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A CASE STUDY ON REACTIVE MANAGED RETREAT FROM LANDSLIDE RISK – LESSONS LEARNED IN AUCKLAND, NEW ZEALAND

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Abstract

New Zealand is a geologically diverse group of islands on a plate boundary with a high exposure to natural hazards including landslides. Since 1760 there have been over 1,500 recorded landslide-related fatalities in New Zealand (more than from earthquakes and tsunami combined), averaging an economic impact of at least NZ \$250–\$300 M/year. In January and February 2023, a series of severe storms caused flooding and triggered over 150,000 landslides, tragically killing fifteen people (six of whom were in Auckland), and ultimately costing New Zealand over NZ\$15 billion in recovery effort. Historically, Central and Local Government in New Zealand held a limited role in supporting homeowners after events of this magnitude; typical involvement would be to manage imminent risk to life, while leaving private insurance to deal with remaining issues. However, in 2023 the New Zealand Government recognised that the scale and impacts of the Auckland Anniversary Storm and Cyclone Gabrielle weather events required additional support. They saw an opportunity to reduce future risk to human life by enabling a form of managed retreat. They developed a categorisation scheme for residential properties, which was implemented by local councils to classify properties by their risk level and remove people from intolerable risk. This paper describes the development and implementation of the scheme and some of the lessons learned that may be applicable to future scenarios of this scale.

Key words

landslides, Auckland, New Zealand, risk, managed retreat, policy

1 Introduction

Situated near an active plate boundary, New Zealand is exposed to many natural hazards. Auckland is New Zealand's largest city. Home to around a third of the 5 million New Zealanders, it contributes almost 40 per cent of the nation's gross domestic product. Auckland has 3,200 km of coastline, many marginally stable hills and flood-prone rivers, and its numerous sandy beaches are backed by volcanoes of the Auckland Volcanic Field. Auckland has a sub-tropical climate, with warm and humid summers which can be associated with intense rainfall.

January 2023 was Auckland's wettest month since records began (Roberts et al, 2024). The heaviest rainfall produced widespread flooding across the region during Auckland's Anniversary weekend on Friday 27 January, which the National Institute of Water and Atmospheric Research (NIWA) described as at least a 1-in-200-year event. Central Auckland experienced over 45% of its yearly rainfall in just one month, which is over 8.5 times the January average (NIWA, 2023). Two weeks later in the early hours of 14 February 2023, a second weather event, Cyclone Gabrielle, hit Auckland. The storm continued south, affecting many other areas along the east coast of the North Island of New Zealand. A National State of Emergency was declared on 14 February.

This series of severe storms triggered over 150,000 landslides, killed fifteen people (six in Auckland), and cost New Zealand over NZ\$15 billion (Roberts et al, 2024). Infrastructure was destroyed, with many roads closed for month to years. Thousands of homes were damaged, and in some cases destroyed by a

combination of flooding and landslides. In the following months, many residents mobilised to demand some form of managed retreat, sparking a debate across academic and political realms (e.g., Stuff, 2023).

2 Central Government policy response

In March 2023 the New Zealand government set up a Cyclone Recovery Unit to lead, coordinate and monitor the severe weather recovery across government. This included a Cyclone Recovery Taskforce (CRT), chaired by Sir Brian Roche, which operated until February 2024 (Mitchell, 2024).

On 2 April 2023, a new Act of Parliament was passed (Severe Weather Emergency Recovery Legislation Act 2023) to assist affected communities and local authorities to respond to, and recover from, the impacts of the severe weather events. This Act enabled faster decision making through Orders in Council, which are tools used to amend existing laws. For example, an Order in Council was used to allow temporary accommodation to be built for displaced families which would otherwise have breached planning rules (Department of the Prime Minister and Cabinet, 2023).

