Natural Hazards Commission Toka Tū Ake

Loss Modelling Strategy

2025

Natural Hazards Commission
Toka Tū Ake

Te Kāwanatanga o Aotearoa
New Zealand Government

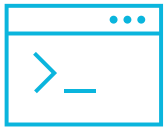
Our vision is for loss modelling insights to inform critical decisions on the management and financing of New Zealand's natural hazard risk.

Our goal is to provide an insightful, robust and trusted view of New Zealand's natural hazard risk.

Objectives:

We **invest** in the data, science, and models that support our loss modelling needs.

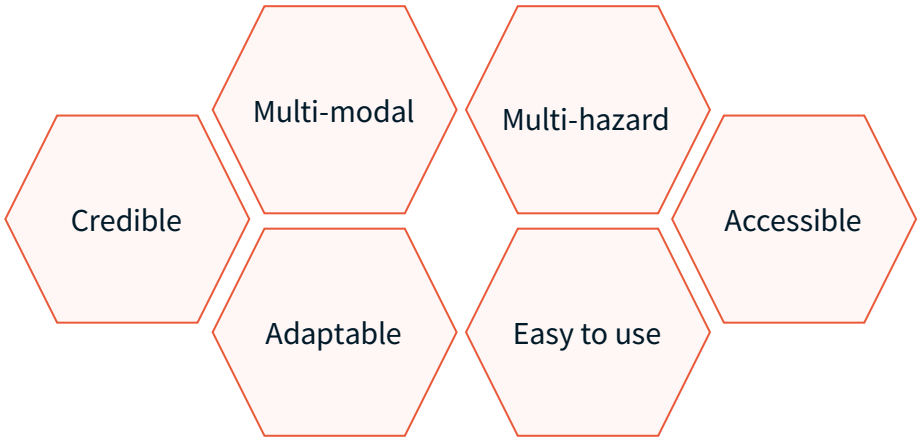
We **develop** and maintain our loss modelling platform and supporting technologies.



We have the **expertise**, and partner with others, to create and run models, and translate outputs into trusted information, insights, and advice.

We **collaborate** and connect across NHC and the wider system to promote the use of loss modelling in decisions.

Principles:



Strategic priorities:

Resilience: build knowledge and understanding of natural hazard risks to inform decisions

Readiness: provide insights on future natural hazard impacts so we are prepared to support recovery, including through effective claims management

Risk financing: provide a New Zealand view of risk to help manage the fiscal risks of providing natural hazards insurance cover

Recovery: estimate the scale and complexity of an event to support recovery decisions and claims management

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Introduction

Natural hazards loss modelling is the process of estimating the impact caused by natural hazard events and is the way we build our view of New Zealand's natural hazard risk. It is a powerful tool that provides data, insights and knowledge to support the decisions we and others make.

At the Natural Hazards Commission Toka Tū Ake (NHC), our vision is to be a world-class public insurance scheme that reduces the impact of natural hazards on people, property, and the community. Our loss modelling capability supports this vision through estimating what impacts are or could be in the future, and informing actions to reduce the impact of natural hazards on insured homeowners.

Purpose of this Strategy

The purpose of this Strategy is to guide the development of our capability so that loss modelling can provide the data and insights needed to:

- build the evidence base to support risk reduction and resilience decision-making (Resilience),
- provide insights on what to expect when a natural hazard event occurs so that we are ready to support homeowners with their insurance claims (Readiness),
- provide a New Zealand view of risk to help manage the financial impacts of natural hazard events (Risk Financing), and
- estimate the scale and complexity of an event to support recovery decision making and claims management (Recovery).

What is natural hazards loss modelling?

Components of natural hazards loss modelling

To build a natural hazards loss model we need:

- modelled or measured hazard severity and location (such as ash thickness or shaking strength)
- location and contruction of assets (such as where and how houses are built)
- vulnerability functions describing how assets are damaged when impacted by a hazard of specific intensity.

Together, these allow us to calculate the consequences (damage and loss) of natural hazard impacts.

