Keeping Christchurch Moving

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ABSTRACT

The Stronger Christchurch Infrastructure Rebuild Team (SCIRT) is the construction alliance established following the 2011 Christchurch earthquake to rebuild the City's horizontal infrastructure to pre-earthquake levels.

As a result of the earthquakes, the extent of the damage caused and the transportation and mobility challenges that the city is facing during the rebuild are presented.

The horizontal infrastructure rebuild is scheduled to be completed by the end of 2016 and estimated to include:

- Over 500 km of wastewater pipe replacement,
- 1000 km of road repairs,
- Repairs to over 90 bridges and 400 retaining walls
- Extensive repair of the city's stormwater system.

This presentation will look at the collaborative effort invested in SCIRT's transport planning and traffic management to keep the 1200 person on-the-ground workforce busy rebuilding the city's horizontal infrastructure over 180 concurrent work sites, including 70 road closures. This presentation will show the tools developed to ensure work can proceed on-time and the travelling public is kept up to date on changes to the transport network.

Close working relationships with the Christchurch Transport Operation Centre (CTOC), SCIRT contractors, local businesses and the community are an integral part of achieving behaviour change around work sites and by commuters, with the goal of keeping Christchurch accessible and vibrant during the rebuild.

1. INTRODUCTION

According to the latest census data (2013) Christchurch's population is approximately 350,000 and is spread over approximately 1,425 km^2. The people of Christchurch have experienced over 13,000 aftershocks since the initial September 2010 earthquake. The following map shows the earthquake and aftershock locations for the various seismic events around the wider Christchurch area, which collectively caused major destruction of the city's horizontal infrastructure (wastewater, stormwater, water supply, utilities, bridges, retaining walls, reservoirs, pump stations and so on).

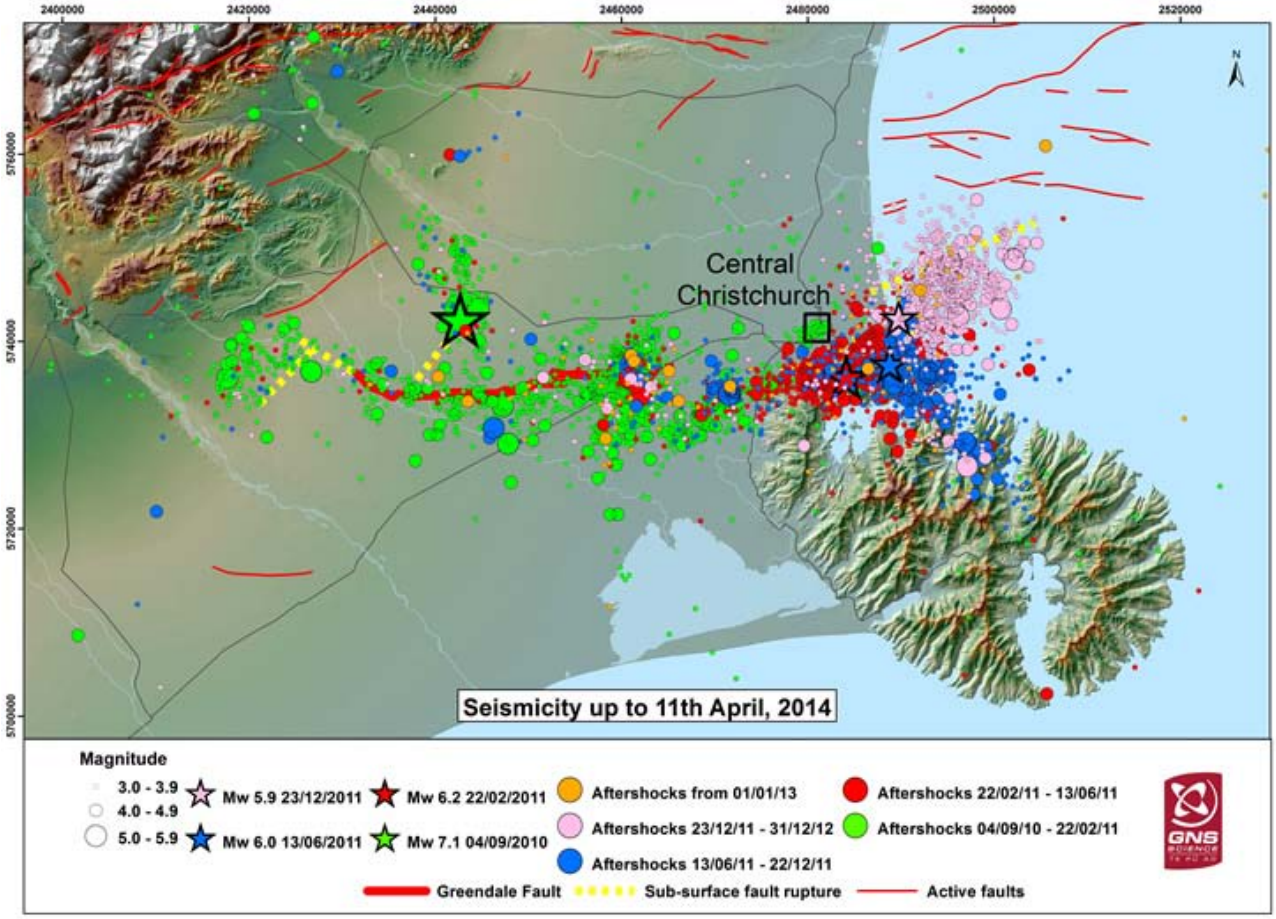

Figure 1 Earthquake map (Source: GNS Science, The most recent aftershock map dated 11 April 2014)

The extent of the damage caused by the most destructive February 2011 earthquake was widespread, with significant liquefaction experienced predominantly in the City Centre and the eastern suburbs. This liquefaction far exceeded the liquefaction experienced in the initial September 2010 earthquake. The liquefaction extents are shown in Figure 2 and Figure 3.

