Risk Assessment Framework

to support implementation of the

Waikato Regional Policy Statement

Natural Hazards (Chapter 13)

December 2018

1. Introduction

This document presents Waikato Regional Council's (WRC) Risk Assessment Framework (Framework) to support implementation of the Regional Policy Statement (RPS) natural hazard provisions. It provides a simple process that can be used to identify, assess and understand risk associated with natural hazards. Information from that risk assessment process should support and inform all aspects of Resource Management Act (RMA) planning and decision-making required to implement the RPS provisions.

WRC intends that the Framework be used by a wide range of users involved in RMA planning and decision-making involving natural hazards. Those users include, for example:

- planners and technical experts developing RMA plans or advising on or preparing applications for resource consent applications;
- communities and interested parties; and
- decision-makers.

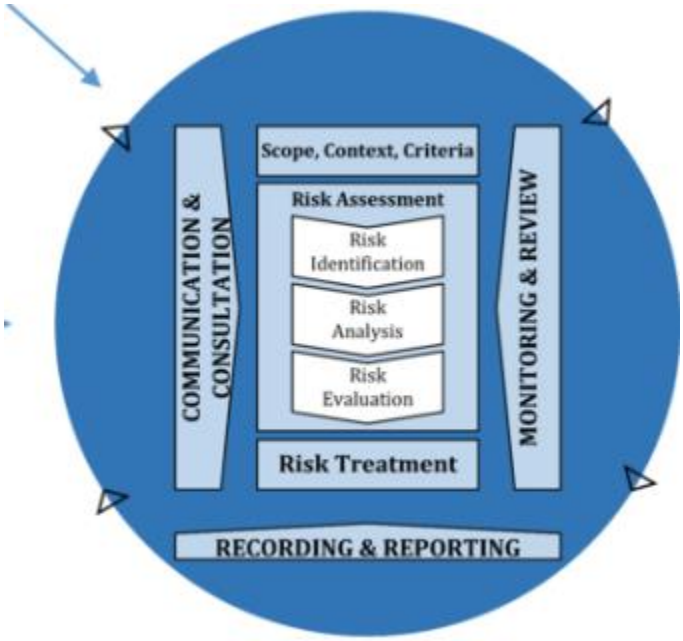
The Framework comprises:

- a Risk Assessment Process Flow Chart (Flow Chart) - see **Section 2**;
- a set of key questions which underpin the Flow Chart - see **Section 3**;
- some brief explanatory text - see **Section 4**; and
- supporting template table tools (referenced in the Flow Chart) and introduced in **Section 4**.

The explanatory text in Section 4 relates the Framework to the applicable RPS provisions on natural hazards. For ease of reference, the RPS provisions are included in Appendix 1.

The RPS has been developed and must be implemented in the wider context of RMA provisions and relevant national policy statements. National guidance, though not mandatory, can also assist implementation. Some brief commentary on this wider context is provided in **Section 5**. This wider context has also shaped the Framework.

The Framework is based on the risk process figure from ISO 31000:2018 *Risk management – Guidelines* (see below) and key concepts and good practice principles from that standard.



A key concept is the definition of risk, which is the "*effect of uncertainty on objectives"* which focuses the risk management process for natural hazards on relevant objectives. These will include applicable regulatory objectives and community/stakeholder objectives. Also important are:

- the notes about the definition that explain that "*risk is usually expressed in terms of risk sources, potential events, their consequences and their likelihood"*; and
- definition of likelihood - "*the chance of something happening";* and
- the notes about the definition of likelihood that explain that likelihood can be "*defined, measured or determined objectively or subjectively, qualitatively or quantitatively and described using general terms or mathematically".*

Taken together these notes provide for a range of approaches to define or express risk, with flexibility to use the most appropriate approach in the relevant context. For RMA decision-making on natural hazards, this will need to reflect the nature of the decisions that need to be made. The approach should reflect the type of information required to understand uncertainty and its effects on the relevant objectives.

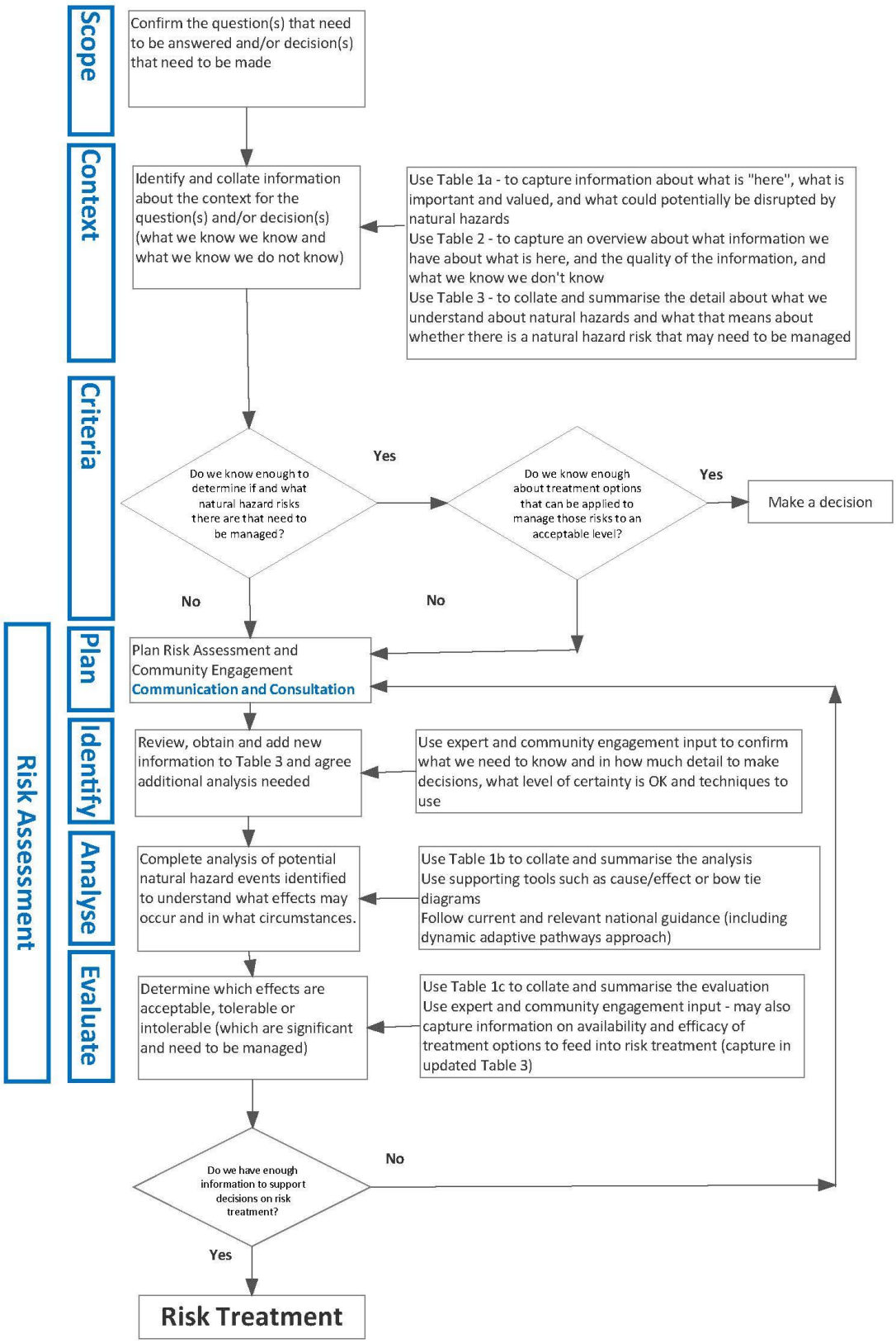
Key principles from ISO 31000 that have shaped the Framework include that the risk management process should: be structured and comprehensive, customised, inclusive, and dynamic; use the best available information and include human and cultural factors.

The Framework covers the Scope, Context, Criteria and touches on the Communication & Consultation parts of the ISO 31000 risk management process. This is in addition to addressing the Risk Assessment steps. Natural hazard risk assessment steps occur within the wider risk management process. The Framework includes these wider elements of the risk management process to ensure that the risk assessment activity:

- is context-appropriate;
- includes (or triggers) appropriate levels of stakeholder engagement; and
- connects with intended risk treatment (or management) options and processes.

The parts of the ISO 31000 risk management process that are part of the Framework are shown in blue in the Flow Chart.

2. Risk Assessment Process Flowchart



3. Key questions underpinning the Flow Chart

Scope, Context, Criteria	**Scope**
	• What is the question we need to answer or the decision we need to make?
	Context
	• What do we know we know?
	• What do we know we do not know?
	Criteria
	• Do we know enough (have criteria) to be able to determine:
	  • No there is not a problem; or
	  • Yes there is a problem; or
	  • Maybe there is a problem; and
	  • If there is, or may be, a problem, what the appropriate treatment(s) are?
	Plan
	• What natural hazards do we need to assess?
	• What level of community engagement is required in this context?