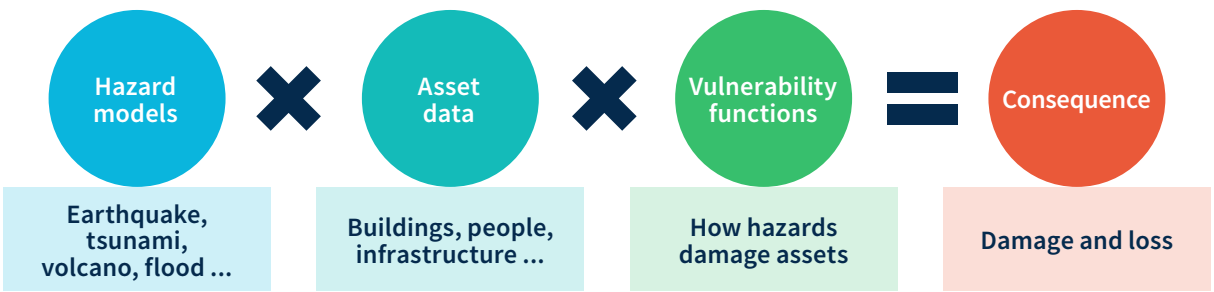

Figure 1. The components of natural hazards loss modelling.

Modes of natural hazards loss modelling

Natural hazards loss modelling can use either:

- a scenario, based on a credible but fictional (e.g., Alpine Fault earthquake) or forecast (e.g., an approaching storm) event,
- post-event data from a real hazard event that has occurred, or
- probabilistic analysis, when a hazard model is available. This allows us to estimate the average annual cost of a hazard be over a long (specified) time period.

These modes of running models have different complexity, computational needs and degrees of uncertainty accounted for.

Advancements in loss modelling in recent years have given rise to the introduction of multi-hazard and cascading hazard models, which can be integrated into each mode. For example, for an earthquake we can now estimate the impact from both ground shaking and liquefaction, and we can estimate the impact of secondary hazards, such as earthquake-induced landslides.

Scenario	Post-event	Probabilistic
• Estimate impacts from a single fictional or forecast event. • Based on our understanding of past events, or modelling, to ensure credibility. • Used to convey potential impacts of a particular event.	• Estimate impacts from a single real event • Based on event data and information • Often includes regular updates and reruns to factor in real-time data updates	• Estimate average impacts over a long time period • Based on a hazard model covering multiple events over a period of time • Reflects the likelihood of occurrence and the range different outcomes

- Generally less complex
- Defines parameters based on assumptions
- Lower computation cost

- Generally more complex
- Defines parameters based on probabilities
- Higher computation cost

Figure 2. Modes of loss modelling.

Strategic context for loss modelling at NHC

Loss Modelling is an enabler and supporting capability for each of NHC's Strategic Priorities:

- Strengthen **resilience** by building knowledge and understanding of natural hazard risks to improve decision-making
- Continuously enhance our **readiness** for natural hazard events
- Use our **risk financing** expertise to manage the fiscal risks of providing natural hazards insurance cover
- Support homeowner and community **recovery** by working with our partners to deliver a transparent, timely, high-quality and responsive process for natural hazards insurance claims

Accordingly, this Strategy aligns with, delivers on, and draws on strategies and needs across the organisation.

The Loss Modelling Strategy is underpinned by the Data and Digital Strategy, which supports the systems and some of the data required for an effective loss modelling programme, and the Research Strategy, which guides our investment in research and research capability that is required for the underpinning science, data, and models that go into our loss model.

Figure 3. Loss modelling strategy in context of other organisational strategies.

How loss modelling delivers outcomes across NHC's Strategic Priorities

Loss modelling is not only a technical tool, but also a strategic capability that drives better outcomes for people, systems, and the Natural Hazards Insurance Scheme. It turns risk into robust, authoritative, and actionable insights, enabling us to anticipate impacts, prioritise investments, and support more informed decisions at every stage of the risk management cycle.

At NHC, loss modelling helps us to:

- **Reduce future natural hazard losses** by informing land use, design, build, and mitigation decisions.
- **Improve readiness** by anticipating the scale and complexity of events before they happen.
- **Safeguard the financial sustainability** of the Natural Hazards Insurance Scheme through a robust, locally grounded understanding of risk.
- **Accelerate and coordinate recovery**, forecasting the scale, type, and location of impacts, to enable us to get resources to where they are needed most, helping homeowners and communities get back on their feet faster.

We are working to embed this capability across NHC and our partners networks, so that risk insights are not only generated, but used to create real-world value.

