Kaikōura Earthquake and Tsunami:

14 November 2016

Post Event Report (MCDEM response)

Contents

1 EXECUTIVE SUMMARY

At 0002 NZDT on Monday 14 November 2016, a magnitude 7.8 earthquake occurred northeast of Culverden. The earthquake resulted in multiple fault ruptures which extended out to sea. Tsunami waves were detected on the New Zealand Tsunami Gauge Network in Kaikōura (c.2-3m), Christchurch (c.1m), Wellington and Castlepoint (c.0.4m). Besides structural and utility damage, road infrastructure in North Canterbury and Marlborough was significantly impacted, while in Wellington the event was marked by its impact on office and other buildings.

The earthquake characteristics were significantly complex, rupturing over 21 faults and generating a local tsunami. Most recent research at the time this report was written shows that wave run-up on shore reached as high as 6.9 m in the Goose Bay area. This earthquake is thought to have approached or exceeded the world record for the number of faults rupturing in a single earthquake. The complexity of this earthquake, rapidly changing magnitude estimates in the first hour and the length of the response provided challenges for the response at the national and the CDEM Group/local levels.

The Ministry of Civil Defence & Emergency Management (MCDEM) activated the National Crisis Management Centre (NCMC) to support the Civil Defence Emergency Management (CDEM) Groups' response to the earthquake and tsunami event. The NCMC was operational until the last CDEM Group transitioned out of response and into recovery. The response lasted 26 days in total.

There were also many positives for MCDEM with the lessons from other recent events such as East Cape Earthquake and Tsunami on 2 September 2016 and Exercise Tangaroa on 31 August 2016 providing valuable preparation leading into this response. MCDEM staff demonstrated composure and proficiency throughout the response.

A comprehensive debriefing process was undertaken during and after the response to ensure that lessons were captured. In terms of areas that will benefit from improvement, four main themes were identified. They relate to:

- Staffing issues (capacity, capability and processes)
- Warning and communication expectations (local source tsunami warning; detailed information roll-up from the local level)
- Activation of the NCMC amidst a Wellington earthquake and/or a tsunami threat (potential tsunami threat to staff; building safety)
- NCMC design and Information Management

The most significant of the above relate to the capacity and capability of staff and subsequent issues around supplementary staff.

The report provides an overview of the event and its impacts, the response at the national level and the lessons captured through the debrief process. It also suggests remedies for areas that can be improved.

2 PURPOSE OF THIS REPORT

The purpose of this report is to outline the MCDEM response to the Kaikōura earthquake and tsunami event in November 2016 and to capture aspects that can be improved upon, as well as what went well.

The report represents MCDEM's standard process of debriefing and capturing lessons and/or corrective actions identified after any response. It is an inwards reflection by MCDEM on itself, and is not a review of the over-all response to the event (which in this instance was led by the Canterbury, Marlborough and Wellington CDEM Groups respectively, supported by MCDEM). Therefore, as an internal process with a focus on MCDEM's own response performance it does not cover the CDEM Groups' responses, neither does it reflect on the wider context of the CDEM framework and its structures.

3 SUMMARY OF THE EVENT

At 0002 NZDT on Monday 14 November 2016, a magnitude 7.8 earthquake occurred northeast of Culverden. Strong shaking was felt throughout New Zealand with 15840 felt reports submitted to GeoNet (figure 1 below). Significant aftershocks continued in the months after the event with several > M6.0 being recorded. The earthquake characteristics were significantly complex, rupturing over 21 faults and generating a local tsunami. This earthquake is thought to have approached or exceeded the world record for the number of faults rupturing in a single earthquake.

