DEPARTMENT OF THE
PRIME MINISTER AND **CABINET**
TE TARI O TE PIRIMIA ME TE KOMITI MATUA

23 October 2019

[redacted]

Reference: OIA-2019/20-0222

Dear [redacted]

Official Information Act request for the report titled *Exercise Ruaumoko '08: Final Report*

Thank you for your Official Information Act 1982 (the Act) request received on 21 October 2019. You requested:

"...the report from Ministry of Civil Defence and Emergency Management from 2008 titled "Exercise Ruaumoko '08: Final Report". I have seen it referenced in other papers with a URL, but it no longer exists. ..."

Please find enclosed a copy of the requested report titled *Exercise Ruaumoko '08: Final Report*.

You have the right to ask the Ombudsman to investigate and review my decision under section 28(3) of the Act.

Finally, for your information, this response will be published on the Department of the Prime Minister and Cabinet's website during our regular publication cycle. Typically, information is released monthly, or as otherwise determined. Your personal information including name and contact details will be removed for publication.

Yours sincerely

Sarah Stuart-Black
Executive Director, MCDEM

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Exercise Ruaumoko '08

Final Exercise Report

August 2008

Te Rākau Whakamarumaru
Ministry of Civil Defence & Emergency Management

AUCKLAND REGION EMERGENCY MANAGEMENT

exercise ruaumoko

Exercise Ruaumoko '08: Final Exercise Report

Table of Contents

Executive Summary

Overview

Exercise Ruaumoko was the second of two national disaster exercises directed by Cabinet. The first of these, Exercise Capital Quake, took place in November 2006 and tested the response to an earthquake in Wellington. Exercise Ruaumoko commenced in November 2007 and culminated with an operational phase in March 2008. The exercise was led by the Department of the Prime Minister and Cabinet, the Ministry of Civil Defence & Emergency Management, and the Auckland Civil Defence Emergency Management (CDEM) Group. It was supported by the Northland, Waikato and Bay of Plenty CDEM Groups, central government departments, emergency services, and lifeline utility organisations amongst others. More than 1,500 participants from approximately 125 organisations were directly involved, including local and central government agencies and private companies, making it the largest CDEM exercise held in New Zealand.

The resource commitment during the planning and delivery phases from major participating agencies was significant, and the intensity of exercise involvement noted by evaluators.

Aims and Objectives

The aim of Exercise Ruaumoko was to test New Zealand's all-of-nation arrangements for responding to a major disaster resulting from a volcanic eruption in Auckland.

There were three core objectives:

- ***Roles and responsibilities:*** understand, develop and practice the respective roles and responsibilities of local, regional and national agencies in response to the exercise scenario
- ***Arrangements:*** embed the planning arrangements in standard processes for all participating agencies
- ***Connections:*** confirm the connections between local, regional, national and international agencies

There were five supporting objectives relating to *evacuation*, *continuance of essential services*, *economic impacts*, *science aspects* and *public information and education*, and four main themes – *Leadership*, *Business*, *Community* and *Safety*.

Scenario

Exercise Ruaumoko was based on the scenario of a volcanic eruption located within the Auckland Volcanic Field in the wider Auckland metropolitan area. The exercise focused on the lead-in to a volcanic eruption, stopping shortly after the eruption itself started. The location of the eruption was not known by any of the participants until the simulated eruption occurred.

The exercise commenced with the identification of precursor activity in the form of unfelt earthquakes in the Auckland region in November 2007. After 48 hours of activity however the earthquakes ceased, and didn't resume until early March 2008. The likelihood of a volcanic eruption increased as the source of seismic activity started to show progressive shallowing of depths. It was not until the morning of 13th March that the epicentral clustering became constrained to an area centred on the Mangere Inlet, where the simulated eruption occurred at 1.50pm on Friday 14th March.

Exercise Outputs and Evaluation

In addition to participation in the main phase of exercise, there were a number of valuable outputs from the initial exercise phase. These included a report on an assessment of the economic impacts of a major eruption, the development of a community behaviour-based communications framework, and the updating of a number of relevant operational documents, along with various public education activities.

In conjunction with the main phase of the exercise, a community focus group was convened and a significant commentary on public expectations produced. A public online survey was also conducted at this time, and gathered valuable information on hazard knowledge, risk perception and evacuation behaviour.

A comprehensive programme of debriefing and evaluation was established to assess the effectiveness of the response, how well the exercise met its objectives and to collect collate and analyse lessons identified by exercise participants. This report summarises the outcomes from the evaluation process, highlighting the key themes and associated recommendations.

Exercise Management

Based on the feedback provided, there was a good level of satisfaction with the exercise co-ordination arrangements during the planning and delivery phases. Most participating agencies reported that the exercise had provided a good framework to test and evaluate their capability under a major scenario that in many cases had not been contemplated by their agencies in detail.

With respect to exercise planning, for the Auckland CDEM Group and the neighbouring CDEM Groups, this exercise had not been programmed and budgeted for. The extensive financial and time commitment required for this exercise has highlighted that CDEM Groups need sufficient notice to plan for and obtain funding for major exercises of this nature.

Performance and Effectiveness: Key Issues Identified

From an analysis of the evaluation reports submitted, eleven key issues have been identified in relation to performance and effectiveness of the exercise functions, as follows:

1. The leaders of the response at regional and national levels should be more clearly identifiable to agencies actively involved and more prominent to the community.
2. There needs to be greater clarity and mutual understanding of the roles and functions of CDEM Group EOCs in co-ordinating across and supporting the delivery by local EOCs.
3. Science information was very well delivered. Further clarification of the operational structures for the Auckland Volcanic Science Advisory Group during event periods is needed, including clarity on how direct advice can be provided at the national level.
4. There needs to be greater socialisation and agreement on key planning assumptions for mass evacuations.
5. The process for consulting on, making and communicating declarations requires better understanding.
6. The reliance of Group and Local EOCs and key government agencies on 'volunteer' personnel from within their organisations and from other agencies must be acknowledged, and addressed via specific access and training arrangements.
7. There is a need for overarching Action Plans at both regional and national levels during responses to convey the short and medium term objectives to all agencies involved.

8. Key messages to the community need to include detailed advice about what people can do for themselves, their families and their communities, as well as information about the event and the CDEM response to it. These messages must be consistent from local through to national level.

9. There was connectivity between CDEM Groups, and between CDEM Groups and the NCMC (e.g. via teleconferences), but not effective cohesiveness around 'who was going to do what, and by when'.

10. The economic impacts of a volcanic eruption in Auckland have been shown to be significant regionally and nationally. The potential for mitigating these impacts needs to be further explored, and recommended actions conveyed to individual agencies and recovery planning progressed.

11. There has been a wider realisation of the criticality of infrastructure generally, and the vulnerability of the Auckland and Northland energy lifelines in particular.

Priority Areas of Development

Following on from the performance and effectiveness issues identified above, there are a number of priority areas of development within and across agencies involved in the response to a major emergency.

A total of seventeen recommendations are made in this report under the following headings:

- **Improving the leadership and co-ordination of the response**
- **Developing capability**
- **The challenge of mass evacuation operations**
- **Understanding volcanic hazard and communicating science advice**
- **Arrangements for the assessment and management of economic impacts**
- **The vulnerability of critical infrastructure: understanding the implications and taking action**

Concluding Observations

Exercise Ruaumoko was a valuable learning experience for all concerned. It illustrated the criticality of Auckland to the New Zealand economy, and also the vulnerability of key elements of its infrastructure. The issues associated with a large-scale event in Auckland requiring significant support from neighbouring regions which are orders of magnitude smaller in capacity were also demonstrated.

The understanding and performance of the ***individual elements*** within a major CDEM operation has typically improved significantly through previous events, exercises and the preparation for Exercise Ruaumoko. The ability to ***co-ordinate the various elements into a cohesive response*** however requires considerable further work. The process of conveying the required ***messages and actions*** to the community also requires a more focused approach, with greater emphasis on the visibility of leadership.

Exercise Ruaumoko is considered to have met its objectives. There were major achievements in the preparatory phase that simply wouldn't have occurred without the context of the exercise.

1. Introduction

1.1 Origins and Scope of the Exercise

Exercise Ruaumoko was the second of two national disaster exercises directed by Cabinet. The first of these, Exercise Capital Quake took place in November 2006 and tested the response to an earthquake in Wellington. Exercise Ruaumoko commenced in November 2007 and culminated with an operational phase in March 2008. The exercise was led by the Department of the Prime Minister and Cabinet (DPMC), the Ministry of Civil Defence & Emergency Management (MCDEM), and the Auckland Civil Defence Emergency Management (CDEM) Group. It was supported by the Northland, Waikato and Bay of Plenty CDEM Groups, central government departments, emergency services, and lifeline utility organisations amongst others.

Exercise Ruaumoko was based on the scenario of a volcanic eruption somewhere within the Auckland Volcanic Field in the wider Auckland metropolitan area. The exercise focused on the lead-in to a volcanic eruption, stopping shortly after the eruption itself started. The location of the eruption was not known by any of the participants until the simulated eruption occurred.

More than 1,500 participants from approximately 125 organisations were directly involved, including local and central government agencies, non-governmental organisations and private companies, making it the largest CDEM exercise held in New Zealand.

1.2 Objective and Scope of Report

This report summarises the process involved in developing the exercise, key elements of the exercise itself and feedback gained from those involved in the exercise. High-level recommendations as to how individual agency and the collective response to major natural hazard events can be enhanced are also outlined.

The principal purpose of this report is to inform exercise participants to assist them in implementing their own sector or organisation's learnings and action points. There are many sector- or agency-specific action points identified by participants that are not included in this report. This report is also intended to inform executive management and others from participating organisations who were not directly involved in the exercise.

Familiarity of the readers of this report with government CDEM arrangements is assumed. These arrangements are outlined in Section 12 of the National CDEM Plan and Section 3.1 of the accompanying Guide.

The focus of this document is on the *operational learnings* and *capability development needs* that have emerged from Exercise Ruaumoko.

2. Exercise Concept

2.1 Exercise Development and Management

The original concept for Exercise Ruaumoko came from a Cabinet directive in November 2005. Along with Exercise Capital Quake, the concept was for a comprehensive test of local, regional and national arrangements for dealing with the impact of a large event on a major population centre.

Exercise Ruaumoko differed from most CDEM exercises in a number of facets. The exercise concept provided for pre-emergency planning rather than operating in the traditional response-only mode. The period over which the exercise was conducted was longer than usual, primarily to provide time for the exercise arrangements to be developed but also to account for the escalation often associated with volcanic activity, and to enable major participants to conduct their planning. The development of the exercise concept was managed centrally by MCDEM and Kestrel Group (under contract) but the responsibility for much of the detailed preparations were devolved to the Auckland CDEM Group.

Project governance was provided through the Steering Committee which comprised MCDEM, DPMC and Auckland CDEM Group representatives. Development and co-ordination of the exercise was undertaken by the Exercise Working Group, which comprised Auckland and Wellington agency representatives.

2.2 Aim and Objectives

The aim of Exercise Ruaumoko was to test New Zealand's all-of-nation arrangements for responding to a major disaster resulting from a volcanic eruption in Auckland.

There were three core objectives:

- ***Roles and responsibilities:*** understand, develop and practice the respective roles and responsibilities of local, regional and national agencies in response to the exercise scenario
- ***Arrangements:*** embed the planning arrangements in standard processes for all participating agencies
- ***Connections:*** confirm the connections between local, regional, national and international agencies

There were five supporting objectives of Exercise Ruaumoko:

- planning for the ***evacuation*** of affected communities;
- planning for the ***continuance of essential services***, including
  - local government
  - lifeline utilities
  - emergency services
  - government agencies.
- management of potential ***economic impacts***;
- co-ordination of ***science*** aspects; and
- management of ***public information and education***.

2.3 Themes and Functions

Exercise Ruaumoko had four main themes, as follows:

1. **Leadership:** making strategic decisions and informing the community and key organisations with co-ordinated and consistent messages
2. **Business:** Planning for and managing the continuance of business, the economy and government
3. **Community:** Understanding and managing the social implications
4. **Safety:** Planning for and delivering response functions

Each of these themes had up to four associated *functions*, as outlined in later sections. These functions only encompassed part of the overall response to a volcanic eruption.

2.4 Exercise Timeline and Structure

Planning commenced at the end of 2006, with the definition of the scope of the exercise being undertaken in the first half of 2007. An Exercise Co-ordination Team was established in June 2007, and prepared guiding documentation which included the *Exercise Co-ordinating Instructions*, *Exercise Control Arrangements and Rules of Play* and the *Evaluation Guidelines and Forms*.

Given the nature of the scenario and the scale of the exercise, two separate phases were defined in order to articulate the difference in participation required from November 2007 to March 2008 – the *Initial* and the *Main* phases. The overall exercise development timeline and log of key scenario developments is included as Appendix 1.

Initial Exercise Phase

The purpose of the Initial Exercise Phase was to enable the identification and exploration of the broader 'big picture' issues that would emerge at the early stage of both organisational and public awareness of a volcanic threat in the Auckland region.

The Initial Exercise Phase ran from November 2007 through to February 2008, and was 'non operational'. For most sectors and agencies, involvement during this phase of the exercise consisted of participating in sector-based workshops or meetings to review existing plans and arrangements and update them as part of preparation activities for the Main Exercise Phase.

Main Exercise Phase

The Main Exercise Phase ran for the first two weeks of March 2008, culminating in two days of full exercise play on 13-14th March, when most agencies were active. This phase was the operational part of the exercise and involved more traditional exercise play, and the exercising of specific response arrangements and procedures. The overview of key activities undertaken during this phase is included in Appendix 2.

Participation was typically through tabletop or operational exercising, or a combination of both. The focus was on the activation and functioning of key facilities, and the assembly and exercising of appropriate decision makers. The exercise was principally during working hours on both days by agreement, with participating agencies making their own decisions about operating hours.

3. Scenario and Master Sequence

3.1 Exercise Scenario

The scenario for Exercise Ruaumoko was a volcanic eruption in the Auckland Volcanic Field, the timing and location of which was kept 'secret' until the eruption itself started.

The exercise commenced with the identification of precursor activity in the form of unfelt earthquakes in the Auckland region in November 2007. The earthquakes were characterised as 'deep long period earthquakes' by seismologists analysing them, events that are usually indicative of fluid movement, making them highly likely to have a volcanic origin. Coupled with the fact that earthquakes are rarely seen in the Auckland region, these events caused GNS Science to raise the Scientific Alert Level for the Auckland Volcanic Field to 1 ("initial signs of volcano unrest').

After 48 hours of activity the earthquakes appeared to stop. There had been no observable shallowing of earthquake depths in that time. Following a week of quiescence, scientists determined that if there had been an intrusion of magma, it had likely stopped or 'failed' at a depth of 40-50km deep.

In early March 2008 seismicity resumed and this time became sustained, giving significant cause for concern for authorities and Auckland communities. As the source of seismic activity started to show progressive shallowing of depths, it became increasingly likely that a volcanic eruption would occur, though the geographic distribution of earthquake epicentres gave few indications as to the possible location of an eruption.

As the magma reached depths of 20-25km below the surface, earthquakes started to be felt across the Auckland region. By 20km depth, numerous events (>50) were being recorded every day, some of which were felt by the population. By 10-15km depth the number of events per day had risen above 100, and some of the larger events (~MM4) were felt as far away as Whangarei and Hamilton. By the afternoon of 12th March, earthquakes started to show distinct clustering of epicentres in an area from Mt Roskill-Hillsborough in the north, to Mangere in the south, and evacuation maps started to be drawn up.

In the morning of 13th March the epicentral clustering became further constrained to an area centred on the Mangere Inlet. Over 300 events were recorded in a 24-hour period from 12pm on 12th March to 12pm on 13th March, many of which were felt by residents at a Mercalli intensity of 4.5. The depth of the earthquakes was recorded as approximately 5km below the surface.

By early morning on Friday 14th March the earthquakes began to merge into a continuous signal (continuous volcanic tremor), the strength of which increased steadily throughout the morning. By late morning ground cracking and slumping was observed in the area around Kiwi Esplanade and Mangere Bridge. Continuous GPS measurements showed increasing ground uplift in the area.

At 12pm on Friday 14th March, discolouration of the water in the Mangere Inlet, off Kiwi Esplanade was noticed. Ground uplift continued to escalate. Bubbles and steam were later observed in the water. At 1.50pm loud explosive noises were heard, and jets of black ash thrown up in the air. A small phreatomagmatic (steam and ash driven) eruption had begun.

3.2 Development of the Scientific Scenario

The scientific part of the scenario ('the volcano') was written by a GNS Science seismologist. It was written with the best scientific evidence available about the Auckland Volcanic Field, as well as what is known about precursory activity in volcanic fields around the world.

The basic idea behind the scenario was that basaltic magma rose rapidly from the mantle (from a depth of about 100 km). As it did so it produced seismicity along the way. As it got within 5–10 km of the surface, other phenomena (degassing and ground uplift) were observed, ultimately producing an eruption. The key feature of the scenario was the rapid rise of the magma, a phenomena thought to be characteristic of Auckland eruptions.

Many of the ideas about precursory activity used in the scenario were taken from Blake et al (2006[1]) and Sherburn et al (2007[2]). Blake et al (2006) is a study of lead times before and precursors to an eruption from the Auckland Volcanic Field. It is based primarily on modelling the rate of dyke ascent of basaltic magma and a literature survey of precursors to eruptions similar to those that have occurred in the Auckland Volcanic Field. Sherburn et al (2007) is a review of seismicity in the Auckland field, and a discussion of what precursors might be seen before an Auckland eruption and lead times that might be expected. It also uses historical analogues, but the overall approach is geophysical[3] rather than the more petrological[4] approach used by Blake et al. The two studies come to broadly the same conclusions.

[1] Blake, S.; Wilson, C.J.N.; Smith, I.E.M.; Leonard, G.S. 2006. Lead times and precursors of eruptions in the Auckland Volcanic Field, New Zealand: indications from historical analogues and theoretical modelling, GNS Science Report 2006/34

[2] Sherburn, S.; Scott, B.J.; Olsen, J.; Miller, C. 2007. Monitoring seismic precursors to an eruption from the Auckland Volcanic Field, New Zealand. New Zealand Journal of Geology & Geophysics, 2007, Vol. 50: 1-11

[3] From the study of seismic signals

[4] From the study of rocks

The scientific scenario comprised a large amount of raw geophysical data that would usually result from monitoring equipment detecting seismicity. These data were passed to the GNS Science Duty Volcanology Team for interpretation – being as much an exercise of GNS staff as anyone else. GNS staff would then analyse the data, make interpretations, and produce Science Alert Bulletins, as necessary, which then formed injects for the wider exercise participants.

Further information about the scientific scenario development process, and precursors that can be expected of the Auckland Volcanic Field can be found in Appendix 3.

An overview of the likely scenario and impacts over the days and months *following* the eruption (i.e. a continuation of the Ruaumoko scenario) is provided in Appendix 4.

