Coastal Risk-Based Planning: Thresholds and Scenarios

Document no: IS355300-NC-RPT-0007
Version: E

Kāpiti Coast District Council

Takutai Kāpiti
30 November 2023

Coastal Risk-Based Planning: Thresholds and Scenarios

Client name: Kāpiti Coast District Council

Project name: Takutai Kāpiti

Client reference: Client Reference

Project no: IS355300

Document no: IS355300-NC-RPT-0007

Project manager: Ian Wiseman

Version: E

Prepared by: Derek Todd, Damian Debski, Kate MacDonald, Devon Alexander, Monique Eade

Date: 30 November 2023

File name: IS355300-NC-RPT-0007-E Coastal Risk Thresholds Scenarios

Document status: Final

Document history and status

Version	Date	Description	Author	Checked	Reviewed	Approved
A	30/05/2022	Draft	D Debski, T Hegarty, K MacDonald	D Todd	A Henderson	
B	01/11/2023	Draft B	D Debski, D Todd, M Eade, D Alexander	T Hegarty	A Henderson	
C	16/11/2023	Draft C	M Eade		A Henderson	
D	27/11/2023	Draft D	M Eade	D Todd	A Henderson	
E	30/11/2023	Final	M Eade			A Henderson

Distribution of copies

Version	Issue approved	Date issued	Issued to	Comments
A	Draft	2/6/2023	KCDC	Draft for Comment
B	Draft	2/11/2023	KCDC	Draft for Review
C	Draft	16/11/2023	KCDC	Draft for Final Review
D	Draft	27/11/2023	KCDC	Election updates
E	Final	30/11/2023	KCDC	Final

Jacobs New Zealand

Level 2, Wynn Williams Building
47 Hereford Street
Christchurch Central 8013
PO Box 1147
Christchurch 8140
New Zealand

T +64 3 940 4900
www.jacobs.com

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to outline coastal risk-based planning thresholds and scenarios in accordance with the scope of services set out in the contract between Jacobs and the Kāpiti Coast District Council ('the Client'). That scope of services, as described in this report, was developed with the Client. In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate, or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from the Client and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations, and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures, and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full, and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of, the Client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

Disclaimer

This Report has been prepared by Jacobs for the Client and does not represent the views of the Client. Nothing in this report should be read as a draft or proposed plan change to the Kapiti Coast Operative District Plan, nor as an evaluation under section 32 of the Resource Management Act 1991 for any future plan change.

Executive summary

The Takutai Kāpiti project is developing recommended adaption pathways to respond to changing coastal hazards in the Kāpiti District. The Coastal Advisory Panel (CAP) will make recommendations to the Kāpiti Coast District Council (KCDC or the Council) on preferred pathways for each coastal cell. These pathways will be supported by planning responses to manage the hazard risk, which will be delivered through a future Coastal Environment Plan Change to the Kapiti Coast District Plan.

This report provides technical advice around what a risk-based planning approach is, summarises KCDC's obligations under the Resource Management Act 1991 in applying a risk-based approach, and provides examples of how a risk-based approach could be applied in Kāpiti. The examples provided show how areas within the district could be categorised, depending on the likelihood of flooding occurring under different scenarios. These options and the recommendations in the report are advisory only and are based on existing technical information previously provided to the Council by Jacobs. The recommendations represent the view of Jacobs and do not represent Council policy.

Existing planning framework

The existing planning framework relating to the management of coastal hazards provides direction on how territorial authorities should approach coastal hazard planning. This framework was explored in *Memorandum No. 1 Summary of the Planning Framework Relevant to Coastal Hazards, June 2022* (Memo 1) which was presented to the CAP on 25 May 2022. Since June 2022, there have been several important changes to the relevant planning framework and therefore, an updated version of Memo 1, is provided in Appendix A.

The New Zealand Coastal Policy Statement (NZCPS) is the primary national direction on the management of coastal issues.[1] Policy 3 requires a precautionary risk management approach to be adopted when the risk of potential significant adverse or irreversible environmental effects cannot be adequately assessed. Policy 25 provides strong direction and requirements on avoiding inappropriate development in areas potentially affected by coastal hazards over at least the next 100 years. This includes avoiding increased risks of harm associated from coastal hazards, encouraging risk reductions by locating activities outside areas of risk, and discouraging hard protection structures.

RPS PC1 Proposed Policy 29 states that district plans shall:

(a) *identify areas <u>affected by</u> natural hazards; and*

(b) *<u>use a risk-based approach to assess the consequences to subdivision, use and development from natural hazard and climate change impacts over a 100 year planning horizon;</u>*

(c) *include <u>objectives</u>, polices and rules to <u>manage</u> subdivision, <u>use</u> and development in those areas <u>where the hazards and risks are assessed as low to moderate; and</u>*

(d) <u>*include objectives, polices and rules to avoid subdivision, use or development and hazard sensitive activities where the hazards* and risks are assessed as high to extreme.</u>

Section 74(2)(a) of the RMA states that territorial authorities shall have regard to any proposed regional policy statement when preparing or changing a district plan. Therefore, in accordance with proposed Policy

[1] KCDC wrote to the Ministry for the Environment (MfE) and Department of Conservation (DOC) in October 2023 to confirm that the correct approach was being adopted. The correspondence is available at https://haveyoursay.kapiticoast.govt.nz/hub-page/takutai-kapiti-documents. MfE and DOC have confirmed that NZCPS policy 24(1) requires coastal hazards identification to take account of national guidance and the best available information on the likely effects of climate change on the region or district. As such, the Ministry and DOC guidance both need to be considered in making planning decisions on coastal hazards, noting the needs of a particular district or region. These are non-statutory documents.

29, KCDC is not only required to use a risk-based approach to assess consequences in natural hazard assessment, KCDC is also required to include overlays, objectives, policies and rules that reflect areas identified as low, medium or high risk within the risk-based assessment. While KCDC must have regard to proposed Policy 29, KCDC is not required to give effect to proposed Policy 29 until RPS PC1 becomes operative. KCDC is required however to give effect to the RPS as it currently stands.

An overlay spatially identifies distinctive values, risks or other factors that require management in addition to the underlying zoning in the District Plan.

A risk-based approach

A risk-based approach to planning is based on the concept that the risk is not the same across the entire mapped hazard extent. A risk-based approach seeks to match land use controls to the degree of risk from the hazard. This differs from the coastal hazard rule framework in the current Kapiti Coast District Plan which includes a simplistic rule framework primarily focused on coastal erosion. The current provisions include a 20 m development setback on sites in Paraparaumu, Raumati, Paekākāriki and a 20 m to 50 m wide relocatable area.

Areas are required by the RPS PC1 to be identified as low, medium or high risk based on the likelihood and consequence of a hazard. A risk-based approach involves applying progressively more stringent rules proportionate to the level of risk and sensitivity of the activity to the hazard, unless there is a functional or operational need for the activity to occur in these areas. The Kapiti Coast District Plan provisions were developed prior to the NZCPS and the RPS. A plan change is required to give effect to the NZCPS and RPS and have regard to RPS PC1 and to implement a risk-based approach.

An example of how this could be applied is shown in Table 1 below.

Table 1.1: Example of activity specific risk-based planning statuses

Risk ⇨	Low	Medium	High
Sensitive Activity	Restricted Discretionary	Non-complying	Non-complying / Prohibited
Potentially Sensitive Activities	Restricted Discretionary	Discretionary	Non-complying
Non-sensitive Activity	Permitted	Restricted Discretionary	Discretionary

Defining sensitivity

The Coastal Environment Plan Change could expand on the hazard sensitive activity definition provided in the RPS PC1. The Proposed Wellington and Porirua District Plans also have detailed lists of activities that can be used as a basis to determine sensitivity. Sensitive activities include residential development, retirement villages and educational facilities. Potentially sensitive activities could include commercial or retail activities and non-sensitive activities or less sensitive activities could include temporary activities, rural activities, or parks.

Defining hazard risk overlays

Hazard risk overlays should be based on technical hazard information currently available. This report outlines a recommended approach to determining the hazard categories. This is through the consideration of thresholds and scenarios for the coastal erosion and inundation hazards. Within this document thresholds are the technical categorisation in which you move from one risk category to another, e.g., the depth of water that makes a change from being in an area of low hazard to a medium hazard area. Scenarios are the Shared Socio-economic Pathways (SSP) / predicted relative sea level rise that is considered most relevant for use in planning.[2] This report suggests how these could be applied to the coastal hazard data developed through the Takutai Kāpiti project.

Scenarios and thresholds that could define these overlays based on the available hazard information is explored in this report for both the inundation and erosion hazards.

Inundation hazard risk overlays

Considering a number of principles and guidance, it is recommended that the most appropriate increments of RSLR to consider for a risk-based approach to land-use planning are from the SSP5-8.5 scenario coupled with a -1 mm/yr VLM rate over 50- and 100-year time frames, with these increments being:

- 0.45 m SLR by 2070, and
- 1.25 m SLR by 2130.

The preferred approach for **inundation overlay thresholds and categorisation** adopts the following principles:

- Uses a single likelihood of flooding of a 1% AEP; and
- Combines the hazard severities of the two increments of RSLR (0.45 m SLR and 1.25 m SLR) into a single measure of 'flood risk'; and
- Considers three categories of hazard severity (low, medium, high), informed by published scientific guidelines and consistent with RPS PC1.

Coastal erosion risk overlays

For coastal erosion overlays, it is considered that the most preferable threshold options for high, medium and low hazard risk overlay boundaries are:

- High Erosion Hazard Risk Overlay: Threshold option of 66% probability under 0.45 m RSLR by 2070.
- Medium Erosion Hazard Risk Overlay: Threshold option of 66% probability under 1.25 m RSLR by 2130.
- Low Erosion Hazard Risk Overlay: Threshold option of 10% probability under 1.25 m RSLR by 2130.

Further consideration is needed for overlays around hydrosystems and additional protection of existing dune systems for continuation of hazard protection in the future as dunes migrate landward. Any approach will need to give effect to the RPS.

[2] KCDC wrote to the Ministry for the Environment and Department of Conservation in October 2023 to confirm that the correct approach was being adopted. The correspondence is available at https://haveyoursay.kapiticoast.govt.nz/hub-page/takutai-kapiti-documents.

Contents

Appendices

Tables

Figures

Acronyms and abbreviations

AEP	Annual Exceedance Probability
AR6	Sixth assessment report
AR&R	Australian Runoff and Rainfall Guidelines
ARI	Average Recurrence Interval
CAP	Coastal Advisory Panel
DEFRA	UK Department for Environment, Food and Rural Affairs
GHG	Greenhouse gas
HDC	Horowhenua District Council
IPCC	Intergovernmental Panel on Climate Change
KCDC	Kāpiti Coast District Council
KCDP	Kapiti Coast District Plan 2021
MfE	Ministry for the Environment
NZCPS	New Zealand Coastal Policy Statement
PCC	Porirua City Council
PFSP	Projected Future Shoreline Position
RCP	Representative Concentration Pathways
RPS	Regional Policy Statement
RMA	Resource Management Act 1991
RSLR	Relative Sea Level Rise
SLR	Sea Level Rise
SSP	Shared Socio-economic Pathway
SVA	Kāpiti Coast Coastal Hazards Susceptibility and Vulnerability Assessment Report
VLM	Vertical Land Movement
WCC	Wellington City Council

1. Introduction

The purpose of this report is to outline what a risk-based approach to managing coastal hazards might look like to inform Coastal Advisory Panel's (CAP) advice to Council on the upcoming Coastal Environment Plan Change. As part of this plan change Kāpiti Coast District Council (KCDC) will need to consider adopting a risk-based approach.

Takutai Kāpiti is KCDC's coastal adaptation project. Through this process, the CAP will make recommendations to Council on how the district could adapt to changing coastal hazards as a result of climate change. One method for managing the changing risk is through planning provisions in the District Plan. This would be delivered through the future Coastal Environment Plan Change to the Operative Kapiti Coast District Plan (the **District Plan**).

The New Zealand Coastal Policy Statement (NZCPS) and Regional Policy Statement for Greater Wellington (RPS) require KCDC to adopt a risk-based approach to managing hazard risk. This report provides technical advice around what a risk-based planning approach is, summarises KCDC's obligations under the Resource Management Act 1991 in applying a risk-based approach, and provides examples of how a risk-based approach could be applied in Kāpiti. It also considers the range of relative sea level rise (RSLR) scenarios that maybe appropriate for a risk-based planning approach.

1.1 Reviewing the coastal hazard provisions in the District Plan

Section 79 of the Resource Management Act 1991 (RMA) requires councils to have commenced a review of the provisions in their district plans no later than 10 years after the date that they became operative. A full review of the 1999 district plan was commenced in 2008, and a second-generation district plan (including proposed coastal hazard provisions) was notified in 2012. However, following Council decisions to withdraw coastal hazard provisions in 2014 and 2017, a defined suite of 1999 provisions remain in effect. Council intends to replace those provisions through a future coastal environment plan change. The scope of the Takutai Kāpiti process includes the delivery to Council of recommendations intended to "…guide development of District Plan provisions to manage coastal issues and an approach for the district dealing with coastal hazards."

KCDC are also required to amend the District Plan to give effect to the National Planning Standards. The District Plan has been amended to give effect to the National Planning Standards. KCDC has until 2026 to align the Coastal Environment Chapter with the standards. A Coastal Environment Plan Change will be required to give effect to the higher order documents, most notably the RMA, NZCPS and RPS.

KCDC are required to review the coastal hazard provisions of the District Plan. This report sets out the legislative and policy framework which the plan change must give effect to and proposes an approach as to how this may be achieved. Further assessment and evaluation will be required as part of the Section 32 Report[3] supporting the plan change.

1.2 What is a risk-based approach?

A risk-based approach considers the likelihood of a hazard occurring combined with the consequence of the hazard occurring. Through this Coastal Hazard Risk Overlays can be developed. A risk-based approach

[3] Section 32 reports are prepared by Council to support a proposed plan change. The reports are mandatory and must "identify and assess the benefits and costs of the environmental, economic, social, and cultural effects that are anticipated." Plan changes are statutory processes and subject to submissions, further submissions, and hearing processes. Through this process all information is considered by the hearing panel.

involves applying progressively more stringent rules proportionate to the level of risk. This usually considers the sensitivity of the activity to the risk. This approach enables councils to have varying degrees of control over the activities that occur within high, medium, and low hazard risk areas. This contrasts to the existing coastal hazards provisions in the Kapiti Coast District Plan (2021), which have not been updated for various reasons since the 1999 District Plan. It is anticipated that new provisions would apply districtwide.

Under a risk-based approach, there is a need to define appropriate relative sea level rise (RSLR) scenarios and boundary thresholds between hazard levels or categories of risk for areas exposed to coastal inundation and erosion. KCDC have commissioned Jacobs to investigate and recommend justifiable and appropriate scenarios and thresholds for defining the coastal hazard categories for land use planning over the Kāpiti Coast District.

1.3 Background information

The data used to undertake this analysis is from the Takutai Kāpiti Coastal Adaptation project, being the Kāpiti Coast Coastal Hazard Susceptibility and Vulnerability Assessment undertaken by Jacobs (Jacobs 2021 (Volume 1 - Methodology) and 2022 (Volume 2 - Results)), and the further updated coastal hazard mapping undertaken by Jacobs for the Coastal Hazard Risk Assessments across five Coastal Adaptation Areas within the district. It is recognised that the primary purpose of the Jacobs assessments was to inform the Takutai Kāpiti Coastal Adaptation project, however, as explained in the Technical Reporting for the assessment, the outputs of the assessment have also been developed for use by KCDC to *"provide base hazard data for future District Plan change processes*."

This report outlines a risk-based approach. As part of a plan change Council is required to prepare a Section 32 evaluation report considering whether the objectives of the proposal are the most appropriate way to achieve the purpose of the Act. As part of this evaluation Council must identify and assess the benefits and costs of the environmental, economic, social, and cultural effects that are anticipated. The approach outlined as part of this report will be subject to this evaluation before it is included as part of any proposed plan change. A proposed plan change is subject to a submission, further submission, and hearing process where the decision-makers are required to consider all evidence and views before making a decision.

Consideration has been given to the available data for mapping hazard areas and how these could be applied. However, given this approach to risk-based planning is yet to be adopted by KCDC, mapping has not been completed. This will be required as part of the plan change.

2. Existing Coastal Hazard Management and Planning Requirements

An overview of the planning framework relevant to coastal hazard planning and assessment is provided in *Memorandum No. 1 Summary of the Planning Framework Relevant to Coastal Hazards, June 2022* (Memo 1). Appendix A includes an updated version of Memo 1 to reflect changes in the New Zealand planning framework including:

- Proposed National Policy Statement for Natural Hazard Decision-making 2023
- Proposed Change 1 to the Regional Policy Statement for Greater Wellington Region 2022
- Plan Change 2 to the Kapiti Coast District Plan
- Planning processes in neighbouring territorial authorities.

Memo 1 states that the document controlling resource management in New Zealand is the Resource Management Act 1991 (RMA), which sets out the functions of territorial authorities including the processes that territorial authorities must follow when developing a plan change to district plans. The RMA identifies a hierarchy of statutory instruments and matters that territorial authorities must ensure plan changes are in accordance with, or have regard to, throughout the plan development process. These instruments are afforded differing weight in the decision-making process and includes (but is not limited to):

- National Policy Statements (including the New Zealand Coastal Policy Statement);
- National Environmental Standards;
- National Adaptation Plans;
- National Planning Standards;
- The Regional Policy Statement and any Proposed Regional Policy Statement;
- Regional Plans and any Proposed Regional Plans;
- Heritage and Water Conservation Orders; and
- District Plans within adjacent territorial authorities.

These statutory instruments provide direction to territorial authorities on how to approach risk-based coastal hazard planning and effectively place obligations on territorial authorities when developing district plan changes relating to coastal hazards. The framework sets out required actions and areas where a territorial authority has or does not have discretion in decision-making. These requirements are briefly summarised below.

2.1 The Resource Management Act 1991 (the RMA)

The RMA is the legislation which governs resource management, including district planning at a territorial authority level. The RMA also sets out clear functions, powers and duties for regional and territorial authorities to achieve the purpose of the RMA. Section 4 of Memo 1 sets out the sections of the RMA of relevance to district plan change addressing natural hazards in the coastal environment. The following provides a summary of important requirements set out in Section 6(h), Section 31(1)(b)(i), and Section 106.

Section 6 sets out the matters of national importance that must be recognised and provided for in RMA processes and decision-making. Although all clauses of Section 6 are relevant when identifying and considering options to address coastal hazards through a plan change, Section 6(h) directly addresses coastal hazards:

> *In achieving the purpose of this Act, all persons exercising functions and powers under it, in relation to managing the use, development, and protection of natural and physical resources, shall recognise and provide for the following matters of national importance:*
>
> …
>
> *(h) the management of significant risks from natural hazards.*

Section 6(h) identifies that councils have a duty, at a minimum, to manage significant risks. Environment Court decisions have established that the requirement to "*recognise and provide for*" section 6 matters implies that these matters have a significant priority and cannot merely be an equal part of a general balancing exercise[4]. However, section 6(h) does not prevent councils from considering other risks (i.e. risks less than significant in scale or risks associated with manmade hazards).

In accordance with Section 31(1)(b)(i)1 of the RMA, KCDC have a function to control any actual or potential effects associated with activities for the purpose of avoiding or mitigating natural hazards. This includes use, development, or protection of land, as well as the control of subdivision. In accordance with Section 106(1) of the RMA a consent authority may refuse to grant a subdivision consent or may grant a subdivision consent subject to conditions if there is a significant risk from natural hazards. In accordance with the RMA, it is the responsibility of KCDC to identify and communicate the existence of known natural hazards. Under Section 106 of the RMA, relevant information on known natural hazards does not need to be within a district plan for a district council to use in a section 106(1)(a) determination. However, it is important that a district plan incorporates clear and accurate identification of coastal hazards to provide certainty to consent applicants, stakeholders and decision-makers on subdivision proposals.

2.1.1 Resource Management Reforms

In the previous Parliamentary term, the Natural and Built Environment Act 2023 (NBA) and the Spatial Planning Act 2023 (SPA) were passed. The new government have committed to repealing both acts and replacing the RMA with new legislation. At this stage, it is impossible to know what the legislation will mean for a future Coastal Environment Plan Change.

Accordingly, this report assumes that the RMA and subsidiary documents (i.e., NZCPS) will remain as currently drafted during the period that the plan change is being prepared. This report may be updated if more information comes to light regarding potential implications of RMA reform.

2.2 New Zealand Coastal Policy Statement (NZCPS 2010)

As noted in Section 2.1, the RMA provides the overarching direction for resource management, including district planning. Underneath the RMA, National Policy Statements (NPS) provide direction on achieving sustainable management of the matters of national significance.

All RMA plans and decisions are required to give effect to NPS's whenever relevant. The NZCPS is directly applicable to coastal hazard planning and provides national direction for the management of and adaption to coastal hazards. According to the Supreme Court, the requirement to "give effect to" simply means "implement". The Court provided the following further guidance on the requirement:

- On the face of it, it is a strong directive, creating a firm obligation on the part of those subject to it.
- However, the implementation of such a directive will be affected by what it relates to, that is, what must be given effect to. A requirement to give effect to a policy which is framed in a specific and unqualified way (i.e., which creates an "environmental bottom line") may, in a practical sense, be more prescriptive than a requirement to give effect to a policy which is worded at a higher level of abstraction.

---

[4] Bleakley v Environmental Risk Management Authority [2001] 3 NZLR 213 (HC) and Harrison v Tasman DC [1994] NZRMA 193 (PT)

The NZCPS includes policies dealing with the identification of coastal hazards, natural defences against coastal hazards, subdivision, use and development in areas of coastal hazard risk and strategies for protecting significant existing development from coastal hazard risk. Of particular relevance are the following provisions:

> ***Objective 5***
>
> *To ensure that coastal hazard risks taking account of climate change, are managed by:*
>
> - *locating new development away from areas prone to such risks;*
> - *considering responses, including managed retreat, for existing development in this situation; and*
> - *protecting or restoring natural defences to coastal hazards.*

Objective 5 sets the required outcomes when developing proposed planning provisions to address coastal hazards.

> **Policy 3**: *Precautionary approach*:
>
> *(1) Adopt a precautionary approach towards proposed activities whose effects on the coastal environment are uncertain, unknown, or little understood, but potentially significantly adverse.*
>
> *(2) In particular, adopt a precautionary approach to use and management of coastal resources potentially vulnerable to effects from climate change, so that:*
>
> *(a) avoidable social and economic loss and harm to communities does not occur; ……*

The precautionary approach requires a risk management approach and is appropriate when the risk of potential significant adverse or irreversible environmental effects cannot be adequately assessed.

- **Policy 24**: The identification of coastal hazards

  Policy 24 outlines the process and the matters that require consideration when identifying coastal hazards, including that the timeframe for consideration is at least 100 years and has to include the effects of climate change and sea level rise. The policy gives priority to the identification of areas at high risk of being affected over this timeframe and includes having to take account of "*national guidance and the best available information on the likely effects of climate change on the region or district'*. This process is reflected in the Jacobs Coastal Hazard Susceptibility and Vulnerability Assessment.