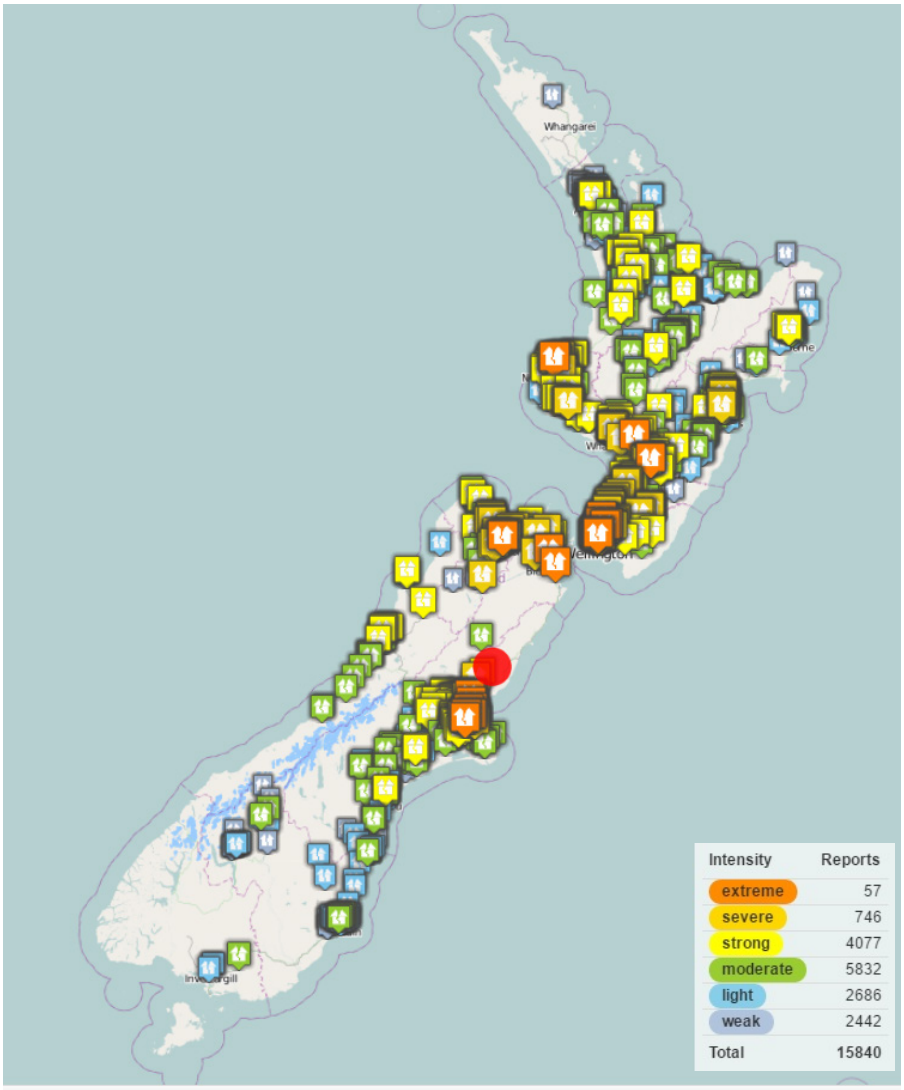

Figure 1 - Map showing the epicentre of earthquake and the felt reports around New Zealand (Source: GeoNet)

The tsunami that was generated is thought to have been largely attributed to the Hundalee Fault, although other faults and offshore landslides may have contributed. Most recent research at the time this report was written shows that wave run-up on shore reached as high as 6.9 m above sea level in the Goose Bay area. Several other locations experienced 3-4 m run-up but as the tsunami largely occurred at low tide and the land was simultaneously lifted, the impact was reduced. The tsunami resulted in damaging effects to a cottage in Little Pigeon Bay in the Banks Peninsula (Canterbury).

Key impacts from the earthquake included two fatalities, the isolation of communities; damage to property, roads and utilities in the Kaikōura and Hurunui districts; and building and infrastructure damage as far away as Wellington. Approximately 150 landslide dams were created by the earthquake across multiple South Island catchments (figure 2 below).