3.3 Development of the Master Sequence

Once the scientific part of the scenario was complete, work began on all other aspects of the scenario to round it into a full and realistic basis for exercise. A team of four exercise writers devised injects in the fields of:

- **Social –** aimed at creating general 'noise' for all exercise participants and specific issues for some agencies (e.g. territorial authorities, CDEM Groups, MCDEM, welfare agencies) in particular. These injects covered a range of social issues, from ever-increasing levels of community concern, to panic buying at supermarkets, to people requiring assistance with evacuation.
- **Health** – aimed at exercising the Ministry of Health, district health boards and St John ambulance. These injects covered primary, secondary and tertiary health care, public health, mental health, emergency response, and offers of assistance.
- **Economy and business** – aimed at all exercise participants, with some specific issues for some agencies (e.g. Reserve Bank, Treasury). These injects covered issues such as cash-flow problems, fluctuations in currency and other financial markets, business closure or relocation, and consideration of damage, clean-up and recovery costs.
- **Infrastructure** – comprising either specific issues to prompt activity at certain infrastructure providers (local, regional or national), or general status reports for the information of all exercise participants.
- **International** – aimed at the NCMC, the Ministry of Foreign Affairs and Trade, Red Cross, and other agencies that routinely deal with international matters in emergencies. These injects mainly took the form of offers of assistance from overseas governments, non-governmental organisations and other organisations and individuals.
- **Evacuation** – giving updates on the numbers of people evacuating (either self evacuation or mandatory evacuation), and progress thereof (see below).

A number of 'cross-checking' exercises were completed to ensure all exercise participants, in all sectors, would have enough to occupy their time during the exercise.

During the main phase of the exercise, most normal means of communication were deemed to be functioning for the majority of the exercise duration. Some telecommunications blackouts were imposed by Exercise Control.

3.4 Development of the Evacuation Scenario

A volcanic eruption in the Auckland region would necessitate a large-scale evacuation of the population, with all that entails for transport, roading, traffic flows, policing, potential accidents and breakdowns along the way, and receipt of evacuees at welfare centres in receiving CDEM Groups.

This process required careful scripting to ensure a degree of realism and to make sure every agency involved in the process was exercised to a sufficient degree. The difficulty was deciding on the likely proportions of mandatory evacuees and self evacuees, those requiring transportation and/or accommodation, and those that didn't. It also required creation of flexible scenarios (in terms of numbers leaving the Auckland region, and arriving in other regions) that could be modified according to decisions made during exercise play.

To establish the total numbers of people to be moved, GIS analysis was performed using 2007 census data. The mandatory evacuation zone was defined as a 5km-radius zone from the volcano location in accordance with the Auckland CDEM group Contingency Plan for the Auckland Volcanic Field, and the resultant population determined. A further 3km-radius zone was added, wherein it was assumed that 70% of people would self-evacuate; an additional 15% of the population from the Auckland and Manukau city council areas were also assumed to be self evacuees (percentages derived from international literature).

Further assumptions (largely evidence-based, or by Exercise Working Group-endorsed estimation) were then made about:

- Percentage of people in the mandatory evacuation zone that would need assistance with transportation and/or accommodation
- Percentage of self evacuees that would present at a welfare centre
- Percentage of self evacuees that would need assistance with accommodation
- Proportions of evacuees going to Northland, Waikato and Bay of Plenty CDEM Groups
- Travel times

A spreadsheet was constructed to document this flow of evacuees over the two-week exercise period. This allowed numbers or percentages to be altered during the exercise based on actual response actions of participants.

The receipt of evacuees was simulated using facilitators from each of the supporting CDEM Groups. Exercise Control in Auckland contacted all Group facilitators with the number of evacuees coming into their regions on an hourly basis. The facilitators then created injects to territorial authorities in their regions outlining how many people had (notionally) arrived at their welfare centres in the last hour.

Overall the evacuation process was difficult to script because of its complexity, the lack of research in public behaviours or actual event experience in New Zealand, and because evacuation procedures and strategies had not fully been developed at the time of scripting. A large number of assumptions were required to be made, which will need to be re-visited in future evacuation planning.

4. Evaluation and Reporting

Exercise evaluation is a critical part of the exercise itself. It was particularly important in Exercise Ruaumoko, where a volcanic scenario was tested in a comprehensive way for the first time in many years, a number of agencies not traditionally involved in CDEM exercises were participants, a new and complex mass evacuation plan for the Auckland region was exercised, and where a different exercise format (initial and main phases) was used for the first time.

A comprehensive programme of debriefing and evaluation was established to assess the effectiveness of the response, how well the exercise met its objectives and to collect, collate and analyse lessons identified by exercise participants.

4.1 Evaluation Framework and Criteria

Exercise Ruaumoko had three main objectives (roles and responsibilities, arrangements, connections), and four themes (leadership, business, community, safety), each with constituent functions. The evaluation framework was a matrix of these objectives versus each of the exercise themes. Each theme was broken down into its functional areas, with a number of criteria – reflecting roles and responsibilities, arrangements, connections and an overall measure of 'effectiveness' – to report on.

The outcome was to be able to report on New Zealand's all-of-nation readiness for a national disaster in terms of leadership, business, community and safety.

	Roles and Responsib.	Arrangements	Connections	Effectiveness
Leadership Function 1 Function 2 Function 3	criteria	criteria	criteria	criteria
Business	criteria	criteria	criteria	criteria
Community	criteria	criteria	criteria	criteria
Safety	criteria	criteria	criteria	criteria

4.2 Evaluation Methodology

The exercise was evaluated in three parts – by in-exercise evaluators, post-exercise debriefing, and by post-exercise agency reports.

Evaluators

All participating agencies were asked to provide evaluators to assess their own performance. In addition, independent evaluators were appointed by the Exercise Director to key venues and organisations to assess key roles and functions during the exercise. The role of evaluators was to assess:

- How effectively the sector/agency dealt with information and messages they were presented with
- How effectively they carried out their response roles as defined in guiding documents
- How familiar the sector/agency was with their roles and responsibilities, response actions and documentation

- The extent to which the overall exercise objectives were met and to identify areas that could be improved; and
- The effectiveness of exercise facilitation and management.

Post-exercise debriefing

As per customary exercise process, all agencies were asked to conduct 'hot' and 'cold' debriefs to capture feedback on the exercise.

The hot debriefs enabled exercise participants to provide immediate feedback and assist in identifying general themes and lessons. The cold debriefs focused more on organisational issues – strengths, weaknesses and areas for improvement.

Post-exercise agency reports

Key organisations and sectors were ultimately asked to provide a post-exercise evaluation report that assessed their role and participation in the exercise in terms of the evaluation framework above.

A series of evaluation forms were devised for this purposes. Forms were provided for each exercise theme (broken down into functional areas, and criteria to report on), as well as an assessment on exercise organisation and design, and overall progress since Exercise Capital Quake.

The forms were deliberately 'free text' format in order to allow qualitative feedback in all cases. There was no quantitative analysis or key performance indicator-based analysis.

Individual agency evaluation was on the basis of:

- feedback from sector/agency 'in exercise' evaluators
- feedback from sector/agency facilitators
- feedback from the hot and cold debriefs
- any other organisational analysis or learnings.

4.3 Analysis and Reporting

The analysis process followed in preparing this report is summarised below:

- Review of evaluation reports and forms, which were received from most sectors and key agencies; these typically comprised the structured forms plus some evaluator reports for CDEM Groups and some key sectors
- Extraction of key participant observations, by theme and function. From this, a view on people's perceptions around performance (theirs and others) and the effectiveness of the response were formed, and where future work emphasis needs to be placed
- Review of additional information such as the report by Phoenix Research on the public focus groups and drawing upon the thoughts of the wider Exercise Co-ordination Team at the time and from subsequent discussions with others
- Identification of key themes and issues and areas for action going forward, and discussion at Exercise Review Workshops in early May
- Preparation of overall exercise report

Separate reports have been prepared by evaluators for the participating CDEM Groups and many of the main agencies involved in the exercise. A comprehensive report was prepared by the Auckland CDEM Group exercise evaluator, including a number of recommendations specific to the Auckland region and CDEM Group.

5. Exercise Preparation and Associated Outputs

Preparation from the exercise involved considerable input from the participating organisations. During the period August to October 2007, there was active engagement with agencies and sectors to progressively work through and establish the following aspects:

- The impact of the general scenario on their operations
- The issues and processes that they wished to have exercised; and from this
- The scope of their exercise participation

Following this interaction, the key sectors and organisations prepared Exercise General Instructions during the November to February period to guide their preparations and define the participation during the main exercise phase.

In addition to the general exercise preparation and participation, the following reports and key documents were produced within the exercise project:

- *Lifeline Utility Co-ordination for Response and Recovery: Integrating the Processes at Local, Regional and National Levels* – by Lifeline Utility Working Group
- *Report of the Economic Workgroup: Assessment of the Impacts of a Volcanic Eruption on the Auckland Economy* – by Shearer Consulting and Market Economics
- *Community Behaviour-based Communication Framework* – by Massey University, GNS Science and MCDEM

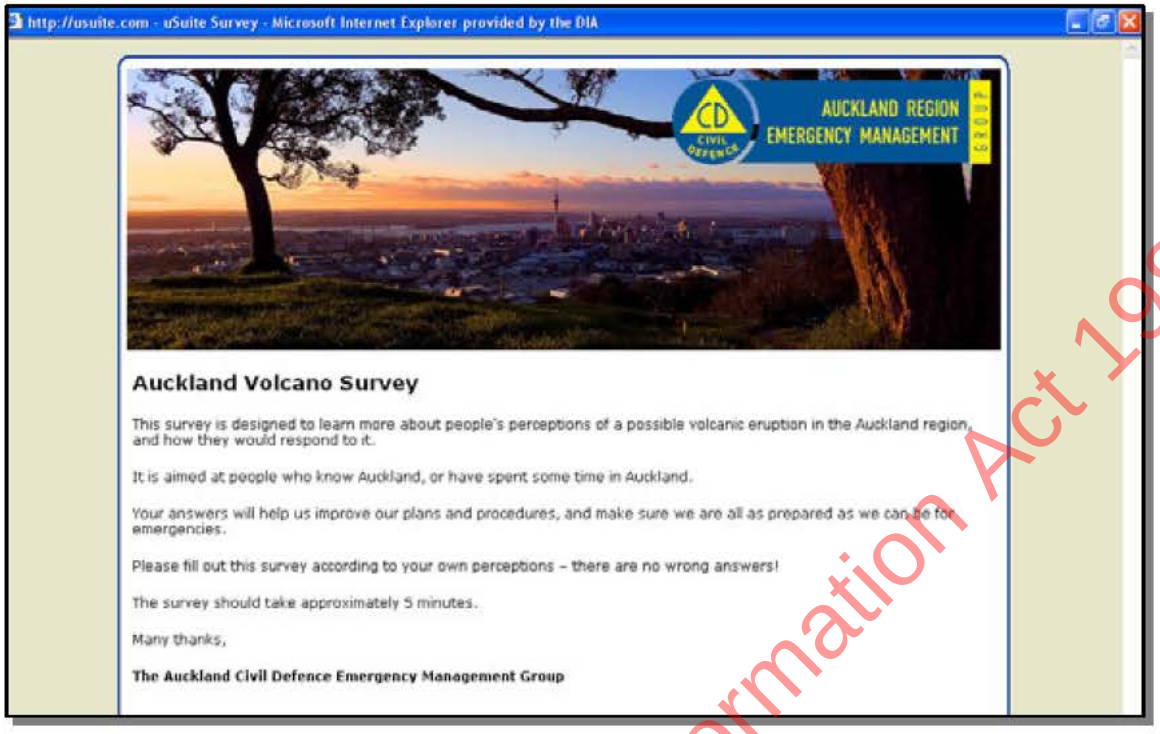
Other documents were produced or specifically upgraded with Exercise Ruaumoko as one of the main drivers:

- Auckland Volcanic Contingency Plan
- Auckland Region Mass Evacuation Contingency Plan
- Auckland Public Information and Media Management Plan (GFP P4)
- Auckland Operational Response Planning Group SOP

Three significant projects were undertaken as part of the 'community' theme of the exercise. These were:

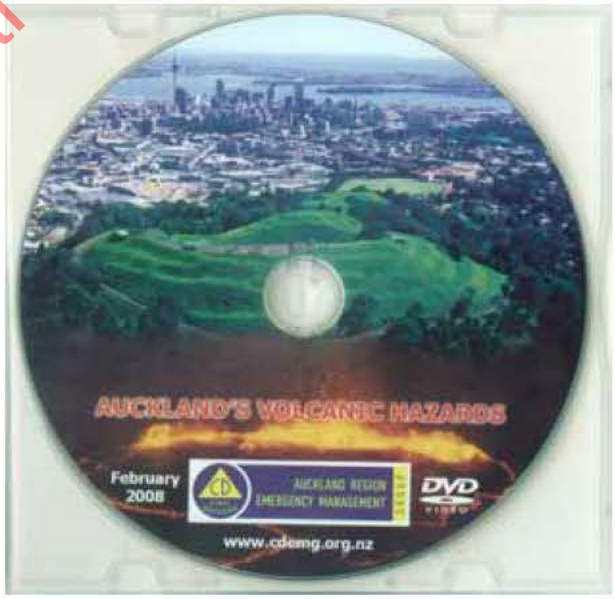
1. **Community Focus Group** – a focus group of 20 people met three times during March 2008 to gauge hazard awareness (from the Auckland Volcanic Field), risk perception, and personal reactions to the Ruaumoko scenario and public information products produced as part of the exercise. The results from this focus group can be found in the document *Modelling the Community Response to the Public Education and Communications Programme* - report by Phoenix Research for the Auckland CDEM Group. A summary of the main findings is given in Appendix 4.

2. **Online Survey** – a 'public' online survey (www.aucklandvolcano.govt.nz) that aimed to follow on from the community focus groups and collect more information about how communities and individuals would react to an escalating volcanic crisis in the Auckland region. The survey contained 24 questions relating to hazard knowledge, risk perception and evacuation behaviour. It ran over a period of 3 months (March to June 2008) and received 2050 responses from a wide range of locations and across all age groups. Analysis of survey results can be found in the report *Community Response to an*



Auckland Volcano: Summary of Results from the Exercise Ruaumoko Online Survey – MCDEM (in preparation).

3. **Auckland Volcanic Hazards DVD for Schools** – a 10-minute DVD commissioned by the Auckland CDEM Group to illustrate the processes and effects of a potential future eruption in the Auckland Volcanic Field. It was aimed primarily at school-aged children (and distributed widely to schools in the region), but proved a useful briefing device for all ages (copies may be available from the Auckland Group Emergency Management Office).



An overall compilation document of the exercise information and documentation, including the scenario data, is also being prepared for future access and retrieval.

6. Exercise Management

Based on the feedback provided, there was a good level of satisfaction with the exercise co-ordination arrangements during the planning and delivery phases. Most participating agencies reported that the exercise had provided a good framework to test and evaluate their capability under a major scenario that in many cases had not been contemplated by their agencies in detail.

The initial exercise phase was considered to have been extremely useful in engaging agencies to plan for an event within Auckland Volcanic Field.

6.1 Exercise Planning

Given the overarching objectives of roles and responsibilities, arrangements and connections, the general focus of this exercise is considered to have been appropriate. This exercise has however highlighted the need to consider issues of breadth and depth of play more carefully at the outset of planning for major exercises. If the objective is to work on the detail of some aspects of a response or specific plan testing, then it can be more effective to hold smaller linked exercises.

The difference in the complexity of planning and delivery between local and regional multi-agency exercises and national exercises involving more than 100 agencies is considerable, and needs to be borne in mind by all parties involved. There are two principal considerations that arise from this observation.

Firstly, there are inevitably challenges within a large exercise context in catering for organisations playing a smaller or non-continuous role with only one or two individuals involved. It is acknowledged that issues such as documentation being tailored for larger organisations with multiple participants and inputs that don't follow a scheduled time frame can cause difficulties.

Secondly, Exercise Ruaumoko has highlighted that there needs to be a more sophisticated exercise management infrastructure for exercises involving this number of organisations, individuals and venues, and duration. While the Auckland CDEM Group website provided a valuable central repository of information and documentation, greater interactive functionality would assist all parties with respect to participant and venue contact details. The management of contact details across the different categories of involvement by agencies and individuals was very time consuming throughout the development and delivery phases of the exercise. The ideal solution for participant registration and management should be a web application that allows participants to self-register and manage their contact details etc directly. Changes would be instantly reflected on the website, and allow Exercise Control to publish a snapshot or milestone PDF version of the participant and venue contact list, thereby reducing the number of versions of the Participant and Venue contact lists circulated.

As noted in Section 3, maintaining secrecy of the eruption location and time was an important factor in maximising the effectiveness of the build-up to and during the main exercise days, and was a considerable achievement.

The exercise overall received good media coverage due to the considerable efforts of Auckland Regional Council and MCDEM communications personnel.

6.2 Exercise Resourcing

The size and scale of Exercise Ruaumoko required a significant financial and resource commitment to planning and delivery from all participants.

The Auckland CDEM Group and MCDEM provided both the main direct financial input and staff resource contributions. During the second half of 2007 when the bulk of exercise planning was undertaken, MCDEM and the Auckland CDEM Group both provided the equivalent of approximately 2-3 full-time personnel dedicated solely to exercise design and organisation. In addition, many of the major participating agencies committed the equivalent of an additional 1-2 full-time personnel in exercise-related operational planning and preparation. Greater levels of resource were provided during the final preparation stages at the beginning of 2008.

For the Auckland CDEM Group and the neighbouring CDEM Groups, this exercise had not been programmed and budgeted for. Furthermore, both the planning and delivery was undertaken prior to the expansion of the Auckland Group Emergency Management Office to a fully staffed complement. This led for the need for significant unscheduled expenditure on external resource to assist during planning and delivery.

CDEM Groups need sufficient notice to plan for and obtain funding for major exercises of this nature. The need for more than two years notice after initial exercise scoping and definition in order to tie in with local authority financial planning cycles needs to be reflected in the National Exercise Programme.

6.3 Exercise Participation

As is expected for an exercise of this scale, the level of participation in the exercise by agencies varied considerably. The resource commitment during the planning and delivery phases from major participating agencies was significant, and their intensity of exercise involvement noted by evaluators.

The scale and duration of this exercise have highlighted that it is much more difficult to source 'volunteers' from within participating agencies for an exercise than a real event.

As the agency participation on the main days was not on a 24 hours basis, there was a consequential lack of process flow, and lack of time for the development of some of the key strategies. As is often the case with large-scale exercises, some agencies encountered difficulties with other organisations participating at different levels of depth, and in some cases at different times. This was highlighted in Auckland where the seven territorial authorities were exercising at different levels.

6.4 Exercise Delivery

The briefing device of a pre-prepared DVD issued to all participating organisations proved successful in bringing the participants up to a common level of awareness of what the public (and other agencies) knew at the beginning of the main exercise days.