Resilience: build knowledge and understanding of natural hazard risks to inform decisions

Outcome sought:

Loss modelling helps us drive better long-term outcomes by informing risk reduction efforts that are targeted, effective, and measurable. It strengthens the case for action - whether through better-informed planning rules, public investment, or behaviour change - and ensures resilience decisions are backed by evidence, not guesswork.

How loss modelling delivers this value:

- Provides the data and predicted losses to influence planning and policy decisions that can reduce future losses.
- Enables cost-benefit comparisons to prioritise the most effective resilience investments.
- Strengthens risk communication to communities, supporting informed decision-making and behaviour change.
- Encourages wider uptake of modelling across agencies, embedding risk-based thinking in public decisions.

Readiness: provide insights on future natural hazard impacts so we are prepared to support recovery, including through effective claims management

Outcome sought:

Loss modelling delivers evidence that helps us to anticipate and plan for what a natural hazard event might look like, so we can appropriately plan the resources we need available to us and policies and arrangements we need in place to enable timely and equitable recoveries for homeowners.

How loss modelling delivers this value:

- Helps us plan for the likely scale and complexity of events, so we can respond more efficiently.
- Supports design of realistic exercises that test our systems and partnerships under pressure.
- Enables improvements to claims systems, processes and policies, including innovation in how we deliver services.

Risk financing: provide a New Zealand view of risk to help manage the fiscal risks of providing natural hazards insurance cover

Outcome sought:

A strong New Zealand-based view of risk supports the financial sustainability of the Natural Hazards Insurance Scheme. It helps us manage our liabilities, make prudent investment decisions, and negotiate from a position of strength with global reinsurance markets.

How loss modelling delivers this value:

- Underpins financial planning and cashflow management after events.
- Supports robust negotiations with reinsurers, using locally tailored models.
- Informs levy setting and investment of the Natural Hazards Fund to ensure long-term sustainability.
- Helps model worst-case scenarios and test our financial resilience.

Recovery: estimate the scale and complexity of an event to support recovery decisions and claims management

Outcome sought:

Loss modelling helps us understand the scale of a disaster quickly – so we can provide clear information to homeowners, coordinate effectively with other agencies, and deliver timely, transparent claims support. Loss modelling helps to ensure recovery efforts are scaled appropriately and reach the right people at the right time.

How loss modelling delivers this value:

- Informs early decisions about claims handling and resource deployment.
- Improves triage, assessment strategies, and fraud detection.
- Supports proactive communication with impacted homeowners and communities.
- Supports broader post-event services and advice through the sharing of loss modelling information across government.

Benefits of building our own view of New Zealand's natural hazard risk

NHC has a long history of investing in New Zealand's view of natural hazard risk, through investment in natural hazard science research and risk modelling.

There are many recognised benefits to having our own national view of natural hazard risk. These include:

- supporting conversations with reinsurers when major disruptions occur, such as significant events locally or overseas, or major changes in scientific understanding,
- providing us with the ability to update models on demand and not be reliant on the development schedule of model vendors to adopt new or developing science,
- ensuring the implementation of the science into models is developed and tested closely with the model creators,
- ensuring that our models are supported by a strong and credible science community that is engaged with industry,
- providing us with an ability to design, test and measure risk management strategies, including risk transfer and risk reduction policies,
- enabling us to quantify the impact of any new understanding of risk and allows us to manage the dialogue with the insurance and reinsurance sector,
- enabling us to quickly implement new understanding and provide insights post-event to fill a potential information void, and
- enabling us to test and provide cost-benefit analysis on risk reduction approaches to support actions to reduce the impact of natural hazard events.

Although the reinsurance sector currently draws on vendor models and their own models to inform pricing, the sector recognises NHC investment into the science and modelling, and potentially modifies results based on insights from our models.

For the reinsurance industry and others to benefit fully from our loss modelling capabilities and investment, and start using them directly, we would need to make the platform and models more accessible, easy to use and compatible with other systems.

Improving the accessibility and ease of use of New Zealand-specific models would also benefit a range of key stakeholders across the public and private sectors who aim to reduce the impact of natural hazard events on people, property and the community, including insurers, local and central government, engineers, and the public.

Our approach to loss modelling

PRUE is NHC's loss modelling solution. To model loss, we require models and data, connected via pipelines to a loss modelling platform (currently RiskScape). The loss modelling platform runs a calculation engine calling on specific models and data as appropriate.

