



# Building urban and infrastructure resilience through connectivity: An institutional perspective on disaster risk management in Christchurch, New Zealand

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## ABSTRACT

The management of large-scale disasters in urban agglomerations often reveals fragmented governance structures. Accordingly, recent debates in the field of disaster risk management call for better coordination of agencies and actors across organisational and territorial boundaries, arguing that this would ultimately improve the resilience of urban areas. However, our analysis of the metropolitan area of Greater Christchurch, which experienced a series of devastating earthquakes in 2010/2011, shows that this conclusion inadequately acknowledges the uncertainties and institutional complexities in the governance of resilience. We show that debates on urban resilience can benefit from the concept of institutional connectivity – defined as institutionalised forms of vertical, horizontal or cross-territorial interaction – to systematically address these complexities. Our empirical results suggest that the efficacy of different forms of institutional connectivity depends on prevailing circumstances. Therefore, particular forms of connectivity should be prioritised on a case-by-case basis. Our empirical study reveals that enhancing institutional connectivity is a resource-intensive and contested process that might induce negative trade-offs. We contend that because institutions shape how different agencies and organisations interact, scholarly debates on urban resilience should put more emphasis on processes of institutional reform and stress the political dimension of institution building for urban resilience.

## 1. Introduction

In 2010 and 2011, the metropolitan area of Greater Christchurch, New Zealand's second largest city region, was struck by a sequence of earthquakes that had severe and ongoing impacts on its social, built, economic and natural environments. The most devastating shock in February 2011 caused 185 fatalities, widespread damage to infrastructure systems, and destroyed or damaged many inner-city buildings. The central business district was cordoned off to the public for up to two years and only slowly became revitalised as businesses and residents returned. Infrastructure repairs and the reconstruction of the city's built environment are still ongoing and are expected to continue for the next two decades. Moreover, a range of long-term mental health impacts such as post-traumatic stress disorders will be felt for decades. In response, Greater Christchurch has carried out institutional reforms in risk management to better prepare for potential future events. Urban resilience has become a visible policy objective, as expressed in the city

region's participation in the Rockefeller Foundation's 100 Resilient Cities programme (100 RC, 2019). This reflects the growing popularity for urban resilience to be deployed as a prescriptive tool for urban decision-makers (Coaffee & Lee, 2016). However, in common with the findings of other studies (Chandler & Coaffee, 2017; Coaffee et al., 2018), operationalising and institutionalising the concept in existing governance systems proved a major challenge. This paper takes an institutional perspective on urban resilience and aims to contribute to defining the institutional prerequisites for the concept's implementation.

Although the series of earthquakes in Christchurch did not trigger wide-ranging cascading effects of failing infrastructure networks that exacerbated the direct threats of the earthquakes, the city council has acknowledged that the ability to prevent and to prepare for infrastructural failures is a major component of urban resilience (CCC, 2018). It thus recognises that intact or quickly recovering infrastructure was crucial for efficient response and recovery after the earthquakes. A

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range of basic services such as communication, electricity, and key transportation nodes (e.g. the airport) experienced relatively minor disruption and were restored relatively quickly, which allowed national and international search and rescue teams to access the city, hospitals to continue services, and police and fire-fighting personnel to communicate with each other. Consequently, if we conceive of infrastructures as being an integral component of urban systems, urban risk management needs to acknowledge their specific materialities, spatialities, functionalities and their specific – often fragmented – governance structures.

Various authors in the field of risk management have argued that fragmented institutional settings within and beyond urban boundaries pose some of the most severe challenges to implementing urban and infrastructure resilience in existing governance practices (Coaffee et al., 2018; de Bruijne & van Eeten, 2007). Others have pointed out that large-scale disasters often unveil dissonant institutions to do with risk management (Mamula-Seadon & McLean, 2015; Sapountzaki et al., 2011) and that they can be seen as providing an opportunity for institutional reform because they raise risk awareness, may lead to improvements in codes and building standards and because “dominant ways of thinking and acting are subject to critical review and revision” (Birkmann et al., 2010, p. 638). Resilience benefits from these developments because they generate learning processes that result in institutional frameworks being adjusted in order to improve the capacity for dealing with future disasters. Hence, it should be possible to learn from processes of institutional reform in the aftermath of a disaster and to draw conclusions about institutional prerequisites for implementing urban and infrastructure resilience. This study particularly addresses the questions of how institutional connectivity – defined as institutionalised forms of vertical, horizontal or cross-territorial interaction – affects urban and infrastructure resilience and how institutional connectivity can be achieved in the first place. Moreover, the case allows conclusions to be drawn on how the complexities and uncertainties induced by disaster situations affect connectivity building and how urban governance can cope with them.

In order to address these questions, we empirically analyse the case of Greater Christchurch. We deliberately chose this case study because the city region responded to the experience of the earthquakes in 2010/2011 with wide-ranging institutional reforms to disaster risk management, urban planning and infrastructure management. To systematise our analysis, in Section 2, we develop a theoretical framework, linking the concept of institutional connectivity to current debates on the governance of urban and infrastructure resilience. We distinguish three dimensions of institutional connectivity (vertical, horizontal and territorial) and three resilience capacities (resistance, recovery and adaptability), as this differentiation permits detailed analysis of how specific dimensions and forms of institutional connectivity change over time and impact the city's resilience. Section 3 introduces our methodology. A qualitative case study approach using in-depth expert interviews as well as scholarly and grey literature allows us to discover the political dimension of institutionalised interaction across policy domains, policy levels and territorial jurisdictions. Moreover, such an approach helps when considering some aspects of the increasing complexity and uncertainty induced by disaster situations. In Section 4, using our analytical dimensions, we describe institutional reforms in Greater Christchurch before and after the earthquakes. In Section 5, we discuss these institutional reforms and elaborate on the influence of connectivity on urban and infrastructure resilience in order to answer the research questions posed above. In Section 6 we conclude by calling for a nuanced view on issues of collaboration and we outline the value of using the concept of connectivity in debates on urban resilience.

