to, including as objectives or negative outcomes to avoid. The results of the previous workshop should be used as a starting point for any future workshops.

### 4.3 Aligning with existing monitoring and evaluation activities

As referenced in Section 2 and outlined in the MfE Guidance [2] and Lawrence et al [5] monitoring, evaluation, reporting and review is supported by legislative mandate in New Zealand – through the *RMA 1991*, the *Local Government Act 2002*, the *Civil Defence and Emergency Management Act 2002* and at a national level under the *Environmental Reporting Act 2015*. These instruments provide useful context and guidance around designing indicators, undertaking reporting and how it can influence decision-making. As such, it should be noted that monitoring can be undertaken at multiple scales – nationally, regionally or in particular areas as directed by scientific strategies or consent requirements. Where possible monitoring, evaluation and reporting activities should be aligned.

### 4.4 Developing an integrated MERL Framework

A robust, pragmatic and flexible Monitoring, Evaluation, Reporting and Learning (MERL) plan should be developed to support the Strategy and track progress. This plan should be sufficiently resourced and embedded in day-to-day business.

Consideration should be given to developing a broad range of metrics that underpin climate change risk assessments and adaptation plans, and can be translated across other Council, agency or group planning mechanisms. Those metrics may be quantitative or qualitative, noting that indicators can be used to monitor for both signals and triggers. Where possible, they should be integrated with other Council and agency functions.

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## Appendix 2

### Workshop 1 Outcomes

| Coastal Hazard Consequence  |                | Elements at risk  |  |  |   |
|---|----------------|---|--|--|---|
|   |                | Human (Society/ Culture)  | Natural Environment  | Economy  | Built Environment   |
| Road Access   | Community      | <ul style="list-style-type: none"> <li>Essential services e.g. Ambulance can't help, dialysis</li> <li>Some residents can't visit or be visited</li> <li>Food – can't get to Four Square</li> <li>Widespread disruption</li> </ul>  | <ul style="list-style-type: none"> <li>People drive over land and damage natural environment</li> <li>Debris scattered polluting environment</li> </ul>  | <ul style="list-style-type: none"> <li>Disrupted economic flow both inward and outward</li> <li>Businesses suffer</li> <li>Can't get to work</li> </ul>  | <ul style="list-style-type: none"> <li>Infrastructure disrupted</li> <li>Pollution e.g. asbestos</li> </ul>   |
|   | Asset Managers | <ul style="list-style-type: none"> <li>Connectivity and transport links impact on communities</li> <li>Significant. cultural areas</li> </ul>   | <ul style="list-style-type: none"> <li>Kiwi creche at Westshore wildlife domain</li> </ul>   | <ul style="list-style-type: none"> <li>Tourism, access to business, transport, freight / commerce</li> <li>Cost to rebuild</li> <li>Insurability of Council-share of assets</li> </ul>   | <ul style="list-style-type: none"> <li>Cost to rebuild</li> <li>Insurability of Council-share of assets</li> <li>Unable to repair other services due to lack of access</li> </ul> |
| Services disruption (power, telecommunications, water, sewage)        | Community      | <ul style="list-style-type: none"> <li>Isolation, psychology</li> <li>Health and safety</li> <li>Reliance on power for dialysis</li> <li>Water essential/no tank</li> <li>No gas supply</li> <li>No recycling</li> </ul>  | <ul style="list-style-type: none"> <li>Sewage pollution</li> <li>Poisonous debris</li> </ul>   | <ul style="list-style-type: none"> <li>Major economic impacts</li> <li>Restoration costs</li> </ul>  | <ul style="list-style-type: none"> <li>Getting rid of damaged infrastructure</li> <li>Can't get new materials to restore in</li> </ul>  |
|   | Asset Managers | <ul style="list-style-type: none"> <li>Changes to day-to-day behaviours and lifestyles</li> <li>WW failures impact on tikanga values and practices</li> <li>Human health impacts on whanau/marae but also on cultural values of te Taiao more generally</li> <li>Impacts on mahinga kai practices – eg. contaminated shellfish gathering</li> </ul>   | <ul style="list-style-type: none"> <li>Eg. WW failure impacting marine ecosystems if untreated coastal discharges</li> <li>Coastal Birdlife affected by spillages/untreated waste</li> <li>Reduced coastal water quality.</li> <li>Water quality of estuarine environments impacted</li> </ul> | <ul style="list-style-type: none"> <li>Cost of region to replace the capital investment elsewhere/or alternative</li> <li>Communities still require services that key infrastructure provide if that infra is disrupted</li> <li>Interim alternatives ongoing? Sustainability/viability of interim measures e.g. potable water supplies, portaloos etc.</li> </ul> | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>   |
| Community psychology e.g. fear, anger                                 | Community      | <ul style="list-style-type: none"> <li>Community/human stress and consequences on health</li> <li>Insecurity and emotional flow on</li> <li>Risk to family adhesion (e.g. no work, no school)</li> <li>Poor understanding leading to anger</li> <li>Chronic illness – fear of lack of services and treatment</li> <li>Crime risk increases</li> </ul> | <ul style="list-style-type: none"> <li>Tip household waste</li> <li>"Bad" decisions</li> </ul>   | <ul style="list-style-type: none"> <li>Dysfunctional community and need for counselling, support and associated costs</li> </ul>   | <ul style="list-style-type: none"> <li>Schools closed</li> <li>Parks not accessible and health and safety risk</li> <li>Flood leading to unhealthy home</li> </ul>                |
| Insurance excesses and premiums unaffordable Or no insurance possible | Community      | <ul style="list-style-type: none"> <li>Stress/ mental health risk</li> </ul>  | <ul style="list-style-type: none"> <li>N/A</li> </ul>  | <ul style="list-style-type: none"> <li>Can't sell and move on</li> <li>Forces rates up</li> </ul>  | <ul style="list-style-type: none"> <li>No maintenance etc</li> </ul>  |

| Coastal Hazard Consequence          |                | Elements at risk   |   |  |   |
|-------------------------------------|----------------|--|---|--|---|
|                                     |                | Human (Society/ Culture)   | Natural Environment   | Economy  | Built Environment   |
|                                     | Asset Managers | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>  | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>                             | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>  | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul> |
| Potential loss of life              | Community      | <ul style="list-style-type: none"> <li>Potential for: <ul style="list-style-type: none"> <li>Grief – individual/community</li> <li>Anger – depends on understanding, blame</li> <li>Fear – community and family</li> </ul> </li> <li>Increase risk taking, further compounding problems</li> </ul>             | <ul style="list-style-type: none"> <li>N/A</li> </ul>   | <ul style="list-style-type: none"> <li>Loss of bread winner</li> <li>Funeral costs</li> <li>Unrealistic expectations</li> </ul>  | <ul style="list-style-type: none"> <li>N/A</li> </ul>                       |
|                                     | Asset Managers | <ul style="list-style-type: none"> <li>Impact on households / whanau / communities</li> </ul>  | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>                             | <ul style="list-style-type: none"> <li>Impact on households / families / businesses</li> <li>Loss of expertise</li> </ul>  | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul> |
| Septic tank damage                  | Community      | <ul style="list-style-type: none"> <li>Disease risk</li> <li>Health and Safety</li> </ul>  | <ul style="list-style-type: none"> <li>Pollution</li> </ul>   | <ul style="list-style-type: none"> <li>Cost of clean up</li> </ul>   | <ul style="list-style-type: none"> <li>Cost of replacement</li> </ul>       |
|                                     | Asset Managers | <ul style="list-style-type: none"> <li>Stress on the community is occurring at a large scale</li> <li>Council to provide alternatives (port-a-loo etc) until a permanent solution found</li> <li>Traditional practices – areas potentially contaminated and food gathering from natural environment</li> </ul> | <ul style="list-style-type: none"> <li>Risks to the natural environmental from contamination</li> </ul> | <ul style="list-style-type: none"> <li>Costs to individuals to provide another means of waste disposal – may mean reticulated network but may not – do you have any other options?</li> <li>Costs to Council of providing alternative means of disposal</li> </ul> | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul> |
| Groundwater changes/impacts         | Community      | <ul style="list-style-type: none"> <li>Lack of clean water</li> </ul>  | <ul style="list-style-type: none"> <li>Lack of irrigation water</li> </ul>                              | <ul style="list-style-type: none"> <li>Loss of agricultural and horticultural production</li> </ul>  | <ul style="list-style-type: none"> <li>Cost to replace</li> </ul>           |
| Ecosystems – estuaries and wetlands | Community      | <ul style="list-style-type: none"> <li>Aesthetics</li> </ul>   | <ul style="list-style-type: none"> <li>Biodiversity destruction</li> </ul>                              | <ul style="list-style-type: none"> <li>N/A</li> </ul>  | <ul style="list-style-type: none"> <li>N/A</li> </ul>                       |