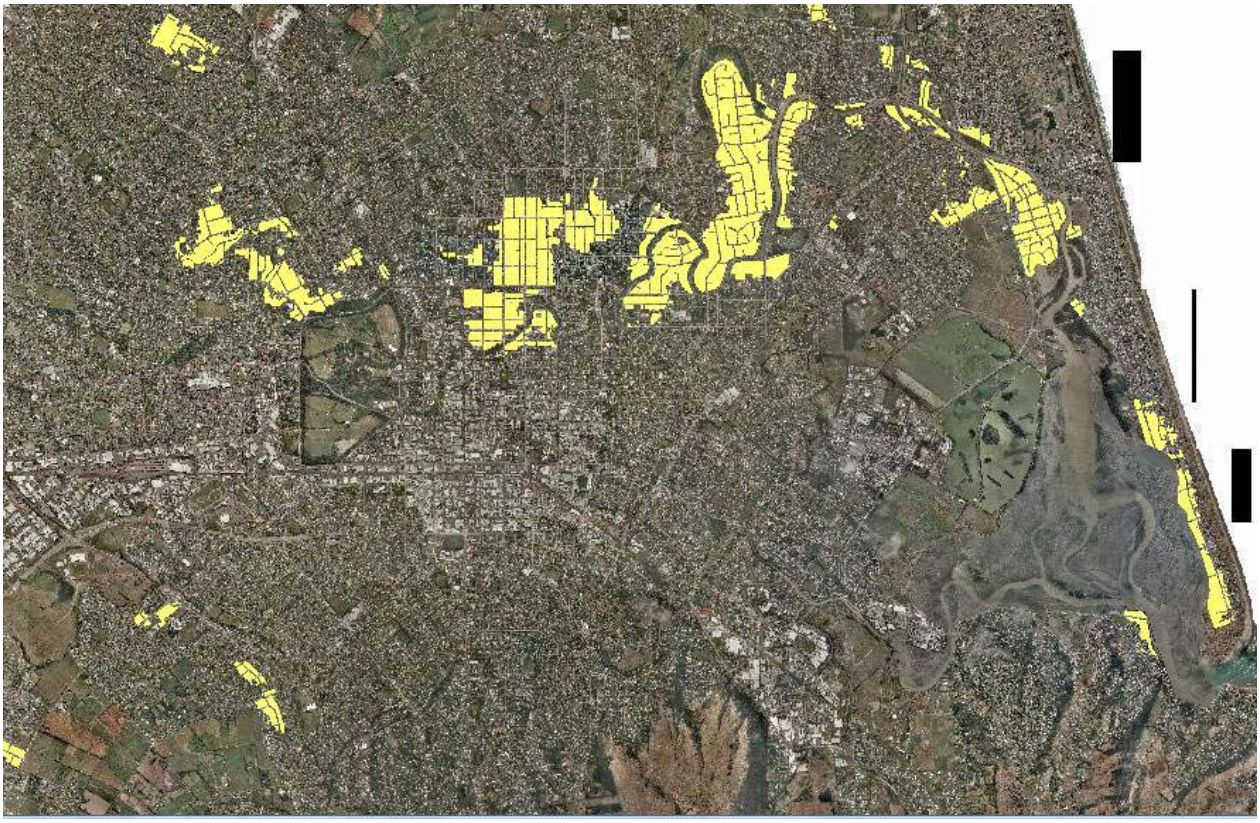

Figure 2 Liquefaction September 2010 (Source: SCIRT viewer, 04 September 2010 - Observed Liquefaction)

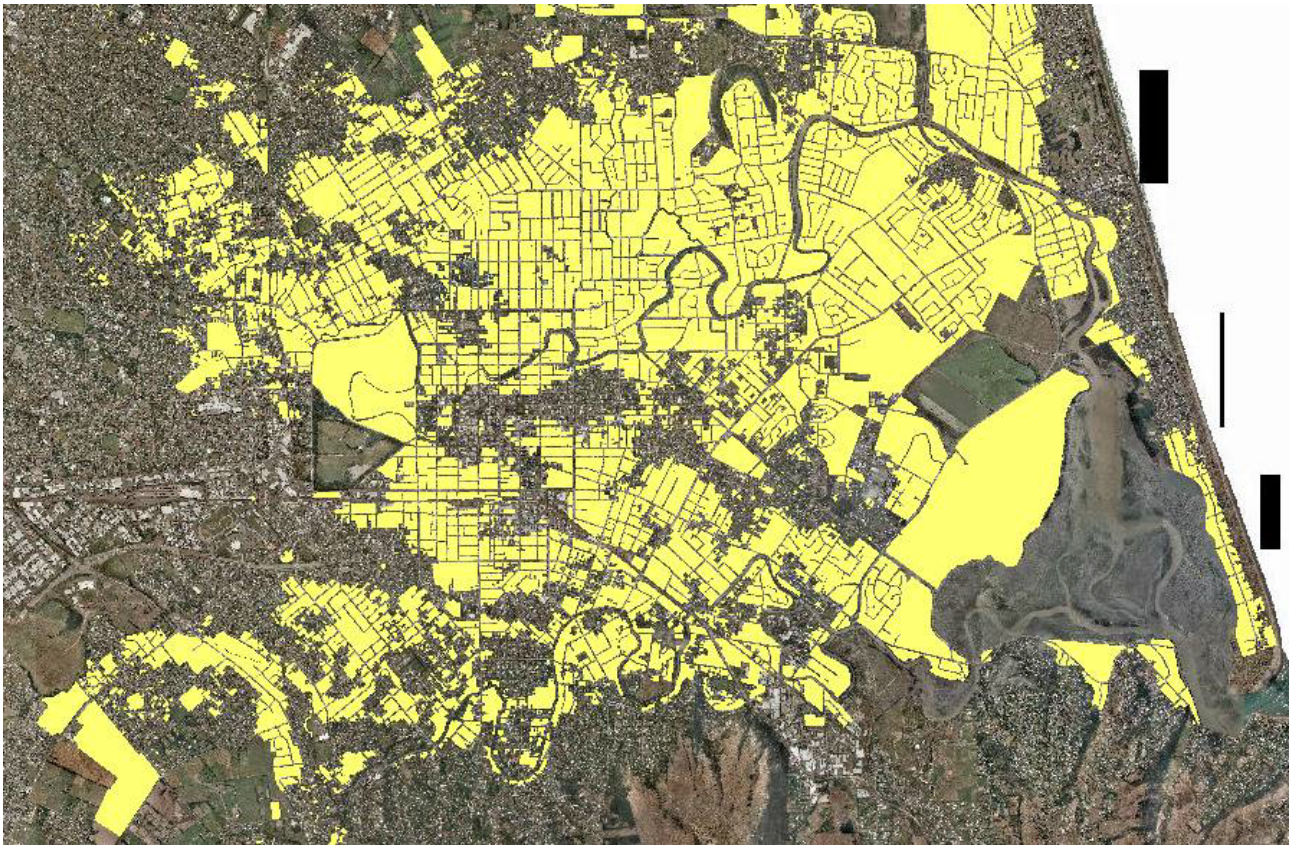

Figure 3 Liquefaction February 2011 (Source: SCIRT viewer, 22 February 2011 - Observed Liquefaction)

After the September 2010 earthquake, the Infrastructure Rebuild Management Office (IRMO) was formed and tasked with the design, construction management, programming, financing and administration of the earthquake repairs. As the extent of damage to the city was considerably increased after the February 2011 earthquake, IRMO was transformed into the Stronger

Christchurch Infrastructure Rebuild Team (SCIRT). SCIRT is an alliance between the three owners and five contractors, tasked with the reinstatement of the horizontal infrastructure to pre-earthquake levels.

