National SCIENCE Challenges

RESILIENCE TO NATURE'S CHALLENGES

Kia manawaroa – Ngā Ākina o Te Ao Tūroa

An evaluation and lessons learned from responses to the Kaikōura earthquake: Workshop Summary Report

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Resilience to Nature's Challenges: An evaluation and lessons learned from responses to the Kaikōura earthquake

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Disclaimer

The findings in this report are those derived from a workshop in November 2017, as part of the first stage of the project presented herein, and do not necessarily reflect official policy or position of any agency. Examples presented within this report relate to situations that occurred following the 2016 Kaikōura earthquake only, and other events (with different spatial and temporal characteristics) will likely reveal different results.

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1. Introduction

1.1. Background

This report presents an overview of the project entitled 'Resilience to Nature's Challenges: An evaluation and lessons learned from responses to the Kaikōura earthquake', a collaboration between the Resilience to Nature's Challenges National Science Challenge (subsequently referred to as the Challenge), QuakeCoRE and the Ministry of Transport (MoT). It operates at the intersection of three of the Challenge's strategic research areas or 'Toolboxes'—Governance, Resilience Trajectories, and Distributed Infrastructure—and the Challenge's Rural laboratory—through the examination of mobility using transport networks in the aftermath of the Kaikōura earthquake.

The focus of this report is the outcomes of a workshop held in Wellington on 22 November, 2017, as part of the first stage of this project. This workshop looked to explore the decision-making process and information usage of key stakeholders following the 2016 Kaikōura earthquake.

Transport Networks

Society in New Zealand relies on the continual movement of people and goods between different locations, which in turn relies on resilient transport networks. The ability of transport networks to provide mobility depends on functional transport infrastructure such as roads, rail, and ports that allow people and goods to be transferred, and on the continuous supply of other critical infrastructure such as electricity and fuel supply.

Management and investment decisions about transportation use are made at many levels. End-users decide when, where, and how to make a journey. Operators decide how resources are deployed, for example, where to undertake maintenance or to manage flows. Investors and planners decide short- and long-term priorities for spending, as well as designs that are 'fit for purpose'. Other agencies and sectors make decisions about operations and future use based on level of service expectations and resilience ratings for different transportation sections. This study investigates when, how, and why such decisions were made following the Kaikōura earthquake, a summary of which is provided below.

Kaikōura Earthquake

The Mw 7.8 Kaikōura earthquake occurred just after midnight on 14 November 2016. The event involved a series of ruptures approximately 15 km deep in the North Canterbury region, centred 15 km from Culverden, New Zealand (GeoNet, 2016). The event caused substantial damage to road, rail, and port infrastructure, resulting in consequences for the operation of New Zealand's transport system with substantial implications for residents, tourists and businesses, particularly in the Canterbury, Marlborough and Wellington regions (Bradley et al. 2017, Davies et al. 2017). Given the impacts to State Highway 1, the Main North Line railway, Port Marlborough and CentrePort Wellington, it is important that we learn from this event. Lessons following the earthquake, including those resulting from this project, can inform key decisions during the response and recovery phases of future natural hazard events and assist investment decisions to improve the resilience of New Zealand's transport system.

1.2. Project Aims And Objectives

This report forms part of a project aimed at enhancing New Zealand's transport system resilience by analysing decisions and information needs following the Kaikōura earthquake. The overall project aims to:

1. Observe and understand the pace at which the transport system, infrastructure and supply chain adapted to earthquake-related disruptions.
2. Understand how information was used to make decisions about all transport modes (road, rail, air, and coastal shipping) so that lessons can be identified from the event to improve how the transport sector manage, plan, and invest in the transport system.
3. Identify short, medium, and long-term measures for on-going performance monitoring of the transport system. This may include recommendations around how best to centralise resilience, recovery, and response related information and developing a case for a centralised data warehouse to share information that currently exists in different sectors and organisations.

The learnings from this project will be used to inform decisions on better use of all transport modes and on how to manage, plan, and invest in a more resilient transport system. The main project stages are:

1. A workshop and workshop summary report (the focus of this report).
2. Interviews and extended data collection to build on the workshop outcomes.
3. A data collection and monitoring structure.
4. A final project report.

The findings from the workshop summary report will be combined with the findings from interviews and extended data collection to compile a final project report that will address Aim 1 and 2 above. This will also inform Aim 3 through the development of the proposal for a further potential project focussing on ongoing performance monitoring, developed in subsequent stages of the project.

1.3. Workshop Aims and Objectives

The workshop was designed to explore the decision-making process and information usage of key stakeholders. A range of organisations were brought together in a collaborative workshop setting, enabling the sharing of response and recovery strategies and identifying important links. The workshop focused on identifying and gathering necessary information that cannot be collected remotely and/or through routinely collected data. It also sought to identify where additional data sources exist to inform extended engagement after the workshop.

A key focus of the workshop was to understand what data were available and what data were not available that would have been important for decision-making following the earthquake. The workshop attendees examined topics including:

- Data coverage (e.g., data ownership/stewards, acquisition frequency)
- Understanding data barriers (e.g., consistency of metadata standards)
- Data governance issues (e.g., what data can be made public and at what level)

The workshop covered data and decision making under the following broad categories:

1. *Physical transportation infrastructure*
   Levels of service including conditions, quality, closure information, disruption of individual modes (e.g. rail or road). This will leverage off the RNC funded Project A summarised in Appendix A.
2. *Transport services for people and freight across all modes*

Aviation (scheduled and non-scheduled services); maritime (national & international shipping, ferry services); rail; road.

3. *Fuel supply and fuel infrastructure*
   Access to fuel security, fuel infrastructure impacts.
4. *Indirect impacts, including substitution and pricing effects*
   Travel times, additional business costs, additional personnel requirements, just-in-time practices, freight pricing dynamics, use of alternative business practices (e.g. teleconferencing).
5. *Displacement of residents and transient populations*
   Tourists, seasonal workers, etc. This will leverage off the RNC funded Projects B and E summarised in Appendix A.

2. Method

2.1. Participant Recruitment

Stakeholders from the main public and private transport entities, central and local government, infrastructure providers, industry groups, freight providers, and tourism representatives were invited to the workshop via direct email from the MoT. Invitations to attend the workshop outlined that participants would explore the types of transport system impacts experienced and observed following the Kaikōura earthquake; how decisions were made with and without 'good' information; and the ability to observe impacts and monitor the response and recovery. Stakeholders were also sent a detailed outline of the activities for the day. Those wishing to participate responded to the MoT, the final attendee list was defined, and any key stakeholders in areas of interest who could not attend were noted for subsequent follow-up.

2.2. Materials

Workshop participants sat at tables in groups of five to ten people. Each workshop group was provided with the following interactive props:

- *Maps*: Two A3 Maps covering an area of New Zealand extending southwards from the Auckland region and northwards from the north of the Otago region, one with territorial boundaries and one with a heat map of earthquake shaking intensity.
- *Timeline*: One large timeline was attached to two long walls of the venue (approx. 30m total). This timeline was divided into a short 'pre-event' section, then into individual days for the first 30 days post-quake, then into weeks up to 12 weeks, then into months up to the twelfth month (November 2017), then finally an 'ongoing' section. Only odd-numbered days, weeks and months were displayed due to the limited extent of wall space in the venue.
- *Note pads*: Pink and orange A5 post-it notes pads and pens were distributed on the tables - pink for recording decisions and orange for recording data.
- *Stars*: Star stickers were also distributed for placing on notes on the timeline to indicate decisions that were seen as particularly important by the participants.
- *Dots*: Green, orange, and red dot stickers were distributed for placing on notes on the timeline to describe data used for decision making - green for data of high quality/availability/usefulness, orange for average, and red for poor. Red dots with a star in the centre were also used, to indicate data that would have been very useful but was not available/accessible at the time of the event.

2.3. Procedure

The workshop was held between 09:30 and 15:30 on 22 November 2017 at Wharewaka Function Centre in Wellington, New Zealand. It was jointly facilitated by the research team listed at the start of this document, with specific exercises led by staff from Opus and Resilient Organisations.

The participants divided themselves into groups around seven tables and listened to an introduction of the aims and objectives of the workshop and the project. Participants were then led through a series of six exercises, which proceeded as follows:

Spatial Considerations

Mapping consequences

- Exercise 1: In their groups, participants used the maps to describe and record the location of direct and indirect consequences of the earthquake event across the country. A representative from each group then used their maps to assist in presenting the consequences back to the whole group.

Temporal Considerations

Identifying decisions on the timeline

- **Exercise 2**: Participants discussed in their groups and then identified individually, the details of key decisions they, other staff at their organisations, or other agencies made in the response and recovery phases of the earthquake event. These details, which included what was decided and who made the decisions (sector, agency, level) were recorded on pink note pads and placed appropriately along the timeline.
- **Exercise 3**: Once all decisions were posted, participants were asked to examine the timeline and classify decisions by their significance using the stars provided. Each person had one sheet of stars that they could allocate to notes as they saw fit.
- **Discussion**: A facilitator identified decisions with a large number of stars (votes) and the group as a whole discussed these further.

Identifying information activities on the timeline

- **Exercise 4**: Participants discussed in their groups and then identified individually, the details of the information and data that was sought, used, or generated to respond to and recover from the earthquake. These details were recorded on orange note pads and placed appropriately along the timeline.
- **Exercise 5**: Once all information and data sources were posted, participants were asked to examine the notes on the timeline and classify the information and data sources by quality, quantity, accessibility and usefulness using a 'traffic light' colour scheme of dot stickers. Again, each person could 'vote' by using as many of their allocated green, orange, and red dots as they saw fit.
- **Discussion**: A facilitator identified data with a large number of both red and green dots (i.e. contrasting opinions) and these were discussed further by the group as a whole, as were data sets with many red starred dots, which indicated that the data was desired but was not usable, accessible, or available at the time.

Information Flows

Evaluating and classifying information flows

- **Discussion**: As a whole group, based on the mapping and timeline exercises, participants reviewed how information was able to flow from data to decisions, focussing on timeliness, sufficiency, and whether it was fit for purpose.

Addressing information flow issues

- **Exercise 6**: As a whole group, participants identified possible solutions to existing and future information issues, including:
  - Information gap filling priorities
  - Supplementary sources of data
  - Sharing information.

2.4. Analysis

Decisions and data notes were collated by date according to the timeline and were photographed and transcribed by a member of the research team. Double-ups were removed, and a master timeline was constructed electronically. Star counts were used to identify key decisions. These were then analysed by two additional members of the research team to iteratively identify and develop key themes. Information and data sources were analysed in terms of quality, accessibility, and usefulness through examination of the coloured dot stickers and additional notes based on the group discussion of these. Flows of interaction between data and decisions were also qualitatively assessed, and key themes and relationships identified. The content analysis was designed to ensure that as many of the diverse perspectives presented in the workshop were captured as accurately as possible to reconstruct a coherent narrative rather than prove or disprove a hypothesis.