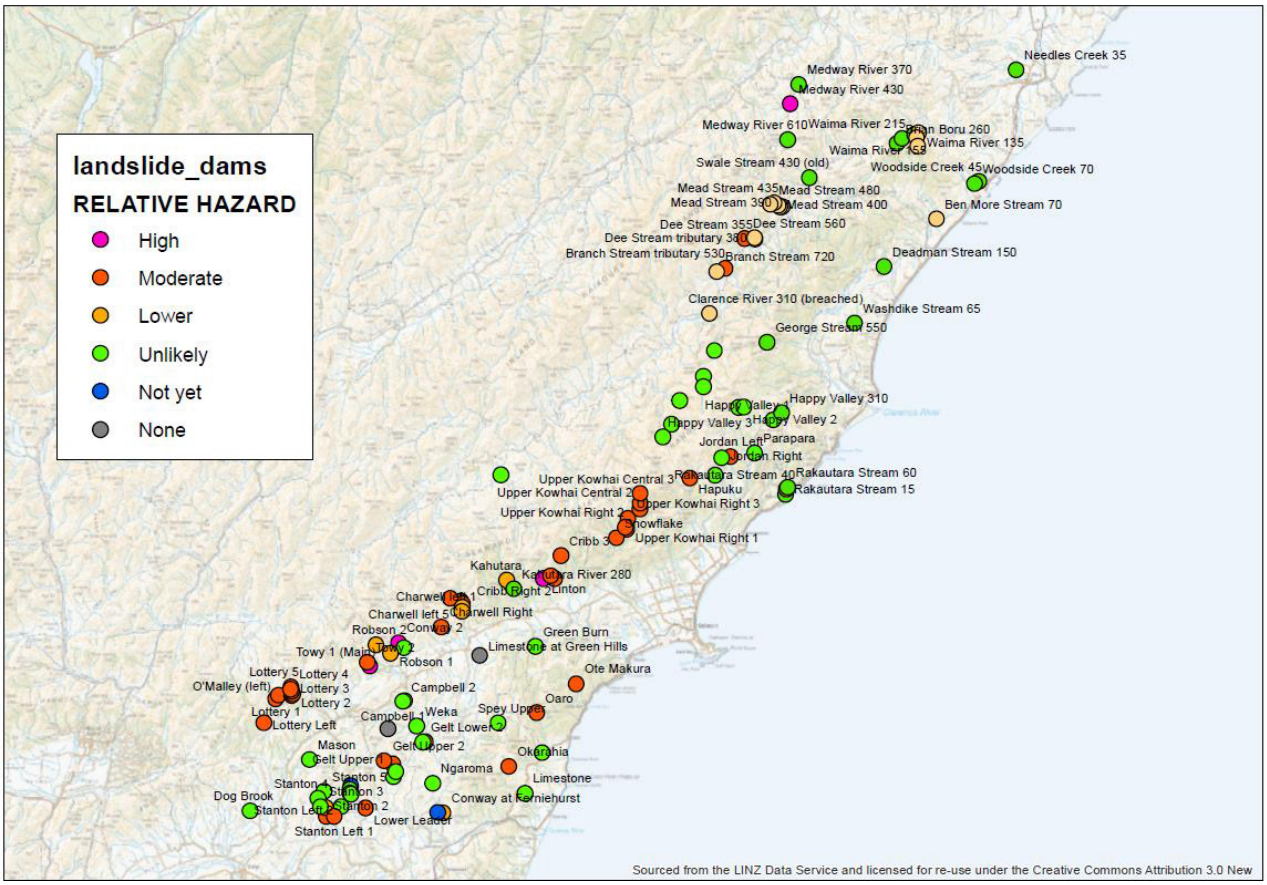

Figure 2 - Landslide dams in the affected area with relative hazard as of 28 November (Source: NZDF)

Summary of key impacts	
Primary	2 Fatalities (1 in Kaikōura and 1 in Hurunui)
	56 Injured
	150 households displaced during the response
	As of 28 March 38,000 residential claims made to EQC
Built	As of 5 December a total of 2076 buildings within the Kaikoura District had placards (86.4% White, 11.0% Yellow and 1.6% Red)
	Closure of SH1 between: - Cheviot to Kaikōura – Goose Bay to Pekata. - Kaikōura to Seddon – Mangamaunu to Okiwi Bay to Clarence.
	Lifeline Utilities damaged: - Waste water – damage to septic tanks and sewer system (repaired by 9 December). - Water – damage to reticulated water system (repaired by 9 December). - Telecommunications – Severe damage to Eastern fibre in the Earthquake area (repaired by January 2017). - Electricity temporarily offline (generators and LPG gas used as an alternate source).
	Access to Kaikoura was limited to one road, the inland route (also known as the Kaikōura Emergency Access Road) which was managed by the Canterbury CDEM Group and later handed over to the NZ Transport Agency.
Social	Helplines received a large volume of calls related to the Kaikōura Earthquake. Since 9 February 2017 there have been: - 749 calls to the Earthquake Support Line (stress and counselling services) - 2,184 calls to the Government Helpline (information and assistance) - 49,054 calls have been answered by Homecare Medical (national telehealth services)
	Significant damage to rural properties – Government allocation of $4 M for an Earthquake Relief Fund for Primary industries for uninsurable (rural) infrastructure repair

Natural	Approximately 150 landslide dams were created by the earthquake across multiple South Island catchments.
	Coastal uplift in the Kaikōura area (1m) resulting in displacement of marine wildlife and significant restrictions to Kaikōura harbour.

4 OVERVIEW OF THE RESPONSE

4.1 The response

This section details how the MCDEM response was conducted from the activation of the NCMC to the transition to recovery. As the activation lasted for 26 days the response section has been divided into four sections:

4.1.1 Activation of the NCMC (14 November)

This stage focuses solely on and the issue of national advisories/warnings and the activation of the NCMC. For a detailed list of the actions taken during this time, see *4.2: Actions taken by MCDEM staff in the first two hours*.

Advisories & warnings

Under the *Guide to the National CDEM Plan 2015* the lead agency for local source tsunami are the CDEM Groups. This is because a tsunami generated by a large local earthquake or undersea landslide may not provide sufficient time to implement official warning procedures. The proximity of local source tsunami and their travel speeds combine to give very little time for meaningful warnings to the areas closest to the source. Comprehensive public education regarding acting immediately on natural warnings is therefore the principal preparedness measure for local source tsunami. Nevertheless, when a local tsunami threat is detected, MCDEM will issue warning messages for New Zealand via the National Warning System, recognising that these messages will likely arrive after tsunami waves arrive in the closest locations to the earthquake.

The Guide to the National CDEM Plan and the Tsunami Advisory and Warning Plan both state that natural warnings are the most reliable and timely warnings for local source tsunami. These natural warnings include long or strong earthquakes and unusual ocean behaviour and sounds.

Under the National Warning System there are prescribed messages that MCDEM may issue during tsunami events (figure 3 below). (*Note: there has been changes to National Warning System messages since the event, but the list below was valid at 14 November 2016).*

National Advisories:

- *National Advisory – No Tsunami Threat to New Zealand*
- *National Advisory – Potential Tsunami Threat*

National Warnings:

- *National Warning – Tsunami Threat*
- *National Warning – Tsunami Threat to Marine and Beach Areas*
- *National Warning – Tsunami Threat to Marine and Land Areas*

Tsunami cancellation messages:

- *National Advisory – Potential Tsunami Threat CANCELLED*
- *National Warning – Tsunami Threat CANCELLED*

Requests for broadcast, or termination of broadcast

- *Request for the broadcast of a Potential Tsunami Threat*
- *Request for the broadcast of a Tsunami Threat*
- *Request for the termination of an emergency announcement*

Figure 3 – Types of Tsunami Notifications MCDEM may issue (National Tsunami Advisory and Warning Plan (revised 2016) SP 01/09)

The complexity of the earthquake in its magnitude and depth had a direct bearing on the decision-making around what type of advisory/threat message should be issued by MCDEM. The Duty Team located in Wellington were awoken by the severe shaking from the earthquake. The Duty Team responded immediately and based on the initial magnitude (M6.6) and location (inland) given by GNS, instructed the NZFS to send a *National Advisory: Earthquake* at 0020 NZDT. Following consultation with GNS and noting the statement from the Pacific Tsunami Warning Centre (PTWC) a *National Advisory: No Tsunami Threat* message was issued at 0040 NZDT. At the same time the *National Advisory: No Tsunami Threat* message was issued, the GNS Duty Officer observed a drop in the tide gauge at Kaikōura which indicated that a tsunami had been generated. Based on this information and the advice of GNS, the Duty Team then issued a *National Warning: Tsunami Threat* for all southern coastal areas at 0100 NZDT via the NZFS.