To support the delivery of this Strategy we will utilise various practices, processes, and tools. These include:

- Best practice product development and management approaches, such as:
    - Use cases and user stories – capturing user needs and requirements.
    - Planning – for the development of loss models for each hazard, and platform development.
    - Evaluation – testing models and analysing their suitability for each use case, based on model maturity and impact.
    - Iteration – improving both the models and how we work.
    - User experience – testing with target users.
- Communication and feedback – effectively working with suppliers to deliver, provide clear expectations, timelines, etc.
- Platform releases follow a workflow (below).
- Assurance framework – in line with risk management guidelines.

A release of a loss model or update to our loss modelling platform will result from:

- an identified use case or output, based on user needs,
- technology upgrades, and/or
- improvements to underlying science.

Challenges to loss modelling

Over the past five years, we have learnt several important lessons and identified key considerations for the future development of our capability, from both a science and delivery perspective. The approach outlined in this Strategy is intended to position NHC well to reduce delivery risk and navigate any challenges that arise.

Some important challenges we have identified:

- **Evolving and novel science and variability of the maturity of scientific models.** This can impact the risks and timelines of our loss modelling capability development. However, we may get benefit sooner if we consider how early versions or components of the models might be used for other use cases, such as for event recovery planning. Evaluation of the models once they are developed is an important step in our process to understand how they can be used.

- **We need to allow for collation and transformation of data in our timelines.** Useful models require several types of high-quality data, gathered from multiple sources and often collected for purposes other than loss modelling.
- **The New Zealand scientific community has excellent capability but limited capacity to create New Zealand-centric natural hazard and loss models.** Expertise is in high demand. Changes in the science system are underway which could prove advantageous for collaboration but could also cause disruption and other unknown impacts. We need to consider these factors in our investment planning and update these plans regularly.
- **We rely heavily on others to implement models into our platforms.** This can often create bottlenecks in implementation.