3. Interim Results

3.1. Participants

Thirty-seven participants took part in the workshop in addition to the research team. These participants represented the 23 key stakeholders listed below.

- Beef and Lamb New Zealand
- Canterbury Civil Defence and Emergency Management (Canterbury CDEM)
- Canterbury Lifelines Group
- Christchurch Transport Operations Centre (CTOC)
- Chartered Institute of Logistics and Transport (CILT)
- New Zealand Defence Force (NZDF)
- Foodstuffs (NZ) Limited
- Halls Group
- Interislander
- KiwiRail
- Land Information New Zealand (LINZ)
- Ministry of Civil Defence and Emergency Management (MCDEM)
- Ministry of Transport (MoT)
- Ministry for Primary Industries (MPI)
- New Zealand Search and Rescue (NZSAR) Council
- New Zealand Wine
- New Zealand Transport Agency (NZ Transport Agency)
- North Canterbury Transport Infrastructure Recovery (NCTIR)
- Progressive Enterprises (Countdown)
- Opus New Zealand
- Transport Consultant - Independent
- New Zealand Treasury
- Wellington Lifelines Group
- New Zealand Lifelines Council

3.2. Mapping Exercise

The mapping exercise focused on capturing a range of direct and indirect impacts of the Kaikōura earthquake. The foremost purpose of the mapping exercise was to re-familiarise people in the room with the wide-ranging impacts of the Kaikōura earthquake and aftershocks, and to encourage participants to consider how the earthquakes impacted the transport system across New Zealand. The earthquakes caused extensive damage across North Canterbury and Marlborough as a result of ground shaking effects (Bradley et al. 2017), surface fault rupture (Stirling et al. 2017), and an estimated 100,000 landslides (Dellow et al. 2017). Davies et al. (2017) provides an overview of the transportation infrastructure performance, Cubrinovski et al. (2017) summarise the CentrePort Wellington damage, and Brunsdon et al. (2017) discusses cordon-related transport disruption in central Wellington after the Kaikōura earthquake. Building damage in Wellington following the earthquake, including to the Ministry of Transport and New Zealand Transport Agency buildings, has also been well documented (see: Henry et al. 2017).

Indirect Impacts

In addition to discussing the varied direct impacts of the earthquakes, workshop participants identified a wide-range of secondary impacts that emerged as a result of damage to buildings and transportation infrastructure:

Freight

Despite the temporary loss of capacity at the Picton port and damage at Wellington's CentrePort, severe damage to State Highway 1 (SH1) and the Inland Kaikōura Road (SH70), and damage to the Main North Line railway, freight continued to move along alternate routes throughout New Zealand within the first few days after the Kaikōura earthquake.

Coastal shipping to and from the Ports of Auckland and Napier Port increased to compensate for reduced container capacity at CentrePort in Wellington, with knock-on implications for road transport to/from these ports.

The loss of the Main North railway line was compensated for by a significant increase in road freight transport. Disruptions to SH1 in the South Island and the use of the alternate route to Picton increased travel times and increased the need for additional truck drivers, as turnaround trips were not possible within legal working hours. The alternate route was less appropriate for high productivity motor vehicles (HPMVs) with heavy loads compared to the previous SH1 route. Additionally, on the alternate route there was reduced capacity for passing which led to slower trips and increased strain on drivers. Traffic accidents involving HPMVs along the alternate route increased in the months following the earthquake.

Increased HPMVs with heavy loads along the alternate routes in the South Island also caused damage to roads and required increased spending to repair and enhance the routes for more traffic, which despite the immediate disruption is considered a future benefit to the area.

Damage to the Progressive Enterprises Countdown distribution centre in Palmerston North caused by the earthquake also altered freight movements in the North Island as goods were subsequently stored elsewhere (at alternative locations in Auckland).

Agriculture

Disruptions to containerisation in Wellington affected wine exports from the greater Wellington region. Dairy farms in the Kaikōura area and along the Inland Kaikōura Road (SH70) dumped milk in the weeks following the earthquake as milk collection tankers could not access farms along damaged roads. There were also animal welfare concerns for livestock being in trucks for much longer periods of time along alternate routes.

Tourism

Tourists were initially isolated in the Kaikōura area and others had to delay Cook Strait crossings for days due to damage at the Picton and Wellington ferry terminals. Tourists planning to travel between Christchurch, Kaikōura, and Picton by road were redirected by organisations including the Police and Department of Conservation (DoC) to other areas. Hanmer Springs and some areas on the West Coast of the South Island benefitted economically from increased tourist numbers.

Support towns

Towns in North Canterbury along SH1 experienced significantly reduced tourist flows while access to Kaikōura was blocked, whereas some of the towns along the alternate route from Christchurch to Picton saw dramatically increased traffic numbers. In these towns, there were some reports of

concerns for the safety of residents. For example, children unused to heightened traffic flows were finding it difficult to cross roads.

Social impacts

Support workers reported that physically isolated residents experienced mental health issues, longer travel times, and more difficult routes. Residents in the Kekerengu and Clarence areas north of Kaikōura were cut off from Kaikōura by landslides and rock falls along SH1 and had to adjust activities so that they always travelled northwards towards Blenheim from their homes - this included changing stores, schools, and medical centres in some circumstances. Air response and convoy management were a critical part of managing psychosocial impacts for people in isolated areas. Aviation in and out of Kaikōura was treated as a response priority and airlines added flights, particularly to and from Blenheim, to accommodate disruptions to the highway system (see Davies et al. 2017).

There was additional strain on farmers affected by damaged routes, and also on transport managers who needed to ensure health and safety in affected parts of North Canterbury and Marlborough. Similarly, health and safety concerns were raised along the Kaikōura coast when paua rescue volunteers breached road construction cordons.

In Wellington, building damage resulted in disrupted traffic flows for workers and residents in the CBD. Building damage in some areas, such as grocery stores, required residents to reroute travel to access supplies. In at least once instance an alternate bus service was introduced to ensure residents could still access groceries despite the loss of a local store.

Additional Impacts

In the days prior to the Kaikōura earthquake a ship hit the Interislander linkspan in Wellington temporarily putting it out of action, and meaning only one linkspan was active at the time of the earthquake.

Storms on 15 November 2016 caused flooding throughout greater Wellington, cutting off SH1 and SH2, restricting movement into and out of the city along certain parts of the road corridor for two days.

Other pre-existing and multi-hazard events added to the challenges of response and recovery for the Kaikōura earthquake. However, these are beyond the scope of this report and not discussed in detail.

3.3. Decisions & Data

The exercises that followed the mapping exercise used a timeline as a basis from which to discuss systematically the types of decisions that were made following the earthquake in response to transportation disruptions and the types of data used to make decisions in the aftermath of the earthquakes. A compiled version of the timeline is included in Appendix B.

The decisions identified range from organisations applying lessons learned from the Canterbury Earthquake Sequence in a way that mitigated disruption in the Kaikōura event, to major funding decisions, to decisions to close or reinstate critical infrastructure services. We discuss these decisions and the data used to support these decisions thematically below.

Response Activities and Damage Assessments

Within two hours of the earthquake, the MoT led Transport Response Team (TRT) activated. The role of the TRT is to provide transport system co-ordinated advice in the whole of government response to a national emergency. In the hours following the earthquake, Wellington CDEM had compiled information on the levels of damage to utility assets in the Wellington region and transportation companies began contacting staff to assess their safety and the impacts on their assets and on critical infrastructure.

In the first two days following the earthquake, various sources of information were used to make initial decisions about response priorities and the need to close transport routes. Information used in these decisions included Google Maps (i.e., real time traffic data), GeoNet, NZ Transport Agency route information maps, the Air New Zealand website, and news media reports. Additional rapid assessment data, including field engineer inspection data was produced and shared with relevant Government sources and with affected and responding agencies. On the morning of 15 November 2016, the Ministry of Civil Defence and Emergency Management (MCDEM) requested that the New Zealand Defence Force (NZDF) take P-3 Orion aircraft reconnaissance trips to record the damage. This was a source of information on the current state of the networks, assets, and alternatives in the immediate aftermath of the earthquake.

Within a week of the earthquake, reconnaissance photos from geotechnical engineers, risk assessments of landslide dams and impact assessments on key roads and bridges also became widely available.

Transport Management

Road

In the first two days after the earthquake, the NZ Transport Agency's decisions to open, restrict, or close state highways had to be made while assessing what was known and not known. These decisions were informed by the NZDF P-3 Orion reconnaissance (e.g., aerial photos) of damage. Weather data was also used to establish the ongoing risk of landslides and rock falls following the earthquake. In the days after the earthquake more robust engineering assessment reports included data from surveying and advice on when and where roads would open.

There was conflicting information given by road transport operators and GPS systems such as Google Maps. The latter routed people along roads as soon as they were deemed opened by identifying any traffic using that road, not distinguishing between traffic types and not accounting for upcoming planned closures. There were also lag times in updating these information services, which meant that some tourists who were planning trips did not know about changes to the level of service of roads, adding challenges to transport management.

Rail

KiwiRail decided to close the Main North Line railway based on NZDF reconnaissance activities, TRT reports, and infrastructure status reports from MCDEM. The railways required extensive assessments in places, including laser scanning of tunnel clearances and information about the distribution of peak ground acceleration (PGA) to inform risk assessments along the network.

Maritime

Port closure decisions were based on staff reports, port company and field engineer assessments of their assets, and TRT reports. In return, the port companies reported back to Maritime New Zealand and MCDEM to alert them of the extent of their damage and of the ports' capacity to operate.

Due to building damage at Port Marlborough in Picton and damage at CentrePort in Wellington, freight movements between the North and South Islands and collections of container freight from CentrePort were suspended until nine days following the earthquake. An interim ferry timetable for Interislander ferry services was produced by the third day following the earthquake. These decisions, in addition to information about road disruption, in turn influenced the response of rural sector businesses. For example, wine and other produce within the North Island was rerouted and decisions were made to dump milk and to dry off cows for the season.

Aviation

Airport closure decisions were based on on-ground assessments, TRT reports, and discussions between airport operators and the Civil Aviation Authority (CAA). From the day following the earthquake aviation authorities used information about the Picton-Wellington transport routes and additional field reports to establish procedures that allowed Kaikōura airport to become a hub for ground-based aid.

Ongoing management

Within a week of the earthquake, the Government committed to rebuilding the damaged sections of SH1 and coastal rail. However, repair options required more detailed assessments and coordinated information sharing. Prioritisation of route inspection and repair was informed by welfare and economic concerns. The MPI helped transportation managers determine the transport needs and priorities for rural residents, the agriculture sector and others in the Kaikōura district. In some cases, primary producers and industry groups engaged directly with transport companies to make adjustments. NZ Wine worked with Port Nelson and QuayConnect (in Napier) to assess the impact on wine transportation from Port Nelson.

Additionally, the NZ Transport Agency required information about vulnerable assets to manage HPMV traffic during the repair, including weight limits for road infrastructure. Such information was not readily available for all parts of the network within the first two weeks following the earthquake. Similarly, while LINZ produced new LiDAR imagery and aerial photos of the damaged area and GNS produced in-depth geological assessments within two weeks of the event, transport consultants working on the ground in Kaikōura noted that they would have benefitted from more timely geotechnical assessments, photographs, and detailed maps.