At 0125 MCDEM sent out another *National Warning: Tsunami Threat* for the eastern coast of North and South Island including the Chatham Islands. The initial warning messages at 0100 NZDT and 0130 NZDT did not have specific terminology of the type of threat the area covered i.e. Marine, Beach or Land threat. At the time of issuing these warnings the Duty Team had to be adaptable to the changing circumstances and rapidly changing scientific assessment and advice. The need to issue a tsunami warning became apparent when a sea level change was noted at the Kaikōura tide gauge and it became apparent that what was considered up to that point as an inland earthquake (and therefore scientifically understood as unable to generate a tsunami) did in fact cause a sea level change. Correct procedures were followed to issue a *National Advisory: Earthquake* and therefore a *National Advisory: No Tsunami Threat*, based on the assessment at the time.

However, when the sea level change was identified it was considered important for the Duty Team to issue warning of a tsunami threat, although it was recognised that some areas would already be experiencing tsunami waves, and the warning would arrive after impact in some locations. However, given that tsunami last for several hours, the first waves are often not the largest, and the waves would not have reached all parts of New Zealand at this time a warning was considered appropriate. GNS provided a threat level map at 0300 NZDT. MCDEM then issued tsunami warning messages until 1500 NZDT on Monday 14 November 2016, at which time the warning was cancelled.

NCMC activation

The NCMC was activated at 'Mode 3' (Assist) by the Duty Team at 00:30. A 'red' staff activation message was sent to MCDEM staff at 0149 NZDT. A red staff activation requires all MCDEM staff to report to the NCMC immediately. A number of MCDEM staff made their way to the NCMC to assist with the activation ahead of the red staff activation message being issued.

4.1.2 Critical stages of the response (15 November – 21 November)

The NCMC operated on a 24/7 basis to support responding CDEM Group Emergency Coordination Centres (ECC's) and Local Emergency Operations Centres (EOC's). While most ECCs around the country were activated for short periods to respond to the tsunami event, the following CDEM Groups were activated for a longer period due to the impact of the earthquake:

- Canterbury
- Marlborough
- Nelson-Tasman
- Wellington

The National Controller's objectives and priorities for this early stage of the response focussed on ensuring the safety of and limiting the disruption to affected communities.

By 15 November 2016, the extent of the damage from the earthquake and tsunami was established. Kaikōura was the most affected area with all routes in and out of the district compromised, isolating the community.

Due to the extent of damage in Hurunui and Kaikōura, both districts declared local states of emergencies. The Canterbury CDEM Group later also declared a Group-wide state of emergency which superseded the Kaikōura and Hurunui declarations. The National Controller advised at this stage there was no requirement for a State of National Emergency (i.e. the necessary support could be provided to the CDEM Group without a state of national emergency), however this would continuously be reviewed.

The NCMC undertook the following activities during the response to the Kaikōura Earthquake.

- Informing and advising the Government of the impact and the response.
- Assisting with the resourcing needs of the CDEM Groups.
- Providing advice through MCDEM's regional staff and the National Controller with regards to decisions at the CDEM Group and local level.
- Coordinating national government agencies in their support of the response.
- Coordinating resource offers from other CDEM Groups and external agencies.
- Supporting government policy formulation.

MCDEM requested the assistance from external agencies and CDEM Groups from around the country with regards to the provision of supplementary staff (see *4.4 Supporting agencies* for a comprehensive list) to assist with the response at a national and local level. Supplementary staff were used to fulfil roles required within the NCMC, Canterbury ECC and several local EOCs.

4.1.3 Later stages of the response (22 November – 9 December)

This stage of the response included the planning process for the scaling down of the NCMC response and the transition to recovery arrangements. During this time, the NCMC resourcing and staffing requirements was reduced as operational tasks diminished.

On 5 December 2016 the NCMC activation status was downgraded from Mode 3 (Assist) to Mode 2 (Engage). This meant that NCMC staffing and hours could be reduced. The decision to downgrade the NCMC activation mode was based upon CDEM Groups all commencing transition to recovery, as well as the reduced need for national resources to assist the response. The reduction in staff was also intended to rest staff should a sizeable aftershock necessitate the scaling up of a new or subsequent response.

MCDEM commenced an enhanced public education campaign in December 2016. The campaign centred on the correct action to take when an earthquake is felt ('drop, cover & hold') as well as the action to take from a tsunami risk perspective ('long or strong, get gone; don't wait for official warnings'). This was in reaction to the public's perceived reliance on official warnings rather than taking action after natural warning signs were felt.

At the same time MCDEM worked closely with GNS Science to enhance warning procedures for local source tsunamis. New warning templates and procedures were developed for large subduction zone earthquakes, and these were communicated with CDEM Groups.