↓	
Risk Assessment	
Risk Identification	What do we need to know about the relevant natural hazard(s)? In how much detail, to work out if there is a problem or not? How much do we need to understand (how much certainty do we need/uncertainty can we live with) to make a decision/answer the question?
↓	
Risk Analysis	How will we find out what we need to know, the techniques to use? What are the results of our analysis? What do we now know and understand?
↓	
Risk Evaluation	What does it mean? Do we know now if there is a problem or not? Do we know what the problem is and if we can live with it or not? Do we know about possible solutions and how to tell if they are good or not? What are the treatments and how good are they?
↓	
Risk Treatment[1]	What treatments will we plan to do?

[1] Note that Risk Treatment is outside the scope of this framework

4. About the Framework and Flow Chart steps

4.1 Scope - the questions we need to answer or the decisions we need to make

There are two different levels of question or decision that the Framework needs to be able to address to implement the RPS:

- the big picture questions – about what the natural hazards and associated risks are that need to be managed, and how shall we plan to manage them; and
- the decisions we should make on specific proposals (e.g. subdivision or land use consent applications).

The first level responds to Policy 13.1 and Policy 13.2 and their associated implementation methods. Policy 13.1 calls for an integrated and holistic planning approach. It is supported by Implementation Methods that include:

- a risk management framework incorporating a risk-based approach in regional and district plans;
- defining primary hazard zones;
- assessing natural hazard risk to communities;
- a regional hazards forum; and
- information, education and advocacy.

Policy 13.2 sets the requirement to manage activities to reduce the risk from natural hazards. It is supported by Implementation Methods that set the outcomes to be achieved through controls to be included in regional and district plans. These are summarised in the table below.

	13.2.1 Subdivision control in areas with intolerable risk	13.2.2 Identify hazard zones & areas	13.2.3 Control structures in primary hazard zones	13.2.4 Flood controls & management	13.2.5 Control development & use in high risk hazard zones & areas	13.2.6 Control development in floodplains & coastal hazard areas	13.2.7 Control subdivision, use & development in residual risk zones	13.2.8 Control subdivision, use & development for other natural hazards
District Plans								
Regional Plans								

The second level will involve decisions that need to be made now, before the RPS policies are implemented in regional and district plans. In the future, those decisions will be made within the context and guidance of regional and district plan provisions.

Until regional and district plan provisions are in place, decisions on applications for resource consents will need to reflect Policy 13.2 and the control outcomes set in the supporting implementation methods. More information will need to be provided by applicants to support risk assessment and decision-making.

It is important to determine the specific context of the questions that need to be answered and decisions that need to be made as a first step to applying the Framework for risk assessment. This context will determine the approach, including nature and level of detail of any risk assessment work that is required.

4.2 Context - what we know we know and what we know we do not know

4.2.1 Things we know we know – what is present and regional community objectives

The RPS sets out an extensive range of RPS objectives and matters that relate to:

- environmental, social, economic and cultural resources (e.g. coastal environment, ecosystem services, built environment, geothermal, historic and cultural heritage) and
- approaches to managing issues (e.g. integrated management, resource use and development, decision making and adapting to climate change).

These objectives are part of the context in which the RPS's implementation of natural hazards provisions must occur. They are important because risk is about the effect of uncertainty on objectives, such as these. The RPS objectives capture important aspects of what is valued by the Waikato community. Appendix 2 identifies and includes some extracted information about the RPS objectives that are likely to be relevant to considering the effects of natural hazards. District plans will also contain similar sorts of objectives and also more detail about what is important by identifying, for example, heritage resources, reserves, community services etc.

Information about the area (relevant to the questions to be answered and decisions to be made) along with information about community objectives, can be used as a starting point to identify what features are present, important and valued in the area of interest. It can also help to identify which of those features, and the values associated with them, may be disrupted by natural hazards, or the uncertainty that is associated with natural hazards.

The Framework's **Template Table 1a** (below) can be used to help capture simple and overview information about what is present and valued in the area of interest. The Template Table is intended to be flexible so as to be tailored for the context by editing the column headings or adding columns. One example entry is included in the Template Table below in blue text.

Template Table 1a: Capturing context information about what is here and valued

What's here →	Homes	Schools	Roads access	Services shops	Meeting places	Ecosystem services	Cultural heritage features	Business Industry	etc.
Brief description	e.g. Village of 100 homes								
What's important about these?	e.g. for them to be: dry, intact, secure, services working, accessible								
Could the important things be disrupted by natural hazards?	e.g. Yes, most of the important things could potentially be disrupted by a range of different natural hazard events								

The question "*Could the important things be disrupted by natural hazards?"* is intended to be answered only at a very high and generic level to provide an indication that there may be some effects that will need to be considered when working through the more detailed steps in the process in the Framework.

Template Table 1a should be "live". New information should be added as work progresses on the risk assessment process. It may be used as a preliminary scoping tool by council staff or other practitioners. It may also be used, where appropriate in the context to capture information from community or wider stakeholder/expert input.

The Framework's **Template Table 2** (below) can be used to capture (at an overview/summary level) what information there is about what is present in the area relevant to the questions to be answered or decisions that need to be made. The call out box "Information Sources", below, provides some examples of possible sources and types of information that may be available.

Information Sources

Types of information & sources on What is Here

About the Built Environment:

- Locations, building purpose and construction materials
- Asset data e.g. in Riskscape or similar
- Aerial photographs, district plan maps

About People and Communities:

- Census data, sparse additional information (e.g. mesh-block census level)
- Detailed information on community characteristics and make-up from published reports
- District plan text

Importantly, comments in **Template Table 2** should include information about:

- the source of the information (e.g. reference to reports available or other sources available);
- the quality of the information (e.g. how current it is, the level of detail, key assumptions that may limit its usefulness);
- what gaps there are in available information and what we know we don't know that is likely to be important to answer the questions or make the decisions that need to be made.

Template Table 2 is intended to be flexible so as to be tailored for the context. The rows used in Table 2 should reflect and build on, the columns used for Table 1a. Table 2 is also intended to be "live". New information should be added as work progresses on the risk assessment process.

Template Table 2: Capturing what information is available about what is present in the area of interest.

What's here?	What information is there about this?	What is the quality of the information?	What don't we know?
People (population data etc.)			
Property (buildings)			
Infrastructure			
Businesses			
Industry			
Community services (schools, marae, health etc.)			
Cultural heritage features			
Ecosystem services and natural heritage			
etc.			

4.2.2 About natural hazards – things we know and things we know we don't know

There is a lot we do know about natural hazards. The Waikato Regional Council (WRC) website[2] provides a starting point for information about natural hazards in the Waikato Region. In the "Natural hazards in our region" call-out box below is information from the website about the types of natural hazards that occur in the Waikato Region.

Natural hazards in our region

Natural hazards are a constant threat to the Waikato region because it has:

- many areas of coastline exposed to erosion and flooding
- waterways and low lying plains vulnerable to inland flooding
- high rainfall in the Coromandel Peninsula, at Waitomo/Kawhia on the west coast and in alpine areas of the Tongariro National Park
- three volcanic zones
- many active faults
- about 20 per cent of our region's population living on soils prone to movement during an earthquake
- about 43 per cent of our region is prone to soil erosion.
- The main natural hazards that are recognised in the Waikato region are:
    - coastal flooding
    - river flooding
    - earthquakes
    - erosion
    - landslides
    - volcanic activity
    - geothermal activity
    - sedimentation – through river flooding and landslides
    - subsidence
    - weather (such as wind and rainfall)
    - tsunami (giant coastal waves)
    - drought
    - rural fires
    - debris flows

The website (and the portal being developed by WRC) includes more specific information about these hazards. In addition, WRC, has other information and reports about natural hazards and should be the first port of call for current information about areas that are known to be susceptible to natural hazards in the Region.

Storing and sharing information that is available about natural hazards in the Waikato Region is part of the RPS implementation method 13.1.5 on Information, education and advocacy. There will also be other sources and types of information that may be available. Call out box "Information on Natural Hazards" below identifies some of this information.