| Coastal Hazard Consequence                               |                | Elements at risk   |   |   |  |
|--|----------------|--|---|---|--|
|  |                | Human (Society/ Culture)   | Natural Environment   | Economy   | Built Environment  |
|  | Asset Managers | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>  | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>   | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>   | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>  |
| Supply & Demand for land                                 | Community      | <ul style="list-style-type: none"> <li>Attraction to the coast would increase if some protection was in place</li> </ul>   | <ul style="list-style-type: none"> <li>N/A</li> </ul>   | <ul style="list-style-type: none"> <li>Raises economics fo the area</li> <li>Community expands</li> </ul>   | <ul style="list-style-type: none"> <li>Leads to growth in the community</li> </ul>   |
| Overall financial impact of staying – community cohesion | Community      | <ul style="list-style-type: none"> <li>Physical and mental health</li> <li>Impact can vary from household to household</li> <li>Education</li> </ul>   | <ul style="list-style-type: none"> <li>Loss of respect and care to the environment as the other factors come to the fore</li> </ul> | <ul style="list-style-type: none"> <li>Breakdown of local economy</li> <li>Increased cost for wider community to support that area</li> </ul>   | <ul style="list-style-type: none"> <li>Reduction in level and standard of services</li> </ul>                                  |
| Effects on Stormwater + Stormwater pumping               | Community      | <ul style="list-style-type: none"> <li>Health hazard</li> </ul>  | <ul style="list-style-type: none"> <li>Release of wastewater and contaminated water into the environment</li> </ul>                 | <ul style="list-style-type: none"> <li>Cost to maintain</li> <li>Cost to repair</li> <li>Insurance premiums</li> </ul>  | <ul style="list-style-type: none"> <li>Damage to infrastructure</li> <li>Water purity</li> <li>Transport disruption</li> </ul> |
|  | Asset Managers | <ul style="list-style-type: none"> <li>Significant effects on properties that may be flooded by stormwater not being pumped away.</li> <li>Insurance risks</li> <li>Large areas likely to be susceptible to failure</li> </ul> | <ul style="list-style-type: none"> <li>Backing up of stormwater with pumps out of action therefore risks of flooding</li> </ul>     | <ul style="list-style-type: none"> <li>Costs to Council – clean up and replacement of infrastructure, damage to property.</li> <li>Insurance premiums likely to be affected.</li> <li>Potential liability to Council from pump failure (1in 50 year rainfall event level of service planned for) – level of service changes as climate change increases risk of storm events</li> </ul> | <ul style="list-style-type: none"> <li>Damage to stormwater outfalls</li> </ul>  |
| Impact on harbour entrance                               | Community      | <ul style="list-style-type: none"> <li>Sport and recreation</li> <li>Impacts on coastal, urban and rural</li> </ul>  | <ul style="list-style-type: none"> <li>Estuary and marine ecosystems</li> </ul>   | <ul style="list-style-type: none"> <li>Impact to fishing companies</li> <li>Impact to harbour side businesses</li> </ul>  | <ul style="list-style-type: none"> <li>Potential damage to protection works</li> </ul>   |
| Frequency of inundation events                           | Community      | <ul style="list-style-type: none"> <li>Confidence and displacement</li> <li>Cost of staying</li> <li>Loss of activity</li> </ul>   | <ul style="list-style-type: none"> <li>Saltwater ingress</li> <li>Destruction of habitat and ecosystems</li> </ul>                  | <ul style="list-style-type: none"> <li>All financial factors can be impacted</li> </ul>   | <ul style="list-style-type: none"> <li>Threat to buildings, roads, services etc</li> </ul>                                     |

| Coastal Hazard Consequence                   |                | Elements at risk  |  |  |   |
|--|----------------|---|--|--|---|
|  |                | Human (Society/ Culture)  | Natural Environment  | Economy  | Built Environment   |
| Recreation access                            | Community      | <ul style="list-style-type: none"> <li>Quality of life affects all communities</li> </ul>   | <ul style="list-style-type: none"> <li>Lack of recreational areas could have a positive impact on the natural environment</li> </ul>   | <ul style="list-style-type: none"> <li>Tourism and service industry</li> </ul>   | <ul style="list-style-type: none"> <li>Boat ramps?</li> </ul>   |
|  | Asset Managers | <ul style="list-style-type: none"> <li>Changes to day-to-day behaviours and lifestyles</li> <li>WW failures impact on tikanga values and practices</li> <li>Human health impacts on whanau/marae but also on cultural values of te Taiao more generally</li> <li>Impacts on mahinga kai practices – eg. contaminated shellfish gathering</li> </ul> | <ul style="list-style-type: none"> <li>Eg. WW failure impacting marine ecosystems if untreated coastal discharges</li> <li>Coastal Birdlife affected by spillages/untreated waste</li> <li>Reduced coastal water quality.</li> <li>Water quality of estuarine environments impacted</li> </ul> | <ul style="list-style-type: none"> <li>Cost of region to replace the capital investment elsewhere/or alternative</li> <li>Communities still require services that key infrastructure provide if that infra is disrupted</li> <li>Interim alternatives ongoing? Sustainability/viability of interim measures e.g. potable water supplies, portaloos etc.</li> </ul> | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>   |
| Isolation of communities (between or within) | Community      | <ul style="list-style-type: none"> <li>Loss of community wellbeing, social cohesion and social welfare</li> <li>Displacement</li> </ul>   | <ul style="list-style-type: none"> <li>Ghost town</li> </ul>   | <ul style="list-style-type: none"> <li>N/A</li> </ul>  | <ul style="list-style-type: none"> <li>Demolition</li> <li>Lack of building</li> </ul>  |
|  | Asset Managers | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>   | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>  | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>  | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>   |
| Raising of rates to cover events             | Community      | <ul style="list-style-type: none"> <li>Mental health issues due to lack of money</li> </ul>   | <ul style="list-style-type: none"> <li>Land use</li> </ul>   | <ul style="list-style-type: none"> <li>Lack of money for infrastructure, services etc</li> </ul>   | <ul style="list-style-type: none"> <li>Infrastructure and services</li> <li>Transport – no maintenance or improvements</li> </ul>   |
| Saltwater intrusion into aquifers            | Community      | <ul style="list-style-type: none"> <li>Cultural – not being able to get water and food from traditional sources</li> <li>Soil pH levels change</li> </ul>   | <ul style="list-style-type: none"> <li>Impact/damage/change ecosystems</li> <li>Increased pests/insects</li> </ul>   | <ul style="list-style-type: none"> <li>Increased costs especially for fisheries, marine</li> </ul>   | <ul style="list-style-type: none"> <li>Different water processing plant requirements</li> </ul>   |
|  | Asset Managers | <ul style="list-style-type: none"> <li>Unsuitable drinking water due to salt water intrusion and breakages in the network.</li> <li>General risk to the community from losing access to drinking water</li> </ul>   | <ul style="list-style-type: none"> <li>Saline intrusion affecting plants and habitats (fauna and flora)</li> <li>Impact on local water tables</li> </ul>   | <ul style="list-style-type: none"> <li>Bore – water becomes unsuitable for drinking and therefore need a new bore or connect to town water supply.</li> <li>Council network effects – costs of ongoing repairs and health implications due to contamination – increases maintenance costs as well</li> </ul>   | <ul style="list-style-type: none"> <li>Council network effects – costs of ongoing repairs and health implications due to contamination – increases maintenance costs as well</li> </ul> |