The CRT identified that the scale of the event required a new approach to disaster recovery and risk management. Key issues included:

- The number of displaced people would have overwhelmed normal support mechanisms.
- The number of homes destroyed would have put at risk the insurability of property in future.
- Insurance payouts would not have covered the costs for risk reduction requirements, leaving people unable to leave/sell their homes while remaining exposed to an intolerable level of risk to life.

To manage these issues the Taskforce developed a non-statutory scheme to categorise residential property affected by landslides or flooding. These were announced by the Cyclone Recovery Minister Grant Robertson on 1 May 2023 (New Zealand Government, 2023).

Table 1. Categories for residential properties

Category	Definitions	Examples
1	Repair to previous state is all that is required to manage future severe weather event risk.	Minor flood damage to repair but no need for significant redesign/retrofitting.
2C	Community level interventions are effective in managing future severe weather event risk.	Local government repairs and enhances flood protection schemes to adequately manage the risk of future flooding events in the face of climate change effects.
2P	Property level interventions are needed to manage future severe weather event risk, including in tandem with community level interventions.	Property specific measures are necessary e.g., improved drainage, raising houses is necessary. Benefits accrue to property owners but some may face affordability issues.
2A	Potential to fall within 2C/2P but significant further assessment required.	Interventions may be required / possible but insufficient information to provide initial categorisation (these may subsequently move between "2" categories or to categories 1 / 3).
3	Future severe weather event risk cannot be sufficiently mitigated. In some cases some current land uses may remain acceptable, while for others there is an intolerable risk of injury or death.	In the face of enhanced climate risks the property may face unacceptable risk of future flooding. Other property could be subject to unstable land that poses an ongoing risk.

On 1 June 2023 the government announced that it would enter into a funding arrangement with councils in affected regions to support them to offer a voluntary buyout for owners of Category 3 designated residential properties, and would co-fund work needed to protect Category 2 properties. Minister Grant Robertson expressed support for a locally-led response and delegated the next steps to local councils.

The division of responsibility is shown in Fig 1.