[2] https://www.waikatoregion.govt.nz/services/regional-services/regional-hazards-and-emergency-management/

Information on Natural Hazards

Flood hazard

- LIDAR survey information
- Broad-scale mapping from previous events
- 1D or 2D flood modelling (with or without climate change effects)

Seismic (rupture, shaking, liquefaction and lateral spreading)

- Fault mapping
- Fault avoidance zones identified in district plans or technical reports
- Deterministic (scenario) hazard mapping
- Probabilistic hazard mapping
- Geology and geomorphology mapping
- Geotechnical site investigation information (at different levels of detail and scope of investigations)
- Groundwater level information/mapping/modelling

Coastal erosion

- Geology, topography, and bathymetry mapping
- Previous event/historic shoreline mapping
- Setback lines (with previous guidance e.g. in district plans)
- Coastal setback lines with climate change (100 year using current guidance)

Land instability

- Slope and geology information
- Previous event mapping
- Site specific model (with single event or scenarios)

Tsunami

- LIDAR/bathymetry information to inform susceptibility
- Broad-scale mapping from previous deposits
- Max credible event hydrodynamic modelling
- Hydrodynamic probabilistic modelling

Volcanic

- Vent/geothermal field/caldera etc. locations
- Previous deposit mapping
- Deterministic hazard mapping
- Probabilistic hazard modelling

The Framework's **Template Table 3** below is intended to be used to capture (at an overview or summary level) what information we have about the natural hazards that may impact on the area of interest for the questions we have or decisions we need to make.

Template Table 3: Capturing what information is available about Natural Hazards

Hazard type	What do we know about the natural system & processes?	What is the quality of the information – level of confidence we can have in it?	Is there a potential issue of concern?*	What do we not know?
Coastal flooding				
River flooding				
Earthquake (shaking, liquefaction etc.)				
Erosion				
Landslides				
Volcanic				
Geothermal				
Sedimentation				
Subsidence				
Weather				
Tsunami				
Drought				
Rural fire				
Debris flow				
etc.				

* N – no, Y – yes, M – maybe, ? – not enough information to tell

Template Table 3 is intended to be flexible and scalable for the context. The rows used in Table 3 template include all the natural hazards identified on the WRC website (see call out box above). This provides a checklist tool that can be used to help identify what is/is not, may/may not be relevant in a particular context: i.e. to the questions to be answered and/or to the decisions that need to be made. It also provides a means to record:

- what has been considered
- what judgements or decisions have been made about what is or is not relevant in the context of the questions we have, decisions to be made and area involved, and
- the basis or information on which those judgements or decision have been made.

There is a lot we know we don't know about natural hazards and there is a lot of uncertainty. We don't fully understand:

- all the natural processes that are potential sources of natural hazards (whether sources of shocks such as earthquakes, or stressors such as climate change);
- when and where natural hazard events may occur;
- how severe events may be and what consequences and effects they may have on people, property or the environment; and
- often, just how those consequences and effects may impact on our objectives.

A key question at each stage in the risk assessment and management process is whether we know enough to be confident that there is, or is not, a natural hazard risk that is of concern. If we know that there is not a risk of concern associated with a particular natural hazard, we can focus any risk assessment work on those natural hazards or areas where we have more uncertainty. If we know, for example, that part of an area of interest is well outside of a river floodplain, or the coastal environment that may be affected by coastal hazards; we can focus resources on those areas we know are, or maybe, impacted by floods or coastal hazards.

The intention for using **Template Table 3** in the first instance, is as a broad scoping tool. It should be used as a conservative filtering tool to identify and eliminate from further consideration those natural hazards we are confident do not present a potential issue of concern. **Template Table 3** is also intended to be "live". It should be revisited and new information should be added as work progresses on the risk assessment process.

Considering the potential for effects on 'other aspects of the environment' (in line with the RMA definition of natural hazards) is most likely to present challenges for risk assessment. This is because, for the most part in the past, risk assessment for natural hazards has been focussed on the potential for effects on people and property. This means available information may be limited.

4.3 Criteria

Criteria are the means to capture and express what nature and amount of risk a community or decision-maker may accept, to achieve their wider objectives. The RPS expresses this using the terms acceptable, tolerable and intolerable, recognising that these thresholds may need to be determined on a case-by-case basis. Explanatory comments in the RPS provide some limited guidance about what could be considered to be intolerable, for example: "*because the risk is considered real within the short term, or because the consequences are considered significant due to the scale or vulnerability of the people, property or environment a risk*" or where the risk "*cannot be justified*".

Implementation methods provide some further guidance, as follows:

- implementation method 13.2.5 indicates that putting habitable structures, significant community infrastructure (hospitals, emergency services) and life line utilities where they would be vulnerable to a natural hazard event would be intolerable;
- implementation method 3.2.6 (iv) indicates a potential threshold related to habitable buildings where they may experience adverse effects in a 1% annual exceedance probability flood event.

There are some thresholds for risk tolerance that are used in a number of contexts, but not formally established within RMA plans. These may provide useful starting points for discussions about risk

appetite or attitude in the different contexts in which appetite or attitudes need to be developed. The call out box "Current Guidance on thresholds for risk tolerance", below presents some of these thresholds.

Current Guidance thresholds for risk tolerance	
Guidance	**Source**
Threshold for defining a High Risk Coastal Hazard Area (HRCH area) - *"the line at which there is a 1% chance of a coastal erosion/inundation event per year currently".*	Early draft of this Risk Assessment Framework
NOTE: This table is to be further developed by WRC	

The Framework provides the means for thresholds to be further determined and reviewed as awareness and understanding of natural hazards and their consequences develops; including through the risk assessment process.

As this work progresses, we need to consider if we know enough to be able to answer the questions we have and/or make the decisions we need to make. Decisions will often need to be made in the face of uncertainty. The important consideration then will be, if we know enough to make decisions that take appropriate account of the uncertainty and risk tolerance thresholds (including tolerance for uncertainty). Risk assessment work may be required to reduce the uncertainty. Community engagement may be required to guide decisions about thresholds or help set priorities for risk assessment work. Community engagement may not be required in all contexts. The need for some engagement may also be set in regional or district plan provisions about notification. The call out box below provides some current guidance about when engagement may or may not be required.

Current Guidance triggers for community engagement	
Guidance	**Source**
Community engagement will be required to develop non-statutory community strategies, provided for in the RPS.	
Community engagement will generally be required for reviews or plan changes involving natural hazards are areas wherever there may be areas or features potentially exposed to natural hazards.	
Community engagement may be required for resource consent applications, depending on the scale of what is proposed and the location.	
NOTE: This table is to be further developed by WRC	

Working progressively through the Flowchart process provides a means to develop context-appropriate thresholds that can be used as criteria to reflect on risk attitude and expectations about consequences and possible interventions to reduce risk.

4.4 Risk Identification

4.4.1 For preparing plan provisions

Identifying hazard zones is the primary implementation tool in the RPS. Four types of hazard zones are referenced in the RPS.

Implementation method 13.1.1 is to identify **Primary Hazard Zones** (PHZ). A PHZ is defined as "*an area in which the risk to life, property or the environment from natural hazards is intolerable".* These areas are to be identified on consultation with stakeholders. They are to be recognised and provided for in regional and district plans.

Implementation method 13.2.2 requires **High Flood Risk Zones** (HRFZ) to be identified in district plans. A HRFZ is defined as *"land that is subject to river or surface flooding during an event with an annual exceedance probability of no more than one per cent, and during such an event:*

i) the depth of flood waters exceeds one metre;
ii) the speed of flood waters exceeds two metres / second; or
iii) the flood depth multiplied by the flood speed exceeds one."

Implementation method 13.2.2 also requires "areas of coastal hazard risk" to be identified in district plans, referring to areas "potentially affected by coastal hazards" and "areas at high risk". There are no definitions in the RPS related to coastal hazard risk areas.

Implementation method 13.2.8 requires **Residual Risk Zones** (RRZ) to be identified in district plans. A RRZ is defined as *"an area subject to residual risk – that is the area that would be at risk from a natural hazard event but for a structural defence***."** Residual risk is defined as "*the risk associated with existing natural hazard structural defences such as stopbanks and seawalls, including the risk of failure of a defence or of a greater than design event occurring***."**

The process of identifying hazard zones incorporates all three elements of risk assessment (identification, analysis and evaluation). The definition of a HRFZ sets out an analysis process, prompting for analysis of flood depth and speed of floodwaters. The definition of a PHZ, based on intolerable risk, requires risk evaluation to be completed. When these hazard zones are included in district plans with associated rules, they will also extend into risk treatment.

Implementation method 13.2.8 addresses controls for 'other natural hazards'. It does not prompt to identify other types of hazards.

4.4.2 Identifying hazards for resource consent applications

In the context of decision making on resource consent applications (once plan provisions are in place) the existence of hazard zones will provide a straightforward step to identify if those hazards, (at that level) present risks that are relevant to an application.

Before hazard zones have been identified and included in plan provisions, applications for resource consents should include assessments that work through the steps set to identify hazard zones. This is to enable applicants and decision-maker to determine if these hazards may be relevant to the application. Applicants should also work through the rest of the list of natural hazards listed on the WRC website to scope the assessment of natural hazard risk required to support any application for

resource consent[3]. The key questions presented in Section 3 can be used to ensure the assessment approach is tailored to the specific context of the application being made, as follows:

- What do we know about each potential hazard that could be relevant in this context?
- Do we know enough to say if it is, is not or maybe relevant on this site, for this application?
- How confident are we about the information (how recent is it, specific/relevant to the site, assumptions involved, nature and level of uncertainty in the information)?
- Do we need more information and if so what?