| Coastal Hazard Consequence                                      |                | Elements at risk   |  |  |   |
|---|----------------|--|--|--|---|
|   |                | Human (Society/ Culture)   | Natural Environment  | Economy  | Built Environment   |
| Amenity impacts   | Community      | <ul style="list-style-type: none"> <li>Lack of/loss of enjoyment of spaces</li> </ul>  | <ul style="list-style-type: none"> <li>Lack of green space</li> </ul>  | <ul style="list-style-type: none"> <li>Lack of tourism and tourism industries including wineries and tours</li> <li>Loss of property values</li> </ul> | <ul style="list-style-type: none"> <li>Waste management impacts</li> </ul>  |
| Loss of property value  | Community      | <ul style="list-style-type: none"> <li>Loss of life savings</li> <li>Inability to repurchase</li> <li>Having to move</li> </ul>  | <ul style="list-style-type: none"> <li>N/A</li> </ul>  | <ul style="list-style-type: none"> <li>Poorer</li> <li>Less money in the community</li> </ul>  | <ul style="list-style-type: none"> <li>Services may degrade</li> <li>Inability to fund improvements</li> </ul>      |
| Displacement of community                                       | Community      | <ul style="list-style-type: none"> <li>Cultural impacts</li> <li>Families upended</li> <li>Mental health</li> </ul>  | <ul style="list-style-type: none"> <li>N/A</li> </ul>  | <ul style="list-style-type: none"> <li>Less wealth</li> <li>Shops unviable</li> <li>Lack of tourists</li> </ul>  | <ul style="list-style-type: none"> <li>Decline in property</li> <li>Less service industry</li> </ul>                |
| Frequency of physical danger                                    | Community      | <ul style="list-style-type: none"> <li>Potential loss of life</li> <li>Mental health</li> <li>Fear/insecurity</li> </ul>   | <ul style="list-style-type: none"> <li>N/A</li> </ul>  | <ul style="list-style-type: none"> <li>Lack of investment</li> <li>Insurance</li> <li>Lack of visitors</li> </ul>                                      | <ul style="list-style-type: none"> <li>Fear of building</li> <li>Lack of investment</li> <li>Degradation</li> </ul> |
| Vulnerable plants   | Community      | <ul style="list-style-type: none"> <li>Diminished amenity and birdlife enjoyment</li> <li>Visual impact</li> </ul>   | <ul style="list-style-type: none"> <li>Diminished greenspaces of coastal defence</li> <li>Loss of biodiversity</li> </ul>  | <ul style="list-style-type: none"> <li>Replanting costs</li> </ul>   | <ul style="list-style-type: none"> <li>N/A</li> </ul>   |
| Reduced stability of riverine stopbanks (particularly at mouth) | Asset Managers | <ul style="list-style-type: none"> <li>Stopbanks are decommissioned for recreational uses</li> <li>Compounding hazards if erosion not addressed (e.g. increasing FW flooding risk)</li> <li>Cycleways become disrupted /re-routed</li> <li>Access to traditional mahinga kai sites/practices affected</li> </ul> | <ul style="list-style-type: none"> <li>Compounding impacts on nearby natural processes (eg. fish spawning, sedimentation of estuaries, meandering river mouths etc)</li> </ul> | <ul style="list-style-type: none"> <li>Increased costs for funding maintenance (costs passed on to community/beneficiary-pays)</li> </ul>              | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>   |

| Coastal Hazard Consequence  |                | Elements at risk   |   |  |  |
|---|----------------|--|---|--|--|
|   |                | Human (Society/ Culture)   | Natural Environment   | Economy  | Built Environment  |
| Access to and along the coastline limited (vehicles and pedestrian), due to steepness of beach escarpments  | Asset Managers | <ul style="list-style-type: none"> <li>• Pedestrian safety increasingly vulnerable</li> <li>• Local boat launching sites affected/un-usable</li> <li>• No vehicles on many beaches – a PLUS!</li> <li>• Access to traditional mahinga kai sites/practices affected</li> </ul>          | <ul style="list-style-type: none"> <li>• Positive no vehicles on beaches (esp. sensitive ecosystems)</li> <li>• Loss of natural ecosystems with nowhere to go/re-create</li> </ul>  | <ul style="list-style-type: none"> <li>• Recreational commercial activities affected/cease</li> </ul>  | <ul style="list-style-type: none"> <li>• Not completed in workshop</li> </ul>  |
| Impact on tourism activities, campsites, freedom camping, use of pathways   | Asset Managers | <ul style="list-style-type: none"> <li>• Multiplier effect of reduced tourism</li> <li>• Reduced amenity/wellbeing from limited recreational activities and coastal sense of place</li> <li>• Loss of sense of place</li> <li>• Disrupted whanau tradition over generations</li> </ul> | <ul style="list-style-type: none"> <li>• Not completed in workshop</li> </ul>   | <ul style="list-style-type: none"> <li>• Reduced commercial operators</li> <li>• Reduced 'choice' in location and market providers.</li> <li>• Impact on HB reputation and marketing as active recreation destination/experience</li> </ul>  | <ul style="list-style-type: none"> <li>• Inappropriate de-commissioning of assets/infrastructure/built stuff</li> </ul>  |
| Loss of cropping and vineyard, productive agricultural land from inundation of sea water – economic impacts of this as well as the physical effects | Asset Managers | <ul style="list-style-type: none"> <li>• Job losses</li> <li>• Seasonal productivity affected so different jobs at different times of year/growing cycle</li> </ul>  | <ul style="list-style-type: none"> <li>• Runoff and contaminants from production land into FW and marine environments</li> <li>• Debris from land use into FW/coastal water</li> <li>• Land use change potential. e.g. cropping types affected therefore prompts wholesale land use change with other consequent impacts</li> </ul> | <ul style="list-style-type: none"> <li>• Impacts on commercial brands (individual business but also the collective region)</li> <li>• Potential loss of entire season/year of product</li> <li>• Soil characteristics altered for subsequent growing conditions</li> <li>• Livestock losses (e.g. loss of life or poorer health)</li> </ul>  | <ul style="list-style-type: none"> <li>• Not completed in workshop</li> </ul>  |
| Public toilets stop operating / not accessible  | Asset Managers | <ul style="list-style-type: none"> <li>• Risk of using inappropriate sites</li> <li>• Risk of food contamination</li> <li>• Loss of park land – where can replacement land be found</li> </ul>   | <ul style="list-style-type: none"> <li>• Potential waste generation in undesirable locations, including existing camping sites</li> </ul>   | <ul style="list-style-type: none"> <li>• Tourism impacts – no facilities for visitors</li> <li>• Reconstruction of the facilities elsewhere – duplicated costs and where?</li> <li>• Need for land purchase for new park areas</li> </ul>  | <ul style="list-style-type: none"> <li>• Loss of park land – where can replacement land be found</li> <li>• Effects on city design – suitable alternative locations for alternative</li> </ul> |
| Port of Napier <sup>1</sup> operations are impacted, more seas, storms – operations but may also impact facilities (general climate change impacts) | Asset Managers | <ul style="list-style-type: none"> <li>• Employment at the Port at risk if there are long term impacts from events – will affect local cities/towns and regionally as well.</li> <li>• Exporters who rely on their products being transported via the port.</li> </ul>                 | <ul style="list-style-type: none"> <li>• Port Storage facilities – bitumen/fuel/hazardous substances – potential for environmental contamination</li> <li>• Ships damaged – potential for fuel contamination as well as cargo being lost</li> </ul>   | <ul style="list-style-type: none"> <li>• Port out of action and cannot provide safe harbour for freight into and out of HB – significant impacts on horticultural, forestry, meat products being exported</li> <li>• Delays will increase costs and have impacts on businesses</li> <li>• Costs of repair at the Port itself</li> <li>• Access routes to the Port are also a source of vulnerability in supplying goods to the port</li> </ul> | <ul style="list-style-type: none"> <li>• Port and Ships damaged</li> </ul>   |