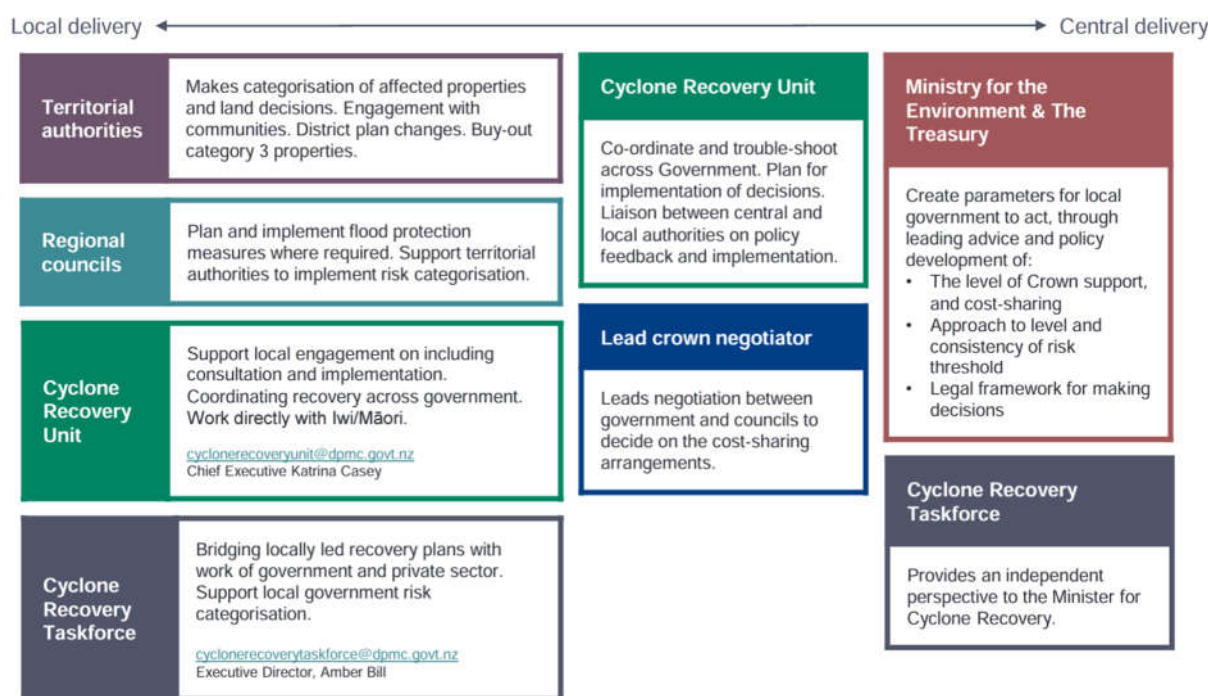


Figure 1. Roles and responsibilities set out by the CRT in the Future of Severely Affected Land (FOSAL) information pack (Cyclone Recovery Unit, 2023). Auckland Council is a Unitary Authority, so takes on the responsibilities of Territorial Authorities and Regional Councils.

3 Auckland Council response

To implement the government policy, each Territorial Authority needed to determine how to categorise the affected homes. Key considerations by Auckland Council included:

- Identifying the scale of the problem and which properties were affected.
- Creating technical definitions of the terms provided by the Taskforce to allow consistent and fair categorisation of properties. In particular, the following terms from Table 1 were challenging:
 - “... cannot be sufficiently mitigated”
 - “Intolerable risk of injury or death”
- Negotiating the split of costs for Categories 2 and 3 with Treasury (Central Government) and finding a funding source for the council component (including community consultation).
- Developing detailed policies enabling decisions to be made transparently, quickly and equitably.

3.1 Assessment of number of affected properties

In April 2023, the CRT asked for initial estimates of the possible number of Category 3 properties in Auckland to inform their policy advice to central government. At this stage there was no clearly defined policies, so Auckland Council staff used data from Rapid Building Assessments and expert judgement to establish how many homes would be extremely challenging to mitigate the risks. The initial assessment was that there would be in the order of 700 homes in this category, of which 200 would be due to landslide risk and 500 would be due to flood risk (Roberts et al, 2024).

3.2 Technical definitions

Auckland Council focused on defining two technical terms: “Intolerable risk” and “Feasible mitigation”. These were required to develop the policies which would ensure that each case was assessed fairly, and to enable the scale of the response and funding requirements to be more accurately defined.

New Zealand has no formal risk tolerance settings. Despite this, intolerable risk was relatively easy to define for landslide affected properties. The Australian Geomechanics Society Guidelines for Landslide

Risk Management were already used in New Zealand and provided a relatively simple mechanism for assessing the Annual Individual Fatality Risk in a way that is appropriate for residential housing (Australian Geomechanics Society, 2007). An annual individual fatality risk of 10^{-4} was taken as the boundary between tolerable and intolerable risk, based on Table 1 of the guidelines. This boundary value had the benefit of having been used and tested in New Zealand for rockfall risk after the Canterbury earthquake sequence (Canterbury Earthquake Recovery Authority, 2011). This risk boundary value was presented to, tested by, and supported by the Independent Hearings Panel at the time (Independent Hearings Panel, 2015). It also had the benefit of being relatively easy to explain to the public and elected officials since it is broadly comparable with the risk of dying each year on the roads in New Zealand (Ministry of Transport, 2024), a risk that our society tolerates but tries to reduce.

It was more challenging to provide a technical definition for the phrase “*Future severe weather event risk cannot be sufficiently mitigated*”. The first problem was deciding what counts as sufficient mitigation. Having defined a risk tolerance, it would seem reasonable to take any reduction in risk to below this threshold as having ‘sufficiently mitigated’ the risk. However, this fails to consider the requirements of the Building Act which could impose a higher standard. Although the Building Act does not explicitly give risk tolerances, it is suggested in the New Zealand Building Code Handbook (Ministry of Business, Innovation & Employment, 2014) that residual risk would need to be acceptable, which it defines as “*the level of risk the public is prepared to accept without further management*”.