## 2. The need for institutional connectivity in order to achieve urban and infrastructure resilience

Although the concept of resilience has undergone a surge in

popularity as an analytical and management-oriented concept for urban studies scholars and urban decision-makers as well for those involved in infrastructure management, there is no consensus on how it should be operationalised and institutionalised in urban governance systems (Chandler & Coaffee, 2017; Coaffee et al., 2018). Consequently, it has been argued there is a disparity between resilience as a policy objective and resilience as manifested in the implementation of risk management (Wagenaar & Wilkinson, 2015). However, scholars seem to agree on the need for policies and actors with joint responsibility for risk management to be better coordinated (Sapountzaki et al., 2011) and for the interdependencies of infrastructure networks to be taken into account (Hokstad, Utne, & Vatn, 2012). Many of them perceive human decision-making and institution building as being too fragmented and poorly coordinated to deal with the increasing interconnectedness of social, environmental and technical systems and with the complex demands of disaster risk management (McFarlane & Rutherford, 2008; Pearce, 2003). Therefore, it is generally accepted that in order to deal with complex change processes, governance systems should mirror the interconnectedness of the external world (Duit, Galaz, Eckerberg, & Ebbesson, 2010, p. 365). Moreover, it is argued that safety increasingly depends on the ability of the actors involved to break up existing policy silos and implement cross-boundary working relationships (Almklov, Antonsen, & Fenstad, 2012; Matyas & Pelling, 2015).

Breaking up silos and enhancing connectivity has been described as one of the main challenges to implementing urban resilience (Coaffee et al., 2018, p. 403) and infrastructure resilience (de Bruijne & van Eeten, 2007). However, it seems that resilience debates tend to overlook typical governance challenges of conflicting interests, politics and discordance about the allocation of costs and benefits; furthermore, they rarely address particular urban contexts and the uncertainties and institutional complexities entrenched in the governance of resilience. Moreover, although critical assessments of partnerships and networked governance approaches prevail in political science and sustainability studies (e.g. Forsyth, 2010; Khan, 2013), some scholars (Harman, Taylor, & Lane, 2015; Surminski & Leck, 2016) argue that the literature on urban and infrastructure resilience contains very few attempts to assess if institutional connectivity is always the best solution. In particular, the literature does not propose specific forms of connectivity for pursuing the goal of urban and infrastructure resilience. To explore this shortcoming, we differentiate between three dimensions of institutional connectivity that are referred to in case studies on urban and infrastructure resilience around the world – horizontal, vertical and territorial – and three capacities of resilient urban systems – resistance, recovery and adaptability. Below, we first distinguish between the three main dimensions of connectivity.

- a) *Horizontal connectivity*: Various authors (e.g. Almklov et al., 2012; McPhearson, Andersson, Elmqvist, & Frantzeskaki, 2015) call for institutional connectivity between different policy domains and infrastructure sectors. From a risk management point of view, it makes sense to focus on policy domains of emergency management, urban and regional planning, and infrastructure management, which can be subdivided into sectoral infrastructure management, as different ministries and governmental departments are responsible for managing or regulating different sectors. Per sector, ownership of the assets varies between public, semi-public and private. Actors across these policy domains potentially shape governance arrangements and outcomes.
- b) *Vertical connectivity*: Several scholars working on disaster risk and urban resilience (e.g. Dewulf, Meijerink, & Runhaar, 2015; Vedeld, Coly, Ndour, & Hellevik, 2016) have set out to identify new architectures in multi-level governance because the policy domains and infrastructure sectors involved are governed at different policy levels. For example, in New Zealand, highways and “roads of national significance” fall under the aegis of the national New Zealand Transport Agency, whilst municipalities are responsible for local

roads. Electricity supply networks can be divided into national and regional/local distribution networks. Although primarily regionally based, Emergency Management uses an upscaling disaster management approach: from local to national states of emergency. Moreover, recovery funding for large-scale disasters is shared between national and local government at specific ratios.

- c) *Territorial connectivity*: Cross-jurisdictional and territorial connectivity has been highlighted by, among others, Coaffee & Clarke, 2016; Monstadt & Schmidt, 2019. Infrastructures comprise a complex web and regularly expand beyond administrative jurisdictions (local or otherwise). In Christchurch, water supply and wastewater management are organised within the territorial jurisdictions of Christchurch City Council. Other infrastructure networks extend beyond the city's boundaries: for example, the electricity network extends north and includes parts of Waimakariri District. Similarly, various roads and other transport systems connect Christchurch to its neighbouring districts as well as to national and international destinations.

Despite the lack of a single definition of the concept of resilience with respect to cities and infrastructures (Elsner, Huck, & Marathe, 2018; Meerow, Newell, & Stults, 2016) and although in each city, different aspects are seen as being important for resilience (Johnson & Blackburn, 2014), three main strains of thought in resilience literature can be distinguished that highlight distinct resilience capacities (cf. Hegger et al., 2016).

- a) *Resistance*: the capacity to resist shocks and stresses, e.g. by protection measures.  
 b) *Recovery*: the capacity to absorb and recover from shocks and stresses, e.g. by crisis management or urban and regional planning.  
 c) *Adaptability*: the capacity to adapt and transform, e.g. by including learning processes in system design and management.

These differentiations allow a nuanced analysis of how institutional connectivity affects urban and infrastructure resilience. Moreover, taking an institutional perspective helps us to examine how connectivity is established or dismantled and to elaborate on the role of politics and actors' conflicting interests, and the particularities of disaster situations in this. It has been argued (Lowndes, 2001) that an institutional perspective helps when seeking to understand change in urban policy development, which confirms the appropriateness of our approach to the analysis of institutional reforms in Greater Christchurch.

For this study, we used the definition of institutions proposed by Young et al. (2008, xiii): "systems of rights, rules, and decision-making procedures... [that] give rise to social practices, assign roles to the participants in these practices and govern the occupants of the various roles". As such, institutions both enable and constrain cooperation and coordination between different actors in a governance regime. They can be formal or informal (North, 1990). Formal institutions are "rules and procedures that are created, communicated, and enforced through channels widely accepted as official" (Helmke & Levitsky, 2004, p. 727). Examples include written laws, regulations or standards. In contrast, informal institutions are "socially shared rules, usually unwritten, that are created, communicated, and enforced outside of officially sanctioned channels" (ibid) such as work routines, traditions and knowledge systems. As such, institutional connectivity might be shaped predominantly by formal or informal institutions, or its foundation can change from the one to the other. Fig. 1 illustrates the analytical framework for this study.