MoT requested new information from the freight sector on post-earthquake adjusted volumes for different routes and modes. Although they needed this information to consider repair priorities and freight management, the data was in some cases delayed or incomplete. This information came from a variety of sources, including NZ Transport Agency traffic count data for SH7 which contains heavy vehicle counts, airport information on the number of flights and passengers, freight company models of road freight volume, and information on where, when, and how much freight volume was being moved by KiwiRail. Such numbers were more challenging for the freight sector to produce due to the number of new variables to consider such as the loss of storage and distribution facilities, increased travel times, and driver availability.

Communications

The Kaikōura earthquake highlighted existing vulnerabilities to communications infrastructure. Workshop participants noted that they were very fortunate that communications services provided by the cable running over a bridge in Kaikōura (that connects communications in the South Island and North Island) continued. Patchy mobile service in the South Island hindered immediate response activities and was later improved with three mobile cell tower boosters. This issue may require a long-term solution and increased investment.

Intra-organisational communications

For all organisations, locating staff and ascertaining staff wellbeing was a high priority in the immediate aftermath of the earthquake. This was hindered in part by communication issues, including patchy mobile services in parts of the South Island.

Organisations needed to know the skills and capacities they had available within their organisations and with consultants or contractors. This was critical information for planning appropriate responses and adaptations. Within three days of the earthquake, transport operators had recruited extra staff and hired additional equipment, while technical engineers were mobilised from across New Zealand and later overseas.

NZ Transport Agency and trucking companies used telematics data to validate information on alternate route usage (e.g., travel times, speeds, and distances travelled). Freight companies also used in-cab cameras to monitor driver performance, assess route conditions, and to investigate traffic accidents.

Inter-organisational communication and collaboration

The Joint Analytical Unit was set up between MBIE, MoT, NZ Transport Agency and Treasury and operated from early December 2016 through to the end of April 2017. The unit was designed to provide a single source of information on the impacts and recovery efforts associated with the Kaikōura earthquake in areas such as transport and infrastructure systems, tourism, the local, regional and national economy etc. With a team of officials from the various agencies, the unit was responsible for providing specific analysis (e.g. the impact of port closures), briefings and regular reporting (e.g. weekly update reports for Ministers and Officials groups). The unit also commissioned external work including the MERIT model to understand wider economic impacts associated with the earthquake. The MoT reports that the value of the Unit was its ability to offer a consolidated view, to bring together and synthesise the views of multiple agencies and to provide a single source of truth in the areas that it was reporting on. There was reportedly wide use and acknowledgement of the analysis and content produced by the Unit and if similar events were to occur again, it offers an example of how agencies can combine to offer necessary data and analytical support to decision makers.

Workshop participants reported that there were often too many requests for information and too much priority was placed on reporting to Ministers and others up the chain of command. Some workshop participants reporting feeling like demands for information at times overrode the need for response actions.

Any hand-over of responsibility required clear communication in the lead up to and during the hand-over. The creation and launch of the North Canterbury Transport Infrastructure Recovery group (NCTIR) in late December 2017 was eased by the timely wind-down of the Stronger Christchurch Infrastructure Rebuild Team (SCIRT – established following the Christchurch 2011 earthquake) with some staff transitioning straight into work with NCTIR. The timing and jurisdiction of other hand-overs, however, were unclear or contested. For example, changing management of residential transport convoys along parts of SH1 between the NZDF or Police to regional CDEM or NZ Transport Agency experienced minor delays due to a lack of clarity about roles and timing.

Cooperative solutions to road safety management emerged within days of the earthquake, including Protranz Earthmoving Ltd organizing earthmoving while the army ran convoys along the Inland Kaikōura Road (SH70). These interactions emerged as entry along SH70 and SH1 evolved, with Protranz coordinating with geotechnical engineers to conduct inspections. Similarly, KiwiRail coordinated with NZ Transport Agency data collection teams to conduct planning and inspections.

Freight companies relied on regular road status updates on the NZ Transport Agency website. Information on journey times and reliability of the road was provided by road users and shared via the NZ Transport Agency. Similarly, the ferry companies used information on traffic flows, KiwiRail information, and port company status information to better understand user needs and produce timetables, extending weeks to months ahead. Conversely, the ferry companies shared timetables and disruption information with the road and rail organisations.

Throughout the initial reconstruction activities of SH1 and the Main North Line railway, MoT made several requests to the NZ Transport Agency for updated information on road traffic through Kaikōura and along alternate routes and freight tonnage being moved along alternate rail lines. Up to a year following the earthquakes, MoT via NZ Transport Agency and NCTIR required regular updates on the stabilisation of slopes, repair status, design of new structures, the resilience of the alternate routes, and prediction of future performances for road and rail. NCTIR provides monthly reporting on progress, risks, costs against the budget, and expenditure forecasts. Direction was sought by engineering firms and others on NZ Transport Agency and NCTIR's philosophy of design for repairs, strengthening, and resilience strategies.

Within two weeks of the earthquake, MBIE was collecting information on tourism flows in the South Island including information from a tourist survey, mobile phone, and expenditure data to track domestic movements, and information on international departures. Some workshop participants noted that this information was not readily available. It is unclear when and how MBIE shared this information and with which organisations.

Communication to the public and others

There was some miscommunication around the cordon in Wellington, resulting in confusion in relation to which areas were accessible in the days following the earthquake.

Manned points along roads in Canterbury and Marlborough were essential for keeping tourists informed of route changes and for maintaining road safety. Transport agencies coordinated with DoC and others to assist tourists in altering travel plans.

The NZ Transport Agency website was an important source of communication to the public and freight companies. Information about road closures, the alternate routes, and future planning were also communicated to residents in local newspapers and through postal and email newsletters.

Pre-existing Data

LiDAR data and Geographical Information System (GIS) transport network files created prior to the Kaikōura earthquake and made available on the NZ Transport Agency information management system were important for effective response and recovery planning and management. In many cases these files were created and shared by external organisations (e.g., GIS transport network information from KiwiRail).

Prior to the earthquakes, there were resilience assessments and some enhancement work on SH1 along the Kaikōura coast. This pre-existing information about the road and railways has been used to manage diversions and reconstruction during the earthquake recovery. Similarly, a wide body of work in Wellington on lifeline utilities and pre-event work to enhance senior management leadership facilitated the response following the Kaikōura event.

Emergent Information Management Processes and Systems

There was a master damage database used by Kiwirail for costing, prioritising, and programming. KiwiRail set up a data and contact centre to deal with information requests and the NZ Transport

Agency regulatory office managed the compilation of damage from field inspections. Damage data was being recorded and reported back to NZ Transport Agency in multiple forms: phone, texts, photos, spreadsheet summaries, and written damage reports.

KiwiRail and the NZ Transport Agency had been developing damage classification systems prior to the earthquake. The NZ Transport Agency also used a system with five categories to depict the level of service on roads (ranging from closed to fully open for all traffic). Freight companies relied on this information to do route planning and to calculate travel times and costs.

The South Island Regional Transport Committee (SIRTC) was established in 2016 (prior to the Kaikōura earthquake) to provide oversight on land transport decisions and outcomes that could affect the South Island. The committee is chaired by representatives from all South Island regional councils.

Information Gaps

Workshop attendees noted instances where information was inadequate, unavailable, or delayed:

- Information from freight drivers could have assisted rapid damage assessments and the re-routing of traffic.
- MCDEM made the decision not to declare a national state of emergency, and this decision would have been aided by better mapping and information about the resource availability in earthquake affected rural areas during the first few days after the earthquake.
- On the day after the earthquake there was reportedly inadequate information about the availability of Interislander Ferry Services and a lack of clarity about the state of passengers and crews. Similarly, there were issues contacting and locating staff members from responding organisations (e.g., MoT and NZ Transport Agency), especially in cases where main buildings in Wellington were damaged.
- There was widespread confusion among various organisations about the tsunami risk in Wellington, Waimakariri District, and elsewhere following the earthquake. There was no clear information shared about whether people should evacuate or not, and from which areas.
- A year after the earthquake (i.e., around the time the workshop was held), there were still reports of ongoing uncertainty about the status of SH1 due to ongoing closure and reopening, changes to slope stability and safety, and repair timelines. This has made planning difficult for some organisations.

Influential Policy and Legislation

The first earthquake bill was passed on 30 November 2016. A second earthquake bill passed on 2 December 2016. A third earthquake bill was passed on 9 December 2016, which made necessary legislation changes and overrode six Acts. Additionally, emergency legislation passed in the Kaikōura and Hurunui districts enabled orders in council to, for example, fast-track consenting processes.

The economic impact of the earthquakes was assessed using a wide range of data from Inland Revenue and regional economic retail activity and employment data produced by Statistics NZ and MBIE. This information was then used in the Modelling the Economics of Resilient Infrastructure Tool (MERIT) to examine the impact of the earthquake on the economy. Although these assessments were not perfect, they were conducted within three weeks of the earthquake and likely informed policy decisions.

In late December 2016, Central Government agreed to fund the reconstruction of the coastal route of SH1 and the Main North Line railway. Emergency legislation was passed to accelerate repairs and

support the repair of the Kaikōura Harbour. At this time, the Government also announced the NCTIR Alliance, which changed decision making processes for both road and rail repairs.

The May 2017 Budget confirmed funding for the SH1 rebuild. Prior to this the National Transport Fund was used. NZ Transport Agency will manage funding to improve route resilience. In July 2017, NCTIR received a $230 million improvement package.

Adaptations

Lessons learned from previous events

An information-sharing platform was established during the evolution of SCIRT. For example, the Forward Works Viewer was built and continues to be a useful model for managing large-scale infrastructure reconstruction projects. The information sharing platform established as part of SCIRT has informed the processes developed for NCTIR. The National Forward Works Viewer is now available for use by others (via LINZ).

Alternative freight routes

Several options were considered following the Kaikōura earthquake that may improve the resilience of coastal shipping, including exploring alternative ferry routes from Motueka to New Plymouth, the enhancement of Napier Port for increased container traffic, and the addition of a floating wharf pontoon in Wellington. Due to lack of urgency and an inability to demonstrate the economic justification of these redundancies, none of these options were pursued in the year following the Kaikōura earthquakes.

Damaged storage tanks in the Marlborough region forced wine producers to send large quantities of wine by road from Wellington to spare storage capacity in Napier and Gisborne, but the weight limits on bridges along SH2 over the Rimutaka Range forced drivers to go via SH1 and Taupo instead.

Route improvements

Within a week and a half of the Kaikōura earthquake it became clear that usage of the Inland Kaikōura Road (SH70) and SH7 and SH63 was going to increase significantly, so the decision was made to improve the alternate Picton to Christchurch route. Two and a half weeks after the earthquake the NZ Transport Agency approved funding of $60 million to make the alternate routes fit for purpose. For example, Bailey bridges were installed adjacent to existing one-way bridges to facilitate greater traffic flows, shoulders were widened, and sections of road were resurfaced.