Answers to these questions should enable the appropriate level of assessment to be completed. For coastal hazards and liquefaction, national guidance (discussed and referenced in Section 5) provides specific guidance on how to address these hazards, including in the context of applications for resource consents.

4.5 Risk Analysis

The RPS provides the rationale and some guidance and direction on the assessment (analysis) to be completed. Policy 13.1 sets out an overall approach. Implementation method 13.1.3 requires WRC to collaborate with stakeholders to assess hazards in communities identified as at risk from natural hazards. This includes identifying risks to the community and infrastructure and the effects on public access, amenity values and natural character (including natural physical processes, indigenous biodiversity, landscape and water quality). No specific methods or techniques are identified for the assessment.

Risk assessment may use a range of different techniques. They may be qualitative or quantitative. What is important is that they include a process approach that links hazard sources to occurrences (events/trends) and through to effects and consequences. Analytical tools such as bow-tie analysis and event/consequence mapping can be helpful and should be able to be used. Some very specific tools are detailed in national guidance for coastal hazards and liquefaction (see Section 5). These generally require or recommend that a number of scenarios be considered. As required in RPS Policy 13.3, this should include considering high impact, low probability natural hazard events.

The Framework's **Template Table 1b**, below, builds on **Template Table 1a**. It provides a tool to capture summary information about different natural hazard event scenarios and the effects that may result. Importantly, it enables those effects to be directly related to the features and values that have been identified when considering and understanding the context for the decisions to be made (see Section 4.2).

As with other template tables, **Table 1b** is intended to tailored for the context, adding rows as appropriate to assess an appropriate range of natural hazard event scenarios. It is also intended to be "live" to capture information as the assessment process progresses and iterations of scenarios are potentially considered. A generic example entry is included in the template table below. In practice a specific size of flood (e.g. a 1% AEP event) would likely be assessed and more quantitative information about areas inundated, length of time flood waters are present etc. may be able to be identified.

[3] RMA Schedule 4 **Information required in an application for resource consent**, clause 7, requires that "*any risk to the neighbourhood, the wider community, or the environment through natural hazards"* is a "*matter that must be addressed by assessment of environmental effects".*

Template Table 1b - Building understanding on how features and values may be impacted

What's here →	**Homes**	**Schools**	**Roads access**	**Services shops**	**Meeting places**	**Ecosystem services**	**Cultural heritage features**	**Business Industry**	**Etc..**
What's important about these?	e.g. dry, intact, secure services working, accessible								
Could the important things be disrupted from natural hazard events?									
How might these be affected by natural hazard scenarios?									
e.g. a big flood	inundated, evacuated electricity out not able to access garden, sheds flooded etc.								
Add other scenarios									
etc.									

4.6 Risk Evaluation

The RPS provides some guidance and direction on evaluation. More specific guidance is in the national guidance documents, particularly on coastal hazards and liquefaction.

Policy 13.1 Natural hazard risk management approach provides a basis for evaluation to determine if action is required on identified risks. The evaluation is based on risk tolerance, as follows:

- not exceeding acceptable levels of risk;
- avoiding creating new intolerable risk; and
- reducing intolerable risk to tolerable or acceptable levels.

Explanation text in the RPS explains that risk tolerance often needs to be determined on a case-by-case basis. It describes some qualitative thresholds for intolerable risk, as where:

- the risk is considered to be real within the short term; and/or
- potential consequences are significant due to the scale or vulnerability of the people, property or the environment at risk.

Several other evaluative criteria that may be relevant to decision on whether action is required to address risk are also included in Policy 13.1:

- ensures the risk from natural hazards does not exceed an acceptable level;
- protects health and safety;
- avoids creating new intolerable risk;
- reduces intolerable risk to tolerable or acceptable levels;
- enhances community resilience; and
- prefers natural defences.

These thresholds are reinforced in implementation method 13.1.1. This RPS guidance and, as appropriate, the "Current Guidance" in the call out boxes in Section 4.3 can be used to help determine if particular effects from particular natural hazard events scenarios are considered to be acceptable, tolerable or intolerable.

The evaluation should allow the relevant community to test the effects the assessment/analysis has revealed could occur (in the scenarios considered) to determine if those effects are acceptable, tolerable or intolerable. The policy settings in the RPS then indicate where some action is required to avoid or reduce risks.

The Framework's **Template Table 1c**, below builds further on **Template Tables 1a and 1b**. It provides a tool to capture summary information about the particular effects that the community considers (or is likely to consider) to be acceptable, tolerable or intolerable. Importantly, **Template Table 1c**, enables the judgements about tolerance etc. to be directly linked to specific scenarios effects and, related in turn, to the features and values that have been identified when considering the context for the decisions to be made (see Section 4.2).

As with other template tables, **Table 1c is** intended to tailored for the context. It is also intended to be "live" to capture information as the assessment process progresses and iterations of scenarios, their effects and community view about attitudes to effects are explored and tested. An example entry, assigning some effects to tolerance levels is included in the template table, to illustrate how the table could be used to provide very specific information about what effects are considered acceptable, tolerable or intolerable.

Table 1c: Capturing information about appetites on tolerance for specific effects

What's here →	Homes	Schools	Roads access	Services shops	Meeting places	Ecosystem services	Cultural heritage features	Business Industry	Etc..
What's important about these?	e.g. dry, intact, secure services working, accessible								
Could the important things be disrupted from natural hazard events?									
How might these be affected by natural hazard scenarios?									
e.g. a big flood	inundated, evacuated electricity out not able to access garden, sheds flooded etc.								
What is and is not OK?									
Acceptable	electricity out several hours								
Tolerable	Power out 1-2 days Inundated less than not more than 1 day								
Intolerable	Becomes uninhabitable Evacuation more than once in 10 years								

4.7 Risk Treatment

Risk treatment is the step in the risk management process that follows the risk assessment steps. It is beyond the scope of the Framework. Risk treatment is the step in which actions to reduce or manage risk are developed. As with other parts of the risk management process, this step needs to be iterative and completed with input of community stakeholders. The process needs to consider relative costs and benefits and the effects of the interventions themselves, as required by the RPS 13.1.3.

It is at this point that the risk management process transitions from assessment into developing the planning and decision-making solutions. These should be reflected in regional and district plan provisions and/or in conditions on resource consents.

5. RMA, National Direction and Guidance Context

5.1 RMA

The RPS has been developed and must be implemented in the context of the RMA. Key relevant RMA provisions include:

- the sustainable management purpose (Section 5) which is, most relevantly, concerned with:
  - enabling people and communities to provide for their wellbeing: and
  - the reasonably foreseeable needs of future generations
- managing significant risks from natural hazards, as a matter of national importance (Section 6);
- managing the effects of climate change (Section 7);
- the definitions of natural hazard, environment and effect; and
- the functions of regional and territorial authorities (Sections 30 and 31).

The fundamental concept of what natural hazard risk assessment should involve is established in the definition of natural hazard[4] in the Resource Management Act (RMA) and the related definitions of environment[5] and effect[6]. Together, these require risk assessment that:

- is based on a systemic understanding of natural phenomena and processes involving air (atmospheric), land (earth) and water, and their interaction;
- involves identifying and assessing "occurrences" which may be events (e.g. an earthquake or flood) or trends (e.g. climate change and sea level rise);
- is process-based, mapping the connections between occurrences and their effects and consequences;
- considers adverse effects on human life (people), property or other aspects of the environment, consistent with the wide definition of environment;
- considers temporary, permanent, past, present, future and cumulative effects; and
- considers potential effects with low probability and high potential impact, as well as potential effects of high probability.

The focus on effects, specifically in relation to climate change, is a RMA Section 7 requirement that those exercising RMA functions must have particular regard to.

Other provisions of the RMA establish the mandate and obligations for assessments, rather than providing guidance on the assessment process. *"The management of significant risks from natural hazards"* is now Matter of National Importance (Section 6), however, there is no guidance as yet

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[4] **Natural hazard** means any atmospheric or earth or water related occurrence (including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire, or flooding) the action of which adversely affects or may adversely affect human life, property, or other aspects of the environment.

[5] **environment** includes—
(a) ecosystems and their constituent parts, including people and communities; and
(b) all natural and physical resources; and
(c) amenity values; and
(d) the social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) or which are affected by those matters.