### 3. Methodology

Our qualitative research involved conducting 29 semi-structured expert interviews between February 2018 and December 2018 covering

the range of policy domains and policy levels outlined above. The interviewees were drawn from different infrastructure sectors and different territorial jurisdictions. They included civil servants as well as elected politicians, senior advisors and consultants, strategic decision-makers from public and private sectors and senior academics with in-depth knowledge of the case. All interviews were audio-recorded, transcribed and anonymised. The interviewees' roles and organisations are listed in Appendix 1. Evidence was also obtained from a range of other sources, such as policy documents, plans and strategies, audits, cabinet papers, project reports, newspaper articles and the plethora of academic work available on the earthquakes and their aftermath. Moreover, the first author of this paper attended workshops and conferences on infrastructure resilience in the region.

We used Qualitative Content Analysis (QCA) (Gläser & Laudel, 2013) to code, categorise and distil relevant information from the data in accordance with the analytical framework. In the first step, several processes of institutional reform relating to risk management, spatial planning and infrastructure management were defined. We did not stipulate the period investigated, thereby allowing interviewees to refer to institutional reform processes further back in the past if they considered them important for the city region's response to the earthquakes. The second step was to analyse the institutional reform processes in relation to the dimensions of institutional connectivity that they affected: horizontal, vertical and territorial. In addition, we focused on identifying conflicts of interest and on discovering uncertainties and complexities induced specifically by the disaster situation. This step allowed us to draw conclusions on how processes of connectivity building take place and how institutions shape connectivity. In the third step, we drew on these insights when assessing information on the city's capacities to resist, recover and adapt. Expert judgement was essential for drawing conclusions on how institutional connectivity affects urban and infrastructure resilience. Because expert interviews inevitably contain bias (Bogner, Littig, & Menz, 2009), we used several techniques to reduce it. For instance, during the interviews, the experts were confronted with the opinions of other experts; we also conducted follow-up discussions with selected interviewees in order to collect specific evidence and to avoid misinterpretations. Interview data was triangulated with existing academic literature as well with public media reports, governmental reports, plans, strategies and assessments. Preliminary results were presented and discussed at the Canterbury Earthquake Symposium in Christchurch on 29/30 November 2018 and a draft version of this paper was sent to all interviewees for their comments.

### 4. Risk management in Greater Christchurch: institutional reforms before and after the 2010–2011 Canterbury Earthquake Sequence

New Zealand is a high-income country with a constitutional monarchy. There are two main tiers of government: central and local. Local government is split into 11 regional councils and 66 territorial authorities (12 city councils and 54 district councils). Among regional councils' responsibilities are environmental management, regional transport planning and regional civil defence – the latter includes the provision of natural hazard information. The territorial authorities are responsible for the well-being of their local communities and the provision of civil infrastructure services, environmental health and safety, building control, district civil defence and land-use control (Government of New Zealand, 2015). With its 624,000 inhabitants, Canterbury Regional Council, also known as Environment Canterbury, is the second most populous regional council in New Zealand and the most populous on the South Island. It comprises ten territorial authorities, including the Christchurch City Council (388,500 inhabitants) and the neighbouring district councils of Waimakariri (60,700) and Selwyn (62,200), which together comprise the Greater Christchurch Area (511,400) (ECan, 2018).

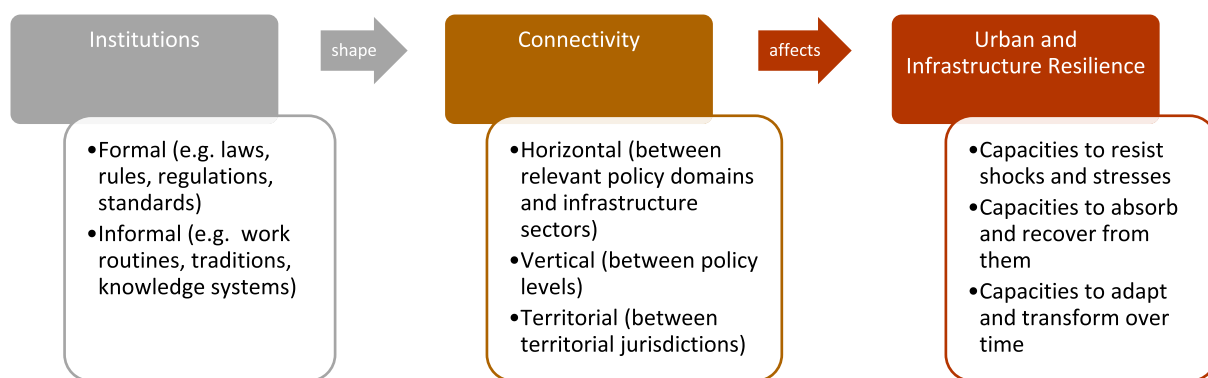


Fig. 1. Analytical framework used in this study.  
(Source: own overview)

New Zealand has a relatively well-established disaster risk management framework that pre-dates the Hyogo Framework for Action 2005–2015 (cf. MacAskill & Guthrie, 2016). The Civil Defence and Emergency Management Act 2002 sets generic objectives and assigns significant responsibility for decision-making to the local governments. Regional Civil Defence Groups are typically led by mayors or their representatives and essentially represent a consortium of local authorities, emergency services and critical infrastructure providers that in New Zealand are called lifeline utilities (Glavovic, Saunders, & Becker, 2010). The Act requires lifeline utilities to “ensure that [they are] able to function to the fullest possible extent, even though this may be at a reduced level, during and after an emergency” (MCDEM, 2002). Despite this obligation, there are barely any mechanisms in place to assess or enforce emergency planning of lifeline utilities (Interviews 2, 11).

Although earthquakes are common in New Zealand, the Canterbury Earthquake Sequence was unexpected and revealed the presence of previously unknown geological faults. Tremors were first felt in and around Christchurch at 4.35 a.m. on 4 September 2010. The Mw 7.1 earthquake – commonly referred to as the “Darfield Earthquake” – had its epicentre approximately 40 km west of Christchurch but was felt widely across the South Island. It caused widespread damage and several power outages but no directly related fatalities. However, the earthquake was followed by a series of aftershocks. The most devastating Mw 6.3 aftershock occurred on 22 February at 12.51 p.m. very close to Christchurch city centre, and at shallow depth. In addition to causing 185 deaths, the “Christchurch Earthquake” destroyed or damaged most of central Christchurch’s built environment and large parts of the metropolitan infrastructure networks (Cubrinovski et al., 2014, 2015). The second most important cause of infrastructure damage after seismic movements was liquefaction. As described in the introduction, Christchurch did not suffer an infrastructure crisis with cascading effects of failing services, but service provision varied significantly between different parts of the city, with the central business district cordoned off for up to two years.