The SCIRT asset owner participants are:

- Christchurch City Council (CCC),
- Canterbury Earthquake Recovery Authority (CERA), and
- New Zealand Transport Agency (NZTA)

The SCIRT Delivery Teams (contractors; non-owner participants) are:

- City Care,
- Downer,
- Fletcher Construction,
- Fulton Hogan, and
- McConnell Dowell

With the transformation from IRMO to SCIRT, the workforce required for the rebuild was increased. At the height of the SCIRT construction period, there were approximately 300 people within the SCIRT Integrated Services Team (IST) office. The IST included staff from each of the Delivery Teams, CCC, NZTA, as well as over 150 designers from various consultancy companies. The Transport Planning and Traffic Management team sits within the SCIRT IST, as illustrated in Figure 3.

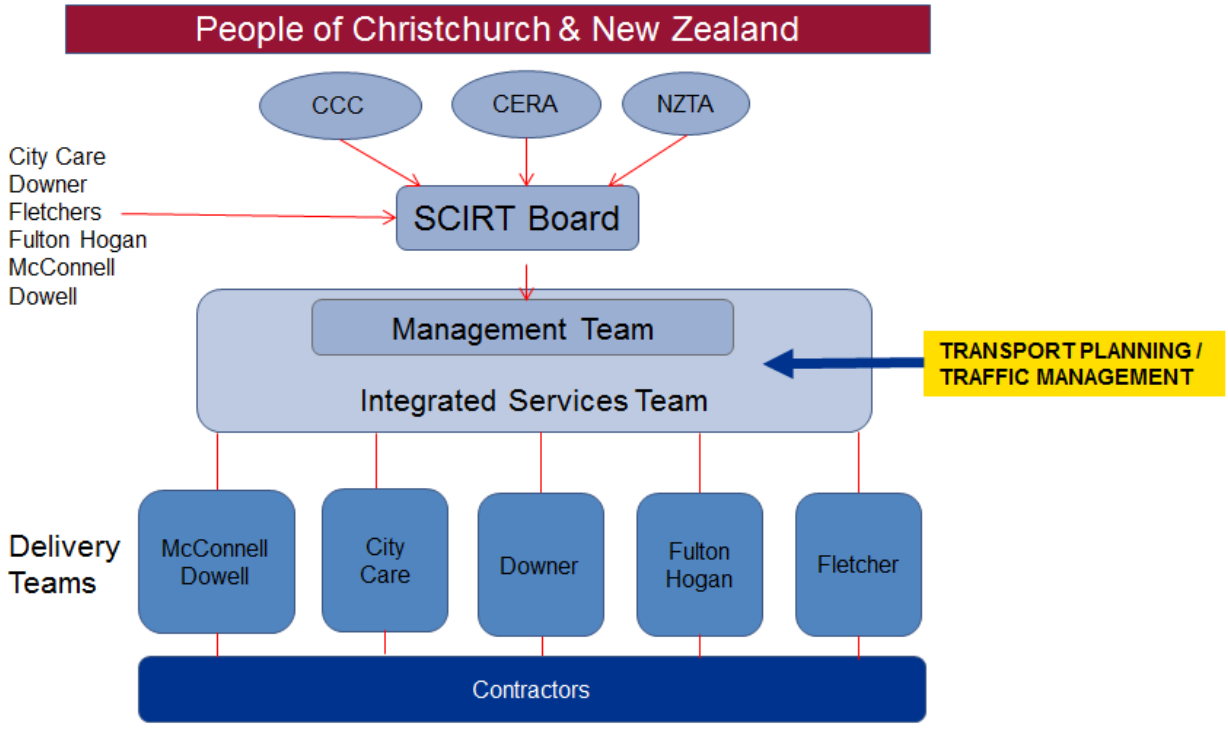

Figure 4 SCIRT team structure (Source: SCIRT)

The following Figure 5 provides an illustration of the horizontal infrastructure under repair by SCIRT.