A number of the injects from Exercise Control requested responses or actions from the targeted players. These were typically process prompts on things they might not be thinking about or not doing, or should be planning for to organise resources for after the eruption occurred. In a number of cases however no response was offered. There were also numerous incidents where agencies provided notional responses that whilst unlikely were difficult to 'umpire' or validate.

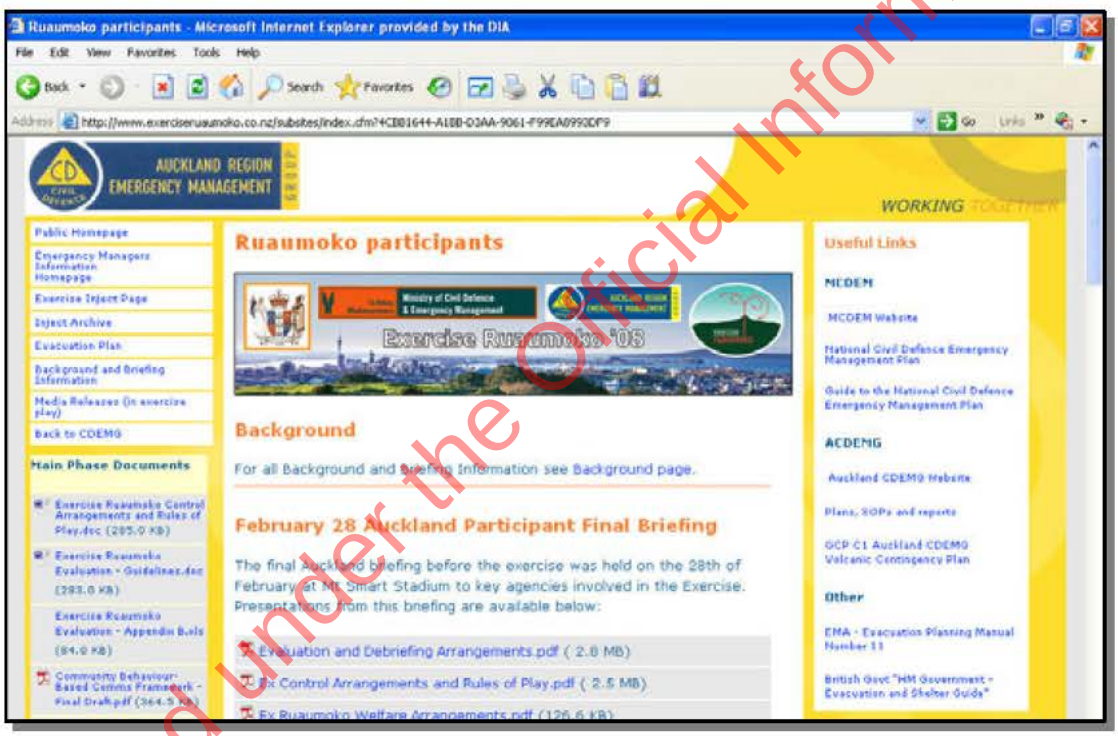
In some cases the notional responses from some organisations caused frustrations for other participants due to a mismatch of expectations.

A number of media releases from CDEM and other participating organisations were only visible to participants that received them directly. Exercise Control could have circulated these to all sectors and players to enhance the sense of the unfolding scenario.

6.5 Website

A website was established for Exercise Ruaumoko with the objectives of:

- Having one easily accessible source with the most up-to-date versions of exercise documents
- Reducing email traffic to participants
- Having a public page to provide public education about the exercise
- Enabling non-participants to follow along with the exercise by having all of the injects placed on the website



The exercise website was not intended to be the primary method of getting injects to actual participants, nor for sharing sensitive information, as the user logons had to be shared quite widely. It was developed by the Auckland Regional Council web team and primarily managed by the Auckland Exercise Co-ordinator. Basic protocols and security measures were agreed by the Exercise Working Group and implemented. During the main phase of the exercise a full-time resource was required to upload the exercise injects.

Feedback from exercise participants about the website was very positive. It allowed very large presentation files to be shared which would not have been possible by email. It also reduced the need for accurate participant email lists early in the exercise development, as the website was shared at briefings and passed on by attendees to colleagues. The Auckland Regional Council web tool was easy and relatively quick to use.

The public page was not used as extensively as it could have been due to resource constraints, which meant that the information was not necessarily attention grabbing, and a potential public education opportunity was not fully taken.

Overall the website was a very valuable tool and the exercise planning would have been significantly more time intensive without it. In future, the following aspects should be considered when developing an exercise site:

- A specific budget should be put aside to develop and maintain the website including ensuring high download speed, stability and large hit capacity
- Comprehensive protocols should be developed and agreed prior to launch
- A secure area of the site should be developed for working group members
- The Public Education strategy should be well integrated with the website and the site updated regularly

7. Review of the Performance and Effectiveness of the Exercise Functions

This section of the report covers aspects relating to the performance and effectiveness of the delivery of the exercise functions by participating agencies. The key points made by exercise participants through the evaluation forms have been extracted and summarised.

7.1 Theme 1: Leadership

The focus of this theme was ***making strategic decisions*** and ***informing the community and key organisations with co-ordinated and consistent messages*.**

Function 1.1: Local Government leadership and continuation of services

Participants and evaluators in the regional Group EOCs observed generally good leadership by Group Controllers and key staff within the EOCs. This was also the case at local territorial authority EOCs.

The Auckland Group EOC improved its leadership and overall performance on the second day, noting that this was the first major exercise for many of the participants. It was also being held at a new alternative facility at Waitakere City, due to the main facility at the Auckland Regional Council not being completed in time for the exercise.

Informing other agencies of leadership arrangements at a Group level was generally not carried out well in the participating regions. Several participating agencies commented that it was difficult at times to identify who was leading the response. The public focus groups conducted in Auckland in conjunction with the exercise also highlighted the importance of visible and effective leadership. A summary from the separate report on the findings from the focus groups prepared by Phoenix Research is included in Appendix 5.

The absence of clearly articulated plans on where evacuated people would be received, processed and housed hampered the ability of some agencies to plan for the impact on services in areas that were to receive large numbers of evacuees. This is particularly the case for the health sector, where capacity is always stretched, and increasing capability and capacity in receiving regions would need to be planned for and initiated early on.

A number of agencies encountered difficulty in getting effective information exchange, briefing or engagement with co-ordinating EOCs (national, Group or local), despite physically locating Liaison Officers in EOCs. Further work is required to ensure that requirements of Liaison Officers and hosting EOCs are understood by both parties, and that Liaison Officers are effectively integrated into the EOC environment (including being fully integrated into the command/control structure, receiving appropriate training and being equipped with access to any EOC logging systems they require).

There were also issues in relation to process, roles and responsibilities at the interface between Group and Local EOCs. The time delay in processing voice and email messages at the Auckland Group EOC on the first day of the exercise impacted adversely on other agencies.

In Auckland, the Group EOC took active control of key regional transport resources at the commencement of the main exercise week to ensure that these resources would be appropriately allocated as the location of the area to be evacuated became clearer. This caused some difficulties for Manukau City Council, who were being very pro-active in their response.

On the second day of the exercise, the Auckland Group EOC notionally took control over fuel services at Wiri Oil Services. It was noted that the Group EOC personnel needed to ascertain that these services were in fact capable of carrying out the function expected of them. There needed to be a wider awareness and understanding of the roles and responsibilities of the Group EOC in *co-ordinating* the regional response (including taking control of key regional assets where necessary) and in supporting the Local EOCs in their *management* of the response.

There were examples of territorial authorities in Auckland and the Bay of Plenty not fully appreciating the need for effective consultation with the CDEM Group EOC and CEG representatives prior to making a local declaration. The purpose of this consultation is to confirm that the declaration is warranted and that the derivation of powers of a Local Controller from the Group Controller are understood, and to ensure all key players are informed in order to provide clear advice to the political leadership. Another question to arise related to the authority of Welfare Advisory Groups without a declaration with respect to access to emergency funding and enactment of memoranda of understanding with major companies. Clearly there is still a need for more clarity on arrangements around declarations, and for these arrangements to be included in training packages.

The dependence of each of the participating operational EOCs on 'non-CDEM' personnel from other council divisions was a common observation by exercise evaluators, particularly at Group level. The challenge is providing appropriate training and engagement opportunities for these people to achieve operational readiness, as well as securing senior council management commitment to releasing staff for such training. The issue of securing non-CDEM personnel for training and exercising is a long-standing problem, having being demonstrated repeatedly (refer Exercise Cruickshank final report amongst others) and needs to be addressed at all levels and with some urgency.

Function 1.2: Central Government leadership

The pro-activity of advice and options from the NCMC was favourably commented on by the Auckland CDEM Group EOC. The pre-exercise briefing by the Director of MCDEM provided good leads on DESC processes and likely requirements.

There was however a lack of clarity in communications from the NCMC to Group EOCs during the main exercise days as to what direction was coming from ODESC once the likelihood of the eruption increased. In particular, the absence of focused action plan from the NCMC which would have summarised the priorities of Government and co-ordinated key activity strands was highlighted by several agencies.

There was uncertainty about what form the operational leadership was taking nationally, given that the Auckland CDEM Group was the operational focus. This arose because although four CDEM Group EOCs were activated, the NCMC was only operating at Mode 3 (Assist). Although no CDEM Group requested assistance or national co-ordination in the exercise, there is a difference between the assistance role that the NCMC may provide in Mode 3 to two or more groups affected by the same event (i.e. flooding) and this scenario where there is a need to actively co-ordinate between a number of groups.

There were associated uncertainties about at what stage a national declaration may have been expected given some of the wider implications. There was increasing discussion of a national declaration on the last afternoon of the exercise when the full scope and scale of the eruption was evident. With respect to the process involved, the statement in a Sitrep that ODESC had decided that a national declaration would not be made was surprising given that the Act clearly makes such matters the Minister's responsibility.

National sectors commented on the adverse effect of not having regular Watch Group meetings after the initial increase in volcanic activity in November. The absence of these meetings during the preparatory phase meant that a great deal of activity that would have been undertaken had not occurred. Health in particular commented that wider participation in and running of Watch Group meetings between November and March would have allowed some of the more strategic issues, such as reduction in tertiary level services and the provision of health care for evacuees, to be properly exercised. While many agencies developed notional responses at the commencement of the main exercise phase based on work they anticipated would have been completed over the previous four months, these notional responses were in effect developed in isolation.

Some decisions with fiscal implications were made without Treasury consultation or advice. More pro-activity on this in the early part of the final week of the exercise would have been warranted, as it became apparent some agencies would have significant and immediate spending requirements. Earlier strategic analysis and closer working with the Auckland CDEM Group with regard to evacuation, for example, may have saved expenditure on some aspects and made the subsequent recovery easier.

Both the Wellington and Canterbury CDEM Groups found it hard to achieve contact with the NCMC and the Auckland Group EOC, and weren't provided with any information from the national cluster groups. While they were not playing a major role in the exercise, they had a reasonable expectation that they would be receiving information from the major regional and national players in order to see where they could offer support. The flow-on effects for the next two biggest cities were not fully explored in this exercise.

As an overview comment, the customary tendency for most response 'groups' or 'facilities' to focus on their own activities was again in evidence during this exercise. There is a need for all activity areas to more actively talk and exchange information with others.

The issue of dependency of some government agencies on non-CDEM 'volunteer' staff from other business units was also commented upon (refer comment under Function 1.1). The NCMC, in particular, used a number of additional staff from the Department of Internal Affairs to supplement MCDEM staff. This relationship worked well again (repeating the experience of Exercise Capital Quake), but there were still questions about how long that level of response (and level of staffing required in the NCMC) could be sustained – reinforcing the need for all agencies to continue procurement and training of volunteer personnel on an ongoing basis.

Function 1.3: Delivery and co-ordination of science information and advice

All participating agencies considered that the science advice was clear, timely and very valuable. The Auckland CDEM Group EOC commented that having a scientific advisor in the Group EOC provided a critical link for instant assessment and decision-making in relation to changing scientific information. Other CDEM Groups commented that the performance of the science providers has engendered a huge degree of confidence about their capacity and capability within

their Groups, and that this forms a good basis for how the scientific side of events can be handled in the future.

There was some degree of frustration expressed about the degree of uncertainty involved in this hazard, particularly when it came to defining evacuation zones. Agencies wanted early indication of likely timing, location and size of eruption so that they could put mitigation measures in place. However because of the nature of the Auckland Volcanic Field, or what is currently known about it, this information could not be given until the eruption became more imminent (1-2 days before eruption).

The Auckland Volcanic Science Advisory Group (AVSAG) and sub-group structures were well understood by the participants and all processes involving meetings and teleconferences functioned smoothly. AVSAG members themselves identified a number of areas for improvement, in terms of their own process. The main strength in the AVSAG approach is its inclusiveness of as wide a range of scientific competency as possible, through a tripartite sub-group system (monitoring, volcanology and social impacts). While these groups operated effectively throughout the exercise, they came under pressure during the most active periods, when inclusivity and 'due process' slowed down the ability of the group to be able to provide quick advice. Some simple streamlining of process for response periods could significantly improve the ability of the group to be able to provide timely advice.

This issue was particularly highlighted in the case of the NCMC and in Watch Group and ODESC meetings, where high-level officials and politicians typically wanted a full-time presence from a science representative. The collaborative AVSAG process, however, was designed around collective deliberation and one source of advice to both local and national agencies. Furthermore, since the focus of activity was in Auckland, the main AVSAG spokesperson was located in Auckland, meaning the NCMC and ODESC went to an alternative source where time was of the essence. It is clear these requirements do not fit well together at present, and consideration is already being given to ways to improve the science advice process to local and national sources.

While there could be some improvements to process, the advice that was given by scientific advisors was well received by all responding agencies. In some cases geological terminology was an issue that affected communication and understanding of AVSAG and GeoNet outputs. Probabilities and uncertainties were not always clearly outlined with advice, in particular agencies noted a desire to see probabilities expressed as numbers as well as descriptors to avoid misinterpretation.

Some agencies additionally noted challenges in interpreting scientific data and that there was a degree of assumed knowledge required. The benefits of receiving local or national (CDEM) comment and/or analysis on each GeoNet Science Alert Bulletin were noted, along with questions of how this information should be added or conveyed. Additional sources of information (for example, websites) could also be given so that an agency could go and research further, if wanted.

Several learnings were identified from the participation of MetService, CAA, Airways Corporation and GNS Science and the utilisation of the New Zealand Volcanic Ash Advisory System (VAAS). These included the need to investigate a system for CAA to be able to quickly designate hazard zones for areas that are currently not specified in the New Zealand VAAS, especially for an area like Auckland.

7.2 Theme 2: Business

The focus of this theme was ***planning for and managing the continuance of business, the economy and government.***

Function 2.1: Assessment and management of economic impacts

The work led by the Auckland CDEM Group with input from the Reserve Bank and Treasury was largely in the form of a "Pilot" study, which proved to be very successful. While only 12 business representatives/sectors were represented out of over 30 major sectors involved in the Auckland economy, participants were able to provide good data on the impacts, and it was recognised that many of the issues (e.g. having Business Continuity Plans prepared) are applicable across all sectors.

The economic consequences of a disaster on this scale are clearly significant for the region and the nation as a whole. For a worst-case Mt Eden eruption, the modelling by Auckland consultants Market Economics anticipates that the Auckland region would suffer a 47% reduction in gross domestic product (GDP), but this could be reduced to 40% if businesses had effective mitigation and preparedness measures in place. The rest of the North Island, together with the South Island, would benefit somewhat from the relocation of some displaced businesses to their regions, with an estimated 3% increase in GDP. Overall, this would result in a 14% decline in GDP for New Zealand, which could be reduced to 12% with effective industry preparedness. It is emphasised that this study was based on a maximum credible scenario rather than the actual exercise scenario which would have less direct physical impacts in terms of land area and populations.

The recovery phase for any eruption event will be critical, and there are very limited arrangements in place to cope with this phase of a major disaster, which will take years to complete. The Economy Workstream report recommends that a review should be undertaken to assess the ability of the nation to effectively recover from a major disaster. The objective of this review would be to ensure that robust and integrated recovery plans and procedures are in place at all levels and are adequately resourced and trained, with sufficient programmes in place to ensure the key sectors (e.g. business, social, and infrastructure) are also sufficiently organised and prepared to recover from a major emergency.

The potential economic effects from the pre-exercise study were regionally and nationally based, and so provided only limited information to local authorities. There is an associated need to articulate more clearly the range of mitigation steps and options for business.

A wider assessment across more of the business sector would undoubtedly produce more robust information which could be usefully applied to other disaster scenarios within Auckland and across New Zealand. It would also be useful to extend the study to take a much longer view of the impacts and the responses needed to recover. The Ruaumoko study only extended over a period of one year, whereas recovery would take several years.

Further work is also required around how to better take into account the impact of fundamental discontinuities e.g. a shutdown of the Marsden Point refinery, EFTPOS failure or whole regions

being without electricity supply for weeks. It is the micro economic effects (e.g. from loss of power supplies) of the disaster that will have the greatest impact.

Function 2.2: Planning for the direct effects on lifeline utilities, and the continuance and restoration of their services

The risks associated with having electricity, gas and telecoms in a very narrow corridor in a major city have been well highlighted by this exercise. The inevitable tension between lifeline utilities wanting to shut down and protect facilities in the evacuation area and wanting to maintain services for people who are preparing to evacuate also appeared to play out well in this exercise. The planning to get extra capacity in place to support key utility operations and whether or not this could be achieved due to access congestion, etc however wasn't as visible.

The involvement of district health board (DHB) emergency planners and facility managers at the Auckland Lifeline Utilities Workshop in November identified a range of issues that could be addressed to improve resilience. This workshop was extremely beneficial in gaining an understanding of the resilience, or otherwise, of networks that support the health system. It placed an appropriate focus on the objective of Engineering Lifelines activities – that is, active engagement with critical end users. The health sector have highlighted that while their facilities can function with a degraded level of utility service, they would require significant support from CDEM in terms of alternative arrangements. The consequence of failure to maintain these arrangements will mean that the health sector cannot provide acute or primary care to resident populations.

In terms of Lifeline Utility Co-ordination processes during the exercise, the number of improvements following recent events and exercises proved very beneficial during the main exercise within the Auckland Group EOC.

The co-ordination process within the NCMC however did not run as smoothly, with degrees of confusion between MCDEM and the Ministry of Economic Development (MED) regarding the nature of inputs required and how the process was to be led. CDEM Groups and other participating agencies noted that national direction would have been useful on priorities for support for lifelines (e.g. fuel) that crossed boundaries. There is also nothing in place to tell Groups how much fuel is actually available, where it is and whether supply is going to be adequate for projected needs or not. There is a need to improve the arrangements in place for liaison between the oil industry and the CDEM sector. This is expected to be addressed by the National Petroleum Contingency Plan being developed by MCDEM. Clarification of the role of the National Energy Sharing Organisation (NESO) is also needed. The role of MED in co-ordinating across the petroleum sector for scenarios such as this where Government assistance is not required needs further clarification.