[6] In this Act, unless the context otherwise requires, the term **effect** includes—
(a) any positive or adverse effect; and
(b) any temporary or permanent effect; and
(c) any past, present, or future effect; and
(d) any cumulative effect which arises over time or in combination with other effects—regardless of the scale, intensity, duration, or frequency of the effect, and also includes—
(e) any potential effect of high probability; and
(f) any potential effect of low probability which has a high potential impact.

about how significance should be determined. RMA Schedule 4 requires assessments of effects on the Environment that are prepared to support resource consent applications to address "*any risk to the neighbourhood, the wider community, or the environment through natural hazards".*

The recently revised Section 106 provides power for consent authorities to refuse, or place conditions on, subdivision consents, if they consider that there *"is a significant risk from natural hazards".* New subsection 1A sets some specific requirements for assessment of risk, providing that it "*requires a combined assessment of - (a) the likelihood of natural hazards occurring (whether individually or in combination); and (b) the material damage to land in respect of which the consent is sought, other land, or structures that would result from natural hazards; and (c) any likely subsequent use of the land in respect of which the consent is sought that would accelerate, worsen or result in material damage of the kind referred to in paragraph (b)."* No guidance is available on how these requirements should be applied by subdivision consent decision-makers. They are more focussed than the wider obligations on consent applicants that are set in Schedule 4 for assessments of effects on the environment.

5.2 National Direction and Guidance

This section provides some summary level contextual information about coastal hazards, liquefaction and flooding. These are the subject of the following national policy direction and guidance.

Coastal Hazards:

- New Zealand Coastal Policy Statement 2010 (NZCPS).
- NZCPS 2010 guidance note: Coastal Hazards Objective 5 and Policies 24, 25, 26 & 27. Department of Conservation December 2017[7] (NZCPS Guidance).
- Coastal Hazards and Climate Change: Guidance for Local Government. Ministry for the Environment December 2017[8] (MfE Guidance).

Liquefaction:

- Planning and engineering guidance for potentially liquefaction-prone land: Resource Management Act and Building Act aspects. Ministry of Business, Innovation & Employment, Ministry for the Environment and Earthquake Commission. September 2017[9] (Liquefaction Guidance).

Flood:

- NZS9401:2008 Managing Flood Risk – a process standard (Flood Guidance).

[7] https://www.doc.govt.nz/about-us/science-publications/conservation-publications/marine-and-coastal/new-zealand-coastal-policy-statement/policy-statement-and-guidance/

[8] http://www.mfe.govt.nz/publications/climate-change/coastal-hazards-and-climate-change-guidance-local-government

[9] http://www.mfe.govt.nz/publications/rma/planning-and-engineering-guidance-potentially-liquefaction-prone-land-resource

5.2.1 Coastal Hazards

Introduction

This section calls out some key concepts from the national direction in the NZCPS and the national guidance document. When considering how to complete any coastal hazard assessment, these documents should be considered in detail.

The NZCPS provides strong national direction in one objective and four policies specifically on coastal hazards. The NZCPS Guidance provides additional guidance on those provisions. Comments below are mostly drawn from the strong and focussed direction provided by the NZCPS.

The MfE Guidance is a large document providing extensive:

- background information on coastal hazards and climate change;
- detailed guidance on how to assess these hazards;
- information and guidance on the overall process to manage risks associated with these hazards, including engagement with the community; and
- a range of tools and resources.

The structure of the guidance is based on a model of a 10 step decision cycle (as shown below). The overall approach and process are consistent with, the ISO 31000:2018 standard process (and this alignment is illustrated in Figure 62 in the MfE Guidance).

Figure 1: The 10-step decision cycle, grouped around five questions

Source: Adapted from Max Oulton (University of Waikato) and UN-Habitat (2014)

The process outlined in the MfE Guidance is a detailed handbook on how to proceed to assess, understand and develop Dynamic Adaptive Planning Pathway (DAPP) responses coastal hazards and climate change.

Risk identification and assessment

Risk identification and assessment (analysis) are addressed together in the NZCPS Policy 24.

Policy 24 Identification of coastal hazards

Identify areas in the coastal environment that are potentially affected by coastal hazards (including tsunami), giving priority to the identification of areas at high risk of being affected. Hazard risks, over at least 100 years, are to be assessed having regard to:

a. physical drivers and processes that cause coastal change including sea level rise;
b. short-term and long-term natural dynamic fluctuations of erosion and accretion;
c. geomorphological character;
d. the potential for inundation of the coastal environment, taking into account potential sources, inundation pathways and overland extent;
e. cumulative effects of sea level rise, storm surge and wave height under storm conditions;
f. influences that humans have had or are having on the coast;
g. the extent and permanence of built development; and
h. the effects of climate change on:
    i. matters (a) to (g) above;
    ii. storm frequency, intensity and surges; and
    iii. coastal sediment dynamics;

    taking into account national guidance and the best available information on the likely effects of climate change on the region or district.

The Policy sets out a two-step process to assess seven identified elements of coastal hazards and then, as a second step, to consider the effects of climate change on those elements. The NZCPS guidance expands this further to describe a two-pass assessment, with a scoping level assessment, followed by a more detailed assessment in areas where there is a high risk of being affected. The NZCPS 2010 guidance note provides more information about the matters Policy 24 requires to be assessed and includes some examples (refer pages 33-43).

Useful guidance is provided on an approach to prioritising investigations "*to identify areas where the greatest risk avoidance or reduction can be achieved includes identifying areas where:*

- *significant new development (or significant intensification) is proposed that may be hazard prone (where the greatest amount of avoidance would be achieved);*
- *development is proposed on or adjacent to natural defence landforms/features – particularly where protecting, restoring and enhancing those natural defences would also reduce the risk of harm to other existing or proposed development nearby (thereby both avoiding and mitigating substantial risks); and*
- *significant existing development may be more hazard prone (for these areas, the development of adaptive risk-reduction strategies required under Policy 27 will need detailed hazard and hazard risk assessments).*

*Areas in the coastal environment often have a wide range of environmental, social, economic and cultural values. The presence and nature of these other values should be considered as part of the coastal hazard risk identification and management." (*NZCPS 2010 Guidance p 29). Caution is advised about deferring more detailed assessments to ensure that risk is identified and planned for, rather than reacting to hazard events. The importance of involving experts and engagement with the community is also noted to be essential (page 30).

The NZCPS 2010 Guidance also provides some useful commentary on how "potentially affected" should be considered, noting that the case law "*suggests that 'potentially' could reasonably be interpreted as falling somewhere below 'unlikely' in the IPCC table (i.e. <33% probability of occurrence over at least 100-year planning timeframe)"* (page 16). It goes on to note the importance of also considering tsunami – very small probability events.

There is a particularly use commentary on the requirement concerning "at least 100 years". The Guidance notes that this will not be sufficient in many cases - *"The inclusion of 'at least the next 100 years' in the NZCPS indicates that a 100-year timeframe for hazard assessments and hazard risk management will not be sufficient in many cases. Examples of where consideration should be given to a timeframe of more than 100 years may include:*

- *Changes in land use, such as subdivision or intensification, that will significantly increase the value of assets for several generations (and are effectively irreversible)*
- *Infrastructure…important for…several generations*
- *Development on or degradation of natural defences…*
- *Construction of hard protection structures…climate change…may result in the destruction of high value habitat…*
- *Hazardous facilities…*
- *Other facilities where there would be human health and safety consequences…." (pages* 20-21).

Risk Evaluation and leading into Risk Treatment

NZCPS Objective 5 provides some clear direction about when further action is required as a result of completing the risk analysis, and broadly what that should involve.

NZCPS 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."

The NZCPS 2010 Guidance (page 5) comments on the objective as follows: "*The overarching goal of the coastal hazard objective and policies is to manage coastal hazard risks to that the likelihood of them causing social, cultural, environmental and economic harm is not increased. This includes harm arising from responses to those coastal hazards, such as the addition of hard protection structures."*

It is important to note that likelihood in this context applies to the outcome effects/harm, rather than the likelihood of a natural hazard event occurring – which may through a chain of cause/effect connections result in harm.

The NZCPS 2010 Guidance provide useful clarification that the concept of precaution (as in NZCPS Objective 3) applies to decisions about the management of risk (risk treatment), not the assessment to identify areas potentially at risk - "*National policy…requires proactive, well-informed, precautionary and risk-based management of coastal hazards…"* (page 9) ."*requiring that a*

precautionary approach is adopted for the use and management of coastal resources that are potentially vulnerable to the effects of climate change" (pages 11-12).

NZCPS 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;
(b) natural adjustments for coastal processes, natural defences, ecosystems, habitat and species are allowed to occur; and
(c) the natural character, public access, amenity and other values of the coastal environment meet the needs of future generations."

Policy 25 provides some clear direction about when further action is required as a result of completing the risk analysis, and the outcomes to be achieved.