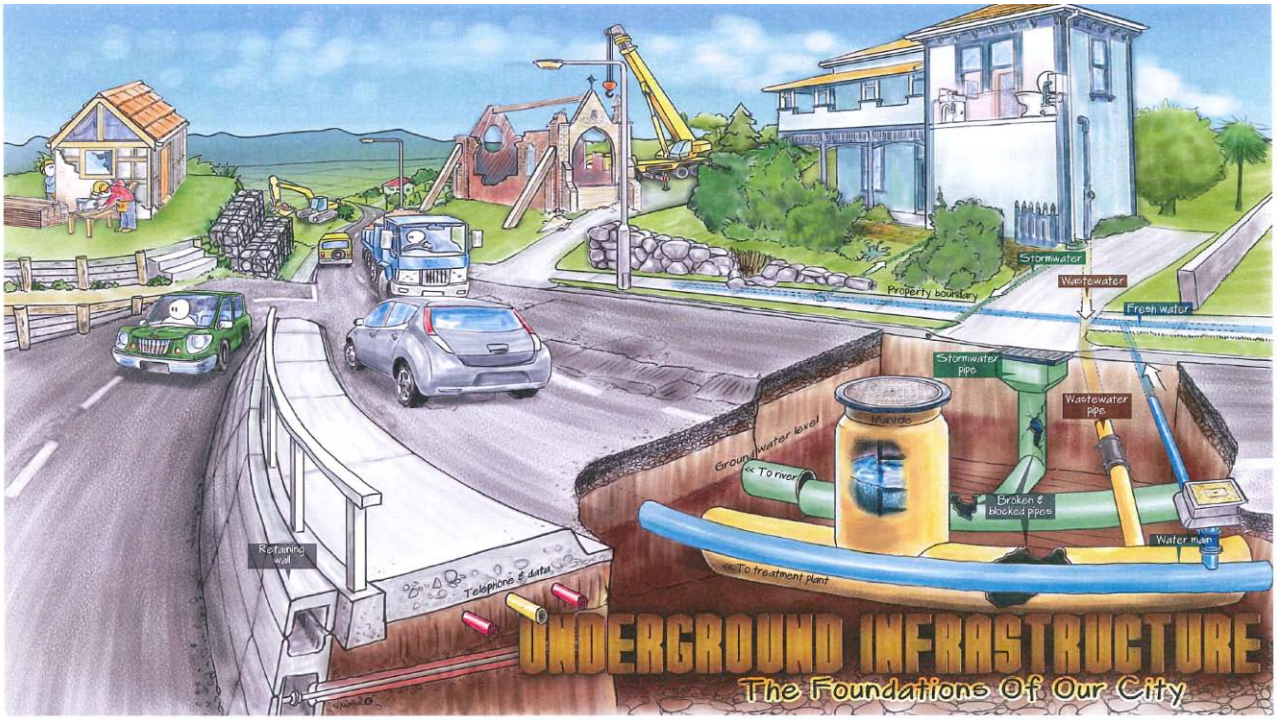

Figure 5 Horizontal Infrastructure Overview (Source: SCIRT)

These assets comprise of:

- Wastewater reticulation
- Stormwater reticulation,
- Water supply,
- Retaining walls,
- Bridges,
- Reservoirs,
- Pump stations (wastewater and stormwater),
- Underground utilities,
- Roads.

2. TRANSPORT PLANNING

The Transport Planning team within SCIRT primarily undertakes the following tasks:

1. Scheduling
2. Impact assessment
3. Economic assessment
4. Communication strategies
5. Traffic management strategies

To fulfil these tasks the following tools are used and will be described in more detail:

2.1. Christchurch Assignment and Simulation Traffic (CAST) SATURN model, SIDRA and economics assessment tool

Due to the earthquakes there was a significant shift in where the bulk of the city's residents lived. The move was predominantly from the east to the relatively less damaged west, according to information provided by NZ Post (2011); shown in Figure 6. Green indicates the pre-earthquake addresses and red for the new post-earthquake addresses.

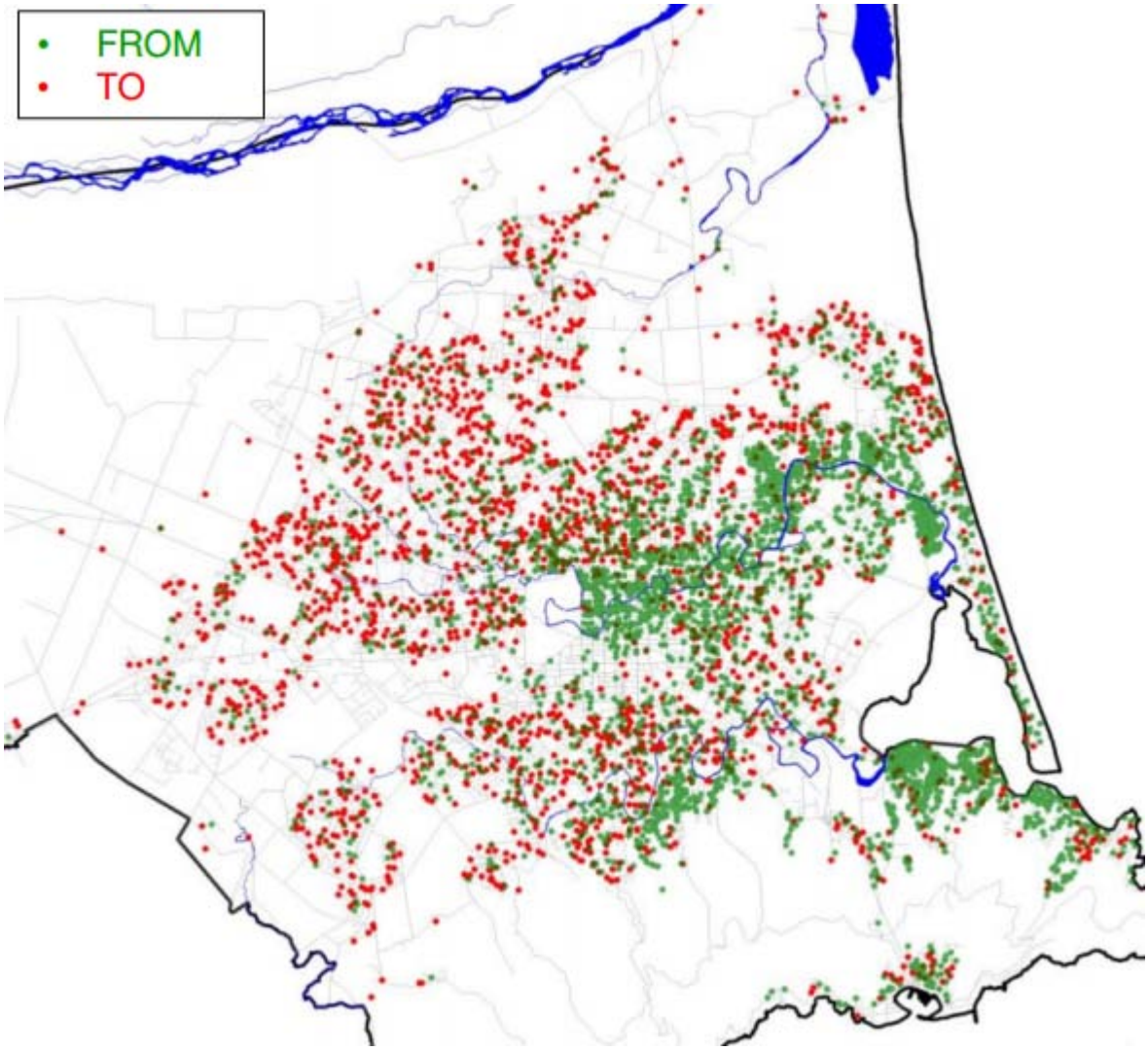

Figure 6 Household Postal Redirections (Source: Blyleven, M., Roberts, P. and Ballantyne, J. (2011))

This move has also changed the classifications of some roads as well as created new strategic routes. Some roads are now subject to heavier traffic loading and others less. These changes to the land-use across the city were taken into account and transport models were updated to reflect these changes.