The discussion document on integrating the co-ordination processes at local, regional and national levels produced during the planning and initial exercise phases was considered useful in showing the information flow paths. The diagrams depicting the information flows across these levels were broadly followed during the main phase of the exercise, and the information in this document is considered suitable for inclusion within the forthcoming update of the Guide to the National CDEM Plan. The issue of Sector Co-ordinating Entities requires further work however.

Several participating agencies expressed concern that email was still the main mode of dissemination, even though it was known that the telecommunications network may not cope with such a large event.

A greater emphasis on assessing the wider impacts on the remainder of the country and the associated requirements for supporting business as usual may have been desirable with respect to airport disruptions. The cessation of commercial flights into and from Auckland Airport is likely to have caused quicker and greater disruption to other airports than was evident from some responses, with for example jet fuel and aircraft parking capacity constrained at Christchurch and Wellington airports. The Ministry of Transport-led Transport Response Team (TRT) has identified the need to formalise arrangements for engaging with industry and transport infrastructure providers and operators when necessary.

Function 2.3: Business continuity and contingency planning

The Auckland CDEM Group used its alternate Group EOC located in the Waitakere City Council EOC. This proved fully operational and functional. While some changes and improvements have been identified, the Business Continuity Plan proved successful for the Group. Arrangements for the transport of Group EOC staff normally based in the Auckland Regional Council offices to the site requires further consideration however.

Manukau City noted that their simulated reduced staff levels from this scenario inhibited Council's ability to perform business as usual activities.

Several government agencies commented that their crisis management plans need to be updated to reflect the process and activities to be undertaken in a nationally-significant emergency that occurs outside of Wellington.

Planning for the continuance of essential services proved effective for the Welfare sector when it came to the Main Exercise Phase in terms of setting up other locations to provide support services to those evacuated, and those who were clients.

The health care system within New Zealand is a highly complex model. Auckland and Counties-Manukau DHBs deliver specialist national services to all of New Zealand. The loss or reduction in service level at those facilities will have a significant impact on the rest of the country, impacting on all DHBs. In some specialist areas treatment may need to be arranged in Australia until (specialist) capability can be redeveloped in New Zealand.

In order to ensure that Middlemore (Counties-Manukau DHB) and Auckland City hospitals were in a position to be able to evacuate acute patients within the very limited and uncertain timeframe that was likely to be available, it was necessary to reduce services to a residual service capacity level at an early stage. These arrangements are well maintained and practiced during strike planning. Approximately 80% of surgical electives may be cancelled with little increased mortality, whilst 40% of acute cases can be managed without admission. These measures, combined with discharge of those currently in hospital (average time 2 days), can significantly reduce the hospital population, leaving more manageable numbers of patients to evacuate at short notice. However, reducing service levels means that many of the non-acute tertiary services delivered at these hospitals would not be available.

The volumes of service provided by Counties-Manukau and Auckland DHBs, even at residual service level, could not be accommodated by other DHBs without significant service disruption.

DHBs are examining how they can extend their current resilience beyond 24-48 hours but an event like this would last far beyond what could ever be prepared for by a DHB facility. Failure to maintain lifeline utility services and alternative supplies to key health facilities (already operating at residual service levels) would mean that the population will have no local access to acute care, with consequential flow-on effects to surrounding functional facilities.

The impact on primary health care providers was not adequately exercised even though the issues were identified. The difficulty in building resilience in small private facilities (e.g. General Practice surgeries, Accident and Emergency clinics) is substantial. The post-eruption effects on the non-evacuated Auckland population would have been significant.

In the financial sector, had there been a telecommunications bottleneck, the banks may not have been able to communicate with the Reserve Bank. The payments system was kept operational by switching from Auckland to Wellington, but the banks may have been unable to make payments if they could not use the system due to a telecommunications failure. This is a significant issue that should be explored further and built into future exercises.

The message from ODESC, a few days prior to eruption, about maintaining business as usual in Auckland was at odds with Treasury's operational need to pull information and communication equipment and vital records out of the potential eruption zone. Relocation instructions had been notionally issued when the scientific likelihood of eruption reached 50%, a day prior to receiving the ODESC instruction. This instruction was however issued approximately 24 hours after being formulated due to exercise constraints.

The participating commercial banks are suggesting that an inter-bank liaison point be established in association with the Reserve Bank for extreme situations, so that industry responses can be released in a structured manner. The banks are also recommending that as a result of the Reserve Bank requirements for banks to have cash supply available to consumers, the banking sector be recognised as an essential service, as it is in other comparable countries. They note that this would subsequently need to extend to cash in transit companies to ensure delivery to ATMs, etc.

The longer-term contingent actions associated with a volcanic eruption need to be specifically addressed in agency business continuity plans.

7.3 Theme 3: Community

The focus of this theme was ***understanding and managing the social implications***.

Function 3.1: Understanding and influencing community behaviours

The two main pieces of work under this function were the community focus group and the online survey. Both were particularly useful in gathering the *public* response to this scenario, taking the exercise beyond the usual realm of CDEM exercises.

A summary of the community focus group results is found in Appendix 5, and are commented on briefly under Function 3.3.

Analysis of data produced from the online survey is still ongoing. However preliminary results support the outcomes of the community focus group, particularly in the areas of hazard

awareness, risk perception, attitudes to authorities, and willingness to follow directions. Results will be published in the document *Community Response to an Auckland Volcano: Summary of Results from the Exercise Ruaumoko Online Survey* in July 2008.

The third piece of work under this function was the development of the *Community Behaviour-Based Communication Framework* (Massey University, GNS Science and MCDEM). This document aimed to provide an 'expected behaviours' basis for communications to the public through an escalating volcanic crisis. It was based on an Auckland volcanic scenario, but the intention is to review the document following the exercise with a view to expanding it to cover other volcanic scenarios.

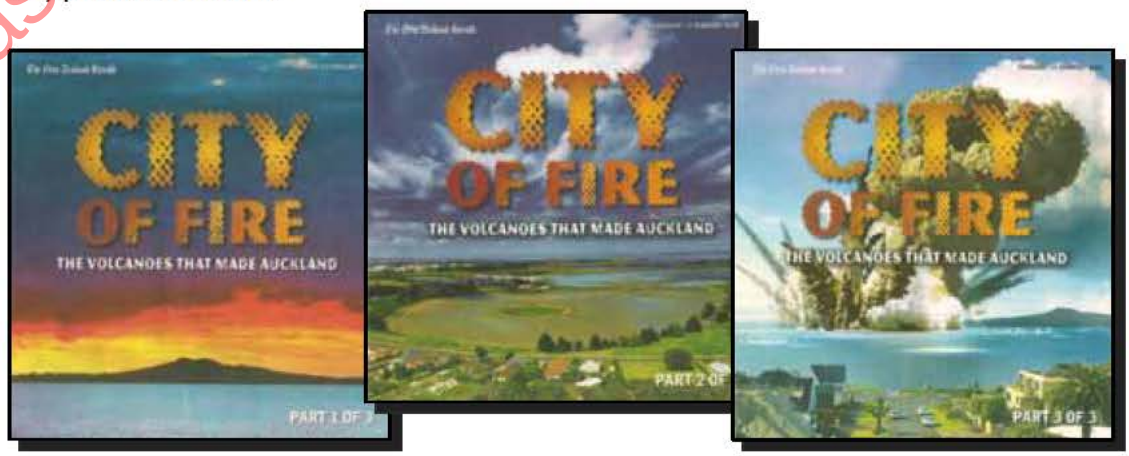
Key public information messages were developed prior to the exercise based on the community behaviours document, providing a useful tool for co-ordination of messages across agencies. The document didn't have much visibility in the response phase of the exercise however, and it is unclear the extent to which information about the behaviours was tested. Participants noted that the extremes of community behaviour due to rising stress levels were probably not fully evident in the scenario, as the sheer volume and scale of behaviour types could not be replicated in an exercise.

The expectation from the Auckland CDEM Group is that a greater level of self evacuation would occur than was indicated. Data from both the community focus groups and online survey, as well as anecdotal feedback from local agencies and organisations indicate this expectation is correct, and that Aucklanders are likely to take a conservative approach to volcanic risk. The self evacuation of people (from outside of the designated evacuation zone) from key workforces such as the health sector would prove very difficult to deal with, and would place additional pressure on transport, accommodation and supply. This reinforces the need for clear, consistent and early public messaging about the need, or not, to evacuate.

The scenario was seen in Canterbury as leading to a strong possibility that there would be rush buying of food and fuel and withdrawal of cash by people in that region. It is suggested that the whole subject of community behaviour needs to consider how the rest of New Zealand would be likely to react and behave.

Function 3.2: Public Education

The Auckland CDEM Group applied considerable effort to increase public awareness of the volcanic risk and to gauge understandings and perceptions of how communities should respond. This aspect of the exercise was helped by the New Zealand Herald which published three volcano supplements during the period leading up to the operational phase. This was considered to have been very effective in raising public awareness. The CDEM Group produced and distributed additional awareness material including a DVD to schools which was received very positive feedback.



The online survey was also a significant public education tool in addition to gathering valuable information for CDEM planning. The survey was designed to convey information about expected phenomena through an escalating volcanic scenario in the Auckland field, and get respondents thinking about how they would respond, including how and where they would evacuate to. It also asked questions about civil defence preparedness, with the intention of linking hazards with impacts with preparedness, and encouraging action in that area where it was lacking.

The exercise successfully heightened awareness of the hazard and risk in the short term, but further analysis is required to gauge the level of retention and changes to community behaviours.

Function 3.3: Public Information Management (PIM)

Media organisations did not participate in the exercise and the exercise did not try to realistically simulate the intense local, regional, national and international media engagement that was likely. As a result, PIM were not tested by the volume of calls and media enquiries that they would expect to receive. It remains unclear how much of local PIM media information would have been picked up, or if radio and TV would only have expected to get information from the Auckland CDEM Group EOC under the Emergency Management Memorandum of Understanding. The Memorandum of Understanding with Television New Zealand and Radio New Zealand was only notionally activated, and the MCDEM website was also not tested. Updates of the Auckland CDEM Group incident webpage needed to be more frequent.

Greater interaction between Group and local Public Information Managers from a messaging point of view is required to ensure consistency, as well as integration with national agencies. The roles of local and Group spokespersons need to be clarified. There was also not enough thought given to differentiating the messages between audience types (public, politicians, business sector).

The research report on the Auckland focus groups held in conjunction with the Main Exercise Phase highlighted a number of important considerations. These included:

- the importance of active public information from the outset of the event threat
- the need for all public information to contain instructions on actions to take rather than just what the situation is
- the need for a consistent, visible spokesperson
- people expect Civil Defence communications to be delivered in a different and separate way from 'normal news'
- the high expectations of the public with respect to assistance to be given to them during evacuation

The participating CDEM Groups observed that there did not seem to be any real co-ordination between the NCMC and PIM personnel from the CDEM Groups involved. It was also commented that the NCMC messages simply reflected those distributed by the Auckland Group, and did not appear to address national issues.

The National Welfare Recovery Co-ordination Group (NWRCG) did not receive or see many of the messages that came through, and these had to be requested. It is important for the NWRCG to know what public information messages are being delivered to the communities.

At a national level, other government agency communications personnel weren't participating and the All of Government Communications Group was not actively involved. The lack of engagement by this group had not been signalled prior to the exercise. Some government

agencies commented that they were not aware of the key communications messages as they had expected from the all-of-government communications approach.

Some aspects of public communication arrangements and protocols across government financial agencies were unclear. There was some initial confusion over whether or not communications with financial market players would be via a public information management function. For example, should the Reserve Bank's media statement reassuring financial markets and the public have been cleared by NCMC public information management? Questions also arose as to whether usual website means of communication with financial markets would be used.

The public information process was also not overly tested from a health perspective, with a lack of information and statements from the Auckland CDEM Group EOC to the DHBs. While the contacts with Public Health Organisations were tested along with the links to GPs via the Public Health Organisations, the public information messages were only observed through media reports (via email inject).

7.4 Theme 4: Safety

The focus of this theme was ***planning for and delivering response functions***.

Function 4.1: Planning, communicating and undertaking evacuation processes (including transport)

The evacuation operation was worked through essentially as a tabletop process. Many aspects of the evacuation operation were not able to be worked through in detail, as the plans in existence were at the strategic rather than detailed operational level.

In a real event, significant planning would have occurred within Auckland and at a national level as the incident grew in the weeks leading up to the heightened seismic activity that occurred in the week of the exercise. The level of resource to integrate planning across national, regional and local needs in relation to mass evacuation needs further consideration. For example, detailed transport resources, access points, corridors and destinations would be expected, resulting in a more structured, functional and operational set of plans.

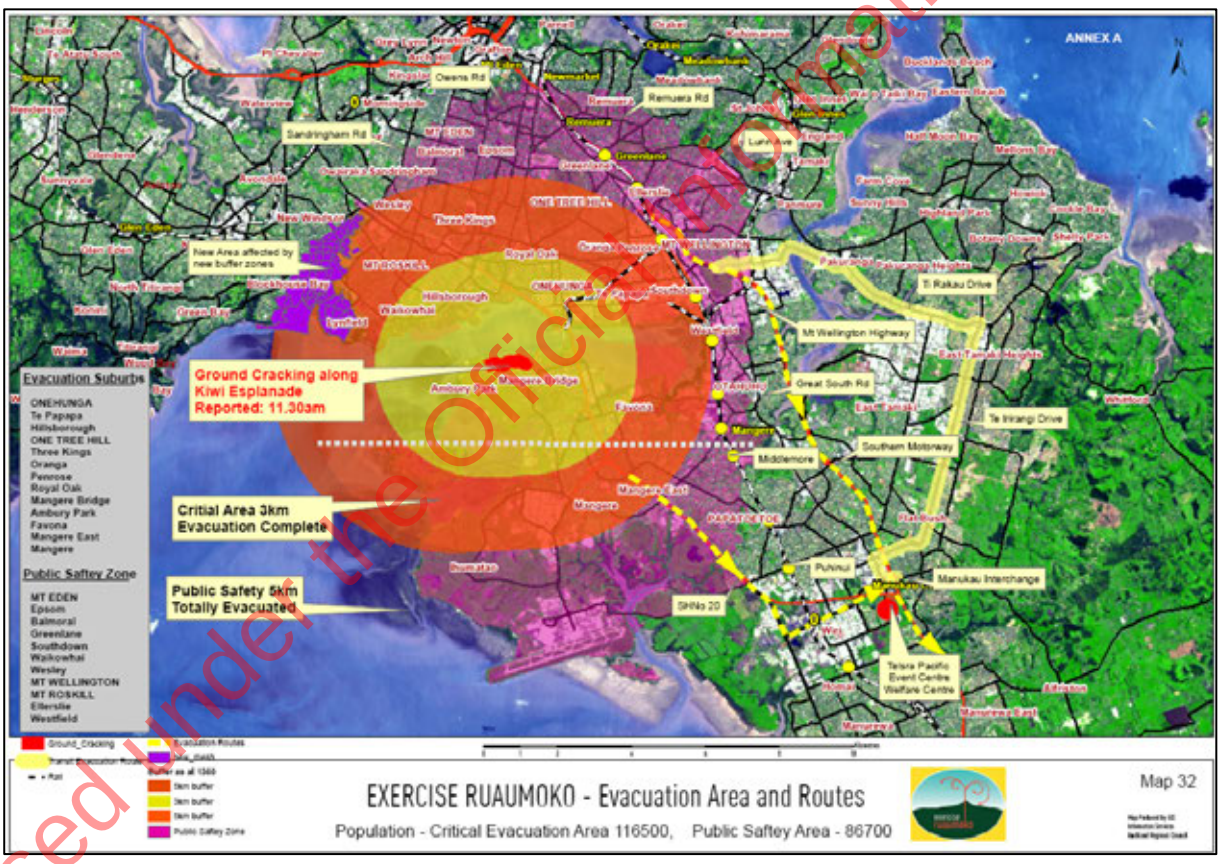
Evacuation strategy appeared to focus on moving people out of the region rather than to a point of safety within the Auckland region. This will always be a difficult decision and risk a subsequent need to evacuate further but, in such an uncertain scenario, there needs to be consideration of whether the latter approach may have allowed for greater continuity of business and services in the affected region, a reduced impact on support services in the surrounding regions, a reduced psychosocial impact, and quicker recovery from the event in general[5].

The timings for evacuation of the general population appeared shorter than some agencies were expecting, with several agencies commenting that greater realism

[5] Refer section 23.3 of the Guide to the National CDEM Plan

about the time it takes to move citizens out of an affected region would appear necessary. This observation does need to be tempered with an appreciation that the time between confirmation that an eruption will occur and the vent forming is likely to be as short as indicated in this scenario. Police commented that there is no practice for mass evacuation on the scale of this scenario, and it is unlikely to go as smoothly as the scenarios and exercise actions suggested it did.

The effectiveness of an evacuation operation on this scale is critically dependent upon effective communication to the public. With respect to effectiveness, far clearer definition of evacuation zones and movement instructions would have been required. The scope of communications was not fully exercised, with not all elements of public information management participating at the various levels as noted earlier. Some government agencies were not aware of the advice or messages being given to those self-evacuating, and considered that it would have been helpful to have known this. A comment was made by a participating organisation that the lines of communicating arrangements for the evacuation are considered too complicated to work in a real disaster.



The need for the CDEM Group to ensure close and effective linkages, for example between welfare and transportation functions, in both the evacuating region and receiving regions was clearly highlighted in the lead up to and during the main exercise week. The potential for overlaps and gaps between these elements is high.

In terms of the resourcing of key operations, there was considered to be potentially sufficient personnel to undertake the cordon function from the evacuated area. Provision of transport to a mass evacuation appeared to have gaps in understanding from various agencies, with the need to better understand the availability of transport in Auckland to move various size groups of people – for example, the different resources required to move 10,000, 20,000 or 80,000 people and the expectation, roles, and timing of such an evacuation.

The evacuation decision-making process, balancing probability of eruption against certainty of location was considered by the health sector to be generally sound and well communicated. The particular needs of the health sector would however in a real event have required earlier planning and further resource consideration, and more effective communication and interaction at this time. From a health perspective, the decision to reduce Auckland, Counties-Manukau and Waitemata DHBs to a residual service level was discussed on Friday 7th March and acted upon on Monday 10th March. This response clearly has national implications and appropriate alert codes were issued to the rest of the sector. Other DHBs identified capacity to receive patients and moved to a residual level of service delivery themselves.