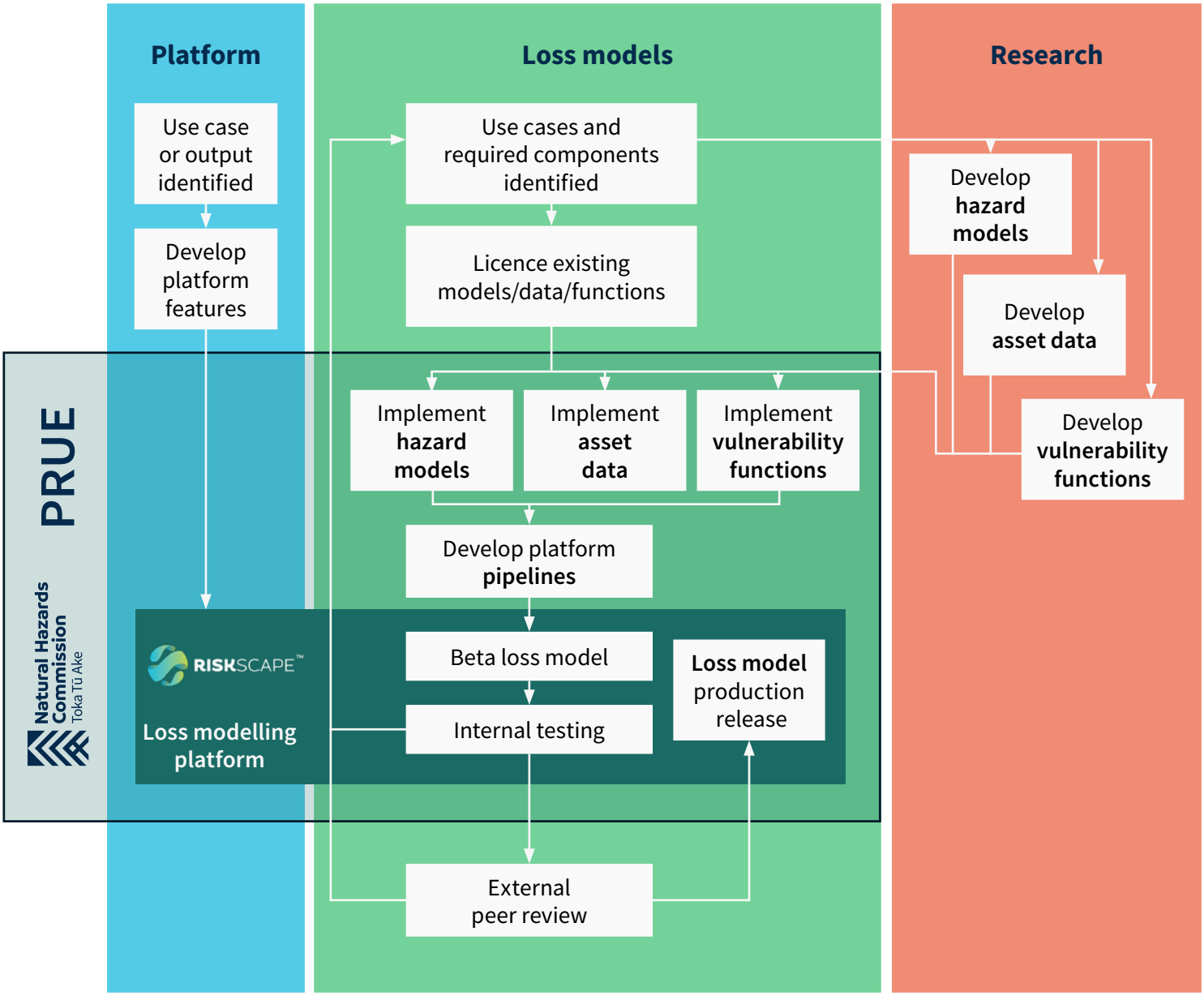

Figure 4. Our loss model and loss modelling platform development process.

Loss Modelling Strategy 2025

Our vision is for loss modelling insights to inform critical decisions on the management and financing of New Zealand's natural hazard risk.

Our goal is to provide an insightful, robust and trusted view of New Zealand's natural hazard risk.

We will achieve this through the following objectives:

- We invest in the data, science, and models that support our loss modelling needs.
- We develop and maintain our loss modelling platform and supporting technologies.
- We have the expertise, and partner with others, to create and run models, and translate outputs into trusted information, insights, and advice.
- We collaborate and connect across NHC and the wider system to promote the use of loss modelling in decisions.

Our work will be guided by our loss modelling principles:

Multi-modal

- We provide scenario, post-event, and probabilistic capability so we have the right information that meets the needs of those we work with.

Multi-hazard

- We aim to model all hazards NHC covers, both individually and concurrently (multiple hazards in the same event).

Credible

- Our models are based on credible, robust and peer-reviewed science.

Accessible

- We strive for our models to be easy for others to access and integrate with.

Adaptable

- Our capability is scalable, so we are responsive to model advancements and changes to business needs, and resilient to business continuity disruptions.

Easy to use

- Our capability is straight forward, fast to use, and easy to understand, so business needs are met and loss modelling is used to inform work across NHC.

How we will meet our objectives

For each of our objectives we have specified priorities, activities and outcomes, to focus our efforts and support us to achieve our goal.

Objective 1: Invest in the data, science, and models necessary to support our loss modelling needs		
Priority	**Key initiatives/actions**	**Outcomes/success indicators**
1.1. Invest in the development of fit-for-purpose models for our business needs.	Invest in science and models across our covered natural hazards, including furthering the development of multi-hazard models. Develop a principled approach to assess what modelling capability is required for which hazards, and provide short term solutions where ideal outcomes are not yet realisable. Secure licenses for non-NHC models related to loss modelling.	Model investment is driven by our use cases linked to our strategic priorities. Our loss modelling capability is used more widely throughout the organisation for planning and decision making. Our loss models are robust and peer reviewed.
1.2. Support initiatives that improve the accessibility and quality of data needed for models.	Collect and collate data that improves our understanding of the attributes of buildings. Improve access to building and land damage data, to support regular updates and improvements to fragility functions.	We have the right data to meet our needs. Our models improve with more accurate and granular data.
1.3. Appropriately prioritise investment in data, research and models.	Investments are prioritised using defined principles, such as the availability of existing research, resourcing, and the potential benefit to the fund or New Zealanders. Validate NHC's planned loss modelling investments with the scientific community to ensure we are aligned with research developments and programmes. Refresh our investment plans annually to ensure they are up-to-date with scientific developments and investments.	We have a well-founded view of the research-to-modelling pipeline and can plan our investment and development accordingly. We optimise our investments and leverage others' investments to balance our development across hazards and support the progression towards our maturity framework target state.
1.4. Ensure that investments are well-managed.	Identify, grow and diversify our group of suppliers that support the development of the models we require. Develop processes for initiatives that include 'gates' where we evaluate the suitability of models for our various use cases. Consider intellectual property needs when commissioning new models and components, guided by NHC's Intellectual Property Principles.	Projects with uncertain outcomes use staging, effective governance, and supplier diversification (where appropriate) to reduce risk. Research needs are identified early so that inputs are available when needed by long-term projects, and timelines are not delayed. Ensure that agreements are future-proofed: intellectual property terms allow NHC to continue using developed models in another platform if we cease using RiskScape.