Resilience planning and improvements

Within a month of the earthquake a collaborative effort was led by the Department of the Prime Minister and Cabinet (DPMC) to generate a list of initiatives to improve Wellington's resilience and the city's ability to respond to events like the Kaikōura earthquake. So far only some aspects of the initiatives have been progressed.

Within three weeks of the earthquake, KiwiRail launched an internal process to improve the resilience of their organisation and network for future events. For example, considering direct charter options could enhance the organisation's flexibility.

In the first month following the earthquake, Foodstuffs assessed and agreed on the degree of additional freight costs from carriers because of the quality of alternate routes and disruption to shipping and distribution centres. As a result of this, Foodstuffs established a contingency fund for such events.

In February 2017, MoT started discussion on lessons learned from the Kaikōura earthquakes and an exploration of what could be changed and what is the 'new business as usual'. As part of this process, some participants expressed concerns about the decision not to maintain or improve the resilience of ports when given the opportunity as part of earthquake repairs. For example, no substantial improvements were made to CentrePort despite vulnerabilities highlighted by the earthquake and there was a decision not to invest in new linkspan facilities at Napier, which would have served as an option for network redundancy. There was also a contested decision not to invest in the Wellington pontoon (or similar infrastructure) following ongoing discussions with CentrePort, although this is now being reconsidered. At the workshop, participants noted that this could have an adverse impact on master planning for transport resilience throughout New Zealand.

4. Discussion

This section provides a summary of the key finding from the workshop, however this is not intended to provide a complete summary of the project findings. A summary of the findings of the wider project will be presented as part of the final project report, as this can be informed by both the workshop and the interview process. This allows for gaps identified during the workshop process to be covered, and to incorporate the input from organisations that could not be present at the workshop.

Key Workshop Findings

Primary datasets that were produced before the Kaikōura earthquake have been beneficial to response and recovery activities. Such information identified during the workshop includes network maps, geotechnical data, and LiDAR data. Similarly, resilience assessments conducted prior to the event assisted in the recovery of the transport system.

Due to the nature of the event and area impacted by the Kaikōura earthquake, there was a need to make particularly rapid decisions regarding the transport system, often by using highly uncertain data. Rapid damage and impact assessments were assisted by the availability of pre-established datasets and were essential for the quick implementation of alternate route detours. This information and subsequent actions allowed the transportation of people and goods to continue across New Zealand, albeit using alternative transport modes at times. Initial impact assessments were conducted within several hours of the earthquake, with more thorough assessments occurring in the subsequent days, utilising a plethora of information from a variety of sources and spurred by central government commitments, legislation changes and funding approvals at different stages. However, transport response and recovery activities faced several key challenges in the days following the earthquake including:

- Physically isolated residents, tourists and business operators (including farms) in Kaikōura and other towns in Canterbury and Marlborough.
- Pre-existing impacts on the transport system such as a damaged Interislander linkspan at Wellington Port.
- Damage from the earthquake to the ports, ferry terminals and buildings at CentrePort, Wellington and Port Marlborough, Picton
- Multi-hazard events. This included the tsunami threat resulting from the Kaikōura earthquake and widespread confusion on the appropriate response including evacuations, and a storm in Wellington on the day after the earthquake. The storm led to flooding and additional restrictions on mobility along key transport routes into and out of the city.
- The capacity of alternate routes to handle increased traffic volume, heavy HPMVs and a mix of different end-users.
- Patchy communication networks in the upper South Island, including several areas along alternate routes.
- Transport staff considerations, including issues on their whereabouts and safety (exacerbated by communication limitations) and availability (e.g. sourcing sufficient truck drivers with appropriate training to cover the additional time incurred due to the alternate routes).

Changes to the movement of freight is arguably the largest secondary impact of the Kaikōura earthquake on transportation, with cascading impacts throughout the country (e.g. the diversion of some goods from CentrePort (Wellington) to QuayConnect (Napier) and changes to food point-of-supply from Palmerston North to Auckland following earthquake damage to a food distribution centre).

Despite pressures exerted by multiple requests for information and an increasing number of datasets to consider, transport infrastructure providers established standard chains of reporting, which reduced repeated requests for information and likely assisted decision making. Transport infrastructure providers demonstrated both intra- and inter-agency collaboration and displayed cross-agency solutions to safety management. For example, ferry companies used information from the NZ Transport Agency, KiwiRail, and port companies to benefit their users, and in return shared information on the status of their transportation modes. Similarly, earthmoving companies coordinated activities to align with NZDF convoys and geotechnical inspections. The NZ Transport Agency and KiwiRail developed classification systems for damage and level of service, which were actively used by freight companies. Collaborative activities were likely assisted by pre-existing working relationships and protocols following the Canterbury Earthquake Sequence and fortunate transition processes that occurred such as the transition of some staff from SCIRT to NCTIR. However, some concerns were raised about the availability and effective sharing of some information between agencies and more work is required to improve some aspects of data transfer in the future, including between agencies and the public and for long-term transport planning requirements following natural hazard events.

Considerations for Future Resilience Planning

Discussions on transport system resilience since the Kaikōura earthquake have revealed some concern on existing network redundancies, particularly at the transfer between road and maritime transport modes when another natural hazard event causes more severe disruption at ports in the lower North Island and upper South Island. For example, the Kaikōura earthquake demonstrated limited containerisation availability and lack of redundancy in available linkspans at ports, and alternate routes required substantial rapid upgrade and maintenance programmes for the increased traffic flows. Ideally, such issues would have been addressed before the event to minimise disruption. Given that there was only one workshop attendee from the maritime sector, these aspects will be further explored in upcoming individual interviews with sector representatives.

The type of data being considered for future transport resilience planning is an important aspect that was highlighted by several workshop participants. In particular, concerns (guided by the Kaikōura earthquake response and recovery activities) were raised about whether current cost-benefit calculation approaches and assessment criteria are adequate to inform transport investment priorities and resilience improvement strategies. We recommend that further work investigates and addresses these concerns, and will be included as part of the one-on-one interview process.

5. Next Steps

The key workshop findings outlined in the previous section will be used to identify opportunities for expanded and extensive engagement, the focus of the second project aim. The engagement will seek to expand on the preliminary data and decision-making issues identified in the workshop, to better understand their extent and consequences. This will make use of both one-on-one interviews with officials at individual sectors and through discussions with other industry group officials. Information collated during the workshop will be circulated to organisations that could not attend the workshop, and where appropriate, interviews will be organised. The information collected from interviews and through industry groups will be combined with the information collected through the workshop process to compile the final project report.

Additional representatives from organisations represented at the workshop have been identified as potential interview candidates through discussion with MoT representatives. Key organisations that did not attend the workshop but were identified for follow up interviews during the workshop planning include:

- Aviation (Airways NZ, Civil Aviation Authority, Airline companies)
- Maritime (Maritime NZ, Shipping Federation, Pacifica Shipping)
- Tourism NZ
- Dairy NZ
- NZ Police
- Freight (Mainfreight, Freightlines, PBT, Halls, Toll)

A number of these organisations have already indicated their interest in being involved in these follow-up interviews. Other organisations will be approached through existing relationships. The final list of interviewees will be developed in collaboration with MoT.

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Appendix A: Related RNC/QuakeCoRE Projects

Project A: Performance and response of the transport networks following the Kaikōura earthquake

Lead Personnel: Ali Davies, Thomas Wilson, Liam Wotherspoon (RNC Rural & Infrastructure)

Summary:

Collaborative quantitative data collection and interview series with key personnel from NZ Transport Agency, Canterbury Civil Defence and KiwiRail.

Relevant Output to date:

Davies AJ, Sadashiva V, Aghababaei M, Barnhill D, Costello SB, Fanslow B, Headifen D, Hughes M, Kotze R, Mackie J, Ranjitkar P, Thompson J, Troitino DR, Wilson T, Woods S and Wotherspoon LM (2017). "Transport infrastructures performance and management in the South Island of New Zealand during the first 100 days following the 2016 Mw7.8 Kaikōura earthquake". Bulletin of the New Zealand Society for Earthquake Engineering, 50(2): 271-299.

Project B: Tourism and Agribusiness value chains

Lead Personnel: Carel Bezuidenhout, Tom Wilson, Caroline Orchiston, Garry McDonald, Nick Cradock-Henry (RNC Rural + Economics)

Summary:

1. Developing an integrated framework for assessing resilience to natural hazards across rural value chains: from households to regions and small to global-scale agribusinesses.

2. Producing tools for resilience-interventions and defining opportunities, through comprehensive scenario activities with key sectors, communities and regions.

This is the overarching focus of RNC Rural programme, with programmes currently underway focussing on tourism and on agribusiness (with a selection of main partners).

Project C: Governance of Resilient Rural Mobility

Lead Personnel: Vivienne Ivory, Margaret Trotter (RNC Governance)

Summary:

1. Mapping the governance actors across the system to describe the institutional architecture of the rural transport system in the Canterbury and West Coast regions.

2. Based on opportunities identified through actor mapping, Task 2 will identify a set of potential future tools (measures, practices and levers) to improve governance interactions and institutional arrangements for the future.

3. Negotiating Future Resilience, creating 'safe places' for difficult conversations. Innovative scenario engagement methodologies and public conflict resolution best practices will put into

practice the ‘future tools’ from Task 2 to enable key governance actors to negotiate how best to chart future resilience pathways.

Project D: RNC Trajectories Toolbox Digital Information System project

Lead Personnel: Joanne Stevenson, John Vargo (RNC Trajectories)

Summary:

1. Resilience Pathway Heuristic: Development of a heuristic modelling tool to define and assess resilience and adaptiveness to dynamic non-equilibrium environments.

2. Resilience Digital Information System: We will identify the data needs for creating resilience trajectory models and resilience enhancement tools with data owners and users. We will then create a repository and a federated model for accumulating and accessing the data - the Data Integration and Visualisation En Masse (DIVE) Platform.