A decision was taken by the Ministry of Education to close the schools around the potentially-affected area on Monday 10th March. This measure had been planned for and well communicated within the Auckland region (to the CDEM Group, Group Controller, and other agencies), and seemed to be a sound measure to take given the uncertain situation, and the potential difficulties of a mass evacuation operation with children still at school. The decision appeared to take ODESC by surprise, however, illustrating the difficulty of co-ordinating the actions of several responding agencies. This reinforces the need for inclusive, multi-agency planning processes at all levels. In particular, it is imperative that measures that have implications and impacts for other sectors are communicated early and at all levels.

Other government agencies and institutions also noted that they would have been giving serious consideration to evacuating their Auckland staff and residents at a relatively early stage in view of both staff welfare concerns and in order to establish operations in alternate locations well prior to the eruption occurring. It is clear there would need to be a very well-co-ordinated, multi-agency response during this phase, and an integrated approach to evacuation planning is essential.

Function 4.2: Planning for the provision of welfare to affected communities

Communications between welfare organisations were considered to have been well co-ordinated across the Auckland region. Communications between welfare agencies and the Group EOC were not always as smooth, however, with some phone and IT problems experienced at that venue. There is also a need to consider how to better integrate welfare with other functions in decision-making with the evacuation planning team, Group Controller and other key players.

Several people observed that there is a need for greater consistency around how CDEM Groups use Welfare Advisory Groups and welfare response teams. Some use Welfare Advisory Groups as a strategic planning team, with Group EOC-based welfare teams managing the direct consequences of an emergency. Others use one or the other as the whole functional group.

The process for registration and establishing reconciliation centres was not "load" tested in this exercise. The resources and efficiency of process for registration are expected to be very time consuming and high in staff numbers to undertake this function, and feedback from the neighbouring CDEM Groups was that they would have struggled with registering large volumes of people.

Communication and co-ordination of information coming through to the NWRCG from the 14 different agencies worked effectively, and made use of the sector's Volcanic Eruptions Guidelines which had been developed prior to the main exercise. The in-exercise number estimation spreadsheet proved very effective and was heavily relied upon. The assumptions involved in developing this spreadsheet need reviewing and sharing with the key players. Areas identified for further development were registration, needs database and analysis, links and

connections between the NWRCG and CDEM Group Managers. The NWRCG considers itself more confident in understanding the welfare challenges from a mass evacuation scenario and the need for strong linkages to CDEM Group welfare arrangements at all modes of activation. Overall, the welfare response to the scenario was considered effective with high levels of engagement during the Initial and Main exercise phases.

Function 4.3: Preparation of specific health responses and planning for the continuance of regular services

The major impacts on the health sector resulting from this scenario were:

- Reduction to residual service levels in DHBs within the Auckland area prior to the eruption followed by a national move to residual service levels in DHBs
- Provision of primary care to evacuated population
- Evacuation of acute cases from hospital following run down to residual service levels
- Maintaining primary and acute care for Auckland population not evacuated but with all health facilities facing significant infrastructure challenges (not tested due to end point of exercise)
- Provision of national specialist services within wider affected area (i.e. Paediatric oncology and neurology at Auckland Starship) (also not tested due to end point of exercise)

Northern Regional Health Co-ordination arrangements were considered to have been extremely effective.

A number of enhancements that have been developed following Exercise Cruickshank, including WebEOC and satellite phones, are not yet reflected in the documented arrangements. WebEOC proved a highly effective communication tool within the health sector providing robust logging and situation reporting.

The potential overload of health facilities in Waikato and the Bay of Plenty became apparent during exercise play, as were the longer-term impacts of evacuees staying in the region for three months or more.

Health agencies in the Wellington CDEM Group EOC noted that there was typically only 2 to 3 days stock of hospital medical supplies in the Wellington region, with dependence on overnight re-supply of stocks from Auckland. Disruption of that supply would have significant consequences for the continuance of health services in other regions.

Several major health suppliers/manufacturers were located in the area directly affected by the potential eruption and evacuation operation, with a large amount of warehousing and national bases involved. Given that health relies on a 'just-in-time' supply chain this would result in short to medium term disruption to the national supply chain for certain products.

Supplementary supplies of certain products could have been air-freighted to other centres from overseas: this should be part of business continuity plans for those suppliers. Products such as intravenous fluids normally come by ship due to their volume and weight, so such products may provide a bigger challenge in terms of timely supply. This will raise issues concerning airfreight and warehousing capacity, including cool store capacity.

Medical gases due to their bulk and weight are manufactured on shore: BOC Gases Ltd, for example, has two main plants – one in Mt Wellington, the other in Christchurch – so there is some extra capacity. However these plants also manufacture other industrial gases, so in theory

there may be a trade off to the types of gases the remaining plant could produce. This will impact on other industries such as construction.

Overall, the health sector response to the scenario was considered to be effective, with high levels of engagement during the initial and main phases of the exercise. It provided a timely opportunity to exercise at a national level nearly one year on from the national pandemic exercise, Exercise Cruickshank, and many areas of improvement were evident. The sector showed that it could engage with CDEM effectively and support the response to a non-health-led event.

Function 4.4: Identifying and co-ordinating the external resources and other logistical support required (national and international)

The physical and process challenges associated with managing fuel supply in major disruptive events were clearly highlighted again in this exercise. There continues to be a difficulty for CDEM in obtaining a clear picture of both the local and regional stored volumes at any point in time and the re-supply plans across the major suppliers.

Several agencies and regions noted resource shortfalls across accommodation and bedding, food, transport and education.

The roles and responsibilities around some aspects of transport logistics require better understanding and clarity. On a number of occasions the Transport Response Team was asked to provide logistic support. One such request originating from the NCMC involved the provision of helicopters. While the Transport Response Team can provide the contact details for air service providers, it cannot requisition assets or direct service providers to perform specific tasks. Improved understanding of the role of the Transport Response Team would help get tasks allocated to those that can complete them. This would also reduce delays in processing requests for assistance etc.

The Department of Corrections observed that the area of co-ordinating logistics in evacuation probably demands a shared website space due to the complexity of the response and the number of agencies potentially involved.

A lack of agreed purchasing mechanisms at national level was noted by MCDEM personnel operating in the NCMC.

The arrangements around international assistance to New Zealand were table-topped on Tuesday 11th March. Some significant steps forward were taken as a result of this table-top exercise, including the development of a draft standard operating procedure for international assistance. However considerable work is still required to develop the capability described in the procedure, and within Section 24 of the Guide to the National CDEM Plan.

7.5 Summary of Key Issues

The key issues identified from the analysis of evaluations and comments on the exercise are summarised below:

1. **The leaders of the response at regional and national levels should be more clearly identifiable to agencies actively involved and more prominent to the community**
   - Several participating agencies commented that the operational leaders at both regional and national levels lacked visibility, particularly for agencies that did not have a detailed understanding of the role of the CDEM Controller.
   - The Auckland public focus groups run in conjunction with the main exercise highlighted the need to select spokespersons and involve them early and prominently to convey authoritative event leadership.

2. **There needs to be greater clarity and mutual understanding of the roles and functions of CDEM Group EOCs in co-ordinating across and supporting the delivery by local EOCs**
   - The roles of Group EOCs in support of local EOCs should be better articulated.
   - This also applies to the processes by which the NCMC co-ordinates across national sectors (e.g. welfare and infrastructure) and agencies.

3. **Science information was very well delivered. Further clarification of the operational structures for AVSAG during event periods is needed, including clarity on how direct advice can be provided at the national level**
   - Local, regional and national agencies commented favourably on the clarity, timeliness and value of the science information received.

4. **There needs to be greater socialisation and agreement on key planning assumptions for mass evacuations.**
   - The complexity of the evacuation process within a rapidly escalating emergency is now better understood, along with the options (e.g. in-region placement of evacuees who are likely to be able to quickly return).
   - An appropriate balance is needed between *pre-agreed strategies* and *event-specific operational plans*.
   - Early establishment and communication of evacuation goals is critical.

5. **The process for consulting on, making and communicating declarations requires better understanding**
   - The importance of interaction between controllers (local, Group or National) before a declaration (local or national) is made needs to be emphasised. This should include any support needs or expectations.
   - More information is needed on the processes and indicative thresholds leading to a national declaration.

6. **The reliance of Group and Local EOCs and key government agencies on 'volunteer' personnel from within their organisations and from other agencies must be acknowledged, and addressed via specific access and training arrangements**

- There is a great deal of assumed knowledge amongst CDEM professionals that is not easily conveyed to non-CDEM personnel (e.g. co-ordination arrangements between other groups and nationally, and information flow arrangements).
- Group EOCs should be resourced and trained appropriately to undertake the co-ordination and support functions.

7. **There is a need for overarching Action Plans at both regional and national levels during responses to convey the short and medium term objectives to all agencies involved**

   - The need for an overarching Action Plan to convey Government's priorities and give clarity around national directions and actions was commented on by national agencies and CDEM Groups.

8. **Key messages to the community need to include detailed advice about what people can do for themselves, their families and their communities, as well as information about the event and the CDEM response to it. These messages must be consistent from local through to national level**

   - Feedback from the Auckland focus groups included that information should be accompanied by instructions.
   - At the local level, there was a need to know which streets defined the boundaries of the evacuation zone, rather than just map lines.

9. **There was connectivity between CDEM Groups, and between CDEM Groups and the NCMC (e.g. via teleconferences), but not effective cohesiveness around 'who was going to do what, and by when'**

   - The CDEM Groups and the NCMC did not have an effective vision across the event – i.e. lacked a common operating picture. As a consequence, the teleconferences lacked focus and effectiveness.
   - There was also inadequate interaction and co-ordination between Groups and the NCMC on key issues such as the receipt and management of evacuees.

10. **The economic impacts of a volcanic eruption in Auckland have been shown to be significant regionally and nationally. The potential for mitigating these impacts needs to be further explored, and recommended actions conveyed to individual agencies and recovery planning progressed**

    - Linkages need to be established between the high-level economic studies undertaken and taking action in the areas of business continuity/ resilience and community recovery planning.

11. **There has been a wider realisation of the criticality of infrastructure generally, and the vulnerability of the Auckland and Northland energy lifelines in particular**

    - Consideration must be given to what can be practically be done to reduce the bottleneck effect of Auckland's energy corridor, and whether the current utility mitigation programmes will reduce this vulnerability.

8. Discussion of Priority Areas of Development

This section of the report follows on from the key exercise issues to consider the priority areas of capability development.

8.1 Improving the Leadership and Co-ordination of the Response

Identifying and Preparing Spokespersons

There was an absence of a visible public face of the response process at the local, regional and national levels. Spokespersons play a vital role of interacting with the media in order to communicate key messages to the community. This role should ideally be separate from that of Controller in order that the latter doesn't get distracted from their core role as operational leader.

The role of spokesperson in a major emergency event typically falls to elected officials. People look for political leadership in these situations; there can be confusion if people previously unknown to the public appear to be making decisions.

Nationally, the Minister of Civil Defence assumes the spokesperson role. Regionally, CDEM group plans typically say that Chair of the CDEM Group is the spokesperson. Locally the Mayors typically take up the spokesperson role. The definition around roles and responsibilities of spokespersons at local and regional level is however considered to be inconsistent and not always adequate. It is also the view of many of the participating agencies in this exercise that many elected local officials don't fully understand their responsibilities with regard to CDEM.

Recommendation 1:

MCDEM, in collaboration with CDEM Groups and member authorities, should prepare guidance to define the roles of Mayors and Group Chairs, to enable them to be fully aware of CDEM response arrangements and to assist them to be prepared for their roles as key spokespersons.

Overarching Operational Strategy/Action Plan

Overarching operational strategies or Action Plans were not in evidence at both regional and national levels in this exercise. Having an agreed Action Plan which is effectively communicated to the operational agencies at all levels is a key component of overall event leadership.

The Group and National Controllers are primarily responsible for the operational leadership of the process. These people must be visible across the agencies involved in the response, and their actions and authorities understood. Having effective Action Plans actively communicated across the participants is a prime means of achieving this visibility.

In this exercise, the Government's strategic priorities weren't presented in such a way that they were effectively conveyed to those outside ODESC. The NCMC Sitrep only stated the NCMC operational priorities.

Recommendation 2:

MCDEM should lead work to define templates for strategic-level Action Plans to be prepared by the NCMC, key operational cluster groups (NWRCG and TRT) and CDEM Group EOCs.

Achieving a Common Operating Picture

The underpinning element of an effective Action Plan is key agencies and overall operational leaders having a clear view of the current situation during a response.

The key players did not have an effective common operating picture in front of them, therefore typically spent more time than they should have in gathering up information. This was due in part to the lack of an Action Plan at the different levels, but also to the Sitreps not having the right level of information in them. As a consequence, the conference calls between Group and National Controllers were inefficient and lacked focus. The majority of time in these calls was spent on seeking and conveying information that should have been otherwise communicated, rather than confirming the direction and clarifying consequential questions.

An associated consequence of the time taken in searching for information is that inadequate time was spent in decision-making mode by operational leaders.

It is the view of a number of people involved in exercises and actual events that Sitreps currently involve too much effort for the value derived. This is in part because they try to cater for too wide an audience. A standard format is required to help people to know where to look for particular pieces of information. There are also different perspectives on the structure and presentation of Sitreps as an event unfolds. The debate here is *achieving quick uptake of new information by avoiding repetition* vs *each Sitrep must be standalone*. Resolution of these viewpoints involves determining a more effective way of highlighting changes between Sitreps.

This debate simply highlights the shortcomings of a static Sitrep, in contrast to a more dynamic emergency management information system.

Police, Fire and Health were able to get a nation-wide picture from their systems and had an effective overview of the event. While these systems were typically available to the rest of the CDEM sector (via independent logins, or in EOCs), and did provide a common operating picture to an extent, an emergency management information system is badly needed by the core CDEM agencies at Group and national levels to address the visibility issues that were observed in this and other recent exercises and responses. CDEM as the lead agency must be able to have an overall vision and continuous feed of the latest information to maximise the efficiency of the response.

Keeping track of people and operational status around the affected area was not fully tested in this exercise, and is clearly an aspect requiring an appropriate electronic system.

Recommendation 3:

A CDEM Emergency Management Information System is required and should be progressed with urgency by MCDEM.

Understanding Co-ordination Roles and Processes

There needs to be greater clarity around the objectives and functions of CDEM Group EOCs in an emergency. Group EOCs provide a crucial 'middle layer' of co-ordination - supporting their local authorities and service providers, linking with neighbouring CDEM Groups and connecting with national agencies via the NCMC. These roles are typically not well understood by responding organisations, leading to ineffectiveness and in some cases the breakdown of connections. Information on this should be included in the current draft national guideline for EOCs.

A particular aspect of this that arose from each of the four main CDEM Groups involved in this exercise is better articulation and understanding of how a Group EOC co-ordinates across and supports the local authorities of an affected region. Group EOCs provide central co-ordination and planning of critical resources across a region, leaving the delivery to local authorities (local EOCs). Group EOCs are expected to be pro-active in allocating resources in order to reflect this model. Once the Group EOC becomes active in this co-ordination mode, the local EOCs need to adjust their approach to dovetail in.

Buses were the sentinel example from this scenario of a specific element of the response requiring early co-ordination and control from the Auckland Group EOC to establish a regional approach, and to avoid 'first in first served' competition occurring for critical resources.

It became apparent that the four neighbouring CDEM Groups should have had a more interactive dialogue with each other regarding evacuation and welfare issues. This interaction would have been more efficiently co-ordinated by the NCMC, given the range of issues that each of the Groups was dealing with.

Feedback from the CDEM Groups has indicated that more pro-active co-ordination from the NCMC of evacuation and welfare support across affected CDEM Groups would have helped them, along with input and direction on national issues such as fuel and maintenance of food supplies.

The NCMC has four modes of activation:

Mode 1: Monitor
Mode 2: Engage
Mode 3: Assist
Mode 4: Manage

The NCMC teams focused on operating within Mode 3 *Assist* during this exercise. The above examples of where national co-ordination and elements of direction are required fall in-between *Assist* and *Manage*. This indicates that either better scope descriptors are required within the current Mode 3 to reflect that the NCMC should be pro-active for some functions. Alternatively, consideration could be given to a revised three-level categorisation of Monitor/Co-ordinate/Direct.

Recommendation 4:

MCDEM should evaluate whether the NCMC modes of operation as defined in the National CDEM Plan adequately provide for the range of event circumstances.

Most of the management of the evolving emergency was conducted in Auckland, with the NCMC operating to support the Auckland Group EOC, and to provide co-ordination and information to ODESC and government departments and agencies. The flow of information was satisfactory in content, but the rhythms of the two main operations centres were not synchronised. This led to some reports being out of date, meetings and conferences clashing and insufficient time to consider plans and to co-ordinate between the centres. By way of an example, the lack of synchronisation and less than ideal communication of plans resulted in the NCMC providing ODESC at one point with its depiction of the intended evacuation zone that was significantly different from that being used in Auckland.

Several participating agencies commented that the triggers for a national declaration should be established and communicated, even if only in broad terms. Issues around the process and

implications of a national declaration from Group EOCs and government agencies for this scenario weren't actively explored in the exercise.

The area of Lifelines Co-ordination at the national level is one where greater clarity of process and responsibilities is also required. During the exercise, the NCMC requested additional input in relation to power and fuel from the Ministry of Economic Development, as they had only limited connections with some national utilities and their contingency frameworks. The Ministry of Economic Development representative that attended found themselves being asked a wide range of utility issues, and uncertainty as to which agency was co-ordinating lifeline utility issues seems to have arisen from there.

Recommendation 5:

MCDEM and MED should clarify the lifeline co-ordination process and arrangements at national level.

Vertical Integration of Information to the Community

The exercise practiced the generation and co-ordination of public information messages to varying degrees at all levels, but stopped short of issuing messages to media outlets other than routine releases explaining that the exercise was underway.

Not involving the media in exercise play was a deliberate decision taken to manage exercise play. Consequently, the capability to respond to Media inputs (e.g. dealing with up to 100 calls per hour) was not tested, and there was a lack of general media 'noise' and media-driven information flows. The media clearly would have driven the pace of the response much harder.

At the national level, the All-of-Government Communications Group is responsible for co-ordinating media messages across central government agencies. This group was not actively involved in this exercise however. As a consequence, the full vertical integration of information messages to the public was not exercised.

Many of the initial media releases were simply a summary or update of the current situation, and were devoid of essential information. Public Information Management team members and CDEM managers need to work more closely together, and think carefully about:

- what information is required by the public
- what do the public need to do (including what actions can they take to help themselves, their families and their communities)
- what don't you want the public to do; and
- where to go for information etc., including important phone numbers

It is apparent that PIM processes at all levels would benefit considerably from a wider set of pre-prepared templates.

Specific consideration also needs to be given to how the media are to be involved in future exercises.

Recommendation 6:

MCDEM should lead work involving CDEM Groups to:

6.1 Define and document the co-ordination mechanisms for the vertical integration of public information messaging, and how media information requests should be responded to.

6.2 Prepare templates for public information at local, Group and national levels, and identify which parts of the general messaging should be pre-prepared.