The second problem was the word “*cannot*”. With the application of unlimited time and money, most natural hazard risks can be mitigated. However, this would probably not be socially or politically acceptable. To resolve this issue, Auckland Council used the “locally-led” mandate from central government to redefine Category 3 by changing this part of the definition to “*There are no feasible mitigation solutions (either property-based or community-based) that would reduce that risk to tolerable levels*”. This allowed a more balanced approach to be taken, as the word “*feasible*” could encompass several factors. Auckland Council’s definition of “*feasible*” for the work required to reduce the risk can be paraphrased as:

- **Expected to comply with legislative requirements.** This allowed the exclusion of potentially cheaper mitigation measures that would fail to get consent for construction.
- **Under normal circumstances would take less than two years to implement from the time of categorisation.** This avoided the risk of people having to live in a home which was exposed to an intolerable risk for a significant period of time.
- **Would cost less than 25% of the value of the property they protect.** This balanced the costs with the likely benefits, considering optimism bias in preliminary costings, construction cost inflation in a very constrained post-disaster market, and the potential that the risk reduction would not be to the level of an equivalent newly built home with the same value. Capital Value (CV) is known for all properties in New Zealand as it is the basis for local taxes, and was used in preference of a formal valuation to significantly speed up the decision-making process.

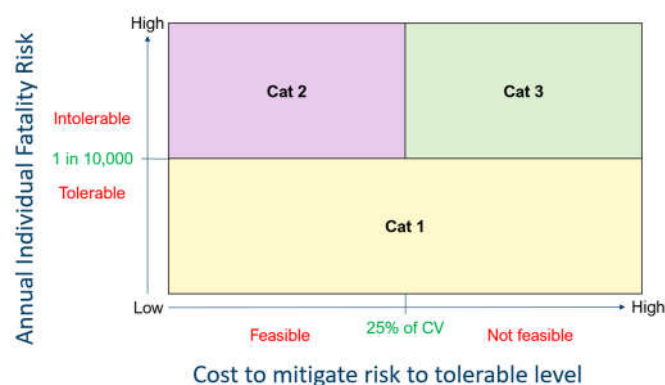


Figure 2. Graphical representation of the risk categories. CV = Capital Value of the home.

A range of options were presented to elected officials. These options included costs ranging from 10% to 75% of the value of the property protected were presented. The benefits and risks associated with the various options were discussed in depth, and the policy settings described above were developed from these debates. These definitions allowed a relatively simple decision-making process by comparing the outcomes of a risk assessment and feasibility-level design for mitigation costs (Fig 2).

3.3 Policy development

A clear policy was written to ensure that people were treated fairly, and that decision-makers have endorsed the process through which individual decisions are made. The overarching objective was “*to support Aucklanders to voluntarily relocate from residential housing situations on properties that pose an intolerable risk to their lives*”. The terms were guided by the following considerations:

- **Effective** – the speed and uptake of buy-out to remove the intolerable risk to life posed to households from their property.
- **Affordable** – the amount of funding available across the number of properties that need to be purchased to remove intolerable risk to life. Affordability assumptions and scenarios have been used to help make an assessment against this criterion as a high level of uncertainty exists.
- **Fair and consistent with policy intent** – our legal obligations to be fair and for the scheme to be consistent with the stated policy intent.
- **Equitable** – scheme equity for those most in need and those who fund the scheme (Auckland Council, 2023a).

3.4 Negotiations

The anticipated local government cost for recovery in Auckland was NZ\$2 billion, making it a very significant cost relative to the annual budget of \$3.7 billion. The negotiated agreement allowed for over \$1 billion contribution from central government with the remaining funds provided by Auckland Council (Auckland Council, 2023b). Key elements funded by central government were:

- 50% of the cost of buying the Category 3 homes (\$774 million total)
- 62% of the cost of implementing Category 2C risk reduction measures (\$820 million total)
- 79% of the cost of transport recovery costs (\$390 million total)

Significant costs remained with Auckland Council including all costs associated with assessing risk, identifying impacted or at-risk properties, transaction and demolition/deconstruction costs, and ongoing operational cost associated with the land. These were consulted on with the public and approved in the Annual Budget.