The CAST traffic model is used to evaluate the impact on the roading network of individual Traffic Management Plans (TMPs) that are required to allow work crews access to the roads. If required, an intersection performance analysis is undertaken using the software SIDRA. The modelling outputs are used in an economic assessment to understand the associated transport costs of the works. The modelling outputs are also used to inform of potential detour routes and to determine the best locations to install Variable Message Signs (VMS) which are one tool to communicate with road users.

2.2. Traffic Impact Management (TIM) model

This model was developed on an SQL server platform. This model used SQL and Python scripting and is based on the assigned paths from the CAST model. It is compatible with the GIS Forward Works Programme (FWP) database and each day it automatically reads in the road works as scheduled by the Delivery Teams. This model is capable of modelling daily scenarios much quicker than CAST as it does not use equilibrium assignment, so weeks' worth of scenarios can be modelled in a few hours.

2.3. Forward Works Viewer (FWV) - SCIRT

The FWV was established to display all work, both current and proposed, in an online viewer available to all stakeholders. This viewer was developed to take the project schedules from all Delivery Teams and map the location, duration and impact of each work stage on an online interactive map. The viewer processing also provides 'back-end' analysis of the raw data to ensure the transport network always has sufficient capacity to accommodate the planned work, and will alert the transport planning and communication stakeholders when excessive congestion may result from a specific work activity.

2.4. Long term traffic impact dashboard

The dashboard provides a summary of the roading network capacities within the` wider Christchurch area and the CBD in particular over time. It is based on the FWV data and displays the traffic impacts for each direction (northbound, southbound, eastbound, westbound) for the next two weeks, as well as showing the reduction in number of lanes and capacities until the end of the SCIRT programme. It also provides statistics such as: the number of works in construction per delivery team, the reduction of lanes in the CBD, and the bridges capacities as percentages and number of lanes open.

2.5. Project approvals and scheduling Gantt chart

Gantt charts are provided for each of the four directions (northbound, southbound, eastbound and westbound) as well as an off-peak overview. The directional Gantt charts are structured street by street and are a collection of works that impact on the capacity of Christchurch's roading network. The impact is collated over all Delivery Teams.
The Gantt charts are also used as a pre-approval tool for works to ensure the level of service within the CBD is maintained at an adequate level at all times. These approvals are given on a bi-weekly cycle by the traffic impact minimisation (TIM) group. Every two weeks, the scheduled project stages are also compared to the previous impacts and dates to track changes made. Figure 7 details the date and impact checks undertaken.

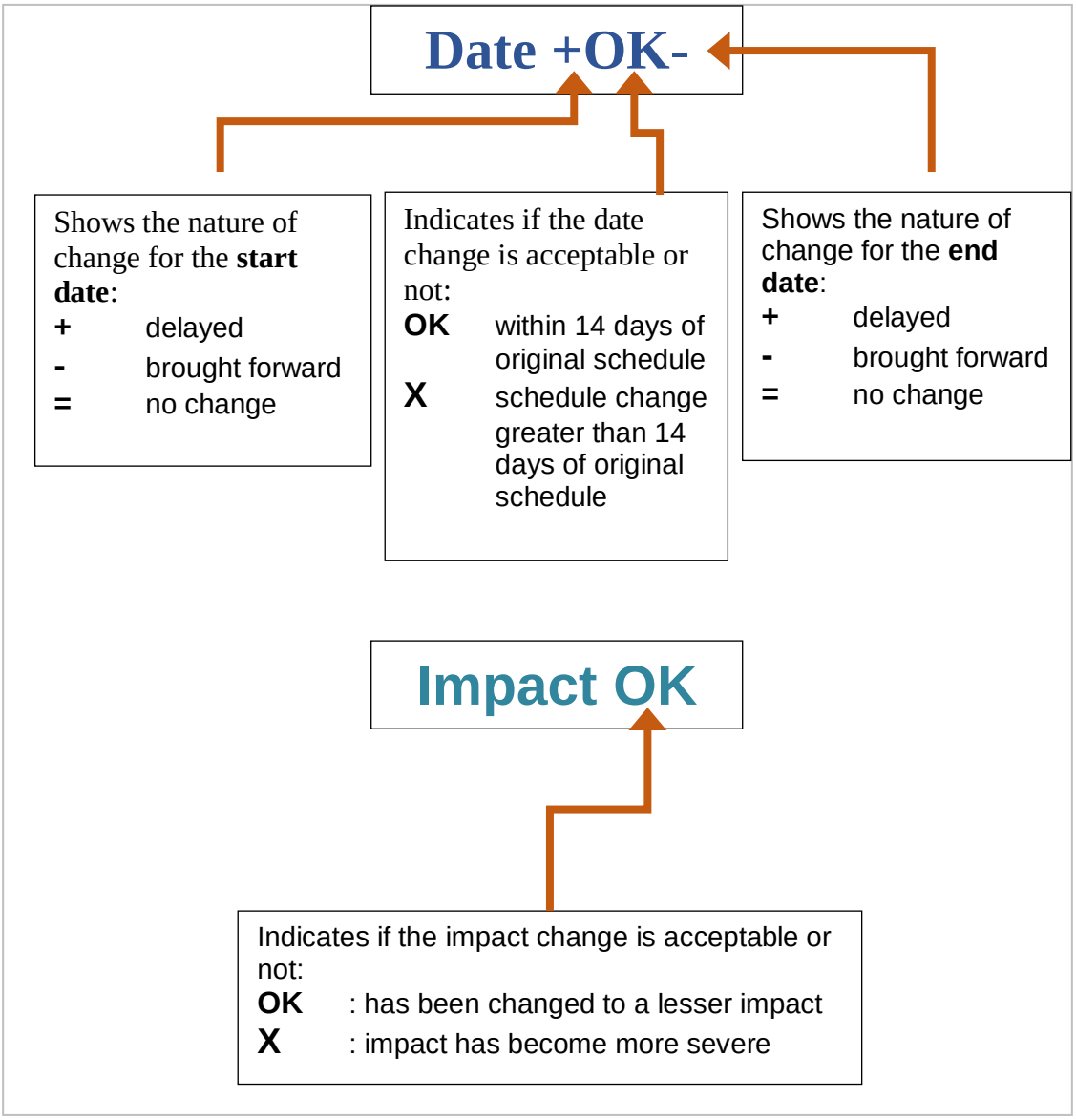

Figure 7 Gantt-chart two weekly comparisons (Source: SCIRT Gantt-chart description)

2.6. Impedance tool

The impedance tool is used to map the day-to-day average delay on the network at a property level. This impedance data is shown in the form of a heat map and determines areas impacted with high impedance due to SCIRTs road works. An example of an impedance heat map is illustrated in Figure 8.