How we will meet our objectives

Objective 2: Develop and maintain our loss modelling platform and supporting technologies		
Priority	**Key initiatives/actions**	**Outcomes/success indicators**
2.1. Develop pathways for models to be incorporated into our platform.	• Develop and test pipelines for data and models to be used in our loss modelling platform. • Refine model development and integration processes to ensure efficient and repeatable delivery to our platform.	• Following an event, we can ingest data and estimate our expected losses. • We can update, test, and run new models, shortly after they become available.

2.2. Contribute to RiskScape planning and development.	• Support partners to maintain and further develop the RiskScape platform.
	• Ensure RiskScape development:
	  • improves our loss modelling capability,
	  • improves the accessibility and ease of use of the RiskScape platform and associated models.
		• RiskScape is secure, stable, resilient, and meets the needs of NHC.
		• RiskScape is increasingly being used by others.

2.3. Develop the PRUE user interface.	• Upgrade the PRUE user interface by utilising the new RiskScape Platform. • Integrate model outputs with NHC GIS capability. • Identify and develop features required to meet business needs.	• The PRUE user interface is functional and secure. • The interface is easy to use and is used across NHC.

Objective 3: We have the expertise, and partner with others, to create and run models, and translate outputs into trusted information, insights, and advice.		
Priority	**Key initiatives/actions**	**Outcomes/success indicators**
3.1. Ensure NHC has the appropriate capability and capacity to run models and interpret results from PRUE.	• Train multiple staff to run loss models for the various uses. • Educate staff to interpret and present the results.	• PRUE has multiple trained users who can run models and interpret results on request. • We can provide timely insights following an event.
3.2. Develop the ability to code new models in the platform.	• Ensure NHC can incorporate new functions or vary parameters in PRUE.	• We can include loss modelling insights in NHC submissions to policy and planning. • We can deliver to different use cases and respond to questions as they arise.
3.3. Educate end users of our models and model outputs.	• Develop training and reference material for staff.	• End-users understand the outputs of our models and feel comfortable using them in impactful ways inform decision making.

How we will meet our objectives

Objective 4: We collaborate and connect across the organisation and wider system to promote the use of loss modelling in decision-making		
Priority	**Key initiatives/actions**	**Outcomes/success indicators**
4.1. Ensure the models we invest in have maximum benefit for New Zealanders.	• Negotiate licence terms for new science, models and data to enable open access to science. • Release new models and outputs for the public to use (when appropriate and in alignment with our IP principles).	• New science is openly accessible to increase uptake and benefits to the public.
4.2. Promote the use of loss modelling insights in decision-making.	• Share actionable loss modelling insights with local and central government and other stakeholders. • Investigate ways to improve access of NZ-specific models, including supporting initiatives to improve ease-of-use of modelling outputs and platforms.	• Local and central government, and other stakeholders, use loss modelling results to act to improve risks based on our insights and advice. • Others in the risk management system engage with natural hazard and risk modelling to inform decision-making.
4.3. Use good product management practice to ensure our investments are driven by user need.	• Continue to test and capture use cases across the business.	• Loss model and loss modelling platform development is driven by NHC's use cases (in support of our strategic priorities).
4.4. Work with industry to build momentum and resource behind larger initiatives that benefit our loss modelling capability.	• Collaborate and connect with organisations and groups who are advancing data, science, and models we can utilise. • Stay aware of advancements and novel developments in modelling capability, such as systems modelling, the use of Artificial Intelligence, plug and play modelling solutions, and economy modelling.	• We can plan for new initiatives, ensure we can use these, and incorporate these in our modelling. • We can make informed loss modelling investment decisions.