<sup>1</sup>For the avoidance of doubt, this commentary reflects community discussion and issue exploration in a workshop setting. The risks posed by coastal hazards for port facilities are managed directly by the Port of Napier, who may take a different view on these matters.

| Coastal Hazard Consequence   |                | Elements at risk   |   |   |  |
|--|----------------|--|---|---|--|
|  |                | Human (Society/ Culture)   | Natural Environment   | Economy   | Built Environment  |
| Loss of housing capacity e.g. uninsurable / uninhabitable (e.g. already short on supply)                                       | Asset Managers | <ul style="list-style-type: none"> <li>Disconnect from the community</li> <li>Loss of identity</li> <li>First home buyer impacts</li> <li>Loss of local social cohesion</li> </ul>   | <ul style="list-style-type: none"> <li>Additional waste to landfill</li> </ul>  | <ul style="list-style-type: none"> <li>Shortage of supply drives up market costs</li> <li>Cost of managed retreat</li> <li>Drives up new infrastructure costs e.g. reticulate to new areas/ abandon old areas</li> </ul>  | <ul style="list-style-type: none"> <li>Greenfields development requirements</li> </ul> |
| Closed landfills (exposed) – Mill Road + others we don't know about  | Asset Managers | <ul style="list-style-type: none"> <li>Blot on the landscape</li> <li>Reputation</li> <li>Enjoyment of areas + impacts on other infrastructure</li> <li>Tourism and transport</li> <li>Health impacts from using environment / contamination</li> <li>Mahinga kai impacts</li> <li>Cultural landscape</li> <li>Mauri impacts</li> </ul>  | <ul style="list-style-type: none"> <li>Impact on waterbodies / pollution and on surrounding land</li> </ul>   | <ul style="list-style-type: none"> <li>Cost of clean up</li> <li>Impacts on productive land</li> <li>Cycle tour operators and other tourism operators</li> </ul>  | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>            |
| Awatoto industrial area impacts  | Asset Managers | <ul style="list-style-type: none"> <li>Blot on the landscape</li> <li>Reputation</li> <li>Enjoyment of areas + impacts on other infrastructure</li> <li>Tourism and transport</li> <li>Health impacts from using environment / contamination</li> <li>Mahinga kai impacts</li> <li>Cultural landscape</li> <li>Mauri impacts</li> <li>Waitangi Regional Park impacts (cultural)</li> </ul> | <ul style="list-style-type: none"> <li>Impact on waterbodies / pollution and on surrounding land</li> <li>Waitangi Regional Park impacts (environmental)</li> </ul> | <ul style="list-style-type: none"> <li>Cost of clean up</li> <li>Impacts on productive land</li> <li>Cycle tour operators and other tourism operators</li> <li>Significant industrial area – jobs, productivity etc</li> <li>Cost to retreat and established elsewhere</li> </ul> | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>            |
| Hawkes Bay Airport – due to low lying nature, at risk of pump failure, access limitations as there are no airport alternatives | Asset Managers | <ul style="list-style-type: none"> <li>Connectivity and transport links impact on communities</li> <li>Sig. cultural areas</li> </ul>  | <ul style="list-style-type: none"> <li>Kiwi creche at Westshore wildlife domain</li> </ul>  | <ul style="list-style-type: none"> <li>Tourism, transport links etc</li> <li>Cycle trails effects</li> <li>Landcorp farm</li> <li>Cost to repair runways or relocate</li> </ul>   | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>            |
| Disruption to residential dwellings  | Asset Managers | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>  | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>   | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>   | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>            |
| River mouth blockages increase (e.g. increased by SLR / high tides)  | Asset Managers | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>  | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>   | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>   | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>            |

| Coastal Hazard Consequence   |                | Elements at risk  |   |   |   |
|--|----------------|---|---|---|---|
|  |                | Human (Society/ Culture)  | Natural Environment   | Economy   | Built Environment   |
| Loss of existing coastal protection works including natural defences such as dunes and gravel barriers and increased maintenance costs | Asset Managers | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul> | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul> | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>                                 | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul> |
| Rail impacts – Awatoto / Napier  | Asset Managers | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul> | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul> | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>                                 | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul> |
| River level impacts – stopbanks / water supply etc   | Asset Managers | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul> | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul> | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul>                                 | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul> |
| Property purgatory affects community wellbeing and community cohesiveness.   | Asset Managers | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul> | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul> | <ul style="list-style-type: none"> <li>Who pays the damaged clean-up costs? Individual vs other?</li> </ul> | <ul style="list-style-type: none"> <li>Not completed in workshop</li> </ul> |

## Appendix 3

# Adaptation Threshold Development

## Potential Physical/ Infrastructure Thresholds

Black text denotes consequences identified by the Community

Blue text denotes additional consequences identified by Council asset managers.

| Coastal Hazard Consequence<br><br>(Identified through community workshop series + Council asset manager workshops – July & November 2021) | Proposed Threshold<br><br>(Developed with feedback from community workshop series - February 2022)  | Likely source of data?                         | Threshold Evaluation and Selection                               |  |                             | Relevant Unit |         |         |           |          |           |         |           |          |            |  |  |  |  |  |  |
|---|---|--|--|--|-----------------------------|---------------|---------|---------|-----------|----------|-----------|---------|-----------|----------|------------|--|--|--|--|--|--|
|   |   |  | 1. Coastal Hazards are the cause of the threshold being breached | 2. Data to assess threshold is available or can readily be collected and interpreted | 3. Selected as a threshold? | ALL UNITS     | Ahuriri | Pandora | Westshore | Bay View | Whirinaki | Clifton | Te Awanga | Haumoana | East Clive |  |  |  |  |  |  |
| <b>Potential Physical/ Infrastructure Thresholds</b>  |   |  |  |  |                             |               |         |         |           |          |           |         |           |          |            |  |  |  |  |  |  |
| Loss of Road Access (Community Scale)   | Coastal inundation in [NAME] causing loss of road access for the majority of the community.<br><i>How long: At least 24 hours</i><br><i>How often: More than once every 5 years.</i>                              | Observed/ inspected/ reported by asset manager | ✓  | ✓  | ✓                           |               |         | ✓       |           |          | ✓         | ✓       | ✓         | ✓        |            |  |  |  |  |  |  |
|   | Coastal erosion in [NAME] causing loss of road access affecting the majority of the community.  | Observed/ inspected/ reported by asset manager | ✓  | ✓  | ✓                           |               |         |         | ✓         | ✓        | ✓         | ✓       |           |          |            |  |  |  |  |  |  |
| Loss of Road Access (Property Scale)  | Coastal inundation in [NAME] causing loss of road access that affects individual properties.<br><i>How long: At least 24 hours</i><br><i>How often: More than once every two years.</i>                           | Observed/ inspected/ reported by asset manager | ✓  | ✓  | ✓                           |               | ✓       | ✓       | ✓         |          | ✓         | ✓       | ✓         | ✓        |            |  |  |  |  |  |  |
|   | Coastal erosion in [NAME] causing loss of road access that affects individual properties.   | Observed/ inspected/ reported by asset manager | ✓  | ✓  | ✓                           |               | ✓       |         | ✓         | ✓        | ✓         | ✓       | ✓         |          |            |  |  |  |  |  |  |
| Services disruption (power, telecommunications, water, sewage)  | Coastal inundation in [NAME] causing the loss of one or more essential services affecting the majority of the community.<br><i>How long: At least 24 hours</i><br><i>How often: More than once every 5 years.</i> | Observed/ inspected/ reported by asset manager | ✓  | ✓  | ✓                           | ✓             |         |         |           |          |           |         |           |          |            |  |  |  |  |  |  |