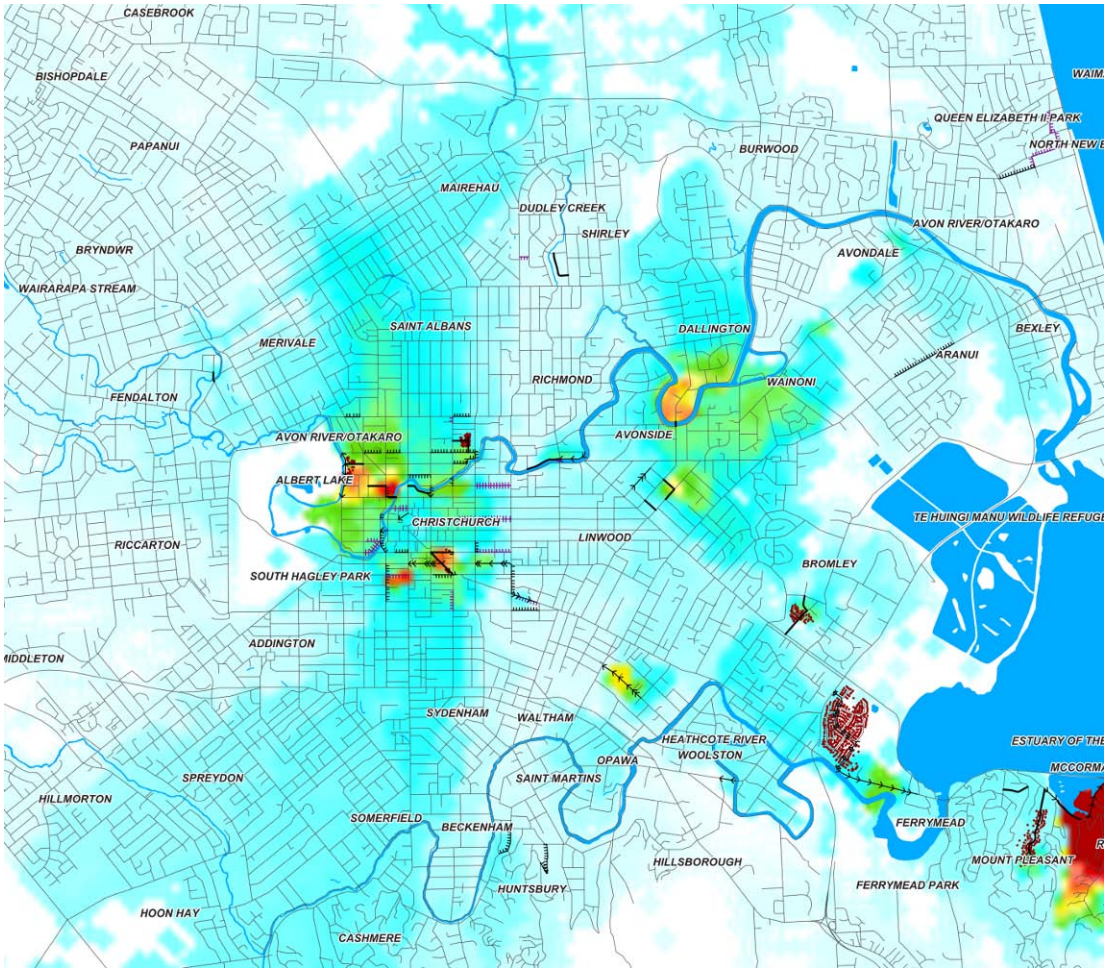

Figure 8 SCIRT impedance tool – heat map (Source: SCIRT internal output)

3. TRAFFIC MANAGEMENT

Transport management within SCIRT comprises of the following five main tasks:

3.1. TMP approvals

The SCIRT Traffic Management Plan (TMP) approving engineers look through lodged TMPs collectively to achieve a common standard across all Delivery Teams. This review process also ensures the TMPs are up to standard before they are submitted to CTOC for formal acceptance. The following are some traffic management statistics in relation to the SCIRT works:

- ~ 250 traffic management personnel and associated people involved *(There are approximately 200 STMSs working on the road and the rest comprises of traffic co-ordinators and designers of TMPs.)*
- ~ 150 active work sites at any one time in the wider Christchurch area with approximately 40 sites within the Christchurch CBD at peak times
- 24 hour a day; seven days a week operation on the roads
- > 3,000 TMPs submitted and processed to date
- > 6,500 TMP revisions
- Approximate processing times for TMPs are:
    - 24 hours for SCIRT
    - 5 days for CTOC

Figure 11 provides a screen shot of the “on the ground activities” within and around Christchurch’s CBD. The figure on the right shows the active site boundaries whereas the

left hand side shows the number of active sites within areas Given the level of activity, this activity level would not be possible without the TMPforchch.govt.nz website to keep track of all the work locations, detours and methodologies.

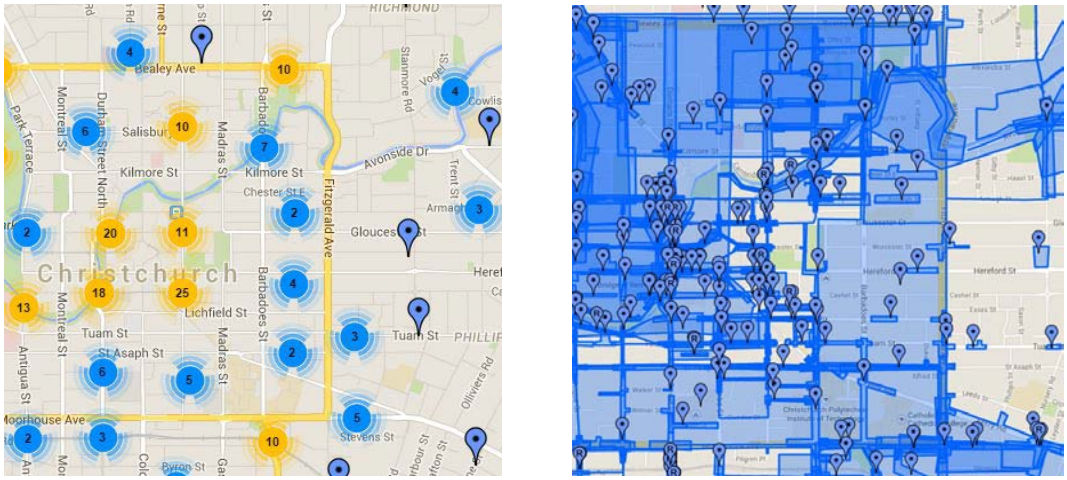

Figure 9 Activity on the ground (Source: TMP for Christchurch, CBD traffic management activity)