3.5 Property assessments

In many cases where properties were subject to both landslide and flooding impacts, property assessments involved both flooding assessments and landslide assessments. The focus of this paper covers landslide assessments only. Because of the nature of the landslide risk, which generally comprised small landslides affecting one or a small cluster of homes, risk assessments had to be undertaken at an individual property level (Fig 3). A balance needed to be struck between accuracy and speed. A swift outcome for owners was crucial. Many affected residents were suffering significant financial and mental health challenges, either living in a potentially risky location or being displaced from their home and community (although some government support was available). However, accuracy was also important; the assessments would have significant cost implications and affect the lives of the homeowners for years to come. To balance these competing demands a two-stage process was set up whereby properties that were clearly not subject to intolerable risk could be identified through a desk study, while resources could be diverted towards the more detailed studies required for riskier properties.

Homeowners who had their properties assessed in the Rapid Building Assessment stage of the response were asked if they wanted to be considered in the voluntary buy-out process. Media involvement through published news articles inviting homeowners to register increased awareness of the categorisation scheme and insurance companies sent letters to their customers. Affected homeowners were asked to

submit information through a Survey123 online form with GIS capabilities. This form allowed rapid collection of information about affected homes, their owners, and the damage. The ability for owners to attach photographs, videos, and reports was particularly useful in the desktop assessment process.

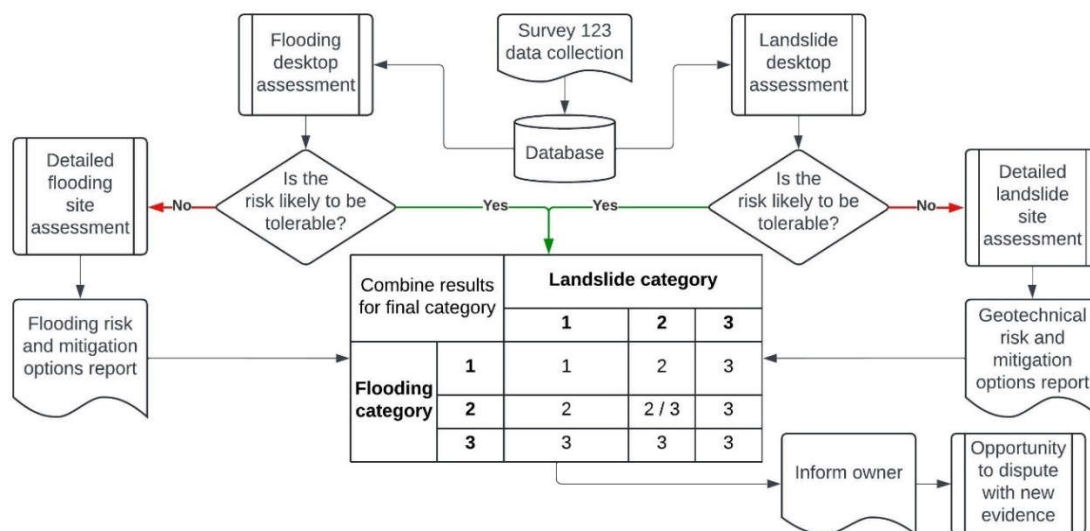


Figure 3. Process to assess final risk category.

The form was operational from 14 June 2023 and within two weeks over 800 submissions were received. By the end of 2023 this increased to 2,385. The property categorisation scheme is set to conclude on 30 September 2024, when there is predicted to be between 3,000 and 3,500 applications submitted (Fig 4).