8.2 Developing Capability

Addressing Staff Dependence

In most cases CDEM Group and local EOCs are staffed by non-CDEM council staff and emergency services personnel, supplemented with volunteers. There is a significant dependence on these people to co-ordinate CDEM activities from EOCs. It was noted that many of the EOC staff in this exercise did not have a comprehensive understanding of the co-ordination arrangements between other Groups and nationally, and the importance of the multi-directional information flow (i.e. up, down and across), and had had only minimal training in EOC functions and operations.

Professional development and training for staff needs to be specifically tailored to the functions of CDEM (including EOCs), and given to the staff involved in response via a structured programme that has been endorsed and has the commitment of senior council management. As well as initial training, ongoing refresher training is required. This represents a significant challenge, given both the time commitment required and the rate of staff change amongst the council departments and agencies from which staff are typically drawn. A number of CDEM Groups have yet to work through a structured resourcing analysis and training programme for their Group EOCs.

Standardised packages about CDEM including the roles of EOCs are needed. These packages exist, but are typically developed on an agency-by-agency basis. Making this information available on DVD or online 'e-learning' modules, rather than in traditional document form is likely to be more effective.

This issue is no less of a concern at national level. MCDEM was well supported by personnel from the Department of Internal Affairs and other agencies in the NCMC during the main exercise days, but ongoing professional development poses a challenge. The concept of an interagency programme across government agencies has emerged in discussions following Ruaumoko as a way of maintaining a core capability, and for people in agencies with limited response roles to retain the operational skills and knowledge they have learned. A programme of this nature would also enable a transfer of knowledge about all-of-government response arrangements to other government agencies via the individuals involved.

Such a programme would involve defined participation parameters (e.g. quarterly training sessions plus one major exercise or response engagement). Appropriate incentives need to be considered, with a critical issue being obtaining commitment of managers and their willingness to release people for training and events. Training and response expectations would need to be included within employment agreements, and the programme advertised and promoted widely across government.

Recommendation 7:

7.1 All CDEM Groups should establish training programmes and acquire training resources for their Group and local EOCs to ensure that capacity is built over time, the interest and commitment of existing personnel is maintained, new staff are inspired to join, and that inter-operability between CDEM Groups is achieved, in line with section 17 (1) (b) of the CDEM Act.

7.2 Selection for key roles in EOCs should be on the basis of skills and experience rather than agency and business-as-usual position.

Recommendation 8:

MCDEM should prepare a discussion paper outlining how to use staff from other agencies to supplement NCMC staff in an emergency.

Training Needs and Mechanisms

This exercise has again highlighted the need for structured training programmes for key response roles. There is a need to differentiate between *attending courses* and *achieving competencies*. There is also a corresponding difference between structured training and participation in exercises. Exercise participation and event response are only one element of a structured training programme.

The challenges of decision-making in situations with only limited information available means that providing appropriate training for Controllers is problematic. In addition to the structured training courses that are available, it is considered that other opportunities such as event experience need to be identified to give Controllers a range of experience.

The added complexity of managing emergencies in large metropolitan areas means that consideration should be given to providing more specific training for Group Controllers in large population areas.

Regular interaction of Local and Group Controllers is an important element of their training and development. By way of example, some CDEM Groups conduct regular workshops for their controllers, and annual meetings to maintain and develop their operational understanding. It is not apparent that this level of regular interaction is systematically occurring in all CDEM Groups.

Recommendation 9:

All CDEM Groups and MCDEM should proactively identify opportunities (in addition to training) for the development of operational understanding of Controllers at Group and national levels as part of their ongoing professional development.

The Role and Future Form of Exercises at Group and National Level

The cost of this exercise in terms of both direct costs and commitment of time by participating organisations was considerable. The scale of this commitment wasn't apparent at the commencement of planning for this exercise however. Future national exercises of this scale will require earlier highlighting in the National Exercise Programme and more specific budget planning well in advance – preferably to fit in with council and other agencies' budget cycles.

It is even more important that the opportunities for smaller-scale exercises targeted at testing and developing specific capabilities be identified. These can be either table-top exercises where a complex and/or multi-agency process is the focus, or operational deployment where one specific process is involved.

One priority area for future exercises to focus on is Information Management. This can be achieved through a series of mini-exercises – for example, getting Geographic Information Systems operators to test information generation and data flow between local EOCs and CDEM Group EOCs, and CDEM Group EOCs and the NCMC.

Another area of priority is the testing of media interaction with CDEM. An exercise to test this would need to involve a reasonable level of scale, potentially a full media Exercise Control team to put scenario 'colour' in, run media conferences etc.

Future exercises should also consider the need for a web-based exercise management infrastructure, especially where there are a large number of participants. An exercise website can, at very least, provide a valuable central repository of information and documentation. Greater interactive functionality would also allow for management of participant contact details, and even inject delivery.

Recommendation 10:

MCDEM should ensure that the scope, budget and resource requirements of Tier 3 and 4 exercises proposed in the National Exercise Programme are defined, discussed with and understood by all participating CDEM Groups well in advance of the exercise.

The Role and Future Form of Plans and Documentation

Evaluators at the Auckland CDEM Group EOC and at other operations centres noted that there was very little use of key strategy and contingency plan documents in the context of evacuation decision-making. The limited use of guiding documents has been noted in previous exercises and event responses.

Some agencies noted that this may be deliberate – i.e. that documents did not need to be referred to because readiness was good, and that staff were familiar with arrangements. However it may also be because plans being produced are not suitable for use in response, and the form and content of operational plans need to be reviewed.

It has also been observed that plans are typically not circulated as widely or effectively as people think, and that integration with other agencies' plans is often not worked on or achieved. One of the consequences is that people typically don't understand where they fit into a plan, particularly if they haven't had a significant input into its development.

There is a wider need to operationalise plans and make them more consistent nationally.

Recommendation 11:

MCDEM should lead the development of a guide for operational planning and the structuring of documentation for use in response.

8.3 The Challenges of Mass Evacuation Operations

The exercise scenario provided a very good focus for the development of a mass evacuation plan, given that there was nothing already available at Group or national level. An interagency planning team led by the Auckland CDEM Group and including Police, welfare, transport, and public information input produced a conceptual plan which took into account the lack of a definite location for the eruption. This was an excellent step forward, and the work completed has provided a good foundation. However, putting the concept into effect as an operational plan requires further detailed work and multi-agency co-operation.

The mechanics of the evacuation (i.e. how certain parts of the operation such as cordon and clear would be undertaken) would benefit from further table-topping. A number of assumptions were made around evacuation that need further testing. Some form of a structured model would be valuable given the complexity and multi-dimensional nature of the issue.

A great deal depends on co-ordinated messaging through PIM. Earlier co-ordination between evacuating region and receiving regions by the NCMC is required, including development of more robust plans by other Groups to receive evacuees. Other issues requiring further attention include greater use of in-region welfare and venues and the sustainability of welfare reception centres in regions receiving evacuees. The co-ordination mechanisms between CDEM Groups receiving evacuees and the NCMC need further development.

The registration process for mass evacuation requires further clarification and development. Several participants commented that the current registration forms simply wouldn't have worked in the context of this or similar scenarios. There are still several different registration forms in use around the country, meaning data entry may not be consistent nationally. Furthermore, there is a need for consideration of multiple points of information entry (e.g. in person, online, by phone).

The wider community implications of closing schools, as well as the mechanisms involved in their closure and re-opening, needs to be taken into consideration in the development of operational plans for evacuation and return. Decisions such as this, with far-reaching implications for other sectors, need to be communicated to all levels (local, Group and national).

Many community, primary, and other health and disability provider facilities are privately owned and operated. The responsibility for these facilities rests with the provider and local CDEM (in line with any other business). Whilst individual facilities should, and often do, have evacuation procedures, these are obviously challenged when significant large-scale evacuation is also taking place. There are responsibilities on both sides that need to be more clearly defined: local authorities should be aware that they are responsible for assisting these facilities with evacuation; DHBs are responsible for providing for any ongoing health needs of the evacuated population. All of CDEM should work together to ensure the needs of vulnerable populations are provided for.

The health sector further considers that the provision of primary care to a large evacuated population as well as the provision of acute care cover is a particular problem that requires greater consideration by health agencies and their CDEM partners, at both national and local levels.

Planning for the evacuation of entire health facilities such as hospitals has been recognised as a capability gap, and work at local, regional and national level on the long-term/permanent evacuation of patients, staff and facilities is being developed.

Recommendation 12:

12.1 The Auckland CDEM Group, supported by MCDEM, and with input from the Waikato, Northland and Bay of Plenty CDEM Groups, should jointly develop a mass evacuation plan for the Auckland region, integrating evacuation, emergency welfare and health functions.

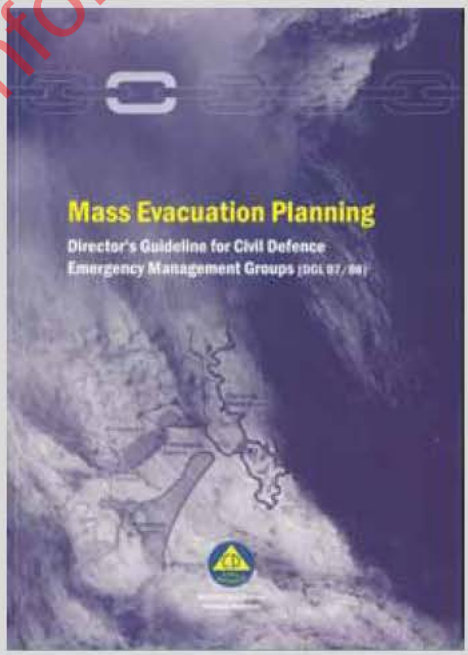
12.2 MCDEM should work with welfare agencies and the New Zealand Red Cross to review the current arrangements for registration, and develop a standardised national system that meets the needs of users.

12.3 The Ministry of Education and schools should routinely notify relevant CDEM agencies on decisions to remain open, close or re-open during emergencies.

Recommendation 13:

The Ministry of Health should co-ordinate the work of DHBs to plan for both the short and long term provision of health care to mass-evacuated people.

Note: Since Exercise Ruaumoko, MCDEM has published the Director's Guideline [07/08] 'Mass Evacuation Planning' that may assist with many of the issues regarding evacuation in this report. This guideline is available on the MCDEM website: www.mcdem.govt.nz



8.4 Understanding Volcanic Hazard and Communicating Science Advice

There was universal agreement that the science advice function was effective and valuable. The exercise has demonstrated that national volcanic science capability can be successfully mobilised. The key issues in terms of future work priorities are:

Risk Perception

There was a wide range of risk perception displayed in this exercise, from both the public (community focus groups or online survey), and from responding agencies and decision makers. Much of this variation resulted from a relatively low knowledge of the hazard, and by assumptions made about the nature of impacts resulting from it. The online survey results

suggest widespread and early self evacuation of communities in the event of unrest in the volcanic field, even from areas that are well outside of the Auckland Volcanic Field area. The focus groups provided further insight into community hazard knowledge, showing people tended to translate what they knew about other volcanoes in New Zealand (e.g. Ruapehu, Taupo), or indeed overseas examples, to the Auckland context, when in reality Auckland volcanoes are much smaller, have different styles of activity, and different impacts. They also took what they knew about earthquakes and translated those to volcanoes, in both cases vastly increasing the perceived risk associated with Auckland volcanoes.

This was seen, too, in the actions of some responding agencies. While a cautionary approach is certainly appropriate where population centres are concerned, the scale of responses indicates that the severity of the hazard was perceived quite differently amongst players.

A common understanding of the hazard and its consequences is important for synchronised and appropriately-scaled emergency management planning and response. It is also important for communities and individuals to understand the hazards and risks around them, and for them to take appropriate preparedness and response activities when needed.

Improved hazard awareness notwithstanding, it is important to take human behaviour into response planning, since communities' response to an event of this nature may be emotional and reactive, rather than rational and according to science.

Exercise Ruaumoko did an excellent job in raising awareness and knowledge about Auckland volcanoes – amongst response agencies and the public – but there is still more to do, and hazard education needs to be a continuous process. For example, 64% of respondents in the online survey (2050 responses) said they didn't feel they had enough information about the risk of volcanic eruptions in Auckland.

Degree of Scientific Uncertainty

The level of uncertainty through the exercise (particularly in the early stages), regarding the probability of an eruption, its eventual location, and potential nature and intensity of an eruption, created a very challenging environment for response planning. An improved understanding of the Auckland Volcanic Field hazard, the precursor monitoring signals associated with magma ascent beneath Auckland, and the likelihood and location of any eruption would greatly assist with response planning.

Operationalising the Science Response

This exercise brought a new level of formality and structure to arrangements for the provision of science advice. Arrangements established for the exercise were generally effective, although there are some key lessons. Firstly, there is a need for further analysis and/or translation of primary science information to limit misinterpretation and to ensure it meets the needs of all organisations. Secondly, there is a need to review local and national requirements for science advice (in planning and response periods), and look at processes for achieving better co-ordination and synchronisation, while also meeting individual agency requirements.

Recommendation 14:

MCDEM should lead work with CDEM Groups and science agencies to:

14.1 Consider options for integrating local and national science capabilities and processes

14.2 Facilitate collaborative planning by science agencies, including universities, for post-event science investigations

CDEM and science agencies should:

14.3 Champion collaborative public-good research to enhance the scientific understanding of the Auckland volcanic system, in particular its precursor and eruptive behaviours

14.4 Support on-going volcanic hazard education about the extent, size and nature of hazards and impacts.

8.5 Arrangements for the Assessment and Management of Economic Impacts

An assessment of the likely economic impact of a major emergency in Auckland was completed during the initial exercise phase. It suggested severe impact on both the Auckland and national economies. The exercise was not designed to play out the economic scenarios, but the study emphasises the need for an all-of-government and an all-of-nation approach as well as for co-ordination and co-operation in every aspect of planning and response. The economic analysis also suggested some key themes that should be taken into account when planning recovery strategies.

Other economic flow-on effects could usefully be explored such as retailers wanting to re-open but employees not being able to return to work, and the wider effect on business of schools still being closed.

Given that this study had just been undertaken, the process for managing the active assessment of economic impacts during the response (i.e. from the beginning of March) was not operated as an exercise activity. Treasury felt that their focus during the exercise on micro-economic impacts (e.g. outage of the Marsden Point refinery) was appropriate, and that a wider report would have been called for immediately following the eruption. The broader question of which agencies would be involved in this process and who would lead the process still requires clarification, along with how this would be linked with Auckland aspects.

Recommendation 15:

The financial and economic agencies (mainly Treasury, Reserve Bank and the Ministry of Economic Development) will ensure their processes are co-ordinated to provide advice on financial and economic impacts of an emergency to the NCMC, ODESC, ministers and other stakeholders as necessary.

8.6 The Vulnerability of Critical Infrastructure: Understanding the Implications and Taking Action

The exercise highlighted again how vulnerable the Auckland region is to disruptions of lifeline utilities, particularly the isthmus and parts north. Utilities in this area include the main electricity supply to Auckland and Northland, the New Zealand Refining Company at Marsden Point, the

fuel pipeline from the refinery, gas, water supply and waste-water treatment, arterial transport routes and the airport. The interruption of electricity and gas supply up to the northern and western parts of Auckland region and Northland and fuel down to Wiri would have significant implications. The exercise highlighted that these utilities have little or no redundancy and few work-arounds or alternatives and many inter-dependencies. The exercise also suggested that the consequences to the community of the failure of infrastructure are not well enough appreciated at any level – by other providers, by CDEM agencies, by businesses or by communities themselves.

There is therefore scope for a significant increase in effort in planning for generating greater resilience in these utilities, including arrangements for managing a disruption.

This exercise has highlighted the following three aspects involved in achieving greater utility resilience:

(i) lifeline utility asset owners and operators actively identifying and implementing physical mitigation actions;

(ii) CDEM and the lifeline utility sector establishing effective lifeline utility co-ordination arrangements at regional and national levels for responding to a threat or an event; and

(iii) promotion of effective business continuity to key users, including realistic expectations of levels of service in regional scale emergencies.

The size of the Auckland Volcanic Field and range of possibilities associated with volcanic hazard make it very challenging for lifeline utilities (or any organisation) to plan and justify mitigation measures for particular sites.

As the first step in developing a strategy to address this vulnerability, lifeline utilities impacted by this scenario should be asked about the degree to which current and planned mitigation measures would have reduced the impact to this or other volcanic scenarios.

Engineering Lifelines activities are essentially regionally based, with one form of output being the identification of regional 'hot spots' or critical areas. There is however no corresponding process at a national level aimed at using this information to identify the significant national vulnerabilities and issues across all hazards. Electricity generation contingency for Northland (generally, not volcanic scenario specific) is a specific aspect that requires further consideration from a national perspective.

The very effective regional co-ordination of lifeline utilities at the Auckland Group EOC during this exercise has highlighted the importance of this function, and the need for other Group EOCs and the NCMC to place greater emphasis on this aspect. Lifeline utility co-ordinators at Group and national level need to be identified, resourced and trained. NCMC Standard Operating Procedures need to be made more consistent with lifeline utility co-ordination arrangements at Group level. The process by which lifeline utility status information and planning activities are co-ordinated at national level during a response as developed during the preparation for this exercise needs to be incorporated in the revised version of Section 10 of the Guide to the National CDEM Plan.

This exercise has again highlighted the 'just-in-time' nature of fuel supply, along with the lack of national fuel sector co-ordination mechanisms. The progression of the national fuel contingency plan by MCDEM therefore remains a priority activity.

The participating commercial banks suggest that an inter-bank liaison point be established in association with the Reserve Bank for extreme situations, so that industry responses can be released in a structured manner. It has also been suggested by banks following this exercise that banks and their key service providers should be noted as essential services, given the criticality of supplying cash to the community and the vulnerability of the ATM and EFTPOS system to loss of either or both of power and telecommunications. Banks should be given access to CDEM-related planning and response information (e.g. situation reports in an event) and be given priority access to key resources (e.g. fuel). Consideration also needs to be given to including the Fast Moving Consumer Goods (i.e. food and grocery products) sector in this category. It will however need to be recognised that operational co-ordination of these sectors cannot necessarily be achieved through the current regional CDEM Group lifeline utility co-ordination arrangements.

The Infrastructure Resilience programme currently being developed by the Department of Prime Minister and Cabinet is seen as being vital to provide national leadership across the large and diverse infrastructure sector. The wider definition of 'infrastructure' being adopted by this programme is consistent with the feedback in the paragraph above. This programme is seen as being the focal point for promoting discussion around the infrastructure issues and vulnerabilities that are of national significance, and how to achieve a better balance between individual agency risk perceptions and mitigation intentions and national interests.

The report by the Economy Workgroup identified that the disruption to lifeline utilities would provide the single biggest constraint for the recovery of business. It is considered that the impacts can be reduced by the adoption of a more aggressive approach to risk management planning and processes by businesses themselves, including the development of business continuity plans.