Implementation of this strategy

Build, buy, or go to market

For each technology, model, or dataset we require for loss modelling, we will consider whether to commission one of our existing modelling providers to build it, to purchase or license the component off the shelf, or to go to market to find a bespoke solution.

This decision-making process will involve assessing the availability, cost, and suitability of existing models, data and other components needed for loss modelling, as well as the feasibility and potential benefits of developing custom components. The availability of researchers or developers to create required components will also be a factor, and if there are potential efficiencies in aligning our investments with existing research efforts.

Our maturity framework

We will use the following maturity framework to guide our work, and to communicate the current state and target state of our loss modelling capability to stakeholders.

In general, our aim is to model the natural hazards we cover. While some hazards require probabilistic modelling, for others, a “rule of thumb” or weighting may suffice. Similarly, some hazards may only require post-event and scenario modelling.

The timing of when New Zealand-specific modelling will be available depends on major advancements in science, and therefore the timing of the target state is not set. Fortunately, large scientific programmes funded by other organisations will help in progressing the maturity of our model. Therefore, our current estimate of the target state is 8-10 years.

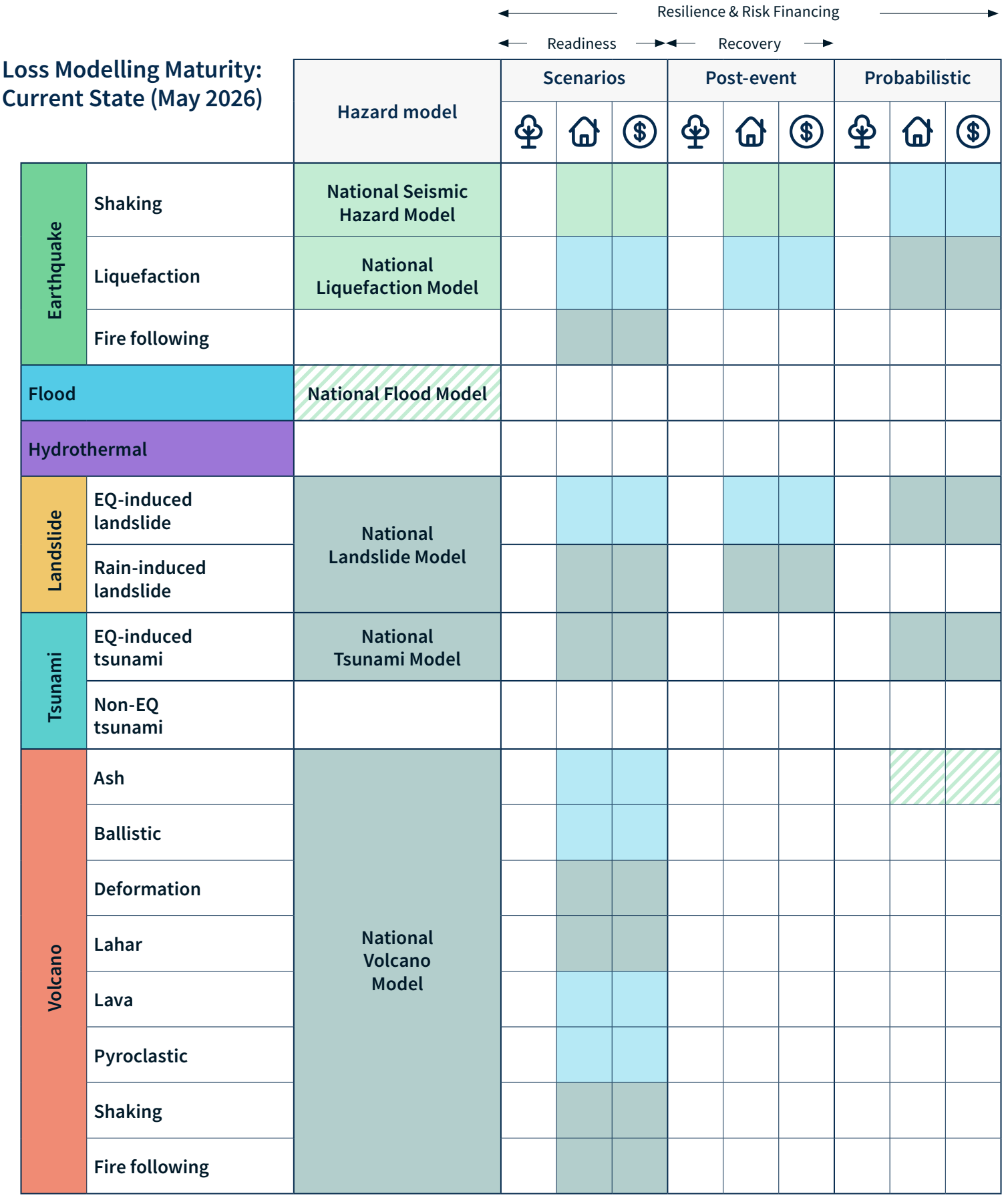

Figure 5. Our maturity framework showing our current loss modelling capability.

Figure 6. Our maturity framework showing our 10-year loss modelling capability target.

Themes and use cases

There are six broad themes that define our uses for loss modelling and inform our development work. While some examples will appear in more than one theme, this model helps us to understand and communicate where loss modelling fits into the business, and the actions required to meet our needs.

Theme	Examples	Stakeholders
Financial planning	Price the NHI levy. Model the future balance of the Natural Hazard Fund. Measure the appropriateness of NHC's risk transfer programme. Inform the investment strategy for the Natural Hazard Fund.	Readiness. Risk Financing. Recovery. Reinsurers. Overseas partners. Treasury.
Scenario planning	Develop post-event plans. Reduce time and cost of claims handling. Explore novel approaches to claim settlement. Test policy. Run scenarios with other organisations.	Resilience. Readiness. Risk Financing. Recovery.
Post-event modelling	Estimate losses after an event. Support response decisions. Inform international partners about predicted losses.	Resilience. Readiness. Recovery. Risk Financing.