Because of their aftermath of thousands of aftershocks, the earthquakes do not represent a single point in time from where the city had to recover, but rather a period of constant uncertainty and fear. Although different phases of disaster risk management overlap, for reasons of readability, we follow a chronological order and subdivide our case analysis into the different phases they were referred to in interviews and grey literature: 1) Pre-earthquake developments, often referred to as “peace-time”; 2) Response (times of local, regional, or national states of emergency); 3) Recovery (short- and medium-term recovery after humanitarian needs have been met), 4) Regeneration (long-term recovery and regeneration activities); 5) Back to normal? (Establishment of new business-as-usual practices). Fig. 2 represents an overview.

#### 4.1. Pre-earthquake developments in Christchurch

In Christchurch, future-oriented asset management began by being complicated by the amalgamation of six boroughs into the Christchurch City Council in 1989. An interviewee recalls that asset managers had difficulty understanding each other’s management practices at the time that digitisation was becoming commonplace and “*paper drawings in the bottom drawer haven’t been pulled out and shared and understood*” (Interview 4). In this sense, creating connectivity between territorial jurisdictions without building institutional capacity to manage previously separated infrastructure systems led to rather reactive asset management procedures, which were overwhelmed by the task of emergency response to the earthquakes (Interview 4).

Stakeholders from different infrastructure sectors nevertheless started to collaborate in an informal project setting within the Centre for Advanced Engineering at the University of Canterbury. As a result of this collaboration, the Risks and Realities Report (Centre for Advanced Engineering, 1997) provided sector-specific and cross-sector risk assessments and proposed protection and mitigation measures. Meanwhile, the ad-hoc collaboration of the parties involved (including infrastructure providers) transformed into the Canterbury Lifelines Group. From the interviews we infer that lifelines that successfully resisted the earthquakes benefitted from this cross-sectoral work and from building relationships and signing mutual aid agreements within and beyond their sector (Interviews 1, 7, 27). For example, interviewees employed by the regional electricity provider Orion noted that the report was one of the main reasons for Orion to invest in resilience (Interviews 8, 25). However, the report failed to have impact beyond the boundaries of the project team (Interview 22). A major issue was that risk information rarely penetrated as far as to spatial planning decisions in the city council, with the result that some land-use decisions were unjustifiable from a risk management perspective, such as developments on liquefiable ground (Interviews 3, 6) (cf. MacAskill & Guthrie, 2016). These examples show that though institutional connectivity between infrastructure sectors helps build a city’s capacity to resist, this capacity can be stultified by a lack of connectivity between policy domains.

In 2004, the city council and its neighbouring districts Selwyn and Waimakariri entered into partnership with the Environment Canterbury regional council and the New Zealand Transport Agency to manage growth in the city region. The resulting Greater Christchurch Partnership devised the Greater Christchurch Urban Development Strategy (CCC et al., 2007). As described in Section 4.4, this cross-jurisdictional Partnership proved to be particularly helpful for post-earthquake regeneration.

In March 2010, shortly before the Darfield Earthquake, regional water management issues resulted in 14 elected regional councillors in Environment Canterbury being replaced by commissioners appointed

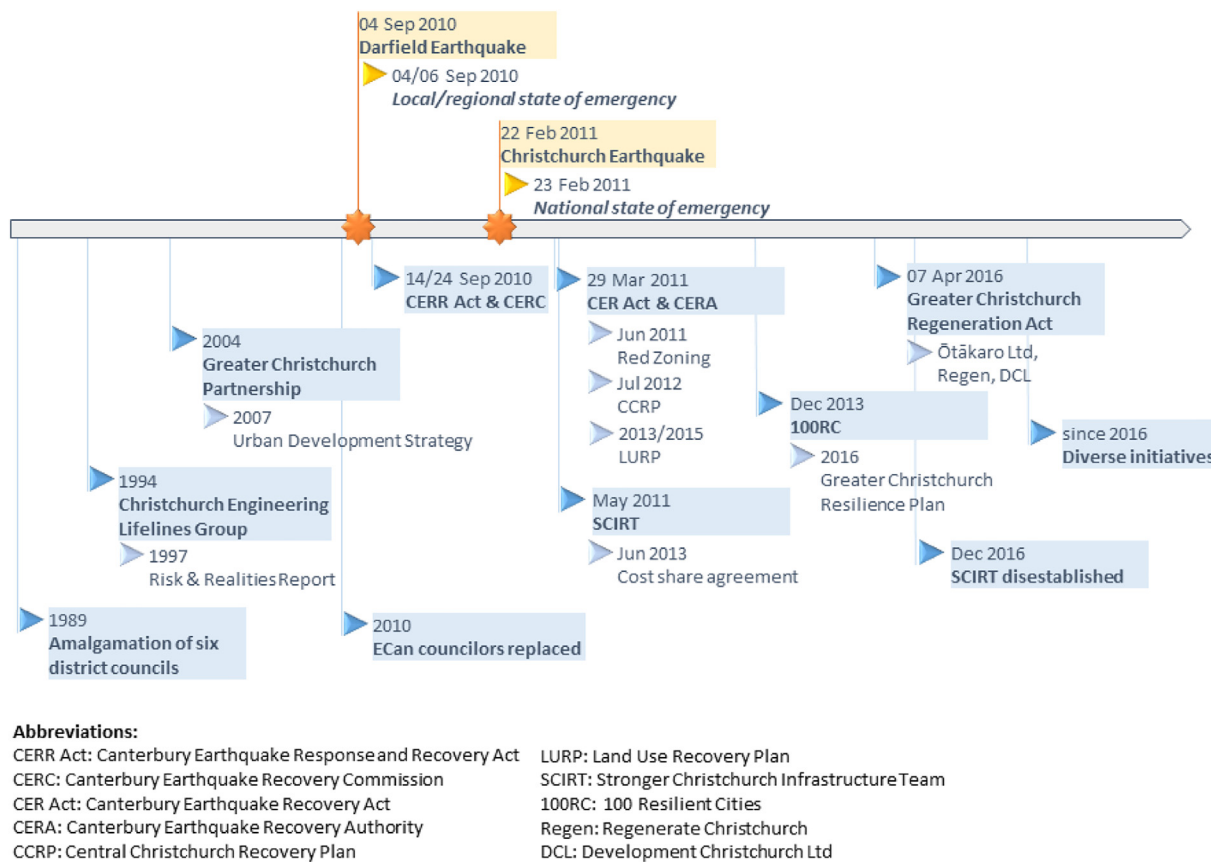


Fig. 2. Timeline with main institutional reforms. (Source: own overview)