Submitted data was extracted for analysis, initially into Microsoft Excel and later into a SharePoint list where the results of detailed assessments could be added. In the case of multiple submissions, each property has a unique identifier separate from the Submission ID that ensured management of information entered through duplicate entries. In later stages of the recovery this process is being transitioned into a fully featured Customer Relationship Management (CRM) platform to enable better case tracking and integration into other council systems.

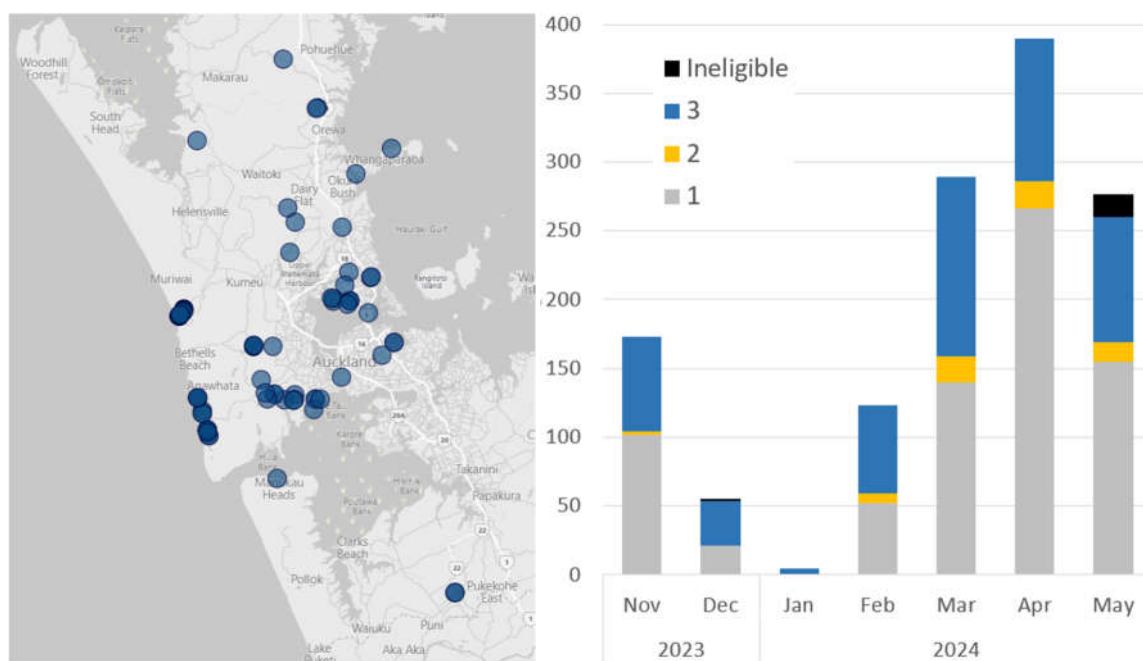


Figure 4. Left: Map of properties assigned Category 3 for landslide risk (to mid-May 2024). Right: rate of progress assigning categories (combined flooding and landslide risk). By the end of April 2023, 1,287 categories had been assigned to homes. A total of 900 Category 3 homes are forecast.

For properties that needed a detailed landslide risk assessment, Auckland Council engaged a panel of nine local supplier consultancies. A standardised reporting template was developed for them to use along with incident-specific guidelines for the application of the AGS2007 methodology to help deliver consistency between assessors. Peer review was undertaken in Australia to reduce the burden on local suppliers who were already stretched in the emergency response. The reporting template was also made freely available to the public should they wish to get alternative advice (Auckland Council, 2023c). Training was provided to these geotechnical suppliers at project initiation and repeated approximately six months later as a refresher and to build upon lessons learned. Input from the authors of AGS 2007 guidelines was also gathered as part of the refresher exercise.