| Coastal Hazard Consequence<br><br>(Identified through community workshop series + Council asset manager workshops – July & November 2021) | Proposed Threshold<br><br>(Developed with feedback from community workshop series - February 2022)   | Likely source of data?                                    | Threshold Evaluation and Selection                               |  |   | Relevant Unit |         |         |           |          |           |         |           |          |            |   |
|---|--|---|--|--|---|---------------|---------|---------|-----------|----------|-----------|---------|-----------|----------|------------|---|
|   |  |   | 1. Coastal Hazards are the cause of the threshold being breached | 2. Data to assess threshold is available or can readily be collected and interpreted | 3. Selected as a threshold?   | ALL UNITS     | Ahuriri | Pandora | Westshore | Bay View | Whirinaki | Clifton | Te Awanga | Haumoana | East Clive |   |
|   | Coastal erosion in [NAME] causing the loss of one or more essential services affecting the majority of the community.  | Observed/ inspected/ reported by asset manager            | ✓  | ✓  | ✓   | ✓             |         |         |           |          |           |         |           |          |            |   |
| Septic tank damage  | Buildings in [NAME] are deemed uninhabitable as a result of coastal hazards (e.g. loss of septic tanks, building structural integrity etc).                      | Observed/ inspected/ reported by homeowner                | ✓  | ✓  | ✓   |               |         |         |           | ✓        | ✓         | ✓       | ✓         | ✓        | ✓          | ✓ |
| Efficiency of Stormwater  | Loss of ability to effectively manage/discharge stormwater from urban areas.   | Observed/ inspected/ reported by asset manager            | ✓  | ✓  | ✗<br>Could be affected by blockage of pipes and/or increasing SLR. Interventions under the Strategy unlikely to address. Best addressed as an asset management function.  |               | ✓       | ✓       | ✓         | ✓        |           |         | ✓         | ✓        | ✓          | ✓ |
| Frequency of inundation events (Community Scale)  | Community-wide coastal inundation causing damage to multiple buildings/services in [NAME].<br>How long: Any duration<br>How often: More than once every 5 years. | Observed/ inspected/ reported by Council/ building owners | ✓  | ✓  | ✓   | ✓             |         |         |           |          |           |         |           |          |            |   |
| Reduced stability of riverine stopbanks (particularly at mouth)   | Stopbanks fail to meet design level of service as a result of coastal hazards.   | Observed/ inspected/ reported by asset manager            | ?  | ✓  | ✗<br>Is a flood control scheme/asset management issue not a coastal hazard issue  |               |         |         |           |          |           |         | ✓         | ✓        | ✓          | ✓ |
| Access to and along the coast is affected as a result of the steepness of beach escarpments   | Steep beach escarpments, created by erosion, prevent safe access to and along the coast.   | Observed/ inspected/ reported by asset manager            | ✓  | ✓  | ✗<br>More appropriate as a signal/trigger; management techniques can be implemented to re-establish access e.g beach scraping and this is a good signal for approaching impacts on infrastructure from erosion. |               |         |         | ✓         | ✓        | ✓         | ✓       | ✓         | ✓        | ✓          | ✓ |
| Public toilets stop operating/are not accessible  | Public toilets in [NAME] are permanently inaccessible or not suitable for public use as a result of coastal hazards.   | Observed/ inspected/ reported by asset manager            | ✓  | ✓<br>Based on asset managers assessment  | ✓   |               | ✓       |         | ✓         |          |           |         | ✓         | ✓        |            |   |
| Rail impacts – Awatoto / Napier   | Rail access is disrupted as a result of coastal hazards.<br>How long: more than 48 hours   | Observed/ inspected/ reported by Kiwirail                 | ✓  | ✓  | ✓   |               | ✓       | ✓       | ✓         | ✓        |           |         |           |          |            |   |

| Coastal Hazard Consequence<br><br>(Identified through community workshop series + Council asset manager workshops – July & November 2021) | Proposed Threshold<br><br>(Developed with feedback from community workshop series - February 2022)   | Likely source of data?  | Threshold Evaluation and Selection  |   |                             | Relevant Unit |         |         |           |          |           |         |           |          |            |
|---|--|---|---|---|-----------------------------|---------------|---------|---------|-----------|----------|-----------|---------|-----------|----------|------------|
|   |  |   | 1. Coastal Hazards are the cause of the threshold being breached  | 2. Data to assess threshold is available or can readily be collected and interpreted  | 3. Selected as a threshold? | ALL UNITS     | Ahuriri | Pandora | Westshore | Bay View | Whirinaki | Clifton | Te Awanga | Haumoana | East Clive |
|   | <i>How often: More than once annually.</i>   |   |   |   |                             |               |         |         |           |          |           |         |           |          |            |
| <b>Potential Social/Cultural Thresholds</b>   |  |   |   |   |                             |               |         |         |           |          |           |         |           |          |            |
| Community psychology  | <i>30% or more of the [NAME] community indicate high levels of anxiety about coastal hazard risks and impacts.</i>   | Community surveys by Councils   | ?<br>Very subjective and personal/ individual measure. May or may not have causal link to hazard. Level of anxiety may or may not be reduced with actions in response to natural hazards. | ?<br>Data would be collected by a survey. Valid results would require a high percentage of the community responding to the survey. Results could be heavily influenced by recent weather events (good/bad) etc. | x                           | ✓             |         |         |           |          |           |         |           |          |            |
| Frequency of physical danger  | <i>Any injuries and/or fatalities that occur as a result of a coastal erosion or coastal inundation event.</i>   | Reporting emergency services, CDEM, media, ACC, DHB<br><br>NB Hazards in scope are slow onset and irregular in scale and frequency but impacts may not be slow onset. | ✓   | ✓<br>Assume we can get reporting on this from media reporting, ACC/ DHB/ St John.   | ✓                           | ✓             |         |         |           |          |           |         |           |          |            |
|   | <i>Civil Defence emergency is declared in response to coastal inundation or coastal erosion.</i><br><br><i>How often: More than once every 5 years.</i>    | CDEM  | ✓   | ✓<br>CDEM   | ✓                           | ✓             |         |         |           |          |           |         |           |          |            |
| Isolation between communities   | <i>30% or more of the [NAME] community feel a sense of their community being isolated as the result of coastal erosion or coastal inundation impacts.</i>  | Community surveys by Councils   | ?<br>Very subjective and personal/ individual measure   | ?<br>Data would be collected by a survey. Valid results would require a high percentage of the community responding to the survey. Results could be heavily influenced by recent weather events (good/bad) etc. | x                           | ✓             |         |         |           |          |           |         |           |          |            |
| Isolation within a community  | <i>30% or more of the [NAME] community feel a sense of isolation within their community as the result of coastal erosion or coastal inundation impacts</i> | Community surveys by Councils   | ?<br>Very subjective and personal/individual measure.   | ?<br>Data would be collected by a survey. Valid results would require a high percentage of the community responding to the survey. Results could be heavily influenced by recent weather events (good/bad) etc. | x                           | ✓             |         |         |           |          |           |         |           |          |            |