3.2. Site compliance

The SCIRT traffic managers undertake regular site checks to ascertain the SCIRT work sites are safe and in compliance with the Code of Practice for Temporary Traffic Management (COPTTM) and Road Controlling Authority (RCA) local operating procedures. The RCA procedures differ considerably in comparison to other RCAs due to the earthquake rebuild context and are generally more relaxed.[1] Site Traffic Management Supervisor (STMS) non-compliance notices can be issued and work sites can be shut down if the public or workers safety is deemed to be at risk.

In turn, awards are presented to recognise the best work sites and where the STMS has a well-organised site. A “super STMS” role was also introduced to help improve the overall setup of work sites and to provide a “go to” person for queries and issues.

3.3. Innovations

The traffic managers within SCIRT have developed several strategies to improve safety and efficiency. These innovative strategies are:

- A cycle strategy: this strategy was formed to make cycling through work sites safer and give cyclists a better experience. Signage from other countries, such as the UK, is being trialled in Christchurch and monitored to determine whether it improves the merge behaviour between cyclists and motorists. Furthermore, having a cyclist strategy in place aids to have a consistent approach from all Delivery Teams for cyclists. To create the strategy the Christchurch cyclist advocate group, SPOKE, were consulted and their input incorporated.

- VMS strategy: SCIRT introduced a VMS strategy within and around the four Avenues (Bealey, Fitzgerald, Moorhouse and Deans Ave) which surround the CBD. SCIRT managed the location and messages on the VMS boards to communicate area wide coverage of upcoming work and preferred routes. This allows for a better area wide communication as opposed to implementing specific treatment.

[1] Christchurch Improvements to Temporary Traffic Management (CITTM) was established to rationalize traffic management in an environment that was far in excess of what was ever anticipated to be dealt with using COPTTM. This allowed Christchurch to come up with innovations which are only applicable during the rebuild but also some innovation which are potentially considered for future best practice.

- CBD perimeter: A perimeter was established around the four Avenues due to the large number of work sites within the CBD. The concept behind the perimeter was to reduce the need for excessive temporary advance warning signs (men at work signs) and reduce the orange signage overload on drivers given the busy context. The CBD perimeter was rolled out under the CITTM projects and is contributing to cost savings for TTM during the rebuild. See Figure 10 for CBD perimeter signage.

Figure 10 SCIRT signage (Source: SCIRT)

- Universal TMPs::The SCIRT traffic managers developed some generic TMP rules that are described by the local RCA as the 'most comprehensive universal traffic management plan received'. These generic TMPs, termed 'universal TMPs', allow the STMS to establish one day work sites on CCC roads and State Highways within the CCC boundaries without any additional approvals or submissions. Prior to the establishment of the universal TMPs, only some basic TMPs were able to be used in this fashion by Maintenance Contractors. Universal TMPs cover all types of traffic management from inspection activities to dig down repairs which can be completed within one day. With the use of a one page road space booking form, the TTM can be approved to remain in place unattended for the duration of the work.

3.4. Speed management

SCIRT noticed that speeding motorists had become an issue on most SCIRT sites and decided to look at ways to encourage speed compliance. SCIRT trialled various speed treatments on site and used a speed radar to gather base data and post- treatment data to evaluate how effective various treatments were. Several trials were used including increasing side friction, VMS messaging, and speed humps. Once all the information was collated, it was issued as a speed management guideline for STMS to help them to reduce speeding past work sites. This document was not issued only for SCIRT STMS, but was supplied by the local RCA to all TTM providers in Christchurch and some companies have now asked that this guideline be used nationally.

3.5. Traffic management strategies

This strategy promotes coordination across multiple work sites in close proximity with each other. The traffic managers make sure communication occurs between the Delivery Teams and provide area wide traffic management plans if required. Project level discussions (PLDs) are also often requested to discuss work methodologies and to aim to ensure a balance between safety[2] versus network efficiency versus economic outcomes is achieved.

[2] All sites have to be planned and be rolled out safely (we strive for zero harm).

4. COMMUNICATION

The overall transport and traffic management processes aim to ensure that the rebuild work is scheduled, optimised, and overlaid with external programmes (such as an Accessible City works from CERA, vertical rebuild works, or the utilities network repairs). Once all the information is compiled, a thorough analysis commences. Based on the analysis of network efficiency versus safety versus economic outcome, the works methodology is confirmed and the traffic impacts communicated to the general public. This involves working closely with the SCIRT communication teams, both within the Delivery Teams as well as the Christchurch Transport Operations Centre (CTOC). This overall process is illustrated in Figure 9.