Stakeholder engagement	Inform homeowners about recovery timelines. Help insurers manage assessments and major recoveries. Help inform government organisations with no modelling capability.	Resilience. Readiness. Recovery. Risk Financing. Recovery. Councils. Insurers. Homeowners. Central government.
User experience	See a single source of truth for loss modelling. Receive automated post-event summaries. Develop clear visuals.	Resilience. Readiness. Recovery. Risk Financing.
Quality, transparent NZ models	Provide advice for as many hazards as possible. Understand and have confidence in the models we use. Negotiate with reinsurers using an NZ view of risk. Commission new data collection.	Resilience. Readiness. Recovery. Risk Financing.

Domain	Example criteria
Capability growth	• Development of our New Zealand view of natural hazard risk, including model sophistication, transparency, and documentation. • Expansion of staff capability in modelling, interpretation, and communication of insights. • Number and diversity of partners (e.g., local government, central agencies, insurers) actively engaging with NHC's loss modelling outputs.
Insight generation and uptake	• Number and quality of insights generated from loss modelling (e.g., scenarios, cost-benefit analyses, exposure summaries). • Feedback from end users (e.g., planners, insurers, reinsurers, claims teams) on the utility and clarity of insights.

Outcomes and Strategic impact monitoring	• Contribution to improved outcomes, including:
	  ◦ Evidence of our modelling influencing external plans, policies, investment decisions, or operational planning.
	  ◦ Ability to anticipate and respond to emerging risks or event scenarios through timely modelling and scenario analysis.
	  ◦ Uptake of New Zealand-specific models and model outputs in reinsurance negotiations or regulatory discussions.
	  ◦ Evidence that loss modelling outputs drive more efficient response and recovery.

Some of the domains and our ability to evaluate them are new for NHC and will take several years to develop.

Reporting approach

We will:

- **Annually review** progress against our maturity framework target state, including delivery of key initiatives and capabilities, and performance against strategic priorities.
- **Track key performance indicators** aligned with the four evaluation domains. These may include quantitative metrics (e.g., number of models produced, partners using insights) and qualitative assessments (e.g., case studies, lessons learnt).
- **Report annually to the Board** on capability development, outcomes achieved, and areas for improvement.
- **Adapt and refine** our investments and work plan based on evaluation findings, user feedback, and advancements in science and technology.

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