The Resilient Buildings Project

Societal expectations for seismic performance of buildings

DETAILED REPORT ON FOCUS GROUPS

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We also gratefully acknowledge the contribution of our 27 focus group participants. In this project we deliberately sought diverse views of seismic resilience: we wanted to talk to people who are typical building users rather than those that think about seismic resilience every day. We are grateful, in particular, to those who agreed to talk to us despite thinking they had nothing to offer. Everyone we spoke to as a building user, owner, or representative of public interest contributed to our understanding of how society uses buildings and expects them to perform.

This is a supplementary report to Brown et al., 2022. Societal expectation for seismic performance of Buildings. The Resilient Buildings Project Research Paper.

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1. Introduction

The Resilient Buildings Project, through which we report our findings, sought to capture a snapshot of societal expectations and tolerance toward seismic risk to inform future performance objectives for new buildings. Historically, these objectives have been framed by technical experts in structural engineering and building science, and this project represents the first time in New Zealand researchers have set out to document from a community perspective nationwide societal expectations for the seismic performance of buildings.

The resilient building project set out to:

- Explore whether there is a social license to redefine statutory performance objectives.
- Develop a clear and shared language of desired performance objectives.
- Map the pluralities of societal risk perception and define how performance objectives shift relative to building and geographical context.
- Understand the importance of seismic resilience relative to other demands on built environment.

In 2021, we interviewed 32 individuals across a range of backgrounds and sectors, as well as 27 individuals in 6 geographically based focus groups, to capture a snapshot of expectations for seismic performance of buildings. The purpose of this report is to highlight the findings from the 6 geographically based focus groups. This is a data report and is intended as a fully documented account of the data collected in the focus groups and a detailed description of the focus group methodology. A comprehensive analysis and synthesis of these findings, alongside the interview findings, can be found in: *Brown et al., 2022. Societal expectation for seismic performance of Buildings. The Resilient Buildings Project Research Paper.*

The specific research questions we sought to address through the focus groups were:

1. What are the desired performance outcomes for buildings following earthquakes of varying scales, this could include
    - human outcomes (e.g. life safety, availability of critical infrastructure services)
    - economic outcomes (e.g. cost, business disruption impacts)
    - social (e.g. social connectivity, heritage, cultural impacts)
    - natural (e.g. sustainability, carbon emissions, waste)
2. How does the desired performance outcome change for different:
    - geographic settings (rural, urban, geographically confined, seismic hazard risk, economic importance of community, other?)
    - building setting (proximity to roads, footpaths, critical infrastructure etc)
    - levels of insurance/societies ability to pay/recover availability
    - types/uses/occupancy/design life of buildings (e.g. critical infrastructure, health, stadiums, office, residential units)
3. How does earthquake resilience or the above desired performance outcomes compare against day-to-day building priorities (e.g. embodied carbon, architectural value, fire safety etc)?

The insights arising from this study will contribute to debate about desired levels of resilience to the impacts of earthquakes, and the design approaches and options available to achieve desired performance.

2. Method

2.1 Overview

To support the overall project outcome, a series of six geographically based focus groups were undertaken in September and October 2021. To ensure a wide range of geographic and community settings were represented, the focus group locations included three urban centres and three smaller towns with a range of seismic hazards. To ensure a wide range of views were represented the focus groups comprised 4-7 individuals who were selected using a combination of purposive and snowball sampling (i.e., existing participants helped to recruit other potential participants) to represent different community perspectives (see Table 1). Representatives included the local or regional civil defence, business community, health sector, welfare sector, environmental interests, and Māori (indigenous people in New Zealand).

Due to COVID-19 pandemic restrictions, each focus group was held over two 2-hour virtual sessions using video conferencing software and an online whiteboard tool called Miro.

Table 1 Focus group participation details

Location	Town/City	Seismic hazard	Number scheduled	Number of participants		Perspectives captured					
				Part 1	Part 2	Civil Defence	Economic	Welfare	Health	Natural	Māori world view
A	Town	Medium	4	4	3	✓	✓			✓	✓
B	City	High	4	4	4	✓	✓	✓		✓	
C	City	High	5	3	5	✓		✓	✓	✓	✓
D	Town	High	5	2	4	✓	✓	✓			✓
E	City	Low	5	4	4		✓✓		✓	✓	
F	Town	Medium	6	6	5	✓✓	✓	✓✓	✓		✓

Participants took part in three activities:

Activity 1 - Town Map exercises: the importance of different types of buildings in a community following a major earthquake.

Activity 2 - Risk matrices: risk tolerance, at community level, to different types and frequencies of earthquake disruption.

Activity 3 – Building design priorities: how important seismic resilience is compared to other building performance priorities.

2.2 Activity 1: Town map exercises

The importance of different types of buildings in a community was explored using a generic town map (Figure 1). The map shows a selection of building types within a community. The building types were chosen to represent a range of services within a community. During the exercises we asked participants to consider the buildings and services shown in the context of their own community. For example, community meeting places could represent a range of community meeting places, such as marae, halls, churches, libraries – any/all venues that enable community connection. The map was deliberately made generic to allow for comparison between all focus groups.

In addition to the buildings, the map also included information on the peak number of occupants and occupancy rate to support Activity 1.1 (below). Peak occupancy is the maximum number of people in a facility at one time. This was presented as low, moderate of high. As with the buildings, qualitative rather than quantitative occupancy information was provided so each focus group could scale their assessment relative to their community size. Occupancy rate represents the likelihood someone is in the building at any one time. This is a combination of the length of time an individual spends in a building and the amount of time the building might be at peak occupancy. As for peak occupancy, these were presented as low medium and high. During the focus group we acknowledged that the occupancy values provided, even qualitatively, might not represent their community, but asked them to consider them as read for Activity 1.1 to allow comparison between focus groups.

Details of the buildings included in the map, the services they provide, and the occupancies are included in Table 2.

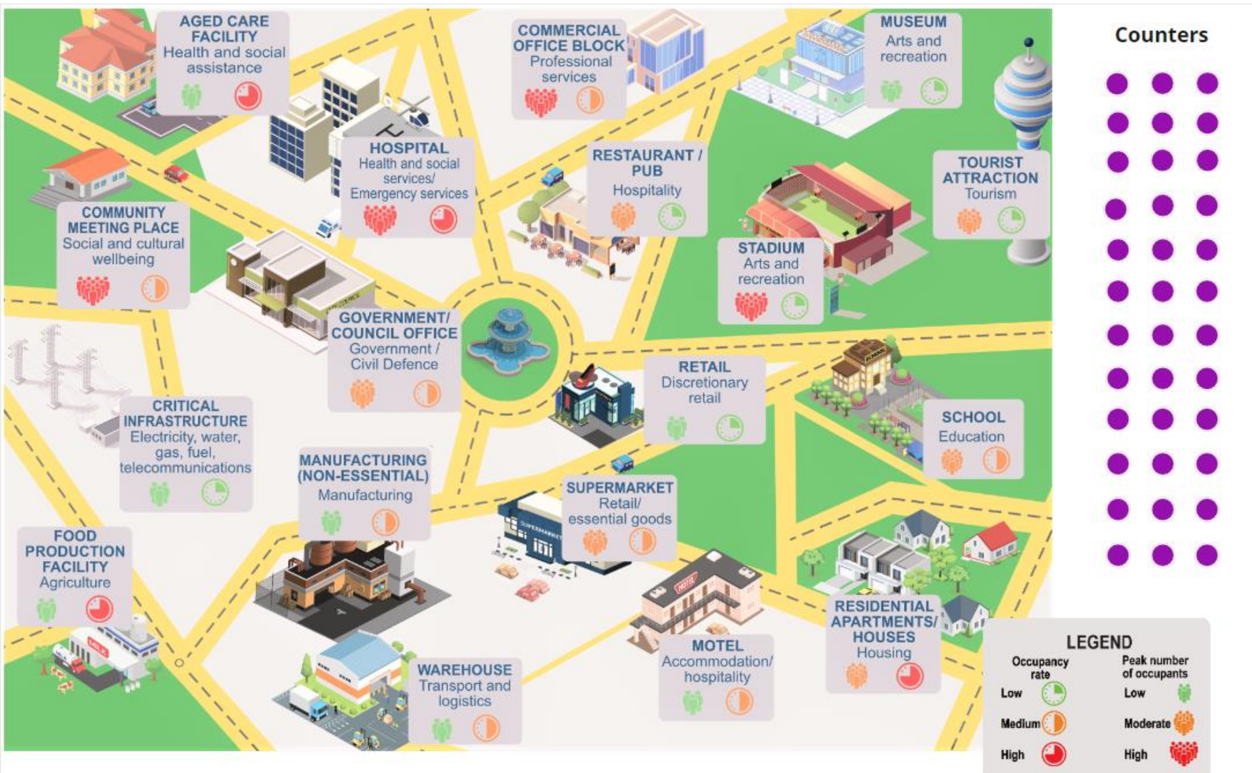

Figure 1 Town map used for exercises in Activity 1.

Table 2 Building details for town map exercise

Building	Peak number of occupants	Occupancy rate	Services
Hospital	High	High	Health and social services/ emergency services
Community meeting place (hall, church, marae, library)	High	Medium	Social and cultural wellbeing
Commercial office block commercial	High	Medium	Professional services
Stadium	High	Low	Arts and recreation
Residential apartments/housing	Moderate	High	Housing
Supermarket	Moderate	Medium	Essential goods
Government/council office	Moderate	Medium	Government
School	Moderate	Medium	Education
Tourist attraction	Moderate	Low	Tourism
Pub/restaurant	Moderate	Low	Hospitality
Aged care facility	Low	High	Health and social assistance
Food production facility	Low	High	Agriculture/manufacturing
Motel	Low	Medium	Accommodation/hospitality
Manufacturing (non-essential)	Low	Medium	Manufacturing
Warehouse	Low	Medium	Transport and logistics
Critical infrastructure	Low	Low	Electricity, water, gas, fuel, telecommunications
Museum	Low	Low	Arts and recreation
Retail (discretionary)	Low	Low	Retail

Participants were asked to work together to allocate 36 counters across the 18 buildings in the town map (an average of 2 per building) while discussing the rationale and agreeing as a group. The more counters allocated to each building the more important it is. Placing no counters on a building did not mean it was not important but that relative to the other buildings it was less important.

Across a series of exercises (Activity 1.1 and 1.2) participants were asked to rate the relative importance of buildings for life safety, social recovery, and economic recovery. In activity 1.3 participants were asked, across a range of time periods following a disruption, how long they could tolerate being without a particular building service. In activity 4 they were asked to combine the above three activities to determine how they would invest in buildings pre-event to prepare for a significant earthquake. In the last exercise, we asked participants to consider whether their investment decisions would change if they considered the proximity of a given building/service to critical infrastructure or cultural assets.

Participants were encouraged to be unconstrained by the current state of the building stock and to think about this as a town/city full of new buildings.

Activity 1.1: Life safety

The first exercise focussed on life safety. The aim of the exercise was to understand how participants perceived life safety and who, where or under what circumstances life safety should be prioritised. Participants were asked how important it is to preserve lives within each building following a major earthquake. The occupancy data was shown on the map and participants were encouraged to consider this and also to think of factors that might not be explicitly shown on the map.

Activity 1.2: Social and economic recovery

The aim of the second exercise was to understand which types of buildings were more important to enable 1) social recovery and 2) economic recovery of a community. The exercise was carried out in two parts. First participants allocated counters across the map to indicate the importance to social recovery and then the counters were reset, and the exercise was repeated for economic recovery. As above, participants were encouraged to verbalise the reasons they were moving counters and seek a consensus across the group. The conversations centred on what the building provides for the community, and the possible direct and indirect impacts of the loss of use of that building following an earthquake.

Social factors were defined for participants as the capabilities and capacity of people to engage in work, study, recreation, and social activities[1]. Includes skills, knowledge, physical and mental health. The norms, rules and institutions that influence the way in which people live and work together and experience a sense of belonging. Includes trust, reciprocity, the rule of law, cultural and community identity, traditions and customs, common values and interest. Economic factors were defined as physical assets, usually closely associated with supporting material living conditions; includes factories, equipment, houses, roads. They also included the employment and wealth necessary to provide many of the requirements that make for social wellbeing, such as health, financial security, and equity of opportunity.

Activity 1.3: Time to restore function

The third activity aimed to understand how quickly each building was needed after a major disruption event. The exercise built on conversations in the earlier exercises so that participants were building a picture of community priorities. This exercise asked them to

[1] For the purposes of this study a hybrid of capital definitions was used from the Treasury Higher Living Standards Framework. treasury.govt.nz/information-and-services/nz-economy/higher-living-standards/our-living-standards-framework and Taituarā community wellbeings taituara.org.nz/Article?Action=View&Article_id=216

add a time element to that prioritisation. Participants were asked to indicate the minimum necessary level of service or functionality for each building at five time periods after an earthquake (1 day, 1 week, 1 month, 3 months, 12 months). For this exercise participants were allocated 18 red (hexagon), orange (triangle) and green (circle) counters (one of each colour per building) (Figure 2). Starting at Day 1, participants were asked to move a red counter onto a building if they thought it was acceptable for that building to be unusable 1 day after a major earthquake. Participants used an orange counter if they thought the building should be partially functional, and green if they expected it to be fully functioning. Only one counter could be placed on each building. Once all buildings had been allocated a counter, we would consider the next time period (i.e. 1 week). Participants were asked to change the counter on any building where they thought the level of service or functionality needed to change. This pattern continued until the final 12-month time period.

During the discussion, participants were also asked to define what functionality (full or partial) means for a given building.

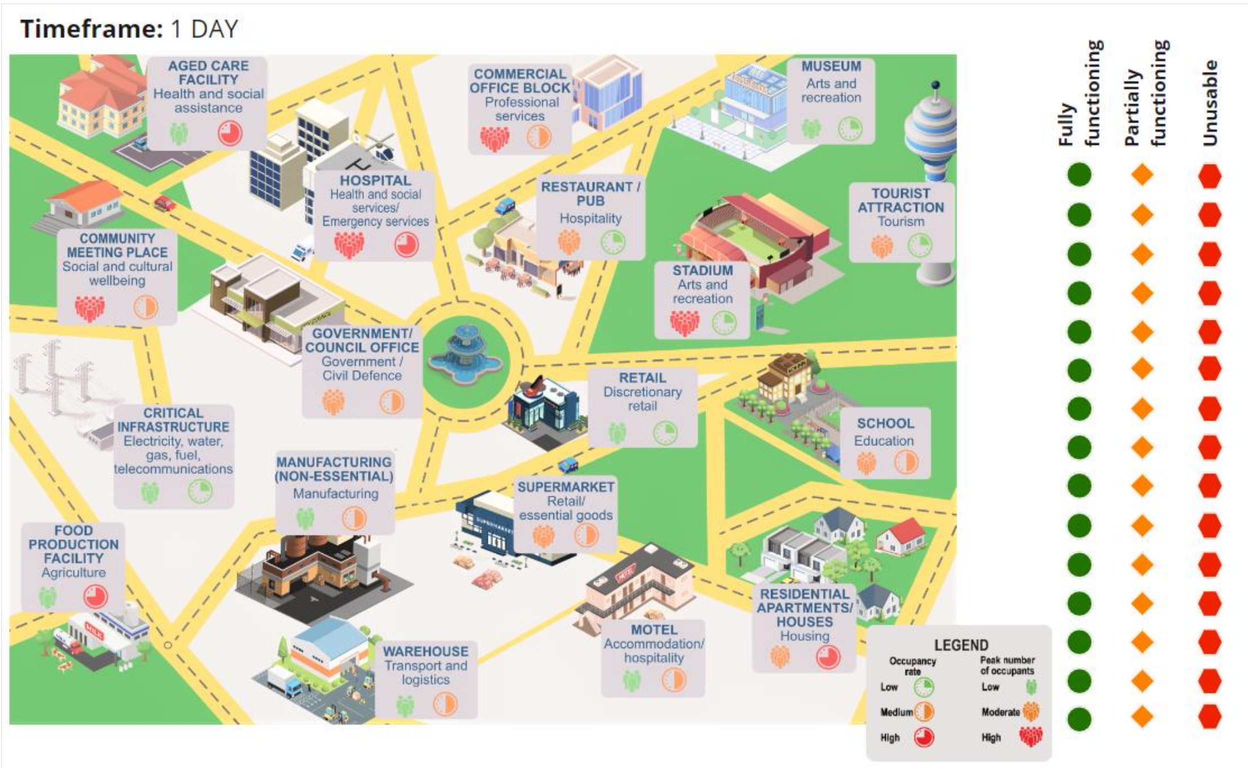

Figure 2: Town map exercise showing counters provided for time to recovery exercise

Activity 1.4: Overall investment

Building on the previous exercises, the aim of exercise 4 was to understand the relative importance of life safety, social and economic recovery and time to recover in the seismic resilience of their community. Participants were asked to think about their responses in previous exercises to determine how they would invest in buildings, before an earthquake, to reduce the impact of seismic events. Using a 'clear' town map they were asked to allocate 36 counters across the buildings to show how they would invest in their building stock pre-event to reduce the impacts of earthquakes. As before, participants worked together to discuss and build a consensus of their priorities.

Activity 1.5: Building context

Depending on the available time an optional activity was also undertaken to understand how overall investment might differ when looking at the buildings as a system rather than individual buildings. In particular whether proximity to critical assets might change how they view the importance of another building. For this activity a water pumping station, critical access road and a heritage (seismically retrofitted heritage building) were placed on the map next to the 3 lowest priority buildings determined in the overall investment activity (Activity 1.4). Participants where asked if they would change their investment priority counter allocation. While previous activities looked at buildings in isolation, this activity required participants to reassess their investment decisions when thinking about neighbouring buildings as damage to one building can impact surrounding buildings and infrastructure through direct damage during earthquake, presence of cordons, and disruption during repair/demolition.

2.3 Activity 2: Risk matrices

The aim of this exercise was to understand risk tolerance, at community level, to different types and frequencies of earthquake disruption. In particular the exercise aimed to explore the type of impacts (human, social, economic, environmental) that participants are most sensitive to at a community level rather than a building level.

To investigate this, four risk matrices were framed around human, economic, social and natural consequences (Figure 3) and frequency/likelihood. For each capital, four consequence categories were defined ranging from no to low impact (category I) to significant damage in (category IV) (Figure 4). The categories were developed by the researchers in collaboration with subject matter experts. The matrices are closely aligned with a 2020 draft Treasury criticality model cited by the New Zealand Lifelines Council[2].

A range of both earthquake frequencies (i.e., how often you may experience a given earthquake) and likelihood (probability that we experience a disruption) were provided to participants. They were expressed both in quantitative terms (years and percentages) as well as fuzzy, relative terms (e.g., rare, unlikely). A range of descriptors was given to help people contextualise their understanding of likelihood. For this exercise likelihood was expressed in terms of how likely you are to experience disruption during the life of a given building (which is nominally 50 years, as defined in the Building Act).

Working on a shared Miro board, participants were asked to individually determine what is acceptable, tolerable or intolerable within the context of the participant's community by moving a green, yellow and red counter, respectively within each cell in the matrix.

After individuals had allocated one marker in each cell, a facilitated discussion explored how risk acceptability was determined, which given consequences were most important, how likelihood factored into decision making, where there were differences and why there was a difference.

2 civildefence.govt.nz/assets/Uploads/lifelines/nzlc-nva-2020-full-report.pdf

New Zealand's Expectations on Seismic Resilience of Buildings

INTOLERABLE	no way – risk is so great that it can't be justified
TOLERABLE	I can put up with this but would like it to change
ACCEPTABLE	part of daily life – these things happen

Average FREQUENCY and LIKELIHOOD	CONSEQUENCE (HUMAN) I • Low impact on human wellbeing *(capacity to work, study recreate, socialise)*	II • < 1 in 20,000 people injured • Some education temporary closures *(< 1 week)* • Some social and recreational activities disrupted *(< 1 week)*	III • No or minimal fatalities • Between 1 in 20,000 and 1 in 2,000 people injured • Education facilities temporary closures *(< 1 month)* • Temporary disruption to social or recreational activities *(< 1 month)* • Some ongoing mental health challenges *(6-12 months)*	IV • Multiple fatalities • > 1 in 2,000 people injured • Education facilities prolonged closures • Limited or no access to social or recreational activities for significant period • Significant and ongoing mental health challenges *(>12 months)*
Less than once every 2500 years (extremely rare) <2% chance in typical building life (extremely unlikely)				
Once every 1000-2500 years (very rare) 2-5% chance in typical building life (very unlikely)				
Once every 250-1000 years (rare) 5-20% chance in typical building life (unlikely)				
Once every 100-250 years (occasional) 20-50% chance in typical building life (less than likely)				
Once every 50 - 100 years (sometimes) 50-100% chance in typical building life (likely)				
Once every 0-50 years (often) Probably once in typical building life (very likely)				

Figure 3: Example of a risk matrix used in Activity 2.