- **Policy 25**: Subdivision, use and development in areas of coastal hazard risk

  Policy 25 provides strong direction and requirements on avoiding inappropriate development in areas potentially affected by coastal hazards over at least the next 100 years. This includes avoiding increased risks of harm associated from coastal hazards, encouraging risk reductions by locating activities outside areas of risk, and discouraging hard protection structures.

- **Policy 26**: Natural defences against coastal hazards

  Policy 26 requires local authorities to provide where appropriate for the protection, restoration or enhancement of natural defences that protect coastal land uses, or sites of significant biodiversity, cultural or historic heritage or geological value, from coastal hazards.

- **Policy 27**: Strategies for protecting significant existing development from coastal hazard risk

  Policy 27 sets out a range of matters that should be assessed when considering options to reduce coastal hazard risk for existing developments, including when it is appropriate to use hard engineering structures. These matters are consistent with the process for considering coastal hazard adaptation pathways under the Takutai Kāpiti project.

2.3 Proposed National Policy Statement for Natural Hazards Decision-making (2023)

The Proposed National Policy Statement for Natural Hazards Decision-making (2023) currently has no legal status or weight. This national policy statement proposes requiring the use of a risk-based approach including defining areas as low, medium or high risk. If the national policy statement becomes operative, the Plan Change will be required to give effect to it. However, its future under a new government is uncertain and accordingly no further discussion is undertaken.

2.4 Proposed Change 1 to the RPS for the Greater Wellington Region

The Regional Policy Statement for the Wellington Region (the RPS) sets out the framework and priorities for resource management in the Greater Wellington region. The RPS provides a framework that identifies the regionally significant issues to manage the regions natural and physical resources in an integrated way and sets out what needs to be achieved (objectives) and the way in which the objectives will be achieved (policies and methods).

The Greater Wellington Regional Council is undertaking a review of the RPS and Proposed Change 1 to the Regional Policy Statement for the Wellington Region (RPS PC1) was notified on 19 August 2022. RPS PC1 is now at the hearings stage of the statutory planning process. The hearings started in June 2023 and are scheduled to finish in March 2024.

Section 74(2)(a) of the RMA states that when preparing or changing a district plan, a territorial authority shall have regard to any proposed regional policy statement. Both the RPS and RPS PC1 are considered in Section 7 of Memo 1. Several of the key provisions are discussed below. Amendments made to the RPS at notification are shown in black. Deletions are shown in strike through, and additions are shown in underline.

RPS PC1 Objective 19 states: The risks and consequences to people, communities, ~~their~~ business~~es~~, property, ~~and~~ infrastructure and the environment from natural hazards and the effects of climate change ~~effects~~ are ~~reduced~~ minimised.

Objective 21 states: The resilience of our ~~C~~communities ~~are more resilient to natural hazards, including the impacts~~ and the natural environment to the short, medium, and long-term effects of climate change~~,~~ and sea level rise is strengthened, and people are better prepared for the consequences of natural hazard events.

Objectives 19 and 21 provide direction that resource management decision-making should consider hazard risk and resilience at varying time scales. Therefore, technical assessments that will inform future resource management and adaption decision making must assess the risk of coastal erosion and water inundation at short, medium, and long-term time periods. Noting that the NZCPS requires hazard risk to be considered over a 100-year time frame, the risk-based approach considered within this report assesses varying timeframes through to 2130.

Policy 29 places firm obligations on what territorial authorities shall include in district plans to manage areas at low, medium, or high risk of natural hazards.

> *Policy 29 ~~Avoiding inappropriate~~ Managing subdivision, use and development in areas at risk from natural hazards – district and regional plans*
>
> Regional and district plans shall:
>
> (a) identify areas affected by natural hazards; and
>
> (b) use a risk-based approach to assess the consequences to subdivision, use and development from natural hazard and climate change impacts over a 100 year planning horizon;

(c) include objectives, polices and rules to manage subdivision, use and development in those areas where the hazards and risks are assessed as low to moderate; and

(d) include objectives, polices and rules to avoid subdivision, use or development and hazard sensitive activities where the hazards and risks are assessed as high to extreme.

To implement Policy 29, appropriate assessment is necessary to accurately identify the areas affected by natural hazards. The policy requires KCDC to adopt a risk-based approach to assessment and requires the areas of low, moderate or high risk identified through assessment to be incorporated within district planning provisions and maps. The proposed amendments to Policy 51 require territorial authorities to consider how the risk and consequences of natural hazards shall be minimised when preparing a district plan change. The implementation of Policy 51(g) requires territorial authorities to include provisions in district plans that avoid subdivision, use or development in areas where hazards and risks are assessed as high. The policy also enables subdivision in low to moderate risk areas provided appropriate risk management and/ or adaption is in place. Specific floor levels are prescribed in Policy 51(j) for specific buildings within flood prone areas. Further details on Policy 51 and other relevant PC1 RPS provisions are set out in Section 7.1 of Memo 1.

Section 75(3) of the RMA states that a district plan must give effect to any regional policy statement and therefore the operative RPS still has significance in district planning process and several of the operative provisions are relevant to coastal hazard planning. Further detail on relevant RPS provisions is provided in Memo 1.

2.5 Current Kapiti Coast District Plan Requirements

The Kapiti Coast District Plan (KCDP 2021) includes, as part of General District Wide Matters, sections on the Coastal Environment and Natural Hazards chapters. With relevance to coastal hazards Objective (DO-O4) includes:

"To have a coastal environment where:

…

3. The effects of inappropriate subdivision, use and development are avoided, remedied, or mitigated; and […]

5. Inappropriate development does not result in further loss of coastal dunes in the area mapped as the coastal environment."

While areas affected by natural hazards are not specifically referenced, this may be a consideration when Council is determining the appropriateness of an activity.

The objective that the Natural Hazards chapter of the KCDP implements (DO-O5) is:

"To ensure the safety and resilience of people and communities by avoiding exposure to increased levels of risk from natural hazards, while recognising the importance of natural processes and systems."

This objective requires the Council to avoid areas at risk of natural hazards or where development exists already, adopting mitigation measures to lessen the impacts of natural hazards and consideration of natural features and processes (e.g., sand dunes, beaches, wetlands, areas of native vegetation) when considering hazard mitigation works.

The policies within the Natural Hazards section apply to all natural hazards excluding coastal hazards, which are still covered by the 1999 District Plan provisions. In this regard, the Operative 2021 KCDP states:

"As a result of the withdrawal of coastal hazard provisions from the Proposed District Plan in 2014 and 2017, there are specific coastal hazard-related provisions in the District Plan 1999 that remain

operative and in force until they are replaced through a Schedule 1 of the Resource Management Act 1991 process."

However, these provisions relate primarily to coastal erosion, and are summarised in section 2.5.1 below. Flood hazard policies are included in the Natural Hazards section, although mainly relating to fluvial and pluvial sources, these are detailed in Memo 1.

2.5.1 KCDP 1999 Coastal Erosion Provisions[5]

As stated above, these provisions, relating primarily to coastal erosion, remain operative and in force until replaced by a District Plan change. The relevant policies under the 1999 District Plan, which pre-date the NZ Coastal Policy Statement and the RPS, include:

> ***Policy 2*** *Discourage the development of buildings and other significant assets in areas which may be prone to Coastal erosion or the effects of sea level rise, unless the structures:*
>
> - *have a significant community benefit and need to be located in the coastal environment; and*
> - *do not adversely effect the natural character of the coastal environment; and*
> - *are relocatable.*

This policy requires the Council to discourage development in areas that are prone to coastal erosion unless the adverse environmental effects are adequately mitigated.

> ***Policy 3*** *In respect of residential buildings, control the location of buildings within areas subject to coastal erosion.*

This policy requires the Council to control development within areas subject to coastal erosion.

> ***Policy 4*** *Discourage coastal protection works on the Coastal Marine Area interface where they are not already present and encourage management options such as managed retreat and coastal renourishment rather than hard engineering works when protection works are sought.*

This policy requires the Council to discourage coastal protection works on the CMA and encourage the implementation of natural management options rather than hard engineering works/structures.

The 1999 District Plan provisions include a simplistic rule framework which enables yards and relocatable buildings within mapped setback lines along parts of the coast. A coastal building line restriction of 20m exists (i.e., a development setback) on sites in Paraparaumu, Raumati, Paekākāriki (shown on District wide and Urban Plan Features Maps 8, 11, 14 and 16). Buildings within a 20 m to 50 m wide relocatable area, as defined in Part Q of the 1999 District Plan provisions and shown on District wide and Urban Plan Features Maps 11, 14, 16 and 19, are required to be relocatable (see Figure 2.1).

Therefore, currently under the district plan, the Council is not able to consider proposed development on all sites within the extent of the coastal environment (shown in Map 11 in Figure 2.1 below) as Standard D.1.2.1 Yard (iii) only applies to buildings on sites within 20 m Building Line Restriction shown in maps 8, 11, 14 and 16. There are no development controls or standards applicable to development within the full extent of the coastal environment, which limits consideration of coastal hazards at other locations.

[5] Background history of the coastal hazard provisions in the District Plan, is included in reports to the 10 December 2020 Council meeting. Available at: https://kapiticoast.infocouncil.biz/Open/2020/12/CO_20201210_AGN_2272_AT_WEB.htm

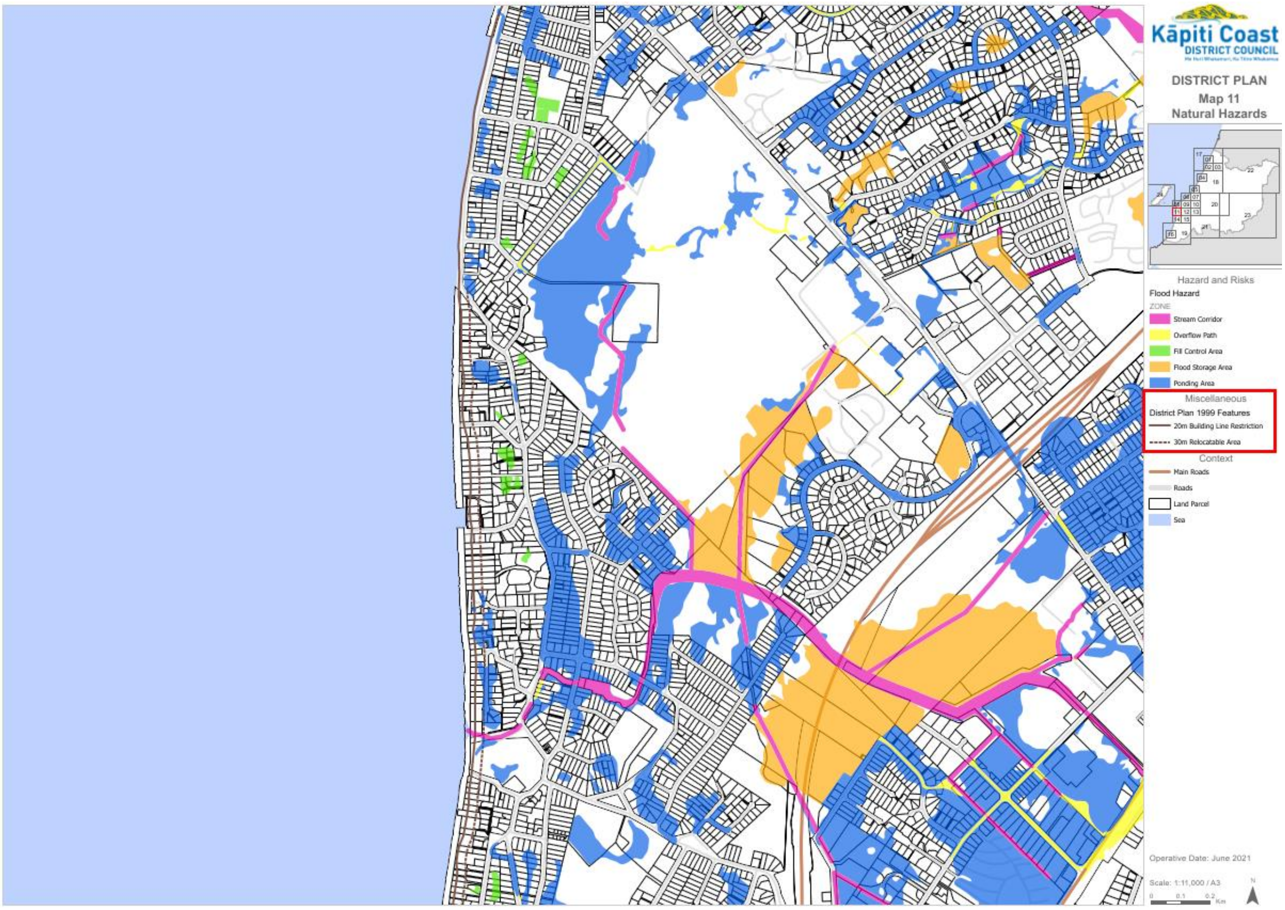

Figure 2.1: Example extract from KCDC District Plan showing current mapped erosion provision lines

2.5.2 Plan Change 2 (PC2)

The Resource Management (Enabling Housing Supply and Other Matters) Amendment Act (2021) made changes to the National Policy Statement on Urban Development (NPS-UD) and introduced the Medium Density Residential Standards (MDRS). Section 77G of the RMA requires that the Council incorporates the MDRS into the District Plan. This means that a proposed District Plan change was required to provide for the construction and use of up to three, three-storey residential units as a permitted activity within "relevant residential zones", which for the Kapiti Coast District Plan means the General Residential Zone. KCDC notified a proposed Plan Change 2 to the District Plan on 18 August 2022, which incorporated the MDRS into the District Plan. Plan Change 2 was made operative from 1 September 2023.

PC2 provides a "*Coastal Qualifying Matter Precinct*" in the part of the district that has been identified as potentially susceptible to coastal erosion hazard. The spatial extent of the Coastal Qualifying Matter Precinct is based on the 2120 P10 projected future shoreline position using the RCP 8.5+ (with -3 mm/year vertical land movement) relative sea level rise scenario described in Jacobs (2022) *Kāpiti Coast Coastal Hazard Susceptibility and Vulnerability Assessment Volume 2: Results*.

Council has publicly stated applying this qualifying matter is "*not…intended to pre-judge what the most suitable planning or other approaches might ultimately be for those affected areas – the intent would be to continue with the Takutai Kāpiti process to guide future decision-making on that.*"[6] Consistent with this, the stated purpose of the precinct is to *"identify the area where it is not considered appropriate to enable the level*

[6] See Council's submission on the Resource Management (Enabling Housing Supply) Amendment Bill, available at: https://www.kapiticoast.govt.nz/media/fnohaaz2/submission-resource-management-enabling-housing-supply-amendment-bill.pdf

of development otherwise required by the MDRS and Policy 3 of the NPS-UD until the management of coastal hazards is addressed through a future coastal environment plan change."[7]

The Independent Hearing Panel's Report to the Councillors on PC2 states "*The Panel considers the Takutai Kāpiti Coastal Adaptation Project should take its course, and the spatial extent of Coastal Qualifying Matter Precinct should not be treated as anything other than a placeholder"*[8]and *"to ensure there is no implicit bias created by introducing the Coastal Qualifying Matter Precinct at this stage to address the unexpected requirements of the RMEHS, PC2 should make it plain that the extent of the Coastal Qualifying Matter Precinct is provisional and subject to further processes."*[9]

PC2 introduced Policy GRZ-P26 *Coastal Qualifying Precinct* which states:

> *"Within the Coastal Qualifying Matter Precinct, the level of subdivision and development otherwise required by the Medium Density Residential Standards and policy 3 of the NPS-UD will not be enabled until the management of coastal hazards within the precinct is addressed through a future coastal environment plan change.*
>
> *Note: The Coastal Qualifying Matter Precinct will be removed when provisions to manage coastal hazards are incorporated into the District Plan as part of a future coastal environment plan change."*

While PC2 does not apply the level of development required by the MDRS or the NPS-UD to these General Residential Zones, it also does not propose any new restriction on development in these areas either, so the development provisions of the Operative District Plan remain unchanged within this zone. In essence, the purpose of PC2 is to therefore avoid the situation where development and 'as of right' subdivision that would otherwise be permitted or authorised under the MDRS or Policy 3 of the NPS-UD may place additional people, allotments, buildings and infrastructure at risk from coastal hazards before the proposed Coastal Environment Plan Change progresses to give effect to the RMA, NZCPS and RPS requirements to manage coastal hazard risk.

2.6 National Adaptation Plan

Section 74(2)(e) of the RMA requires Council to have regard to any national adaptation plan made in accordance with section 5ZS of the Climate Change Response Act 2002. New Zealand's first National Adaptation Plan was published in August 2022. The National Adaptation Plan outlines a range of Government-led strategies, policies and proposals that will help New Zealanders adapt to the changing climate and its effects. The current relevant direction in the National Adaptation Plan is provided below.

> *"To assist local government make good decisions about where and how to develop in the face of climate risk, the Government published interim guidance on the use of new sea-level rise projections in July 2022. The interim guidance updates the Coastal hazards and climate change: Guidance for local government (coastal hazards guidance). A full update to the coastal hazards guidance will be published in 2023.*
>
> *The interim guidance is non-statutory. However, from 30 November 2022, councils will be required to 'have regard to' this plan when making or changing regional policy statements or regional or district plans. For that reason, this plan directs councils as follows.*

[7] Proposed Plan Change 2 – Intensification Section 32 Evaluation Report, p.153. Available at: https://www.kapiticoast.govt.nz/media/xmzfukmb/pc2_s32.pdf

[8] The Independent Hearing Panel's Report to the Councillors of the Kāpiti Coast District Council on Plan Change 2 Under RMA Schedule 1, Part 6, Clause 100, p.47. Available at: https://www.kapiticoast.govt.nz/media/jrmofuz1/ihp-report-to-kapiti-coast-district-council-on-pc2.pdf

[9] The Independent Hearing Panel's Report to the Councillors of the Kāpiti Coast District Council on Plan Change 2 Under RMA Schedule 1, Part 6, Clause 100, p.50. Available at: https://www.kapiticoast.govt.nz/media/jrmofuz1/ihp-report-to-kapiti-coast-district-council-on-pc2.pdf

> *When making or changing policy statements or plans under the RMA, including to give effect to the provisions of the NZCPS, councils should use the recommended climate change scenarios outlined below, as a minimum:*
>
> - *to screen for hazards and risks in coastal areas, use the Shared Socioeconomic Pathway scenario for fossil fuel intensive development (SSP5-8.5) where available, or the Representative Concentration Pathway RCP 8.5 to 2130*
> - *for detailed hazard and risk assessments in coastal and non-coastal areas, use both the middle-of-the-road scenario (SSP2-4.5) and the fossil fuel intensive development scenario (SSP5-8.5) where available, RCP 4.5 and RCP 8.5, to 2130, for areas at high risk of being affected, adding the relevant rate of vertical land movement locally. Where SSP2-4.5 and SSP5-8.5 are not available, use RCP 4.5 and RCP 8.5 to 2130, adding the relevant rate of vertical land movement locally*
> - *for all other climate hazards and risks, use the most recent downscaled climate projections for Aotearoa."*
>
> In addition, councils should stress test plans, policies and strategies using a range of scenarios as recommended in the interim guidance and the National Climate Change Risk Assessment Framework, as relevant to the circumstance.
>
> These recommended climate scenarios reflect the latest global climate projections released in the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6 WG1) (2021) and VLM projections from NZSeaRise.[10]

This sets the minimum climate change scenarios to be considered as part of any plan change. The SSP2-4.5 and SSP5-8.5 scenarios have been used for the Takutai Kāpiti Risk Assessments.

2.7 Adjacent Council Approaches

Section 74(2)(c) of the RMA requires territorial authorities to have regard to the extent to which the district plan needs to be consistent with the plans or proposed plans of adjacent territorial authorities. Kāpiti Coast is adjacent to Horowhenua District Council to the north and Porirua City Council to the south. For completeness the Wellington City Council Proposed District Plan is also considered as this is the most recent Proposed District Plan in the Wellington Region. All relevant objectives and policies are detailed in Appendix One. The sections below outline the high-level approach adopted by each Council.

2.7.1 Porirua City Council Proposed District Plan

Porirua City Council (PCC) notified their Proposed District Plan on 28 August 2020. Hearings on the Proposed District Plan are complete, and decisions on submissions are expected in December 2023. The provisions of the proposed District Plan are provided below however it is noted that these are subject to change. The Officer's Right of Reply provides an indication of where the provisions were heading at the end of the hearing. There are changes proposed to the wording however the overall direction of the objectives and policies remains unchanged.

PCC adopts a risk-based approach including a breakdown of the susceptibility of different activities and the corresponding sensitivities to natural hazards (including coastal hazards).

The most relevant objective is **CE-O2 Risk from natural hazards:** Subdivision, use and development in the Coastal Hazard Overlays do not significantly increase the risk to life, or property and do not reduce the ability for communities to recover from a natural hazard event.

This is given effect to through policies CE-P9 to CE-P14.

[10] The Takiwā platform provides high-spatial estimates of VLM rates in mm/yr in 2km increments along the whole NZ coastline.

Policy CE-P9 Identification of natural hazards in the coastal environment

Identify and map natural hazards in the coastal environment in the Coastal Hazard Overlays and take a risk-based approach to the management of development within the Coastal Hazard Overlays based on the approach outlined in APP10 - Natural Hazard Risk Assessment, including:

1. *The sensitivity of the activity to loss of life, damage from a natural hazard and the ability for communities to recover after a natural hazard event; and*
2. *The level of risk presented to people and property from a natural hazard.*

This policy sets the foundation for the risk-based approach with the subsequent policies providing specific direction on the activities anticipated in each of the coastal hazard overlays, provided in Appendix A.

Appendix 10 Natural Hazard Risk Assessment

Appendix 10 sets out how risk is to be considered by the District Plan. The approach applies to all natural hazards including coastal hazards.

Likelihood

APP10-Table 1 sets out how likelihood will be determined.

APP10-Table 1 Likelihood guidance

Likelihood	Likelihood ranking
Less than 1:100-year event (1 in 100 year event) or annual exceedance probability (AEP) 1% or more	Very likely
1:101 – 1:200 year event or AEP range 0.5% to 1%	Likely
1:201 – 1:500 year event or AEP range 0.2% to 0.5%	Unlikely
1:501 – 1:2500 year event or AEP range 0.04% to 0.2%	Very unlikely
More than 1:2500 or AEP 0.04% or less	Extremely unlikely

Sensitivity

APP10-Table 2 classifies land use activities into three categories and provides a detailed list of activities for each. The rating is based on the potential sensitivity to human life and property as a result of those respective activities occurring within an identified Hazard Area. The categories are:

- Hazard-Sensitive Activities (e.g., childcare services, hospitals, residential units)
- Potentially-Hazard-Sensitive Activities (e.g., commercial activity, retail activity)
- Less-Hazard-Sensitive Activities (e.g., parks facilities, temporary activities).

Hazard overlays

PCC proposes coastal hazard overlays that cover erosion, inundation and tsunami risk. The plan considers both the current hazard and the projected hazard. The proposed provisions adopt 1.0 m of sea level rise when considering the future hazard out to 2120 as recommended by the Ministry for the Environment's (2017) *Coastal Hazards and Climate Change Guidance*. This figure is recommended where adaptive planning is yet to be completed.