| Coastal Hazard Consequence<br><br>(Identified through community workshop series + Council asset manager workshops – July & November 2021) | Proposed Threshold<br><br>(Developed with feedback from community workshop series - February 2022)   | Likely source of data?  | Threshold Evaluation and Selection   |   |   | Relevant Unit |         |         |           |          |           |         |           |          |            |
|---|--|---|--|---|---|---------------|---------|---------|-----------|----------|-----------|---------|-----------|----------|------------|
|   |  |   | 1. Coastal Hazards are the cause of the threshold being breached   | 2. Data to assess threshold is available or can readily be collected and interpreted  | 3. Selected as a threshold?   | ALL UNITS     | Ahuriri | Pandora | Westshore | Bay View | Whirinaki | Clifton | Te Awanga | Haumoana | East Clive |
| Amenity impacts   | 30% of the [NAME] community consider that a significant loss of amenity has occurred as a result of coastal erosion or coastal inundation impacts  | Community surveys by Councils, Observed/ Inspected/ Report by asset managers    | ✓  | ✓<br>Could survey to obtain this information – would require skilled questioning and social science skills to complete this monitoring – this will be a subjective assessment for people/communities. | ✓   | ✓             |         |         |           |          |           |         |           |          |            |
| Property purgatory affects community wellbeing and community cohesiveness   | The majority of the community in [NAME] report actual or perceived property purgatory effects i.e. actual or foreseeable damage to their properties from coastal erosion or coastal inundation and uncertainty about being able to recover their losses. | Community surveys by Councils, Observed/ inspected/ reported by asset managers  | ✓  | ✓<br>Could survey to obtain this information  | ✓   | ✓             |         |         |           |          |           |         |           |          |            |
| River mouth blockages increase (increase by SLR/high tides)   | [NAME] River mouth clearance fails to maintain flood capacity as a result of coastal hazards.  | Observed/ inspected/ reported by asset manager                                  | ?<br>More likely influenced by riverine systems? Strategy does not consider effects of river flooding nor groundwater effects. Note these need to be considered post-Strategy. | ✓   | ✗<br>Expectation that these levels will be managed by the flood control scheme and the coastal hazard mitigations will not be effective in managing this consequence.   |               |         |         |           | ✓        |           | ✓       | ✓         | ✓        |            |
| Loss of existing coastal protection works including natural defences such as dunes and gravel barriers and increased maintenance costs    | Loss of efficacy of existing coastal protection structures in [NAME].  | Observed/ inspected/ reported by asset manager                                  | ✓  | ✓   | ✗<br>Could be used as a trigger as are an indicator of changes occurring. Thresholds are more related to the effects of the change on buildings and infrastructure.   |               |         | ✓       | ✓         | ✓        | ✓         | ✓       |           |          |            |
| Frequency of inundation events (Property Scale)   | Localised inundation of buildings in [NAME].<br>How long: Any duration<br>How often: More than once every 2 years.   | Observed/ inspected/ reported by asset manager                                  | ✓  | ✓   | ✗<br>This is likely to be better suited as a trigger rather than a threshold as it could be used to monitor for repeated events to prompt a decision about whether action is needed.  | ✓             |         |         |           |          |           |         |           |          |            |
| Saltwater intrusion into aquifers   | [XX Name bore] becomes unsuitable for drinking water/ farming/horticultural use as a result of saltwater intrusion.  | Observed/ inspected/ reported by landowners/ homeowners, surveys and interviews | ✓  | ✓   | ✗<br>This threshold would occur as a result of SLR and/or excessive aquifer use at the coast. Actions under the Strategy are not able to address this. This is a freshwater management function for the TA's/ Taumata Arowai entity and likely to | ✓             |         |         |           |          |           |         |           |          |            |

| Coastal Hazard Consequence<br><br>(Identified through community workshop series + Council asset manager workshops – July & November 2021)           | Proposed Threshold<br><br>(Developed with feedback from community workshop series - February 2022)  | Likely source of data?  | Threshold Evaluation and Selection                               |  |   | Relevant Unit |         |         |           |          |           |         |           |          |            |
|---|---|---|--|--|---|---------------|---------|---------|-----------|----------|-----------|---------|-----------|----------|------------|
|   |   |   | 1. Coastal Hazards are the cause of the threshold being breached | 2. Data to assess threshold is available or can readily be collected and interpreted   | 3. Selected as a threshold?   | ALL UNITS     | Ahuriri | Pandora | Westshore | Bay View | Whirinaki | Clifton | Te Awanga | Haumoana | East Clive |
|   |   |   |  |  | result from a reduction in pressure in freshwater.  |               |         |         |           |          |           |         |           |          |            |
| <b>Potential Economic Thresholds</b>  |   |   |  |  |   |               |         |         |           |          |           |         |           |          |            |
| Insurance excesses and premiums unaffordable<br>Or no insurance possible  | The majority of properties in [NAME] are unable to secure building insurance for losses from coastal hazards.                                   | Reported by Insurance Council/ Insurance Companies / property owners.           | ✓  | ✓<br>Best source for data would be directly from insurance companies however, it would likely become widely know through media /home owner reporting if broad scale insurance retreat was occurring. | ✓   | ✓             |         |         |           |          |           |         |           |          |            |
|   | 10% or more of properties in [NAME] do not hold insurance due to owners deeming insurance premiums/excesses unaffordable.                       | Reported by Insurance Council/ Insurance Companies / property owners.           | ?  | ?<br>Could be multiple factors contributing to unaffordable premiums   | x   | ✓             |         |         |           |          |           |         |           |          |            |
| Loss of property value  | Median house price for coastal properties in [NAME], drops by 10% or more in 2 years.   | Reported by real estate sector.   | x  | x<br>Difficult to link property price solely to coastal hazards  | ✓   | ✓             |         |         |           |          |           |         |           |          |            |
| Raising of rates to cover events  | Council unwilling or unable to cover the cost of reinstating damaged services to properties impacted by coastal hazards in [NAME].              | Reported by Council(s)  | ✓  | ✓  | x<br>Consider this is more appropriate as a trigger for other consequences as a result of coastal hazards                   | ✓             |         |         |           |          |           |         |           |          |            |
| Impact on tourism activities, campsites, freedom camping, use of recreational pathways.   | Council unwilling or unable to cover increasing costs from maintaining existing coastal defence structures/ renourishment programmes in [NAME]. | Reported by Council(s)  | ✓  | ✓  | x<br>Considered more appropriate as a trigger such as when financial limits are reached for renourishment programmes        | ✓             |         |         |           |          |           |         |           |          |            |
| Loss of cropping and vineyard, productive agricultural land from inundation of sea water – economic impacts of this as well as the physical effects | XX ha or XX% of Plains Zone land becomes unsuitable for productive purposes as a result of coastal inundation.                                  | Observed/ inspected/ reported by landowners/ homeowners, surveys and interviews | ✓  | ✓  | x<br>Geological feature that cannot be retreated and covers a significant area that would be difficult to actively protect. |               |         |         |           | ✓        |           | ✓       | ✓         | ✓        |            |
| Impacts on Hawkes Bay Airport – due to low lying nature, risk of pump   | Coastal inundation in [NAME] causing inaccessibility of Hawke's Bay Airport   | Reported by Hawke's Bay Airport   | ✓  | ✓  | x<br>Not currently a priority unit under the Strategy – no risk of erosion and  |               |         |         |           |          |           |         |           |          |            |

| Coastal Hazard Consequence   | Proposed Threshold   | Likely source of data?                         | Threshold Evaluation and Selection                               |  |   | Relevant Unit |         |         |           |          |           |         |           |          |            |
|--|--|--|--|--|---|---------------|---------|---------|-----------|----------|-----------|---------|-----------|----------|------------|
|  |  |  | 1. Coastal Hazards are the cause of the threshold being breached | 2. Data to assess threshold is available or can readily be collected and interpreted | 3. Selected as a threshold?   | ALL UNITS     | Ahuriri | Pandora | Westshore | Bay View | Whirinaki | Clifton | Te Awanga | Haumoana | East Clive |
| <i>failure (stormwater), access limitations as there are no airport alternatives</i> | <i>facilities for the majority of the community.<br/>How long: At least 24 hours<br/>How often: More than once annually.</i>   |  |  |  | current inundation modelling shows no impact for next 100 years. Increasing ground water level is likely the main issue here. |               |         |         |           |          |           |         |           |          |            |
| <b>Potential Environmental Thresholds</b>  |  |  |  |  |   |               |         |         |           |          |           |         |           |          |            |
| Recreation access  | <i>Access to and use of the beach, coastal reserves and/or recreational facilities is prevented as a result of coastal inundation.<br/>How long: At least 24 hours<br/>How often: More than once annually.</i> | Observed/ inspected/ reported by asset manager | ✓  | ✓  | ✓   | ✓             |         |         |           |          |           |         |           |          |            |
| Ecosystems – estuaries and wetlands  | <i>(Specified ecological feature) is significantly adversely affected by coastal erosion or coastal inundation in [NAME].</i>  | Observed/ inspected/ reported by asset manager | ?  | ?  | ?   |               | ?       | ?       | ?         | ?        | ?         | ?       | ?         | ?        | ?          |