New Zealand's Expectations on Seismic Resilience of Buildings

CONSEQUENCES	CAPITAL MEASURED			
	Human	**Economic**	**Social**	**Natural**
I	• Low impact on human wellbeing (capacity to work, study recreate, socialise)	• <1% capital loss • Business revenue reduced by <1% (peak loss)	• Low impact on social wellbeing of community	• Low impact on natural environment (waste produced, carbon emissions etc)
II	• < 10 injured • Some education temporary closures (< 1 week) • Some social and recreational activities disrupted (< 1 week)	• Uninsured capital loss 1-5% of value of built assets • Average business revenue reduced by 1-10% (peak loss) • <1% people lose their jobs (peak loss)	• < 1% residents leave region • Minor temporary disruption to cultural assets and some social groups • Critical community assets are disrupted temporarily (e.g. community centres) • Temporary loss of cultural assets (< 1 month)	• Limited building demolition • Buildings mostly repairable • Small volumes of waste and recycling • Limited carbon and resource required for recovery
III	• No or minimal fatalities • 10-100 injured • Education facilities temporary closures (< 1 month) • Temporary disruption to social or recreational activities (< 1 month) • Some ongoing mental health challenges (6-12 months)	• Uninsured capital loss 5-30% value of built assets • Average business revenue reduced by 10-30% (peak loss) • 1-5% of community lose their jobs (peak loss) • Minor impact on export market (*perception issues affecting tourism, higher education, agriculture etc.)*	• 1-10% residents leave the region • Critical community assets are disrupted – some permanently • Temporary loss of cultural assets (< 12 months) • Some loss of trust in governance and community identify	• Waste from damaged buildings uses sizeable volumes of available waste management facilities • Some recycling • Some hazardous waste • Considerable embodied carbon and new resources required for demolition and rebuild
IV	• Multiple fatalities • > 100 injured • Education facilities prolonged closures • Limited or no access to social or recreational activities for significant period • Significant and ongoing mental health challenges (>12 months)	• Uninsured capital loss >30% value of built assets • Average business revenue reduced by > 30% (peak loss) • >5% of community lose their jobs (peak loss) • Major impact on export market (*perception issues affecting tourism, higher education, agriculture etc.)*	• Significant social disconnection • > 10% of residents leave region permanently • Permanent loss of critical cultural capital • Significant loss of trust in governance and community identity	• Waste from damaged buildings overwhelms waste management facilities (new facilities needed) • Limited recycling • Hazardous waste cannot be effectively managed • Significant embodied carbon and new resources required for demolition and rebuild

Figure 4: Consequence categories across all four capitals

2.4 Activity 3: Building design priorities

Seismic resilience is just one of many requirements needing to be considered when building communities. To understand how willing people are to invest in seismic resilience and to contextualise the findings from this research it is useful to understand how seismic resilience compares to other priorities in the built environment. It also provides an opportunity to see how seismic resilience aligns with other priorities and where co-benefits in seismic resilience investment could be gained.

For the final exercise, participants were presented a table of building design requirements that included day-to-day building priorities (embodied carbon, fire safety, architectural value and cost) and seismic resilience priorities (life safety, social, economic recovery and reducing environmental impacts of building damage) (Figure 5). They were asked to individually rank the relative importance of each of the priorities (1= most important to 5= least important) and then discuss their choices as a group.

How important is seismic resilience is relative to day-to-day building attributes?

	Most Important				Least Important
Building Design Requirement	**1**	**2**	**3**	**4**	**5**
Ability to access the building (customers, goods, etc.)					
Accessibility (disabled access)					
Adaptability of building configuration /use over time					
Air quality (indoor environment)					
Architectural value					
Capital cost					
Durability					
Economic recovery following an earthquake					
Fire safety					
Functionality					
Heritage value					
Life safety during an earthquake					
Low impact on natural environment following an earthquake (e.g. waste production, reduced rebuild material requirements etc)					
Protection from other hazards (flooding/volcano/climate change induced hazards)					
Safety of users day to day					
Social recovery following an earthquake					
Sustainability / energy efficiency / carbon (both embodied and operational)					
Wellbeing of users					
Whole of life cost					
Other					
Other					

Figure 5: Table of building design requirements for building design priorities exercise

2.5 Overview of report and analysis

This report documents the activities and discussions from the six focus groups. Predominantly this includes presentation of quantitative analysis of the activities (for example counter placement in the map activities) and tabulated presentation of key themes that emerged during the activity discussions. Unless noted otherwise, the themes presented are in the authors words and aim to summarise sentiments raised by participants.

It is important to note that the quantitative analysis in this report is not intended to signal a statistical representation of the population. Readers should focus on the nature of the sentiments raised by participants during discussion (summarised in the 'Themes' tables in each section) and general patterns of views. Useful patterns include the frequency a view is raised, and whether views are similar or differ between different groups (e.g. town/city, high/low seismic zones).

Eliciting societal tolerance for seismic risk is influenced by a number of dynamic factors[3]. Social norms evolve[4] [5] and are influenced by proximity to adverse events[6]. Social norms are also influenced by current policy settings, community context and how hazard information is presented[7]. Risk preferences can vary significantly among individuals based on education, experiences and personal circumstances. This temporal and individual heterogeneity needs to be acknowledged and reflected in the interpretation of data on societal risk expectations. Hence this analysis is designed to show a snapshot of perspectives, in time, across a diverse range of individuals and groups. It is not intended to be representative of all views across New Zealand but rather demonstrate the breadth and trends in expectations.

This data and data from the interviews (available in a separate report) have been combined and analysed and are included in the March 2022 Societal Expectations for Seismic Performance of Buildings Research Report.

3 May PJ. (2001). Societal Perspectives about Earthquake Performance: The Fallacy of "Acceptable Risk". Earthquake Spectra; 17 (4): 725–737. doi:10.1193/1.1423904

4 Legros, S., & Cislaghi, B. (2020). Mapping the Social-Norms Literature: An Overview of Reviews. Perspectives on Psychological Science, 15(1), 62–80. https://doi.org/10.1177/1745691619866455

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6 McClure J, Ferrick M, Henrich L, Johnston D. (2019). Risk judgments and social norms: Do they relate to preparedness after the Kaikoura earthquake? Australasian Journal of Disaster and Trauma Studies; 23 (2): 41–51.

7 Vinnell, L. J., Milfont, T. L., & McClure, J. (2019). Do Social Norms Affect Support for Earthquake-Strengthening Legislation? Comparing the Effects of Descriptive and Injunctive Norms. Environment and Behavior, 51(4), 376–400. https://doi.org/10.1177/0013916517752435

3. Results

3.1 Activity 1: Town map exercises

The town map activities generated both quantitative data, in terms of counter placement on the town map, and also qualitative data, through focus group discussion. In this section we present both the quantitative and qualitative results. The counter placements are summarised in tables showing how important each building is, as rated by each focus group. Unless noted otherwise, the scores presented are normalised scores where 0 is least important and 1 is most important. Scores were normalised because groups were given freedom over the maximum number of counters they could allocate to a given building (the total number of counters for the activity was set but there were no rules about allocation). In some instances the focus group responses are grouped together and results across the groups averaged to allow for comparison between different urban settings (town and city); and seismic hazard zones (high and medium/low).

Themes arising from the discussion are also presented in tables. Each theme is linked to the focus group(s) where the sentiment arose. As with the quantitative data, this allows for identification of patterns between town and city settings and high and low seismic hazard zones.

Activity 1.1: Life safety

Table 3 summarises how focus groups prioritised life safety within different building types. Generally properties with high occupancy and post-disaster functions were prioritised. Participants conflated risk of death/injury with capacity to sustain life immediately after an event and provide emergency response services. Participants also strongly considered the vulnerability of individuals using the buildings, their ability to protect themselves and/or evacuate. This is why 'Aged Care' facilities often scored highly.

As shown in Table 4, there are differences in the importance of life safety across building types between town and city settings. Generally the buildings that have high occupancy in cities (hospitals, community meetings places, stadiums etc) were relatively less important in towns. The only building type that was considered more important from a life safety perspective was manufacturing. In part this was due to the presence of one or two key industries present in smaller communities and the significant impact of loss of lives following a major earthquake.

The discussion around life safety of buildings is captured in the themes presented in Table 5. In addition some commentary around what influenced individual and group perceptions of life safety and tolerance for risk are included at the end of the table.

Table 3: Relative importance of life safety in different building types. Darker shading represents a higher importance.

Building	Peak Number of Occupants	Occupancy rate	Community Setting:	Town	City	City	Town	City	Town
			Seismic Zone:	Low	High	High	High	Low	Medium
			Average	**A**	**B**	**C**	**D**	**E**	**F**
Hospital	High	High	0.84	0.25	0.80	1.00	1.00	1.00	1.00
School	Moderate	Medium	0.67	1.00	0.60	0.67	0.50	0.75	0.50
Aged Care	Low	High	0.61	0.50	0.60	0.33	0.75	1.00	0.50
Community Meeting Place	High	Medium	0.54	0.75	0.60	0.67	0.00	0.75	0.50
Government/Council Office	Moderate	Medium	0.48	0.25	0.60	0.67	0.50	0.50	0.33
Residential Apartments/Houses	Moderate	High	0.43	0.00	0.80	0.67	0.50	0.25	0.33
Critical Infrastructure	Low	Low	0.42	0.50	0.20	0.33	0.50	0.50	0.50
Stadium	High	Low	0.36	0.00	1.00	0.33	0.00	0.50	0.33
Commercial Office Block	High	Medium	0.27	0.00	0.60	0.33	0.00	0.50	0.17
Food Production Facility	Low	High	0.26	0.25	0.40	0.33	0.00	0.25	0.33
Supermarket	Moderate	Medium	0.23	0.00	0.60	0.33	0.00	0.25	0.17
Motel	Low	Medium	0.16	0.00	0.20	0.33	0.00	0.25	0.17
Warehouse	Low	Medium	0.10	0.25	0.20	0.00	0.00	0.00	0.17
Manufacturing (non-essential)	Low	Medium	0.10	0.25	0.00	0.00	0.00	0.00	0.33
Restaurant/Pub	Moderate	Low	0.08	0.00	0.00	0.00	0.00	0.00	0.50
Tourist Attraction	Moderate	Low	0.08	0.25	0.00	0.00	0.00	0.25	0.00
Retail	Low	Low	0.07	0.00	0.00	0.00	0.00	0.25	0.17
Museum	Low	Low	0.04	0.00	0.00	0.00	0.00	0.25	0.00

Table 4 Life safety priorities for different building types. Comparison between towns and cities

Building	Average	Town	City
Hospital	0.84	▼ -0.09	▲ 0.09
School	0.67	▬ 0.00	▬ 0.00
Aged Care	0.61	▬ -0.03	▬ 0.03
Community Meeting Place	0.54	▼ -0.13	▲ 0.13
Government/Council Office	0.48	▼ -0.11	▲ 0.11
Residential Apartments/Houses	0.43	▼ -0.15	▲ 0.15
Critical Infrastructure	0.42	▬ 0.08	▬ -0.08
Stadium	0.36	▼ -0.25	▲ 0.25
Commercial Office Block	0.27	▼ -0.21	▲ 0.21
Food Production Facility	0.26	▬ -0.07	▬ 0.07
Supermarket	0.23	▼ -0.17	▲ 0.17
Motel	0.16	▼ -0.10	▲ 0.10
Warehouse	0.10	▬ 0.04	▬ -0.04
Manufacturing (non-essential)	0.10	▲ 0.10	▼ -0.10
Restaurant/Pub	0.08	▬ 0.08	▬ -0.08
Tourist Attraction	0.08	▬ 0.00	▬ 0.00
Retail	0.07	▬ -0.01	▬ 0.01
Museum	0.04	▬ -0.04	▬ 0.04

Table 5 Themes relating to life safety in buildings subject to earthquakes

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Life safety is a priority	**Life preservation should be a minimum priority for all buildings.**	✓	✓	✓	✓	✓	
Life safety risk should be less in buildings with high occupancy and exposure times	**Reduce risk of failure in buildings with high occupancy** Buildings with higher maximum occupancy, in particular buildings with multiple stories, should be built to a more stringent level than single storey low occupancy buildings. Failure of these buildings, resulting in mass loss of life and injuries, would be catastrophic and unacceptable, particularly in communities where a significant portion of the population are working in a particular building (e.g. food processing/ manufacturing facilities in rural towns). These buildings also provide the biggest "bang for buck" for protecting lives.	✓	✓	✓	✓	✓	✓
	Reduce risk of failure in buildings where occupants are exposed for long periods There should be less risk to life safety in buildings where people spend majority of their time.	✓		✓	✓	✓	
People and buildings with capability should be protected	**Ensure capacity to sustain life following an earthquake** Buildings that house people and facilities that can protect and sustain life following an earthquake are important. These buildings may contain emergency services, medical staff and resources (including services to aid in the aged care sector), critical infrastructure and people with the skillsets to manage it (telecommunication, power and water) and food distribution (including all steps of the food supply chain e.g., supermarkets, food production, manufacturing, warehouses). These services are critical following an earthquake event. Preservation of these life sustaining services is particularly important if capacity is limited in the area (e.g., medical staff, dementia care facilities, critical infrastructure networks) or where failure could hinder other lifesaving functions (e.g., loss of function in an aged care facility may increase demand on the hospital) or there ongoing operation could reduce pressure on other services (e.g., aged care facilities can be used to take overflow from hospitals given their medically trained staff and life-saving equipment).	✓	✓	✓	✓	✓	✓
	Ensure capability for response and recovery Protection of buildings with the capability to support response and recovery are important. Response capabilities included Civil Defence and Emergency Management (CDEM) activation and	✓	✓	✓	✓	✓	✓

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
	communication, buildings housing CDEM hubs/centres, immediate government functions (decision making, critical infrastructure enablement and rubbish collection) and critical infrastructure access.						
	Protection of critical infrastructure Critical infrastructure facilities and personnel should be protected to enable life sustaining services in other buildings. If critical infrastructure is impacted, it affects functionality of other infrastructure. This is particularly important in areas with limited/basic critical infrastructure services (e.g., widespread low occupancy rural areas).				✓	✓	✓
Vulnerable people should be protected	**Vulnerable people** Buildings containing vulnerable people need to be seismically resilient. Vulnerable occupants include injured, sick, elderly, children/young people, and tourists (i.e., those unfamiliar with the area). This also includes places where those that are vulnerable following an earthquake might go for support (e.g., CDEM hub, hospital). Vulnerability was driven by mobility and capacity to protect oneself discussed below.	✓	✓	✓	✓	✓	✓
	Mobility Mobility is a key factor in determining vulnerability of occupants. People who are unable to get in a safe position (drop, cover, hold) or are unable to safely egress a building without requiring outside help are more vulnerable than those that are mobile. People with lower mobility include unwell or hospital patients, the elderly and the very young. Low mobility can also mean that occupant spends a lot of time in the same building (e.g., in hospital beds, elderly at home or in aged care), therefore having increased exposure.	✓	✓	✓	✓	✓	
	Ability to protect oneself The ability to protect oneself is a component of vulnerability. Children/younger people, visitors, cognitively impaired persons are some of the groups of people that may need support to respond to an earthquake appropriately (e.g., with teachers or trained staff at attractions). Therefore the safety of the building they are in becomes more important.			✓	✓	✓	✓
	Living conditions impact ability to sustain temporary loss Access to essential goods and services is more critical for people with lack of resources in their households. This included how many days' worth of food they might have available at home, whether				✓	✓	

Theme	Description						
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
	they stocked emergency supplies or had access to alternative ways to heat or cook food. Those with limited supplies relied more heavily on supermarkets and critical infrastructure following an event.						
	Familiarity of users with building/location Buildings and surrounding areas where there is a high chance of having occupants that are unfamiliar with the location should be prioritise life safety. This includes central business districts and tourism attractions where people are unlikely to know what to do/where to go during an event. If injured tourists suffer the additional impact of being cared for in an unfamiliar location (away from home).	✓		✓			
Value of potential lives lost should arguably be considered (Ethical prioritisation)	**Generally the safety of children is prioritised over the elderly.** Reasons for this included a bias toward protecting the young, the psychological impact on people if a child dies, the loss of productive years, lower staff ratios in schools compared to aged care facilities, and younger people being (physiologically) better at dealing with traumatic injuries compared to older people.		✓	✓		✓	✓
Perception of safety impacts behaviours during an event and mental health after an event	**Feeling of safety and confidence in buildings pre-event** “Wanting to feel safe” was a common sentiment when discussing life safety of buildings. All buildings should make you feel safe, especially buildings housing vulnerable populations such as children. This includes the structural elements as well as non-structural elements and contents (e.g., supermarket stacking).	✓	✓	✓		✓	✓
	Fear and safety post-event Fear of how a building will perform can impact the behaviour of individuals post event. If parents are concerned about safety of buildings holding their children (e.g., schools) this can cause significant anxiety and cause parents to rush to collect children. If these locations have a higher standard there is a reduction in stress/worry and allows parents to support in immediate response, if necessary. Similarly, those seeking help post disaster will naturally go somewhere familiar or safe.	✓				✓	
	Mental health impact of injuries The impact of building damage and injuries/deaths on mental health can take a long time to restore. It can lead to anxiety when in unfamiliar buildings or entering into particular buildings (e.g., some people affected by the 2011 Christchurch earthquake avoid multistorey buildings).	✓	✓	✓		✓	✓

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Post-disaster gathering spaces should be prioritised	**Protecting places where people will head in an emergency** Essential hubs during emergencies such as hospitals, community places (e.g., maraes, town halls, churches), and schools are usually inundated with people after an earthquake. These places are important to protect as they provide a feeling of safeness and familiarity, and it is often the vulnerable and injured heading here for help.		✓	✓	✓	✓	✓
Safe evacuation and egress routes are essential	**Accessibility to safe egress routes and emergency evacuation points are required** As a minimum, all buildings should enable occupants to egress; 'everybody has the same right to escape'. Larger building (e.g., commercial office blocks/multistorey) design should enable good crowd control and egress to avoid creating additional dangers through crowd behaviour. Buildings with occupants that are difficult to evacuate/require more support for evacuation (e.g., low mobility or propensity to respond occupants) should be designed to ensure occupants can stay within the building.	✓	✓	✓			
Accessibility to a region	**Location accessibility** Accessibility in and out, and within, an affected region is important for ensuring access to essential goods and services. Limited access routes into isolated areas (in particular where rivers run through settlements) were of considerable concern. For example, for one focus group half the town's population would lose access to medical services if one bridge was impacted during an earthquake.	✓			✓		✓
Multipurpose spaces should be prioritised	Multipurpose facilities that can be used for post-event response and recovery have increased importance (e.g., stadium can be used for temporary accommodation or relief staging).						✓
Community meeting places should be prioritised	Social meeting places (e.g., community meeting places) serve an important role in communities to enable social connection and support following an event. Pubs are of particular importance to rural communities.	✓				✓	✓
Cultural and heritage value of contents within building should be preserved	Protection of buildings that hold heritage and cultural value to ensure the content of these buildings are undamaged. While not specifically life safety, loss of important taonga may occur if buildings are significantly damaged.					✓	

	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
Theme	**Description** / Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Safety investments should prioritise residents over visitors	Respondents would rather see buildings used by residents prioritised over building used mainly by tourists. Short-term stays of individuals tourists reduced the risk individuals faced, compare to those building consistently used by residents.					✓	✓
Influences of life safety risk tolerance	**High trust** There is high trust in New Zealand's building regulations to make buildings safe and there is an assumption that if buildings are open, they are safe. Many individuals rely on regulation to ensure buildings are safe occupy.			✓			
	Comparative risk The risk to life safety of being in a New Zealand building during an earthquake is lower than the risk of riding a bike/being on the road and life safety of buildings needs to be put into broader context.			✓			
	Risk tolerance is based on personal experience and life history Previous earthquake experience and relative safety of buildings where an individual grew up impacts personal risk tolerance. Some participants mentioned weariness of entering buildings following their Christchurch experience. Low profile, single storey buildings, in particular residential housing, was seen as having lower risk to life safety. Experience from Christchurch with low deaths from housing damage were used as examples for this perception.	✓		✓			✓

COVID-19 Influence

COVID-19 has influenced the importance in protecting people and systems that sustain life functions (e.g., food production and supermarkets).