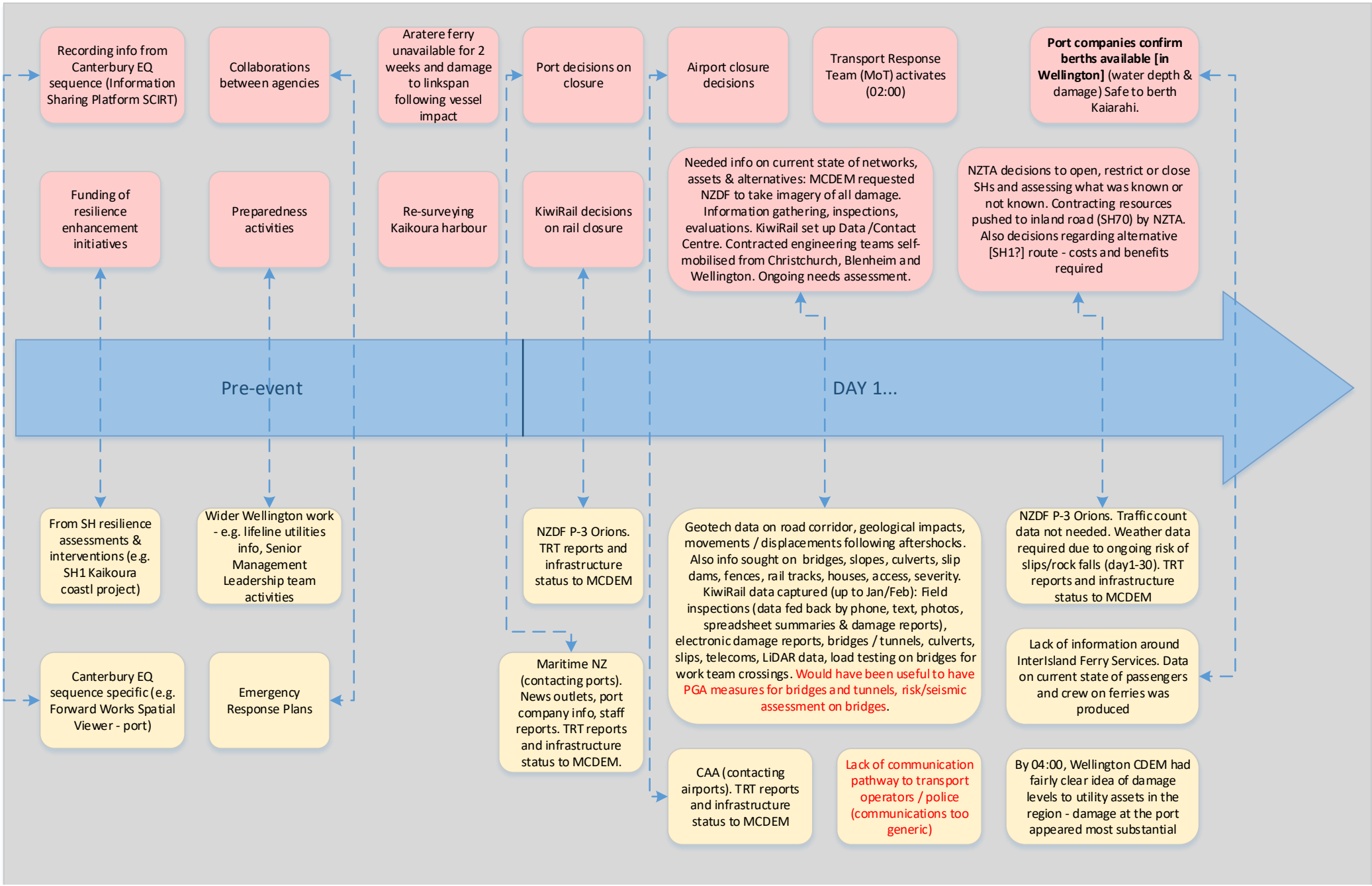
3. Resilience Indicators: We will identify a range of indicators across a multi-capitals model in a variety of settings, linking resilience indicators to data sources and identifying gaps for ongoing development of the suite of indicators. These indicators will allow users to benchmark resilience, monitor progress, and evaluate the efficacy of resilience interventions.

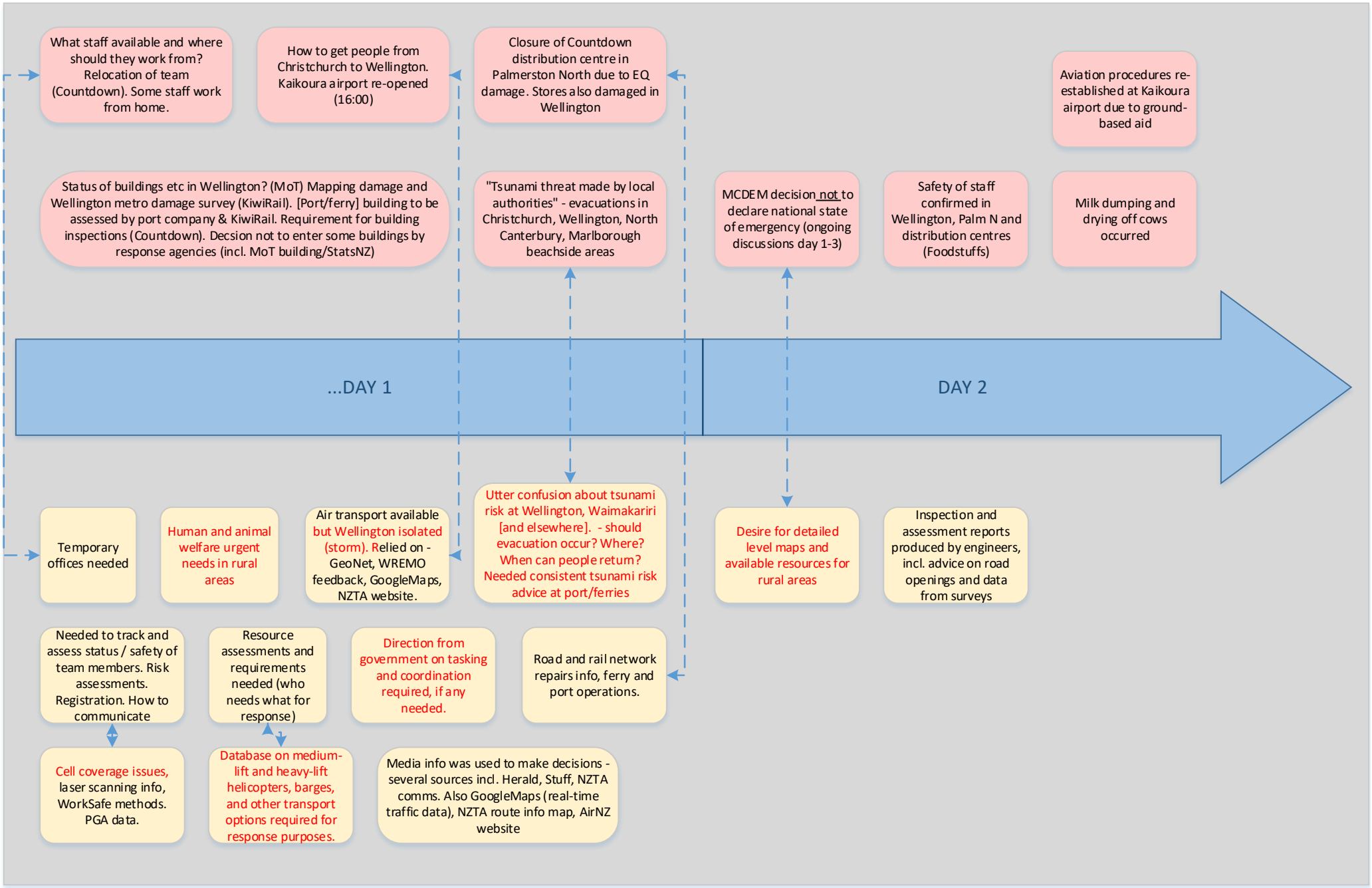
Project E: Impacts of Kaikōura Earthquake on transient populations

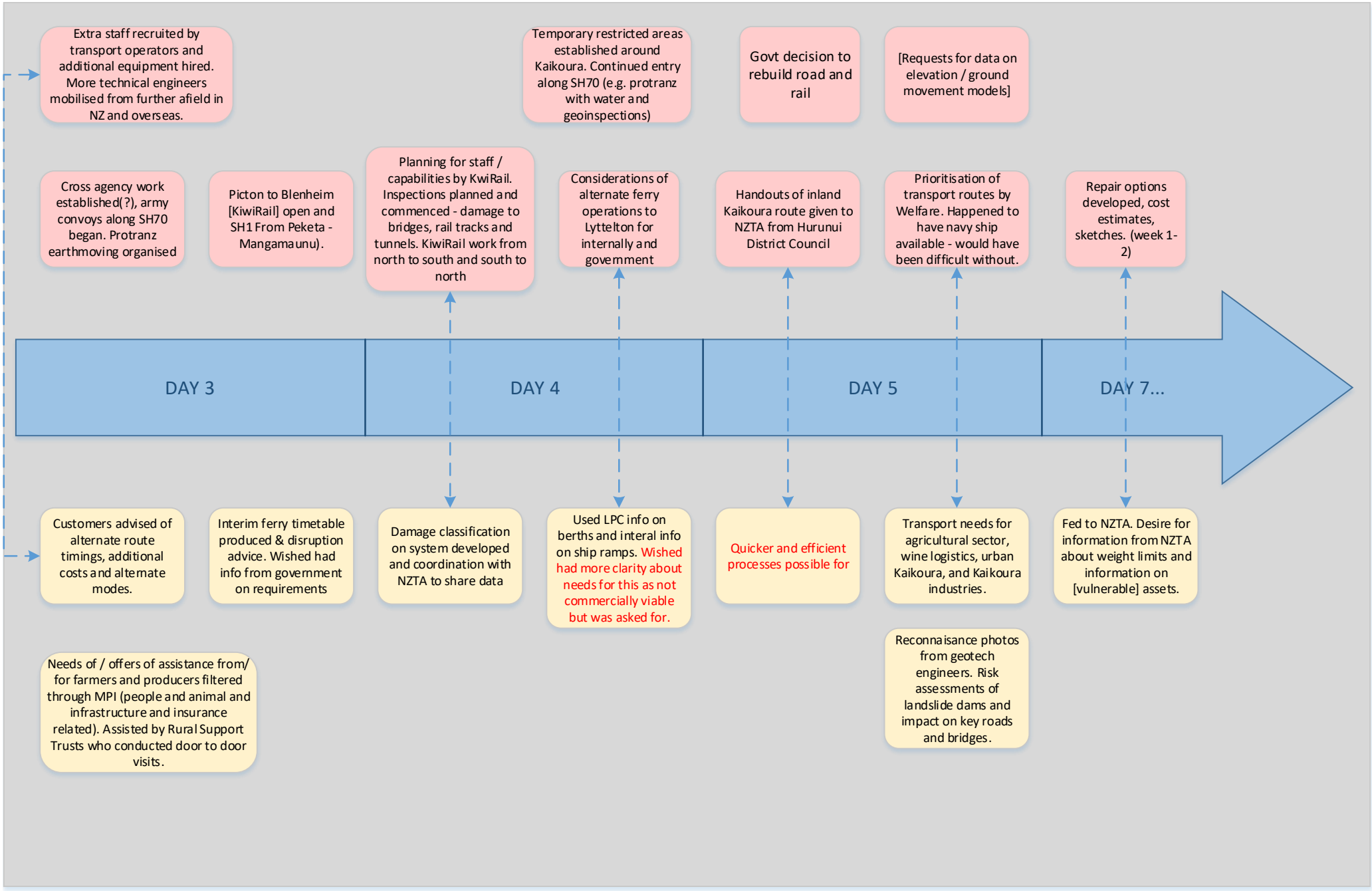
Lead Personnel: David Simmons (RNC Rural)