Kāpiti Coast will have completed their adaptive planning process and can apply the Ministry for the Environment's (MfE) updated (2022) *Interim guidance on the use of new sea level rise projections*. Therefore, there will be minor discrepancies between the two approaches.

APP10-Table 4 sets out how the coastal hazard overlays have been mapped.

Coastal Hazard Overlay	Hazard areas
Tsunami Hazard – 1:100 year inundation extent	High
Coastal Hazard – Current Inundation; and Coastal Hazard – Current Erosion	
Tsunami Hazard – 1:500 year inundation extent	Medium
Coastal Hazard – Future Inundation (with 1 m SLR); and Coastal Hazard – Future Erosion (with 1 m SLR)	
Tsunami Hazard – 1:1000 year inundation extent	Low

2.7.2 Wellington City Council Proposed District Plan

Wellington City Council notified their Proposed District Plan on 18 July 2022. The natural hazards and coastal hazards provisions were heard in August 2023 and the District Plan hearings are scheduled to continue through to mid-2024. The provisions of the proposed District Plan are provided below however it is noted that these are subject to change. The Officer's Right of Reply provides an indication of where the provisions were heading at the end of the hearing. There are changes proposed to the wording however the overall direction of the objectives and policies remains unchanged.

WCC adopts a risk-based approach including a breakdown of the susceptibility of different activities and the corresponding sensitivities to natural hazards (including coastal hazards). The relevant objectives and policies are outlined below and include the s42a recommendations and supplementary s42a recommendations.

The approach is similar to that adopted by PCC. The most relevant objectives are:

> ***CE-O5 Risk from coastal hazards***[11]
>
> *Subdivision, use and development in the Coastal Hazard Overlays reduces or does not increase the risk to people, property, and infrastructure.*

These are given effect to through policies CE-P11 to CE-P23. Policies CE-P11 and CE-P12 provide holistic guidance with the subsequent policies providing more detailed policy direction.

> ***CE-P11 Identification of coastal hazards***
>
> *Identify coastal hazards within the District Plan and take a risk-based approach to the management of subdivision, use and development based on the following:*
>
> *1. The sensitivity of the activities to the impacts of coastal hazards;*

[11] Through the hearing process it is currently recommended that this policy is split in two to cover high hazard and medium and low hazard separately.

2. *The risk posed to people, property, and infrastructure, by considering the likelihood and consequences of different coastal hazard events; and*

3. *The longer term impacts of climate change and sea level rise.*

CE-P12 Levels of risk

Subdivision, use and development reduces the risk to people, property, and infrastructure by:

1. *Enable subdivision, use and development that have either low occupancy, risk, or replacement value within the low, medium and high hazard areas of the Coastal Hazard Overlays;*

2. *Requiring mitigation for subdivision, use and development that addresses the impacts from the relevant coastal hazards to people, property, and infrastructure in the low and medium hazard areas; and*

3. *Avoiding subdivision, use and development in the high hazard area unless there is a functional and operational need for the building or activity to be located in this area and incorporates mitigation measures are incorporated that reduces the risk to people, property, and infrastructure.*

Likelihood

Policy CE-P11 requires consideration of the likelihood of an event but unlike PCC no guidance is provided as to what scenarios should be considered.

Sensitivity

Like PCC, three sensitivity categories are included. The detailed list of activities that fall within each category are included in the definitions. While the categories are the same the list of activities differs slightly between the two Councils. The categories are:

- Hazard-Sensitive Activities (e.g. childcare services, hospitals, residential units)
- Potentially-Hazard-Sensitive Activities (e.g. commercial activity, retail activity)
- Less Hazard Sensitive Activities (e.g. parks facilities, marine emergency activities).

Hazard overlays

The classification of hazards is set out in the Coastal Environment Chapter Introduction and replicated below:

Table 2.1: Classification of high, medium and low risk hazards

Layer	Hazard Ranking
Tsunami – 1:100 year scenario inundation extent with 1 m sea level rise	High
Existing coastal inundation extent with a 1:100-year storm	
Tsunami – 1:500 year inundation extent with 1 m sea level rise	Medium
Coastal inundation extent – with 1.49 m[12] sea level rise scenario and 1:100 year storm	

[12] 1.49 m was included as typo, and it is proposed to correct this to read 1.43 m

Tsunami – 1:1000 year inundation extent with 1 m sea level rise	Low

2.7.3 Horowhenua District Plan (2015)

The Horowhenua District (HDC) is an adjacent council although they are located outside the Wellington Region. The Horowhenua District Plan was made operative on 1 July 2015 and predates the inclusion of natural hazards as a matter of national importance in the RMA and is yet to implement the National Planning Standards.

As the council is located in a different region, the regional policy framework they must give effect to differs. HDC are not required to give effect to the RPS for Greater Wellington, instead their relevant regional policy statement is the Horizons One Plan 2014. The RPS for Greater Wellington does require KCDC to consult with Horizons Regional Council when preparing plans for the purpose of achieving consistency across boundaries.[13] The Horizons One Plan places this responsibility on the regional council.[14]

Currently the Horowhenua District Plan includes one combined Coastal Natural Character and Hazard Area mapping layer. The plan does not implement a risk-based approach, instead it leaves it to the consent planner to determine whether the activity appropriately avoids or mitigates the risk.

2.7.4 Horizons One Plan (2014)

Policy 4 of the NZCPS requires a coordinated approach across local authority boundaries. The Horizons One Plan was notified in 2007 and predates the inclusion of natural hazards as a matter of national importance in the RMA. KCDC does not need to give effect to the Horizons One Plan but will be required to consult with them as part of a plan change process.

Policies 8-4 and 8-5 require appropriate use and development of the CMA and for the ongoing provision of public access.

2.7.5 Conclusion

Due to the age of the Horowhenua District Plan and the regional policy framework being different it would be more appropriate for KCDC to align their planning approach with PCC and WCC. These plans take a more contemporary approach and give effect to the higher order documents applicable to KCDC.

2.8 Guidance documents

Various guidance documents are provided to support in the implementation of the national legislation. The relevant guidance documents include:

- Coastal Hazards and Climate Change: Guidance for Local Government (2017)
- Interim guidance on the use of new sea-level rise projections (2022)
- NZCPS 2010 Guidance Note: Coastal Hazards (2017).

KCDC wrote to the Ministry of Environment and the Department of Conservation to confirm the hierarchy of these documents.[15] The response from Ministry of Environment states that: "None of these national guidance

[13] Regional Policy Statement for the Wellington Region Section 2.5

[14] Horizons One Plan Section 10.1(j)

[15] Letters to the Government Departments and the responses are available on the KCDC website.

documents are statutory; the guidance is not legally binding, nor does it constitute legal advice. There is no legal hierarchy between the Ministry and DOC guidance documents, as they are both non-statutory.

NZCPS policy 24(1) requires coastal hazards identification to take account of national guidance and the best available information on the likely effects of climate change on the region or district. As such, the Ministry and DOC guidance both need to be considered in making planning decisions on coastal hazards, noting the needs of a particular district or region."

3. Applying a risk-based approach in Kāpiti Coast

Under the RMA, risk can be managed in several ways. District plans can set objectives, policies, and rules to control the use of land and subdivision. The RPS PC1 requires KCDC to adopt a risk-based approach.

A risk-based approach involves applying progressively more stringent rules proportionate to the level of risk. Using this approach, territorial authorities are able to have varying degrees of control over subdivision, use and development within their boundaries through the consenting process. In general, the different classes of activities under the RMA can be split into three broad categories with varying degrees of consenting complexities and restrictions. These are detailed in Table 3.1 below:

Table 3.1: Stringency of Activities under the RMA

Least Stringent	More Stringent	Most Stringent
Permitted/Controlled Activity	Restricted Discretionary/Discretionary Activity	Non-complying/Prohibited Activity

In terms of what this means in practice, a consent authority has more power on whether to grant or decline an application as the activity status becomes more stringent, as well as apply a broader variety of conditions. Table 3.2 presents further information on activity status under the RMA.

Table 3.2: Further Information on Activity Status

Permitted	Controlled	Restricted Discretionary	Discretionary	Non-complying	Prohibited
No resource consent required. No notification possible.	Resource consent required to be granted for most activities.[16] Conditions are limited to the matters in which Council has reserved its control. Public notification is generally precluded and only allowed under special circumstances.	Resource consent may be either declined or granted. Conditions are limited to the matters in which Council has restricted its discretion. Chance of public notification low. Limited notification likelihood increased.	Resource consent may be either declined or granted. May require limited or public notification.	Resource consent may be declined or granted. If granted, must pass further assessment. Higher probability of public or limited notification.	No resource consent may be lodged for a prohibited activity. A plan change would be required.

As part of a risk-based approach there is a need to determine the:

[16] Section 87A(2) provides two exceptions to the requirement to grant a controlled activity. 1. A consent authority may refuse to grant a subdivision consent if there is a significant risk from natural hazards or there is not sufficient legal and physical access to each allotment. 2. The site is a protected customary rights area and the activity will or is likely to have adverse effects that are more than minor on the exercise of a protected customary right.

- Area in which the provisions are to apply – this is to include areas of high, medium and low risk as required by the RPS. This is to be determined by the likelihood and consequence of the hazard.
- Sensitivity of the activity to the hazard – subdivision, use and development and hazard sensitive activities are to be avoided in high hazard risk areas unless there is functional or operational need to be located in these areas[17].

Sections 4 to 7 provides the technical background for how these overlays can be developed. The below sets out why sensitivity is important and how it can be applied to coastal hazard overlays.

3.1 Determining sensitivity

Different activities have varying degrees of sensitivity and require a different management approach. RPS PC1 requires the sensitivity of activity to be considered. WCC and PCC include detailed tables that rate the sensitivity of various activities. The rating is based on the potential risk sensitivity to human life and property as a result of those respective activities occurring within an identified hazard area. For example, PCC identifies three categories of sensitivity:

- Hazard-Sensitive Activities (e.g., childcare services, hospitals, residential units)
- Potentially-Hazard-Sensitive Activities (e.g., commercial activity, retail activity)
- Less-Hazard-Sensitive Activities (e.g., parks facilities, temporary activities).

Despite the sensitivity of an activity there may also be certain activities that have an operational or functional need to be located within a high hazard area. For example, a surf lifesaving club may need to be located within a high hazard area due to the nature of the activity. The RPS PC1 provides for this.

3.2 Applying a risk-based approach

Table 3.4 shows an example of how hazard sensitive activities could be managed using this approach, this would need to be refined further through the Coastal Environment Plan Change process once the coastal hazard overlays and sensitivity categories have been confirmed.

Table 3.3: Activity specific risk-based status

Risk ⇨	Low	Medium	High
Sensitive activity	Restricted Discretionary	Non-complying	Non-complying / Prohibited
Potentially sensitive activity	Restricted Discretionary	Discretionary	Non-complying
Non-sensitive activity	Permitted	Restricted Discretionary	Discretionary

Table 3.5 shows an example of how PCC have used the hazard matrix to inform their district plan provisions. PCC have different information informing their hazard overlays and therefore while a useful comparison should not be replicated without a full assessment. Notably, their low-risk overlay only includes the 1:1000-year tsunami hazard.

[17] Policy 29(d) RPS PC1

Table 3.4: Activity status for different sensitivity activities across the hazard overlays (amended from PCC Section 32 Report)

Risk	Low	Medium	High
Sensitive activity	Restricted Discretionary	Discretionary	Non-complying
Potentially sensitive activity	Controlled	Restricted Discretionary	Discretionary
Less hazard sensitive activity	Permitted	Permitted	Permitted

Adopting this approach would allow KCDC to implement hazard overlays, while recognising that not all activities carry the same risk of harm (even where the exposure to coastal hazard is the same). Additionally, the framework enables KCDC to include conditions as part of resource consents to better manage coastal hazard risks to subdivision, use and development and to refuse consent when the risk is too high.

Overall, a district plan provides a direction on how subdivision, use and development should occur. A district plan's rules, consent activity status and activity standards influence the amount of supporting material required with the application, the expectations around public notification of applications, and ultimately whether an application may be granted consent.

4. Technical Background

The above proposed risk-based planning approach requires the projected hazard extents to be classified into areas of low, medium and high risk. These can then be mapped and form the basis of categories or hazard overlays in which the planning approach in Section 3 applies.

The following sections outline the technical principles recommended in developing these categories. These are focused on a series of thresholds and scenarios. Within this document thresholds are the technical categorisation in which you move from one risk category to another, for example, the depth of water that makes a change from being in an area of low hazard to a medium hazard area. Scenarios are the Shared Socio-economic Pathway (SSP)/projected relative sea level rise scenarios that are considered most relevant for use in planning.

Consideration of the appropriate relative sea level rise scenario is discussed first in Section 5 as it is recommended that the same scenario should apply across both erosion and inundation hazards.

Section 6 then presents and discusses the technical approach to developing coastal inundation thresholds and Section 7 does the same for erosion-based thresholds.

At this stage, maps of the resulting hazard categorisations have not been included in this report. Given that this approach is for the consideration of the Takutai Kāpiti project, it is not yet an adopted KCDC planning approach and as such producing maps that could show locations of hazard categories to a property level may not be appropriate given that the approach and thus mapped hazard areas could change.

5. Relative Sea Level Rise Scenarios

This section discusses the range of relative sea level rise (RSLR) scenarios that maybe appropriate for a risk-based planning approach and identifies which scenario is considered to be the most applicable for use within this district plan risk analysis framework.

5.1 Background on RSLR scenarios

Global SLR projections are developed by the Intergovernmental Panel on Climate Change (IPCC)[18] according to the scenarios of population growth, future greenhouse gas (GHG) emissions including the influence of global political measures to reduce emissions and associated global temperature change. In the most recent IPCC assessment report (AR6 2021)[19], the scenarios are referred to as SSP's (Shared Socio-economic Pathways), of which there are five scenario families that IPCC assess a medium confidence of occurring (SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0, SSP5-8.5). The last two numbers of each scenario refer to radiative forcing by 2100 in the same way as the previous RCP scenarios from the previous IPCC (2014) AR5 assessment. The IPCC do not assign any likelihoods to any of the medium confidence scenarios occurring, however they assign a probability range of SLR occurring under each scenario, with the data presented as the median value (P50), upper value (P83) and lower value (P17). The commonly quoted SLR value for each of the SSP scenarios is the median value. IPCC (2021) also presents three additional "low confidence" scenarios associated with the SSP1-2.6, SSP2-4.5, and SSP5-8.5 scenarios to indicate the potential effect on sea level rise of low likelihood, high impact ice sheet processes that cannot be ruled out.

Local SLR projections also need to include local Vertical Land Movement (VLM) to give an estimate of sea-level rise relative to the local landmass, referred to as RSLR.

The NZSeaRise tool (https://searise.takiwa.co/) presents local VLM estimates at 2 km spacings right around the New Zealand coast, with 21 sites being presented within the Kāpiti District.[20] The VLM data presented in the NZSeaRise tool is the median VLM taken from a short record of satellite imagery (2003-2011), with the assumption that land movements which occurred over this timeframe will continue into the future. There are several limitations with the dataset which should be recognised:

- The period over which these observations were taken is short and excludes some major tectonic events which have affected land levels, such as the 2016 Kaikoura Earthquake. With it being such a short timeframe of information, there is uncertainty in how this should be extrapolated into the future.
- The information accounts for VLM along the coastline but does not consider how VLM will change inland where coastal hazards such a groundwater rise and coastal flooding will impact coastal communities. There can be large variability in the VLM within the 2 km radius alongshore, and it is unknown on how the VLM translates inland.
- There is spatial variability in the VLM captured across the district, with the range of median VLM over the 21 sites in the district being 0 mm/yr to -1.75 mm/yr. However, 50% of the sites have median VLM within a narrower range of -0.8 to -1.4 mm/yr, with an average median value of -1.07 mm/yr.

[18] "The IPCC is the United Nations body for assessing the science related to climate change. The IPCC Sixth Assessment Report (AR6) is internationally agreed and provides the most comprehensive summary of the state of scientific, technical, and socio-economic knowledge on climate change, its impacts and future risks, and options for adaptation and mitigation. It is a key source of scientific information and technical guidance to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. As a member country of the IPCC and the UNFCCC and a signatory of the Paris Agreement, New Zealand is 'encouraged' to use the scientific and technical outputs of the IPCC." MfE response KCDC letter dated 8 November 2023.

[19] Climate Change 2021 The Physical Science Basis. Working Group I contribution to the sixth Assessment Report of the Intergovernmental Panel on Climate Change

[20] This data is still undergoing peer review and reliance on the results before it is finalised needs to be used with caution.

5.2 RSLR Scenarios applied in Takutai Kāpiti Project

The RSLR projections presented in the Jacobs Volume 1 (Table 3.2) and Volume 2 (Table 2.1) reports are the lower and upper projections provided by MfE in their (2017) *Coastal Hazard and Climate Change Guidance to Local Government*, with an increase of 0.1 m by 2100 as a result of the interim IPCC (2019) report, *Special Report on the Ocean and Cryosphere in a Changing Climate: Summary for Policymakers*, and a VLM rate of between 1 mm/yr and 3 mm/yr based on the best information available at the time. The lower projection was the former national RCP 2.6 scenario combined with a 1 mm/yr VLM, which give a projected rise of 0.3 m by 2070 and 0.6 m by 2120 from a 2020 base date. The upper scenario was a RCP 8.5H+ scenario, which was the 83rd percentile of the RCP 8.5 scenario combined with a 3 mm/yr VLM, which give a projected rise of 0.7 m by 2070 and 1.65 m by 2120 from a 2020 base date. This upper scenario was recommended to be applied in the MfE (2017) guidance as:

> *"this higher scenario reflects the possibility of future surprises towards the upper range in SLR projections of an RCP 8.5 scenario, being representative of a situation where more rapid rates of SLR could occur early next century due to dynamic ice sheet processes and instability thresholds that were not fully quantified in the IPCC AR5 projections."*

Due to the wide range of projected RSLR by 2120, two intermediary projections for this time frame were also applied; 0.85 m and 1.25 m from a 2020 base date, being equivalent to the RCP 4.5 and RCP 8.5 scenarios respectively combined with 2 mm/yr VLM.

Since the investigations for the Jacobs (2022) assessments, updated RSLR projections have been released via the IPCC AR6 (2021) assessment and the NZSeaRise programme (2022) as mentioned above, plus additional guidance in the form of the MfE (2022a) *Interim guidance on the use of new sea-level rise projections* and the MfE (2022b) *National Adaptation Plan*. KCDC are currently using the most recent data, policy, and guidance.

The MfE (2022) guidance recommends the use of all of the local RSLR "medium confidence SSP" scenarios except for SSP1-1.9, plus the additional SSP5-8.5H+ scenario (e.g., 83rd percentile of the SSP5-8.5 scenario) in assessing Dynamic Adaptation Planning Pathways (DAPP). However, the National Adaptation Plan directs that for detailed hazard and risk assessments in coastal and non-coastal areas, both the middle-of-the-road scenario (**SSP2-4.5**) and the local fossil fuel intensive development scenario (**SSP5-8.5**) to 2130, with inclusion of local vertical land movement to get a relative sea level rise, should be used to define areas at high risk of being affected.

In line with the direction of the National Adaptation Plan, the SSP2-4.5 and SSP5-8.5 scenarios have been adopted for the risk assessments produced for each adaptation area under the Takutai Kāpiti project. The resulting RSLR applied in the risk assessments are 0.35 and 0.45 m from a 2020 base date by 2070, and 0.85 and 1.25 m from a 2020 base date by 2130, as shown in Figure 5.1. These RSLR estimates include a -1 mm/yr VLM, being a rounded value of the average VLM across all 21 NZSeaRise assessment sites within the district boundary.

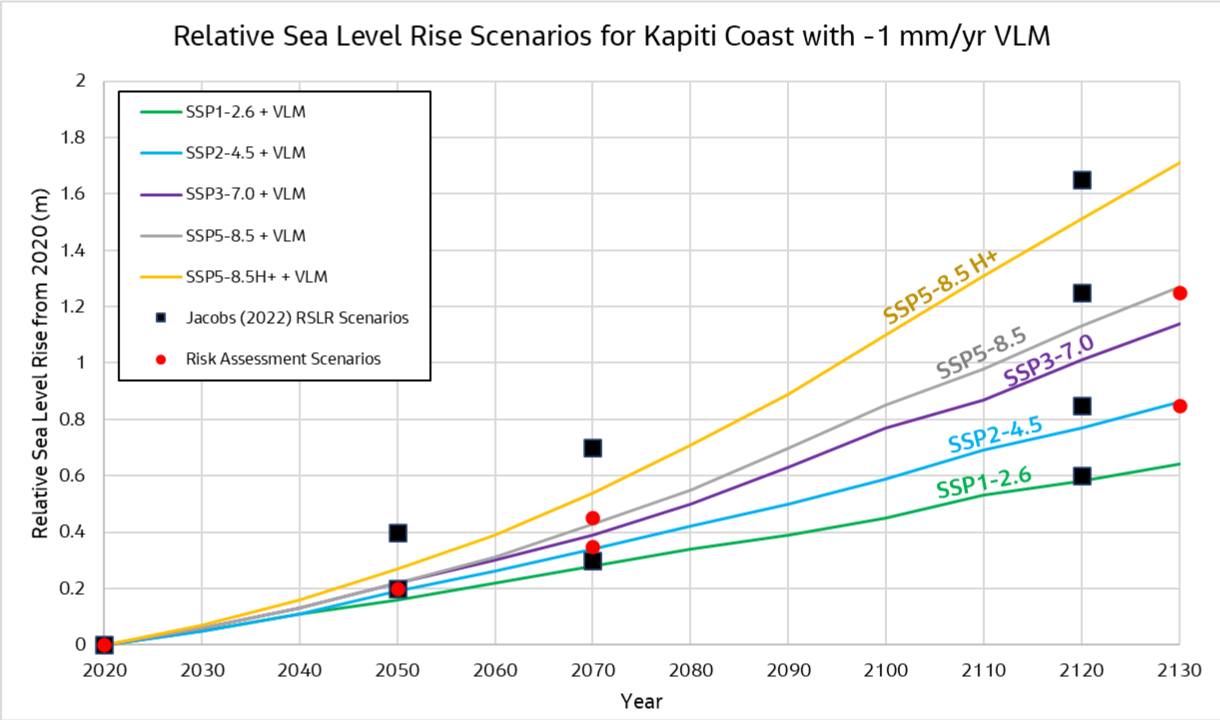

Figure 5.1: Relative sea level rise scenarios from NZSeaRise from SSP1-2.6 to SSP5-8.5+ with -1 mm/yr VLM. Black squares show the RSLR increments used in the Volume 2 Jacobs (2022) report; and red circles show the RSLR increments adopted for the Adaptation Area Risk Assessments

5.3 Selection of RSLR Scenario for Land-use Planning Purposes

In order to adopt a risk-based planning approach for a district plan change and comply with the relevant planning requirements of higher-order documents, a sea level rise scenario needs to be selected to plan for. The selection of a RSLR scenario for use in the district plan change is, at this stage, limited to the increments of RSLR produced for Jacobs Volume 2 report and the subsequent mapping for the Adaptation Area risk assessments, as presented in Figure 5.1. The sea level rise scenario selected should be an accepted scenario from IPCC (2021), which is reflective of the following principles and guidance outlined below.