by central government. This action took place at a time of relative political uncertainty and dispute about the future of Greater Christchurch and provoked political dissent between the city council and its neighbouring districts as well as between local, regional and national policy makers. Interviewees described the relationship between the city council, Environment Canterbury and central government as troublesome, non-trusting and tremendously uncooperative (Interviews 1, 3, 4, 7). These cross-jurisdictional and cross-level discrepancies subsequently significantly hampered response and recovery work in Christchurch, as outlined in the following sections.

4.2. Response: local, regional and national states of emergency

Responding to the Darfield Earthquake, the three affected local authorities – Christchurch City Council, Waimakariri and Selwyn – announced the local state of emergency; the regional state of emergency was announced two days later. Our analysis reveals that during the following weeks there was a major disconnect between the city council, Environment Canterbury and central government due to political disagreement and personal disagreement between key decision-makers (cf. Parker & Farrington, 2012). Many interviewees accused the city council of being extremely uncooperative and unwilling to work in the foreseen emergency structures that would place response coordination in the hands of the regional coordinator (Interviews 7, 11, 24). One day before the local state of emergency ended, the government introduced the Canterbury Earthquake Response and Recovery (CERR) Act and established the Canterbury Earthquake Recovery Commission consisting of the mayors of the three affected territorial authorities plus one representative each from Environment Canterbury and central government. However, this did not change matters but instead created confusion about who was in charge of the overall recovery (Brookie, 2014,

p. 260). An official review concluded that local civil defence and emergency structures were dysfunctional and that recovery from the Darfield Earthquake had stalled by the time of the Christchurch Earthquake (McLean, Oughton, Ellis, Wakelin, & Rubin, 2012). In this sense, vertical and territorial connectivity that was institutionalised during a crisis situation did not bring the expected outcome of better cooperation but was outweighed by existing political discrepancies. This was one of the reasons why central government stepped in directly after the Christchurch Earthquake and declared a national state of emergency: an action that put the Director of the Civil Defence Ministry in charge of the response, implementing a clear command and control structure.

Two interviews (11, 24) confirm that political disputes played hardly any role in the acute response phase. Hence, the concentration of decision-making power for emergency response in a national authority contributed greatly to the city's capacity to resist. In terms of immediate infrastructure recovery at a technical level; however, our interviews suggest that the shift of responsibility caused some delay in early response work, as the staff responsible (i.e. national lifeline controllers) were not familiar with the regional specifics and had not been actively involved in existing regional networks (Interview 25). This indicates a trade-off, in the sense that vertical connectivity enforced by the national state of emergency did help to temporarily sidestep political dissent, but also contributed to negative consequences on infrastructure networks' capacities to resist and recover. Moreover, in the next section we show that the concentration of decision-making power in hierarchical structures was transmitted to the recovery phase, where it gave rise to major disputes and negatively affected the city's capacity to recover.

### 4.3. Recovery: rebuilding a city

The Canterbury Earthquake Recovery (CER) Act 2011 came into force on 19 April of that year, repealing the Canterbury Earthquake Response and Recovery (CERR) Act. It established the Canterbury Earthquake Recovery Authority (CERA), a government department with former energy minister Gerry Brownlee functioning as Minister of Earthquake Recovery to lead the recovery process and to create and maintain working relationships with the local authorities. CERA had powers under the Act to decide reconstruction priorities, compulsorily acquire land, enter premises, undertake works and demolish and dispose of dangerous buildings (Brookie, 2014, p. 262). Moreover, the Act allowed a recovery plan approved by the Minister to override the requirements of New Zealand planning legislation frameworks embodied in the Resource Management Act, the Conservation and Reserves Acts and large parts of the Local Government Act and the Land Transport Act (Brand & Nicholson, 2016). Therefore, CERA can be described as an organisation encompassing all three connectivity dimensions whilst simultaneously concentrating extraordinary decision-making power in the person of Gerry Brownlee, a representative of the national government. An early report on roles and responsibilities in recovering from the earthquakes (Office of the Auditor-General, 2012) stresses the need for collaboration between CERA and other public sector agencies, communities, non-governmental organisations and the private sector.

CERA's status as a national department strengthened horizontal connectivity between different policy fields at the national level (Parker & Farrington, 2012, p. 172). However, a former CERA staff member recalled that it became increasingly difficult to coordinate vertically across policy levels due to the existing political discord (Interview 21). Disagreement between the city council and central government peaked in 2013, "when the real costs of recovery became visible" (Interview 22). Dissent grew on a number of occasions: for example, during the development of a Central City Recovery Plan which CERA took over from the city council. Whilst the Auditor-General's Report stresses the need for closely involving the city council as well as Christchurch's citizens (Office of the Auditor-General, 2012, p. 61) the council felt "stripped of their authority" (Parker & Farrington, 2012, p. 161) and citizens felt left out of the discussion. Moreover, CERA developed a zoning plan in which red-zoned land was deemed unsuitable for redevelopment due to the extent of damage and expected future risk and so homeowners were offered the opportunity to be bought out. However, some decided to stay and others in more rural areas out of CERA's zoning exercise's scope were never given a buyout option (Interview 22). Under the provisions of the Local Government Act, the city council had to continue providing services to single premises in areas where most residents had left, which was immensely costly. Several interviews (18, 20, 29) suggest that such negative side-effects could have been avoided if the environment had been more conducive to collaboration. It seems that the existing conflicts and different interests of local and central government clashed with the hierarchical approach to recovery. This complicated the recovery process by undermining well-intended vertical and horizontal connectivity.