Challenges with activity

Some respondents found it hard to prioritise life or separating life safety from what was needed for recovery.

Activity 1.2a: Social recovery

Table 6 summarises how important different buildings are for enabling social recovery following an earthquake. Generally buildings of highest importance are places that enable recovery (through care for young and vulnerable), buildings where individuals and groups can connect, welfare services and buildings that enable a sense of normality, all of which support wellbeing. This includes schools, hospitals, meetings places, supermarkets and housing. Of least important are buildings that support discretionary activities (such as tourism related infrastructure), non-essential manufacturing, or buildings where tenants could continue to function elsewhere (e.g. office buildings where businesses can work from home).

Table 6: Relative importance of different building types for enabling social recovery following an earthquake. Darker shading represents a higher importance.

	Community Setting:	Town	City	City	Town	City	Town
	Seismic Zone:	Low	High	High	High	Low	Medium
Building	**Average**	**A**	**B**	**C**	**D**	**E**	**F**
School	0.89	0.8	1	1	0.75	1	0.8
Hospital	0.88	1	0.75	0.5	1	1	1
Community Meeting Place	0.85	0.6	0.75	1	0.75	1	1
Supermarket	0.75	0.6	0.5	1	1	1	0.4
Residential Apartments/Houses	0.71	0.6	0.75	1	0.75	0.33	0.8
Aged Care	0.6	0.6	0.5	0.5	0.75	0.67	0.6
Critical Infrastructure	0.58	0.6	1	0	0.75	0.33	0.8
Government/Council Office	0.49	0.4	0.25	0.5	0.75	0.67	0.4
Food Production Facility	0.41	0.2	0.5	0.5	0.75	0.33	0.2
Warehouse	0.39	0.8	0.5	0	0.5	0.33	0.2
Restaurant/Pub	0.38	0.2	0.5	0.5	0	0.67	0.4
Retail	0.38	0.4	0.5	0.5	0	0.67	0.2
Stadium	0.37	0.2	0.75	0.5	0.25	0.33	0.2
Commercial Office Block	0.26	0	0.5	0.5	0.25	0.33	0
Museum	0.26	0	0.25	0.5	0.25	0.33	0.2
Motel	0.13	0.2	0	0	0.25	0.33	0
Manufacturing (non-essential)	0.1	0	0	0	0.25	0.33	0
Tourist Attraction	0.08	0	0	0.5	0	0	0

As shown in Table 7, there are differences in the importance of building types between town and city settings. City focus group participants saw more importance in activities that epitomise normal city life, e.g., restaurants and pubs, retail, office buildings and stadiums. Logistics related buildings such as warehouses were a higher priority in town, largely due to the heavy reliance on supply chains to move goods into and out of the community.

Table 7 Difference in relative importance of building types for social recovery following an earthquake in towns and cities

Building	Average	Town	City
School	0.89	▼ -0.11	▲ 0.11
Hospital	0.88	▲ 0.13	▼ -0.13
Community Meeting Place	0.85	▬ -0.07	▬ 0.07
Supermarket	0.75	▬ -0.08	▬ 0.08
Residential Apartments/Houses	0.71	▬ 0.01	▬ -0.01
Aged Care	0.60	▬ 0.05	▬ -0.05
Critical Infrastructure	0.58	▲ 0.14	▼ -0.14
Government/Council Office	0.49	▬ 0.02	▬ -0.02
Food Production Facility	0.41	▬ -0.03	▬ 0.03
Warehouse	0.39	▲ 0.11	▼ -0.11
Restaurant/Pub	0.38	▼ -0.18	▲ 0.18
Retail	0.38	▼ -0.18	▲ 0.18
Stadium	0.37	▼ -0.16	▲ 0.16
Commercial Office Block	0.26	▼ -0.18	▲ 0.18
Museum	0.26	▼ -0.11	▲ 0.11
Motel	0.13	▬ 0.02	▬ -0.02
Manufacturing (non-essential)	0.10	▬ -0.01	▬ 0.01
Tourist Attraction	0.08	▬ -0.08	▬ 0.08

The discussion around social recovery following earthquakes and the role that different types of building play is captured in the themes presented in Table 8.

Table 8 Themes relating to how buildings support social recovery following earthquakes

	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
Theme	**Description** / Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Basic survival needs must be met	To enable social recovery, people need to have their basic survival needs meet, including shelter, food, water, electricity, and communication.	✓	✓	✓	✓		✓
	Emergency housing Important to ensure that places that can provide additional housing are functional post-event (e.g., community meeting places and maraes).	✓					
Physical health must be protected	Assistance and services must be available to those that are injured (e.g., hospital, emergency services) but also additional support services such as social workers, general practitioners, community health outreach and dentists. Government services such as rubbish collection and management of critical infrastructure also plays a role in protecting physical health.		✓	✓	✓		✓
Many buildings / services enable recovery by allowing people to return to work	Several services were highlighted as a priority post-event to enable recovery. Immediate priorities were CDEM function enablement through government and functionality of hospitals. Getting children back to school and knowing elderly are okay allows for people to get back to work and get on with recovery of their businesses and/or the community. To reduce impacts on recovery there has been a movement away from using schools as CDEM centres due to the important role they play in ensuring parents can get back to work. Previous experience has highlighted impacts of having a school closed for extended periods due to its use as a CDEM centre.	✓	✓	✓	✓	✓	✓
Mental health is a priority	**Mental health and building damage** Mental health can be impacted in many ways after an event, from trauma of the event, anxiety from not being able to get the supplies, to the closure of school or work and the social networks they provide. It is important that building damage and subsequent service loss limits impacts on mental health. COVID-19 has highlighted the mental health impact from having numerous buildings closed (e.g., museum, retail, supermarket, hospitality, commercial office, community facilities) and has heightened the importance of these buildings and services to support mental health through a sense of normalcy and community connection.	✓		✓			
	Feeling of Safety The perception of safety or lack of safety can cause significant anxiety. A feeling of safety can be reinforced by reducing the risk of damage to buildings (e.g., following Canterbury earthquakes it was		✓	✓			

Theme	Description	Focus Group Location	A	B	C	D	E	F
		Community Setting (Town/City)	T	C	C	T	C	T
		Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
	noted there was some fear in returning to the CBD) and ensuring lifesaving services are functional (e.g., reassurance of knowing hospital services are accessible).							
	Self sufficiency Social recovery is impacted when people's ability to fend for themselves is removed. A key example was the ability to purchase food for themselves from a supermarket rather than relying on food banks. The removal of choice and autonomy has significant impacts on mental health and slows recovery.				✓			
Vulnerable populations	Protection and aid for vulnerable populations is important for social recovery. Ensuring there is functionality in buildings that support those with lower mobility and increased care requirements to provide for their basic needs met (e.g., food provision). Ensuring consistency in their surroundings during and after an event is also important for mental health, in particular those already in emergency housing and dementia patients.					✓	✓	✓
Enable a sense of normality as soon as possible	Normalcy was a key priority for social recovery. Providing the opportunities to go back to school or work, return to supermarkets and retail, community meeting places, arts and recreation were all important aspects of normality. The value of going back to normality and engaging in regular day to day activities was heavily weighted for its positive impact on mental health and wellbeing.		✓	✓	✓	✓	✓	✓
Ability to meet and connect is important	The ability to meet and connect with peers is an important aspect of social recovery and links strongly with getting back to normality. Social connection is found in many forms and even limited interaction (e.g., going to the supermarket) can play a vital role in supporting wellbeing. Places that played a large role in supporting the social fabric of the community included schools and workplaces, community meeting places, retail and hospitality and arts and recreation. These locations allow for engagement with friends and family and provide support in challenging times.		✓	✓	✓	✓	✓	✓
	Connecting with culture The ability to connect with our culture was a critical component of wellbeing. Culture is large part of who we are and being able to connect with that helps to re-embed is.				✓	✓	✓	✓
	Community meeting places Community meeting places play significant role in urban settings, enabling social connection and community wellbeing through localised and supportive community run networks. The loss of these				✓	✓	✓	✓

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
	facilities has a large impact on community wellbeing (e.g., the loss of community facilities in East Christchurch following the 2011 earthquake). These community facilities support existing hubs (neighbourhood support groups) and can have large catchments of people connecting with their peers. The locations are usually well-attended and become places of support in the aftermath of an event. They can include religious buildings, marae, town and country clubs, pools, libraries and sporting clubs. These locations were often utilised during COVID-19 for testing and vaccination due to these connections.						
	Retail and hospitality Retail and hospitality contribute significantly to social experience for many, especially those with poor social networks. From walking between shops and interacting with staff, to connecting with friends and family over meals and coffee, they are important for enabling social connection. Pubs are particularly important in some location contexts.		✓			✓	✓
	Sports and recreation Sports and recreation aids in social recovery, especially in regions where participation in sport is high. Club sport is particularly important, while professional sport was seen as a luxury. These activities are linked with social connection following a social game, and in rural areas these connections can support economic activity (e.g., impromptu business meetings as rural residents come to town).	✓				✓	✓
Prioritise buildings with social and physical infrastructure	Regions often have their own established community hubs that provide strong social and physical infrastructure that can support recovery. These micro-communities and the buildings that house them are important to protect for social recovery. Maraes are a key example due to their good physical infrastructure to house large numbers of people but also their strong social infrastructure that provides a community in one location. Town and country clubs and religious buildings are also micro-communities of note.	✓			✓	✓	✓
Avoid mass relocation of people	Damage to housing in previous earthquake events has highlighted the lasting impacts of mass relocations on social recovery. With the current housing crisis (affordability and shortage), there is a greater need to keep people in their current accommodation and reduce the amount of people in emergency and substandard accommodation.			✓	✓		✓

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Protect livelihoods	The ability to work and the fulfilment of a job, while a key part of economic recovery, is also a part of the social fabric of a community and aids in social recovery. Ensuring that people are able to return to work as soon as possible is important. Some may be able to work from home, and protection of residential homes is highlighted to ensure this is a priority. Buildings where employees are unable to work from home are more important so people can continue to work. Examples included transport and logistics, supermarkets, manufacturing, food production. Returning to work rapidly supports wellbeing.		✓	✓	✓	✓	✓
Support industries that are integrated into the social fabric of a community	Some industries are part of the social fabric of a small community and provide employment for a large portion of the society. Place based industries of importance include tourism, manufacturing, commercial etc. In rural settings, industry connections often play a significant role in recovery (e.g., industry tools can be used for a community self-managed response and recovery).				✓		
Rural decision making, industry and community	Community spaces and social connections play a role in business (e.g., wheeling and dealing in community centres/sporting clubs),	✓			✓		✓
Social recovery is underpinned by interconnected industries	**Maintaining supply chains** Numerous building types (transportation, logistics, warehousing, critical infrastructure etc) play a role in maintaining supply chains and all are required to be functional to enable access to food and essential goods. It is important that these supply chains are established as soon as possible to enable food supply and allow retail to function.		✓		✓		✓
	Knock on effects The importance a building for social recovery can depend on what other buildings are dependent on it. For example, critical infrastructure such as electricity supports other infrastructure such as water supply; motels are dependent on outside visitors. The loss of reduction in function of a building can have knock on affects to services in other buildings. An example was given of the reduced use of commercial office spaces since COVID-19 and the impact it has had on central business districts.		✓	✓	✓	✓	✓

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Enable regional accessibility	Accessibility within and in and out of town is important to social connection. Enabling the movement of people and goods in and out of town and access to health services were highlighted as key access needs.		✓		✓		
Maintain a sense of law and order	Ensuring law and order continues post event enables a feeling of control. Communication from government and ensuring regulatory and critical infrastructure services are running as normal as possible gives confidence.		✓		✓	✓	✓

COVID-19 influence

COVID-19 has increased the importance of some services such as transport and logistics, and deflated the importance of other (e.g., commercial office blocks due to the ability of many to work from home). It has also highlighted to respondents the mental health impacts of having some buildings closed (e.g., retail, hospitality, museum, supermarkets) and places they desired to have back as soon as possible following lockdowns (e.g., pubs and restaurants). It is likely the importance of these buildings has increased now compared to two years ago.

Activity 1.2b: Economic recovery

Table 9 summarises how important different buildings are for enabling economic recovery following an earthquake. Generally buildings / infrastructure that enables economic activity were rated highly, including critical infrastructure and warehousing and transportation. Food production facilities also rated highly. Less important from an economic perspective community meeting places and aged care facilities and buildings that primarily rely on tourists (e.g. motels and museums).

As shown in Table 10, there are differences in the importance of building types between town and city settings. In town settings priorities were more likely to be around food production facilities (as a major industry in many rural settings). In city settings economic recovery priorities were more likely to include housing (to ensure employees are able to continue to work), retail, office blocks and government offices – the latter of which comprise a larger part of city economies.

The discussion around economic recovery following earthquakes and the role that different types of building play is captured in the themes presented in Table 11.

Table 9 Importance of different building types to economic recovery following an earthquake.

	Community Setting:	Town	City	City	Town	City	Town
	Seismic Zone:	Low	High	High	High	Low	Medium
Building	**Average**	**A**	**B**	**C**	**D**	**E**	**F**
Critical Infrastructure	0.97	1	1	1	0.8	1	1
Warehouse	0.64	0.33	0.33	0.67	1	1	0.5
Food Production Facility	0.63	0.67	0	0.67	1	0.67	0.75
Retail	0.5	0.67	0.33	0.33	0.4	1	0.25
Residential Apartments/Houses	0.48	0	1	0.33	0.4	0.67	0.5
Restaurant/Pub	0.44	0.33	0.33	0.33	0.4	1	0.25
Supermarket	0.44	0.33	0.67	0.33	0.4	0.67	0.25
Manufacturing (non-essential)	0.41	0.67	0	0.33	0.8	0.67	0
Hospital	0.34	0	0.67	0.33	0.4	0.67	0
School	0.33	0.33	0.33	0.33	0.4	0.33	0.25
Tourist Attraction	0.29	0.67	0	0.33	0.4	0.33	0
Government/Council Office	0.26	0	0.33	0	0	1	0.25
Commercial Office Block	0.26	0	0.33	0.33	0	0.67	0.25
Museum	0.22	0.33	0.33	0.33	0	0.33	0
Motel	0.22	0.33	0	0	0.4	0.33	0.25
Stadium	0.17	0	0	0.33	0	0.67	0
Aged Care	0.12	0	0	0	0.4	0.33	0
Community Meeting Place	0.06	0	0.33	0	0	0	0

Table 10 Difference in relative importance of building types for economic recovery following an earthquake in towns and cities

Building	Average	Town	City
Critical Infrastructure	0.97	-0.03	0.03
Warehouse	0.64	-0.03	0.03
Food Production Facility	0.63	0.18	-0.18
Retail	0.50	-0.06	0.06
Residential Apartments/Houses	0.48	-0.18	0.18
Restaurant/Pub	0.44	-0.11	0.11
Supermarket	0.44	-0.11	0.11
Manufacturing (non-essential)	0.41	0.08	-0.08
Hospital	0.34	-0.21	0.21
School	0.33	0.00	0.00
Tourist Attraction	0.29	0.07	-0.07
Government/Council Office	0.26	-0.18	0.18
Commercial Office Block	0.26	-0.18	0.18
Museum	0.22	-0.11	0.11
Motel	0.22	0.11	-0.11
Stadium	0.17	-0.17	0.17
Aged Care	0.12	0.01	-0.01
Community Meeting Place	0.06	-0.06	0.06

Table 11 Themes relating to how buildings support economic recovery following earthquakes

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Buildings / services that are enablers of economic recovery should be prioritised	**Enabling production** Enabling a functioning modern economy relies on a number of key industries. Critical infrastructure in particular provides basic inputs for most economic activity. For example, primary production requires water and electricity to maintain the quality of their product to meet high standards for export.	✓	✓	✓	✓	✓	✓
	Enabling people Getting people back to work as soon as possible following an event is important to economic recovery. There are four key enablers to achieve this; access to health services, access to food, shelter (particularly in your own home) and getting children back to school. Knowing your home is safe and secure enables more effectiveness at work (whether that be working from home or going to another building), while children at school frees up time and responsibilities to enable income generation.	✓	✓	✓	✓	✓	✓
	Governance Ensuring government functions are underway supports economic recovery through the provision of a recovery framework and regulatory processes (e.g., provision of building consents). These functions have the ability to stimulate the economy, through building and construction, and provide a sense of leadership and confidence.		✓	✓		✓	✓
Economies function as an interconnected system	Industries are interlinked and depend on each other to function. For example, food and manufacturing industries depend on raw material production, transport and logistics; tourist attractions rely on availability of motels, retail and hospitality to attract tourists; sufficient accommodation for seasonal workers is needed to support tourism or food production industries. When considering economic resilience, there are a range of built assets that support a single industry.	✓	✓	✓	✓		✓
Prioritise flow of people and goods	**Supply chains** Important to keep key supply routes functioning to allow the flow of goods and supplies in and out of the region. The impact of disrupted supply chains can be large, both to costs to individuals and to the export market. Supply chains are also critical to supplying basic needs (e.g., food). **Regional accessibility** Ensuring limited impacts to transportation infrastructure will prevent isolation and will help to maintain movement of workers, tourists and goods in and out of the region. Key pieces of infrastructure include airports, ports, and critical access routes (roads).		✓	✓	✓	✓	✓

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Prioritise buildings / industries that employ a lot of people	In communities with reliance on a particular industry, buildings that large proportion of a population are important. Whether that employment is in one large organisation/facility (e.g., hospital, primary production) or through a large quantity of smaller ones (SME's) (e.g., retail and hospitality) it is important to limit job loss and the cascade impact through the community of that job loss.	✓	✓	✓	✓	✓	✓
Economic priorities are place- based	There are specific place-based priorities for economic recovery in different urban settings. Destination towns require buildings to be functioning to support tourism, and festival and sporting events. Economic (typically cities) place higher importance on government and commercial buildings. Locations with large primary production industries support the functioning of food production facilities. These priorities are important to the functioning of a specific community. Understanding the economic drivers of not only regions but New Zealand as a whole helps to understand which industries to protect. And this priority changes over time. For example, prior to covid, international students in universities were a key economic driver, while building and renovations is a currently a large player.	✓	✓	✓		✓	
Time sensitive industries should be more resilient	Certain industries are seasonal, and their production and earnings are impacted differently depending on the time of a disruptive event. For example, primary production has certain times of the year for milking and harvest. If an event impacted during their core production time, they would be unable to recoup their losses till the following season.						✓
Perception of damage and disruption affects economic confidence	**Economic Hubs** Confidence in commercial hubs has to be maintained following an event, to ensure ongoing support of both national and global investors. A loss of confidence could lead to migration of investment and industries, slowing economic development that would have otherwise occurred.		✓			✓	
	Export Market The export market is competitive and New Zealand industries cannot afford to lose their advantage. Perceived impacts to the quality and delivery of export goods can significantly affect the reputation of New Zealand's produce, which can be hard to gain back.						✓
	Feeling of Safety People want to feel safe before they start looking at economic recovery. This is driven by confidence and security and links to the safety of homes and functioning of hospitals.		✓				✓

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
In rural communities social infrastructure plays a key role in rural business	Rural economies utilise social infrastructure (e.g., social meeting places, pubs, sports clubs) for networking, recruitment, and business deals. It is important these informal networks and the buildings that support these activities are available following an earthquake.						✓
Reliance on some buildings is reducing over time	Respondents noted that there have been several changes to how we do business that reduces the reliance on some types of buildings. For example, increased capacity and tolerance for working from has decreased the reliance on commercial office blocks (particularly since COVID-19). Many retail stores have moved online, and this lowers the requirement for store front businesses (although stock storage is still required, this is less location sensitive).				✓	✓	✓
Specific industry comments	**Tourism** Despite COVID-19 tourism is still an important part of the economy, albeit with a focus more on domestic tourism. Tourism brings economic activity to numerous connected industries and building types (motels, hospitality, retail, stadium, tourist attractions, museums) and provides a large source of employment for some communities.	✓	✓	✓	✓	✓	✓
	Agricultural sector The agricultural sector is critical to town economies through primary production and additional rural support services. There is a strong need to minimise damage to the environment to ensure there is an ability to continue production from the land. Protection of produce quality is vital to ensure export quality standards are met, along with ensuring the ability to harvest and transport produce during seasonal production periods.	✓		✓	✓		✓
	Aged Care With the current ageing population, the aged care industry is a=n large part of the economy. There is concern that this sector may not prioritise high enough building standards given the nature of services and the vulnerable populations these buildings support.				✓		✓

Activity 1.3: Time to restore function

Table 12 summarises how quickly buildings should ideally be functional following a major event. Generally highest priority was given to facilities that preserve life and provide essential services (hospitals/medical facilities and critical infrastructure). Community meeting places are also important but often a partial level of functionality was acceptable for some time (without connection to essential services) as long as there was a safe place for communities to meet and support each other. Less time critical were tourist attractions, and museums. Table 13 how the relative time priority given to buildings for each of our focus groups.