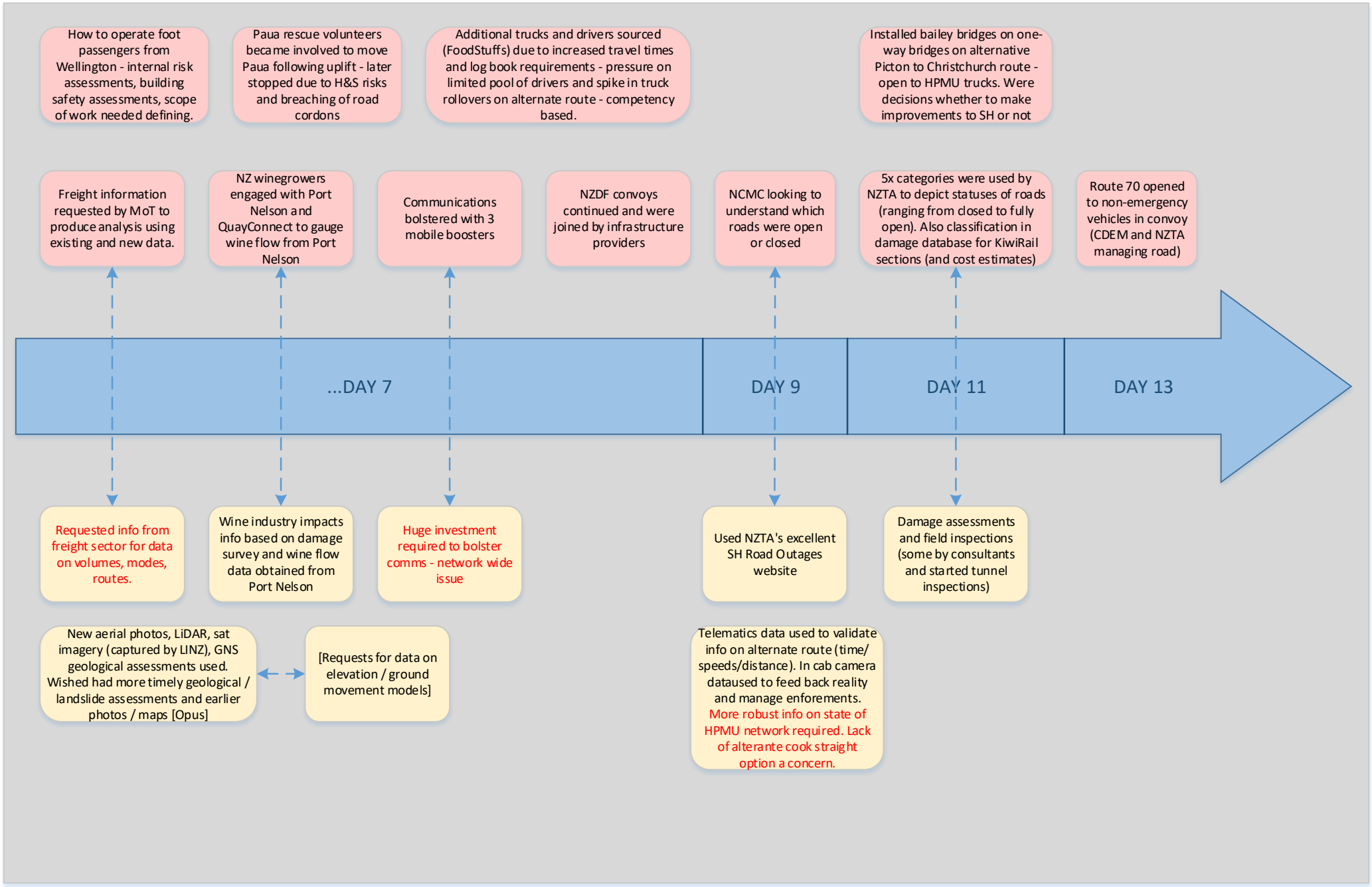
There is the RNC contestable project that will focus on the impact of the Kaikōura /Hurunui earthquake on the transient population dynamics in 3-4 case-study locations in North Canterbury and Marlborough. A key focus of this work will be the change in flows on the State Highway network.