The recovery of publicly owned networked infrastructure was organised in an unprecedented institutional setting by establishing the alliance-based Stronger Christchurch Infrastructure Rebuild Team (SCIRT), which was funded by CERA, the city council and New Zealand Transport Agency and included five of New Zealand's largest contracting companies as non-owner participants. The unique alliance structure bypassed competition between the construction companies and created a climate of cooperation (see Walker, Vries, & Nilakant, 2017 for detailed discussion). However, a review by the Auditor-General (Office of the Auditor-General, 2013) revealed that despite collaborative intentions, CERA failed to actively engage in SCIRT operations, resulting in a lack of direction. In addition, a contretemps between CERA and the city council culminated in disagreement about financing infrastructure recovery. Because central government contributes 60%

to the cost of repairing infrastructure after a disaster, CERA feared overspending and that the government would effectively finance the council's regular infrastructure renewal costs. This led to new cost-sharing negotiations and to subsequent changes to the design guidelines applied within SCIRT. The new design guidelines slowed down the recovery process by putting projects on hold, changing project outlines and erasing projects from SCIRT's portfolio. Moreover, recovery funding and insurance barely paid for improving infrastructure systems beyond the pre-earthquake state (see MacAskill, 2016, p. 162 for a detailed discussion). The inability to agree on financing resilience improvements (MacAskill & Guthrie, 2018) and the protracted decision-making caused by the misalignment of SCIRT's rapid operational pace with the slower progress of strategic planning by CERA (Office of the Auditor-General, 2013, p. 7) considerably reduced the city's capacity to adapt and exploit the opportunities arising from the vertical connectivity formalised in response to the disaster.

### 4.4. Regeneration: long-term recovery in Christchurch

In 2013, the Land Use Recovery Plan, an important strategic planning document for regeneration, was developed to supplement the existing Greater Christchurch Recovery Strategy. Interestingly, the Greater Christchurch Partnership proved to be particularly helpful because it could provide 1) a pre-agreed common understanding across territorial jurisdictions of how the region should be developed and 2) a range of existing analyses which accelerated the process of developing the plan. It was a lucky coincidence that the scope of the partnership exactly matched the spatial scope of direct earthquake effects. The partnership itself has since adapted a more recovery-related approach and in 2016 updated the Urban Development Strategy and expanded its partner base. The portfolio of common planning goals has been enriched by a transport statement, a freight strategy and a Greater Christchurch Resilience Plan (see below). Previously established cross-jurisdictional and cross-level connectivity in the form of the Greater Christchurch Partnership arguably supported the city region's capacity to recover and has proved to be contributing importantly to its ability to adapt in the future.

In 2016, the Canterbury Earthquake Recovery Act expired and with it, CERA. The Greater Christchurch Regeneration Act 2016 marked a transition period from recovery to regeneration. Ōtākaro Ltd., a government-led agency, now manages some of the crown-led anchor projects in the central city. Development Christchurch Ltd., the city's new urban development agency, leads development projects in Christchurch's eastern suburbs. Regenerate Christchurch, co-led by the central government and the city council, is overseeing the regeneration of Christchurch, with a focus on the central business district, the coastal suburb of New Brighton and the Red Zones. One interviewee (10) sees these changes positively in that responsibilities are now more clearly allocated and the city is slowly becoming the master of its own destiny again. However, there are still major uncertainties with regard to how long-term recovery is managed. For example, at the time of data gathering, it was still unclear who would own, govern and fund land development in the Red Zones (McDonald, 2018). In addition, another interview (4) suggests that the different organisations, specifically local and national government, still lack a cooperative attitude, which is slowing down the regeneration process. Moreover, changes in national government – in 2017 the Labour Party took over from the National Party – have led to much uncertainty about future arrangements (Interview 1). In this sense, Greater Christchurch is still struggling to find its optimum in terms of institutionalising connectivity, particularly across policy levels and policy domains.

### 4.5. Back to normal? New developments and lessons learned from the earthquakes

A range of ongoing initiatives across all policy levels can be ascribed

to learning processes from the earthquakes; several are specifically aimed at increasing institutional connectivity. For instance, the new Justice and Emergency Services Precinct in Christchurch hosts city, regional and national civil defence offices in one open-plan floor of a building, to increase the vertical connectivity of emergency services. Moreover, the Canterbury Lifelines Group is currently updating the 1997 Risks and Realities report. The new report – “Risk and Resilience” – widens the scope to regional level and aims to increase working relationships between different infrastructure sectors (Interviews 9, 16). In addition, the apparent gap between local and regional decision-makers is being approached both formally and informally. For instance, the Mayoral Forum has been revitalised as a virtual unitary mechanism to serve as a coordinating body between local authorities. This formal cross-jurisdictional collaboration is considered beneficial for knowledge exchange and coordination (Interviews 9, 14). In addition, the council is collaborating with the Canterbury Civil Defence Group on a project called “regional approach to natural hazards” that aims to define responsibilities and links across different organisations more clearly and to better involve civil defence officers and asset managers in spatial planning processes. Moreover, the council is striving to involve emergency services in engineering codes of practice to ensure infrastructure is designed to meet risk management requirements. However, this cross-domain initiative is struggling to receive support from higher political levels and thus lacks formative impact at this stage (Interviews 23, 26). Nevertheless, interviewees find that the relationship between the city council and Environment Canterbury has greatly improved since pre-quake times (Interviews 2, 4, 23).

Another example of institutional reform is Christchurch's participation in the Rockefeller Foundation's 100 Resilient Cities programme (100 RC, 2019) and the development of a resilience plan for Greater Christchurch in close collaboration with the Greater Christchurch Partnership (CCC, 2016). Whilst interviewees described the development process, which involved a vast number of stakeholders in and around Christchurch, as extremely valuable to encourage conversations across policy domains, the momentum seems to be tailing off as responsibility across different projects is distributed among participating organisations with little need for cooperation. Regular large-scale cross-domain consultation comparable to the development phase of the plan is considered desirable by interviewees (Interviews 3, 12) but is not foreseen in the near future. Moreover, the timing of the development of a resilience strategy was described as unfortunate because the respective actors were busy with recovery and were already operating under enormous time pressure and resource constraints (Interview 12). Finally, the voluntary and informal character of the resilience plan raises doubts about how successfully it can be integrated into existing plans and strategies in the future (Interviews 10, 12, 29).