Government agencies should also review their crisis management/business continuity plans to ensure that the processes and activities they need to undertake for major emergencies outside of Wellington are adequately covered.

Recommendation 16:

The Auckland CDEM Group should ask all lifeline utilities impacted by this scenario to report on the degree to which current and planned mitigation measures would have reduced the impact from this or other volcanic scenarios.

Recommendation 17:

The Ministry of Economic Development should promote the Infrastructure Resilience programme and, in conjunction with MCDEM and the Ministry of Transport, lead work across government agencies to establish a process for identifying and addressing lifeline utility vulnerabilities that are of national significance.

9. Concluding Observations

Exercise Ruaumoko was a valuable learning experience for all concerned. It illustrated the criticality of Auckland to the New Zealand economy, and also the vulnerability of key elements of its infrastructure. The issues associated with a large-scale event in Auckland requiring significant support from neighbouring regions which are orders of magnitude smaller in capacity were also demonstrated.

Planning was made challenging but realistic due to the complex exercise scenario and associated uncertainty. Much of the response planning was devolved to, and undertaken by the Auckland CDEM Group. While the planning conducted was of a high standard, the process showed the need for the lead to communicate vertically and horizontally with other organisations to ensure that assumptions, sequencing and co-ordinating factors are understood and worked through by all. It is assessed that the planning completed would have needed considerable further development and testing before it could have been used for an operation.

The public awareness of the volcanic risk in Auckland was increased at both agency and community levels. The exercise has emphasised again the vulnerability of, and community and business dependence on, the many lifeline utilities located on the Auckland isthmus. Now there is a need to understand how well this is being retained, and what the CDEM sector should do to maintain this level of awareness.

The exercise provided an insight into the required levels of preparedness to manage a large-scale emergency in the Auckland region. In particular, the preparations for the exercise provided an excellent start to understanding mass evacuation issues in a New Zealand urban context. Taking these concepts and making them into an effective operational plan however will require more work on specific aspects.

The exercise provided another powerful indication of the value of understanding the hazards and risks faced by communities, the value of undertaking preparation, and the critical importance of completing detailed and co-ordinated planning and preparation in advance of an emergency.

The process by which scientific advice was made available to emergency planners at local, regional and national levels was very effectively tested by the exercise. The process worked well and will now be refined to provide better co-ordination of the content of the advice to ensure there is only one "trusted source" and to ensure ODESC and DES have access to scientific advice first hand.

The national sector or cluster co-ordinating work is bearing fruit; the Welfare and Transport clusters are benefiting from the cumulative effect of previous exercises and the pre-exercise activities for this exercise.

The Health sector noted that this exercise was extremely useful in allowing the sector to realign on an all-hazards basis following the quantum change in capability driven by pandemic planning.

The NCMC performed well overall, with the efforts and outputs being generally viewed as a significant improvement on Exercise Capital Quake. The NCMC as a facility has shown the benefit of implementation of process improvements identified from exercises and event responses over the past three years.

The Auckland CDEM Group has also made significant progress in terms of operational preparedness through the various exercises and work of the Group Emergency Management Office over the past three years. It must be recognised that the Auckland, Northland, Waikato and Bay of Plenty Group EOCs were each experiencing their first major exercise on a scenario of this scale. Moreover, many of the individuals working in the regional Group EOCs and some at national level were having their first operational involvement, and this exercise provided very good experience. All of those involved have achieved a much better understanding of event impacts across a wide range of organisations, and of how CDEM operations work.

The understanding and performance of the ***individual elements*** within a major CDEM operation has typically improved significantly through previous events, exercises and the preparation for Exercise Ruaumoko. The ability to ***co-ordinate the various elements into a cohesive response*** however requires considerable further work. The process of conveying the required ***messages and actions*** to the community also requires a more focused approach, with greater emphasis on the visibility of leadership.

Exercise Ruaumoko is considered to have met its objectives. There were major achievements in the preparatory phase that simply wouldn't have occurred without the context of the exercise. In some respects the exercise scenario took CDEM into new territory as it called for planning and preparedness rather than response, and planning in uncertain conditions and across many new and varied aspects. It successfully tested extant all-of-nation arrangements for responding to an emergency by practicing the roles, responsibilities and procedures that are included in the National CDEM Plan. It enabled staff at the key levels to practice and develop planning and the management of response activities using the connections and procedures that are in place. It again highlighted the need for detailed co-ordination and co-operation to take place.

The huge commitment of organisations and the individual leadership of key people within organisations to assist with the delivery of the exercise is particularly acknowledged.

10. Summary of Recommendations

Recommendation 1:	***MCDEM**, in collaboration with CDEM Groups and member authorities, should prepare guidance to define the roles of Mayors and Group Chairs, to enable them to be fully aware of CDEM response arrangements and to assist them to be prepared for their roles as key spokespersons.*
Recommendation 2:	***MCDEM** should lead work to define templates for strategic-level Action Plans to be prepared by the National Crisis Management Centre, key operational cluster groups (e.g. the National Welfare Recovery Co-ordination Group and the Transport Response Team) and CDEM Group Emergency Operations Centres.*
Recommendation 3:	*A CDEM Emergency Management Information System is required and should be progressed with urgency by **MCDEM**.*
Recommendation 4:	***MCDEM** should evaluate whether the National Crisis Management Centre modes of operation as defined in the National CDEM Plan adequately provide for the range of event circumstances.*
Recommendation 5:	***MCDEM** and **Ministry of Economic Development** should clarify the lifeline co-ordination process and arrangements at national level.*
Recommendation 6:	***MCDEM** should lead work involving CDEM Groups to:* *6.1 Define and document the co-ordination mechanisms for the vertical integration of public information messaging, and how media information requests should be responded to.* *6.2 Prepare templates for public information at local, Group and national levels, and identify which parts of the general messaging should be pre-prepared.*
Recommendation 7:	*7.1 **All CDEM Groups** should establish training programmes and acquire training resources for their Group and local Emergency Operations Centres to ensure that capacity is built over time, the interest and commitment of existing personnel is maintained, new staff are inspired to join, and that inter-operability between CDEM Groups is achieved, in line with section 17 (1) (b) of the CDEM Act.* *7.2 Selection for key roles in Emergency Operations Centres should be on the basis of skills and experience rather than agency and business-as-usual position.*
Recommendation 8:	***MCDEM** should prepare a discussion paper outlining how to use staff from other agencies to supplement National Crisis Management Centre staff in an emergency.*
Recommendation 9:	***All CDEM Groups** and **MCDEM** should proactively identify opportunities (in addition to training) for the development of operational understanding of Controllers at Group and national levels as part of their ongoing professional development.*
Recommendation 10:	***MCDEM** should ensure that the scope, budget and resource requirements of Tier 3 and 4 exercises proposed in the National Exercise Programme are defined, discussed with and understood by all participating CDEM Groups well in advance of the exercise.*

Recommendation 11:	***MCDEM** should lead the development of a guide for operational planning and the structuring of documentation for use in Emergency Operations Centres.*
Recommendation 12:	*12.1 The **Auckland CDEM Group**, supported by **MCDEM**, and with input from the **Waikato, Northland and Bay of Plenty CDEM Groups**, should jointly develop a mass evacuation plan for the Auckland region, integrating evacuation, emergency welfare and health functions.* *12.2 **MCDEM** should work with **welfare agencies** and the **New Zealand Red Cross** to review the current arrangements for registration, and develop a standardised national system that meets the needs of users.* *12.3 The **Ministry of Education** and schools should routinely notify relevant CDEM agencies on decisions to remain open, close or re-open during emergencies.*
Recommendation 13:	*The **Ministry of Health** should co-ordinate the work of District Health Boards to plan for both the short and long term provision of health care to mass-evacuated people.*
Recommendation 14:	***MCDEM** should lead work with **CDEM Groups** and **science agencies** to:* *14.1 Consider options for integrating local and national science capabilities and processes* *14.2 Facilitate collaborative planning by science agencies, including universities, for post-event science investigations* ***CDEM** and **science agencies** should:* *14.3 Champion collaborative public-good research to enhance the scientific understanding of the Auckland volcanic system, in particular its precursor and eruptive behaviours* *14.4 Support on-going volcanic hazard education about the extent, size and nature of hazards and impacts.*
Recommendation 15:	*The financial and economic agencies (mainly **Treasury**, **Reserve Bank** and the **Ministry of Economic Development**) will ensure their processes are co-ordinated to provide advice on financial and economic impacts of an emergency to the National Crisis Management Centre, ODESC, ministers and other stakeholders as necessary.*
Recommendation 16:	*The **Auckland CDEM Group** should ask all lifeline utilities impacted by this scenario to report on the degree to which current and planned mitigation measures would have reduced the impact from this or other volcanic scenarios.*
Recommendation 17:	*The **Ministry of Economic Development** should promote the Infrastructure Resilience programme and, in conjunction with **MCDEM** and the **Ministry of Transport**, lead work across government agencies to establish a process for identifying and addressing lifeline utility vulnerabilities that are of national significance.*

Appendix 1: Exercise Development Timeline and Event Log

Exercise Development Timeline and Event Log

Ref	Event	Date
1	*Exercise Working Group Meeting 1*	8/12/2006
2	*Exercise Working Group Meeting 2*	16/02/2007
3	*Exercise Working Group Meeting 3*	16/03/2007
4	*Exercise Working Group Meeting 4*	21/05/2007
5	*Exercise Working Group Meeting 5*	15/06/2007
6	**First Participant Briefing, Auckland**	11/07/2007
7	**First Participant Briefing, Wellington**	12/07/2007
8	*Exercise Working Group Meeting 6*	20/07/2007
9	Briefing of Northland CDEM Group CEG	07/08/2007
10	Briefing of Waikato CDEM Group CEG	13/08/2007
11	**Second Participant Briefing, Auckland**	14/08/2007
12	*Exercise Working Group Meeting 7*	17/08/2007
13	*Exercise Working Group Meeting 8*	19/09/2007
14	Economy workstream meeting	19/09/2007
15	Community workstream meeting	19/09/2007
16	Briefing of Bay of Plenty CDEM Group CEG	27/09/2007
17	**Second Participant Briefing, Wellington**	28/09/2007
18	Exercise Co-ordinating Instruction v1 issued	31/08/2007
19	Economy workstream meeting	18/10/2007
20	*Exercise Working Group Meeting 9*	18/10/2007
21	ACDEMG Evacuation Plan v1 Issued	19/10/2007
22	Exercise Co-ordinating Instruction v2 issued	1/11/2007
23	GNS Science issue Science Alert Bulletin AK-07/01	6/11/2007
24	AVSAG Meeting	7/11/2007
25	*Exercise Working Group Meeting 10*	8/11/2007
26	Briefing of Auckland Group Controller	8/11/2007
27	Briefing of Auckland Operational Response Group	8/11/2007
28	Briefing of wider Auckland CDEM Group participants	13/11/2007
29	ODESC Meeting	14/11/2007
30	GNS Science reduce Science Alert Level as no further activity	16/11/2007
31	Auckland Lifelines planning meeting: included DHB operational/facilities managers and Emergency Management planners	27/11/2007
32	Auckland health workshop: large workshop with all DHB and health agencies represented	29/11/2007
33	Auckland CDEM Group evacuation planning workshops	30/11/2007
34	Transport Emergency Management Co-ordination Group workshop	3/12/2007
35	*Exercise Working Group Meeting 11*	5/12/2007
36	Economic workstream meeting	5/12/2007
37	ACDEMG Evacuation Plan v2 Issued	15/01/2008
38	*Exercise Working Group Meeting 12*	16/01/2008
39	Leadership Theme Meeting	16/01/2008
40	Exercise Control Arrangements & Rules of Play issued	31/01/2008
41	Exercise Evaluation Guidelines & Forms issued	31/01/2008
42	ACDEMG Exercise Ruaumoko Media & Communications Plan update issued	31/01/2008
43	*Exercise Working Group Meeting 13*	5/02/2008
44	Public Information Managers Briefing for Exercise Ruaumoko where communications processes and ACDEMG Exercise Ruaumoko Media & Communications Plan agreed	5/02/2008
45	Leadership Theme Meeting	5/02/2008
46	Northland Lifelines Group workshop and updated reporting protocol and communications details prior to exercise	5/02/2008
47	Economy Report First Draft Issued	10/02/2008
48	Auckland Group Physical Evacuation Plan issued in Draft	11/02/2008
49	New Zealand Herald "City of Fire - the volcanoes that made Auckland" supplement 1 of 3	12/02/2008

50	ACDEMG Exercise Ruaumoko Media & Communications Plan Issued as Final	13/02/2008
51	Auckland Group Controllers Briefing	13/02/2008
52	New Zealand Herald "City of Fire - the volcanoes that made Auckland" supplement 2 of 3	13/02/2008
53	New Zealand Herald "City of Fire - the volcanoes that made Auckland" supplement 3 of 3	14/02/2008
54	Auckland Group Evacuation Welfare Plan issued in Draft	18/02/2008
55	ACDEMG Evacuation Plan v3 Issued	19/02/2008
56	Bay of Plenty CDEM Group meeting with National Controller	21/02/2008
57	Group Welfare Plan issued in Draft - Group Welfare Manager	21/02/2008
58	Auckland Controllers briefing	22/02/2008
59	Economy Report Final Draft Issued	25/02/2008
61	Media Briefing, Auckland	26/02/2008
62	*Exercise Working Group Meeting 14*	28/02/2008
63	Group Physical Evacuation Plan v2 issued	28/02/2008
64	**Final Participant Briefing, Auckland**	28/02/2008
65	**Final Participant Briefing, Wellington**	29/02/2008
66	Earthquakes recommence, all small and unfelt this week	3/03/2008
67	Science Alert Level raised to Level 1	3/03/2008
68	Scheduled Auckland Operational Response Group Meeting	5/03/2008
69	Science Alert Level raised to Level 2	8/03/2008
70	First FELT earthquakes	9/03/2008
71	Online Survey goes live at www.aucklandvolcano.govt.nz	10/03/2008
72	Activation of the National Crisis Management Centre	10/03/2008
73	Scheduled Auckland Operational Response Group Meeting	10/03/2008
74	Community Focus Group 1 run by Phoenix Research	10/03/2008
75	Manukau City EOC declared a state of local emergency	11/03/2008
76	Scheduled Auckland Operational Response Group Meeting	11/03/2008
77	Group Physical Evacuation Plan v3 issued	12/03/2008
78	Auckland City EOC declared a state of local emergency	12/03/2008
79	Scheduled Auckland Operational Response Group Meeting	12/03/2008
80	Auckland CDEM Group declared a state of local emergency	12/03/2008
81	Science Alert Level raised to Level 3	12/03/2008
82	**Main Exercise Day 1**	13/03/2008
83	Community Focus Group 2 run by Phoenix Research	13/03/2008
84	Rotorua Local EOC declared a state of local emergency	13/03/2008
85	Evacuation order made 1000 hrs, effective from 12 noon	13/03/2008
86	MCDEM issues a National Advisory: Volcanic Activity: Potential Threat to NZ	13/04/2008
87	The Western Bay / Tauranga Local EOC declared a state of local emergency	13/03/2008
88	The Waikato CDEM Group declared a state of local emergency	13/03/2008
89	Exercise activation of Northland Group and Local EOCs at Whangarei, Kaipara and Far North District Councils	13/03/2008
90	**Main Exercise Day 2**	14/03/2008
91	Canterbury Group Emergency Management Team meeting	14/03/2008
92	MCDEM issues a National Warning: Tsunami: Threat to NZ	14/03/2008
93	Ground cracking and brown clouds evidenced in Mangere inlet	14/03/2008
94	Steam observed at Mangere inlet	14/03/2008
95	MCDEM issues a National Warning: Volcanic Activity	14/03/2008
96	Eruption observed at Mangere inlet	14/03/2008
97	Science Alert Level raised to Level 4	14/03/2008
98	**End of exercise (1600)**	
99	Community Focus Group 3 run by Phoenix Research	17/03/2008
100	Agency cold debriefs held	17/3–4/4/08
101	*Exercise Working Group Meeting 15*	6/05/2008
102	Wellington Exercise Review Workshop	7/05/2008

Appendix 2: Exercise Activities March 2008

Overview of the Main Exercise Phase (3-14th March 2008)

	Scientific Scenario	Auckland CDEMG	Auckland Agencies	Neighbouring CDEMGs	NCMC	Govt Agencies
Week of 3rd to 7th March	Unfelt earthquakes	Operational Response Group/ Controllers' briefing			Duty Officer only	Watch Group meeting
Monday 10th	Felt tremors	AVSAG teleconference Operational Response Group/ Controllers' briefing			**Mode 1** Daily sitrep	Watch Group meeting
Tuesday 11th	Slow down of activity	AVSAG teleconference Operational Response Group/ Controllers' briefing			**Mode 1** Daily sitrep	ODESC meeting
Wednesday 12th	Felt tremors resume	AVSAG meeting			**Mode 1**	
	General vent area broadly established (late in day)	GEOC partial activation (pm) Preparing notifications and key messages Initiate preparations for Decision to Evacuate	Receiving notifications and key messages	Activate GEOCs Receiving notifications and key messages Activating plans to receive evacuees	**Mode 2/3** Daily sitrep	Receiving notifications and key messages Watch Group meeting
Thursday 13th	Strongly felt earthquakes; vent location refined	Making Decision to Evacuate Implementing Evacuation strategy Arrangements for continuing essential services Declarations (if not earlier)			**Mode 3/4** Supporting CDEM Group assistance requests; ODESC/DES Meetings; All of Govt CDEM Comms	
Friday 14th	Continuous volcanic tremors leading to …	Continuing with Evac Plan implementation Arrangements for continuing essential services			**Mode 3/4** Supporting CDEM Group assistance requests; ODESC/DES Meetings; All of Govt CDEM Comms	

Appendix 3: Development of the Scientific Scenario: A Summary of What is Known About Precursor Activity in the Auckland Volcanic Field

Development of the Scientific Scenario: A Summary of What is Known About Precursor Activity in the Auckland Volcanic Field

Steve Sherburn
GNS Science

The Basic Idea

The idea behind the scenario was that basaltic magma rose rapidly from the mantle (from a depth of about 100 km). As it did so it produced seismicity along the way. As it got within 5 – 10 km of the surface, other phenomena (degassing and ground uplift) were observed, ultimately producing an eruption. The key aspect of the scenario was the rapid rise of the magma, a phenomena thought to be characteristic of Auckland eruptions.

Kinds of Precursors

Precursors mainly took the form of seismic activity. This is partly because we know more about seismic precursors to AVF-like eruptions than any other kind of precursor, and partly because a seismic network is the only established, real-time monitoring system in the AVF.