5.3.1 Principles

The following underlying principles are applied to select the most appropriate RSLR scenario for use in land-use planning:

1. The approach needs to be consistent with the National Adaptation Plan, NZCPS and RPS. The National Adaptation Plan directs councils to use SSP5-8.5 for risk screening and the NZCPS requires councils to consider coastal hazards over at least the next 100 years.

2. Needs to be cognisant of the precautionary approach required in coastal planning by the NZCPS to account for uncertainties in RSLR projections and current modelling.

3. There needs to be consistency between the selected scenarios for both inundation and erosion planning.

4. The scenarios need to reflect both timeframe and RSLR magnitude, as it is the rate of RSLR that is important in determining future erosion.

5. The timeframe is important to ensure activities allowed in the provisions have sufficient and reasonable time to occur in an appropriate manner without the need for hazard mitigation measures.

Timeframes are also important for defining the 'certainty' of the magnitude of SLR. While all scenarios have the same assumed likelihood of occurrence, there is much greater certainty in the lower projected magnitudes occurring over the shorter timeframes. Applying a risk-based approach to select a SLR magnitude is shown schematically in Figure 5.2. The upper pane shows that for a specified planning timeframe, there is a generalised probability distribution of possible SLR magnitudes, peaking with a 'most likely' SLR value and a skewed-tail distribution influenced by a wider range of process responses to climate change. The lower pane shows that a generalised SLR risk profile can also be obtained by multiplying the likelihood of SLR distribution curve by the consequences curve. This simplified example demonstrates that, in most cases, the peak of the risk curve within the specified timeframe will typically occur at a SLR above the mid-range SLR value. This is important in consideration of the RSLR scenario to be applied to land-use planning.

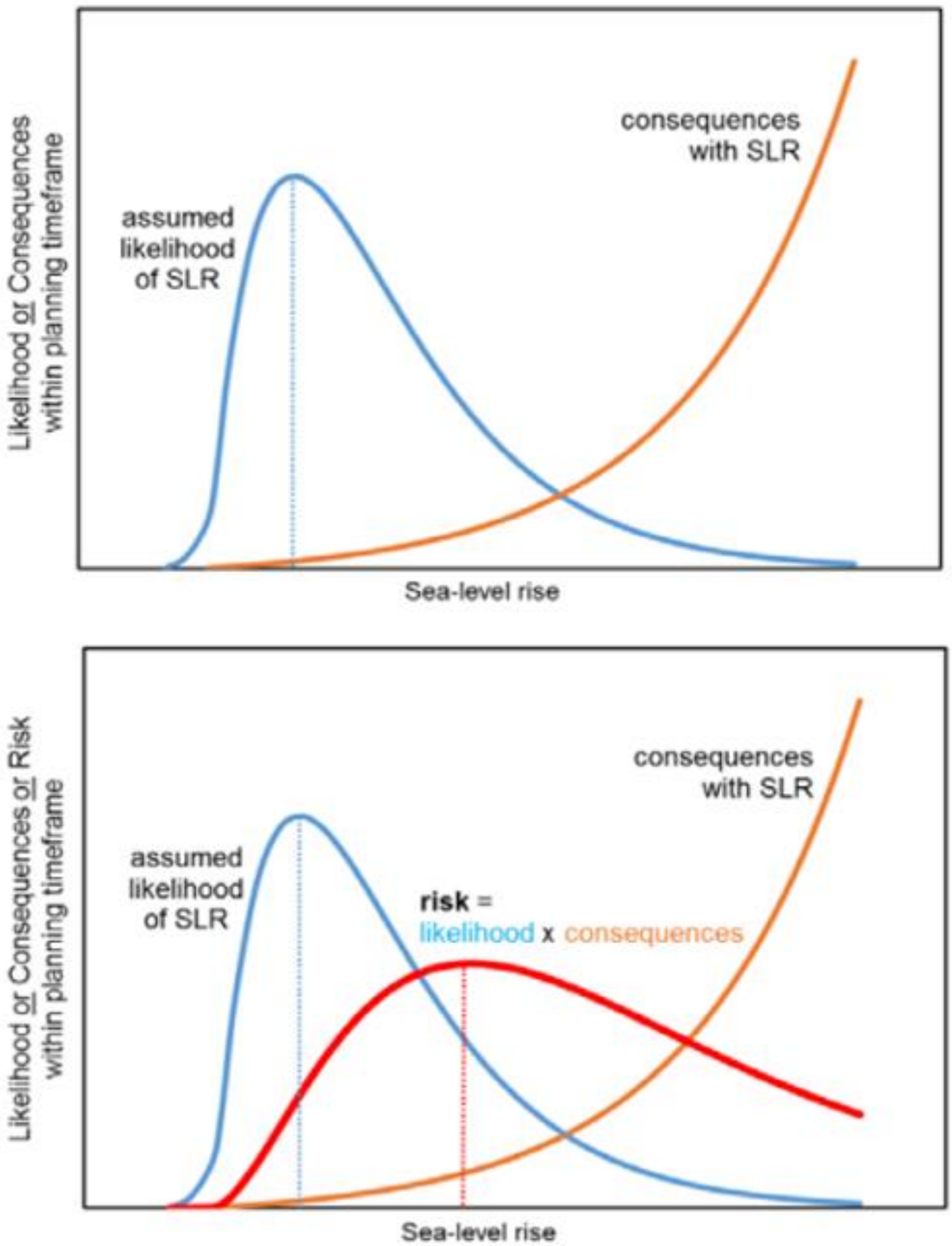

Figure 5.2: Generalised SLR probability and generic consequence curve (upper pane) resulting in the risk profile (lower pane). (From MfE, 2017)

5.3.2 Policy direction and guidance on RSLR

The National Adaptation Plan directs councils to use SSP5-8.5 to screen for hazards and risks in coastal areas and the SSP2-4.5 and SSP5-8.5 scenarios for detailed hazard assessments when changing plans under the RMA.

The MfE (2022) *Interim guidance on the use of new sea level rise projections* provides an update of the MfE (2017) guidance associated with the new SLR projections produced in the NZ SeaRise programme and supersedes Sections 5.3-5.7 of the 2017 guidance document.

Key recommendations from the 2022 interim guidance in relation to land-use planning is from Table 3 of the guidance are reproduced below in Table 5.1. The table sets out the RSLR allowances to use for various categories for land use planning. This guidance presents a preference of using the higher SLR scenarios of SSP5-8.5 and SSP5-8.5H+ for land-use planning purposes across all four categories, with reference in the guidance for lower RSLR scenarios being for adaptation planning purposes.

Table 5.1: Recommended updates to the minimum transitional procedures of RSLR allowances (Source: MfE (2022a), Table 3)

Category	Description	Transitional allowances to use now, until the refresh of the coastal guidance
A	Coastal subdivision, greenfield developments, and major new infrastructure	▪ Avoid new hazard risk by using "medium confidence" sea-level rise out to 2130 for the **SSP5-8.5 H+** (83rd percentile SSP5-8.5 or p83) scenario that includes the relevant VLM for the local/regional area. ▪ Check the lifetime and utility of new developments using the median RSLR projections for the "low confidence" SSP scenarios out to 2150 and beyond.
B	Changes in land use and redevelopment (intensification)	Adapt to hazards by conducting a risk assessment using the range of updated "medium confidence" RSLR scenarios (including VLM) out to 2130 with the dynamic adaptive pathways planning approach; or if a more immediate decision is needed: ▪ Avoid new and increased hazard risk by using "medium confidence" sea-level rise out to 2130 and the **SSP5-8.5 H+** (83rd percentile SSP5-8.5 or p83) scenario that includes the relevant VLM for the local/regional area
C	Land-use planning controls for existing coastal development and assets planning. Use of single values at local/district scale transitional until dynamic adaptive pathways planning is undertaken	Use the **SSP5-8.5 M** scenario out to 2130, which includes the relevant VLM for the local/regional area
D	Non-habitable, short-lived assets with a functional need to be at the coast, and either low-consequences or readily adaptable (including services)	Use the **SSP5-8.5 M** scenario out to 2090 that includes the relevant VLM for the local/regional area.

Category C, land-use planning controls for existing coastal development and asset planning, is of particular relevance for Kāpiti Coast's coastal environment plan change. This recommends using the SSP5-8.5 scenario including VLM to 2130 for a single value at a district scale until dynamic adaptive pathways planning (e.g., Takutai Kāpiti) is undertaken.

For new developments (e.g., greenfield development, coastal subdivision, major infrastructure) or intensification (Categories A and B) the guidance recommends using the higher SSP5-8.5H+ scenario to be risk-averse. For Category D, developments that have a functional requirement to be located on the coastline, the guidance still recommends using the SSP5-8.5 scenario, but over a shorter timeframe to 2090, recognising the likely reduced lifespan for the short-lived assets.

Generally, across all Categories of development, the guidance recommends the use of the SSP5-8.5 or SSP-8.5H+ scenario out to 2130, with exceptions being for areas where localised risk assessments are undertaken, or the expected lifetime of the facility is limited to less than 100 years.

PC2 (intensification) adopted the SSP5-8.5H+ scenario which is consistent with Category B of the guidance. Kāpiti Coast's Coastal Environment Plan Change should consider the range of "medium confidence" RSLR scenarios including VLM out to 2130 once adaptation planning (Takutai Kāpiti) has been completed, the outcomes accepted, and implementation has begun.

5.3.3 Discussion

It is recommended that the most appropriate increments of RSLR to consider for a risk-based approach to land use planning are from the SSP5-8.5 scenario coupled with a -1 mm/yr VLM rate over 50- and 100-year time frames, as shown in Figure 5.1. These increments are:

- 0.45 m SLR by 2070, and
- 1.25 m SLR by 2130.

The justifications for this recommendation include:

- Using the SSP5-8.5 scenario including an appropriate district wide VLM rate is consistent with the *National Adaptation Plan* (MFE 2022) and the *Interim guidance on the use of new sea-level rise projections* (MfE 2022). The use of SSP5-8.5 is confirmed as being appropriate for stress testing the upper bound of hazard assessments by MfE.[21]
- The SSP5-8.5 scenario is considered to be an appropriate precautionary approach to hazard planning, consistent with the principles of the RMA, but not overly precautionary in not taking the highest scenario (e.g., SSP5-8.5H+).
- The RMA requires district plans to give effect to higher order documents:
  - Policy 25 of the NZCPS requires hazard risk to be assessed over at least 100 years. The 1.25 m SLR is consistent with the timeframe required by the NZCPS.
  - Policy 51 of the RPS PC1 sets out a range of considerations that must be had regard to as part of any plan change. The policy does not give any direction in regard to which scenario to use. However, it does require floor levels of habitable buildings and buildings used as places of employment above the 1% AEP (1:100 year) flood level, in identified flood hazard areas but does not direct which climate change should be adopted.
- Reflects the slightly higher most recent SSP projections over the previous commonly used scenarios of planning (e.g., 1 m SLR in 100 years), as recommended in the *Interim guidance on the use of new sea-level rise projections*.

[21] KCDC wrote to the Ministry for the Environment (MfE) and Department of Conservation (DOC) in October 2023 to confirm that the correct approach was being adopted. The correspondence is available at https://haveyoursay.kapiticoast.govt.nz/hub-page/takutai-kapiti-documents.

- PCC's district plan review predated the *Interim guidance on the use of new sea-level rise projections* and accordingly they have adopted 1 m of SLR over 100 years as previously accepted. WCC have used the SSP5-8.5 scenario and have adopted 1.43 m of sea level rise over 100 years. The proposed approach for KCDC is the same as WCC and reflects current guidance and best practice.
- Although it is recognised that globally there are likely to be more serious emission mitigation efforts in the future, the scenario chosen is not dependent on global political responses to reduce emissions.
- Under the SSP5-8.5 scenario, both increments are unlikely to occur much before the specified timeframe (only 17% probability that 0.45 m will occur before 2060, and 1.25 m will occur before 2105), hence there is a high degree of certainty that proposed risk-based land-use planning controls will be able to achieve their purpose over appropriate timeframes and will not require earlier amendments via additional plan change processes.
- We have a high degree of confidence that the lower magnitude of SLR (0.45 m) will occur at sometime within a reasonable planning timeframe, even if global emission reductions can be successfully implemented (i.e., likely to occur within 2070-2100 timeframe under the SSP2-4.5 RSLR scenario). From Figure 5.2 under the lower SSP2-4.5 RSLR scenario, a 0.45 m of SLR by 2070 is likely to be close to the magnitude of SLR producing the greatest risk over this time frame (i.e., close to the SSP-8.5/SSP5-8.5H+ scenarios).
- There is less certainty about the timing of the higher magnitude of SLR (1.25 m) and this may be delayed beyond a reasonable planning timeframe if global emission reduction is successful. However, there is still a medium degree of confidence that this magnitude of rise will occur within the next 100 years required to be addressed by land-use planning.

5.3.4 Alternative approaches

In further analysis to support a future plan change it would still be recommended that KCDC consider what hazard overlays may look like in their district under the alternate SSP2-4.5 and SSP5-8.5H+ scenarios. This could aid consideration and discussion of alternative approaches as well as providing further justification that the SSP5-8.5 scenario does provide a suitable and practical outcome for land use planning in the district as well as being in accordance with the above guidance.

This sensitivity testing of scenarios to be used to determine hazard overlay is recommended in the MfE guidance in both 2017 and 2022, particularly the SSP5-8.5H+ scenario, which both guidance documents state should be used to stress test plans, and policies.

6. Coastal inundation thresholds

This section sets out our approach to identifying thresholds for defining the severity of inundation hazards and consequently a suggested method for categorising 'coastal flood risk'.

An overall summary of the method is provided in Section 6.1. Sections 6.2 to 6.7 provide a discussion of the reasoning behind the method and consideration of other thresholds and scenarios. They explain how we have applied the approach using available data and discusses the implications of the limitations of the data used, uncertainties, application of freeboard and thresholds for 'nuisance flooding'.

6.1 Summary of method

The main coastal processes which cause inundation are storm surge and wave setup, combined with the astronomical tide and RSLR.[22] Inundation has the potential to result in loss of, or damage to, properties, possessions, buildings, and infrastructure, and can cause injury to people or loss of life. The consequence of inundation depends on the nature of the flooding – primarily the depth of water and speed of flow – and the vulnerability of people and assets to flooding.

Land use planning seeks to limit these consequences through risk-based control of development under the RMA. Several methods for mapping coastal inundation to inform planning decisions on subdivision, use and development have been considered. The objective is to identify a simple set of thresholds which:

- are consistent with the RMA requirement to recognise and provide for the management of significant risks from natural hazards, the NZCPS requirement to consider coastal hazard risk over at least 100 years, and is consistent with the requirements of the RPS,
- can be applied to simple 'bathtub' depth mapping of coastal inundation, as produced in the Kāpiti Coast Coastal Hazards Susceptibility and Vulnerability Assessment[23] ('the SVA') as well as the results of hydrodynamic modelling – in particular, the updated modelling of flooding from combined coastal, pluvial, fluvial and groundwater sources, currently being prepared by KCDC, once this is available, and
- considers the sensitivity of the activity to inundation.

The suggested method for categorising 'coastal flood risk' considers three main factors:

- likelihood of flooding,
- consequence of flooding or flood hazard, and
- change in likelihood and consequence in the future because of climate change.

Likelihood of flooding

- The RPS requires the use of the 1% annual exceedance probability (AEP). We suggest that the single probability is used in defining categories of coastal flood risk. This is the same likelihood considered in the SVA, the current district flood hazard maps and required by the RPS. We consider this is consistent with the purpose of the RMA to promote sustainable management of natural and physical resources, ensures that the District Planning framework considers intergenerational needs, and a precautionary approach is applied. It is also consistent with the approaches taken by PCC and WCC.

Flood hazard

[22] Other process may cause inundation including fluvial and pluvial flooding, a high groundwater table or land subsidence. These factors are outside the scope of this report.

[23] Kāpiti Coast Coastal Hazards Susceptibility and Vulnerability Assessment Volume 2: Results, Jacobs, February 2022

- We recommend that published scientific hazard thresholds for people in flood water[24] (the 'AR&R guidelines') are used to categorise the severity of flood hazard. This reflects the fact that most development will be occupied by or used by people, who will need to access and egress buildings during a flood and for whom the depth thresholds for a given severity of hazard are lower than for buildings.
- The AR&R guidelines define six thresholds of flood hazard relating to the consequences for people, vehicles and buildings. We suggest that these are grouped as shown in Table 6.1 to define three thresholds and severities of hazard ('low hazard', 'medium hazard', 'high hazard') relating primarily to the hazard to people.
- The AR&R hazard thresholds take account of both the depth of flooding and the velocity ('speed') of the flood water. When applying the method to the SVA 'bathtub' flood maps, in which velocity is not calculated, the thresholds are defined by the AR&R 'still water' depth criterion alone (indicated in Table 6.1). The KCDC hydrodynamic modelling will provide both depth and velocity outputs which can be combined to define flood hazard.

Table 6.1: Suggested definitions of flood hazard severity based on the AR&R hazard class thresholds

Flood hazard severity	AR&R Hazard Class	AR&R Description of hazard	AR&R Still water depth (d) thresholds
Low	H1	Generally safe for vehicles, people and buildings.	0.0 m < d < 0.3 m
	H2	Unsafe for small vehicles.	0.3 m < d < 0.5 m
Medium	H3	Unsafe for vehicles, children and the elderly.	0.5 m < d < 1.2 m
High	H4	Unsafe for vehicles and people.	1.2 m < d < 2.0 m
	H5	Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.	2.0 m < d < 4.0 m
	H6	Unsafe for vehicles and people. All building types considered vulnerable to failure.	4.0 m < d

Effect of climate change

- The flood hazard thresholds can be applied to the flooding predicted under any given climate scenario. For KCDC, we suggest that the flood hazard is evaluated under two future climate scenarios as part of a risk-based approach to planning:
  - a 'lower' scenario of the projected change in climate to 2070 under the SSP5-8.5 scenario (i.e., 50 years in the future)
  - a 'higher' scenario of the projected change in climate to 2130 under the SSP5-8.5 scenario (i.e., 100 years in the future)
- The lower climate change scenario is more likely to occur within the planning timeframe (i.e., it is projected to occur sooner) than the higher scenario. There is less confidence in the timing of the higher climate change scenario (i.e., it is projected to occur later) but it can reasonably be expected to occur at some point in the future.

To rationalise mapping and planning provisions, we suggest that the flood hazard severities evaluated under the two separate climate change scenarios could be combined to define a single set of four 'coastal flood risk' categories ('very low', 'low', 'medium', 'high') by means of the matrix in Figure 6.1. For a given severity of hazard, the categories reflect a higher risk associated with the hazard occurring in a shorter time (in 2070), where there is greater confidence in the projected change in climate, and a lower risk if the same hazard is

[24] Australian Rainfall and Runoff: A Guide to Flood Estimation, Book 6, Chapter 7 (Smith and Cox, 2019)

projected to occur in the longer timeframe (2130) where there is less confidence in the timing of the projected change in climate.

Flood hazard in HIGHER climate change scenario				
High	MEDIUM RISK	MEDIUM RISK	MEDIUM RISK	HIGH RISK
Medium	LOW RISK	LOW RISK	MEDIUM RISK	HIGH RISK
Low	VERY LOW RISK	LOW RISK	MEDIUM RISK	HIGH RISK
None	NO RISK	LOW RISK	MEDIUM RISK	HIGH RISK
	None	Low	Medium	High

Flood hazard in LOWER climate change scenario

Figure 6.1: Matrix defining suggested coastal flood risk categories from flood hazards in two climate change scenarios

In applying this method to the SVA 'bathtub' data, the only effect of climate change considered is the relative sea level rise (RSLR). We propose using RSLR values of 0.45 m and 1.25 m for the 'lower' and 'higher' climate change scenarios respectively. These are the values adopted in the Takutai Kāpiti project for RSLR from the year 2020 to the years 2070 and 2130 using the SSP5-8.5 climate change scenario and including an allowance for vertical land movement of -1 mm/year.

Table 6.2 summarises the suggested definitions of the coastal flood risk categories using the SVA 'bathtub' flood mapping approach. If the method is applied to other data, such as the updated KCDC modelling of flooding from combined sources of flooding, the modelling should include allowances for the effects of climate change on the other sources of flooding – e.g., rainfall intensity and groundwater levels – for the relevant scenario.

Table 6.2: Proposed definitions for coastal flood risk mapping using the SVA 'bathtub' approach (d = water depth for 1% annual exceedance probability)

Coastal flood risk category	Flood hazard with 0.45 m RSLR			Flood hazard with 1.25 m RSLR		
	Hazard	AR&R class	Depth range	Hazard	AR&R class	Depth range
Very low	None	n/a	dry	Low	H1 and H2	d < 0.5 m
Low	Low	H1 and H2	d < 0.4 m	Medium	H3	0.5 m < d < 1.2 m
Medium	Medium	H2 and H3	0.4 m < d < 1.2 m	High	H4	1.2 m < d < 2.0 m
High	High	H4 and above	d > 1.2 m	High	H5 and above	d > 2.0 m

6.2 Coastal inundation processes and modelling

Coastal inundation is usually understood to mean flooding from the sea caused by a 'storm tide'. Storm tide is a combination of the astronomical high tide and 'storm surge' – the temporary rise in mean sea level during a storm caused by low atmospheric pressure, wind, and wave setup. The level of storm tides will increase in the future as the mean sea level rises in response to climate change.

A weather event that causes a storm tide can also result in heavy rainfall and high flow in rivers at the coast and coastal inundation is often a combination of flooding from different sources, arising from the same weather event. In any particular event, the individual probabilities of the storm tide level and the rainfall or river flow usually differ from each other, and multiple combinations are possible for the same combined probability of occurrence. For example, the combined probability of a 1% AEP storm tide and 10% AEP river flow occurring together, or a 10% AEP storm tide and 1% AEP river flow occurring together may be 1% AEP in both cases. However, the maximum flood levels in each combination of events may be different. Nearer the coast, events with smaller probability storm tides are likely to result in higher flood levels. Further inland, flooding from events with a smaller probability fluvial flow is likely to be worse. Figure 6.2 illustrates conceptually how these sources of flooding can combine in a coastal area for a given likelihood of occurrence.

To take account of combined sources of flooding, multiple combinations of storm tide and fluvial flow need to be considered so that a maximum 'envelope' of flood extent can be produced. The relationship between the probability of storm tide and the probability of fluvial flow varies with location and depends on the correlation between the two conditions during a weather event. The correlation can be assessed from an analysis of historical records, or a simpler 'rule of thumb' can be used to define pairs of events to consider in estimating the combined water level.

The coastal inundation processes and the interaction of the different sources of flooding during a storm event are naturally dynamic, and accurate mapping of flood extents and depths usually requires computational hydrodynamic modelling of multiple combinations of events. However, the tendency of the storm tide to dominate flood level in areas closest to the coastline means that in these areas a simpler approach can also be applied. In the 'bathtub' method the storm tide level is projected across the entire coastal area to estimate the area susceptible to inundation. Figure 6.2 shows how the 'bathtub' method compares to an envelope of maximum flood level derived from a range of combined events.