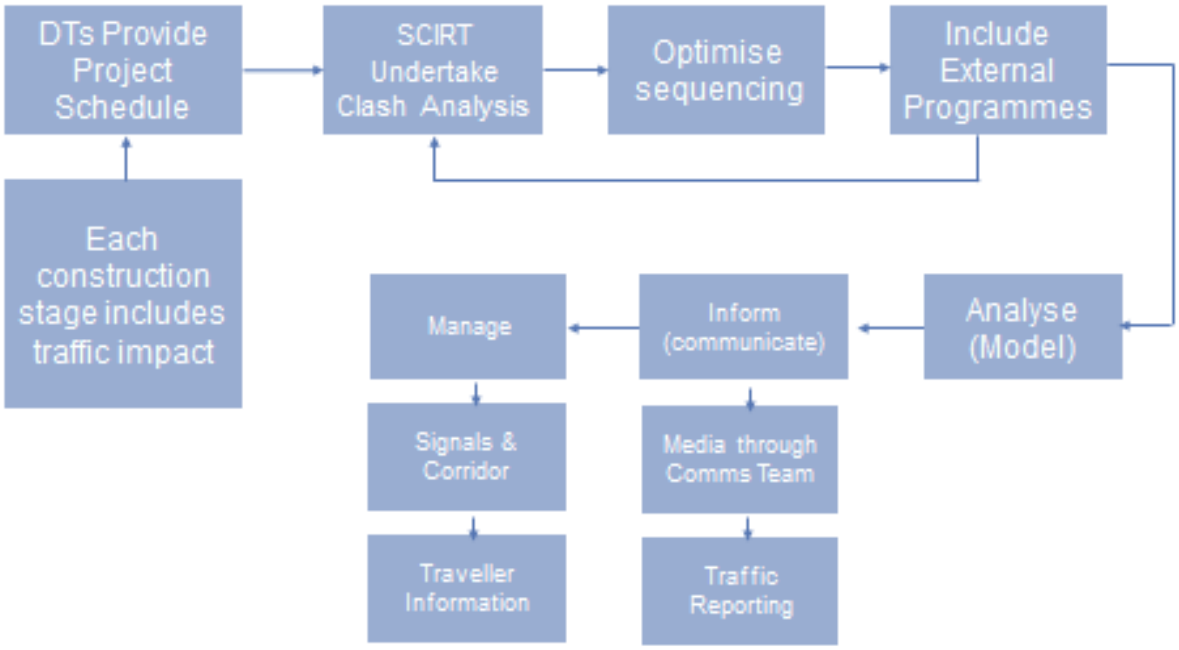

Figure 11 Transport planning and traffic management process (Source: SCIRT)

Being open and transparent in communications is essential to gain trust and maintain a positive public image of the SCIRT and the rebuild work. Informing the Delivery Teams, residents, emergency services, businesses, CTOC and the local RCA is undertaken through meetings, letterbox drops, radio announcements, newsletters, school visits and community groups. This engagement is important to achieve behaviour change and traffic rerouting in an intended way and to gain acceptance for the works undertaken. It is only possible to keep Christchurch moving and avoid gridlocking the city by strong communication with road users. But it is also essential that messages such as “Open for business” are communicated to minimise the impacts the road works have on businesses and therefore people’s livelihoods. CTOC provide weekly updates on recommended main routes by taking into account all road works on the ground; see Figure 10 for an example. Furthermore, a web-based journey planner is available allowing the public to plan their journeys to avoid road works and account for detours.

Figure 12 Keep Christchurch Moving - Printed Advertisement (Source: Transport for Christchurch website, CTOC)

5. CONCLUSION

- So far, being over halfway through the SCIRT programme, it can be concluded that a detailed Forward Works Programme is essential to manage the impacts of SCIRT work sites on the Christchurch roading network and keep the city moving during the rebuild activities. Figure 12 shows the progress to date of the SCIRT programme at approximately 57% complete with 76% of the Christchurch CBD horizontal infrastructure restored.
- A common spatial system and regular data capture is essential in undertaking transport planning with multiple work sites in close proximity to each other, especially within the CBD.
- Good communications with stakeholders and the public is essential to help set public expectations and to successfully carry out the work. Due to the good communications to date, the people of Christchurch view SCIRT road works mostly as a sign of progress (as per survey results) and accept the importance of these works and the disruption they create.
- Not making the “news” is taken to be a sign of a successful delivery of SCIRT works without causing major disruption or attracting negative perceptions.

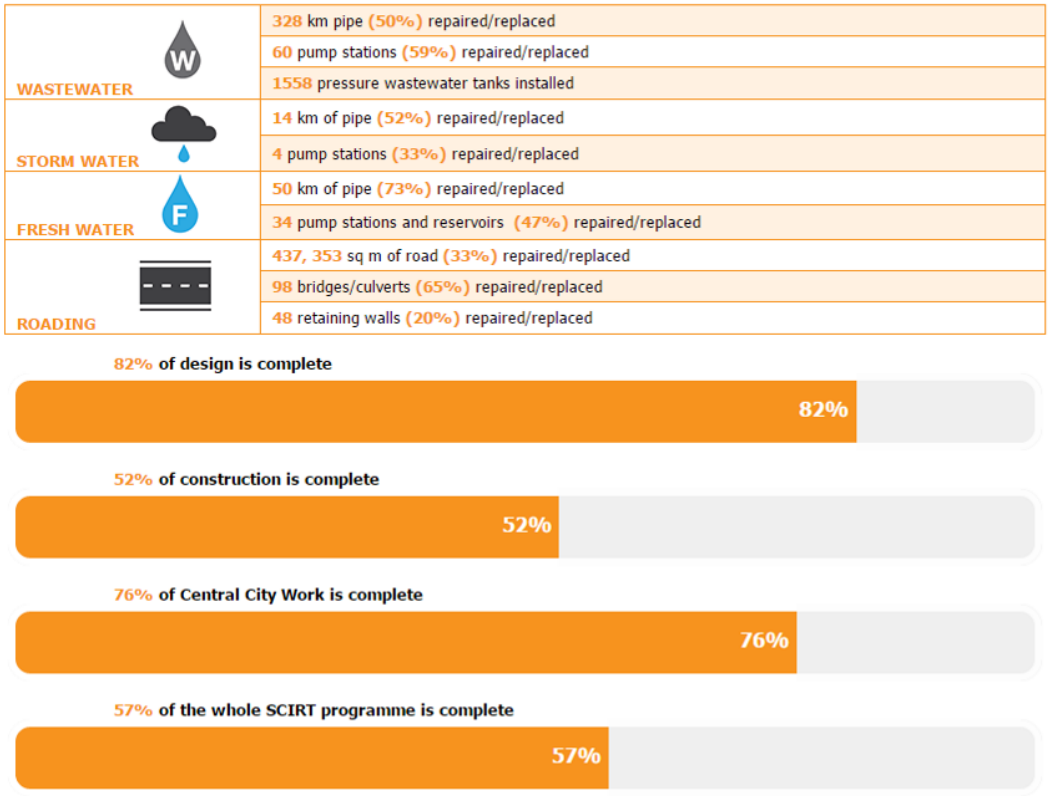

Figure 13 Progress to date (Source: SCIRT progress statistics)

ACKNOWLEDGEMENTS

- Thank you to CTOC for informing road users as well as working together with SCIRT in evaluating traffic impacts and approving TMPs
- Thanks also to ECan for being very accommodating with adapting their passenger transport service routes to facilitate SCIRT works
- Finally, thank you to the SCIRT Delivery teams for planning and communicating their works

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