4.1.4 Transition to recovery

Kaikōura, Hurunui, Marlborough and Wellington districts all established recovery structures and appointed Local Recovery Managers early in the response phase. All Recovery Managers are

supported by teams to coordinate and collaborate on recovery activities, based on the four 'environments' of social, built, economic, and natural.

Three new pieces of legislation passed within two weeks of the earthquake:

- **Civil Defence Emergency Management 2016 Amendment Act** (bringing forward implementation of provisions giving statutory status to Recovery Managers, introducing the concept of local and national 'transition periods', wherein designated individuals have access to a range of powers that can be used to manage the recovery after a state of emergency has been terminated).
- **Hurunui/Kaikōura Earthquakes Emergency Relief Act 2016** (provides for emergency works to land and structures).
- **Hurunui/Kaikōura Earthquakes Recovery Act 2016** (allows Acts, plans and bylaws to be amended by an Order in Council and establishes a Hurunui/Kaikōura Recovery Review Panel to review draft Orders in Council).

On 9 December 2016, the Acting Minister of Civil Defence gave notice of a national transition period for the three affected South Island districts. This enabled the government to manage certain aspects of the recovery centrally via a National Recovery Manager, which was important given the extent of national infrastructure affected. A National Recovery Manager was subsequently appointed and a National Recovery Office established within MCDEM.

On 14 December 2016, Wellington City gave notice of a 'local transition period' under the new legislation to help them manage the recovery (particularly issues with requiring building owners to undertake structural assessments).

4.2 Summary of response actions in the first two hours

Due to the length of the response spanning 26 days, the collated table (below) only summarises the actions taken by the MCDEM duty team on 14 November between the hours of the initial impact 0002 and 0200 hrs when the NCMC staff activation message was issued.

Monday 14 November	
TIME	**Action Taken**
0002	Earthquake occurs northeast of Culverden.
0004	Preliminary Earthquake Report received from GeoNet. Magnitude 6.8, depth 44km, 20 km north-west of Cheviot.
0005	MCDEM Duty Officer (DO) and Duty Manager (DM) discuss the need to activate the NCMC based on the initial earthquake parameters. It was agreed that the NCMC be activated and to issue an NWS Earthquake Advisory.
0006	MCDEM Webmaster posts on Facebook and Twitter a safety message in the case of any aftershocks.
0009	MCDEM DO requests the NZFS to send out (on behalf of MCDEM) a Duty team NCMC activation pager message and a National Advisory: Earthquake.
0009	GeoNet updates the magnitude and location of the earthquake on the GeoNet website: Magnitude 6.6, depth 16km, location 15km north-east of Culverden.

0010	GNS DO calls the MCDEM DO to discuss the earthquake parameters and likely impacts as a result.
0011	MCDEM DO calls MCDEM DM to relay the conversation with GNS DO and asks for confirmation to issue a National Advisory: No Tsunami Threat to New Zealand (via NZFS).
0013	MCDEM DO calls NZFS back to request a 'No Threat' message be issued.
0014	PTWC issues Tsunami Information Statement 1 with the following preliminary earthquake parameters: Magnitude: 7.4 Depth: 10km "Based on all available data there is no tsunami threat from this Earthquake."
0016	MCDEM Webmaster posts on Twitter that MCDEM are undergoing an assessment of the situation, supplementary safety message in the case of any aftershocks.
0016	MCDEM DO calls MCDEM Southern REMA to discuss initial impacts. Southern REMA will contact other REMAs and try to get an initial assessment from CDEM Groups in the southern regions
0020	National Advisory: Earthquake issued (Magnitude: 6.6; Depth: 16km)
0027	MCDEM Webmaster publishes on Twitter and Facebook that MCDEM are undergoing an assessment of tsunami generation.
0030	NCMC Activated
0037	MCDEM Webmaster publishes on Twitter and Facebook that there is no Tsunami Threat.
0040	National Advisory: No Tsunami Threat to New Zealand issued
0040	GNS DO calls to inform MCDEM DO of an observed sea-level drop on one tide gauge (~2m at Kaikoura). As a result they advise MCDEM issues a national tsunami warning. GNS DO requested the Tsunami Experts panel (TEP) to stand up as per SOPs.
0041	MCDEM DO informs MCDEM DM of conversation with the GNS Duty Officer. MCDEM DM agrees to issue a National Warning: Tsunami Threat (via NZFS).
0043	MCDEM DO asks the NZFS: Tsunami Threat as the situation has changed provided on new information.
0044	MCDEM DO calls GNS DO asking for confirmation that a National Warning: Tsunami Threat is to be issued. GNS DO informs that the tsunami is likely to be more widespread than initially thought.
0045	MCDEM DO calls NZFS confirming content of national warning post GNS science conversation.
0045	MCDEM Activator confirms with NZFS that the NCMC has been activated; checked with NZFS on actions and advised to continue issuing national warning.
0051	GNS DO calls MCDEM DO, discussion about the stand up of Tsunami Experts Panel and the implications for issuing a 'land threat' warning for the whole of the East Coast of New Zealand.