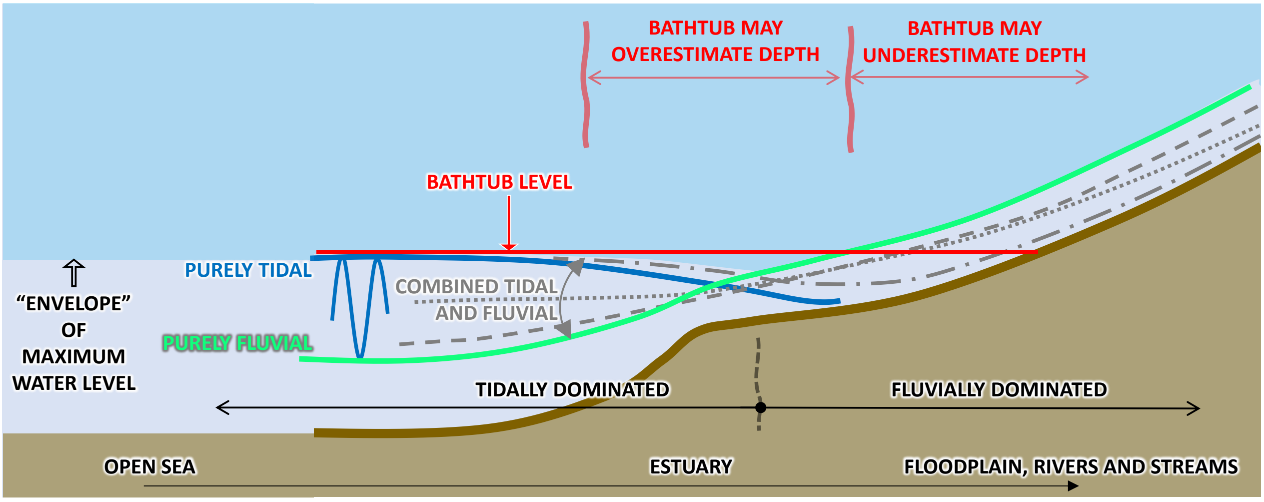

Figure 6.2: Conceptual cross-section of a coastal area comparing maximum flood levels for purely tidal events, purely fluvial events and a range of combined events, all of the same likelihoods of occurring. The 'bathtub' level of the maximum storm tide is shown for comparison.

Close to the coast the difference between a simple 'bathtub' approach and hydrodynamic modelling can be relatively small and the 'bathtub' method usually provides a conservative (higher) estimate of flood extent and depth. In this way, the method can be considered appropriate as a precautionary approach to defining flood risk in such areas for the purpose of land use planning at a district level. A more detailed investigation of flooding may however be appropriate for assessing applications for subdivision, use or development.

The uncertainty in flood extent and depth calculated using the 'bathtub' method generally increases the further inland it is applied. This is because in reality the storm tide level usually becomes increasingly transformed as it travels inland due to frictional resistance and storage in the floodplain and river channels or 'funnelling' of flow upriver estuaries. Flooding from fluvial and pluvial events also starts to become more important than the tidal event of the same probability and these sources of flooding cannot be readily included in the 'bathtub' method. The increase in uncertainty means there is a limit to how far inland the 'bathtub' method is appropriate for planning purposes.

The 'bathtub' method only provides estimates of the maximum extent and depths of flooding whereas hydrodynamic modelling of coastal inundation can provide time-variant water depth and velocity data for a simulated inundation event, allowing consideration of factors other than just depth in assessing the flood hazard.

6.3 Inundation factors

6.3.1 Likelihood of flooding

The likelihood of a given magnitude of flooding (water level or depth, for example) is usually measured by the Average Recurrence Interval (ARI) – how often, on average it occurs – or the Annual Exceedance Probability (AEP) – the chance it will happen in any one year.

The chance a given magnitude event will occur increases with the length of time considered, as summarised in Table 6.3.

Table 6.3: Likelihood of flooding over varying time periods

Flood magnitude	ARI	AEP	Chance an event will occur during a period of		
			30 years	60 years	100 years
'Small'	5 years	20%	100%	100%	100%
↓	10 years	10%	96%	100%	100%
↓	20 years	5%	79%	95%	99%
↓	50 years	2%	45%	70%	87%
↓	100 years	1%	26%	45%	63%
'Large'	200 years	0.5%	14%	26%	39%

The chance that a low probability event (such as the 1% or 0.5% AEP) will occur becomes relatively likely (a 40% to 50% chance) when considering a time period of 60 to 100 years. In the SVA, the 1% AEP storm tide was selected for defining areas susceptible to coastal inundation, as a reasonably foreseeable event over the lifetime of a development. This approach is consistent with the requirements of the RPS and has been adopted by PCC and WCC.

Inundation mapping for planning and development control is often based on one or more likelihoods or probability of flooding. For example, the Christchurch District Plan currently defines a 'Flood Management Area' as the 0.5% AEP flood extent and a 'High Flood Hazard Management Area' through the 0.2% AEP flood extent. PCC includes the following table to determine how the likelihood of hazard risk is to be determined.

Table 6.4: PCC Proposed District Plan APP10-Table 1 Likelihood guidance

Likelihood	Likelihood ranking
Less than 1:100-year event (1 in 100 year event) or annual exceedance probability (AEP) 1% or more	Very likely
1:101 – 1:200 year event or AEP range 0.5% to 1%	Likely

1:201 – 1:500 year event or AEP range 0.2% to 0.5%	Unlikely
1:501 – 1:2500 year event or AEP range 0.04% to 0.2%	Very unlikely
More than 1:2500 or AEP 0.04% or less	Extremely unlikely

6.3.2 Consequence of flooding

The consequence of flooding can be quantified in terms of financial costs for example, damages to property and assets, loss of possessions, disruption to services. This requires a detailed assessment of the value of properties and assets and calculation of damages for a range of flood probabilities and is usually applied to assessing protection of existing development rather than planning new development.

For planning purposes, the consequence is more usually quantified in terms of the 'flood hazard', a measure of the severity of the danger to people and vehicles and of damage to or failure of buildings during a flood. Methods for evaluating flood hazard, based on scientific research which includes full scale laboratory testing, are provided in Australian[25] ('the AR&R method') and UK[26] ('the DEFRA method') guidelines amongst others. The AR&R method is generally adopted by Greater Wellington Regional Council[27] in mapping flood hazards.

In these methods, flood hazard is generally defined as a function of the depth and velocity of the flood water. Additional factors such as the effects of debris in flood water are included in some methods. Figure 6.3 and Figure 6.4 show respectively the Combined Hazard Vulnerability Curves of the AR&R method and the Hazard to People Classification of the DEFRA method.

In the flood hazard curves in Figure 6.3, the thresholds for hazard to people are lower than for buildings, and the thresholds for hazard to vehicles are lower than for people. For lower velocities, less than 0.5 m/s, the hazard thresholds are independent of velocity and are defined by water depth only. The hazard ratings in Figure 6.4 depend on velocity over most of the velocity range considered.

The 'bathtub' method does not provide velocity information and so flood hazard can only be assessed using the water depth data from the DVA outputs. From our experience of coastal inundation modelling using hydrodynamic models, for example in assessing coastal inundation hazards for Waimakariri District Council, floodplain velocities during coastal inundation are usually relatively low – below the 0.5 m/s value for inclusion in hazard definition in the AR&R method (Figure 6.3). For these reasons we consider it appropriate to categorise coastal flood hazard using only water depth when using the 'bathtub' method, referenced to the 'still water' depth thresholds from hazard guidelines.

The DEFRA method specifically considers the hazards to people while the AR&R method considers hazards to people, vehicles, and buildings. However, the lower flood depth thresholds in the AR&R method reflect hazard to people rather than hazard to buildings.

District plans control the subdivision, use and development of land. More recent district plans have focused on managing the risk to people by identifying more and less sensitive activities. Buildings and other infrastructure can be designed and constructed to perform safely in areas of relatively deep flooding. However, it should be recognised that most development will be occupied or used by people who will need to access or egress buildings during a flood. The depth thresholds for the same category of hazard are lower for people than for buildings.

[25] Australian Rainfall and Runoff: A Guide to Flood Estimation, Book 6, Chapter 7 (Smith and Cox, 2019)

[26] Framework and Guidance for Assessing and Managing Flood Risk for New Development, UK Defra/Environment Agency Flood and Coastal Defence R&D Programme FD2320/TR22

[27] Flood Hazard Modelling Standard, Greater Wellington Regional Council, May 2021

We therefore consider it appropriate, and consistent with the requirements of Section 6(h) of the RMA, to consider 'significant risks', to define flood hazard depth thresholds based on hazards to people, such as those considered in the AR&R and DEFRA methods and included in the Greater Wellington Regional Council's Flood Hazard Modelling Standard (2021).

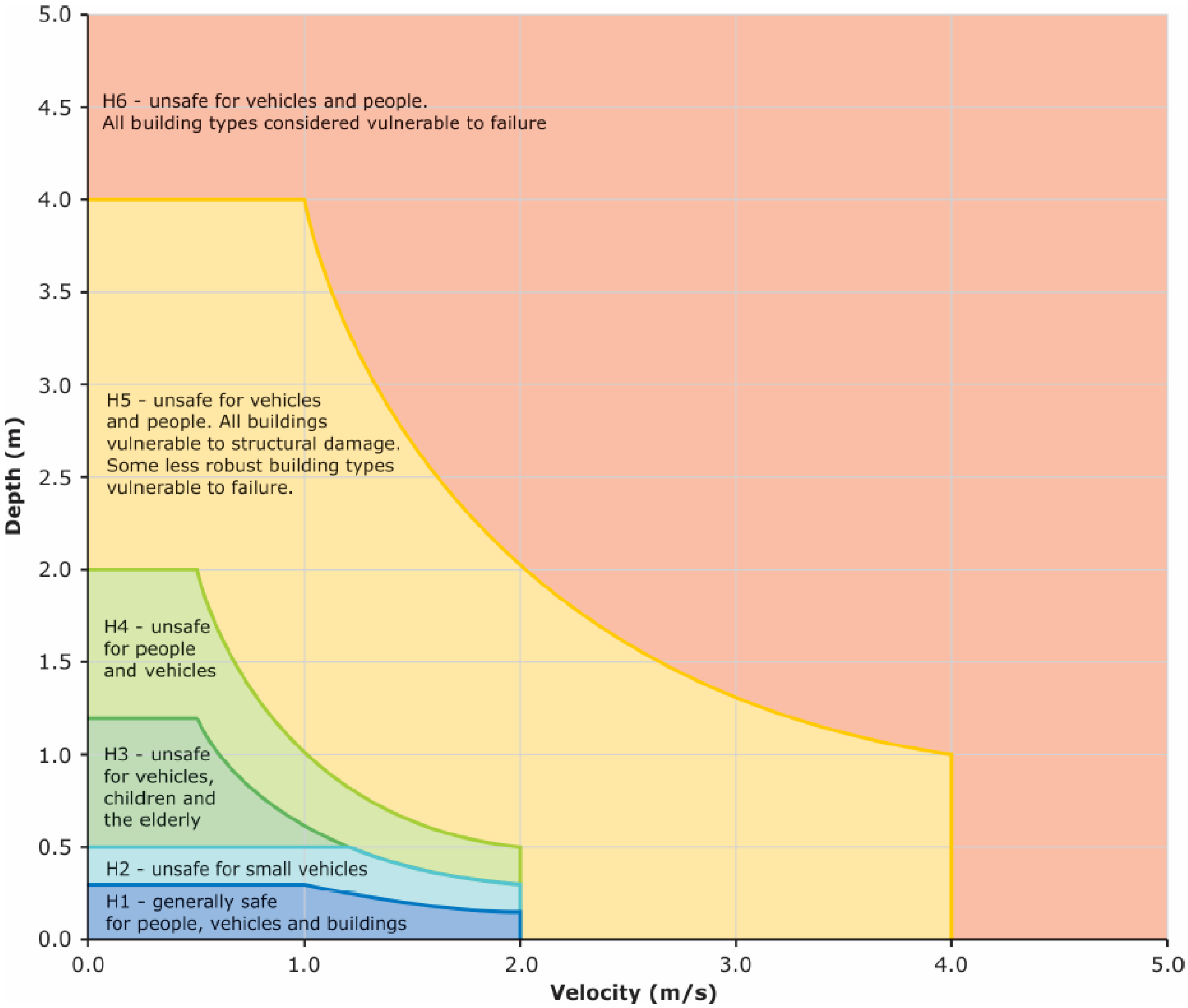

Figure 6.3: Combined flood hazard curves (Figure 6.7.9 of Australian Rainfall and Runoff: A Guide to Flood Estimation, Book 6, Chapter 7)

HR	Depth of flooding - d (m)												
	DF = 0.5				DF = 1								
Velocity v (m/s)	0.05	0.10	0.20	0.25	0.30	0.40	0.50	0.60	0.80	1.00	1.50	2.00	2.50
0.0	0.03 + 0.5 = 0.53	0.05 + 0.5 = 0.55	0.10 + 0.5 = 0.60	0.13 + 0.5 = 0.63	0.15 + 1.0 = 1.15	0.20 + 1.0 = 1.20	0.25 + 1.0 = 1.25	0.30 + 1.0 = 1.30	0.40 + 1.0 = 1.40	0.50 + 1.0 = 1.50	0.75 + 1.0 = 1.75	1.00 + 1.0 = 2.00	1.25 + 1.0 = 2.25
0.1	0.03 + 0.5 = 0.53	0.06 + 0.5 = 0.56	0.12 + 0.5 = 0.62	0.15 + 0.5 = 0.65	0.18 + 1.0 = 1.18	0.24 + 1.0 = 1.24	0.30 + 1.0 = 1.30	0.36 + 1.0 = 1.36	0.48 + 1.0 = 1.48	0.60 + 1.0 = 1.60	0.90 + 1.0 = 1.90	1.20 + 1.0 = 2.20	1.50 + 1.0 = 2.55
0.3	0.04 + 0.5 = 0.54	0.08 + 0.5 = 0.58	0.15 + 0.5 = 0.65	0.19 + 0.5 = 0.69	0.23 + 1.0 = 1.23	0.30 + 1.0 = 1.30	0.38 + 1.0 = 1.38	0.45 + 1.0 = 1.45	0.60 + 1.0 = 1.60	0.75 + 1.0 = 1.75	1.13 + 1.0 = 2.13	1.50 + 1.0 = 2.50	1.88 + 1.0 = 2.88
0.5	0.05 + 0.5 = 0.55	0.10 + 0.5 = 0.60	0.20 + 0.5 = 0.70	0.25 + 0.5 = 0.75	0.30 + 1.0 = 1.30	0.40 + 1.0 = 1.40	0.50 + 1.0 = 1.50	0.60 + 1.0 = 1.60	0.80 + 1.0 = 1.80	1.00 + 1.0 = 2.00	1.50 + 1.0 = 2.50	2.00 + 1.0 = 3.00	2.50 + 1.0 = 3.50
1.0	0.08 + 0.5 = 0.58	0.15 + 0.5 = 0.65	0.30 + 0.5 = 0.80	0.38 + 0.5 = 0.88	0.45 + 1.0 = 1.45	0.60 + 1.0 = 1.60	0.75 + 1.0 = 1.75	0.90 + 1.0 = 1.90	1.20 + 1.0 = 2.20	1.50 + 1.0 = 2.50	2.25 + 1.0 = 3.25	3.00 + 1.0 = 4.00	3.75 + 1.0 = 4.75
1.5	0.10 + 0.5 = 0.60	0.20 + 0.5 = 0.70	0.40 + 0.5 = 0.90	0.50 + 0.5 = 1.00	0.60 + 1.0 = 1.60	0.80 + 1.0 = 1.80	1.00 + 1.0 = 2.00	1.20 + 1.0 = 2.20	1.60 + 1.0 = 2.60	2.00 + 1.0 = 3.00	3.00 + 1.0 = 4.00	4.00 + 1.0 = 5.00	5.00 + 1.0 = 6.00
2.0	0.13 + 0.5 = 0.63	0.25 + 0.5 = 0.75	0.50 + 0.5 = 1.00	0.63 + 0.5 = 1.13	0.75 + 1.0 = 1.75	1.00 + 1.0 = 2.00	1.25 + 1.0 = 2.25	1.50 + 1.0 = 2.50	2.00 + 1.0 = 3.00	3.50	4.75	6.00	7.25
2.5	0.15 + 0.5 = 0.65	0.30 + 0.5 = 0.80	0.60 + 0.5 = 1.10	0.75 + 0.5 = 1.25	0.90 + 1.0 = 1.90	1.20 + 1.0 = 2.20	1.50 + 1.0 = 2.50	1.80 + 1.0 = 2.80	3.40	4.00	5.50	7.00	8.50
3.0	0.18 + 0.5 = 0.68	0.35 + 0.5 = 0.85	0.70 + 0.5 = 1.20	0.88 + 0.5 = 1.38	1.05 + 1.0 = 2.05	1.40 + 1.0 = 2.40	1.75 + 1.0 = 2.75	3.10	3.80	4.50	6.25	8.00	9.75
3.5	0.20 + 0.5 = 0.70	0.40 + 0.5 = 0.90	0.80 + 0.5 = 1.30	1.00 + 0.5 = 1.50	1.20 + 1.0 = 2.20	1.60 + 1.0 = 2.60	3.00	3.40	4.20	5.00	7.00	9.00	11.00
4.0	0.23 + 0.5 = 0.73	0.45 + 0.5 = 0.95	0.90 + 0.5 = 1.40	1.13 + 0.5 = 1.63	1.35 + 1.0 = 2.35	1.80 + 1.0 = 2.80	3.25	3.70	4.60	5.50	7.75	10.00	12.25
4.5	0.25 + 0.5 = 0.75	0.50 + 0.5 = 1.00	1.00 + 0.5 = 1.50	1.25 + 0.5 = 1.75	1.50 + 1.0 = 2.50	2.00 + 1.0 = 3.00	3.50	4.00	5.00	6.00	8.50	11.00	13.50
5.0	0.28 + 0.5 = 0.78	0.60 + 0.5 = 1.10	1.10 + 0.5 = 1.60	1.38 + 0.5 = 1.88	1.65 + 1.0 = 2.65	3.20	3.75	4.30	5.40	6.50	9.25	12.00	14.75

Flood Hazard Rating (HR)	Colour Code	Hazard to People Classification
Less than 0.75		Very low hazard - Caution
0.75 to 1.25		Danger for some – includes children, the elderly and the infirm
1.25 to 2.0		Danger for most – includes the general public
More than 2.0		Danger for all – includes the emergency services

Figure 6.4: Hazard to People Classification using Hazard Rating (Table 13.1 from Framework and Guidance for Assessing and Managing Flood Risk for New Development, UK Defra/Environment Agency Flood and Coastal Defence R&D Programme FD2320/TR22– Extended version) – Hazard Rating (HR) = d x (v+0.5) + DF (d is water depth, v is velocity and DF is the Debris Factor)

6.3.3 Change in likelihood and consequences in the future

The likelihood and consequences of coastal inundation in the Kāpiti Coast District will increase in the future due to sea level rise resulting from climate change, which will increase storm tide levels. Figure 6.5 shows how the frequency of the present day 100-year and 10-year storm tides at Paraparaumu Beach, as estimated in the SVA, will increase in the future based on NZ SeaRise (2022) projections of relative sea level rise for the SSP5-8.5 scenario with VLM allowance. Climate change will also affect rainfall intensity and the frequency of flooding in pluvially or fluvially dominated flood events.

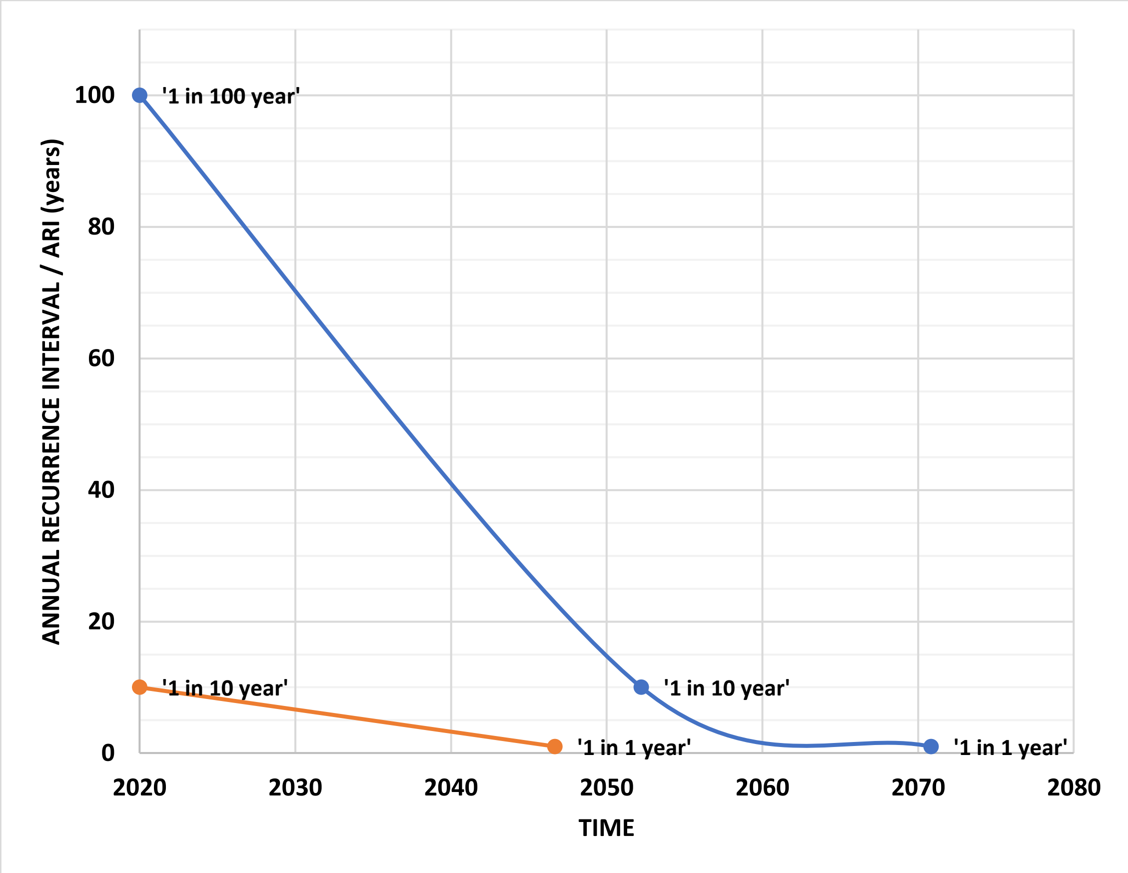

Figure 6.5: Estimated change in Annual Recurrence Interval of present-day 100-year and 10-year ARI storm tides at Paraparaumu Beach (based on Relative Sea Level Rise obtained from NZSeaRise for SSP5-8.5 with Vertical Land Movement)

Land use planning should take account of reasonably foreseeable effects of climate change in considering coastal inundation hazard. Figure 6.5 shows that based on current projections, the frequency of present-day extreme tides will increase rapidly over the next 20 to 40 years. The effect of RSLR on inundation can be included by mapping inundation for representative scenarios of RSLR values combined with the present-day storm tide level. We have selected RSLR values of 0.45 m and 1.25 m as 'lower' and 'higher' RSLR scenarios for inundation risk mapping as set out in Section 5 of this report.