NZCPS Policy 25 Subdivision, use and development in areas of coastal hazard risk

"*In areas potentially affected by coastal hazards over at least the next 100 years:*
(a) avoid increasing the risk of social, environmental and economic harm from coastal hazards;
(b) avoid redevelopment, or change in land use, that would increase the risk of adverse effects from coastal hazards;
(c) encourage redevelopment, or change in land use, where that would reduce the risk of adverse effects from coastal hazards, including managed retreat by relocation or removal of existing structures or their abandonment in extreme circumstances, and designing for relocatability or recoverability from hazard events;
(d) encourage the location of infrastructure away from areas of hazard risk where practicable;
(e) discourage hard protection structures and promote the use of alternatives to them, including natural defences; and
(f) consider the potential effects of tsunami and how to avoid or mitigate them."

NZCPS 2010 Guidance highlights that evaluation needs to include considering residual risk**. -** "*Local authorities also need to include an appraisal of residual risks from coastal hazards as a consequence of implementing Policy 25 (c), e.g. the likelihood that natural defences or hard protection structures will be breached or overtopped by hazard events in the future, and the adverse effects that would flow from such a breach or overtopping."*

Policy 26 provides some clear direction about when further action may be required to protect, restore or enhance natural defences.

NZCPS Policy 26 National defences against coastal hazards

"(1) 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.

(2) Recognise that such natural defences include beaches, estuaries, wetlands, intertidal areas, coastal vegetation, dunes and barrier islands."

NZCPS 2010 Guidance provides more information about the elements of Policy 26 and examples of issues and effects (pages 60-62).

Evaluation needs to also consider other objectives and policies in the NZCPS, provisions in the RMA and other legislation. It also needs consider the information about objectives and values (that can form the basis for criteria to assess risk) that are identified as part of Step 1 – context. Pages 75-84 of the NZCPS 2010 Guidance describes the relevance of other objectives and policies in the NZCPS. Pages 84-87 briefly identify provisions in the RMA, Civil Defence and Emergency Management Act and the Building Act.

Risk Treatment

Policy 27 provides clear guidance on the range of treatment or management options that should be considered to develop strategies and provisions in RMA plans.

NZCPS Policy 27 Strategies for protecting significant existing development from coastal hazard risk

"(1) In areas of significant existing development likely to be affected by coastal hazards, the range of options for reducing coastal hazard risk that should be assessed includes:

(a) promoting and identifying long-term sustainable risk reduction approaches including the relocation or removal of existing development or structures at risk;

(b) identifying the consequences of potential strategic options relative to the option of 'do-nothing';

(c) recognising that hard protection structures may be the only practical means to protect existing infrastructure of national or regional importance, to sustain the potential of built physical resources to meet the reasonably foreseeable needs of future generations;

(d) recognising and considering the environmental and social costs of permitting hard protection structures to protect private property; and

(e) identifying and planning for transition mechanisms and timeframes for moving to more sustainable approaches.

(2) In evaluating options under (1):

(a) focus on approaches to risk management that reduce the need for hard protection structures and similar engineering interventions;

(b) take into account the nature of the coastal hazard risk and how it might change over at least a 100-year timeframe, including the expected effects of climate change; and

(c) evaluate the likely costs and benefits of any proposed coastal hazard risk reduction options.

(3) Where hard protection structures are considered to be necessary, ensure that the form and location of any structures are designed to minimise adverse effects on the coastal environment.

(4) Hard protection structures, where considered necessary to protect private assets, should not be located on public land if there is no significant public or environmental benefit in doing so."

More information about the elements of Policy 27 and examples of issues and effects are provided in the NZCPS 2010 Guidance. This includes information on dynamic adaptive pathway approaches (see pages 63-74).

About Probability and Uncertainty

The NZCPS Guidance and the MfE Guidance provide some insights into how to consider the concepts of probability and uncertainty. The NZCPS Guidance provides some commentary on case law on the term "potentially affected" in NZCPS policy 24. The MfE Guidance addresses uncertainty in a broader way, describing different types of uncertainty and the analytical/assessment techniques that are appropriate to address these in Section 4.3 and Figure 13. It goes on to illustrate how uncertainty should be addressed in different decision contexts, hazard assessments and decisions (Figure 14).

The MfE Guidance promotes the use of scenarios for future sea level rise, based on those developed by the Intergovernmental Panel on Climate Change (IPCC). It identifies four scenarios that should be used to assess the potential impacts of climate change. Those four scenarios are:

- a low to eventual net-zero emission scenario (RCP2.6)
- an intermediate-low scenario based on the RCP4.5 median projections
- a scenario with continuing high emissions, based on the RCP8.5 medial projections
- a higher H+ scenario, taking into account instabilities in polar ice sheets, based on the RCP8.5 (83rd percentile) projections from Kipp et al (2014).

The scenarios for sea level rise are intended to be used in hazard assessments to help determine decision points for response-option pathways and inform decision-making to develop dynamic adaptive planning pathways within regional and district plans (or other non-statutory strategies). More explanation of the representative concentration pathways the thresholds are based on and how they are intended to be used in provided in a call out box in the MfE guidance and additional explanation text.

The MfE Guidance also provides guidance about how sea level rise allowances should be used for assessment of resource consent applications, before DAPP plans are in place. This guidance is in Table 12 reproduced below.

Table 12: Minimum transitional New Zealand-wide SLR allowances and scenarios for use in planning instruments where a single value is required at local/district scale while in transition towards adaptive pathways planning using the New Zealand-wide SLR scenarios

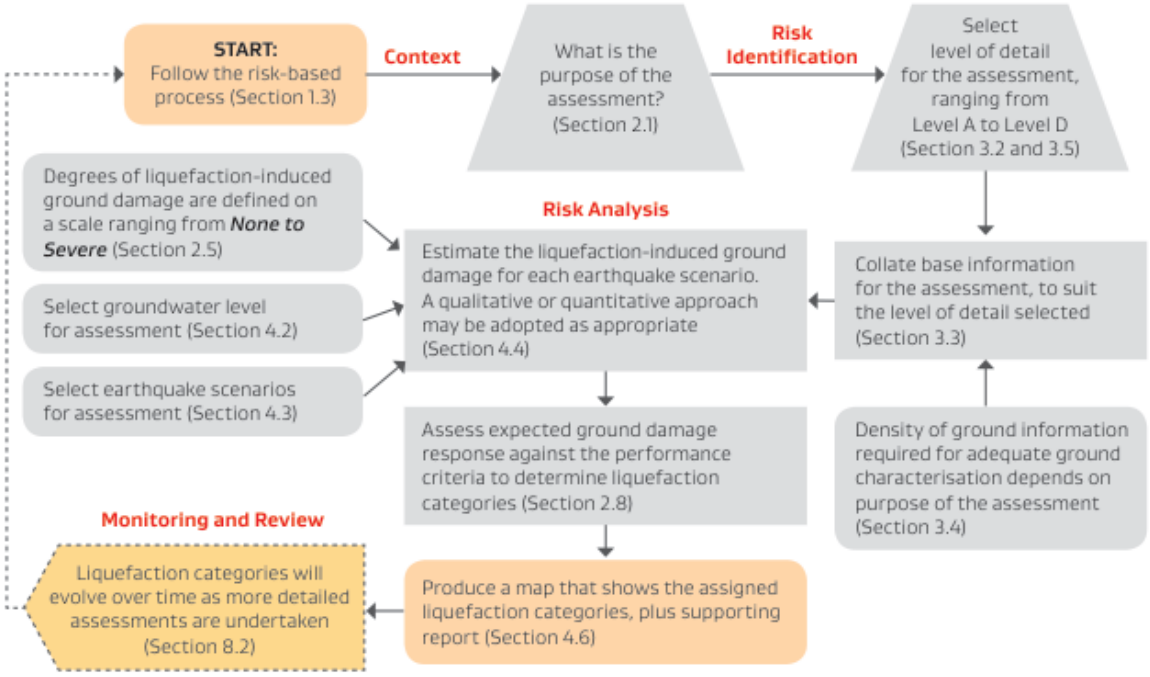
Category	Description	Transitional response
A	Coastal subdividion, greenfield developments and major new infrastructure	Avoid hazard risk by using sea-level rise over more than 100 years and the H+ scenario
B	Changes in land use and redevelopment (intensification)	Adapt to hazards by conducting a risk assessment using the range of scenarios and using the pathways approach
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	1.0 m SLR
D	Non-habitable short-lived assets with a functional need to be at the coast, and either low-consequences or readily adaptable (including services)	0.65 m SLR

5.2.2 Liquefaction

The Liquefaction Guidance provides guidance for a risk-based process to manage liquefaction-related risk in land use planning and development decision-making. It is based on the ISO 31000 risk management approach. It examines adverse effects from earthquake-induced liquefaction, with a focus on identifying if the liquefaction is likely to be consequential to land, buildings and infrastructure. The Liquefaction Guidance seeks to encourage consistency in the approaches used across New Zealand, to make it easier to transfer knowledge and develop efficient standardised solutions.