As shown in Table 14 there are differences in the importance of building types between town and city settings. Residential apartments and motels are more time critical in city settings, largely driven by the need to prevent/support displaced populations and support recovery efforts. In towns, manufacturing, as a symbol of large employers or significant contributor to regional economies are more time critical. Restaurants/pubs were also more time critical because of the role they play in social and economic structure of rural communities.

The key priorities at different time steps following earthquakes and the role that different building types play is captured in Table 15.

Table 12 Average desired level of functionality of different building types over time (1= full function, 0 = not functional)

Building	1 Day	1 Week	1 Month	3 Months	12 Months
Critical Infrastructure	1	1	1	1	1
Hospital	1	1	1	1	1
Community Meeting Place	0.8	0.8	0.9	1	1
Aged Care	0.8	0.9	1	1	1
Government/Council Office	0.7	0.8	1	1	1
Supermarket	0.7	0.9	0.9	1	1
Food Production Facility	0.6	1	1	1	1
Motel	0.6	0.6	0.7	0.8	1
Residential Apartments/Houses	0.5	0.7	0.9	1	1
Warehouse	0.4	0.8	1	1	1
School	0.3	0.5	1	1	1
Stadium	0.3	0.4	0.5	0.6	1
Restaurant/Pub	0.1	0.1	0.7	0.8	1
Commercial Office Block	0	0.2	0.7	0.8	1
Manufacturing (non-essential)	0	0.1	0.7	0.8	1
Museum	0	0	0.2	0.6	1
Retail	0	0.1	0.6	0.8	1
Tourist Attraction	0	0	0.2	0.4	1

Table 13 Relative speed of return to function following an earthquake (1= immediate full functionality, 0= functionality after 6 months)

Community Setting:		Town	City	City	Town	City	Town
Seismic Zone:		Low	High	High	High	Low	Medium
Building	**Average**	**A**	**B**	**C**	**D**	**E**	**F**
Critical Infrastructure	1	1	1	1	1	1	1
Hospital	1	1	1	1	1	1	1
Aged Care	0.83	1	1	0.5	0.75	0.75	1
Food Production Facility	0.83	1	0.75	0.75	0.75	1	0.75
Community Meeting Place	0.79	1	1	0.5	0.25	1	1
Supermarket	0.79	1	1	0.25	0.75	1	0.75
Government/Council Office	0.74	0.67	0.5	1	1	0.75	0.5
Warehouse	0.65	0.67	0.5	0.5	0.75	0.75	0.75
School	0.51	0.33	0.75	0.5	0.5	0.5	0.5
Residential Apartments/Houses	0.51	0.33	0.75	0.5	0.5	0.75	0.25
Motel	0.29	0	0.25	0	0	1	0.5
Manufacturing (non-essential)	0.22	0.33	0	0	0.5	0.25	0.25
Commercial Office Block	0.18	0.33	0.25	0.5	0	0	0
Restaurant/Pub	0.18	0.33	0	0	0	0.25	0.5
Retail	0.14	0.33	0	0	0	0.25	0.25
Museum	0	0	0	0	0	0	0
Tourist Attraction	0	0	0	0	0	0	0
Stadium	0	0	0	0	0	0	0

Table 14 Difference in relative speed of recovery for different building types in towns and cities (1 = immediate full functionality, 0= functionality after 6 months)

Building	Average	Town	City
Critical Infrastructure	1.00	0.00	0.00
Hospital	1.00	0.00	0.00
Aged Care	0.83	0.08	-0.08
Food Production Facility	0.83	0.00	0.00
Community Meeting Place	0.79	-0.04	0.04
Supermarket	0.79	0.04	-0.04
Government/Council Office	0.74	-0.01	0.01
Warehouse	0.65	0.07	-0.07
School	0.51	-0.07	0.07
Residential Apartments/Houses	0.51	-0.15	0.15
Motel	0.29	-0.13	0.13
Manufacturing (non-essential)	0.22	0.14	-0.14
Commercial Office Block	0.18	-0.07	0.07
Restaurant/Pub	0.18	0.10	-0.10
Retail	0.14	0.06	-0.06
Museum	0.00	0.00	0.00
Tourist Attraction	0.00	0.00	0.00
Stadium	0.00	0.00	0.00

Table 15 Themes relating to how built environment priorities overtime following an earthquake

Short Term Function Requirements (days)	←	→	**Long Term Function Requirements (>6 months)**
Support life (e.g., aged care, health care)	Access to essential goods and materials to support businesses (e.g., access to commercial office blocks)	Enable economic activity (e.g., commercial office blocks, manufacturing, retail, particularly building dependent services)	Enable domestic tourism (e.g., motels, museum, stadium, tourist attractions) and manage perception issues
Minimise disruption to vulnerable persons include aged and infirm, homeless, tourists, displaced persons (e.g., aged care, motels, health care)	Enable safe living conditions (e.g., power for heating homes and electricity for cooking)	Enable employment (e.g., commercial office blocks, manufacturing, retail, particularly building dependent services)	Support recovery process (e.g., motels to house rebuild workers, community spaces such as churches to support individuals)
Minimise potential disruption to other services (e.g., aged care impacting tertiary healthcare, critical infrastructure)	Enable working from home (e.g., power and internet)	Provide some sense of normalcy (e.g., places of employment, commercial office blocks, manufacturing, retail, schools)	
Safe community gathering points (e.g., Community centre, marae, stadium)	Enable government functions (e.g., welfare payments, regulatory services, infrastructure repair)	Provide opportunities for social connection (e.g., restaurants and pubs, sports facilities)	
Emergency shelter and food (e.g., Marae, community centres, motels, schools, stadium)	Provide essential goods other than food (e.g., baby clothes)	Enable people to go back to work (e.g., schools)	
In-home shelter, security and facility to prepare food (residential house and apartments)	Provide childcare for critical workers	Reduce equity issues (e.g., schools providing both food and education for many children)	
Essential goods such as food (supermarkets)	Enable supply chains to operate to support movement of essential goods, and export products particularly agricultural areas	Reduce impacts on mental health (e.g., access to schools, livelihoods, sports facilities)	
Emergency response functions	Provide livelihoods / employment where possible (particularly building dependent roles)		
Protect public health and safety (e.g., Rubbish collection, sanitation, water)	Enable local food production/agriculture		
Basic supply chains operational to support movement of essential goods			
Support animal welfare (e.g., Agricultural facilities)			

Activity 1.4: Overall investment

Table 16 summarises how focus groups participants would prioritise investment in their building stock before an earthquake. This activity was deliberately saved until last so that participants would be informed by their earlier assessments of life safety, economic and social recovery, and desired speed of recovery. Comparing the ranking of buildings in the earlier exercises with the priority given in this exercise, we assessed the relative importance of life safety, social or economic recovery priorities for investment. As shown in Table 17 life safety was the biggest driver for most, followed by social recovery and then economic recovery. Many groups also made their investment decisions by mentally comparing and averaging the different priorities. Therefore their final rating for each building was similar to the average of their scores across the exercises.

Table 18 indicates that there are differences in the importance of building types between town and city settings. In towns food production facilities, museums (as a symbol of cultural heritage) and critical infrastructure were relatively more important than in cities. In towns many were concerned about transportation links that might leave them geographically isolated. In cities, government/council offices scored more highly.

The discussion around overall investment priorities is captured in the themes presented in Table 19.

Table 16 Overall importance of investing in different building types to support recovery following an earthquake.

			Community Setting:	Town	City	City	Town	City	Town
			Seismic Zone:	Low	High	High	High	Low	Medium
Building	**Peak Number of Occupants**	**Occupancy rate**	**Average**	**A**	**B**	**C**	**D**	**E**	**F**
Hospital	High	High	0.93	1	1	1	0.8	1	0.8
Critical Infrastructure	Low	Low	0.9	1	1	0.67	1	0.75	1
School	Moderate	Medium	0.76	1	0.75	0.67	0.8	0.75	0.6
Aged Care	Low	High	0.73	1	0.5	0.67	0.4	1	0.8
Community Meeting Place	High	Medium	0.66	1	0.75	0.67	0.4	0.75	0.4
Residential Apartments/Houses	Moderate	High	0.65	1	0.75	0.67	0.4	0.5	0.6
Supermarket	Moderate	Medium	0.61	1	0.75	0.33	0.6	0.75	0.2
Government/Council Office	Moderate	Medium	0.57	0	1	0.67	0.6	0.75	0.4
Food Production Facility	Low	High	0.46	0.5	0.25	0.33	0.4	0.5	0.8
Warehouse	Low	Medium	0.44	0.5	0.5	0.33	0.4	0.5	0.4
Stadium	High	Low	0.24	0.5	0.5	0	0	0.25	0.2
Commercial Office Block	High	Medium	0.18	0	0.5	0	0.4	0	0.2
Retail	Low	Low	0.18	0	0.25	0	0.4	0.25	0.2
Museum	Low	Low	0.1	0	0	0	0.6	0	0
Tourist Attraction	Moderate	Low	0.08	0.5	0	0	0	0	0
Restaurant/Pub	Moderate	Low	0.08	0	0.25	0	0	0	0.2
Motel	Low	Medium	0.08	0	0.25	0	0	0	0.2

Table 17 Relative importance of life safety, social and economic recovery for investment in resilience

Town/ City	Community Setting	Seismic Zone	Relative importance* 1st	2nd	3rd	4th
A	Town	Low	Social	Average	Life Safety	Economic
B	City	High	Average	Social	Life Safety	Economic
C	City	High	Life Safety	Average	Economic	Social
D	Town	High	Average	Social	Life Safety	Economic
E	City	Low	Life Safety	Average	Social	Economic
F	Town	Medium	Average	Life Safety	Social	Economic

**Average is the average score across life safety, social and economic recovery priorities, indicating where groups are trying to balance priorities.*

Table 18 Difference in relative importance of investing in different building types before an earthquake in towns and cities

Building	Average	Town	City
Hospital	0.93	-0.07	0.07
Critical Infrastructure	0.90	▲ 0.10	▼ -0.10
School	0.76	0.04	-0.04
Aged Care	0.73	0.01	-0.01
Community Meeting Place	0.66	-0.06	0.06
Residential Apartments/Houses	0.65	0.01	-0.01
Supermarket	0.61	-0.01	0.01
Government/Council Office	0.57	▼ -0.24	▲ 0.24
Food Production Facility	0.46	▲ 0.10	▼ -0.10
Warehouse	0.44	-0.01	0.01
Stadium	0.24	-0.01	0.01
Commercial Office Block	0.18	0.02	-0.02
Retail	0.18	0.02	-0.02
Museum	0.10	▲ 0.10	▼ -0.10
Tourist Attraction	0.08	0.08	-0.08
Restaurant/Pub	0.08	-0.01	0.01
Motel	0.08	-0.01	0.01
Manufacturing (non-essential)	0.03	0.03	-0.03

Table 19 Themes relating to overall priority of seismic investment to enhance recovery following an earthquake

	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
Theme	**Description** / Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Life Safety is the highest priority	**High occupancy buildings** Preservation of life and reduction of injury are important. Investment in buildings with either high peak occupancy (e.g., stadium) and/or high occupancy rates (e.g., apartment blocks) were of top concern.	✓	✓	✓		✓	
	Changing density in residential areas There was concern for the protection of life safety in the future due to a rise in higher density, multi-storey buildings (in particular residential housing). A need for these buildings to be more robustly built was clear.	✓			✓	✓	✓
	Vulnerable people Protection of vulnerable populations where mobility impacted egress was important (e.g., aged care).					✓	
Basic survival needs must be provided	Ensuring people have access to the basic needs of shelter, food, electricity and water was critical, including production and distribution of food.		✓	✓			✓
Response and recovery needs to be enabled	Buildings and services that are critical following an event need to be protected. For example, emergency services, civil defence, hospitals and community meeting places are needed to protect life and provide places of support immediately post event. Military installations were also noted as an important response and recovery service need.	✓	✓	✓	✓	✓	
Investment priorities should balance impacts	**Investment is an amalgamation of several drivers** While life safety is prominent, it is important to balance social and economic drivers in investment decisions. Pragmatic combination of where buildings scored relative to life safety, social and economic recovery.		✓	✓			✓
	Timeline of impacts Investment should consider short-, medium- and long-term impacts. Ensuring buildings where losses might have impact in the medium to long term also need to be protected. For example, while not a priority in previous exercises, long-term loss of tourism was seen to significantly impact economic recovery. Often the things you think you can live without have a larger impact on community resilience and wellbeing than you might think.	✓		✓			✓

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
It is important that the building stock support the economy	Investment should be in buildings that play a role in local and national economy. Central government is particularly important to the economy as it impacts on employment and spending.	✓	✓				✓
Maintaining employment post-earthquake is important	Investment should be prioritised where damage to a building can flow on and impact jobs and employers. This is particularly important for buildings that house large employers in a region (e.g. commercial office blocks, manufacturing). Central government also has an important role in providing employment.		✓				✓
Investment should support normality post-event	Protect buildings that can create a sense of normality after an event, in particular schools.		✓				
Provide places for social connection	Social recovery is a big driver. Protecting buildings that provide places for social connection is important to support recovery.	✓	✓				
Preserve cultural identity	It is important to protect buildings that represent our cultural identity. These buildings help to preserve our identity in an uncertain world. This includes places to meet and value culture, that represents who we are, what we are proud of and what we want to work towards. While this often broader than buildings you still go to buildings to experience this (e.g., marae, museums).				✓	✓	
Reduce potential for population relocation	Tolerance for relocation of residential populations is low. Experience from the Canterbury earthquakes highlight the large impacts community disaggregation can have on community wellbeing. Protection of houses and community structure is important to community wellbeing.			✓			
Investment priority is place based	There are specific place-based requirements driving investment priorities. Differing priorities in urban settings and economic markets lead to desired investment in different buildings. E.g., cities with a strong professional service and government influence prioritise commercial office blocks and government buildings, while farming communities highlight the importance of food production. These differences are not just in between urban settings but also within, with various micro communities favouring specific buildings to maintain wellbeing (e.g., local community centres or universities requiring social spaces soon after events). Preserving the range of buildings required by different aspects of a community is important.		✓	✓	✓		✓

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Priorities should account for interdependencies in the built environment	Being aware of interdependencies in building systems is important in preventing cascading impacts. Examples include failure of aged care facilities placing additional pressures on hospitals; appropriate secondary accommodation is required if houses are unliveable; and damage to critical infrastructure prevents functionality of homes and businesses. Prioritising buildings that others depend on will reduce impacts to functionality of other buildings.	✓	✓			✓	✓
	Supply chains It is important to ensure that supply chains (including transportation, warehouses, etc) are running to support supply of basic needs, local economy recovery and export of goods.	✓					
Consider the dependence of users on buildings	Some users and the services they provide are not dependent on their building. Commercial office blocks are a good example of where services can be undertaken elsewhere (e.g., working from home) with limited disturbance if their buildings were unusable. Other services are more dependent on their buildings (e.g. warehouses and manufacturing facilities).		✓		✓		✓
Prioritise building with multiple functions	**Flexibility in Function** Invest in buildings that have the potential to have alternative functions post-earthquake. We need to start thinking about our buildings differently, creating buildings that can adapt to meet various needs.		✓				
	Buildings with more than one function Some buildings hold more than one function (e.g. commercial office block with critical infrastructure assets). It is important that investment in seismic resilience meets the needs of the most critical function (e.g. critical infrastructure).						✓
Cost-benefit of resilience versus affordability should be considered	Resilience shouldn't be at the expense of affordability, particularly if that cost falls on individuals who cannot afford it (e.g. tenants). Understanding where the cost will fall is important to understand, particular when housing is so unaffordable. Understanding the trade-offs is important, as there is no point in a building being safe building if no one can afford to live in it/rent it. For the private sector, investment in buildings depends on the likely return on investment.				✓		✓
Perception is important for community confidence	Ensuring national government and civil defence are up and running is important for building trust in the recovery and supporting community morale.		✓				

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Animal Welfare is also important	Animal welfare should also be considered, this includes ensuring access to vet services and having milking up and running as quickly as possible.	✓					
Factors affecting risk to tolerance and priorities	**Current perception of building stock** Currently engineering and building resilience in New Zealand is already pretty good as demonstrated by the narrow range of building types impacting life safety during the Christchurch earthquakes. Additional investment should take current stock performance into account and whether additional resilience is necessary.		✓		✓		
	Other risks more important For some earthquakes are not the most important hazard to manage. Other hazards such as volcanic eruptions, tsunami, flood and fire are more critical.					✓	
	Challenges with improving existing code Transitioning to new standards has a big impact on building owners. Owners must decide whether to rebuild or strengthen and there is significant cost.		✓		✓		

COVID-19 Influence

COVID-19 has influenced how people perceive the importance of buildings. COVID-19 has changed the way we work, people have become less dependent on commercial office blocks, and this has lowered the perceived priority of these buildings. Although the social impacts of prolonged working from home do not necessarily make commercial buildings redundant.

Activity 1.5: Building context

Four of the focus groups were able to undertake the building context activity.

It was clear that the building environment is important to consider when establishing seismic resilience requirements. Critical infrastructure and significant buildings need to be protected. However, there is a recognised challenge of implementation, as building uses over time.

Two clear themes from the discussion are highlighted below:

Buildings as a system

It was clear that buildings needed to be acknowledged as part of a system and not as lone entities. Neighbourhood context (buildings and assets) need to be considered when designing a new building. It is important to ensure that critical access routes, critical infrastructure and other buildings with important functions or high community value are not impacted by damage to neighbouring buildings

Time criticality

If a building had the potential to impact a building with time critical services than it was important to invest in its seismic resilience. These time critical services linked strongly with the need to protect life safety (e.g., emergency service access, water, electricity), or aided in the recovery. While buildings less time critical were important, these were less important as ‘people aren’t going to die if it isn’t functional straight away’.

Summary

The average results from Activity 1 are summarised In Appendix A. A description and summary of recovery time and relative importance for each building discussed during the focus groups is provided.

3.2 Activity 2: Risk matrices

Participants undertook this activity individually. In each section the responses of all participants are divided into those who thought each risk (combination of consequence and likelihood) was 1) acceptable, 2) tolerable or 3) intolerable. The cells are shaded to indicate risk tolerance and degree of agreement amongst the groups: green is acceptable, yellow is tolerable and red is intolerable; the darkness of the shading correlates to the proportion of participants with a particular response.

Then, to enable comparison between city and town and high and low/medium hazard zone focus group locations, a second set of risk matrices is presented. This time the responses, split into groups, are aggregated so that there is one score for each combination of consequence and likelihood. The single score is calculated using a weighted score based on the number of votes for each tolerance level and scores of 1 for acceptable, 0 for tolerable and -1 for intolerable. The cells in the matrix have been shaded to indicate the proportion of participants with a particular response. The total number of respondents was different in each group, so the shading is relative to the total number within each group.

INTOLERABLE	No way – risk is so great that it can't be justified
TOLERABLE	I can put up with this but would like it to change
ACCEPTABLE	Part of daily life – these things happen

Human

Table 20 shows the responses of all participants. Generally loss of multiple lives is unacceptable, and this is relatively consistent across city and town focus groups, Table 21. Those in higher hazard zones, however, were slightly more accepting of the human consequences of disruptive events, largely because of their knowledge and acceptance of living in a high hazard zone, Table 22. Beyond loss of life, the potential for mental health impacts or impacts that might affect multiple generations reduces tolerance to risks, Table 23.