The lower value RSLR scenario is more likely to occur within the planning timeframe due to it being projected to occur sooner than the higher value. Although there is less confidence in the timing of the higher value RSLR scenario due to it being projected to occur later, it can still reasonably be expected to occur at some point in the future.

6.4 Potential methods and thresholds

6.4.1 Thresholds considered

We have considered two main methods for defining thresholds of the severity of flooding and tested their application by using them to map coastal inundation in the district using the SVA 'bathtub' data.

Method 1: Inundation severity categorised according to thresholds of the likelihood or frequency of flooding, regardless of the depth of flood water or the hazard posed by it. In this method we have used the 10-year ARI and 100-year ARI (10% and 1% AEP) coastal flood events as thresholds to define three inundation categories. In the SVA the 10-year ARI flood level has only been estimated at one location (Paraparaumu Beach), so our assessment is based on mapping in this example area.

Method 2: Inundation severity categorised according to thresholds of hazard during a low frequency coastal flood event. In this method we have used depths calculated by the 'bathtub' method for the 100-year ARI (1% AEP) storm tide event considered in the SVA to categorise flood hazard. We have tested two different hazard classification systems:

Method 2a: Water depth bands based on the AR&R Combined Hazard Vulnerability Curves. This method is consistent with Greater Wellington Regional Council's Flood Hazard Modelling Standard which requires that the AR&R classification method is generally adopted in mapping flood hazards.

Method 2b: Water depth bands based on the DEFRA method. Both classification systems also consider flood water velocity as a factor in categorising hazard. Since the 'bathtub' method does not determine velocity, we have categorised hazard using only the 'still water' depth criteria, or zero velocity. However, these methods could also be applied to the outputs of hydrodynamic modelling which include both depth and velocity information. This method is not referenced in the Greater Wellington Regional Council's Flood Hazard Modelling Standard but is not precluded from use by the standard or RPS.

We have used these methods to map the categories of severity of flooding for each of the two selected representative values of RSLR – a lower value scenario of 0.45 m and a higher value scenario of 1.25 m. Table 6.5 to Table 6.7 summarise the definitions of the inundation categories for each RSLR scenario under each method tested.

We have used these methods to map the categories of severity of flooding for each of the two selected representative values of RSLR – a lower value scenario of 0.45 m and a higher value scenario of 1.25 m. Table 6.5 to Table 6.7 summarise the definitions of the inundation categories for each RSLR scenario under each method tested.

Table 6.5: Definition of categories and scenarios for severity of coastal inundation – Method 1 (likelihood)

Scenario		Probability of flooding	Rating	Likelihood description	Overall likelihood category
RSLR	Timescale				
0.45 m	Likely to occur soon	Less than 1% AEP	Low	Less likely to flood (<39% chance over 50 years)	Low in the near future
		Between 1% AEP and 10% AEP	Medium	Likely to flood (39% to 99% chance over 50 years)	Medium in the near future
		10% AEP or greater	High	Very likely to flood (more than 99% chance over 50 years)	High in the near future
1.25 m	Unlikely to occur soon, likely to occur later	Less than 1% AEP	Low	Less likely to flood (<39% chance over 50 years)	Low further in the future
		Between 1% AEP and 10% AEP	Medium	Likely to flood (39% to 99% chance over 50 years)	Medium further in the future

		10% AEP or greater	High	Very likely to flood (more than 99% chance over 50 years)	High further in the future

Table 6.6: Definition of categories and scenarios for severity of coastal inundation – Method 2a (hazard/flood depth based on the AR&R method)

Scenario		'Bathtub' water depth (1% AEP)	Rating	Hazard description	Overall hazard Category
RSLR	Timescale				
0.45 m	Likely to occur soon	0 m to 0.5 m	Low	Generally safe for people	Low in the near future
		0.5 m to 1.2 m	Medium	Unsafe for children and the elderly and for vehicles	Medium in the near future
		Over 1.2 m	High	Unsafe for people and vehicles	High in the near future
1.25 m	Unlikely to occur soon, likely to occur later	0 m to 0.5 m	Low	Generally safe for people	Low further in the future
		0.5 m to 1.2 m	Medium	Unsafe for children and the elderly and for vehicles	Medium further in the future
		Over 1.2 m	High	Unsafe for people and vehicles	High further in the future

Table 6.7: Definition of categories and scenarios for severity of coastal inundation – Method 2b (hazard/flood depth based on the DEFRA method)

Scenario		'Bathtub' water depth (1% AEP)	Rating	Hazard description	Overall hazard Category
RSLR	Timescale				
0.45 m	Likely to occur soon	0 m to 0.3 m	Low	Very low hazard	Low in the near future
		0.3 m to 0.5 m	Medium	Danger for some (children, elderly, infirm)	Medium in the near future
		Over 0.5 m	High	Danger for most (general public)	High in the near future
1.25 m	Unlikely to occur soon, likely to occur later	0 m to 0.3 m	Low	Very low hazard	Low further in the future
		0.3 m to 0.5 m	Medium	Danger for some (children, elderly, infirm)	Medium further in the future
		Over 0.5 m	High	Danger for most (general public)	High further in the future

6.4.2 Test results

Method 1 Likelihood thresholds

A sample inundation map for Method 1 at the Waikanae Estuary for both RSLR scenarios is provided in Figure 6.6.

In both scenarios the map shows that the extent of the 'high' likelihood category (>10% AEP) is large and the extent of the 'medium' likelihood category (1% to 10% AEP) is very small in comparison. This is because the variation in estimated storm tide level for different likelihoods is relatively small (i.e., 0.24 m between the 10% and 1% AEP for Paraparaumu Beach) and the land is relatively flat and bounded by steeper ground. The difference in flood depth between the two likelihoods is also relatively small compared to typical hazard classification thresholds. Most of the inundated area is categorised as a 'high' likelihood of flooding but the actual flood hazard will vary within it.

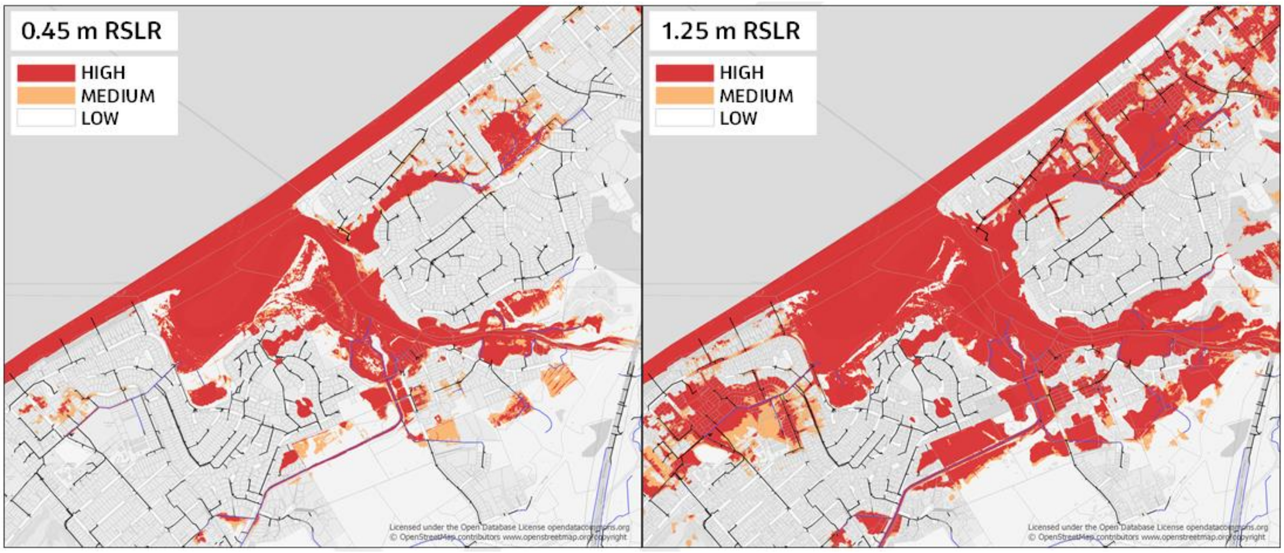

Figure 6.6: Inundation hazard map for Method 1 (flood likelihood) – note that, for clarity, 'low' likelihood has not been shaded in the map. It is defined as all land outside of 'high' and 'medium' likelihood.

- The difference in inundation extent for different likelihoods is small and the method does not adequately differentiate between areas of higher and lower hazard. The RPS requires hazards to be classified as low, medium or high and therefore, therefore this method of categorising inundation is not recommended for planning purposes.
- Given the small difference in extents, use of a single likelihood for mapping is appropriate. Using the SVA data, we recommend mapping based on 1% AEP water levels. This is consistent with the requirements of Policy 51 of the RPS.

Method 2a Hazard thresholds (AR&R categories)

A sample inundation map for Method 2a at the Waikanae Estuary for both SLR scenarios is shown in Figure 6.7.

The map shows clear differentiation between the three categories of hazard for both SLR scenarios when using the AR&R hazard thresholds method applied to the 1% AEP flood depths. The likelihood of inundation is not explicitly taken into account in this method. However, the difference in depths between the 1% AEP and 10% AEP depths (generally between 0.1 m and 0.3 m) means that when the inundation thresholds are applied to the less likely 1% AEP water depth, they are equivalent to a lower depth threshold for the more likely 10% AEP depths. For example, in the area around the Waikanae Estuary the 'medium' hazard depth threshold of 0.5 m for the 1% AEP corresponds to a depth of 0.26 m (similar to the more conservative DEFRA method threshold) for the 10% AEP. In this way the hazard thresholds reflect a lower depth threshold for more frequent events and a higher depth threshold for less frequent events. This is shown in Figure 6.8.

- For these reasons this hazard threshold method is recommended as the basis for mapping inundation. However, to avoid the need for separate flood maps for each SLR scenario, it would be preferable to incorporate the effect of RSLR on hazards within a single classification method. This approach gives effect to PC1 to the RPS by categorising hazards as being low, medium and high risk. This change was notified after the Proposed District Plans for PCC and WCC and is not given effect to in their proposed plans. PCC and WCC include a high and medium hazard overlay based on the current and future risk of inundation.

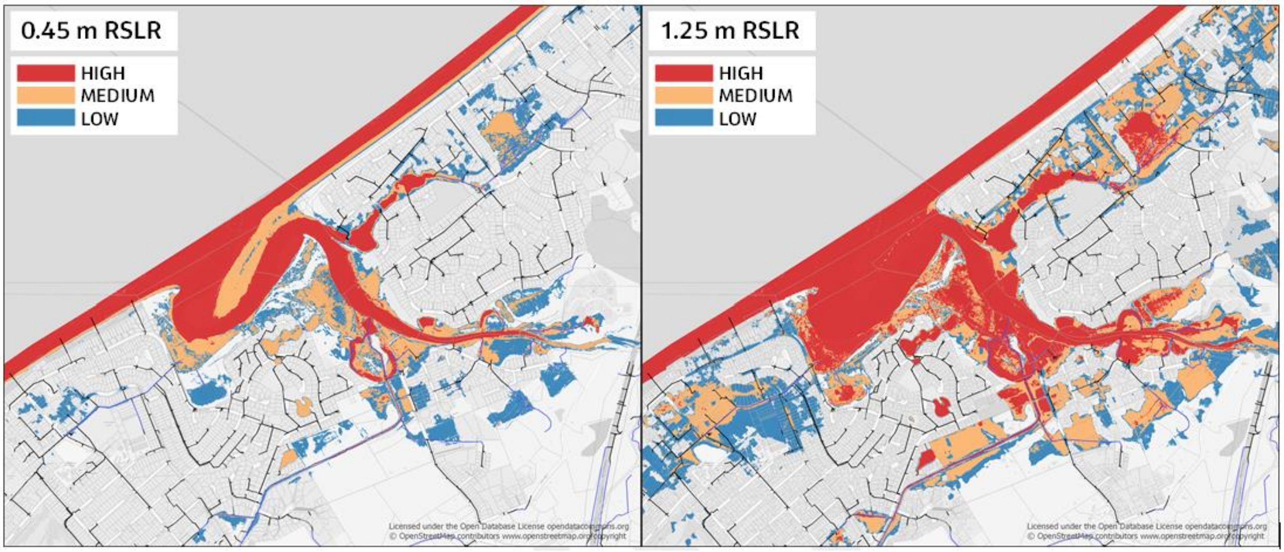

Figure 6.7: Inundation hazard map for Method 2a (flood hazard – AR&R method)

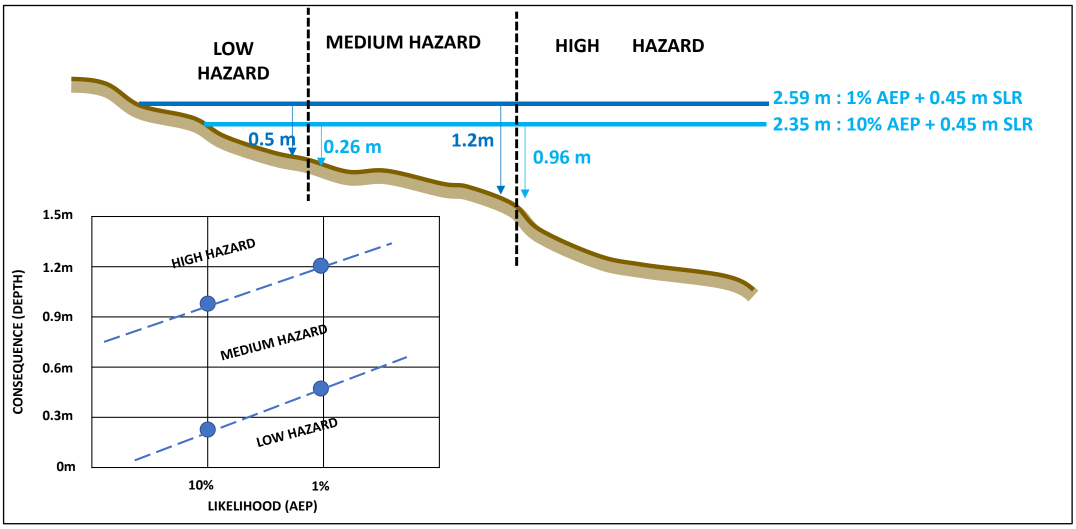

Figure 6.8: Example of the relationship between threshold values for 1% and 10% AEP flood depths using the AR&R method (Paraparaumu Beach)

Method 2b Hazard thresholds (DEFRA categories)

A sample inundation map for Method 2b at the Waikanae Estuary for both SLR scenarios is shown in Figure 6.9.

The map shows less differentiation between the three categories of hazard for both SLR scenarios when applied to the 1% AEP flood depths than when using the AR&R hazard thresholds method (Method 2a). This is because of the relatively small difference between the 'medium' and 'high' depth thresholds (0.3 m and 0.5 m respectively). The 'medium' hazard depth threshold of 0.3 m applied to the 1% AEP depths equates to a 0.1 m or lower threshold when applied to the 10% AEP depths which is less appropriate than the equivalent depths using the AR&R thresholds.

- For these reasons we recommend Method 2a (AR&R hazard thresholds) instead of Method 2b (DEFRA hazard thresholds) as the basis for inundation mapping.

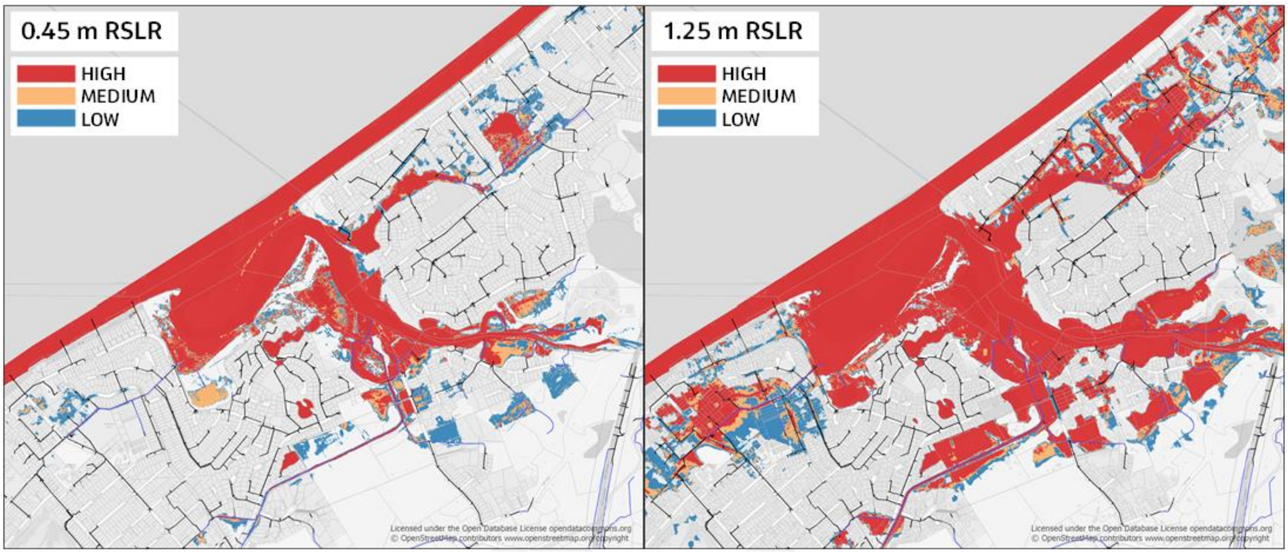

Figure 6.9: Inundation hazard map for Method 2b (flood hazard – DEFRA method)

6.5 Proposed approach

From our review of existing methods of flood risk mapping and the results of our tests of applying alternative methods and thresholds to the SVA data, we propose a method for mapping 'coastal inundation risk' which:

1. Uses a single likelihood of flooding

We recommend mapping and categorising inundation risk using water depths for a single low probability event. Using the SVA data, the smallest AEP for which outputs are available is 1% AEP. We consider this is consistent with the purpose of the RMA to promote sustainable management of natural and physical resources, ensures that the District Planning framework considers intergenerational needs, and a precautionary approach is applied. This probability is also consistent with Policy 51(i) of the RPS which requires that particular regard be given to *the need to locate floor levels of habitable buildings and buildings used as places of employment above the 1% AEP (1:100-year) flood level, in identified flood hazard areas*, to minimise damages, as a minimum standard.

2. Considers three categories of hazard severity, informed by published scientific guidelines

We recommend adopting three categories of hazard– 'low', 'medium' and 'high' – informed by the hazard vulnerability classifications of the Australian Rainfall and Runoff (AR&R) guidelines. This is consistent with Greater Wellington Regional Council's Flood Hazard Modelling Standard which requires that the AR&R classification method is generally adopted in mapping flood hazards and is required by Policy 29 of the RPS.

The corresponding thresholds for each category are presented in Table 6.8.

The selection of these classifications reflects the fact that most development will be occupied or used by people who will need to access and egress buildings during a flood and for whom the depth thresholds for the same category of hazard are lower than for buildings. We therefore consider it appropriate, and consistent with the requirements of Section 6(h) of the RMA to consider 'significant risks', to define flood hazard depth thresholds based primarily on hazards to people.

Table 6.8: Definition of proposed hazard severity categories and thresholds for coastal inundation

Proposed Hazard Severity Category	AR&R Classification	Description	Classification Limit (D and V in combination)	Limiting Still Water Depth D (m)	Limiting Velocity V (m/s)
Low	H1 to H2	Generally safe for vehicles, people and buildings Unsafe for small vehicles	D*V ≤ 0.6	0.5	2.0
Medium	H3	Unsafe for vehicles. Children and the elderly.	D*V ≤ 0.6	1.2	2.0
High	H4 or higher	Unsafe for vehicles and people.	-	-	-

3. Considers the effects of two increments of RSLR

Climate change allowance can be used as a measure of the likelihood of future flooding because it reflects both the degree of certainty of occurrence and the time period in which it is likely to occur; and, for tidally dominated flooding, the depth of flooding varies more with RSLR than with AEP for a range of 'reasonably foreseeable' and 'significant' occurrences.

We recommend that two RSLR scenarios are considered to define the change in future flood hazard. As discussed in Section 5.3, we recommend adopting the SSP5-8.5 scenario at future dates of 2070 and 2130. For tidally dominated coastal flooding we recommend corresponding RSLR values, including allowance for vertical land movement, of

- a lower value, 0.45 m, which is more certain to occur within the planning timescale and which will occur sooner, and
- a higher value, 1.25 m, which is less certain to occur within the planning timescale and will occur later but can reasonably be expected to occur at some point in the future.

We recommend that the overall inundation area is mapped using the higher climate change scenario (RSLR of 1.25 m). This ensures that areas which are not at risk in the shorter time frame but may become at risk of flooding under longer time frames are included in planning considerations. If this method is applied to mapping outputs which include the combined effects of rainfall, river flow and storm tide then corresponding allowances for climate change effects on the other sources of flooding for the same scenarios should also be include in the assessment.

4. Combines the hazard severities in the two RSLR scenarios into a single measure of 'flood risk'

To rationalise mapping and planning provisions, we suggest that the flood hazard severities evaluated under each of the two separate climate change scenarios could be combined to define a single set of four 'coastal flood risk' categories ('very low', 'low', 'medium', 'high') by means of the matrix in Figure 6.10.

For a given severity of hazard, the categories reflect a higher risk associated with the hazard occurring in a shorter time (in 2070), where there is greater confidence in the projected change in climate, and a lower risk if the same hazard is projected to occur in the longer timeframe (2130) where there is less confidence in the timing of the projected change in climate.

Flood hazard in HIGHER climate change scenario (1.25 m RSLR) ↓ / Flood hazard in LOWER climate change scenario (0.45 m RSLR) →	None	Low	Medium	High
High	MEDIUM RISK	MEDIUM RISK	MEDIUM RISK	HIGH RISK
Medium	LOW RISK	LOW RISK	MEDIUM RISK	HIGH RISK
Low	VERY LOW RISK	LOW RISK	MEDIUM RISK	HIGH RISK
None	NO RISK	LOW RISK	MEDIUM RISK	HIGH RISK

Figure 6.10: Matrix for proposed coastal inundation risk from flood hazards in two climate change scenarios

6.6 Application of the thresholds and scenarios

6.6.1 Available data

Section 6.5 sets out the principles of the proposed method for defining thresholds, scenarios and resulting coastal flood risk category. The method can be applied to different types of source data. The sources of data considered for this assessment are:

1. 2022 Kāpiti Coast Coastal Hazards Susceptibility and Vulnerability Assessment ('the SVA')

The SVA used a simple 'bathtub' method to define the extent of land susceptible to coastal inundation under a range of climate change scenarios. This method can also be readily used to estimate the potential depth of flooding within the susceptible area but does not provide estimates of the velocity of the flood water. The method does not include areas of land which are higher than the mapped storm tide level (including RSLR), where flooding from other sources may, however, be influenced by coastal conditions.