The Liquefaction Guidance focuses on assessing the potential for liquefaction-induced ground damage to inform decision making. It presents a hierarchy of tools, with higher-level regional policy statement and plans providing an overarching framework that empowers the management of liquefaction-related risk via the lower-level district plan and consent processes. An assessment process to identify and categorise land, based on its potential for liquefaction damage is key in the Liquefaction Guidance. The process is summarised in Figure 1.2, reproduced below.

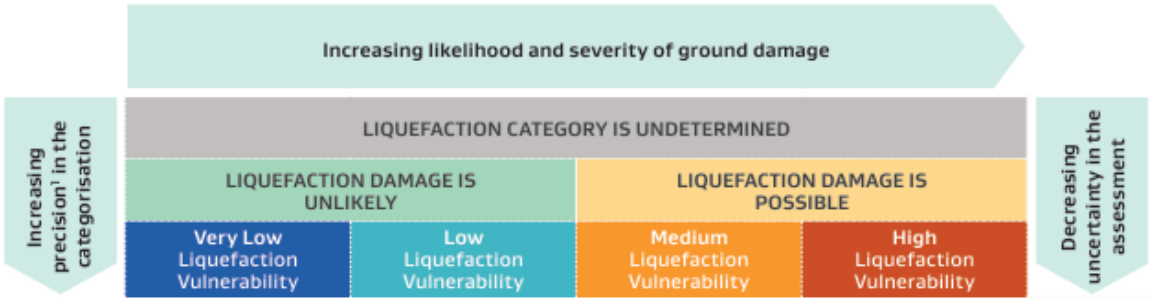
Figure 1.2: Overview of the recommended process for categorising the potential for liquefaction-induced ground damage



Note:
Refer to the referenced sections of this report and the more detailed flowchart in Appendix C for further information.

The Liquefaction Guidance recommends a standardised approach to identify land, based on liquefaction vulnerability as shown in Table 1.1 reproduced below.

Table 1.1: Recommended liquefaction vulnerability categories for use in liquefaction assessment studies to inform planning and consenting processes (refer to Section 4.5 for details)



Note:

1 In this context the 'precision' of the categorisation means how explicitly the level of liquefaction vulnerability is described. The precision is different to the accuracy (ie trueness) of the categorisation.

Recognising that different levels of detail are required for different types of decisions, the Liquefaction Guidance outlines four levels of detail for liquefaction assessment (as summarised below). Extensive more detail is included in the Liquefaction Guidance about these levels of assessment studies.

Table 1.2: Levels of detail for liquefaction assessment studies

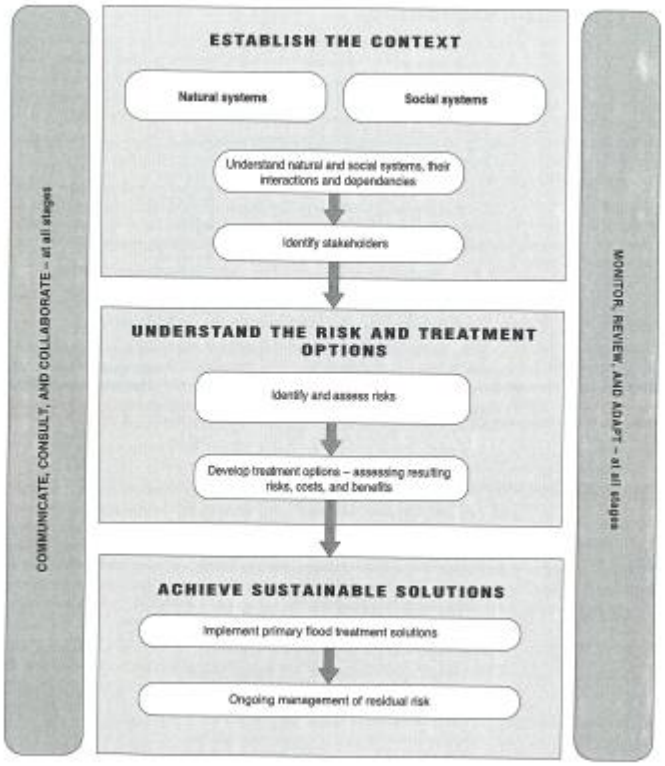
LEVEL OF DETAIL
Level A – Basic Desktop Assessment
Level B – Calibrated Desktop Assessment
Level C – Detailed Area-Wide Assessment
Level D – Site-Specific Assessment

The targeted approach outlined in the Liquefaction Guidance aims for efficiency by investing effort in reducing the uncertainty in situations where the overall impact of the liquefaction-related risk is the greatest. It also aims to incorporate management of liquefaction-related risk in a progressive manner throughout the land use planning and development framework, with appropriate risk treatments implemented at the point in the framework where they can be the most efficient and effective.

The Liquefaction Guidance provides detailed information on the risk assessment process. As part of risk identification, the Liquefaction Guidance contains detail on the investigations required for different decisions, summarised in Table 3.1 and further detailed guidance about sources of information and ground investigations. For risk analysis, the Liquefaction Guidance describes the aim of this step to be to analyse the collated information to determine how vulnerable the land is to liquefaction-induced ground damage. This includes analysis of scenarios for earthquake events, consideration of groundwater levels and the impacts of sea level rise on those groundwater levels. A series of figures and flow charts illustrate the key concepts of risk analysis. Risk evaluation is summarised in a figure (Figure 5.1).

5.2.3 Flood

The Flood Guidance takes a similar risk-based approach as in the other guidance, as can be seen in the diagram below, reproduced from the Flood guidance.



The approach is based on a risk framework that comprises five elements and six principles and outcomes. Important aspects of these are:

- taking a catchment-based approach to manage flood risks, requiring understanding the relevant natural systems and catchment processes;
- drawing together natural and social systems, requiring an understanding of both and their interactions;
- adaptive management responses;
- stakeholder engagement and local decision making;
- considering a wide range of management options and addressing residual risk.

The Flood Guidance provides broad information on identifying, analysing and evaluating. It does not provide details on specific assessment techniques or methods that may be used within the approach set out in the guidance.

Appendix 1: RPS Provisions

Policy 13.1 Natural hazard risk management approach	Natural hazard risks are managed using an integrated and holistic approach that: a) ensures the risk from natural hazards does not exceed an acceptable level; b) protects health and safety; c) avoids the creation of new intolerable risk; d) Reduces intolerable risk to tolerable or acceptable levels; e) enhances community resilience; f) is aligned with civil defence approaches; g) prefers the use of natural features over man-made structures as defences against natural hazards; h) recognises natural systems and takes a 'whole of system' approach; and i) seeks to use the best available information/best practice.
Implementation methods	
13.1.1 Risk management framework	Regional and district plans shall incorporate a risk-based approach into the management of subdivision, use and development in relation to natural hazards. This should be in accordance with relevant standards, strategies and plans, and ensure that: a) new development is managed so that natural hazard risks do not exceed acceptable levels; b) intolerable risk is reduced to tolerable or acceptable levels c) the creation of new intolerable risk is avoided; d) any intolerable risk as a result of existing use and development is as low as reasonably achievable; and e) where intolerable risk remains, the risks will be managed until an acceptable level is achieved.
13.1.2 Define primary hazard zones	Waikato Regional Council will identify primary hazard zones in consultation with key stakeholders including but not limited to territorial authorities, tāngata whenua, infrastructure providers, and affected communities and these shall be recognised and provided for in regional and district plans.
13.1.3 Assess natural hazard risk to communities	Waikato Regional Council will collaborate with territorial authorities, tāngata whenua and other agencies to undertake assessments of coastal and other communities at risk or potentially at risk from natural hazards, and develop long-term strategies for these communities. The strategies will, as a minimum: a) include recommendations for any hazard zones that should be applied, including primary hazard zones; b) identify risks to the community and existing infrastructure from natural hazards; and c) identify options for reducing the risks to the community to an acceptable level and the relative benefits and costs of those options, including taking into account any effects on: i) public access; ii) amenity values; or iii) natural character (including natural physical processes, indigenous biodiversity, landscape and water quality).
13.1.4 Regional natural hazards forum	Waikato Regional Council will establish and co-ordinate a regional natural hazards forum to promote organisational integration and information sharing across jurisdictional and plan boundaries.
13.1.5 Information, education and advocacy	Waikato Regional Council will: a) collaborate with: i) territorial authorities to support the collection and analysis of natural hazard risk information; ii) territorial authorities, the Ministry of Civil Defence and Emergency Management, the Waikato Civil Defence and Emergency Management Group and other agencies to develop

	and implement public education and awareness programmes on natural hazards and their associated risks; iii) agencies involved in the property market, including insurance companies, lending agencies and real estate agencies to promote understanding and awareness of natural hazard risk to properties; and iv) research organisations; and b) store all natural hazard risk information that is available and relevant to the Waikato region, and share this information with territorial authorities and other relevant stakeholders; and c) advocate for: i) a proactive approach to natural hazard identification in district and regional plans; ii) the use of best practice approaches, including mātauranga Māori, to natural hazard identification and management of the associated risks; and iii) a strategic approach to development (including redevelopment) that seeks that any increase in risk from natural hazards (including residual risk) is minimised.