The discussion around tolerance to human impacts following earthquakes is captured in the themes presented in Table 23.

Table 20 Risk tolerance for impacts on human wellbeing (green is acceptable, yellow is tolerable and red is intolerable; the darkness of the shading correlates to the proportion of participants with a particular response, the number reflects the number of participants with a specific response)

	Consequence (Human)			
	I	II	III	IV
Frequency/Likelihood	• Low impact on human wellbeing *(capacity to work, study recreate, socialise)*	• < 1 in 20,000 people injured • Some education temporary closures *(< 1 week)* • Some social and recreational activities disrupted *(< 1 week)*	• No or minimal fatalities • Between 1 in 20,000 and 1 in 2,000 people injured • -Education facilities temporary closures *(< 1 month)* • Temporary disruption to social or recreational activities *(< 1 month)* • Some ongoing mental health challenges *(6-12 months)*	• Multiple fatalities • 1 in 2,000 people injured • Education facilities prolonged closures • Limited or no access to social or recreational activities for significant period • Significant and ongoing mental health challenges *(>12 months)*
Less than once every 2500 years; <2% chance in typical building life	0	0	1	4
	0	3	4	8
	23	19	19	10
Once every 1000-2500 years; 2-5% chance in typical building life	0	0	1	4
	0	4	4	11
	23	19	16	7
Once every 250-1000 years; 5-20% chance in typical building life	0	0	1	9
	0	6	14	13
	22	17	8	1
Once every 100-250 years; 20-50% chance in typical building life	0	1	6	16
	1	7	15	7
	21	15	2	0
Once every 50-100 years; 50-100% chance in typical building life	0	5	13	21
	2	9	8	2
	19	8	2	0
Once every 0-50 years; probably once in typical building life	1	9	19	23
	6	9	4	0
	14	4	0	0

Table 21 Comparison of risk tolerance between city and town focus group members for risk to human wellbeing (number within each cell reflects the number of participants with a specific response)

	Consequence (Human) City			
Frequency/Likelihood	**I**	**II**	**III**	**IV**
Less than once every 2500 years; <2% change in typical building life	12	9	9	3
Once every 1000-2500 years; 2-5% chance in typical building life	12	9	8	1
Once every 250-1000 years; 5-20% chance in typical building life	11	7	3	-5
Once every 100-250 years; 20-50% chance in typical building life	10	5	-2	-7
Once every 50-100 years; 50-100% chance in typical building life	8	-1	-6	-10
Once every 0-50 years; probably once in typical building life	6	-4	-9	-12

	Consequence (Human) Town			
Frequency/Likelihood	**I**	**II**	**III**	**IV**
Less than once every 2500 years; <2% change in typical building life	11	10	9	3
Once every 1000-2500 years; 2-5% chance in typical building life	11	10	7	2
Once every 250-1000 years; 5-20% chance in typical building life	11	10	4	-3
Once every 100-250 years; 20-50% chance in typical building life	11	9	-2	-9
Once every 50-100 years; 50-100% chance in typical building life	11	4	-5	-11
Once every 0-50 years; probably once in typical building life	7	-1	-10	-11

Table 22 Comparison of risk tolerance between high and medium/low hazard zone focus group members for risk to human wellbeing (number within each cell reflects the number of participants with a specific response)

	Consequence (Human) High Seismic Zone			
Frequency/Likelihood	**I**	**II**	**III**	**IV**
Less than once every 2500 years; <2% change in typical building life	11	8	8	5
Once every 1000-2500 years; 2-5% chance in typical building life	11	8	7	3
Once every 250-1000 years; 5-20% chance in typical building life	10	8	5	-3
Once every 100-250 years; 20-50% chance in typical building life	10	6	-1	-5
Once every 50-100 years; 50-100% chance in typical building life	10	2	-4	-9
Once every 0-50 years; probably once in typical building life	7	-1	-7	-11

	Consequence (Human) Low/Medium Seismic Zone			
Frequency/Likelihood	**I**	**II**	**III**	**IV**
Less than once every 2500 years; <2% change in typical building life	12	11	10	1
Once every 1000-2500 years; 2-5% chance in typical building life	12	11	8	0
Once every 250-1000 years; 5-20% chance in typical building life	12	9	2	-5
Once every 100-250 years; 20-50% chance in typical building life	11	8	-3	-11
Once every 50-100 years; 50-100% chance in typical building life	9	1	-7	-12
Once every 0-50 years; probably once in typical building life	6	-4	-12	-12

Table 23 Themes relating to risk tolerance for human impacts following disruption events

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Fatalities and injuries were of most concern	Loss of life was a key driver for risk acceptability. Tolerance for fatalities is low for most; 'Fatalities is most important; facilities can be rebuilt'. Views on acceptability of loss of life ranged from the majority view that 'one loss of life is too much' to others who thought that eliminating fatality risks was impracticable and multiple fatalities were tolerable, as long as they were less frequent than once in every 100 years.	✓	✓	✓	✓	✓	✓
Fatality consequence should be avoided regardless of likelihood	Some found consequence to be a stronger driver than likelihood. They feel that even if the chance was low (2% chance in a building life or 2,500-year events), it was still unacceptable to have fatalities.		✓	✓	✓	✓	
Mental health impacts is an important consideration	Ongoing mental health impacts were also a consequence of concern for many. Impacts to mental health reduce a person's ability to recover and their overall wellbeing. Impacts that cause enduring mental health issues (12 months or more) are unacceptable. It was noted that mental health cannot always be directly linked to a building, but depends on the resilience of people, and resources they can access.		✓	✓	✓	✓	✓
Duration of consequences affects risk tolerance	The length of disruption and consequences plays a role in risk tolerance. For example mental health impacts for a short time might be okay but for they are not acceptable if they persist for 12 months or more.			✓	✓		
Community resilience or capacity affects risk tolerance	Society used to be a lot more self-sufficient and cohesive. Society has changed and become less resilient impacting our ability to handle consequences. For example, our communities are less self-sufficient and are heavily dependent on supply chains. Our vulnerability to supply chain disruption has been highlighted during the COVID-19 and the challenges of getting goods into the country.						✓
Risk tolerance changes over time depending on the presence of compounding stressors	Having multiple disruptive events occurring simultaneously or sequentially reduces the capacity of a community to manage the impacts as resilience takes time to rebuild. For example, having an earthquake while dealing with COVID-19 would magnify the consequences. Similarly, recovering from 2 or more earthquakes within a generation will amplify the consequences and reduce the ability of the community to cope.						✓

		A	B	C	D	E	F
	Focus Group Location	**A**	**B**	**C**	**D**	**E**	**F**
	Community Setting (Town/City)	**T**	**C**	**C**	**T**	**C**	**T**
Theme	**Description** / **Seismic Zone (Low, Medium, High)**	**L**	**H**	**H**	**H**	**L**	**M**
Risk tolerance is lower in higher density areas	Higher density populations and housing can magnify the impact of earthquakes (e.g., loss of life, person displacement) of earthquakes. Higher seismic design standards are necessary in higher density areas to reduce concentrated risk.					✓	
Risk tolerance is higher in high hazard zones	Understanding of the presence and high risk of earthquake hazards in a region, led respondents to be more accepting of the environment they were set in. There was a degree of acceptability indicated by choosing to live in a high hazard zone. In these circumstances participants believed the use of non-structural disaster risk reduction activities are necessary to reduce risk rather than relying on more seismic resilient buildings (for example emergency planning).		✓				
Risk tolerance depends on cost	**Cost of seismic resilience** Many participants indicated that their preference may shift depending on the cost of achieving enhanced resilience. What is the cost of increasing seismic resilience of buildings? How would increasing seismic resilience change the cost of buildings and how might these additional costs impact how we live. Participants indicated a need to be realistic about what the code can achieve and the impact of trying to achieve high standards, particularly when earthquakes are not occurring regularly. We also need to be aware of what can be achieved with design, and whether it is necessary to design (and pay for) bulletproof buildings when there are other ways to prevent risk.	✓	✓	✓	✓	✓	
	Commercial Drivers Commercial building owners' risk tolerance is driven by largely commercial factors such as a tenant demands, return on investment, the influence of the insurance industry and banks.				✓		
Seismic resilience is competing with other societal risks	Over time competing issues, such as climate change, are going to become more important than seismic risk. Given the low likelihood of an earthquake event, and the fact that human and environmental impacts of climate change are currently upon us, climate issues should be of higher consideration than earthquakes.	✓		✓			
Buildings are part of a system contributing to overall impacts of earthquakes	Buildings are only one component of reducing seismic impacts on society. Buildings codes can be supplemented by other risk reducing measures. Other, less direct investments can also reduce our risk, for example a robust healthcare system in New Zealand has the ability to prevent fatalities.		✓	✓		✓	

	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
Theme	**Description** Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Likelihood inconsistently affects risk tolerance	Decisions were made by thinking about the likelihood of event. If it was deemed extremely rare, it was mostly acceptable. For some the 250–1000-years return period events felt like the tipping point for risk acceptability, while for others, it was between 50-100 years. Consequences were considered more impactful in smaller time frames, and disruption unavoidable at low likelihoods.	✓	✓	✓	✓	✓	✓
	Split of likelihood thresholds: 250-1,000 years	✓	✓	✓		✓	
	50 to 100 years	✓	✓		✓	✓	✓
Potential for catastrophic impacts on consecutive generations should be avoided.	Likelihood drivers for those with a tipping point between 50-100 years often used the impact on generations as their reasoning. Wanting to avoid impacts across two generations; impacts to one generation was okay, more than that (impact on multiple generations in small timeframes) would compound impacts and cause higher consequences. The threshold of 100 years would allow for generational interruption of consequences.						✓
Building design lives are too short	Likelihood in the activity was presented proportional to the nominal design life of a building (50 years). This led to discussion about building life. The current building design life of 50 years was considered to be too short to majority of participants. While there is no expectation that a building will last forever, increasing building design life to 100 years was more comfortable. The value that other countries (e.g., England) puts on their longer-lived buildings is something we should aim be doing. If we designed and expected our buildings to be longer lasting, we might place higher values for our longer lasting buildings.			✓	✓	✓	✓
Seismic risk should be compared to other risks	**Comparing likelihoods** Respondents used various other risks that can cause these human consequences as comparisons/reference points for not only what was acceptable, but also what can and can't be designed for. Flood frequency was a common benchmark when discussing risk tolerance and likelihood of occurrence. There was concern that flood frequency has been increasing and that we are experiencing more '1 in 100 years' floods than every once in a hundred years. Respondents felt a false sense of security in the annual return event value and therefore tended to interpret the return periods more conservatively. Fires were also another risk of common comparison.		✓	✓	✓	✓	✓

Theme	Description	Focus Group Location	A	B	C	D	E	F
		Community Setting (Town/City)	T	C	C	T	C	T
		Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
	Mitigating other threats/hazards There were other incidents in our lives that have consequences similar to earthquakes that we accept/don't mitigate (e.g., terrorist attacks). Is the cost for designing for earthquakes, especially those 1:2500-year events, acceptable when these consequences occur elsewhere where we don't mitigate?				✓			

Activity Issues

Some respondents found it hard to interpret likelihood / frequency, despite the number of terms that were provided. Many focused on the return period which was difficult to conceptualise for many. Many compared likelihood to recent experiences of flood events, and experience of having 1 in 100-year floods happen repeatedly in the space of a few years. In these situations respondents tended to interpret the return periods more conservatively. Many found the concept of 'acceptability' of fatalities difficult and noted that it felt immoral to accept any deaths. Some struggled with understanding Consequence III, particularly 'no to minimal fatalities'.

COVID-19 Influence

COVID-19 has led respondents to reflect on the impact of being removed from buildings during lockdowns- were there any impacts and what were they? Some respondents felt that we are currently underestimating the impact of COVID-19 on mental health, and that there will be ongoing challenges/greater impact noticed over time. An earthquake on top of dealing with COVID-19 would add on additional stress to an already impacted society. These feelings might influence the importance placed on reducing mental health impacts. COVID-19 also highlighted the importance of air flow/good air-conditioning systems as a way to protect public health.

Economic

Aggregated responses across all focus groups is shown in Table 24. Generally participants are more accepting of economic consequences than human consequences. Participants often translated the economic impacts into human terms and focused on consequences such as job losses, as this was more tangible to them. Impacts on reputation (particularly to investor and export markets) is a concern. Town participants are marginally less tolerant to economic losses than city respondents, but the difference is not significant, Table 25. As with risks to human wellbeing, those in low seismic hazard zones are less tolerant of economic risks, Table 26.

The discussion around tolerance to economic impacts following earthquakes is captured in the themes presented in Table 27.

Table 24 Risk tolerance for impacts on economic wellbeing (green is acceptable, yellow is tolerable and red is intolerable; the darkness of the shading correlates to the proportion of participants with a particular response) (number in each cell reflects the number of participants with a specific response)

	Consequence (Economic)			
	I	II	III	IV
Frequency/Likelihood	• <1% capital loss • Business revenue reduced by <1% (peak loss)	• Uninsured capital loss 1-5% of value of built assets • Average business revenue reduced by 1-10% (peak loss) • <1% people lose their jobs (peak loss)	• Uninsured capital loss 5-30% value of built assets • Average business revenue reduced by 10-30% (peak loss) • 1-5% of community lose their jobs (peak loss) • Minor impact on export market (perception issues affecting tourism, higher education, agriculture etc.)	• Uninsured capital loss >30% value of built assets • Average business revenue reduced by > 30% (peak loss) • >5% of community lose their jobs (peak loss) • Major impact on export market (perception issues affecting tourism, higher education, agriculture etc.)
Less than once every 2500 years; <2% change in typical building life	0 0 22	0 1 22	0 1 21	1 5 16
Once every 1000-2500 years; 2-5% chance in typical building life	0 0 22	0 1 21	0 2 19	1 5 15
Once every 250-1000 years; 5-20% chance in typical building life	0 0 22	0 2 20	0 5 18	4 16 2
Once every 100-250 years; 20-50% chance in typical building life	0 6 16	0 10 12	2 16 4	9 13 0
Once every 50-100 years; 50-100% chance in typical building life	1 8 13	3 11 8	7 16 0	21 2 0
Once every 0-50 years; probably once in typical building life	8 4 10	9 8 5	19 3 0	23 0 0

Table 25 Comparison of risk tolerance between city and town focus group members for risk to economic wellbeing (number in each cell reflects the number of participants with a specific response)

	Consequence (Economic) - City			
Frequency/Likelihood	**I**	**II**	**III**	**IV**
Less than once every 2500 years; <2% change in typical building life	11	12	12	8
Once every 1000-2500 years; 2-5% chance in typical building life	11	11	11	8
Once every 250-1000 years; 5-20% chance in typical building life	11	11	10	-2
Once every 100-250 years; 20-50% chance in typical building life	8	7	3	-5
Once every 50-100 years; 50-100% chance in typical building life	8	6	-2	-11
Once every 0-50 years; probably once in typical building life	6	2	-8	-12

	Consequence (Economic) - Town			
Frequency/Likelihood	**I**	**II**	**III**	**IV**
Less than once every 2500 years; <2% change in typical building life	11	10	9	7
Once every 1000-2500 years; 2-5% chance in typical building life	11	10	8	6
Once every 250-1000 years; 5-20% chance in typical building life	11	9	8	0
Once every 100-250 years; 20-50% chance in typical building life	8	5	-1	-4
Once every 50-100 years; 50-100% chance in typical building life	4	-1	-5	-10
Once every 0-50 years; probably once in typical building life	-4	-6	-11	-11

Table 26 Comparison of risk tolerance between high and low/medium hazard zone focus group members for risk to economic wellbeing (number in each cell reflects the number of participants with a specific response)

	Consequence (Economic) High Seismic Zone			
Frequency/Likelihood	**I**	**II**	**III**	**IV**
Less than once every 2500 years; <2% change in typical building life	10	11	11	10
Once every 1000-2500 years; 2-5% chance in typical building life	10	10	11	9
Once every 250-1000 years; 5-20% chance in typical building life	10	10	11	1
Once every 100-250 years; 20-50% chance in typical building life	10	9	4	-2
Once every 50-100 years; 50-100% chance in typical building life	10	7	-2	-10
Once every 0-50 years; probably once in typical building life	9	4	-7	-11

	Consequence (Economic) Low/Medium Seismic Zone			
Frequency/Likelihood	**I**	**II**	**III**	**IV**
Less than once every 2500 years; <2% change in typical building life	12	11	10	5
Once every 1000-2500 years; 2-5% chance in typical building life	12	11	8	5
Once every 250-1000 years; 5-20% chance in typical building life	12	10	7	-3
Once every 100-250 years; 20-50% chance in typical building life	6	3	-2	-7
Once every 50-100 years; 50-100% chance in typical building life	2	-2	-5	-11
Once every 0-50 years; probably once in typical building life	-7	-8	-12	-12

Table 27 Themes relating to risk tolerance for economic impacts following disruption events

Theme	Description — Focus group location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Private Investment is focussed on short terms risks (high likelihood events)	Financial return on investment (ROI) works on a relatively short term: Securities typically have a 50-year period/bank repayment periods are typically 20 years. Potential losses, risks with low risk of occurring in that timeframe are less important. Return on investment might change as the economy and market shifts, but overall financial risks only tend to factor in short-term risks.				✓		
Generational impacts are unacceptable	**Significant impacts** (e.g., loss of job, income, business) across two consecutive generations was seen as intolerable. Consequences were more acceptable if they affected every second generation as this allowed for recovery.	✓					
Impacts on export markets could have a significant impact	Participants were more tolerant of rare events on the export market as it was perceived that these economic impacts could bounce back quickly.	✓					
	Export market critical for agriculture The export market is critical for agriculture, and frequent disruption to export markets is intolerable.						✓
Capital Loss	**Capital loss could lead to damaging debt levels** From a community viewpoint, capital loss could lead to damaging debt levels. Capital loss in consequence III and IV (5-30% and >30%) could lead to problems for residential housing. Loss of value in property, especially in areas with high debt ratios, in combination with loss of employment would lead to damaging financial impact on individuals and consequential mental health impacts. From a commercial perspective, commercial debt sits around 30-40%. 1% capital loss wouldn't lead to a loss of sleep, while 5% loss would impact businesses in their early years, while more established ones would recover over time. Over 5% loss would be of great concern.	✓			✓	✓	
	Job loss causes greater impact than capital loss Capital loss is recoverable, however, people losing their jobs can have lingering social consequences.			✓			
The severity of loss of business revenue is dependent on the	The tolerance of loss of business revenue was dependent on the length of the time the business revenue was impacted. However, the loss of a 1/3 of business revenue was viewed as quite severe.	✓					

Theme	Description	A	B	C	D	E	F
	Focus group location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
duration of reduced earnings							
Job loss is an intolerable risk.	Loss of livelihoods was one of the main drivers for economic risk intolerance. Over 10% job loss for most was intolerable. This was felt particularly strong in towns, where a significant loss of jobs would significantly impact recovery and potential cause the town to become a 'ghost town'. The social impacts were felt strongly, with smaller towns feeling like job loss would be more acutely felt than in an urban setting, as 'everyone would know someone' who was affected. In turn this would affect community wellbeing.	✓	✓	✓	✓	✓	✓
Job loss will be offset by the recovery	While job loss is intolerable, opportunities for other employment could arise during recovery (e.g. rebuild) and this could reduce the impacts on a community level.	✓	✓				
The link between building and employment is changing and will continue to change	The link between building damage and loss of jobs will be different in the future. For example, adaptation to COVID-19 has led to increased capacity to work from home.				✓		
How losses are felt across a community is important (equity)	Often impacts affect the people who don't have the means to cope. For example lower paid workers are often more vulnerable to job losses due to the nature of their contractual and working conditions. Lower income families also often live in less resilient buildings on less resilient land.			✓			
The felt impact depends on presence of compounding stressors	Economic impacts (e.g., job loss) are felt greater when added to existing stressors such as COVID-19. The resilience of society is currently lowered due to COVID-19, and if an earthquake event was to occur existing stressors would be adding to the overall impact and reducing capacity to recover quickly.						✓
Insurance availability	The availability of insurance for businesses was noted as a barrier to economic resilience. Hard to get and/or expensive insurance puts extra pressure on businesses including ability to provide jobs and to innovate.			✓			