0052	PTWC issues Tsunami Information Statement 2 with the following preliminary earthquake parameters: Magnitude: 7.9 Depth: 10km PTWC message: "A drawdown of 2.5m was observed at Kaikōura tide station. A damaging local tsunami might have occurred. Tsunami observations: Kaikōura gauge height: 2.49m @0053."
0054	MCDEM DO calls NZFS to ensure that a land evacuation is stated for southern coastal areas. NZFS asks if they should use the revised PTWC magnitude of 7.9, DO confers with the PIM team and decides to stick with the original GeoNet magnitude of 6.6.
0056	MCDEM Webmaster publishes on Twitter and Facebook that the Situation has changed and a tsunami threat is possible. Evacuation message for those near the coast of the South Island.
0056	MCDEM DO called GeoNet Director after no response from GNS DO to check on assessment by the TEP. GeoNet Director informed he was struggling to get hold of anyone.
0058	MCDEM DO directly requests additional DO/Intelligence function staff to travel to NCMC and assist due to increased warning requirements for tsunami.
0100	National Warning: Tsunami Threat #1 for all southern coastal areas of New Zealand issued.
0100	MCDEM Webmaster publishes tsunami warning on the MCDEM website.
0101	MCDEM Webmaster publishes on Twitter supplementary tsunami warning for the Eastern coast of the South island – evacuation message for those near the coast.
0103	MCDEM DO calls MCDEM Southern Regional Coordinator. Southern Regional Coordinator indicates that initial information stipulates Kaikōura is heavily impacted from the earthquake.
0104	MCDEM Webmaster publishes on Twitter and Facebook a supplementary tsunami evacuation message for the east coast of the South island.
0111	MCDEM Webmaster publishes on Twitter and Facebook that they are experiencing technical difficulties with the Website and that information will be displayed on Social Media channels.
0112	MCDEM DO calls NZFS and requests another National Warning: Tsunami Threat message to be sent out as the situation has changed. DO informs that the threat is now for all eastern coastlines for the North and South Islands, including the Chatham Islands. DO also asks NZFS to send a 'request for broadcast' message to broadcasters. DO asks to alleviate these ASAP.
0115	Request for the broadcast of an emergency announcement – tsunami warning issued.

0121	MCDEM Webmaster publishes on Twitter and Facebook that the tsunami warning is for the East Coast of New Zealand (including Christchurch, Wellington and Chatham Islands).
0122	Request for Group Controllers teleconference at 0130hrs is sent to CDEM Groups.
0125	National Warning: Tsunami Threat – Imminent Threat (#2) for Eastern Coast of North and South Island including the Chatham Islands issued.
0128	MCDEM Webmaster publishes on Twitter that this is a local source event and they do not have information on specific locations.
0128	MCDEM DO informs NZFS that MCDEM (NCMC) will take over the warnings m from this point on.
0130	MCDEM Webmaster publishes on Twitter and Facebook with a supplementary tsunami evacuation message for the Eastern Coast of the North Island.
0130	Group Controllers teleconference starts.
0132	MCDEM Webmaster updates tsunami warning on the MCDEM website.
0135	MCDEM Webmaster publishes on Twitter and Facebook with a supplementary Tsunami evacuation message.
0140	MCDEM Webmaster publishes on Twitter with a supplementary educational "drop, cover and hold" earthquake messaging.
0145	Request for the broadcast of an emergency announcement –tsunami warning updated.
0149	MCDEM Staff Activation Red issued.
0149	MCDEM Webmaster publishes on Twitter and Facebook supplementary tsunami warning message.
014851	GeoNet upgrades updates earthquake parameters on GeoNet website: Magnitude 7.5, 15km deep, 15km north-east of Culverden.
0153	Request for Group Controllers teleconference at 0230hrs sent to CDEM Groups.
0155	MCDEM Webmaster updates the tsunami warning on the MCDEM website.
0158	MCDEM Webmaster publishes on Twitter and Facebook supplementary tsunami warning message for the Chatham Islands.

0200	National Warning: Tsunami Threat #3 – Marine and Land Threat for Eastern Coast of North and South Island including the Chatham Islands issued.

4.3 Supporting agencies

The following table includes the number of agencies and support staff that registered into the NCMC during the response.

Type of agency	Number of organisations	Number of support staff
Central Government	28	310
Regional/Local Government	29	119
Private	6	13
Not for profit	1	10
Total	64	452

5 EVALUATION

The evaluation of the response included a comprehensive debrief process to capture the lessons from the NCMC operations. The debrief process included four separate debriefs:

1. Capturing emerging issues during the response (18 November – 1 December 2016).
2. MCDEM staff debrief (14 December 2016).
3. External Agencies debrief (21 December 2016).
4. Supplementary staff debrief (online 16 December – 23 December 2016).

Debrief 1) was undertaken during the response. process for the following three debriefs after the response followed three steps: The first step offered participants an opportunity to provide feedback on what went well, what did not go so well and what could be improved, along specific themes (see table below). The next step involved a count/score ranking, where participants ranked the importance of all the feedback in accordance with their own opinions. The feedback that accumulated the highest scores were then discussed by the collective group to ensure a sufficient level of understanding of each issue was captured. The findings of this report are shaped from this ranking process.

Themes	
Theme #	Theme
1	**Activation** 1.1 NCMC 1.2 MCDEM Regional Emergency Management Advisors (REMAs) 1.3 National warning System (NWS)
2	**Staff training and capacity** 2.1 Staff welfare 2.2 Liaison Officers 2.3 Role Clarity 2.4 Rostering/Resourcing
3	**Communications** 3.1 Internal 3.2 Media & public information 3.3 Information flows
4	**NCMC processes** 4.1 Security 4.2 IT 4.3 Functions (Desk SOPs/etc.) 4.4 General
5	**Miscellaneous**

The comments received through the debrief process were analysed and summarised into 'what went well (see *5.1 What went well*) and specific themes for improvement (see *5.2 What could be improved*).