2. Ongoing Kāpiti Coast District Council stormwater modelling

KCDC is currently preparing updated stormwater models covering most of the Kāpiti coastal area. These hydrodynamic models will be used to simulate flooding for a range of pluvial and fluvial flood events in combination with storm tide and including the effect of groundwater levels on surface water flooding. The models can be used to simulate flooding under a range of climate change scenarios. The model outputs will include both water depth and velocity information. The models will not, however, cover the entire coastal area of the district.

3. Other sources

The existing hydrodynamic models which were used to produce the current KCDC flood hazard maps have not been considered appropriate for use due to their age, the time required to obtain the necessary outputs and because the models will soon be superseded by the ongoing updated modelling.

Updated flood models and flood maps are currently being produced by Greater Wellington Regional Council (GWRC) for the Ōtaki River, Mangaone Stream and Waikanae River. However, unlike the KCDC models, the GWRC models do not include a detailed representation of the stormwater network in these areas and the new, more detailed, KCDC models will cover most of the relevant areas around the Ōtaki and Waikanae Rivers. There may be potential to make use of the GWRC models of the Mangaone Stream and Ōtaki River to provide improved estimates of flooding in the area between the Ōtaki River and the Mangaone Stream once the models are finalised.

Storm surge inundation modelling was completed in 2013 and 2019 by NIWA, on behalf of GWRC, for parts of the Kāpiti coastal area. The resolution of the models around some of the stream mouths – key pathways for coastal inundation – is relatively coarse in some areas (e.g., the Wharemauku Stream), the models would have to be re-run for the climate change scenarios in the proposed method and they do not cover the whole coastal area so have therefore not been considered further.

The new KCDC stormwater models will provide the most accurate mapping of flood depths in the coastal area, will take account of coincident pluvial and fluvial events, and will provide more detailed information – velocity and water depth – for determining flood hazard and risk. However, the project is still in progress and will not cover the entire coastal area.

The simpler SVA bathtub data could be used for mapping flood risk categories within the coastal area where flood depths and extents are largely determined by the storm tide level. Although this approach does not allow the velocity of the flood water to be considered when determining flood hazard, velocities in the coastal area are generally expected to be below the threshold at which they are a factor in determining hazard under the AR&R guidelines.

6.6.2 Application to the SVA data

Since the SVA 'bathtub' data does not include velocity information, the flood hazard vulnerability classification under the AR&R guidelines is determined using the 'still water depth' thresholds.

Table 6.9 shows how the resulting combined flood risk categories over RSLR scenarios are defined using the definitions of flood hazard in Table 6.8 and the risk matrix in Figure 6.10 when applied to the SVA 'bathtub' data. Figure 6.11 shows the proposed combined risk categories and depth thresholds diagrammatically.

Table 6.9: Proposed definitions for coastal flood risk mapping using the SVA 'bathtub' approach (d = water depth for 1% annual exceedance probability)

Coastal flood risk category	Flood hazard with 0.45 m RSLR			Flood hazard with 1.25 m RSLR		
	Hazard	AR&R class	Depth range	Hazard	AR&R class	Depth range
Very low	None	n/a	dry	Low	H1 and H2	d < 0.5 m
Low	Low	H1 and H2	d < 0.4 m	Medium	H3	0.5 m < d < 1.2 m
Medium	Medium	H2 and H3	0.4 m < d < 1.2 m	High	H4	1.2 m < d < 2.0 m
High	High	H4 and above	d > 1.2 m	High	H5 and above	d > 2.0 m

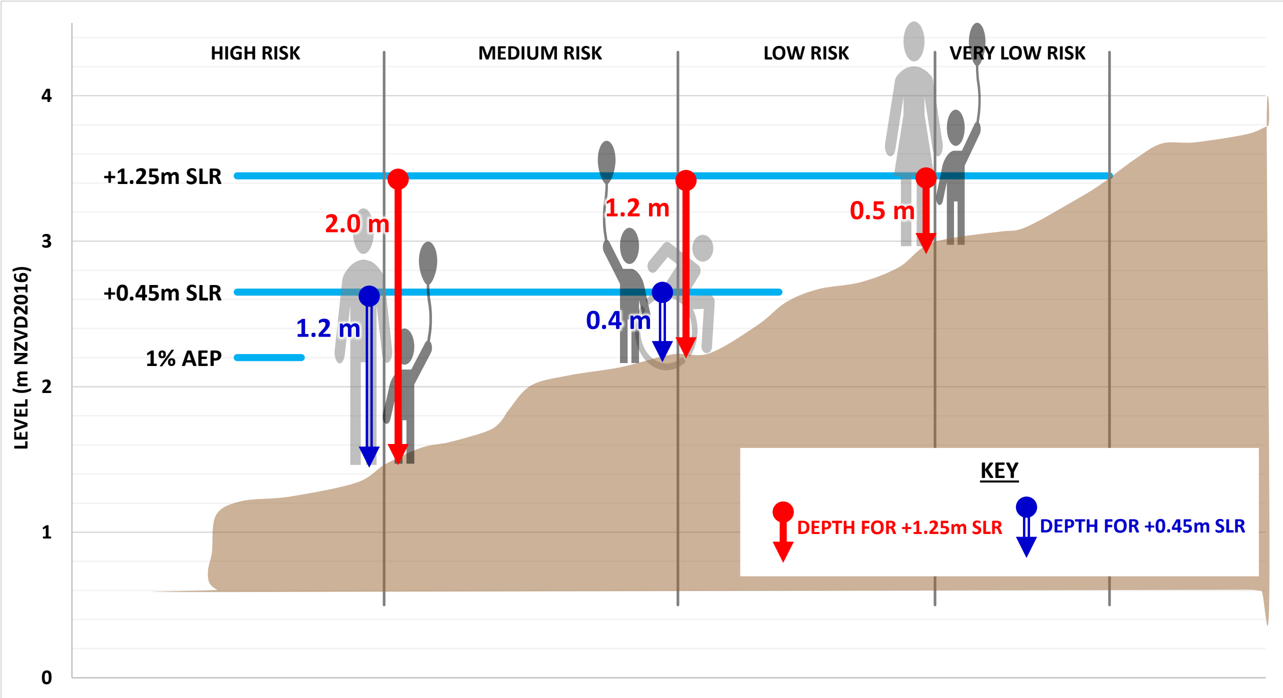

Figure 6.11: Proposed depth thresholds for defining risk categories using the SVA bathtub data and RSLR values of 0.45 m and 1.25 m

6.7 Considerations in applying the risk thresholds

6.7.1 Uncertainties

We have developed our proposed method for risk mapping as one which can potentially be applied to different types of flood data obtained from various sources. We would recommend that KCDC should consider a common approach to thresholds and scenarios for district planning purposes for fluvial, pluvial and groundwater flooding.

For the purposes of our assessment and to demonstrate the method we have applied the method to the SVA bathtub approach for mapping susceptibility to coastal inundation. For inundation from purely tidal events, this dataset tends to be conservative within the area of coverage defined in the SVA. For this reason, we consider it unnecessary to include an additional allowance for uncertainty in the depth data for mapping the inundation area or defining flood risk. In areas of higher flood risk, mitigation measures such as minimum floor level requirements should include an appropriate freeboard allowance above estimated flood level. More detailed assessment of flood level, including consideration of flooding from other sources, may be warranted for individual developments to determine floor levels or other measures.

6.7.2 Unconnected areas

The bathtub method maps all land below the flood level without taking account of connectivity with the source of flooding or the hydraulic capacity of pathways connecting flooded areas.

Some flood risk areas may be separated by higher ground from the source of flooding, which could prevent flooding in the 'unconnected area'. In common with the SVA, we have included both 'connected' and 'potentially unconnected' areas when mapping flood risk using the proposed depth thresholds. Including all land which is below the source flood level in the inundation area allows the residual risk from breaches of stopbanks or impedance of stormwater drainage in low-lying areas to be included in the mapping.

Potentially unconnected areas could be highlighted through different colouring to help guide adaptation responses. These could include more detailed, case by case assessments to determine if pathways, such as culverts or sub-surface stormwater drains which are not represented in the terrain data, would connect such areas and if their capacity would allow significant inundation.

The new KCDC stormwater models will include representation of these types of pathways and defences and will provide more accurate mapping of flooding. However, it may still be beneficial to include areas protected from flooding by such measures but still susceptible to flooding in the event of a failure.

6.7.3 Risk of isolation

There may be properties in some locations which are not at risk of flooding but are potentially at risk of becoming inaccessible by normal vehicular means during a flood which has implications for the safety of residents. These could be identified during future mapping and consideration made of how to apply risk categories to control land use planning in these incidences.

6.7.4 Negligible risk

Future flood risk maps could show all depths of water. Areas of very shallow water are sometimes excluded from flood maps on the basis that such flooding constitutes a 'nuisance' rather than a danger and additional controls are not needed. If a minimum depth of flooding is used to define the inundation area and so the area where planning rules, such as minimum floor level, are applied then this should be consistent with other development controls.

For example, for sites which are 'free from a history of flooding, not adjacent to a watercourse, not located in a low-lying area and not located in a secondary flow path', the acceptable minimum floor height under the Building Code Acceptable Solution E1/AS1 is 150 mm above the adjacent ground level. Areas which are outside a mapped flood risk area might be considered to meet these criteria. But if the mapping excludes areas where the flood depth is less than 100 mm, for example, then the freeboard to floor level might be only 50 mm. In areas where such secondary flow is identified, the Building Code requires a freeboard of 150 mm for depths which are less than 100 mm and 500 mm for greater depths.

We recommend that areas of shallow water are not excluded from the mapping. The risk-based approach provides a rationale which identifies the lower risk in such areas and allows planning controls to recognise the differences in risk.

6.7.5 Data post-processing

For planning purposes mapped data could be smoothed to create a dataset more useful for planning map purposes and there are various, automated, means to do this. This post processing could include removal of any areas at "indirect" risk of flooding if these are confirmed to be unconnected.

7. Coastal Erosion Thresholds

This section first presents a summary of the recommended coastal erosion thresholds, and similarly to the inundation section, then provides the discussion and reasoning behind this recommendation and consideration of other approaches.

7.1 Summary of Preferred Approach

In alignment with the discussion of RSLR scenarios presented in Section 4, the thresholds for coastal erosion hazards have been developed based on the information generated from the Jacobs (2023) updated mapping of the SSP2-4.5 and SSP5-8.5 RSLR scenarios. Using this information, our preferred approach for the open coast shoreline is that there should be three Coastal Erosion Hazard Risk Overlays comprising of:

- High Erosion Hazard Risk Overlay:
  (Ha) Threshold Option of 66% probability under 0.45 m RSLR by 2070. Erosion up to this distance is likely within a 50-year timeframe, and a very high degree of certainty that will occur over longer time frames. There is also a high residual risk (66%) that erosion will exceed this distance within the 50-year timeframe should RSLR reach this level.
- Medium Erosion Hazard Risk Overlay:
  (Mb) Threshold Option of 66% probability under 1.25 m RSLR by 2130. Erosion up to this distance is likely within a 100-year timeframe, but less certainty that RSLR to this magnitude will occur within this timeframe. There is also a high residual risk (66%) that erosion will exceed this distance within the 100-year timeframe should RSLR reach this level.
- Low Erosion Hazard Risk Overlay:
  (Lb) Threshold Option of 10% probability under 1.25 m RSLR by 2130. Greater erosion is very unlikely within a 100-year timeframe should RSLR reach this level.

Open coast shorelines which have existing dune systems that provide protection from coastal hazards will need further consideration of whether an additional factor, termed a "Dune Resilience Factor", should be applied to allow for the dune systems to be maintained in the future to continue to provide a protection function.

Thresholds based on percentiles are not relevant for the mapped coastal hydrosystem areas, which are based on deterministic measurements and a qualitative site assessment. Further consideration of the methods and proposed controls on hydrosystem environments would be required to determine whether these areas could rely on controls implemented through coastal inundation provisions.

7.2 Critical Thinking

In applying a risk-based approach to land-use planning for coastal erosion hazards, the key determination is likelihood as the consequence is always high, for example land is eroded and therefore will be unusable after a certain time.

To define appropriate erosion likelihoods for different coastal erosion risk categories for land-use planning a combination of SLR scenario, timeframes and probability of occurrence needs to be considered so risk can be expressed as:

> *"xxx probability that erosion will occur within yyy timeframe under zzz SLR scenario".*

As per Section 5, we have defined the most appropriate SLR scenarios and timeframes as being 0.45 m SLR by 2070, and 1.25 m SLR by 2130. So, the probabilities that a certain erosion distance will occur within these scenarios and timeframes can be used to define the thresholds for determining different categories of hazard risk.

The critical thinking behind the selection of these thresholds includes:

- What level of "statistical uncertainty" is acceptable for defining the different hazard categories in open coast areas where Projected Future Shoreline Positions (PFSP)'s are defined by a probabilistic approach?
- How do you achieve consistency between the probabilistic approach on open coasts and the deterministic approach at hydrosystems?
- What is a suitable minimum width of a hazard overlay for each hazard category?
- Is there a need for an additional "dune resilience factor" in environments where the PFSP does not include the whole current dune?

Each of these is addressed in the following discussions.

7.2.1 Statistical Uncertainty

Under the probabilistic approach to estimating PFSP's along the open coast, the probabilities are a measure of the "Statistical Uncertainty" of resulting erosion distance based on distribution of certainty in the input data used for the erosion models and calculations. All the distributions of input data applied were assumed to be triangular and are dependent on data availability. In the Jacobs (2022) report, the probabilities are expressed as the likelihood that the erosion will reach or be greater than the calculated PFSP at that location. Therefore, the probabilities decrease with distance from the current shoreline position, as there is decreasing likelihood that erosion will reach or exceed this position with the specified magnitude of SLR within the specified timeframe. Hence for the same SLR magnitude and timeframe, we can be more certain that erosion will reach the positions with higher probabilities, and less certain it will reach the positions with lower probabilities.

The probabilities used in the thresholds link to the quantitative likelihood ratings presented in MfE guidance (2017) as shown in Figure 7.1.

Likelihood rating	Probability that a hazard event with a given annual exceedance probability will occur within the design life or planning timeframe (%)
Virtually certain:	≥ 99% probability of occurrence
Very likely:	≥ 90% probability of occurrence
Likely:	≥ 66% probability of occurrence
About as likely as not:	33–66% probability of occurrence
Unlikely:	≤ 33% probability of occurrence
Very unlikely:	≤ 10% probability of occurrence
Exceptionally unlikely:	≤ 1% probability of occurrence

Figure 7.1: Relationship between quantitative likelihood ratings and probabilities. (Source MfE: 2017; Table F-3)

An example of how these likelihood ratings convert to a probability distribution of erosion distance is shown in Figure 7.2. For interpretation, the probability of occurrence can also be viewed as the likelihood that the erosion will exceed the given distance. For example, an erosion distance with 90% probability of occurrence is very likely to occur under the given RSLR scenario with only a 10% chance that erosion distances will be less. But there is also a 90% chance that erosion will exceed this distance, so there is a large residual risk that planning provisions based on this threshold will not achieve the desired level of avoidance of hazard risk. Conversely, an erosion distance with 10% probability of occurrence, is very unlikely to be exceeded under the given RSLR scenario, so while planning provisions based on this threshold are very likely to be conservative, there is also very low residual risk, and we can be more certain that they will achieve the level of avoidance of hazard risk desired.

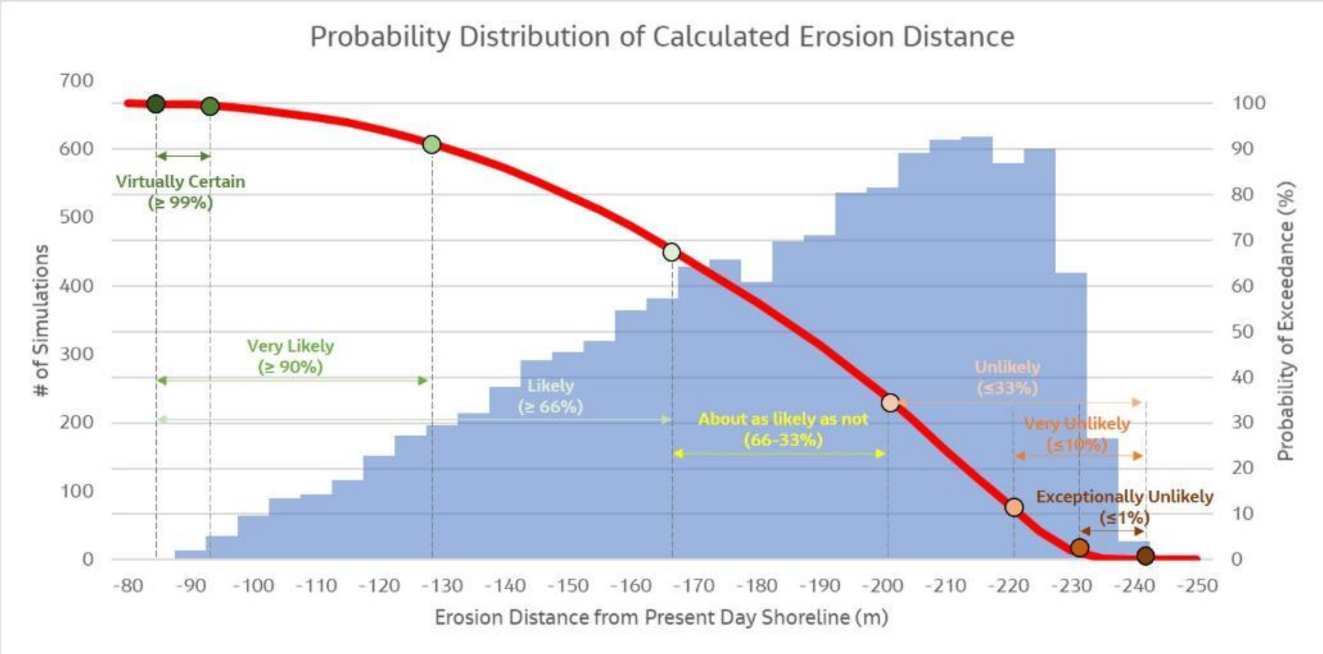

Figure 7.2: Example of probability distribution of erosion distances

Under a precautionary approach to deal with uncertainties, the most common likelihood ratings to be used as thresholds include:

- Likely (≥66%). More certain than not that erosion to the projected distances will occur, but also 66% chance that they will be exceeded within the specified timeframe under the projected RSLR scenario,
- Unlikely (≤33%). Less certainty that erosion to these distances will occur, but more unlikely that they will be exceeded; and
- Very unlikely (≤10%). Far less certainty that erosion to these distances will occur, but very unlikely that they will be exceeded.

The combination of different threshold options that could be applied to each hazard risk category are examined in section 6.3.

7.2.2 Coastal Hydrosystems

For consistency of risk assessment, there needs to be a degree of consistency between the thresholds applied across the different assessment types – open coast and hydrosystems. While the above consideration of probabilities can be applied along the open coast, this is not the case for hydrosystem cells where the PFSP's for the same SLR scenarios are based on deterministic measurements and a qualitative site assessment on a case-by-case basis of historical mouth movements, adjacent shoreline projected response to RSLR, and the effect of structures and infrastructure on constraining mouth migration. As a result, different methods were employed to map the potential erosion hazard across hydrosystems located on eroding shorelines (i.e., to link with the P10 position of adjacent shoreline), accreting shorelines (i.e., maximum historical extent), and large river mouth systems (e.g., Otaki & Waikanae based on future projected flood extent). Therefore, the probability thresholds applied on the open coast cannot be applied in these hydrosystem cells.

At this stage, further consideration of these areas needs to be undertaken including:

- The differences in the methods used to assess the hydrosystems in terms of eroding vs accreting coasts, assumptions around structures, and assumptions about responses in fluvial dominated hydrosystems (e.g., Waikanae Estuary; Otaki River mouth). If there is more certainty around a method, then a high-risk category could be applied (i.e., in eroding coastal settings); whereas in an accreting coastal setting where there is less certainty around the landward extent, a lower risk categorisation could be applied.

- An assessment of the overlap between the mapped erosion and inundation hazard in hydrosystems, and whether planning provisions included in inundation planning controls would also be sufficient to solely manage the future risks to any erosion hazard within the river/stream mouth.

7.2.3 Minimum Widths of Hazard overlays for each Risk Category

The distance between the zones defining different hazard risk categories needs to be sufficient for likely land-use activity to be reasonably able to be carried out in the zone. For example, it is considered that the use of thresholds which only produce 5 m wide hazard overlays are not going to be practical. This raises the following two questions:

1. Whether the number of erosion hazard categories required can be reduced for some environments from the three originally envisaged to one or two to provide practical widths for land-use planning purposes.
2. Where the distance between thresholds is too narrow for a practical planning zone width, should the position be shown just for information that there are hazards in the area (e.g., low risk of erosion for sea level rise over a 100-year timeframe) without associated planning provisions, or should a generic acceptance zone width be applied even though some (and possibly most) of the zone doesn't meet the risk threshold?

7.2.4 Dune Resilience Factor

For open coast beach environments with existing dune systems the erosion distances presented in Jacobs (2022) are calculated from the position of the seaward dune toe, therefore the resulting PFSP's presented are also the seaward dune toe position and do not include any migration of the natural dune environment. In many areas, the high degree of dune vegetation cover in established dunes, or the location of infrastructure immediately behind the primary dune, will result in the landward toe of the primary dune being essentially locked in position and will not migrate with erosion of the front of the dune. In the long-term, this will result in a reduction in dune widths and elevations, hence a reduction in the ability for the dune to act as an effective natural buffer against both coastal erosion and inundation hazards. In the worst case, failure to provide for this buffer could result in the dune being totally breached in an extreme storm event, leading to coastal inundation in areas not mapped for this to occur, and making it very difficult for natural dune rehabilitation to occur following the event to provide ongoing erosion and inundation protection.

One approach to overcoming this issue where there are established dune systems is for the hazard planning overlays to include an additional area of land behind the mapped PFSP's that would allow for future continuation of natural dune protection. We refer to this additional width as a 'Dune resilience factor', which is consistent with the intent of NZCPS Policy 25(e) and 26 (natural defences against coastal hazards)[28] and strongly aligns with the commentary of NZCPS Policy 26 (DoC Guidance notes, 2017, Page 60):

> *"As a result of climate change, the protection, restoration and enhancement of natural defences will often require protective measures to ensure that a sufficient landward buffer is protected from development that would otherwise compromise the functioning of the natural defences over the long term by restricting its ability to migrate inland with sea-level rise (or as a result of long term coastal retreat for any other reason."*

The approach also aligns with the objectives and policies of RPS PC1. Objective CC.4 requires that *"Nature-based solutions are an integral part of climate change mitigation and adaptation, improving the health and*

[28] Department of Conservation (2010) NZCPS 2010 Guidance note: Coastal Hazards Objective 5 and Policies 24, 25, 26 & 27

resilience of people, biodiversity, and the natural environment." Policy CC.7 recognises the value that natural ecosystems can provide as nature-based solutions for climate change and the critical importance of working with and supporting landowners and other key stakeholders to improve the health and functioning of ecosystems.

The outcome will be mapped hazard areas and land-use planning controls further inland from the Jacobs (2023) mapped erosion extents. From a coastal processes and hazard protection perspective, we support this approach, but it raises questions about whether this area should cover the whole dune width, and if not, how wide is the 'Dune resilience factor' required to be to provide adequate hazard protection.