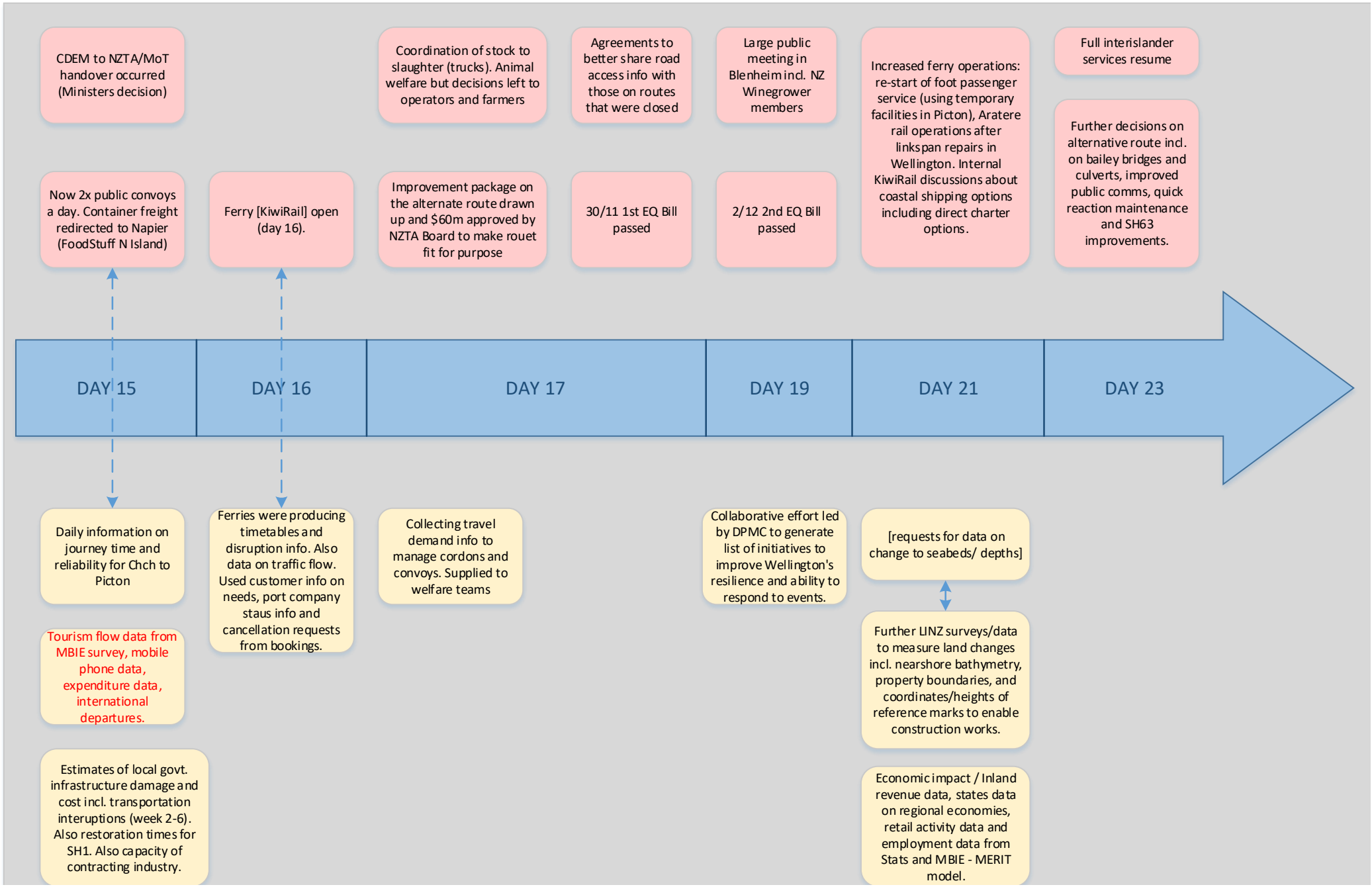
Appendix B: Compiled Timeline

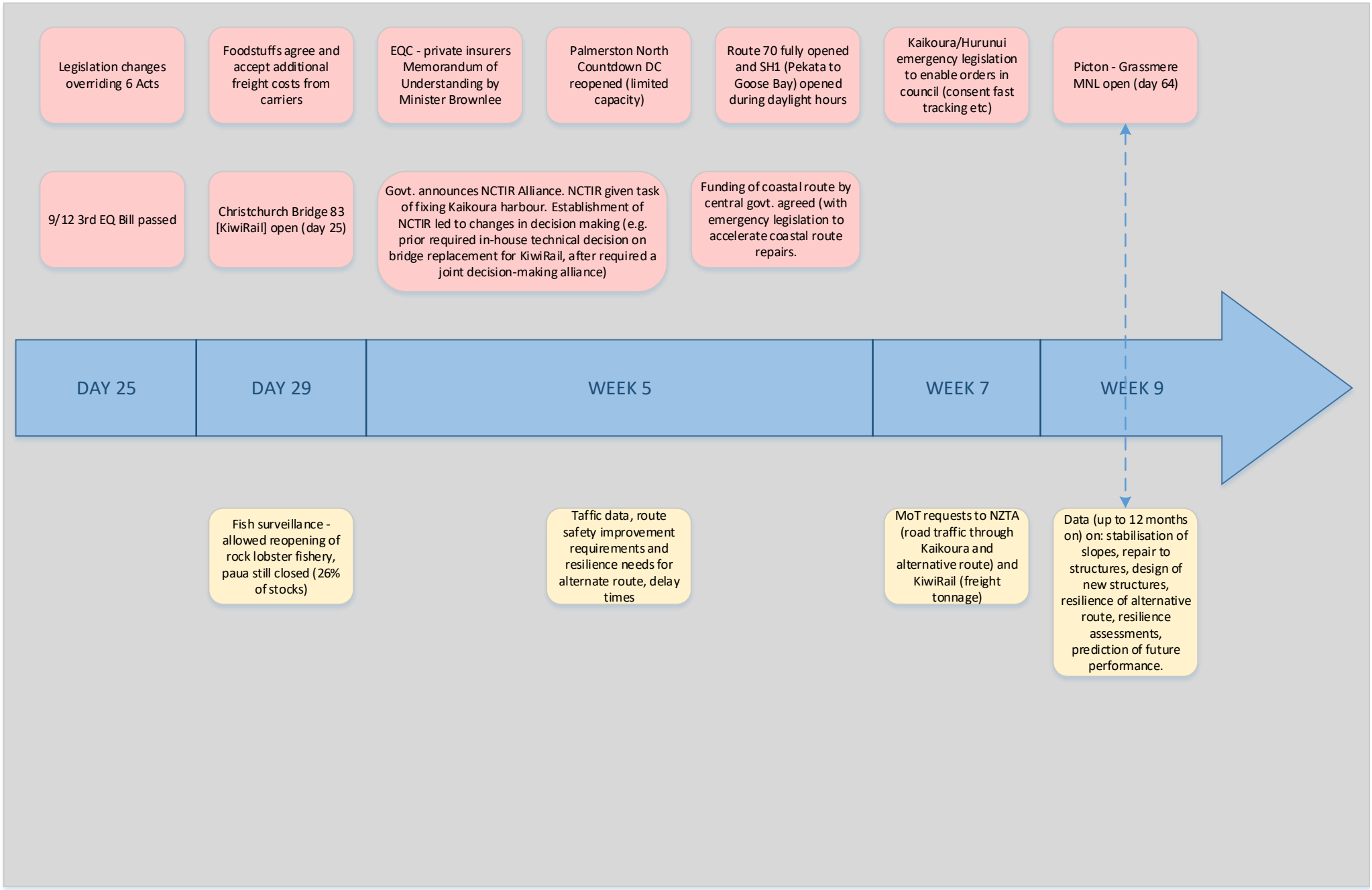

Recording info from Canterbury EQ sequence (Information Sharing Platform SCIRT)
Collaborations between agencies
Aratere ferry unavailable for 2 weeks and damage to linkspan following vessel impact
Port decisions on closure
Airport closure decisions
Transport Response Team (MoT) activates (02:00)
Port companies confirm berths available [in Wellington] (water depth & damage) Safe to berth Kaiarahi.
Funding of resilience enhancement initiatives
Preparedness activities
Re-surveying Kaikoura harbour
KiwiRail decisions on rail closure
Needed info on current state of networks, assets & alternatives: MCDEM requested NZDF to take imagery of all damage. Information gathering, inspections, evaluations. KiwiRail set up Data /Contact Centre. Contracted engineering teams self-mobilised from Christchurch, Blenheim and Wellington. Ongoing needs assessment.
NZTA decisions to open, restrict or close SHs and assessing what was known or not known. Contracting resources pushed to inland road (SH70) by NZTA. Also decisions regarding alternative [SH1?] route - costs and benefits required
Pre-event
DAY 1...
From SH resilience assessments & interventions (e.g. SH1 Kaikoura coastl project)
Wider Wellington work - e.g. lifeline utilities info, Senior Management Leadership team activities
NZDF P-3 Orions. TRT reports and infrastructure status to MCDEM
Geotech data on road corridor, geological impacts, movements / displacements following aftershocks. Also info sought on bridges, slopes, culverts, slip dams, fences, rail tracks, houses, access, severity. KiwiRail data captured (up to Jan/Feb): Field inspections (data fed back by phone, text, photos, spreadsheet summaries & damage reports), electronic damage reports, bridges / tunnels, culverts, slips, telecoms, LiDAR data, load testing on bridges for work team crossings. Would have been useful to have PGA measures for bridges and tunnels, risk/seismic assessment on bridges.
NZDF P-3 Orions. Traffic count data not needed. Weather data required due to ongoing risk of slips/rock falls (day1-30). TRT reports and infrastructure status to MCDEM
Canterbury EQ sequence specific (e.g. Forward Works Spatial Viewer - port)
Emergency Response Plans
Maritime NZ (contacting ports). News outlets, port company info, staff reports. TRT reports and infrastructure status to MCDEM.
Lack of information around InterIsland Ferry Services. Data on current state of passengers and crew on ferries was produced
CAA (contacting airports). TRT reports and infrastructure status to MCDEM
Lack of communication pathway to transport operators / police (communications too generic)
By 04:00, Wellington CDEM had fairly clear idea of damage levels to utility assets in the region - damage at the port appeared most substantial

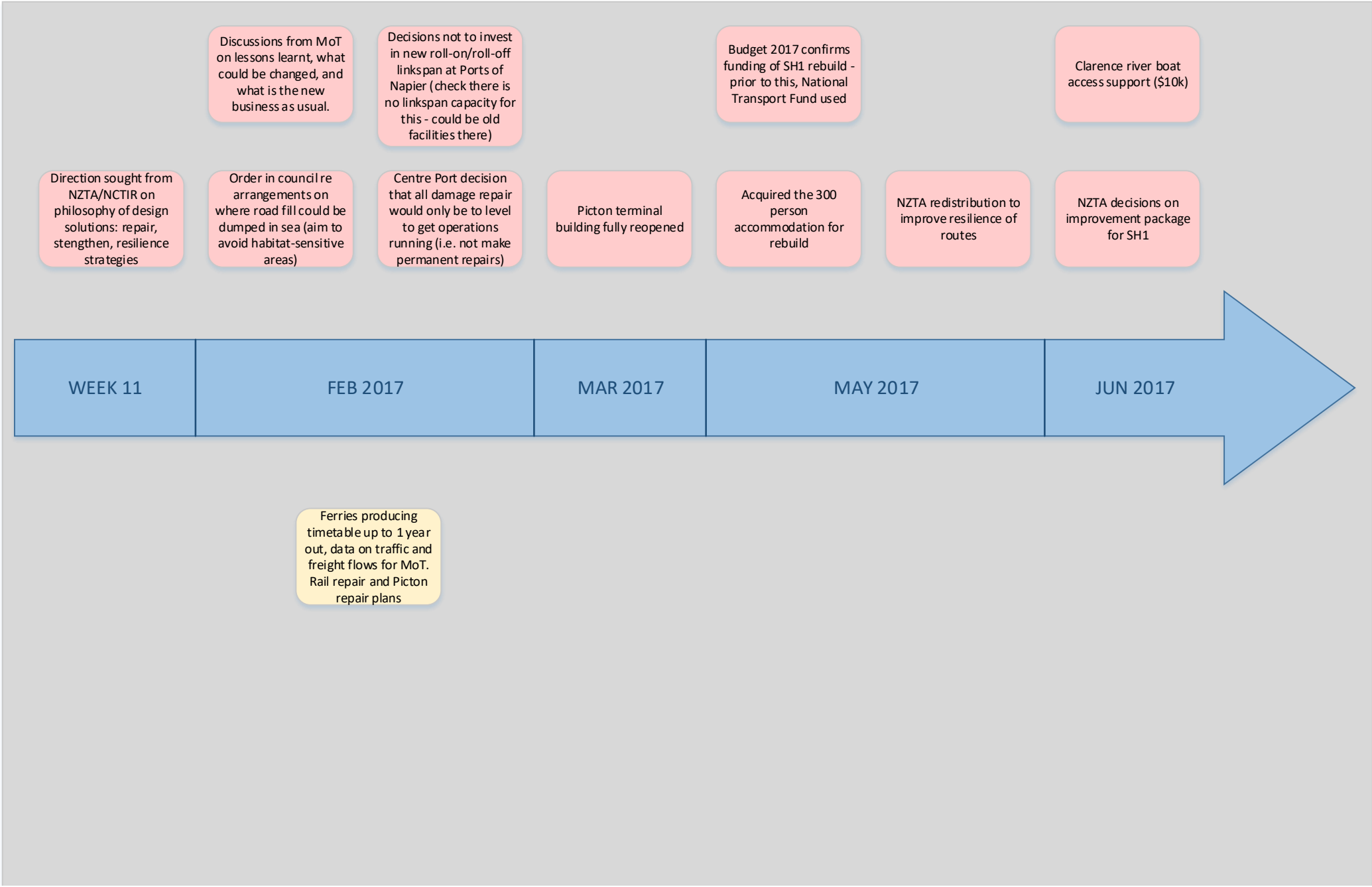

What staff available and where should they work from? Relocation of team (Countdown). Some staff work from home.
How to get people from Christchurch to Wellington. Kaikoura airport re-opened (16:00)
Closure of Countdown distribution centre in Palmerston North due to EQ damage. Stores also damaged in Wellington
Aviation procedures re-established at Kaikoura airport due to ground-based aid
Status of buildings etc in Wellington? (MoT) Mapping damage and Wellington metro damage survey (KiwiRail). [Port/ferry] building to be assessed by port company & KiwiRail. Requirement for building inspections (Countdown). Decsion not to enter some buildings by response agencies (incl. MoT building/StatsNZ)
"Tsunami threat made by local authorities" - evacuations in Christchurch, Wellington, North Canterbury, Marlborough beachside areas
MCDEM decision not to declare national state of emergency (ongoing discussions day 1-3)
Safety of staff confirmed in Wellington, Palm N and distribution centres (Foodstuffs)
Milk dumping and drying off cows occurred
...DAY 1
DAY 2
Temporary offices needed
Human and animal welfare urgent needs in rural areas
Air transport available but Wellington isolated (storm). Relied on - GeoNet, WREMO feedback, GoogleMaps, NZTA website.
Utter confusion about tsunami risk at Wellington, Waimakariri [and elsewhere]. - should evacuation occur? Where? When can people return? Needed consistent tsunami risk advice at port/ferries
Desire for detailed level maps and available resources for rural areas
Inspection and assessment reports produced by engineers, incl. advice on road openings and data from surveys
Needed to track and assess status / safety of team members. Risk assessments. Registration. How to communicate
Resource assessments and requirements needed (who needs what for response)
Direction from government on tasking and coordination required, if any needed.
Road and rail network repairs info, ferry and port operations.
Cell coverage issues, laser scanning info, WorkSafe methods. PGA data.
Database on medium-lift and heavy-lift helicopters, barges, and other transport options required for response purposes.
Media info was used to make decisions - several sources incl. Herald, Stuff, NZTA comms. Also GoogleMaps (real-time traffic data), NZTA route info map, AirNZ website