## First pass assessment- thresholds recommended not to progress

The following thresholds were identified in the workshops but during the first pass assessment were proposed not to be progressed further for the reasons in the table below.

| Coastal Hazard Consequence identified by Community/ Asset Managers                          | Reason not to progress threshold   |
|---|--|
| Potential loss of life  | Perception/ potential for loss of life   |
| Supply & Demand for land  | Difficult to monitor and link directly to coastal hazards  |
| Overall financial impact of staying – community cohesion                                    | Already covered by other identified thresholds   |
| Groundwater changes/impacts   | Already covered by other identified thresholds   |
| Vulnerable plants   | Already covered by other identified thresholds   |
| Displacement of community   | Already covered by other identified thresholds   |
| Impact on harbour entrance  | No direct link to erosion/inundation hazards   |
| <i>River level impacts stopbanks/water supply etc</i>                                       | Already covered by other identified thresholds   |
| <i>Port of Napier operations are impacted, more big seas, more storms</i>                   | Strategy not proposing actions/solutions for the Port  |
| <i>Loss of housing capacity e.g. uninsurable/uninhabitable e.g. already short on supply</i> | Limited spatial extent of strategy i.e. coastal areas at risk from natural hazards – not anticipated to have a significant effect on housing capacity at a district/regional scale |
| <i>Awatoto Industrial Area Impacts</i>  | Awatoto unit not currently identified as a priority for developing a long-term pathway however, is proposed to be included at next strategy review                                 |
| <i>Closed landfills exposed (Mill Road and others we don't know about).</i>                 | Expect other thresholds to be triggered before known sites are at risk. Monitoring only possible where we know about the contaminated sites.                                       |

# Appendix 4

## Panel feedback

## Revised thresholds as a result of community feedback (from workshop 22 June 2022)

| General Proposed Thresholds (apply to all Units)  |   |  |  |
|---|---|--|--|
| Threshold + Threshold Measure   | Primary responsibility for monitoring and reporting to HBRC | Monitoring method/ data source   | Rationale for changes made in response to feedback as a result of community workshop held 22 June 2022   |
| <p><i>Coastal inundation causing the loss of one or more essential services affecting the majority of the community.</i></p> <p><i>How long: At least 48 hours</i></p> <p><i>How often: More often than once every 5 years.</i></p> | HBRC + Relevant TA  | Observations during and following a coastal inundation event, including community feedback.  | Majority of feedback suggested that in order for the impact to be substantial and therefore act as a threshold, not a trigger, duration should be extended to 48 hrs from 24 hrs   |
| <p><i>Community-wide coastal inundation causing damage to multiple buildings/service.</i></p> <p><i>How long: Any duration</i></p> <p><i>How often: More often than once every 5 years.</i></p>                                     | HBRC  | Observations during and following a coastal inundation event, including community feedback.  | Some feedback proposed reducing this threshold to 3 years however retained as 5 to have parity with above threshold.   |
| <p><i>Any serious injuries and/or fatalities that occur as a result of a coastal erosion or coastal inundation event.</i></p>   | Civil Defence   | CDEM observations during and following a coastal erosion or coastal inundation event, including community feedback.  | Extensive debate on this threshold. All agreed that no fatalities are acceptable. Generally agreed that for injuries, threshold should be for serious injuries caused as a result of coastal hazards. Note, there are some standard definitions available.   |
| <p><i>Civil Defence emergency is declared in response to coastal inundation or coastal erosion.</i></p> <p><i>How often: More often than once every 10 years.</i></p>   | Civil Defence   | CDEM reporting during and following a coastal erosion or coastal inundation event, including community feedback.   | Feedback suggested moving to 10 years from 5 to reflect that a Civil Defence Emergency is a major event that is not tolerable more frequently.   |
| <p><i>50% of an affected coastal community consider that a permanent loss of amenity has occurred as a result of coastal erosion or coastal inundation impacts</i></p>  | HBRC  | Community regularly surveyed by Councils and Observed/ inspected/ reported by Council staff e.g. parks staff during/ following coastal erosion or coastal inundation events, including community feedback. | <p>Feedback to make specific to an affected coastal community clear and to replace significant amenity impact with permanent impact to reduce subjectivity.</p> <p>Adopt approach from debate on threshold re: property purgatory where 50% threshold measure is used alongside a 30% trigger.</p> |

**General Proposed Thresholds (apply to all Units)**

| Threshold + Threshold Measure  | Primary responsibility for monitoring and reporting to HBRC | Monitoring method/ data source   | Rationale for changes made in response to feedback as a result of community workshop held 22 June 2022   |
|--|---|--|--|
| <p><i>50% of the community report actual or perceived property purgatory effects i.e. actual or foreseeable damage to their properties from coastal erosion or coastal inundation and uncertainty about being able to recover their losses</i></p> | <p>HBRC</p>   | <p>Community regularly surveyed by Councils</p>  | <p>Extensive debate on appropriate measure 30%/50%/80%/ majority. Propose 50% as this is a meaningful proportion of a given community as a threshold. Suggestion that this was more appropriate as a trigger – suggest utilising 30% as a trigger.</p>   |
| <p><i>50% of properties are unable to secure building insurance for losses from coastal hazards.</i></p>   | <p>HBRC</p>   | <p>Council seeks regular reporting from Insurance Council/ Insurance Companies. Opportunity to also be informed by property owners through survey results.</p>       | <p>Adopt approach from debate on threshold re: property purgatory where 50% threshold measure is used alongside a 30% trigger.</p>   |
| <p><i>Access to and use of the beach, coastal reserves and/or recreational facilities is prevented as a result of coastal inundation.</i></p> <p><i>How long: At least 7 days</i></p> <p><i>How often: More often than once every 5 years.</i></p> | <p>Relevant TA</p>  | <p>Observed/ inspected/ reported by Council staff e.g. parks staff during/ following coastal erosion or coastal inundation events, including community feedback.</p> | <p>Feedback suggested that access to reserves is important but not fundamental and there is a high degree of tolerance of interrupted use and enjoyment of reserves, suggesting longer duration events are tolerable. Therefore, change made from 24 hours to 7 days as suggested.</p> <p>Change also suggested to the frequency from an annual event to a 5-yearly event to reflect this.</p> |

## Whirinaki Proposed Thresholds

| Threshold + Threshold Measure   | Primary responsibility for monitoring and reporting to HBRC | Monitoring method/ data source  | Rationale for changes made in response to feedback as a result of community workshop held 22 June 2022   |
|---|---|---|--|
| <i>Coastal erosion in Whirinaki affecting Whirinaki Road and/or North Shore Road, causing loss of road access for the majority of the community.</i>  | HDC   | Observed/ inspected/ reported by Council asset managers during/ following coastal erosion or coastal inundation events. | No changes suggested but change made to specifically reference Whirinaki and North Shore Roads as loss of access to either of these roads from coastal erosion would affect the majority of the community. |
| <i>Buildings in Whirinaki are deemed uninhabitable as a result of coastal hazards (e.g. loss of septic tanks, building structural integrity etc).</i> | CDEM/ HDC   | Observed/ inspected/ reported by Council asset managers during/ following coastal erosion or coastal inundation events. | No changes suggested   |