Theme	Description	A	B	C	D	E	F
	Focus group location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
	Potential lack of insurance in the future and the impact on housing quality was highlighted as a concern. In particular, the potential for unrepaired 'as-is'-where-is" housing following earthquakes, (as seen following the Christchurch and Kaikōura earthquakes), was concerning for participants. The subsequent link between housing quality and adverse health impacts was also noted.			✓			
National economic resilience can offset regional economic impacts	Industries with national geographic diversity are more resilient and are able to offset regional disruptions. Therefore investing in resilience in a given region is less important (as it is unlikely that multiple regions will be affected by one seismic event).	✓					
There is an opportunity cost of resilience	There is a balancing act between costs of doing business and enhancing seismic resilience. High building codes may not be affordable and could increase the cost of setting up a business. Having a strong economy, where businesses can afford to operate will provide resources to respond when an earthquake occurs.		✓				
Responsibility for individual ownership of risk needs to be factored in	From a commercial perspective, participants noted that economic impacts are often self-mitigated by businesses. Businesses often manage risks individually, undertaking activities such as self-insurance and business continuity planning; there is an element of responsibility to prepare for some events.					✓	
Earthquake damage can affect reputation/image of an area	Economic regions/hubs need to be seen as robust and resilient locations, able to recover quickly from events. Damage to this perception could cause loss of large businesses, retreat of government departments or international investors who are key to the economics of the region.		✓				
Recovery potential is a key risk tolerance driver	Participants risk tolerance was based on their understanding of how quickly they and/or their community would be able to bounce back from events.	✓					✓

Theme	Description	A	B	C	D	E	F
	Focus group location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Economic risks from seismic events need to be considered alongside other comparable events	Economic impacts can be incurred by various market shocks, not just from earthquakes. Due to the numerous factors that can cause economic shocks there is an expectation that there will be disruptions. Therefore there is a reasonably high tolerance to economic impacts.			✓		✓	
	Lower-level economic consequences (consequences I and II) are comparable with the current economic consequences of COVID-19 in New Zealand; these consequences are currently acceptable/society is supporting the current COVID-19 response. Some businesses are able to adapt, while other are severely impacted.	✓		✓		✓	
	Our treatment of seismic risk needs to be comparable to other economic risks. It is important to balance these decisions with how we design our risk settings of buildings to ensure that it is not out of kilter with other policy decisions.			✓			
Comparison to other wellbeings	**More tolerance of economic impacts than human impacts** Participants are more focussed on reducing social impacts than economic impacts. Participants are more concerned about human life and are willing to accept economic consequences, as long as this doesn't impact individuals directly (e.g. through job loss). The current health centric approach to the COVID-19 pandemic was cited as a comparable example – COVID-19 was a clear reference point for what people were willing to accept.		✓	✓	✓	✓	
	Economic impacts are strongly linked to social impacts Economic impacts such as job loss, increase in debt, and loss of capital value on houses can negatively affect mental health, wellbeing and could lead to wider social problems. The economy has a strong role in social recovery, and respondents were concerned about generational impacts from the prolonged loss of jobs and a poor economy.	✓	✓		✓	✓	

COVID-19 influence

COVID-19 showed how quickly international markets are able to bounce back, and many businesses in New Zealand have been able to adapt to the disruption. This recent experience increased participants tolerance to economic disruption. The political, health-centric response to the pandemic, and the support from society, was also a clear reference point for determining risk tolerance.

Social

Generally participants consider the consequence IV risks intolerable, regardless of likelihood, Table 28. This is largely because of the perceived long-term implications of the consequences (including loss of population, social disconnection and loss of trust), Table 31. Cities in particular are less tolerant of severe social consequences, Table 29. Low seismic hazard zones are also less tolerant, Table 30.

The discussion around tolerance to social impacts following earthquakes is captured in the themes presented in Table 31.

Table 28 Risk tolerance for impacts on social wellbeing (green is acceptable, yellow is tolerable and red is intolerable; the darkness of the shading correlates to the proportion of participants with a particular response, number in each cell reflects the number of participants with a specific response)

	Consequence (Social)			
	I	II	III	IV
Frequency/Likelihood	• Low impact on social wellbeing of community	• < 1% residents leave region • Critical community assets are disrupted temporarily (e.g. community centres) • Temporary loss of cultural assets (< 1 month)	• 1-10% residents leave the region • Critical community assets are disrupted – some permanently • Temporary loss of cultural assets (< 12 months) • Some loss of trust in governance and community identity	• Significant social disconnection • 10% of residents leave region permanently • Permanent loss of critical cultural capital • Significant loss of trust in governance and community identity
Less than once every 2500 years; <2% change in typical building life	0	0	2	7
	0	2	7	8
	23	20	14	7
Once every 1000-2500 years; 2-5% chance in typical building life	0	0	3	9
	2	5	7	8
	21	18	11	5
Once every 250-1000 years; 5-20% chance in typical building life	0	0	8	15
	2	10	9	6
	21	13	6	2
Once every 100-250 years; 20-50% chance in typical building life	2	4	9	20
	3	9	11	3
	18	10	3	0
Once every 50-100 years; 50-100% chance in typical building life	2	12	18	23
	3	4	5	0
	18	6	0	0
Once every 0-50 years; probably once in typical building life	5	13	22	23
	0	6	0	0
	18	4	0	0

Table 29 Comparison of risk tolerance between city and town focus group members for risk to social wellbeing (number in each cell reflects the number of participants with a specific response)

Social

	Consequence (Social) City			
Frequency/Likelihood	**I**	**II**	**III**	**IV**
Less than once every 2500 years; <2% change in typical building life	12	10	4	-3
Once every 1000-2500 years; 2-5% chance in typical building life	10	8	2	-5
Once every 250-1000 years; 5-20% chance in typical building life	10	6	-6	-10
Once every 100-250 years; 20-50% chance in typical building life	7	3	-7	-12
Once every 50-100 years; 50-100% chance in typical building life	7	-3	-11	-12
Once every 0-50 years; probably once in typical building life	6	-2	-11	-12

	Consequence (Social) Town			
Frequency/Likelihood	**I**	**II**	**III**	**IV**
Less than once every 2500 years; <2% change in typical building life	11	10	8	3
Once every 1000-2500 years; 2-5% chance in typical building life	11	10	6	1
Once every 250-1000 years; 5-20% chance in typical building life	11	7	4	-3
Once every 100-250 years; 20-50% chance in typical building life	9	3	1	-8
Once every 50-100 years; 50-100% chance in typical building life	9	-3	-7	-11
Once every 0-50 years; probably once in typical building life	7	-7	-11	-11

Table 30 Comparison of risk tolerance between high and low/medium hazard zone focus group members for risk to social wellbeing (number in each cell reflects the number of participants with a specific response)

	Consequence (Social) High Seismic Zone			
Frequency/Likelihood	**I**	**II**	**III**	**IV**
Less than once every 2500 years; <2% change in typical building life	11	9	7	0
Once every 1000-2500 years; 2-5% chance in typical building life	11	9	4	-4
Once every 250-1000 years; 5-20% chance in typical building life	11	7	-2	-8
Once every 100-250 years; 20-50% chance in typical building life	11	6	-4	-11
Once every 50-100 years; 50-100% chance in typical building life	11	1	-9	-11
Once every 0-50 years; probably once in typical building life	11	0	-10	-11

	Consequence (Social) Low/Medium Seismic Zone			
Frequency/Likelihood	**I**	**II**	**III**	**IV**
Less than once every 2500 years; <2% change in typical building life	12	11	5	0
Once every 1000-2500 years; 2-5% chance in typical building life	10	9	4	0
Once every 250-1000 years; 5-20% chance in typical building life	10	6	0	-5
Once every 100-250 years; 20-50% chance in typical building life	5	0	-2	-9
Once every 50-100 years; 50-100% chance in typical building life	5	-7	-9	-12
Once every 0-50 years; probably once in typical building life	2	-9	-12	-12

Table 31 Themes relating to risk tolerance for social impacts following disruption events

Theme	Description / Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Intolerant of impacts with perceived permanence	**Permanent or irreversible impacts** Participants generally did not accept any social impacts with perceived permanence / irreversibility (e.g., significant social disruption, loss of trust, social dislocation and permanent loss of people). It takes time to create community; the longer people are in a place, the deeper the roots in terms of the land and connectedness as a community. Severe social consequences breakdown the foundations of communities and take a long time to restore.	✓	✓	✓			✓
	Impacts on future generations The length of time it takes to heal and rebuild following some of the social consequences can take a generation or more to recover from. While short term impacts can be tolerated, respondents found that impacts that might affect multiple future generations are unacceptable.	✓				✓	✓
Critical cultural capital should be protected and what is considered cultural capital evolves over time	Loss of critical culture assets is intolerable. Cultural assets can comprise marae, religious or heritage buildings and public gathering places. The preservation of these socio-cultural assets ensures there are places for people to meet and connect with each other and our culture. Culture also emerges between buildings, the feeling of the system as a whole and the vibe of the community. This can be hard to restore. The cultural value of buildings changes over time. It is important to take stock of the cultural value of buildings regularly to identify what needs to be protected.	✓	✓	✓		✓	✓
Cultural value is more than buildings	For some cultural capital/buildings is not critical. For example, tikanga and reo are not tied to a marae. As long as there is a place to gather, tikanga can be practiced: it is bound to people not buildings.	✓	✓	✓	✓	✓	
	Contents within buildings Often the drive to invest in buildings of cultural value is to protect the taonga inside a building more than the building itself. The cultural value of the contents of some buildings (e.g. of a museum, art gallery, marae) are higher than the building itself.				✓		

	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
Theme	**Description** Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Loss of trust and governance is intolerable	Significant loss of trust in governance is an important consequence to avoid. Loss of trust can create and deepen division within a community. Trust is also important for mobilising communities following an event to support recovery. Functioning government buildings post-earthquake, particularly in the capital, are important for reducing the risk of significant loss of trust. Trust takes significant time to restore.	✓	✓	✓	✓	✓	✓
Mass displacement of population and community dislocation are intolerable	Connectivity between people is important for community wellbeing. Community connection takes years to build up, and the permanent loss of people from an area can dislocate a community. The loss of community support and neighbourhood networks on remaining residents can diminish their sense of community. This can have secondary effects including increased crime and disharmony, impacting the wellbeing of community members. Enabling community connection also allows society to solve problems together and is important for effective recovery. Significant displacement of people (>10%) from a community was therefore intolerable.	✓	✓	✓	✓	✓	✓
Resilience capacity of community determines felt impact of disruption	The general resilience of people in communities often plays into the felt consequence. Fragile communities may have suppressed coping mechanisms and could feel the impacts of an earthquake more acutely. Participants noted that the resilience capacity of New Zealand's people may not be as resilient as it used to be (change of time) or compared to other countries that experience more frequent hazard events. They worry that society will struggle with a disaster and the impact it would have on livelihoods/lives.			✓		✓	
Equity of impacts should be considered.	Earthquakes have variable impacts on different groups of people. Those that are less resilient/more disadvantaged often experience more significant impacts. The inequity in impacts can translate through the recovery process as some vulnerable people cannot access resources and have a slower recovery trajectory. Equity issues can be exacerbated by the dislocation of communities and loss of neighbourhood support mechanisms.			✓		✓	✓
A sense of safety is good for social recovery.	There is an inherent security from knowing your own building and those in your community are robust and safe. A feeling of safety can underpin recovery in a community. It was noted that there were large psychological impacts following the Christchurch earthquakes due to the significant damage to buildings. Some people were unnerved and lost their sense of security in buildings and that sense of safety takes time to rebuild.					✓	

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Value of building often extends beyond building owner	Values of buildings often extends beyond buildings owners, particularly when it comes to community buildings (e.g., the Christchurch Cathedral). So it is important that private building owners have the right incentives/regulatory measures to protect cultural assets/				✓		
Building value changes over time	There are changing capacities and priorities in communities. Buildings change importance over time as communities adapt and change. Over the past few decades, technology has led to drastic changes within communities, and this will continue to evolve as populations adapt to these changes. Therefore, there is a time sensitive nature to these risk assessments.				✓		✓
There is an opportunity cost to enhanced seismic resilience	Beyond a minimum level of investment (e.g., to protect life safety), the cost of seismic resilience needs to be compared to the cost of disruption. This can include the duration of disruption (e.g., one month of disruption may be acceptable, one year may be intolerable).			✓	✓		
	Better value spending money elsewhere Some respondents were unsure where return on investment sits relative to other societal risk mitigation we could be investing in (e.g. road safety, healthcare). There can be adverse impacts from other risks (e.g. volcanic eruptions) that we are not necessarily mitigating. It is important to understand the best place to be spending our money.				✓	✓	
The felt impact depends on presence of compounding stressors	Currently, locations in New Zealand have already undergone cultural loss, loss of land, dramatic urban development, changes in community structure, political wars, and some are lacking in community engagement. The impacts of an earthquake on social wellbeing may compound and create greater social consequences.					✓	
Comparison to other wellbeings	Compared to other wellbeings, respondents are more intolerant of social impacts. Social impacts appear to be more enduring and harder to reverse than economic impacts. However, social impacts often stem from economic impacts, for example severe economic impacts often cause mass population movement out of regions permanently, so both are important to mitigate.		✓	✓	✓		

Theme	Description / Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Comparative risks	Respondents mentioned that we are susceptible to other forms of risk that cause these levels of impacts that we either can't or are unable to mitigate against (e.g., volcanic eruptions, climate change).			✓		✓	

COVID-19 Influence
COVID-19 has exacerbated the loss of trust in governance, increasing the importance of this consequence for some.

Natural

Similar to social impacts, participants consider significant natural impacts less tolerable than human and economic impacts, Table 32. Natural impacts are considered more long term (in some cases irreversible or permanent) than human and economic impacts and there are strong links between natural wellbeing and human and social wellbeing, Table 35. There is slightly less tolerance for environmental impacts in town settings, Table 33 and low/medium hazard zones, Table 34.

The discussion around tolerance to social impacts following earthquakes is captured in the themes presented in Table 35.

Table 32 Risk tolerance for impacts on natural wellbeing (green is acceptable, yellow is tolerable and red is intolerable; the darkness of the shading correlates to the proportion of participants with a particular response, number in each cell reflects the number of participants with a specific response)

	Consequence (Natural)			
	I	**II**	**III**	**IV**
Frequency/Likelihood	• Low impact on natural environment (waste produced, carbon emissions etc)	• Limited building demolition • Buildings mostly repairable • Small volumes of waste and recycling • Limited carbon and resource required for recovery	• Waste from damaged buildings uses sizeable volumes of available waste management facilities • Some recycling • Some hazardous waste • Considerable embodied carbon and new resources required for demolition and rebuild	• Waste from damaged buildings overwhelms waste management facilities (new facilities needed) • Limited recycling • Hazardous waste cannot be effectively managed • Significant embodied carbon and new resources required for demolition and rebuild
Less than once every 2500 years; <2% change in typical building life	0 2 22	0 4 19	3 10 10	10 6 7
Once every 1000-2500 years; 2-5% chance in typical building life	0 2 21	0 4 20	5 11 7	10 9 4
Once every 250-1000 years; 5-20% chance in typical building life	0 3 21	0 6 18	5 13 5	11 12 1
Once every 100-250 years; 20-50% chance in typical building life	0 5 18	3 5 14	7 16 0	17 6 0
Once every 50-100 years; 50-100% chance in typical building life	2 6 15	4 7 13	15 9 0	23 1 0
Once every 0-50 years; probably once in typical building life	2 8 13	4 8 12	18 4 0	23 1 0

Table 33 Comparison of risk tolerance between city and town focus group members for risk to natural wellbeing (number in each cell reflects the number of participants with a specific response)

Natural

	Consequence (Natural) City			
Frequency/Likelihood	**I**	**II**	**III**	**IV**
Less than once every 2500 years; <2% change in typical building life	12	12	4	0
Once every 1000-2500 years; 2-5% chance in typical building life	11	12	2	-3
Once every 250-1000 years; 5-20% chance in typical building life	12	12	0	-4
Once every 100-250 years; 20-50% chance in typical building life	11	9	-3	-9
Once every 50-100 years; 50-100% chance in typical building life	9	9	-8	-12
Once every 0-50 years; probably once in typical building life	9	9	-9	-12

	Consequence (Natural) Town			
Frequency/Likelihood	**I**	**II**	**III**	**IV**
Less than once every 2500 years; <2% change in typical building life	10	7	3	-3
Once every 1000-2500 years; 2-5% chance in typical building life	10	8	0	-3
Once every 250-1000 years; 5-20% chance in typical building life	9	6	0	-6
Once every 100-250 years; 20-50% chance in typical building life	7	2	-4	-8
Once every 50-100 years; 50-100% chance in typical building life	4	0	-7	-11
Once every 0-50 years; probably once in typical building life	2	-1	-9	-11

Table 34 Comparison of risk tolerance between high and low/medium hazard zone focus group members for risk to natural wellbeing (number in each cell reflects the number of participants with a specific response)

	Consequence (Natural) High Seismic Zone			
Frequency/Likelihood	**I**	**II**	**III**	**IV**
Less than once every 2500 years; <2% change in typical building life	11	11	3	-2
Once every 1000-2500 years; 2-5% chance in typical building life	10	11	3	-3
Once every 250-1000 years; 5-20% chance in typical building life	11	11	2	-4
Once every 100-250 years; 20-50% chance in typical building life	12	10	-2	-9
Once every 50-100 years; 50-100% chance in typical building life	11	10	-8	-12
Once every 0-50 years; probably once in typical building life	10	9	-10	-12

	Consequence (Natural) Low/Medium Seismic Zone			
Frequency/Likelihood	**I**	**II**	**III**	**IV**
Less than once every 2500 years; <2% change in typical building life	11	8	4	-1
Once every 1000-2500 years; 2-5% chance in typical building life	11	9	-1	-3
Once every 250-1000 years; 5-20% chance in typical building life	10	7	-2	-6
Once every 100-250 years; 20-50% chance in typical building life	6	1	-5	-8
Once every 50-100 years; 50-100% chance in typical building life	2	-1	-7	-11
Once every 0-50 years; probably once in typical building life	1	-1	-8	-11

Table 35 Themes relating to risk tolerance for natural impacts following disruption events

	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
Theme	**Description** — Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Intolerant of impacts with perceived permanence	Natural consequences are perceived to be more permanent with no means of recovery in short, or even long term. For example, some participants do not accept an outcome where hazardous waste gets into our environment. These long-term permanent consequences can also have long term downstream implications that we may not even understand right now. Intolerance for this type of risk tends to be independent of the likelihood of the consequences occurring.	✓	✓	✓	✓	✓	✓
	Reversibility Environmental impacts can take a long time to reverse if they can be reversed at all.	✓					
	Impact on future generations Like some social consequences, natural environment consequences can have generational impacts. The impact of decisions made today can affect our whakapapa. There is a need to think about future generations and how our current built environment can prevent long term impacts for future generations. Consequences like creation of large volumes of normal and hazardous waste as well as unnecessary destruction of embodied carbon can have long-term or permanent impacts. We need to ensure resources for the future and reduce intergenerational impacts. Iwi planning works in 100–150-year planning blocks to incorporate future generations.	✓	✓		✓	✓	
The environment underpins human existence and is critical to protect	For some, the environment almost comes before people, and we have a duty of kaitiakitanga. The environment underpins human existence through provision of water and food (mahinga kai). What happens to our waterways and land impacts our natural resources, leading to downstream impacts on other wellbeings (social and economic) and affects our capacity to recover from disruptions. Consequently, participants have a high-level of intolerance toward consequences in the natural environment.	✓	✓	✓		✓	✓
Water contamination is a key risk	Participants are particularly concerned about impacts to waterways through damage to sewage systems and disposal of waste. In many places current water systems are comprised of older infrastructure with the likelihood for failure in these systems high risking contamination of waterways. The impacts of contamination include public health impacts and reduction in recreational activities.	✓			✓		