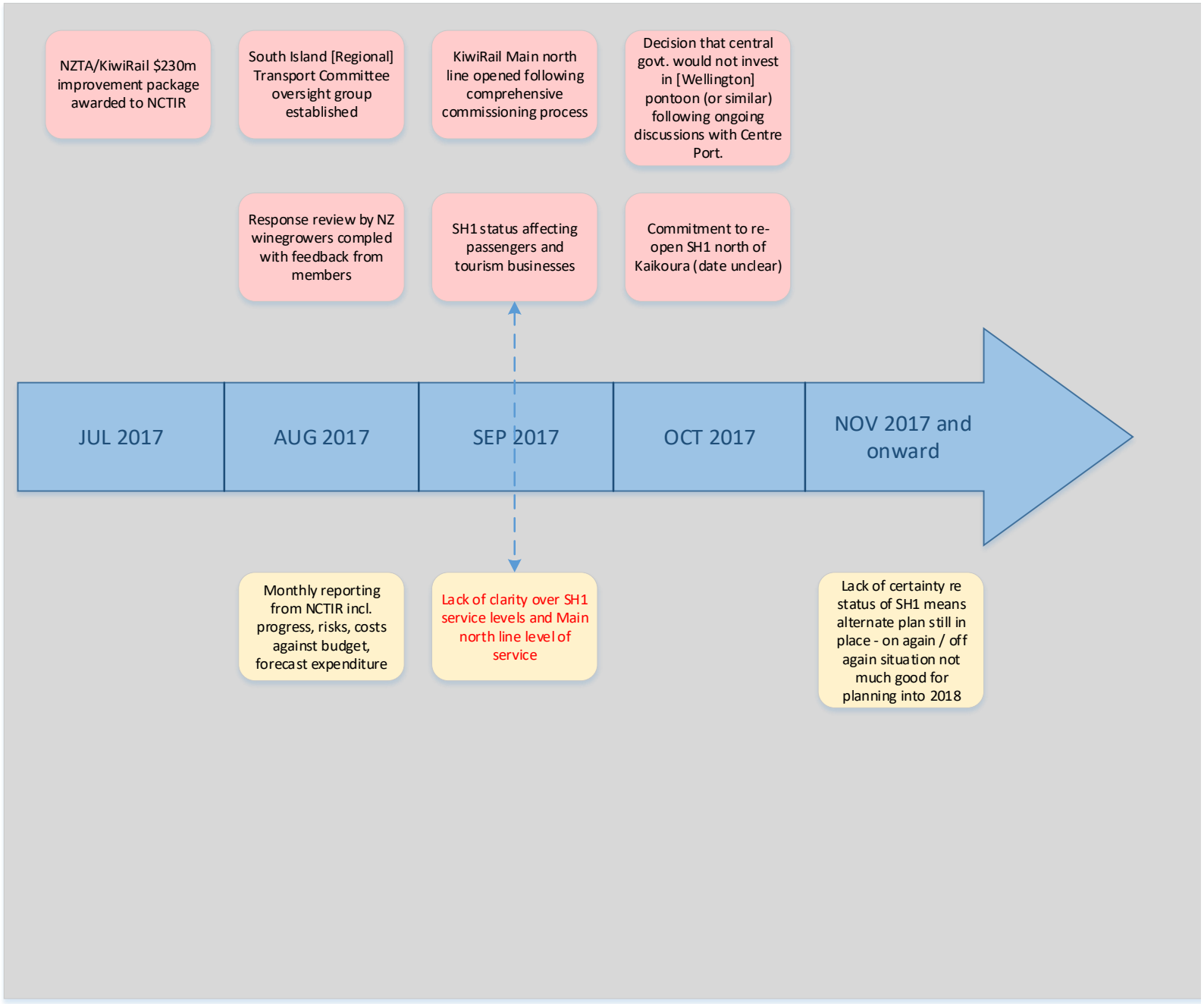

Extra staff recruited by transport operators and additional equipment hired. More technical engineers mobilised from further afield in NZ and overseas.
Temporary restricted areas established around Kaikoura. Continued entry along SH70 (e.g. protranz with water and geoinspections)
Govt decision to rebuild road and rail
[Requests for data on elevation / ground movement models]
Cross agency work established(?), army convoys along SH70 began. Protranz earthmoving organised
Picton to Blenheim [KiwiRail] open and SH1 From Peketa - Mangamaunu).
Planning for staff / capabilities by KwiRail. Inspections planned and commenced - damage to bridges, rail tracks and tunnels. KiwiRail work from north to south and south to north
Considerations of alternate ferry operations to Lyttelton for internally and government
Handouts of inland Kaikoura route given to NZTA from Hurunui District Council
Prioritisation of transport routes by Welfare. Happened to have navy ship available - would have been difficult without.
Repair options developed, cost estimates, sketches. (week 1-2)
DAY 3
DAY 4
DAY 5
DAY 7...
Customers advised of alternate route timings, additional costs and alternate modes.
Interim ferry timetable produced & disruption advice. Wished had info from government on requirements
Damage classification on system developed and coordination with NZTA to share data
Used LPC info on berths and interal info on ship ramps. Wished had more clarity about needs for this as not commercially viable but was asked for.
Quicker and efficient processes possible for
Transport needs for agricultural sector, wine logistics, urban Kaikoura, and Kaikoura industries.
Fed to NZTA. Desire for information from NZTA about weight limits and information on [vulnerable] assets.
Needs of / offers of assistance from/ for farmers and producers filtered through MPI (people and animal and infrastructure and insurance related). Assisted by Rural Support Trusts who conducted door to door visits.
Reconnaisance photos from geotech engineers. Risk assessments of landslide dams and impact on key roads and bridges.


How to operate foot passengers from Wellington - internal risk assessments, building safety assessments, scope of work needed defining.
Paua rescue volunteers became involved to move Paua following uplift - later stopped due to H&S risks and breaching of road cordons
Additional trucks and drivers sourced (FoodStuffs) due to increased travel times and log book requirements - pressure on limited pool of drivers and spike in truck rollovers on alternate route - competency based.
Installed bailey bridges on one-way bridges on alternative Picton to Christchurch route - open to HPMU trucks. Were decisions whether to make improvements to SH or not
Freight information requested by MoT to produce analysis using existing and new data.
NZ winegrowers engaged with Port Nelson and QuayConnect to gauge wine flow from Port Nelson
Communications bolstered with 3 mobile boosters
NZDF convoys continued and were joined by infrastructure providers
NCMC looking to understand which roads were open or closed
5x categories were used by NZTA to depict statuses of roads (ranging from closed to fully open). Also classification in damage database for KiwiRail sections (and cost estimates)
Route 70 opened to non-emergency vehicles in convoy (CDEM and NZTA managing road)
...DAY 7
DAY 9
DAY 11
DAY 13
Requested info from freight sector for data on volumes, modes, routes.
Wine industry impacts info based on damage survey and wine flow data obtained from Port Nelson
Huge investment required to bolster comms - network wide issue
Used NZTA's excellent SH Road Outages website
Damage assessments and field inspections (some by consultants and started tunnel inspections)
New aerial photos, LiDAR, sat imagery (captured by LINZ), GNS geological assessments used. Wished had more timely geological / landslide assessments and earlier photos / maps [Opus]
[Requests for data on elevation / ground movement models]
Telematics data used to validate info on alternate route (time/ speeds/distance). In cab camera dataused to feed back reality and manage enforements. More robust info on state of HPMU network required. Lack of alterante cook straight option a concern.


CDEM to NZTA/MoT handover occurred (Ministers decision)
Coordination of stock to slaughter (trucks). Animal welfare but decisions left to operators and farmers
Agreements to better share road access info with those on routes that were closed
Large public meeting in Blenheim incl. NZ Winegrower members
Increased ferry operations: re-start of foot passenger service (using temporary facilities in Picton), Aratere rail operations after linkspan repairs in Wellington. Internal KiwiRail discussions about coastal shipping options including direct charter options.
Full interislander services resume
Now 2x public convoys a day. Container freight redirected to Napier (FoodStuff N Island)
Ferry [KiwiRail] open (day 16).
Improvement package on the alternate route drawn up and $60m approved by NZTA Board to make rouet fit for purpose
30/11 1st EQ Bill passed
2/12 2nd EQ Bill passed
Further decisions on alternative route incl. on bailey bridges and culverts, improved public comms, quick reaction maintenance and SH63 improvements.
DAY 15
DAY 16
DAY 17
DAY 19
DAY 21
DAY 23
Daily information on journey time and reliability for Chch to Picton
Ferries were producing timetables and disruption info. Also data on traffic flow. Used customer info on needs, port company staus info and cancellation requests from bookings.
Collecting travel demand info to manage cordons and convoys. Supplied to welfare teams
Collaborative effort led by DPMC to generate list of initiatives to improve Wellington's resilience and ability to respond to events.
[requests for data on change to seabeds/ depths]
Tourism flow data from MBIE survey, mobile phone data, expenditure data, international departures.
Further LINZ surveys/data to measure land changes incl. nearshore bathymetry, property boundaries, and coordinates/heights of reference marks to enable construction works.
Estimates of local govt. infrastructure damage and cost incl. transportation interuptions (week 2-6). Also restoration times for SH1. Also capacity of contracting industry.
Economic impact / Inland revenue data, states data on regional economies, retail activity data and employment data from Stats and MBIE - MERIT model.


Legislation changes overriding 6 Acts
Foodstuffs agree and accept additional freight costs from carriers
EQC - private insurers Memorandum of Understanding by Minister Brownlee
Palmerston North Countdown DC reopened (limited capacity)
Route 70 fully opened and SH1 (Pekata to Goose Bay) opened during daylight hours
Kaikoura/Hurunui emergency legislation to enable orders in council (consent fast tracking etc)
Picton - Grassmere MNL open (day 64)
9/12 3rd EQ Bill passed
Christchurch Bridge 83 [KiwiRail] open (day 25)
Govt. announces NCTIR Alliance. NCTIR given task of fixing Kaikoura harbour. Establishment of NCTIR led to changes in decision making (e.g. prior required in-house technical decision on bridge replacement for KiwiRail, after required a joint decision-making alliance)
Funding of coastal route by central govt. agreed (with emergency legislation to accelerate coastal route repairs.
DAY 25
DAY 29
WEEK 5
WEEK 7
WEEK 9
Fish surveillance - allowed reopening of rock lobster fishery, paua still closed (26% of stocks)
Taffic data, route safety improvement requirements and resilience needs for alternate route, delay times
MoT requests to NZTA (road traffic through Kaikoura and alternative route) and KiwiRail (freight tonnage)
Data (up to 12 months on) on: stabilisation of slopes, repair to structures, design of new structures, resilience of alternative route, resilience assessments, prediction of future performance.


Discussions from MoT on lessons learnt, what could be changed, and what is the new business as usual.
Decisions not to invest in new roll-on/roll-off linkspan at Ports of Napier (check there is no linkspan capacity for this - could be old facilities there)
Budget 2017 confirms funding of SH1 rebuild - prior to this, National Transport Fund used
Clarence river boat access support ($10k)
Direction sought from NZTA/NCTIR on philosophy of design solutions: repair, stengthen, resilience strategies
Order in council re arrangements on where road fill could be dumped in sea (aim to avoid habitat-sensitive areas)
Centre Port decision that all damage repair would only be to level to get operations running (i.e. not make permanent repairs)
Picton terminal building fully reopened
Acquired the 300 person accommodation for rebuild
NZTA redistribution to improve resilience of routes
NZTA decisions on improvement package for SH1
WEEK 11
FEB 2017
MAR 2017
MAY 2017
JUN 2017
Ferries producing timetable up to 1 year out, data on traffic and freight flows for MoT. Rail repair and Picton repair plans


NZTA/KiwiRail $230m improvement package awarded to NCTIR
South Island [Regional] Transport Committee oversight group established
KiwiRail Main north line opened following comprehensive commissioning process
Decision that central govt. would not invest in [Wellington] pontoon (or similar) following ongoing discussions with Centre Port.
Response review by NZ winegrowers compled with feedback from members
SH1 status affecting passengers and tourism businesses
Commitment to re-open SH1 north of Kaikoura (date unclear)
JUL 2017
AUG 2017
SEP 2017
OCT 2017
NOV 2017 and onward
Monthly reporting from NCTIR incl. progress, risks, costs against budget, forecast expenditure
Lack of clarity over SH1 service levels and Main north line level of service
Lack of certainty re status of SH1 means alternate plan still in place - on again / off again situation not much good for planning into 2018