## Bay View Proposed Thresholds

| Threshold + Threshold Measure   | Primary responsibility for monitoring and reporting to HBRC | Monitoring method/ data source  | Rationale for changes made in response to feedback as a result of community workshop held 22 June 2022  |
|---|---|---|---|
| <i>Coastal erosion in Bay View affecting Le Quesne Road, causing loss of road access for majority of the community.</i> | NCC   | Observed/ inspected/ reported by Council asset managers during/ following coastal erosion or coastal inundation events. | Suggestion to make to specifically reference Le Quesne Road as loss of access to this road from coastal erosion would affect the majority of the community. |

| Westshore Proposed Thresholds  |   |                                |  |
|--|---|--------------------------------|--|
| Threshold + Threshold Measure  | Primary responsibility for monitoring and reporting to HBRC | Monitoring method/ data source | Rationale for changes made in response to feedback as a result of community workshop held 22 June 2022 |
| <i>No Unit Specific Thresholds were identified for Westshore – All Units Thresholds to apply</i> |   |                                |  |

## Ahuriri Proposed Thresholds

| Threshold + Threshold Measure | Primary responsibility for monitoring and reporting to HBRC | Monitoring method/ data source | Rationale for changes made in response to feedback as a result of community workshop held 22 June 2022 |
|-------------------------------|---|--------------------------------|--|
|-------------------------------|---|--------------------------------|--|

*No Unit Specific Thresholds were identified for Westshore – All Units Thresholds to apply*

| Pandora Proposed Thresholds   |   |   |  |
|---|---|---|--|
| Threshold + Threshold Measure   | Primary responsibility for monitoring and reporting to HBRC | Monitoring method/ data source  | Rationale for changes made in response to feedback as a result of community workshop held 22 June 2022   |
| <p><i>Coastal inundation in Pandora affecting Thames Street and Severn Street causing loss of road access for the majority of the community.</i></p> <p><i>How long: At least 48 hours</i></p> <p><i>How often: More often than once every 5 years.</i></p> | NCC   | Observed/ inspected/ reported by Council asset managers during/ following coastal erosion or coastal inundation events. | <p>No changes suggested however suggestion to change the duration from 24 to 48 hours made to be consistent with feedback on this threshold for other units.</p> <p>Also, suggestion to specifically reference Thames and Severn Streets as loss of access to both these roads from coastal inundation would affect the majority of the community.</p> |

## East Clive Proposed Thresholds

| Threshold + Threshold Measure  | Primary responsibility for monitoring and reporting to HBRC | Monitoring method/ data source  | Rationale for changes made in response to feedback as a result of community workshop held 22 June 2022 |
|--|---|---|--|
| <i>Buildings in East Clive are deemed uninhabitable as a result of coastal hazards (e.g. loss of septic tanks, building structural integrity etc).</i> | CDEM/ HDC   | Observed/ inspected/ reported by Council asset managers during/ following coastal erosion or coastal inundation events. | No changes suggested   |

| Haumoana Proposed Thresholds  |   |   |  |
|---|---|---|--|
| Threshold + Threshold Measure   | Primary responsibility for monitoring and reporting to HBRC | Monitoring method/ data source  | Rationale for changes made in response to feedback as a result of community workshop held 22 June 2022   |
| <p><i>Coastal inundation in Haumoana affecting Haumoana and/or Beach Road causing loss of road access for the majority of the community.</i></p> <p><i>How long: At least 48 hours</i></p> <p><i>How often: More often than once every 5 years.</i></p> | HDC   | Observed/ inspected/ reported by Council asset managers during/ following coastal erosion or coastal inundation events. | <p>Feedback suggested that in order for the impact to be substantial and therefore act as a threshold, not a trigger, duration should be extended to 48 hrs from 24 hrs</p> <p>Also, suggestion to specifically reference Beach Road and Haumoana Road as coastal inundation of these either or both these roads from coastal inundation would affect the majority of the community.</p> |
| <p><i>Buildings in Haumoana are deemed uninhabitable as a result of coastal hazards (e.g. loss of septic tanks, building structural integrity etc).</i></p>   | CDEM/ HDC   | Observed/ inspected/ reported by Council asset managers during/ following coastal erosion or coastal inundation events. | No changes suggested   |

| Te Awanga Proposed Thresholds  |   |   |  |
|--|---|---|--|
| Threshold + Threshold Measure  | Primary responsibility for monitoring and reporting to HBRC | Monitoring method/ data source  | Rationale for changes made in response to feedback as a result of community workshop held 22 June 2022   |
| <p><i>Coastal inundation in Te Awanga affecting Clifton Road causing loss of road access for the majority of the community.</i></p> <p><i>How long: At least 48 hours</i></p> <p><i>How often: More often than once every 5 years.</i></p> | HDC   | Observed/ inspected/ reported by Council asset managers during/ following coastal erosion or coastal inundation events, including community feedback. | <p>Feedback suggested that in order for the impact to be substantial and therefore act as a threshold, not a trigger, duration should be extended to 48 hrs from 24 hrs.</p> <p>Suggestion to specifically reference Clifton Road as coastal inundation of this road would affect the majority of the community.</p> |
| <p><i>Coastal erosion in Te Awanga affecting Clifton Road causing loss of road access affecting the majority of the community.</i></p>   | HDC   | Observed/ inspected/ reported by Council asset managers during/ following coastal erosion or coastal inundation events.                               | Suggestion to specifically reference Clifton Road as coastal erosion of this road would likely cause community-wide loss of road access.   |
| <p><i>Buildings in Te Awanga are deemed uninhabitable as a result of coastal hazards (e.g. loss of septic tanks, building structural integrity etc).</i></p>   | CDEM/ HDC   | Observed/ inspected/ reported by Council asset managers during/ following coastal erosion or coastal inundation events, including community feedback. | No changes suggested   |

| Clifton Proposed Thresholds  |   |   |   |
|--|---|---|---|
| Threshold + Threshold Measure  | Primary responsibility for monitoring and reporting to HBRC | Monitoring method/ data source  | Rationale for changes made in response to feedback as a result of community workshop held 22 June 2022  |
| <p><i>Coastal inundation in Clifton affecting Clifton Road causing loss of road access for the majority of the community.</i></p> <p><i>How long: At least 48 hours</i></p> <p><i>How often: More often than once every 5 years.</i></p> | HDC   | Observed/ inspected/ reported by Council asset managers during/ following coastal erosion or coastal inundation events. | <p>Feedback suggested that in order for the impact to be substantial and therefore act as a threshold, not a trigger, duration should be extended to 48 hrs from 24 hrs.</p> <p>Suggestion to specifically reference Clifton Road as coastal inundation of this road would affect the majority of the community.</p> <p>Note: Coastal inundation of Clifton Road in Haumoana unit could have access implication for the Clifton unit. Threshold in Haumoana unit covers this.</p> |
| <p><i>Coastal erosion in Clifton affecting Clifton Road causing loss of road access affecting the majority of the community.</i></p>   | HDC   | Observed/ inspected/ reported by Council asset managers during/ following coastal erosion or coastal inundation events. | <p>Suggestion to specifically reference Clifton Road as coastal erosion of this road would likely cause community-wide loss of road access.</p> <p>Note: Coastal erosion of Clifton Road in Haumoana unit could have access implication for the on the Clifton unit. Threshold in Haumoana unit covers this.</p>  |
| <p><i>Buildings in Clifton are deemed uninhabitable as a result of coastal hazards (e.g. loss of septic tanks, building structural integrity etc).</i></p>   | CDEM/ HDC   | Observed/ inspected/ reported by Council asset managers during/ following coastal erosion or coastal inundation events. | No changes suggested  |