The assessment process in the west coast communities of Muriwai, Piha and Karekare was carried out differently in that initially an area-wide lens to the risk assessment was adopted as opposed to the property-specific approach taken for majority of categorisation scheme applications. This was due to the large number of homes affected (many of which were evacuated and therefore vulnerable to looting), the fatalities that occurred, and the severe damage to roads and other lifeline utilities. Strict cordons were placed around these communities limiting access these areas. As owners were unable to easily get access to geotechnical advice, an area-wide risk assessment was undertaken on their behalf.

4 Conclusions and lessons

4.1 ‘Gut-feel’ and data-led decision-making

Many early decisions made with limited information proved to be remarkably accurate. For example, the initial estimate that there would be about 700 category 3 homes, made before policy had been developed or detailed site assessments had been started, appears to be broadly correct. Best estimates (as of May 2024) range from 650 to 900 homes.

4.2 Policy and policy development

The clearly documented policy (Auckland Council, 2023a) was valuable in guiding and justifying decisions made throughout the process of categorisation. As a non-statutory form of managed retreat without underpinning legislation, having these rules clearly set out and approved by the appropriate political body significantly reduced the risk of scope creep and disputes.

The evolution and development of policy after the disaster introduced several challenges. The methodology initially used in Muriwai, Piha and Karekare only evaluated the risk and did not quantify the cost of mitigating the risk. This was because at the time these west coast community areas were being assessed, it was not Auckland Council’s role to complete this. Thirdly, due to categorisation decisions being issued on the cumulative risk consequences from both flooding and landslides, alignment of assessment programmes and outcomes between different technical teams proved challenging in communicating expected timelines for assessment completion to homeowners. Once the policy settings changed, additional work was required to assess mitigation costs. This could have caused serious delays if the underlying approach Auckland Council had taken had been incompatible with the central government policy. This was avoided by working closely with the CRT. By helping guide their direction the risk assessment approaches already commenced in the west coast communities were continued and the definitions given by the government were compatible, meaning there was no need to re-do any of the risk assessment work.

In the response to the weather events of 2023, it took approximately six months to develop policy, negotiate funding, develop systems, and fully implement a process for managed retreat. Figure 4 shows that the first Category 3 homes were formally categorised in November 2023, eight months after the disaster. The technical process of undertaking the assessments can take only a few months if a system is set up and functioning, although more complex cases will always take longer. Similar properties could be categorised much more quickly in future events if appropriate advanced planning and policy work

has been completed, and data management systems and structures are in place to track and manage risk assessment cases.

4.3 Communication and evolving opinions

Communication with affected homeowners proved to be a key challenge. In Muriwai, because it was the community with the highest concentration of affected homes, Auckland Council held a series of public meetings to explain what was happening. 24 newsletters were issued by Council between March and August 2023, which were well received by the community. A similar approach was taken in Piha and Karekare. For other areas of Auckland, communications were less consistent. Because the affected homes were widely distributed, public meetings were not very effective and it was hard to create newsletters that were relevant. This led to people feeling isolated and ignored. The most successful communication channel was through webinars and pre-recorded YouTube videos.

The opinions of many homeowners changed, sometimes multiple times, through the year. The majority of these were initially adamant that they would never leave their home, and over time changed their position. This was most apparent in Muriwai, where the frequent detailed technical communications to the community and with individuals helped them to understand the risk. In other areas where communications weren't so detailed, the transition from rejection to acceptance was less successful.

4.4 Timeframes

The most commonly asked questions in response and recovery were about timeframes. Homeowners wanted to know when information would be available, and when decisions would be made. From the experiences in Auckland, four main lessons stood out.

- 1 In an emergency response tasks takes longer than usual. Even with a clear plan and good management, delays will occur.
- 2 Technical staff will often apply business-as-usual thinking, giving promises that in the circumstances they cannot meet.
- 3 If policy isn't defined in advance, or is altered through the recovery, timeframes will change. When this happens it is essential to communicate this quickly and widely. The community will find this frustrating, and it may be seen as a breach of trust, but it is better than having to justify a delay later.
- 4 There will be significant pressure to resolve all issues quickly. However, it is much better to under-promise and over-deliver. The impact (particularly financial and on mental health) for the community of a series of broken promises on timeframes should not be underestimated. It may also result in a loss of trust in the technical outcomes.