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
There is less tolerance of manmade impacts on natural resources	Participants distinguished natural consequences of hazards and manmade implications of hazards. There is less tolerance of manmade impacts on the environment (e.g. hazardous waste impacting waterways and land).	✓					
Appropriate management of disaster waste a significant concern	**Lack of capacity to manage waste** Participants felt that we needed to be more ambitious about our waste reduction. Many places are already constrained in the ability to manage waste and are concerned about how they would manage large quantities of building waste following an earthquake. Overwhelming waste management facilities is not only a concern for the environment but moreover there is potential to impact public health. There is a desire to reduce current waste production and think more effectively about disaster waste to avoid negative impacts. However, they is limited faith in the current desire and propensity of society to manage waste.		✓	✓	✓	✓	✓
	Building debris has to be dealt with at some time A contrasting view to above, is that buildings, whether standing or demolished, are already in our environment and the waste has to be dealt with at some point. Therefore it is not a priority risk when considering seismic resilience. Building waste, in particular hazardous building waste (e.g. asbestos), needs to be managed appropriately to limit impacts on the natural environment in the everyday. Following an earthquake event, the amount of debris off buildings could be considerable, with debris disposal becoming tricky; it's important to have appropriate management in place prior.				✓	✓	✓
There is intolerance for hazardous waste	Hazardous waste from damaged buildings is a consequence of concern due to the potential permanence of impacts: the impacts will be felt for generations. The is concern around the potential for inefficient management leading to contamination of the surrounding environment, and effects on personal health.	✓	✓	✓	✓	✓	✓
Impacts on destruction and creation of embodied carbon/ carbon a growing concern	The impacts of climate change are of concern, and there is an expectation to reduce carbon. Some participants expect that new buildings won't produce additional burdens on climate change and future generations. With the current state of our environment, we need to be more ambitious about climate change, avoiding emissions today and in the future. Undertaking whole of lifecycle analysis of buildings and ensuring new resilient buildings aren't at the cost of higher embodied carbon are		✓	✓	✓		

Theme	Description Focus Group Location Community Setting (Town/City) Seismic Zone (Low, Medium, High)	A T L	B C H	C C H	D T H	E C L	F T M
	important. Critical decision making regarding seismic strengthening vs demolishing buildings to make space for new buildings is also required to ensure carbon emissions are limited.						
Building lifecycle	**Building life** Building lives should be 100 years or more, not 50 years as they nominally are now. However, it was also acknowledged that if building lives are extended, buildings are still going to be pulled down regardless due to other reasons (e.g. usefulness, functionality, need)					✓	
	Whole of life and circular economy of new buildings Some believe that reducing emissions now is more important than reducing emissions at the end of a building life (i.e. considering the impact of disposal of embodied carbon or creation of new carbon in an earthquake rebuild). There is too much uncertainty in looking forward.			✓			
New building materials could reduce environmental damage of earthquakes	The introduction of new materials that reduce impacts on the environment should be considered when improving resilience. Building codes could improve to account for recyclable (at end of life) and environmentally low risk materials. Overall buildings should aim to include more sustainable materials, good whole of life emissions, and be able to withstand seismic forces. Future technologies should aim to aid in this endeavour.		✓			✓	✓
Comparison to other wellbeings	Compared to other types of consequences respondents generally felt natural consequences, like social consequences, were more permanent and could have generational impacts. Participants also indicated that they understood the implications of natural consequences more so than economic impacts.	✓			✓	✓	

Comparative risks	**Unknown risks** Participants benchmark their risk tolerance based on their exposure and knowledge of environmental impacts. People have been exposed to more information on impacts to the natural environment in the past 5 to 10 years due to the prominence of climate change. This knowledge has highlighted how little we previously knew about climate change impacts and how these impacts are coming to play out know. Participants are cautious about unknown downstream, long-term impacts that we may currently be unaware of.	✓			✓	✓
	Imminence of climate change When considering the likelihood of an earthquake event, some participants felt that the human and environmental impacts of climate change are currently happening and therefore require higher consideration than earthquakes.	✓	✓	✓		
	Other risks Air pollution and flooding are other risks participants benchmarked their risk tolerance against. Air pollution is a long-lasting issue that is not easily corrected, and increasing frequency of flooding events due to climate change is a concern for future generations	✓		✓	✓	

3.3 Activity 3: Seismic resilience compared to other building design priorities

In this exercise participants were asked to individually rank the relative importance of each of the priorities (1= most important to 5= least important) and then discuss their choices as a group. There was not limit to the number of items that could be given a particular rating. Table 36 summarises the responses across all focus groups, include the mode (most frequent response), average, standard deviation and the percentage of participants that identified each item as either most or least important. Overall items relating to safety were generally considered most important (fire safety, safety of users day to day, life safety during an earthquake); building accessibility and sustainability were also important for many. Societal, economic and environmental impacts following earthquakes had moderate importance. Architectural and heritage value were considered least important by many, although there was a high variation in responses to this item as it appear quite value driven. Architectural value is also interpreted in different ways: some considering purely building aesthetics, while others considered the functionality of the building.

Table 37 compares the difference in priorities for town and city focus group participants. Comparing frequency of those that identified an item as most important (using an ANOVA statistical test), city participants tended to rate ‘Adaptability of building configuration/use over time’ ($p=0.014$) and ‘Sustainability/ energy efficiency/carbon (both embodied and operational)’($p=0.015$) more important than participants located in towns.

Table 38 compares the difference in priorities for participants in high and low seismic hazard zones. Statistical analysis (ANOVA) found that ‘Whole of life cost’ ($p=0.025$) and ‘Sustainability/ energy efficiency/carbon (both embodied and operational)’($p=0.065$) were statistically significantly more important for high seismic zones than low seismic zones. However, this is likely influenced by the high hazard zone focus groups comprising 2 cities and 1 town, reflecting the priorities above.

More pertinent is that low seismic hazard zone focus group participants rated ‘Life safety during an earthquake’ higher than participants in high seismic hazard zones ($p=0.097$).

Table 39 summarises the themes from the discussion around building design requirements.

Table 36 Overall prioritisation of building design requirements (1 is most important, 5 is least important)

Building Design Requirements	Mode	Average	Standard Deviation	Percent of participants identifying item as: Most Important	Least Important
Fire safety	1	1.0	0.0	100%	0%
Safety of users day to day	1	1.0	0.2	95%	0%
Life safety during an earthquake	1	1.1	0.4	86%	0%
Protection from other hazards (flooding/volcano/climate change induced hazards)	1	1.4	0.7	73%	9%
Ability to access the building (customers, goods, etc) (Focus Group)	1	1.6	0.9	64%	5%
Accessibility (disabled access) (Focus group)	1	1.5	0.9	64%	9%
Sustainability / energy efficiency / carbon (both embodied and operational)	1	1.6	0.8	59%	5%
Dry air / environmental health	1	1.6	0.7	55%	5%
Wellbeing of users	1	1.6	0.8	50%	9%
Low impact on natural environment following an earthquake (e.g., waste production, reduced rebuild material requirements etc)	1	1.8	0.8	48%	5%
Durability	2	1.6	0.6	41%	0%
Functionality	2	2.1	0.8	23%	9%
Adaptability of building configuration / use over time	3	2.7	0.9	10%	10%
Whole of life cost	2	2.7	1.2	10%	30%
Economic recovery following an earthquake	2	2.7	1.2	9%	14%
Capital cost	2	3.1	1.3	5%	32%
Heritage value	4	3.5	1.1	5%	55%
Social recovery following an earthquake	2	2.4	0.6	5%	9%
Architectural value	5	3.8	1.2	0%	68%

Table 37 Prioritisation of building design requirements, comparing cities and towns

Building Design Requirements	Percent of participants identifying item as most Important		
	All	City	Town
Fire safety	100%	100%	100%
Safety of users day to day	95%	100%	90%
Life safety during an earthquake	86%	92%	80%
Protection from other hazards (flooding/volcano/climate change induced hazards)	73%	75%	70%
Ability to access the building (customers, goods, etc) (Focus Group)	64%	58%	70%
Accessibility (disabled access) (Focus group)	64%	67%	60%
Sustainability/energy efficiency/carbon (both embodied and operational)	59%	75%	40%
Dry air / environmental health	55%	50%	60%
Wellbeing of users	50%	42%	60%
Low impact on natural environment following an earthquake (e.g., waste production, reduced rebuild material requirements etc)	48%	33%	67%
Durability	41%	50%	30%
Functionality	23%	17%	30%
Whole of life cost	10%	9%	11%
Adaptability of building configuration / use over time	10%	18%	0%
Economic recovery following an earthquake	9%	17%	0%
Capital cost	5%	0%	10%
Heritage value	5%	8%	0%
Social recovery following an earthquake	5%	8%	0%
Architectural value	0%	0%	0%

Table 38 Prioritisation of building design requirements, comparing high and low seismic hazard zones

Building Design Requirements	Percent of participants identifying item as most Important		
	All	High	Low
Fire safety	100%	100%	100%
Safety of users day to day	95%	92%	100%
Life safety during an earthquake	86%	75%	100%
Protection from other hazards (flooding/volcano/climate change induced hazards)	73%	67%	80%
Ability to access the building (customers, goods, etc) (Focus Group)	64%	67%	60%
Accessibility (disabled access) (Focus group)	64%	67%	60%
Sustainability / energy efficiency / carbon (both embodied and operational)	59%	75%	40%
Dry air / environmental health	55%	50%	60%
Wellbeing of users	50%	50%	50%
Low impact on natural environment following an earthquake (e.g., waste production, reduced rebuild material requirements etc)	48%	42%	56%
Durability	41%	42%	40%
Functionality	23%	17%	30%
Adaptability of building configuration / use over time	10%	9%	10%
Whole of life cost	10%	18%	0%
Economic recovery following an earthquake	9%	8%	10%
Capital cost	5%	0%	10%
Heritage value	5%	8%	0%
Social recovery following an earthquake	5%	8%	0%
Architectural value	0%	0%	0%

Table 39 Themes relating to prioritisation of building design requirements

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Safety is the first priority	Safety, both during an earthquake or fire and day to day, is the number one priority. All buildings are expected to have a baseline safety, in particular homes and workplaces are expected to be as safe as possible.	✓	✓	✓	✓	✓	✓
	Life safety is a priority over cost.	✓					
	Day to day safety (e.g., fire safety) is more important than earthquake safety due to the higher likelihood of fires.			✓			✓
	Accessibility plays a role in life safety. Buildings need to be accessible for evacuation and emergency services.			✓			
Life safety following an earthquake is important despite low likelihood	Earthquake likelihoods are not widely considered when determining priority/importance. Earthquakes are viewed as events that are bound to happen ("not if but when"). Experience of recent earthquakes in New Zealand is evidence of this.	✓	✓	✓	✓	✓	✓
Day to day requirements are more important than seismic resilience	Factors likely to impact users' day to day (e.g., accessibility) held a higher importance for many. Focus should be on protecting what is needed daily and ensuring safety of users day to day.			✓			✓
Accessibility	**Enabling access and use of buildings for wellbeing** It is important that buildings are able to be used and are accessible to everyone, including disabled access. Not all buildings are currently accessible. Accessibility ensures inclusiveness and aids in the wellbeing of building users.		✓	✓		✓	
	Accessibility has economic value Accessibility drives commercial interest and rent values of buildings.				✓		

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
	Accessibility is a nice to have Compared to other communities, accessibility is less important than other needs. It is a nice to have. Important but not a top priority.			✓			
Air quality is important for public health	Air quality is crucial as it contributes to physical wellbeing and is important for public health. This sentiment has increased since COVID-19 with air quality and transmission of viruses now a safety concern.	✓		✓	✓	✓	
Durability	**Durability and safety** Durability is an important aspect of building safety. Buildings that can withstand their environment and stay structurally sound are safer than buildings that are impacted by their environment, becoming unsafe over time.		✓			✓	
	Durability and whole of life cost Durable buildings have a lower whole of life cost and are better value for money. If buildings are going to have higher cost, they need to last longer.		✓				
There is a link between durability, adaptability, resilience and sustainability	**Long lasting resilient buildings** Buildings need to last a lifetime with minimal repair. New Zealand has a record of not building durable buildings. We need to start building durable buildings that can withstand earthquakes and can stand for a long time.		✓			✓	
	Adaptable buildings are more resilient and sustainable Having a building stock that can be adapted to fit changing needs improves sustainability long term. It ensures buildings don't fall into disuse when functional needs change. For example, changing commercial buildings to residential property to relieve pressure on housing, or respond to changing ways of working. Adaptable buildings are also valuable for building resilience and supporting post-earthquake recovery needs. For example, aiding in response and recovery functions, and provision of short to medium term accommodation.		✓			✓	

Theme	Description	A	B	C	D	E	F
	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
	Durability and sustainability Buildings represent carbon emissions created at the time it was built (e.g., 80-year-old heritage building represents emissions made 80 years ago). Buildings that are not durable are demolished and replaced with new buildings creating new emissions. Durable buildings therefore reduce the creation of new carbon emissions and are more sustainable.		✓	✓			
	Earthquake resilience is one aspect of an integrated design Buildings should be designed with a 'solutions' approach, with the full breadth of arguable competing requirements combined into an integrated design. This includes earthquake and climate resilience, ecological design, environmental protection, and wellbeing of users should all be components in this integrated and responsive design.	✓			✓		
Sustainability	**Future thinking required** Buildings need to address future issues like climate change and sea level rise.	✓	✓				
	Creating self-sufficient buildings We need to build capacity for buildings to be self-sustaining by investing in solar, rain gardens, and rooftop food hubs.		✓				
	Increase resilience of old buildings for sustainability Older/heritage buildings are durable, and hold embodied created. We can reduce new carbon emissions by making existing buildings seismically resilient rather than demolishing and rebuilding.		✓	✓			
	Maintaining building functionality is key to sustainability A lot of carbon is sunk into buildings, if the building doesn't function the carbon is wasted.			✓			
Functionality is more important than cost, aesthetics and heritage value	Building functionality and accessibility are more important than the capital cost, architectural and heritage value. Architectural and heritage value are nice to haves, with heritage value valued differently depending on place and their attachment to the community.		✓	✓	✓	✓	

	Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
Theme	**Description** / Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
Wellbeing	**Supporting wellbeing** Wellbeing of users is important. Aspects such as functionality, architectural value, and accessibility support wellbeing. Functionality enables buildings and people to work together, while architectural value in buildings links to mental health and wellbeing. Changing how we build houses to enhance the wellbeing of users and account for environmental factors should be explored. New architectural approaches such as biophilic design were highlighted as a way to improve wellbeing through the interaction with the natural environment. Wellbeing was specifically noted as a priority for design of marae.		✓	✓	✓	✓	
	Identity and connection to place Architectural value in buildings supports community identity and connection to place. Communities do not want to live somewhere where all the buildings look the same ('avoid tilt slab city'). Communities need a variety of buildings that look good, make community members happy and that help to retain the character of the location. Heritage and cultural value of buildings are part of this.		✓	✓		✓	✓
Cost	**Affordability and how costs are recovered** Capital cost needs to be factored in and balanced to ensure affordability. There are many building services and standards that are expected to be a given for a base price that people are willing to pay for (e.g., accessibility, fire safety). People are willing to pay to get it right but that doesn't mean a blank cheque. Willingness to pay for additional benefits (e.g., seismic resilience or green buildings) will depend on affordability and who bears the costs of these. For example, additional costs must be considered in light of the need for affordable housing and sustainable residential and commercial rents.		✓	✓	✓		✓
	Return on Investment For some, the value of earthquake resilience and, subsequently, the return on investment needs to be balanced in comparison to other investment factors such as accessibility, architectural value, fire safety etc. These factors often drive economics and desirability of buildings.	✓	✓		✓		
	Cost of not embedding resilience	✓					

Theme	Description — Focus Group Location	A	B	C	D	E	F
	Community Setting (Town/City)	T	C	C	T	C	T
	Seismic Zone (Low, Medium, High)	L	H	H	H	L	M
	While the cost of embedding resilience is importance, it is also important to consider the cost of not doing it and the potential impacts of not having seismically resilient buildings.						
Context influences priorities	**Perception that earthquake recovery will be paid for** Insurance availability impacts priorities for some. There is a perception that there will always be insurance or finance to cover earthquake damages, either through private insurance or the government. This means that earthquake related investment priorities are of less concern. The money injected during recovery is also viewed to boost economic recovery, as seen in the Christchurch earthquake recovery.		✓				✓
	Building density Pressures on the building stock to increase intensive dwelling could impact priorities. Higher density housing (in particular multi-storey) should be built to a higher seismic standard to manage and protect the larger number of people in a limited area.		✓				
	Current time and place views Priorities are impacted by place and time. Social norms change over time, and so will priorities. For example, changes in population diversity in one urban setting has changed the value attached to heritage buildings over time.			✓		✓	
People should be able to shelter in place	It is importance for communities to be able to stay in their buildings following an earthquake. Buildings with higher density of people (e.g., high risk apartment buildings) should build in resilience to allow for residents to shelter in place even with loss of lifelines.		✓				

4. Summary

This data report provides a comprehensive summary of the focus group consultation undertaken as part of the Resilient Buildings Project: Societal Expectations for Seismic Performance of Buildings.

The data demonstrates the breadth of perspectives across participants and the influence of place and time on risk priorities and preferences. The data also provides some strong and consistent themes and priorities that have significant implications for the design and regulation of new buildings.

Analysis and synthesis of this data is provided in the companion report: *Brown et al., 2022. Societal expectation for seismic performance of Buildings. The Resilient Buildings Project Research Paper.*

This report highlights a number of key messages from the focus groups including:

- Life safety remains central to priorities for investment in seismic resilience
- Enabling social and economic recovery are emerging priorities for seismic performance of buildings
- Earthquake impacts that cause permanent damage (e.g. community dislocation, loss of trust in governance, environmental damage) are intolerable
- Regular and minor damage is tolerable, provided repair does not disrupt tenants
- Risk tolerance is influenced by place and time. Factors that might lead a community to be more risk averse include
    - Low seismic hazard zones
    - Dense urban area
    - Geographic isolation
    - Low recovery capacity
- Seismic resilience competes with a number of other building performance goals.
    - Safety, whether during an earthquake, fire or day to day is imperative
    - Wellbeing, functionality and building longevity are equally important objectives that are in many ways complementary.

Appendix A

Aged Care

City	**Town**
Time to restore function: • Partial: 1 Day • Full: 1 Week Importance by category (Very High to Very Low): • Overall: High • Life Safety: High • Social recovery: Moderate • Economic recovery: Very Low	Time to restore function: • Partial: 1 Day • Full: 1 Day Importance by category (Very High to Very Low): • Overall: High • Life Safety: Moderate • Social recovery: High • Economic recovery: Very Low

Description (Town & City)

Overall importance and time to restore functionality were primarily influenced by the vulnerability of building occupants and the preservation of life-sustaining services. The elderly occupants tend to be less mobile and less able to protect themselves when compared to the general population. Furthermore, aged care facilities are occupied day and night by people that rely on their life-sustaining services. The loss of function in an aged care facility may increase demand on local hospitals. Conversely, some aged care facilities can provide overflow capacity for overwhelmed hospital facilities.

Commercial Office Block

City	Town
Time to restore function: • Partial: 1 Month • Full: 3 Months Importance by category (Very High to Very Low): • Overall: Very Low • Life Safety: Moderate • Social recovery: Moderate • Economic recovery: Moderate	Time to restore function: • Partial: 1 Month • Full: 12 Months Importance by category (Very High to Very Low): • Overall: Very Low • Life Safety: Very Low • Social recovery: Very Low • Economic recovery: Very Low

City Description

Commercial office blocks were considered moderately important for life safety, social recovery, and economic recovery because of the high number of occupants and the amount of economic activity that occurs within these buildings in cities. However, the overall importance was low because, relative to other buildings, many of the services provided by these buildings can be undertaken elsewhere (e.g., working from home). A return to partial or full functionality was desired in the medium term to allow for social workplace connections and to restore a sense of normalcy. Furthermore, people returning to work in the CBD positively impacts other businesses in the area (e.g., cafes and restaurants).

Town Description

Commercial office blocks were typically considered of very low importance within towns because these buildings were perceived to be of relatively low occupancy in a town setting and not critical to the often agriculture-centred economies of town. Restoring function to commercial office blocks was not considered a priority because many of the services provided by these buildings can be undertaken elsewhere (e.g., working from home). However, a return to partial or full functionality was desired in the medium term to allow for social workplace connections and to restore a sense of normalcy.