5.1 What went well

Activation	• The NCMC was able to activate immediately. • The MCDEM Duty Team was adaptable in response to the changing set of circumstances. • NWS worked well for notifying external agencies. • Webmaster worked quickly to change the required tsunami threat messaging.
Staff training and capacity	• Good communication in handover meetings. • Quality of support staff for Public Information Management (PIM), • Availability of support staff from external agencies. • HRG (Travel Agency) were valuable in the response for logistics. • GNS liaison was helpful during the tsunami warning phase. • MCDEM staff showed flexibility and conscientiousness. • NCMC followed good adherence to the Coordinated Incident management System (CIMS).
Communications	• Good flow of information in the NCMC. • All of Government PIM was well established. • Welfare teleconferences were valuable. • Briefings from Response Manager and National Controller were valuable to external agencies. • Good communication with the Ministers office. • Good communications with the functional managers. • SitRep format was well received. • Approach and accessibility of the National Controller was helpful. • National Welfare Coordination Group (NWCG) worked well. • Rolling log was invaluable to the response. • Useful having the roster at reception.
NCMC processes	• Emergency Management Information System (EMIS) worked well. • Central Agency Shared Services (CASS) IT was very responsive. • Having CASS IT onsite was valuable to the response. • New initiatives and improvements on the Intelligence desk. • Night shift were able to effectively process outstanding tasks overnight. • Meetings were on time and to the point.
Miscellaneous	• MCDEM staff had a real sense of comradery and looked out for each other. • Having a dedicated teleconference facility was excellent and necessary for the Welfare function.

5.2 What could be improved

The feedback that was registered from the debrief process can be grouped into four main themes. This section deals with the four themes and suggest remedies for the key points identified in each.

5.2.1 Staffing issues

Resources

MCDEM and CDEM Group/local response staff capacity was stretched during this response and supplementary staff had to be called upon to bolster NCMC and CDEM Group/local response functions from across New Zealand. Over 60 agencies (see 4.4) provided 476 staff to supplement NCMC and CDEM Group/local operations.

Specialist response functions requires specific training to understand the processes and systems involved in a coordinated response. Therefore the continued resourcing of multiple shifts with specialist staff in a prolonged response is challenging. This was further impacted by the withdrawal of some NCMC staff midway through the response to re-focus towards Wellington resilience planning.

While general supplementary staff were put in place quickly, the process for requesting and matching the need for specialist support staff with available skills was ineffective. It took time to get specified requests from the Group, while the offers of assistance from other CDEM Groups and external agencies were not aligned with the NCMC's requests for assistance. Subsequently some support staff did not represent the skills required or were unfamiliar with processes and/or systems. It should be noted steps were taken to address this matter during the response. MCDEM commissioned an external logistician to review the resource request and matching process used during the response.

Facilitating support staff into the NCMC

The access process for support staff entering the NCMC was double handled by Parliament Security and the NCMC, resulting in delays. Some staff were also unclear about who to report to and where to go, while at the same time Parliamentary Security were uncertain who to send staff to. As Parliamentary Security staff work in shifts, the issue arose repeatedly even when the process was explained to them.

A cause for this issue related to the reception desk within the NCMC not being staffed. Instead, incoming staff had to report to the Operations function who might have been occupied with other matters. The reception role typically falls under the Logistics function, however, while there were staff shortages across all the functions of the NCMC, this particularly applied to the Logistics function which impacted their ability to undertake the role of 'Administration' in the response. In an attempt to alleviate their pressures and allow them to deal with the sourcing and travel of support staff as well as with rostering, the reception role was transferred to the Operations function.

Rostering

Effective and efficient rostering of staff is critical to ensuring the NCMC operates smoothly with the right personnel in the right place at the right time. However, rostering takes significant effort that is found to be a recurring challenge during responses due to the general shortage of specialist staff for the respective functions.

This event was no different. Shifts could not be equally staffed in terms of both capacity (numbers) and experience/skills across all NCMC functions, while the Logistics function struggled to meet the challenge with managing the roster. Subsequently the NCMC rostering responsibilities changed hands from the Logistics function to the Operations function, then back again to the Logistics function.

Suggested remedies re Staffing issues:

- Establish a pool of sufficiently trained staff across agencies to support a prolonged response.
- Establish pre-reading/briefing packages for supplementary staff on their designated roles and responsibilities. Additionally a 'how to' user guide for the NCMC and its systems will be beneficial.
- Establish a procedure between MCDEM and Parliament Security for staff processing during NCMC activations.
- Establish a template for rostering that aligns staff requirements with the outputs of the NCMC, and provide specific rostering training.
- Ensure sufficient and appropriate staffing of the Logistics function.

5.2.2 Warning and communication expectations

The complexity of the earthquake in its magnitude, depth and rupture extent had a direct bearing on the decision-making around what type of advisory/threat message issued by MCDEM. A number of advisories about the earthquake and tsunami were issued, based on the information available at the time. In all instances procedures were followed correctly, however the information and advice received changed significantly during the first hours after the earthquake leading to decisions also changing in accordance with the procedures (see 4.1.1 for more detail).