If in doubt, it is recommended to double any estimates before communicating this to the community, and to be transparent about uncertainties. Saying "I don't know" in a public meeting is hard but earns trust. Regular updates and explanations around programme constraints assisted in alleviating worry.

4.5 Data and reporting issues

In a large-scale emergency it is vital that data is managed sensitively and carefully. There will be many problems to manage, and without robust and reliable data sources there is a serious risk that cases can be lost or forgotten. Some of the data issues encountered are summarised below:

- 1 Public submissions will vary significantly in quality and detail. A plan to fill in the gaps for people who can't (or won't) engage through defined channels is essential. These must consider the range of needs in the community, such as the need for interpreters or dealing with people who are not capable of managing their own affairs.
- 2 Reporting tools will be used in ways you might not envisage. Auckland Council's Survey123 tool was used by some people to request further information. Others made multiple submissions, sometimes to add new information and in some cases to raise the profile of their case seeking a faster resolution. This meant that there were more submissions than there were affected properties. Some included very specific requests which the system wasn't set up to follow up on.
- 3 There is not a one-to-one relationship between people and homes. Care needs to be taken to set up a database to reflect this. Auckland Council's database was set up to have unique datasets for each

home, which best aligned with the government policy settings. This became problematic where there were multiple parties involved (e.g. a landlord and tenant) or where people moved house during the process. Eventually Auckland Council migrated to a fully-featured CRM tool that could deal with more complex data relationships.

- 4 Careful decisions need to be made about data governance and security. There will be an obligation to keep personal information private while sharing other information, and for data that is held to be kept on record in perpetuity. Some tools are flexible and quick, but are not ideal long-term data repositories and may have limitations around security and quality assurance.
- 5 Visibility and transparency between datasets and different recovery teams is key to minimise time querying reporting status and progress to both internal and external stakeholders, and ensure each discipline can prioritise the completion and review of assessments over information-gathering.

Best outcomes can be achieved when existing business-as-usual systems can be scaled up for use in emergency situations. New systems developed in response can be faster to align with new policies, but will cause problems later. Agencies involved in emergency response and recovery should build appropriate functionality into systems before events occur. This should include the ability to rapidly add many additional users, including from external agencies, to support the recovery.

4.6 Systemic gaps and issues

It is apparent from the need to create the categorisation system in the aftermath of a disaster that New Zealand's approach to natural hazard risk management has gaps. For example, there are cases of individuals whose homes are severely damaged (or at risk), but are not eligible for buy-out because the risk to life is not intolerable. In some of these cases the insurance payout for the damage is not sufficient to cover the costs of the mitigation, and the homeowners are unable to borrow additional funds to do the work because banks will not lend on these homes. These owners are trapped in homes they can't afford to fix, but are unable to sell, insure or remortgage. Further work is needed to identify and investigate these gaps, and to determine how people in these situations can be supported in a way that is fair and equitable for them and other members of society who may be providing the underlying funding, for example through taxes and rate payments.

4.7 Reactive managed retreat is achievable in recovery

Experience in Auckland shows that in the aftermath of a disaster, managed retreat can be achieved, and may well be called for by communities. For this to be implemented effectively it is essential that there is a clearly defined and easily understood policy explaining how decisions will be made. Clear, frequent communications explaining the technical decisions will be needed to bring members of the community on the journey as information becomes available. Having technical experts available to support communities (alongside other disciplines offering support for mental health, financial advice etc.) creates much better outcomes.

New Zealand can be better prepared for managed retreat in future by continuing work started under the last government to develop cross-party consensus, and matching legislation, building on Action 4.1 of the National Adaptation Plan (Ministry for the Environment, 2022). An important debate needs to be held as a nation to determine what our risk tolerance is, and how much we are prepared to pay (individually and collectively) for greater safety from natural hazards.

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