Whilst considering the entirety of the dune system as a 'Dune resilience factor' to coastal hazards creates opportunities to manage the dune holistically, which we support, it creates inconsistencies in hazard overlay widths along the coast. Where there are areas that have much wider dune systems a larger hazard zone will be mapped despite a greater level of protection from the hazard being provided for by the dune; and conversely, areas with narrower dunes have smaller hazard zones, despite being less protected.

In defining a 'Dune resilience factor' for just hazard risk, the width of the additional area needs to be sufficient to still provide for a dune following an extreme storm erosion event (e.g., 1% AEP) beyond the end of the planning timeframe, such that dune rehabilitation can occur following such a storm. Although a short-term storm factor is already included in the calculation of the PFSP, it is recommended that the additional 'Dune resilience factor' be this width again to ensure that there is greater on-going certainty of continued future hazard protection by the dunes should such a storm occur at the end of the planning timeframe, and that this residual dune is sufficient to form a base for natural rehabilitation of the dune. These short-term storm factors range from 15 m at Raumati to 5 m at Paraparaumu.

The KCDP already contains Policies CE-P6 and CE-P7 which protect the dune environment. CE-P6 states that: Natural shoreline movement will be accommodated where practicable and the resilience of coastal communities will be increased by using best practice coastal management options, including:

1. dune management;
2. inlet management; and
3. engineering measures.

Policy CE-P7 states that: Natural dune systems will be protected and enhanced (including through restoration) and natural dune function will be enabled where practicable.

Should the resulting 'Dune resilience factor' not cover the full extent of the dune environment, separate planning controls around natural character, landscape vegetation removal, and earthworks would be required to provide holistic protection of the whole dune environment. Conversely, should the area of the defined 'Dune resilience factor' extent beyond the current dune, then discussions around the appropriateness of including these potential dune migration areas in the hazard overlays, and how this migration may be achieved, are required. These discussions are as much about adaptation to coastal hazards, as they are about land use planning, so should form part of the CAP discussions under Takutai Kāpiti project.

7.3 Hazard Threshold Options

The analysis for the probabilistic assessment cells involved trialling two approaches to defining thresholds for erosion hazard categories.

1. The first approach discussed in section 7.3.1 below involves adjusting both the timeframe and threshold probability by reducing the probabilities and/or increasing the timeframe over which RSLR is considered to define descending hazard categories from high to low. This approach recognises different levels of certainty in the erosion calculations, and to reflect that different land-uses may be appropriate over different timeframes.

2. The second approach, discussed in section 7.3.2 involves applying a consistent timeframe and SLR scenario across all hazard categories, with the decreasing probabilities being used to define the thresholds between hazard categories.

7.3.1 Adjusting both the timeframe and the threshold probability

Under this approach, both the 0.45 m RSLR over a 50-year period and the 1.25 m RSLR scenario over a 100 period are used to test potential probability thresholds for “high”, “medium” and “low” risk category. In recognising the trade-offs between a precautionary approach, the increasing uncertainty in the magnitude of RSLR with time, and the need for greater certainty for high-risk areas and activities, the best two options for combining the two scenarios and different probability thresholds for each risk category are presented in Table 7.1. Also included for sensitivity testing of a complete range of options are the 0.2 m SLR by 2050 and 1.65 m SLR by 2120 scenarios, although they do not fit the recommended SLR scenarios from Section 2.3 (e.g., 0.45 m by 2070 and 1.25 m by 2130).

Table 7.1: Threshold options for recommended probabilistic assessment approach to defining coastal erosion hazard categories

Risk Category	Option	Timeframe	SLR since 2020	Probability	Certainty and Likelihood descriptions (Statistical uncertainty)
High	(Ha)	2070	0.45 m	66%	Erosion up to this distance is likely within a 50-year timeframe, and a very high degree of certainty that will occur over longer time frames. But there is also a high residual risk (66%) that erosion will exceed this distance within the 50-year timeframe.
	(Hb)	2070	0.45 m	33%	Erosion up to this distance is less likely over a 50-year timeframe than option (Ha), but more certainty that it will not be exceeded over this time frame. There is still a high degree of certainty that these erosion distances will occur over longer planning time frames.
	(Hc)	2050	0.2 m	10%	Greater erosion is very unlikely, so very certain an erosion distance landward of this would not occur over this short (20 year) timeframe. However, a very high certainty that this magnitude of sea level and therefore erosion distances will be exceeded over a 50-year period.
Medium	(Ma)	2070	0.45 m	33%	As above, greater erosion than this position is unlikely within this 50-year timeframe, but there is a high degree of certainty that these erosion distances will occur over longer planning time frames. Would only work with the (Ha) high hazards option or as a combined High-Medium option.
	(Mb)	2130	1.25 m	66%	Erosion up to this distance is likely within this longer 100-year timeframe, but less

Risk Category	Option	Timeframe	SLR since 2020	Probability	Certainty and Likelihood descriptions (Statistical uncertainty)
					certainty that RSLR to this magnitude will occur within this timeframe.
Low	(La)	2130	1.25 m	33%	Is unlikely that greater erosion will occur within this longer 100-year timeframe.
	(Lb)			10%	Greater erosion is very unlikely within this longer 100-year timeframe.
	(Lc)	2120	1.65 m	33%	Greater erosion than this position is unlikely within this 100-year timeframe, but very low certainty that RSLR to this magnitude will occur within the timeframe due to inclusion of very high VLM rates.

Note that threshold option (Hb) and (Ma) are the same. It is considered that this threshold could be the boundary for either a high or medium erosion hazard risk category.

Examples of the resulting erosion hazard risk overlay boundaries and relative placement to one another in Queen Elizabeth Park is shown in Figure 7.3 below. This location is used as the example as it is projected to have the greatest erosion on the Kāpiti Coast, and hence, would be the location that would have the widest 'hazard overlays' under the different thresholds. We can use this figure as a first pass test of which combinations of thresholds for each of the high, medium, and low risk categories would not provide meaningful widths for risk-based hazard Categories for this area of potentially widest overlays, and therefore, would not be viable combinations in other areas where zones would be narrower.

From Figure 7.3, it is noted that the High and Low Erosion Hazard Risk scenarios supplied for sensitivity of the thresholds (e.g. (Hc) and (Lc)) provide the most seaward and landward zones tested. This is due to the greatest response in erosion distance being due to changes in the RSLR magnitude and timeframe, and the least due to changes in the probability of occurrence under the same scenario. For example, the difference in projected erosion distance from 1.25 m RSLR by 2130 to 1.65 m by 2120 is in the order of 50 m.

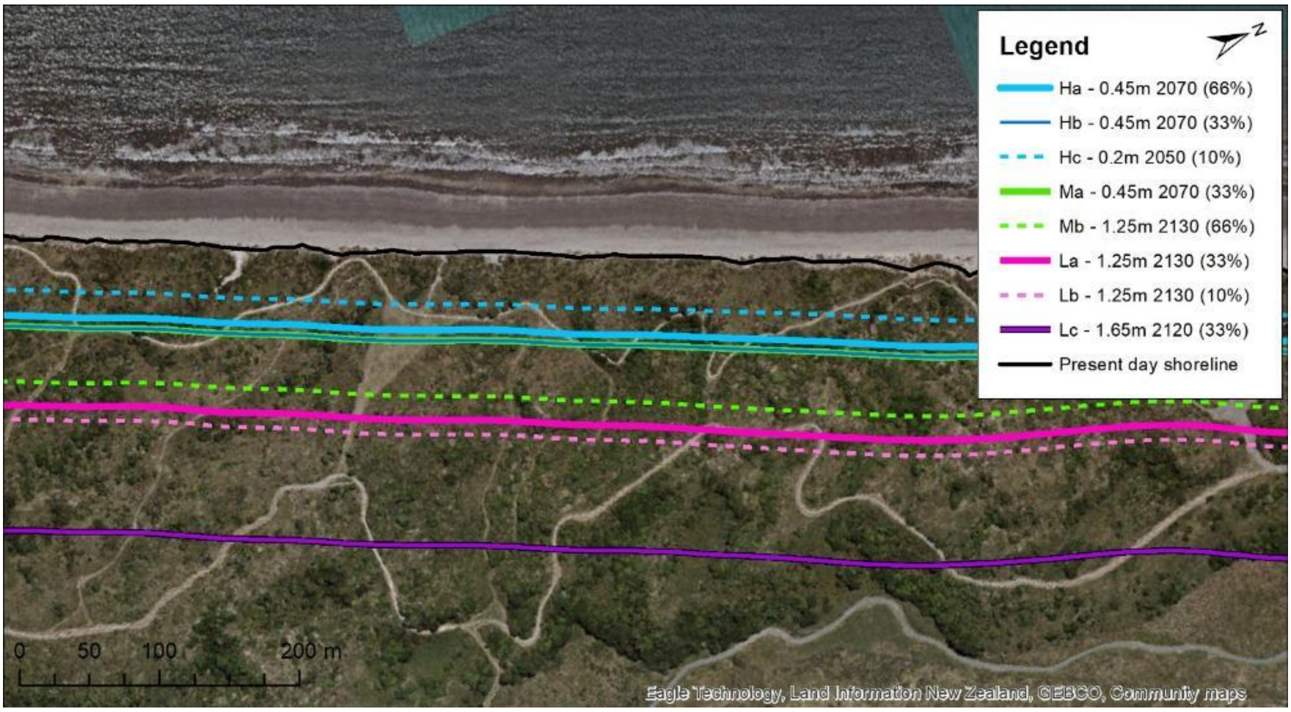

Figure 7.3: Example from Queen Elizabeth Park of spatial representation of the thresholds tested in Table 7.1

From Figure 7.3, the following points can be made about the viability of the threshold options for high, medium and low hazard risk boundaries to provide practical planning overlay widths:

- High Erosion Hazard Risk Category:
  All three options are viable, with the resulting high hazard overlay widths being in the order of 40-60 m.
- Medium Erosion Hazard Risk Category:
  Option **(Ma)** (33% probability PFSP from the 0.45 m RSLR by 2070 scenario) is not appropriate in combination with High Hazard risk (Ha) option (66% probability PFSP from the 0.45 m RSLR by 2070 scenario) due to a resulting very narrow medium hazard risk zone. This occurs because the different probability results in very little difference to erosion distance. So, if the **(Ma)** option was to be applied for the Medium Hazard Risk boundary, it would have to be in combination with the **(Hc)** High Hazard Risk option, otherwise the **(Mb)** Medium Hazard Risk option would need to be applied.
- Low Erosion Hazard Risk Category:
  Option **(La)** (33% probability PFSP from the 1.25 m RSLR by 2130 scenario) would not be appropriate in combination with option **(Mb)** (66% probability PFSP from the 1.25 m RSLR by 2130 scenario) for the same reason of a very narrow and likely impractical Low Hazard Risk zone. It is noted that the resulting zone from the combination of **(Lb)** and **(Mb)** options is only marginally better at providing a practical width for a Low Hazard Risk zone.

From this discussion, the following combinations may be appropriate to definite High – Medium – Low Erosion Hazard Risk Zones:

1. (Hc) → (Ma) → either (La) or (Lb);
2. Either (Ha) or (Hb) → (Mb) → either (Lb) or (Lc).

In further assessing the viably of these combinations, we have looked at the general widths of the respective High, Medium, and Low Erosion Hazard Risk overlay widths at Otaki, Waikanae and Raumati to determine whether they would result in sufficient widths for a practical planning in these areas. The results of this assessment are presented in Table 7.2.

Table 7.2: Widths of possible high, medium and low Erosion Hazard Risk Zones under different threshold options

Hazard Risk Category	Thresholds	General Width of Resulting Hazard Zone			Threshold Description
		Otaki Beach	Waikanae	Raumati	
High	(Ha)	18 m[(1)]	6 m[(1)]	72 m[(1)]	(Ha): 66% probability under 0.45 m RSLR by 2070
	(Hb)	21 m[(1)]	9 m[(1)]	76 m[(1)]	(Hb): 33% probability under 0.45 m RSLR by 2070
	(Hc)	13 m[(1)]	7 m[(1)]	47 m[(1)]	(Hc): 10% probability under 0.2 m RSLR by 2050
Medium	(Ha) → (Mb)	33 m	15 m	58 m	(Mb): 66% probability under 1.25 m RSLR by 2130
	(Hb) → (Mb)	4 m	1 m	25 m	
	(Hc) → (Ma)	8 m	3 m	30 m	(Ma): 33% probability under 0.45 m RSLR by 2070
Low	(Ma) → (La)	36 m	19 m	67 m	(La): 33% probability under 1.25 m RSLR by 2130
	(Ma) → (Lb)	44 m	28 m	75 m	(Lb): 10% probability under 1.25 m RSLR by 2130
	(Mb) → (Lb)	14 m	16 m	17 m	
	(Mb) → (Lc)	45 m	39 m	94 m	(Lc): 33% probability under 1.65 m RSLR by 2120
Notes: (1) Distance to High Erosion Hazard Risk boundary is from the current shoreline position and does not include any consideration of a "Dune Resilience Factor" as discussed in section 6.2.4					

These results confirm that all the three of the possible thresholds for the boundary of a High Erosion Hazard Risk Overlay would provide viable zone widths at Otaki Beach and Raumati, the width at Waikanae would not be practical for planning purposes at Waikanae under any of the thresholds. This could be overcome by having a combined High-Medium Erosion Hazard Overlay in this shoreline cell; however, this would create an inconsistency in zone definition and provisions across the District. It could also be overcome by the incorporation of a "Dune Resilience Factor" as described in Section 7.2.4.

From the results in Table 7.2, the only thresholds for defining a Medium Erosion Hazard Risk Overlay that produces viable overlay widths for land-use planning over the whole of the Kāpiti Coast District would be from a High Hazard Risk boundary at the **(Ha)** threshold (66% probability under 0.45m RSLR by 2070) to the **(Mb)** threshold (66% probability under 1.25 m RSLR by 2130). For the other possible Medium Hazard Risk options, the overlay would have to be a combined High-Medium Hazard Risk Overlay.

For defining a Low Hazard Risk Overlay and applying the **(Mb)** threshold as the boundary for the Medium Hazard Risk Overlay from above, the results in Table 6.2 indicate that the **(Lb)** threshold (10% probability under 1.25 m RSLR by 2130) provides a marginally viable zone width for planning purposes, and may to be enlarged to an appropriate generic width (e.g., 20 m) to provide a more practical width. It may also be enlarged by combining with the Medium Hazard Risk Overlay to have a Medium-Low risk Overlay. The **(Lc)** threshold (33% probability under 1.65 m RSLR by 2120) as used as the boundary for the "*Coastal Qualifying*

Matter Precinct" under PC2 would provide a viable Low Hazard Overlay width but may not be acceptable due to the very low certainty that RSLR to this magnitude will occur within the planning timeframe.

From this discussion, and taking into account the certainty and likelihood of the RSLR scenarios and threshold options, it is considered that the most preferrable threshold options for High, Medium and Low Hazard Risk Overlay boundaries are:

- High Erosion Hazard Risk Overlay:
  (Ha) Threshold Option of 66% probability under 0.45 m RSLR by 2070. Erosion up to this distance is likely within a 50-year timeframe, and a very high degree of certainty that will occur over longer time frames. There is also a high residual risk (66%) that erosion will exceed this distance within the 50-year timeframe should RSLR reach this level.
- Medium Erosion Hazard Risk Overlay:
  (Mb) Threshold Option of 66% probability under 1.25 m RSLR by 2130. Erosion up to this distance is likely within a 100-year timeframe, but less certainty that RSLR to this magnitude will occur within this timeframe. There is also a high residual risk (66%) that erosion will exceed this distance within the 100-year timeframe should RSLR reach this level.
- Low Erosion Hazard Risk Overlay:
  (Lb) Threshold Option of 10% probability under 1.25 m RSLR by 2130. Greater erosion is very unlikely within a 100-year timeframe should RSLR reach this level.

7.3.2 Adjusting the probability under a single timeframe

The alternative approach for erosion hazard thresholds on the open coast involved applying a consistent timeframe and RSLR magnitude across all hazard categories, with the decreasing probabilities being used to define the thresholds between hazard categories. The chosen SLR scenario to test was the 1.25 m by 2130 under the SSP5-8.5 climate change scenario with 1 mm/yr VLM, with the threshold options being as shown in Table 7.3. A second option under this approach of applying the 1.65 m SLR by 2120 scenario as the low hazard threshold was also included in the sensitivity testing.

Table 7.3: Threshold options for alternative probabilistic assessment approach to defining hazard categories.

Hazard Category	Option	Timeframe	SLR since 2020	Probability	Likelihood description (Statistical uncertainty)
High	(Ha)	2130	1.25 m	90%	Erosion very likely up to this distance over this long timeframe. But there is also a high residual risk (90%) that erosion will exceed this distance over the 100-year timeframe.
	(Hb)			66%	Erosion likely up to this distance over this long timeframe, so less certain than (Ha) option, but less residual risk of being exceeded.
Medium	(Ma)	2130	1.25 m	66%	Erosion likely up to this distance over this longer timeframe.
	(Mb)			33%	Greater erosion than this position is unlikely within this longer timeframe.

Hazard Category	Option	Timeframe	SLR since 2020	Probability	Likelihood description (Statistical uncertainty)
Low	(La)	2130	1.25 m	33%	Greater erosion than this position is unlikely within this longer timeframe.
	(Lb)			10%	Greater erosion than this position is very unlikely within this longer timeframe.
	(Lc)	2120	1.65 m	33%	Greater erosion is unlikely within this shorter timeframe, but also less certainty that SLR to this magnitude will occur within the timeframe due to inclusion of very high VLM rates.

As outlined in section 7.3.1, testing showed that by taking this approach, there was unlikely to be sufficient width between overlays to implement practical planning controls consistently along the coast as erosion distances responded less to changes in the probability of occurrence under the same scenario than due to changes in the RSLR magnitude and timeframe. For example, the width between the 10%, 33%, and 66% probability threshold for the 1.25 m by 2130 scenario is in the order of 5-10 m between each threshold. Therefore, using these thresholds will not result in practical Medium and Low Erosion Hazard Risk planning overlay widths unless they are combined in a single Medium-Low Erosion Hazard Risk Overlay.

7.4 Other Considerations in Applying the Risk Thresholds

7.4.1.1 Uncertainties

The RSLR scenarios have been chosen with regard to the uncertainties in the magnitude of rise, and the timeframes over which they will occur. We have developed our preferred erosion thresholds based on the statistical uncertainty of the erosion occurring under these scenarios. However, there are other sources of uncertainty in the data used to create the thresholds. These include:

- The modelling uncertainty, in that how well do the models used estimate future erosion? This is particularly relevant to;
  - the extrapolation of past historical rates of shoreline movement, which is dependent on sand supply from the four major rivers outside of the district, and the longshore transport by waves.
  - the accuracy of the Bruun Rule to calculate the erosional effects of SLR.

  There is nothing that can be done to reduce these modelling uncertainties.
- Uncertainty about the future effectiveness and lifetimes of current protection structures and any future erosion mitigation measures. This is addressed within the existing PFSP through the inclusion of existing protection structure providing protection for their expected design life/assessed future condition. This approach has assumed that after its assessed or assumed point in time that it would fail and be removed, and natural erosion processes will take place. The decision on the likelihood of continued protection in these areas into the future will be reliant on the outcomes of the Takutai Kāpiti programme. However, a precautionary approach has been taken as to not rely on any commitment to continuing to protect these areas after their current design life.

7.4.2 Data limitations

The analysis of possible scenario and threshold combinations is limited to the data provided in the Jacobs (2022) hazards assessment, and the remapping undertaken for the Jacobs (2023) risk assessments for each adaptation area. These limitations include:

- Data common to all assessment methods being limited to only three timeframes (2050, 2070, 2130), and therefore our consideration of scenarios is limited to these timeframes.
- Data in the hydrosystem assessment cells is limited to a deterministic/qualitative approach, and therefore limiting the ability for direct comparison with the open coast assessment cells or use of the recommended thresholds in these areas.

Sweetman Planning Services
11 Mataroa Avenue
Northland
Wellington 6012
Email: gina.s@sweetmanplanning.co.nz

30 November 2023

Takutai Kāpiti Coastal Advisory Panel

Tēnā koutou Panel Chair and Panel Members

Endorsement of the Coastal Risk-Based Planning: Thresholds and Scenarios Report

I hereby provide my endorsement of the Coastal Risk-Based Planning: Thresholds and Scenarios Report, prepared by Jacobs, dated November 2023 (the Report).

I was contracted by Kapiti Coast District Council to undertake an independent peer review of the planning advice provided in the Report and to:

a. assess the appropriateness of the draft advice, including whether the proposed approach would suitably implement relevant national and regional statutory direction relating to coastal hazards; and

b. if necessary, recommend changes to the draft advice to ensure it is appropriate.

Having reviewed drafts of the Report and recommended changes to ensure it is appropriate, I am satisfied that the approach set out in the Report, subject to a section 32 evaluation under the Resource Management Act 1991:

a. would suitably implement relevant national and regional statutory direction relating to coastal hazards
b. is consistent with good planning practice through Aotearoa.

I trust my endorsement will assist the Panel in their evaluation of the Report. A brief copy of my CV is attached for the Panel's reference.

Nāku iti noa, nā,

Gina Sweetman
Sweetman Planning Services

Gina Sweetman

Sweetman Planning Services

Bachelor of Planning, Auckland University, 1993
Masters of Planning (First Class Honours), Auckland University, 2006
Fellow NZPI, NZPI Distinguished Services Award 2014

I am an accredited and experienced RMA Hearings Commissioner (Chair endorsement), a Freshwater Commissioner, one of 12 appointed Development Contribution Commissioners nationwide, independent chairperson and facilitator. I have a wide range of management, planning and policy experience, having worked for over thirty-one years in local government, central government and private practice. I have a strong knowledge of all aspects of Resource Management Act (RMA), and wider natural resources planning in New Zealand, with particular strengths in policy analysis and advice, freshwater policy, development contributions policy, statutory planning, Māori planning issues training and implementing best RMA practice into everyday practice. Through my work with central government, I have significant experience with policy development and government processes. I have provided expert evidence to both council hearings, the Environment Court and have been involved in central government committee processes. I am a Fellow of the NZPI and a recipient of the NZPI Distinguished Service Award.

Areas of particular expertise:

- ✓ Accredited Hearings Commissioner (Chair endorsement)
- ✓ Freshwater Commissioner
- ✓ Development Contributions Commissioner
- ✓ Facilitator
- ✓ Expert witness
- ✓ Policy and plan development and review
- ✓ Development and financial contributions policy and implementation
- ✓ Central and local government processes, including budgeting, reporting, staff development, policy development and advice, development, implementation, evaluation and audits
- ✓ Team and project management and leadership
- ✓ Consent processing and reviews
- ✓ Māori planning issues
- ✓ Best practice, training and guidance
- ✓ RMA, Treaty, Takutai Moana, aquaculture, freshwater and climate change

Professional Affiliations and Responsibilities:

Fellow, New Zealand Planning Institute
Member, Resource Management Law Association

Chair Certification, Making Good Decisions
Development Contributions Commissioner
Freshwater Commissioner