The learning processes and institutional adaptation appear to vary tremendously. After SCIRT was disestablished in 2016, the city council incorporated the remaining repairs in their business-as-usual asset management programme. The changes in design guidelines described in Section 4.3 are adding to the city's bill for regular maintenance work. For instance, the costs of wastewater asset management in the city are expected to rocket in the next couple of years due to postponed recovery work (CCC, 2018). The postponement might be partly attributable to institutional disconnect between the city council and SCIRT, as business-as-usual maintenance remained the city council's responsibility whereas repairing earthquake damage was SCIRT's responsibility (MacAskill & Guthrie, 2017). In addition, although the city council was one of three owner organisations of SCIRT, interviewees from SCIRT and from the city council regret that the council has made only very limited use of lessons learned from SCIRT for taking over earthquake repairs and for delivering effective asset management (Interviews 4, 17). It seems that the city council is sticking to traditional working habits and that SCIRT's contribution to institutional adaptation in the long term has been negligible: the institutional connectivity SCIRT provided during the recovery phase was temporary and as it affected

earthquake repairs only and was not incorporated into business-as-usual practices, it was limited in scope.

## 5. Discussion: institutions, connectivity and resilience

Our empirical analysis of Greater Christchurch reveals that enhancing connectivity is a highly political and contested process and that it is a fluid construct. The cooperation of different actors waxes and wanes, the connectivity between all three dimensions analysed becomes institutionalised and de-institutionalised, and conflicts between different parties intensify and decline. Our results confirm that large-scale disasters potentially foster changes in institutional arrangements and organisational structures. More explicitly, actors across the analysed policy levels, policy domains and territorial jurisdictions identified specific gaps in connectivity, and various initiatives are attempting to close them (see e.g. Section 4.5). However, the case study also shows that enhancing the institutional connectivity for risk management is not a smooth process, as it often encounters entrenched and conflicting interests of key players and requires the reallocation of resources. As such, the insights yielded by this study reveal four interesting points that are worth discussing in respect to the research questions introduced in Section 1.

Firstly, we found that institutional connectivity may appear in various forms and is shaped by, but not limited to, the cooperation between different organisations and actors in a specific field. It may entail a) the integration or amalgamation of policy domains, policy levels or territorial jurisdictions into one coherent arrangement, b) institutionalised forms of cross-boundary collaboration and coordination or c) ad hoc, temporary or informal cooperation of actors across boundaries. Moreover, institutional connectivity can comprise hierarchical decision-making structures, as exemplified in CERA or more partnership-oriented liaisons like SCIRT. It became apparent that institutional connectivity can be derived bottom-up, with several actors recognising the benefits of enhanced cooperation and coordination, as the case of the Canterbury Lifelines Group shows. However, it can also be enforced top-down, as was the case when the national government established CERA. The case of Greater Christchurch shows that adopting a particular form of institutional connectivity is neither right nor wrong. Rather, what determines which form of connectivity is preferable depends on the circumstances. For instance, whilst a hierarchical form of connectivity induced top-down might bring benefits for direct response to disasters, long-term recovery might require more networked forms of governance prompted in a bottom-up manner.

Secondly, our analysis shows that different connectivity dimensions had very specific impacts on the three resilience capacities of resistance, recovery and adaptability. For instance, links between policy levels proved to be especially important for the capacity to recover from disasters when local authorities lack the capabilities and resources to adequately respond. The institutionalised connection between the city council and the national government within CERA drastically impacted recovery work both positively and negatively (see Section 4.3). Apart from that, coordination between different policy domains is an essential prerequisite for building the capacity to adapt and transform over time. This becomes visible in the lack of connectivity between civil defence, spatial planning and infrastructure management prior the earthquakes (Section 4.1). Then again, connectivity between territorial jurisdictions proved to be important for long-term recovery goals in the regeneration phase, as the example of the Greater Christchurch Partnership (Section 4.4) shows. Therefore, and in critique of the main body of literature, we argue that approaches to enhance connectivity require critical review and prioritisation in terms of what particular forms and dimensions of connectivity should be enhanced according to the prevailing circumstances.

Thirdly, the case reveals that recovery, regeneration and adaptation are contested processes where entrenched political and financial interests of individual actors or involved political parties are at stake,

institutional or financial resources are reallocated and power imbalances and disputes over autonomy become visible. It also became clear that cross-boundary decision-making processes in response and recovery are highly influenced by the personal relationships and economic and political interests of the actors involved. Along with uncertainty about roles and responsibilities, diverging interests of the actors involved or poor personal relationships might cancel out the positive effects of formally institutionalised connectivity. For example, in the response phase to the Darfield Earthquakes institutionalised connectivity for disaster response between the city council and Environment Canterbury was essentially ineffective due to personal and political conflicts between key actors. Moreover, a lack of clarity about roles and responsibilities, no common understanding about recovery targets and misaligned paces of decision-making were among the main reasons for the difficulties CERA and SCIRT experienced in aligning local and national stakes. These insights stand in contrast to the often unpoliticised call for institutional connectivity in academic debates on risk management and urban resilience. Because institutions shape the way different agencies and organisations interact, we believe that processes of institutional reform and the politics involved should receive more attention in these strands of literature.

Fourthly, during response to and recovery of a large-scale disaster, limitations in time and financial resources as well as public pressure might complicate approaches to enhance connectivity and constitute some of the complexities and uncertainties of resilience governance. After all, coordination and cooperation cost time and money which cannot be invested elsewhere. Often, scarce resources are used to quickly reinstall services for the community rather than to introduce new innovative ways to adapt and transform (cf. MacAskill & Guthrie, 2015). This contributes to preserving the status quo and shows that emergency situations might provoke trade-offs between different resilient capacities (i.e. resistance, recovery, adaptation). The case of the Greater Christchurch Partnership demonstrates the positive effects of pre-agreed arrangements, plans and processes for response and recovery. At the same time, the difficulties of reaching cross-boundary agreements in CERA and the challenges in developing the Greater Christchurch Resilience Plan in the midst of recovery exemplify the difficulty of enhancing connectivity shortly after a disaster. Moreover, our results show that disaster situations can provoke temporary institutional reforms. Whilst institutions are usually designed for longer time periods, the case of the Canterbury Earthquake Recovery Act and of SCIRT's design guidelines show that institutional connectivity that has been established in the aftermath of a disaster might be only temporary. Conversely, connectivity institutionalised before the disaster, as was the case for the Greater Christchurch Partnership or the Canterbury Lifelines Group, tends to remain in place and become more important for shaping the city region's future. This finding supports existing work on Christchurch's recovery demonstrating the need for clearer terms of engagement between central and local government (MacAskill & Guthrie, 2018). Consequently, the point in time at which connectivity is enhanced matters hugely. These insights can contribute to a better understanding of how the uncertainties and complexities induced in disaster situations affect connectivity building and make clear that institutional connectivity should ideally be in place prior to a disaster.