Community Meeting Place

City	Town
Time to restore function: • Partial: 1 Day • Full: 1 Day Importance by category (Very High to Very Low): • Overall: High • Life Safety: High • Social recovery: Very High • Economic recovery: Very Low	Time to restore function: • Partial: 1 Day • Full: 1 Day Importance by category (Very High to Very Low): • Overall: High • Life Safety: Moderate • Social recovery: High • Economic recovery: Very Low

Description (Town & City)

Community meeting places could include religious buildings, maraes, town and country clubs, libraries, and sporting clubs. These buildings tend to be natural gathering places for those seeking help in the aftermath of an earthquake, providing a sense of safety and familiarity by tapping into existing social networks. An almost immediate return to partial or full functionality was desired to enable these post-disaster gathering spaces to assist in the response (e.g., housing civil defence, providing emergency shelter or supplies). These buildings remain essential during the recovery process by enabling social connection and wellbeing through localised and supportive community-run networks.

Critical Infrastructure

City	Town
Time to restore function: • Partial: 1 Day • Full: 1 Day Importance by category (Very High to Very Low): • Overall: Very high • Life Safety: Low • Social recovery: Moderate • Economic recovery: Very high	Time to restore function: • Partial: 1 Day • Full: 1 Day Importance by category (Very High to Very Low): • Overall: Very high • Life Safety: Moderate • Social recovery: High • Economic recovery: Very high

Description (Town & City)

Critical infrastructure (e.g., power, water, sewer, and telecommunications) was considered one of the most important building types in cities/towns because the functionality of most other buildings in the community is dependent upon the services that critical infrastructure provides. Life-sustaining services like power and water are time-critical following an earthquake, particularly for buildings with post-disaster functions. Uninterrupted access to telecommunication was desired to assist with emergency response and reduce anxiety about the welfare of loved ones. Furthermore, the continued functionality of critical infrastructure services gives the public confidence and helps to maintain a sense of law and order. In the days to weeks following an earthquake, critical infrastructure is essential to ensure safe living conditions in homes. It also provides the basic inputs for most economic activity, enabling manufacturing facilities to operate, supply chains to be maintained, and people to work from homes or offices.

Food Production

City	Town
Time to restore function: • Partial: 1 Day • Full: 1 Week Importance by category (Very High to Very Low): • Overall: Low • Life Safety: Low • Social recovery: Moderate • Economic recovery: Moderate	Time to restore function: • Partial: 1 Day • Full: 1 Week Importance by category (Very High to Very Low): • Overall: Moderate • Life Safety: Very low • Social recovery: Low • Economic recovery: Very high

City Description

Food production facilities were rated low importance relative to other buildings in cities. However, a timely return to functionality was desired to ensure that food distribution supply chains are not severely impacted, particularly for seasonal products, where disruptions during the core harvest/processing times would cause massive losses. It was noted that COVID-19 highlighted the importance of systems that sustain life (e.g., food production and supermarkets). Food production facilities also tend to (collectively) be large employers, and the ability to return to work to earn a livelihood and retain a sense of normalcy can aid in social recovery.

Town Description

Food production facilities were rated moderate importance within towns because of the very high importance of primary production industries in towns with agricultural-based economies. A catastrophic failure of a building where a significant proportion of the population worked would be devastating both in terms of the potential human loss and the impact on social and economic recovery. A timely return to functionality was desired to ensure that food distribution supply chains are not severely impacted. Ongoing functionality is essential for seasonal products, where disruptions during the core harvest/processing times would cause massive losses, and for animal products (e.g., meat and dairy), where animal welfare needs to be supported. Also, the ability to return to work to earn a livelihood and retain a sense of normalcy can aid in social recovery.

Government/Council Office

City	Town
Time to restore function: • Partial: 1 Day • Full: 1 Week Importance by category (Very High to Very Low): • Overall: Very high • Life Safety: Moderate • Social recovery: Moderate • Economic recovery: Moderate	Time to restore function: • Partial: 1 Day • Full: 1 Week Importance by category (Very High to Very Low): • Overall: Low • Life Safety: Low • Social recovery: Moderate • Economic recovery: Very low

City Description

Government/council offices were rated very high importance in cities because of their role as Civil Defence and Emergency Management (CDEM) hubs following a major earthquake. Immediate functionality is required from government buildings that support response and recovery. Early communication and action from the government gives the public confidence and helps maintain a sense of law and order. It is desired that other buildings that support essential government functions such as welfare payments, rubbish collection, and infrastructure (water, roads) are functional within 1 week. A functioning government supports economic recovery by providing a recovery framework and regulatory processes (e.g., building consents), which stimulate the economy through building and construction and provides a sense of leadership and confidence. Additionally, the government is a significant employer in many New Zealand cities.

Town Description

Government/council offices were rated low importance relative to other buildings in towns. Most towns do not have a dedicated Civil Defence and Emergency Management (CDEM) hub. Other buildings in the community would need to take on special post-disaster functions to support response and recovery. However, early communication and action from the government gives the public confidence and helps maintain a sense of law and order. It is desired that other buildings that support essential government functions such as welfare payments, rubbish collection, and infrastructure repair are functional within 1 week. A functioning government supports economic recovery by providing a recovery framework and regulatory processes (e.g., building consents), which stimulate the economy through building and construction and provides a sense of leadership and confidence.

Hospital

City	Town
Time to restore function: • Partial: 1 Day • Full: 1 Day Importance by category (Very High to Very Low): • Overall: Very high • Life Safety: Very high • Social recovery: High • Economic recovery: Moderate	Time to restore function: • Partial: 1 Day • Full: 1 Day Importance by category (Very High to Very Low): • Overall: Very high • Life Safety: High • Social recovery: Very high • Economic recovery: Very low

Description (Town & City)

Hospitals were considered one of the most important buildings in cities/towns. The preservation of emergency life-sustaining services is essential in the aftermath of an earthquake, and hospitals house skilled medical personnel and medical equipment necessary to treat injuries and save lives. Hospitals are also occupied day and night by vulnerable occupants with low mobility that would be unable to safely egress from a building without assistance. The ongoing operability of hospitals aids in recovery by giving citizens a sense of confidence and security in knowing life-saving and social services are available.

Manufacturing (non-essential)

City	Town
Time to restore function: • Partial: 1 Month • Full: 12 Months Importance by category (Very High to Very Low): • Overall: Very low • Life Safety: Very low • Social recovery: Very low • Economic recovery: Low	Time to restore function: • Partial: 1 Month • Full: 1 Month Importance by category (Very High to Very Low): • Overall: Very low • Life Safety: Very low • Social recovery: Very low • Economic recovery: Moderate

City Description

Manufacturing (non-essential) facilities were rated very low importance relative to other buildings in cities. These facilities tend to have a low peak occupancy rate and do not serve an essential post-disaster function. Ideally, function should be partially restored to this building type within 1 month to aid social and economic recovery, allowing people to return to work, earn an income, and have a sense of normalcy. The reopening of manufacturing facilities also helps repair the supply chain, and it was desired that manufacturing facilities be fully functional within 12 months.

Town Description

Manufacturing (non-essential) facilities were rated very low importance relative to other buildings in towns. However, it was noted that large manufacturing facilities are the primary employer in some towns, and so the importance of these facilities can be place-based. A catastrophic failure of a building where a significant proportion of the population worked would be devastating both in terms of the potential human loss and the impact on social and economic recovery. It was desired that function be restored to this building type within 1 month to aid social and economic recovery, allowing people to return to work, earn an income, and have a sense of normalcy. The reopening of manufacturing facilities is dependent on a functioning supply chain - transporting raw products in and manufactured goods out of the region.

Motel

City	Town
Time to restore function: • Partial: 1 Day • Full: 3 Months Importance by category (Very High to Very Low): • Overall: Very low • Life Safety: Low • Social recovery: Very low • Economic recovery: Very low	Time to restore function: • Partial: 1 Day • Full: 3 Months Importance by category (Very High to Very Low): • Overall: Very low • Life Safety: Very low • Social recovery: Very low • Economic recovery: Low

Description (Town & City)

Motels were considered very low importance relative to other buildings in towns/cities. However, it was desired that buildings of this type be partially functional within 1 day of a major earthquake to provide short-term accommodation for visitors to the area or act as emergency shelters for displaced residents. Motels should be able to provide safe living conditions for occupants during the response phase. Full functionality was desired within 3 months to support the recovery process, particularly if workers need to be brought in to help with the rebuild. In the longer term, operating motels will enable tourists to return to an area.

Museum

City	Town
Time to restore function: • Partial: 3 Months • Full: 12 Months Importance by category (Very High to Very Low): • Overall: Very Low • Life Safety: Very Low • Social recovery: Low • Economic recovery: Low	Time to restore function: • Partial: 3 Months • Full: 12 Months Importance by category (Very High to Very Low): • Overall: Low • Life Safety: Very Low • Social recovery: Very Low • Economic recovery: Very Low

Description (Town & City)

Museums scored low across all categories relative to the other buildings in the town/city. However, museums were notable for being associated with place-based cultural identity, either from the building itself or its contents. It was desired that functionality would be restored in the 3–12-month timeframe to signal to those outside the region that the area is operating again and promoting tourism. Additionally, the return to functionality of arts and recreations facilities supports the mental health of residents by restoring a sense of normalcy, community and cultural connection.

Residential Apartments

City	Town
City Time to restore function: • Partial: 1 Day • Full: 1 Week Importance by category (Very High to Very Low): • Overall: High • Life Safety: Moderate • Social recovery: High • Economic recovery: High	**Town** Time to restore function: • Partial: 1 Day • Full: 1 Month Importance by category (Very High to Very Low): • Overall: High • Life Safety: Low • Social recovery: High • Economic recovery: Low

Cities Description

Residential apartments were rated highly important relative to other buildings in cities because the provision of shelter is vital in both the response and recovery process. Urban communities were concerned that high-density multi-storey apartment complexes would be unable to provide basic services to residents after a major earthquake, resulting in displacement of people, potentially beyond what emergency services could reasonably be expected to manage. Therefore, partial functionality was desired within 1 day to ensure that people can stay in homes that provide shelter, security, and facilities to prepare food. It is particularly important to prevent the displacement of vulnerable people (e.g., people with mental health issues or already in emergency housing) from their homes in the aftermath of a disaster. Full functionality was desired within 1 week. This would allow people to participate more actively in the recovery, as they would not be burdened by the stress associated with unstable living conditions. It would also enable economic recovery by allowing people to continue to work from home.

Town Description

Residential apartments were rated highly important relative to other buildings in cities because the provision of shelter is vital in both the response and recovery process. Towns were concerned that newly constructed multi-unit housing would not be able to provide basic services to occupants following a major earthquake, resulting in many residents' displacement. Therefore, partial functionality was desired within 1 day to ensure that people can stay in homes that provide shelter, security, and facilities to prepare food. It is particularly important to prevent the displacement of vulnerable people (e.g., people with mental health issues) from their homes in the aftermath of a disaster. Full functionality was desired within 1 month. This would allow people to participate more actively in the recovery, as they would not be burdened by the stress associated with unstable living conditions. It would also enable economic recovery by allowing people to continue to work from home.

Residential Houses

City	**Town**
Time to restore function: • Partial: 1 Day • Full: 1 Week Importance by category (Very High to Very Low): • Overall: High • Life Safety: Moderate • Social recovery: High • Economic recovery: High	Time to restore function: • Partial: 1 Day • Full: 1 Month Importance by category (Very High to Very Low): • Overall: High • Life Safety: Low • Social recovery: High • Economic recovery: Low

Description (Town & City)

Residential houses were rated highly important relative to other buildings in towns/cities because the provision of shelter is vital in both the response and recovery process. Most residential dwellings are low profile (1-2 storey) timber structures that have historically performed well in earthquakes and are not considered a significant life-safety threat. Partial functionality was desired within 1 day to ensure that people can stay in homes that provide shelter, security, and facilities to prepare food. It is particularly important to prevent the displacement of vulnerable people (e.g., people with mental health issues) from their homes in the aftermath of a disaster. Full functionality was desired within 1 month/1 week. This would allow people to participate more actively in the recovery, as they would not be burdened by the stress associated with unstable living conditions. It would also enable economic recovery by allowing people to continue to work from home.

Retail

City	Town
Time to restore function: • Partial: 1 Month • Full: 12 Months Importance by category (Very High to Very Low): • Overall: Very low • Life Safety: Very low • Social recovery: Moderate • Economic recovery: Moderate	Time to restore function: • Partial: 1 Month • Full: 3 Months Importance by category (Very High to Very Low): • Overall: Low • Life Safety: Very Low • Social recovery: Low • Economic recovery: Moderate

Description (Town & City)

Discretionary retail was rated low in overall importance relative to other buildings in cities/towns. This low rating was in part due to the fact that the ability to shop online has reduced the importance of 'brick and mortar' stores in recent years. The typically low occupancy rates and time of occupant exposure made these types of buildings relatively low priority for life safety. A return to partial functionality was not prioritised until approximately 1-month post-earthquake. At that time, it was desired that retail stores begin to reopen in order to provide a sense of normalcy and opportunity for social connections. The reopening of retail also promotes economic activity completing supply chains and allowing people to return to work.

Restaurant/Pub

City	Town
City Time to restore function: • Partial: 1 Month • Full: 12 Months Importance by category (Very High to Very Low): • Overall: Very low • Life Safety: Very low • Social recovery: Moderate • Economic recovery: Moderate	**Town** Time to restore function: • Partial: 1 Month • Full: 1 Month Importance by category (Very High to Very Low): • Overall: Very low • Life Safety: Very low • Social recovery: Low • Economic recovery: Low

City Description

Restaurants and pubs were considered less important than many other buildings in the cities. It was desired that businesses within the hospitality sector began to return to operation within about 1 month. In general, many see the ability to dine out as an activity that epitomises normal city life and provides an opportunity for social connection. Following the Christchurch earthquakes, a poll of university students revealed that re-establishing a student pub was one of their top priorities for the recovery. The hospitality sector also employs many people in cities, and its revival post-earthquake would aid in economic recovery.

Town Description

Restaurants and pubs were considered less important than many other buildings in the towns. It was, however, still desired that businesses within the hospitality sector are partially functional within 1 week to 1 month and fully functional within 1-3 months. The timely re-establishment of pubs was important because of the role they play in the social and economic structure of rural communities, providing a place for social connection as well as an informal location for networking, recruitment, and business deals.

Schools

City	Town
Time to restore function: • Partial: 1 Day • Full: 1 Month Importance by category (Very High to Very Low): • Overall: High • Life Safety: High • Social recovery: Very high • Economic recovery: Low	Time to restore function: • Partial: 1 Week • Full: 1 Month Importance by category (Very High to Very Low): • Overall: Very high • Life Safety: High • Social recovery: High • Economic recovery: Low

City Description (Town & City)

Schools were rated high overall importance in towns/cities primarily because of the need to protect the vulnerable occupants—focus groups often prioritised the life safety of children above all other groups—and the importance of schools in the social fabric of communities. Schools often take on post-disaster functions as the school halls can provide a safe and familiar gathering place for many. Therefore, partial functionality was desired soon (1 week) after a major earthquake. It was then desired that schools return to full functionality within 1 month, providing equity for children that rely on school lunch programmes as well as a sense of normalcy and social connections for all students as they return to classes. The timely return to school also enables parents/guardians to get back to work or attend to the recovery of their businesses and/or communities.

Stadium

City	Town
Time to restore function: • Partial: 1 Day • Full: 12 Months Importance by category (Very High to Very Low): • Overall: Low • Life Safety: High • Social recovery: Moderate • Economic recovery: Low	Time to restore function: • Partial: 1 Day • Full: 12 Months Importance by category (Very High to Very Low): • Overall: Low • Life Safety: Very low • Social recovery: Low • Economic recovery: Very low

City Description

Stadiums were rated low in overall importance relative to other buildings in cities but still scored high for life safety and moderate for social recovery. Stadiums are high occupancy buildings in which the safety of occupants should be prioritised, given the concentration of risk and potential for panic during an earthquake. Stadiums were identified as multipurpose facilities that could be used in the response stage as a community gathering point and/or emergency shelter. Therefore, it was desired that stadiums remain at least partially functioning following a major earthquake. A return to full functionality was desired within 12 months because stadiums were viewed as buildings that characterise normal city life by providing a sense of social connection for both residents and tourists by hosting sports, concerts, and social events.

Town Description

Stadiums were rated low in overall importance relative to other buildings in town but were still notable for their role in the response and recovery processes. Town stadiums are typically not as large as city stadiums and, therefore, not viewed as an area where the concentration of risk was of particular concern. Stadiums were identified as multipurpose facilities that could be used in the response stage as a community gathering point and/or emergency shelter. Therefore, it was desired that stadiums remain at least partially functioning following an earthquake. In the months following a major earthquake, the ability to play sport was identified as important for providing social connections and a sense of normalcy. Full functionality was desired to be restored within 12 months to allow for hosting events that would stimulate the local economy.

Supermarket

City	Town
Time to restore function: • Partial: 1 Day • Full: 1 Week **Importance by category (Very High to Very Low):** • Overall: High • Life Safety: Low • Social recovery: Very high • Economic recovery: Moderate	**Time to restore function:** • Partial: 1 Day • Full: 1 Week **Importance by category (Very High to Very Low):** • Overall: High • Life Safety: Very low • Social recovery: High • Economic recovery: Low

Description (Town & City)

Supermarkets were considered high importance relative to other buildings in towns/cities because of their role in distributing essential goods following a major earthquake. It was desired that supermarkets be partially functional after 1 day to ensure food is available, particularly for those who do not have the resources to have emergency stockpiles. A return to full functionality was desired within 1 week to aid in social recovery by allowing for self-sufficiency and a sense of normalcy in being able to purchase food. It was noted that participants' experience with COVID-19 highlighted the mental health impact from having numerous buildings closed and heightened the perceived importance of systems that support food supply chains, including supermarkets.

Tourist Attraction

City	Town
Time to restore function: • Partial: 12 Months • Full: 12 Month Importance by category (Very High to Very Low): • Overall: Very low • Life Safety: Very low • Social recovery: Very low • Economic recovery: Low	Time to restore function: • Partial: 3 Months • Full: 12 Months Importance by category (Very High to Very Low): • Overall: Very low • Life Safety: Very low • Social recovery: Very low • Economic recovery: Low

Description (Town & City)

Tourist attractions were considered very low importance relative to the other buildings represented on the town/city map. Some participants often felt that buildings residents used consistently should be prioritised over buildings primarily used by tourists, given the long versus short-term exposure risks. On the other hand, tourists were identified as a vulnerable group that may require extra protection, given their lack of familiarity with the building and city/town. Given the discretionary nature of tourism, the desired time to return to functionality was in the longer term, around 3 to 12 months. After which time, a revitalisation of tourism was desired to stimulate economic activity for numerous connected industries (e.g., accommodation, hospitality, retail) and provide employment. This is particularly important in towns with tourism-based economies.

Warehouse

City	Town
Time to restore function: • Partial: 1 Day • Full: 1 Month Importance by category (Very High to Very Low): • Overall: Moderate • Life Safety: Very low • Social recovery: Low • Economic recovery: High	Time to restore function: • Partial: 1 Day • Full: 1 Week Importance by category (Very High to Very Low): • Overall: Moderate • Life Safety: Very low • Social recovery: Moderate • Economic recovery: High

City Description

Warehouses were considered moderately important relative to other buildings in cities because of their role in the supply chain as hubs for transportation and logistics. Other businesses such as supermarkets and retail are reliant on warehouse operations. Partial functionality was desired within 1 day to ensure that basic supply chains continue to support the movement of essential goods. Full functionality was desired to be restored in 1 month to aid economic recovery by enabling supply chains to move both essential and discretionary products. Also, the ability for employees to return to work to earn a livelihood and retain a sense of normalcy can aid in social recovery.

Town Description

Warehouses were considered moderately important relative to other buildings in towns because of their role in the supply chain as hubs for transportation and logistics. Other businesses such as supermarkets and retail are reliant on warehouse operations. Partial functionality was desired within 1 day to ensure that basic supply chains continue to support the movement of essential goods. Towns with primary industries typically indicated that warehouse transportation and logistics should be fully functional within 1 week to allow for the export of time-critical products from the area. Also, the ability for employees to return to work to earn a livelihood and retain a sense of normalcy can aid in social recovery.