Policy 13.2 Manage activities to reduce the risks from natural hazards	Subdivision, use and development are managed to reduce the risks from natural hazards to an acceptable or tolerable level including by: a) ensuring risk is assessed for proposed activities on land subject to natural hazards; b) reducing the risks associated with existing use and development where these risks are intolerable; c) avoiding intolerable risk in any new use or development in areas subject to natural hazards; d) minimising any increase in vulnerability due to residual risk; e) avoiding the need or demand for new structural protection works; and f) discouraging hard protection structures and promoting the use of alternatives to them, including natural defences in the coastal environment.
Implementation methods	
13.2.1 Control of subdivision within areas of intolerable risk	District plans shall control subdivision to avoid creating demand for new structures within identified high risk flood zones and identified primary hazard zones, and areas at high risk of coastal hazard.
13.2.2 Identification of areas of coastal hazard risk and high risk flood zones	District plans shall identify the location of areas: a) potentially affected by coastal hazards, prioritising the identification of those areas at high risk; and b) affected by high risk flood hazard.
13.2.3 Control of structures within primary hazard zones	Regional plans shall control any use or development of structures within identified primary hazard zones to reduce the risk from natural hazards to an acceptable level over time.
13.2.4 Floodplain management	Regional plans shall: a) control activities that divert or discharge flood water, including the importation of cleanfill into floodplains, in order to avoid or mitigate adverse effects of flooding and erosion; and

	b) ensure that an integrated catchment approach to flood management is adopted.
13.2.5 Control of use and development (high risk flood zones and areas of high coastal hazard risk)	Regional and district plans shall ensure that use and development within high risk flood zones and areas of high coastal hazard risk is appropriate, including by avoiding the placement of structures or development where these would be vulnerable to a natural hazard event or would place a community at intolerable risk. These include: a) habitable structures; b) significant community infrastructure such as hospitals and emergency services; and c) lifeline utilities.
13.2.6 Control of development within a floodplain or coastal hazard area	Regional and district plans shall ensure that: a) Subdivision, use and development can only occur in a floodplain with an annual exceedance probability of 1% (where the floodplain does not match the definition of being a High Risk Flood Zone) or in an identified potential coastal hazard area (not being a High Risk Coastal Hazard) area where: i) appropriate assessment of the risks has been undertaken and these risks will not exceed acceptable levels; ii) appropriate assessment of the likely effects has been undertaken, including the effects of any new structure or fill on the diversion of overland flows or any consequential increased runoff volumes; iii) the creation of a new, or exacerbation of an existing hazard, including those off site, and any adverse effects are avoided, remedied or mitigated; iv) any adverse effects of a 1% annual exceedance probability flood event on habitable buildings are avoided or mitigated; v) has been designed and located to minimise the level of coastal hazard risk over its intended lifetime; and vi) any hazardous substance stored as part of the development, or during the construction, or found on or near to the site, will not create a hazard; or b) it is essential infrastructure, and: i) it cannot be located elsewhere; or ii) it will not increase the risk of or from natural hazard.
13.2.7 Control of subdivision, use and development (residual risk zones)	District plans shall identify residual risk zones and shall control subdivision, use and development within these zones so that residual risk is minimised. In doing so, particular regard shall be had to: a) the level of service provided by the structural defences; b) the physical, environmental and financial sustainability of the structural defences over a period of at least 100 years; c) the impact caused by an overwhelming or a structural failure of protection works; and d) a reduction in the ability of a community to respond to and recover from a natural hazard event.
13.2.8 Control of subdivision, use and development for other natural hazards and associated risk	Regional and district plans shall control subdivision, use and development outside primary hazard zones, high risk flood zones, floodplains and residual risk zones to ensure: a) they do not create or exacerbate natural hazard risks elsewhere; b) they are appropriate by considering: i) the likelihood that defensive structures or works will be required to protect the activity from the effects of natural hazards; ii) the vulnerability of the activity to the effects of natural hazards; iii) the potential for adverse effects on the wider local and/or regional community; and iv) whether or not the development is consistent with a growth strategy or structure plan; and c) the role of natural features to avoid or mitigate natural hazards should be recognised and maintained or enhanced.

Policy 13.3 High impact, low probability natural hazard events	The risks associated with high impact, low probability natural hazard events such as tsunami, volcanic eruptions, earthquakes and debris flows are considered, having particular regard to: a) personal health and safety; b) damage and/or disruption to essential community services; c) the ability of a community to respond and recover; and d) civil defence readiness, response and recovery planning.
Implementation methods	
13.3.1 Planning for readiness, response and recovery	Local authorities should consider the potential effects of high impact, low probability natural hazard events and address these, including by: a) where possible avoiding new development in high risk hazard areas (for example, tsunami run-up areas). Development that may be directed away from such areas could include: i) residential, commercial and industrial uses (especially those involving hazardous materials); ii) lifeline utilities; and iii) emergency services facilities including police, hospital and fire services; b) using other land use planning measures where it is not feasible to restrict land uses to open-space uses. These may include controlling the type of development and uses allowed in hazard areas, and avoiding high value and/or high occupancy uses to the greatest degree possible; c) for tsunami risk, considering site-specific mitigation measures aimed at slowing, blocking, or redirecting water, or raising structures and habitable areas above the expected level of inundation; d) avoiding or restricting the location of facilities such as hospitals, schools and other facilities that may be difficult to evacuate quickly in areas at risk from tsunami, lahars, lava and pyroclastic flows, and debris avalanches; e) liaising with civil defence and lifeline utility agencies; and f) designing safeguards for critical community networks (for example, water supply).
13.3.2 Advocacy	Waikato Regional Council will advocate for appropriate consideration and recognition of the likely effects of high impact, low probability natural hazard events, including through regional and district plans, structure plans, growth strategies and resource consent processes.

Appendix 2: RPS Objectives

What the Waikato community wants – as expressed in RPS objectives

Environmental, social, cultural and economic outcomes (extracts)

Objective 3.2 Resource use and development	Recognise and provide for the role of sustainable resource use and development…enabling people to provide for their wellbeing…maintaining or enhancing: • Access for natural and physical resources for regionally significant industry & primary production • Life supporting capacity of soils, water and ecosystems to support primary production
Objective 3.4 Waikato River	Restore and protect health and wellbeing… • Including extensive specific objectives in Vision section 2.5.2…
Objective 3.5 Energy	• Recognise & provide for electricity transmission and renewable energy generation • Recognise constraints of the transmission network and generation activities
Objective 3.7 Coastal environment	• Preserve/protect natural character, features and landscape values • Recognise dynamic, complex and interdependencies of biological and physical processes
Objective 3.8 Ecosystem services	Maintain or enhance
Objective 3.12 Built environment	• Enable positive environmental, social, cultural and economic outcomes • Preserve/protect natural character, features and landscape values • Protect long-term value of regionally significant infrastructure
Objectives 3.13 & 3.14 Mauri & health marine & freshwater bodies	• Maintain natural character & functions, biodiversity • Maintain human relationships and use – harvesting, recreation • Improve life supporting capacity • Safeguard ecosystem processes • Safeguard outstanding and significant values – wetlands
Objective 3.16 Riparian areas & wetlands	Maintain and enhance…amenity & cultural values, water quality, biodiversity, habitat quality…
Objective 3.17 Geothermal	Protect regional resource from significant adverse effects
Objective 3.18 Historic & cultural heritage	Protect, maintain or enhance structures, landscapes, areas, places to retain Region's identity

Specifically relevant to natural hazards

Objective 3.24 Natural hazards	Manage effects on people, property on the environment: • Increase community resilience • Reduce risks to acceptable & tolerable levels • Enable effective/efficient response and recovery
Objective 3.6 Adapting to climate change	Manage land use to avoid potential adverse effects induced by weather variability and sea level rise on: • Amenity, built environment & infrastructure, indigenous biodiversity, natural character, public health & safety, public access.

About decision making and management

Objective 3.1 Integrated management	Recognise: • Natural processes & complex interactions (air, water, land, living things) • Needs of future generations • Interrelationships – natural resources & built environment
Objective 3.3 Decision-making	• Precautionary approach & adaptive management where effects may be significant or irreversible and are uncertain • Based on best available information • Based on matauranga Maori and working with tangata whenua • Flexible to reflect local variations • Recognise time needed to make change