The above resulted in what was publicly perceived to be a delay with issuing a tsunami warning, while inconsistent response to the warning at the local level further fuelled criticism.

While the primary tsunami warning for a local source earthquake will always have to be the natural warning signs themselves (i.e. the shaking), this is still not commonly understood. At the same time there is a clear expectation that an official warning will be issued, while the reality is that official warnings are unlikely to be issued rapidly enough to warn communities nearest to the tsunami source. Further, rapid and effective warnings are hampered by the current practice where tsunami monitoring and assessment rests with GNS Science, while the responsibility for warnings rests with MCDEM. This practice is unnecessary complicated and can cause delay, which is further impaired by the fact that neither MCDEM nor GNS Science conduct their responsibilities from a dedicated, 24/7 monitoring and warning centre.

As a result of the above, an enhanced public education campaign centred on local-source tsunami warning signs was launched in December 2016, while MCDEM also initiated work with the GNS Science and CDEM Groups to enable more effective warnings for local-source tsunami. New warning templates and procedures for such events were created and workshops held with CDEM Groups to explain them and to support more consistent response at local level to warnings in the future.

The information flow from the local level to the CDEM Group, and then on to the NCMC also created challenges. The NCMC was not in a position to collate timely and extensive detail about the impact, consequences and response at the local level.

Suggested remedies:

- Continue to work with GNS Science on tools, procedures and templates for official warnings for local source tsunamis.
- Enhance 24/7 monitoring, assessment and warning presence, and consider streamlining responsibilities (GNS Science and MCDEM).
- Continue to work with CDEM Groups with regards to tsunami warning procedures to ensure consistent response at local levels.
- Continue the public education campaign.

- Consider ways to enhance information flow within the CDEM structure (local to national) and the maintenance of a common operating picture at the national level.

5.2.3 Activation of the NCMC amidst a Wellington earthquake and/or tsunami threat

The NCMC was activated while there was a potential tsunami threat to the Wellington region. It was subsequently not clear to some MCDEM staff how to respond to the activation call-out given they would have to make their way to the NCMC through potential tsunami hazard zones. In addition, staff also felt uneasy in the NCMC during the initial stages of the response due to uncertainty about building safety.

The event exposed the reality that when the NCMC and other buildings in Wellington are compromised, there is no suitable option where MCDEM staff can respond from. While MCDEM has established protocols for its regional managers (outside Wellington) to initiate a response, the matter of an alternative facility and its staffing is a work in progress that has not been completed.

Suggested remedies:

- Continue work towards establishing an alternative NCMC and appropriate staffing complement outside Wellington.
- Establish arrangements to undertake and communicate a rapid building assessment of the Executive Wing/NCMC after a severe earthquake.
- Consider the feasibility of staff responding remotely until a tsunami threat has passed and/or a building assessment has been conducted.

5.2.4 NCMC design and information management

Feedback suggested that the functional layout of the NCMC limited the respective functions' ability to communicate or share information. The layout of the NCMC follows the building's circular design around the centre core, meaning there are limitations to have one communal operating space that can accommodate all functions. Feedback also commented on the equipment (computers, monitors, displays etc.) being relatively old and below optimal levels.

Not all support staff were confident with the Emergency Management Information System (EMIS). While MCDEM and CDEM Group staff are regular users, the system is not used by all external agencies which meant they had to get some initial assistance.

Information was not managed consistently across the functions- some used EMIS and others the NCMC 'Shared Drive' to store information. While both types of storage may be appropriate for certain types of information, the information management process was unclear. In instances this caused duplication (i.e. communicating information via both EMIS and email) and difficulties in finding stored information.

Suggested remedies:

- Consider the layout of the NCMC.
- Consider the upgrade of NCMC infrastructure.
- Consider an online orientation module for EMIS.
- Review the information management process in the NCMC and establish clear guidelines.

6 CONCLUSIONS

The size and complexity of this earthquake, the rapidly changing assessment in the initial hours and the length of the NCMC activation provided for a challenging response for MCDEM. There were however also many positives for MCDEM with the lessons from other recent events such as East Cape Earthquake and Tsunami on 2 September 2016 and Exercise Tangaroa on 31 August 2016 providing valuable preparation leading into the response. MCDEM staff demonstrated composure, flexibility and conscientiousness under pressure.

The comprehensive debriefing process during and after the response ensured a thorough capturing of issues. The debrief process highlighted the matters that can be enhanced or improved upon and proposed remedies have been identified for consideration.

Four main themes were identified for further attention. They relate to:

- Staffing issues (capacity, capability and processes)
- Warning and communication expectations (local source tsunami warning; detailed information roll-up from the local level)
- Activation of the NCMC amidst a Wellington earthquake and/or a tsunami threat (potential tsunami threat to staff; building safety)
- NCMC design and Information Management

The most highlighted issue was around the capacity and capability of staff. This applied to staff that were deployed to the impacted areas as well as those that were operating within the NCMC stretching resources beyond capacity.

The second main issue involves the expectation among the public and CDEM Groups about local source tsunami warnings. While the complexities and limitations in this regard are generally not well understood, MCDEM took quick actions to address the matter.

The other main themes are specific to the NCMC as facility. They involve the limitations of building design and location in Wellington as an earthquake and tsunami prone city, as well as specific issues around information management and ageing infrastructure.