## 6. Conclusion

Enhancing institutional connectivity is often described as the main way of achieving resilient cities and infrastructures. However, calls for more cooperation in risk management often remain vague and do not fully take account of the politics involved in institutional reform or of

## Appendix 1. List of interviews

Sometimes, two persons were interviewed simultaneously, e.g. to stimulate discussion between representatives of two organisations or because interviewees asked knowledgeable personnel from their organisation to join in the conversation. Interviews lasted between 45 and 120 min. In total,

the uncertainties and complexities associated with disaster situations. The results of our analysis of the institutional reforms in the city region of Greater Christchurch eight years after the devastating Canterbury Earthquake Sequence suggest that different forms of institutional connectivity are unequally important for enhancing urban resilience; they depend on prevailing circumstances. Moreover, we found that enhancing institutional connectivity is a resource-intensive and contested process that might induce negative trade-offs.

The concept of connectivity provided us with a lens for analysing the effects of practised and missing coordination and cooperation on the resilience of a city region. Specifically, it proved to be useful for identifying and analysing different forms and dimensions of connectivity and their effects on particular resilience capacities such as resistance, recovery and adaptability. Our conclusion that these effects differ depending on the circumstances enriches existing literature on urban resilience, which so far has paid little attention to such nuances. Moreover, the results of our analysis highlight the importance of politics for processes of institutional reform. Because the interaction of agencies and actors is shaped by institutions, contested processes of institution building deserve more attention in the literature on urban and infrastructure resilience. We argue that scholars of risk management should not see institutional connectivity as a goal in itself but rather as contested processes that can either support or impede specific resilience capacities. This might make it possible to define more accurate and appropriate institutional prerequisites for implementing resilience in existing urban governance arrangements on a case-by-case basis. Accordingly, risk management and urban resilience practice can benefit from a more nuanced and contextualised view of institutional connectivity by prioritising and defining bespoke connectivity needs for the given situation (e.g. acute response vs. long-term recovery) that lend themselves to be fostered by particular resilience capacities (e.g. resistance vs. adaptability). We thus encourage other researchers to critically apply the concept of institutional connectivity in resilience research so as to enrich conceptual discussions and to further explore the implementation gap of urban resilience.

## Author statement

**Andreas Huck:** Conceptualisation, Methodology, Formal analysis, Investigation, Writing – Original Draft, Visualisation, Project administration.

**Jochen Monstadt:** Conceptualisation, Writing – Review & Editing, Supervision.

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there were 21 interviews and 8 follow-up discussions with 27 interviewees. Table 1 represents an overview.

Table 1  
Overview of interviews.

Interview #	Organisation/former organisation	Date	Place	Type of interview
1	100 Resilient Cities – Asia Pacific: senior manager	15.02.2018	Darmstadt/Singapore	Skype
2	Resilient Organisations Ltd.: senior manager	09.04.2018	Christchurch	Face to face
3	Canterbury Civil Defence and Emergency Management Group: civil servant	16.04.2018	Christchurch	Face to face
4	Stronger Christchurch Infrastructure Recovery Team: senior manager	19.04.2018	Christchurch	Face to face
5	Canterbury University – Engineering: senior academic	20.04.2018	Christchurch	Face to face
6	Lincoln University – Environmental management: senior academic	26.04.2018	Lincoln	Face to face
7	Canterbury Lifelines Group: senior advisor	30.04.2018	Christchurch	Face to face
8	Canterbury Earthquake Recovery Authority: senior manager	30.04.2018	Christchurch	Face to face
9	Waimakariri District Council: civil servant	02.05.2018	Rangiora	Face to face
10	Greater Christchurch Partnership: civil servant	03.05.2018	Christchurch	Face to face
11	Development Christchurch Ltd.: senior manager	04.05.2018	Christchurch	Face to face
	National Infrastructure Unit: board member			Face to face
12	Christchurch City Council: civil servant	07.05.2018	Christchurch	Face to face
13	Christchurch City Council: civil servant	08.05.2018	Christchurch	Face to face
14	Canterbury Lifelines Group: senior advisor	10.05.2018	Christchurch	Face to face (follow-up)
15	National Lifelines Council: senior manager	14.05.2018	Christchurch/Wellington	Skype
	Land Information New Zealand: senior manager			Skype
16	Canterbury Lifelines Group: senior advisor	21.05.2018	Christchurch	Face to face
17	Christchurch City Council: civil servant	25.05.2018	Christchurch	Face to face
18	Stronger Christchurch Infrastructure Recovery Team: senior manager	25.05.2018	Christchurch	Face to face (follow-up)
19	Wellington Lifelines Group: senior manager	18.10.2018	Wellington	Face to face
20	Christchurch City Council: civil servant	23.10.2018	Christchurch	Face to face (follow-up)
21	Canterbury Earthquake Recovery Authority: senior manager	23.10.2018	Christchurch	Face to face (follow-up)
22	Canterbury Earthquake Recovery Authority: senior advisor	25.10.2018	Tai Tapu	Face to face
23	Canterbury CDEM Group: civil servant	26.10.2018	Christchurch	Face to face
	Christchurch City Council: civil servant			Face to face (follow-up)
24	Ministry of Civil Defence and Emergency Management: civil servant	30.10.2018	Christchurch	Face to face
25	Orion: senior manager	31.10.2018	Christchurch	Face to face
	Orion: senior manager			Face to face
26	Canterbury CDEM Group: civil servant	01.11.2018	Christchurch	Face to face (follow-up)
27	Resilient Organisations Ltd.: senior manager	15.11.2018	Christchurch	Face to face (follow-up)
	Resilient Organisations Ltd.: senior manager		Christchurch/Christchurch	Skype
28	Christchurch City Council: civil servant	07.12.2018	Christchurch	Face to face (follow-up)
	Christchurch City Council: civil servant			Face to face
29	Christchurch City Council: politician	14.12.2018	Christchurch	Face to face

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