There were four types of seismic precursors:

1. **Deep long-period (DLP) earthquakes**. These earthquakes are similar in appearance to the more common shallow long-period volcanic earthquakes seen at volcanoes such as Ruapehu, Ngauruhoe, and White Island, but, as their name suggests, are significantly deeper. The have been recorded in many volcanic areas in the world, though not beneath the AVF. Only one example is known from New Zealand. Worldwide they occur at depths ranging from the mid-lower crust to the mantle, that is, anywhere from about 15- 50 km deep, but at individual volcanoes often occur in a very restricted depth range. In some cases these DLP earthquakes have been seen as precursors to, or consequences of, eruptions but in many cases they form part of the background activity. Worldwide, the largest examples of these earthquakes are less than magnitude 2.5, hence are rarely felt given their significant depth. The mechanism that produces these earthquakes is not well understood. In some cases there has been a measured increase in surface CO_2 discharge after these earthquakes, and for this exercise I have taken them to indicate CO_2 degassing.

2. **Volcano-tectonic (VT) earthquakes.** These represent normal faulting earthquakes, but at or close to a volcano. In a volcanic environment they do not directly reflect the presence of magma, but are a by-product it. They can result from stress adjustment required as magma intrudes into the shallow crust, an increase in temperature as magma intrudes into crustal rocks that are several hundred degrees cooler, and the effect of exsolved magmatic fluids on fault friction (and probably a number of other processes). For this reason they do not always "track the magma" and indicate exactly where an eruption will occur. Often significant VT activity may occur several kilometres from the subsequent eruption site, or at least the seismic volume will be several times larger than the true magmatic volume. As they represent brittle failure or rocks (faulting) VT earthquakes largely occur above the brittle-ductile transition zone, the depth below which rocks deform by creep. This depth is a function of several parameters, the values of most of which are poorly known or not known at all. Experience suggests that in the AVF this depth may be about 15 km, that is, most VT earthquakes will occur above 15 km. VT earthquakes can be felt. In analogue eruptions examples up to magnitude 5.5 have been reported, certain magnitude 4 and larger. Such earthquakes would be wider felt over the Auckland urban area. If DLP earthquakes occur around 40 km depth (as in the scenario) and significant VT earthquake activity begins around 15 km deep, there is a depth range in which there is limited seismic activity, in which the scientists have little indication of where the magma may be.

3. **Shallow volcanic earthquakes.** These are a common occurrence at volcanoes worldwide and commonly represent a number of processes associated with magma, its movement, degassing, and eruption. While the exact mechanism isn't important, they are shallow (top 2-3 km?) phenomena. In this scenario they are taken to occur once magma begins to interact with ground water (significantly deeper than the know groundwater tables at a few hundred metres depth). In like the AVF scenario with magma ascent, the occurrence of shallow volcanic earthquakes is a sign that magma has reached within a few kilometres of the surface. While this doesn't mean an eruption is guaranteed, it probably means it is very likely.

4. **Volcanic tremor.** This is a continuous or semi-continuous ground shaking. In the AVF scenario this represents a more vigorous magma-groundwater interaction than depicted by the shallow volcanic earthquakes. It is the final precursor to the eruption, and might be expected to build in intensity towards as the eruption approaches. It will also jump in intensity as the eruption begins.

Non-seismic precursors were not written into the original scenario as there are no permanent monitoring programmes for these phenomena in the AVF, but they formed part of the monitoring plan devised by scientists and had to be included at the last minute.

Soil gas measurements attempt to measure the amount of magmatic gases, primarily CO_2 coming through the soil. Such measurements are performed regularly at White Island and have recently been made at Ngauruhoe. In the AVF scenario the idea was that the highest concentrations of CO_2 would show where the magma was most likely to erupt. However, this can be affected by the presence of "easy paths" to the surface, such as fault lines which might confuse the data pattern. Soil CO_2 is probably not seen it magma is deeper than 5 – 10 km, so does not give a long-term indication of eruption location if the magma ascends quickly.

The other potential precursor was ground deformation. Modelling shows that 0.1 km^3 of magma (typical of medium-sized AVF eruptions) might produce measurable ground movement from about 5 km deep, while 1 km^3 of magma may be able to be seen at about 20 km. As there is no permanent ground movement monitoring network one would have to be established quickly using existing benchmarks.

Ascent Rate

Seismicity precursors to historical analogue eruptions and dyke modelling give a wide range of possible ascent rates, from about 100 km depth. Most of these can be described as "a few days to a few weeks". The length of the build-up period to the eruption was constrained by plans for involvement of different participants, but still had to be scientifically realistic. An ascent rate of 4-5 km/day was chosen. A uniform rate was used, though there is no scientific evidence that it has to be uniform.

Precursory Activity

The precursory activity initially consisted of two parts, a period of minor unrest in November 2007 and then the main unrest and eruption in March 2008. The November 2007 was requested by the event organisers to focus attention of the upcoming exercise and to give participating organisations some impetus to get prepared for March 2008.

November 2007

1. The idea behind the November 2007 precursory activity was a deep failed intrusion, that is, an intrusion that started to ascend but "ran out of gas" on the way.
2. Blake et al. (2006) note that dykes with very low flow rates may cool and solidify without reaching the surface and this provided the scientific justification for this event.

3. The earthquakes would not be felt. They would therefore be unknown to the general public and responding agencies without being told by GNS. These earthquakes are typically M2.3 and smaller in reported overseas cases and the one known NZ case.
4. In overseas examples the earthquake epicenters are not always concentrated directly beneath the vent and often occur some distance, up to 15 km, from the vent. Based on this the earthquakes were centered some distance northeast of the ultimate eruption site.
5. The earthquakes were in the depth range 40–45 km. This is towards the deeper end of the range for this kind of earthquakes, but deeper overseas examples have been reported.

3rd – 10th March Activity

1. The exercise required that most of the precursory activity must occur in the 'main' week of the exercise. A very rapid ascent rate (two weeks or less, from 100 km depth) would mean that VT earthquakes (that probably don't occur in significant numbers below 15-20 km depth) would be crammed into the final 1-3 days of the exercise.
2. An ascent rate of four weeks or longer would push the early stage precursors well before the main exercise period. This would disrupt the exercise and require the AVSAG to be active for an inconvenient period of time.
3. A compromise is to have a three week ascent period (5 km/day ascent rate). This would put the deep long-period earthquake precursors approximately one week before the main exercise which is believed to be reasonable.
4. These precursors would initially appear as a re-run of the November unrest, but would occur in larger numbers and show some upward migration. It was hoped that this would convince the scientists that they represented something more than the failed intrusion of November 2007.

10th – 14th March Activity (main exercise week)

1. VT earthquakes began in very limited numbers the weekend before the exercise, but did not increase significantly until the Monday morning of the exercise as the magma get to 15 – 20 km depth.
2. Pre-eruption activity rarely increases continuously. A period of 'relative quiescence' was included during part of Tuesday and Wednesday to simulate this.
3. As VT earthquakes shallowed, driven indirectly by magma ascent, some larger events would occur. This would be felt widely around Auckland, in some cases strongly enough to cause minor damage. A maximum magnitude of 4 was assumed, and models were run to calculate the ground shaking in different parts of Auckland for different magnitude earthquakes at different depths.
4. It was hoped that an increase in VT earthquake activity would prompt widespread public reaction, and eventually an evacuation of the epicentral area. As discussed earlier, these earthquakes are the indirect result of magma ascent and do not necessarily provide a 1:1 guide to where the may erupt and when.
5. Volcanic earthquakes and tremor were programmed to occur as magma and gas from the magma begins to 'see' groundwater. This would occur in the ~12 hours before the eruption.
6. Given that they can 'see' magma only once it is less than 10 km deep, and possibly less than 5 km deep, soil degassing and ground movement results would only become apparent in the day to day and a half before the eruption. But given the difficulty of pinpointing the eruption location from VT and shallow volcanic seismicity, the data from these techniques would provide the key information to deciding when and where an eruption may take place.

Appendix 4: Summary of Likely Physical Impacts Following the Ruaumoko Eruption Scenario

Ruaumoko Post-Outbreak Scenario

Jan Lindsay
Auckland University

Background: Ruaumoko eruption onset

The Ruaumoko eruption began on the 14th March at 13:00 hrs after a two week period of precursory activity involving escalating seismicity, anomalous CO_2 emissions and ground deformation. The eruption commenced with steam emissions through the shallow waters of Mangere Inlet, less than 500 m offshore from Kiwi Esplanade. Small explosions throwing mostly lithic (non-magmatic) rock fragments ~ 100 m into the air in vertically directed dark plumes began less than an hour later.

Immediate impacts, first 5 hours

- Explosions rapidly increase in violence as magma reaching the surface is blasted apart due to interaction with the water in the harbour
- Some of the larger explosions send jets of ash and steam to > 1km above the surface and generate air shock waves that blow out windows in buildings within 2 km of the vent
- Outward directed components of the explosions send spear-headed plumes out to 600 m laterally from the vent, where they collapse to generate minor surges that reach land at Kiwi Esplanade and Onehunga Wharf
- A voluminous white and grey, vigorously convecting eruption column quickly rises to several km elevation above the vent, expanding to a steam and ash cloud drifting downwind and depositing fine ash; frequent lightening pulses within the eruption column and cloud cause some interference with communications
- Violent and rapid base surges of ash and steam spread outwards from the base of the eruption column, reaching 1 km from the vent in most directions; more violent surges from periodic collapse of the eruption column travel out to ~ 2 km radially from the vent
- Persistent showering of coarse ash and small scoria fragments over a roughly circular area approximately 2 km in radius from the vent; meter-sized ballistic clasts fall out to 1.5 km from the vent in all directions
- Rapid excavation of an explosion crater in the vent area and development around the vent of a rampart of ash and coarse scoria approximately 0.5 km in diameter
- Ash deposits are up to 50 cm and 0.5 cm thick, 1 and 10 km from the vent, respectively; fall out of wet ash and accretionary lapilli (small hardened balls of ash that fall like hailstones) downwind of the vent in places
- Continued seismic tremor interspersed with periodic felt VT earthquakes (largest M4.5); ground shaking causes damage to buildings in Mangere Bridge area
- Continued emission of CO_2 and other volcanic gases from the vent area; a SE wind blows the steam/gas plume to the NW at low elevations and strong gas smells are detected
- Waves resembling storm surge hit surrounding coastlines

Impacts, first 5 days

- During the first day discrete eruptions become increasingly frequent and associated eruption columns reach 8 km above the vent, spreading into an expanding eruption cloud at 10-12 km elevation
- Heavy tephra fall (> 64 mm thickness) occurring within 3 km of vent in all directions and downwind to 8 km (see Figure 1).

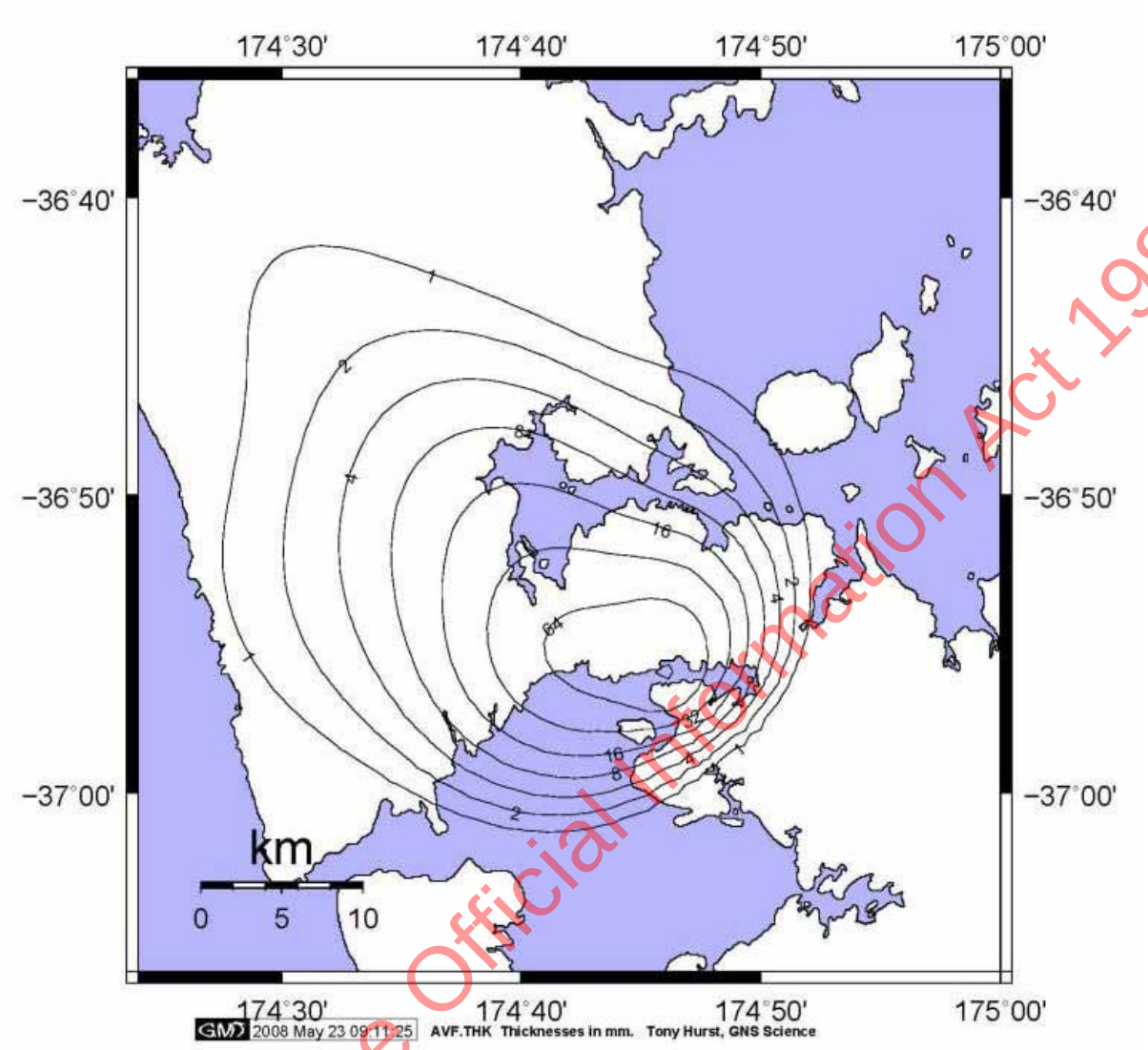


Figure 1 *Predicted ash fall thickness (in mm) after 5 days of the Ruaumoko eruption (model based on 0.001 km^3 of material erupted in the first 5 days, and an eruption column 3-8 km high). Courtesy Tony Hurst, GNS Science.*

- Development of a 0.5 – 0.7 km wide explosion crater and surrounding 50 m high tuff ring rampart of coarse ash and scoria isolates the magma from the surrounding shallow seawater
- Base surges affect areas within 2 km from the vent in all directions; and further in some cases
- Fire fountaining begins, sending blobs of magma 300 m into the air above the vent and producing localised spatter and scoria rampart (within a few hundred meters of vent)
- Continuous sub-plinian ash column produces cinder cone by fall-out, which reaches 70 m in height and several hundred meters in width by day 5
- The growing volcano encroaches on land, joining the promontory north of Kiwi Esplanade and Ngaio Ave (to the south) and Onehunga Wharf (to the north), effectively cutting off the Mangere inlet west of SH20 and Mangere bridge
- High water levels at each high tide erode tephra deposits and portions of the tuff rampart and the sediment load begins to cause drainage and erosion problems in all impacted areas
- Continued seismic tremor interspersed with periodic felt VT earthquakes (largest M4.5), that may be large enough to cause damage; seismicity drops off after 5 days.
- Continued emission of CO_2 and other volcanic gases from the vent area

- Occasional waves resembling storm surge hitting surrounding coastlines

Impacts, first month

- At the end of the first week, lava flows begin issuing from the base of the scoria cone into the harbour, travelling intermittently at about 100 m per hour in two main directions; SE towards Ambury Park and NE towards Onehunga Wharf and SH20
- On day 10, lava flows fill much of the harbour in the Onehunga Wharf area, and reach the Wharf, generating explosions and fires
- By day 11, lava has also filled a good portion of the harbour north of Ambury Park and is encroaching on land near Seaforth Avenue
- Lava flows stop on day 13, after destroying much of Onehunga Wharf and filling much of the surrounding harbour and the southern portion of Gloucester Park, as well as much of the harbour to the west of the vent and coastal areas of Mangere Bridge township (see Figure 2)
- Semi-continuous ash and lapilli eruption column continues to build scoria cone, which completely fills the initial explosion crater and reaches 120 m in height by day 25
- The blocked Mangere Inlet causes water from catchment drainage to begin ponding east of Mangare Bridge causing local flooding of upstream shorelines

Impacts, first 6 months

- Fire fountaining (and ash column) stops on day 35, and the eruption finishes. The scoria cone is now 150 m high
- Ash continues to be a problem in large areas of the city for up to 6 months; undisturbed deposits within 10 km are up to 1-10 cm (thicker in downwind direction). Local telescoping results in even thicker patches
- The interior of the thickest part of the lava flows remains hot for months to even years after the eruption finishes
- The areas in Mangere Bridge and Onehunga directly impacted by the scoria cone, lava flows, surges and tuff ring remain in an exclusion zone for several months after the eruption ceases. Damage to SH 20 is eventually repaired and it is reopened one year after cessation of activity
- The blocked Mangere 'Lake' continues to fill up, causing continued flooding, until a new channel is cut through to Otahuhu Creek to the east.

Figure 2 *Ruaumoko volcano on day 35 (ash deposits not shown).*

Appendix 5: Summary of the Key Points from the Phoenix Research Report on the Auckland Community Focus Groups

Summary of the Phoenix Research Report

"Modelling the Community Response to the Public Education and Communications Programme"

Phoenix Research was contracted by the Auckland CDEM Group to conduct focus group based research to gauge:

- the effectiveness and timeliness of Exercise Ruaumoko media injects/public information messages;
- public awareness and perception of volcanic hazard and risk; and
- personal reactions to the scenario that Exercise Ruaumoko will have communicated and modelled.

A sample of twenty people were recruited onto a panel which met three times on March 10, 13 and 17. Each group had a mix of gender, ethnicity, age, income spread and location relative to the eruption site.

Key Recommendations for Public Information

- Current perceptions about Civil Defence are very positive
- The most vital communication is not about declaring an emergency, it is about managing the huge stage before the emergency so that people listen when it is declared
- People will self-evacuate as soon as they start to feel tremors
- You have to get in before people make their own decisions, to self-evacuate therefore get in early – at the first sign with single directive, short directives
- Any information must be accompanied by instruction, i.e. something to do and when I'll be back
- Injecting into the media means that communication takes on their context i.e. it becomes 'news' and not a command or vital information. People expect Civil Defence communications to be delivered in a different and separate way from 'normal news'
- Radio is especially important for people from lower socio-economic levels, particularly the different cultural stations.
- CD has to have somebody visibly in charge (of being the spokesperson)
- Have one voice – clear, rehearsed, calm, direct, simple, short statements, authoritative and confident
- From the beginning, CD must be a consistent and predictable voice, and not drop out of view, i.e. every day at the appointed time – establish a pattern and stick to it
- All the cues matter, Tone of voice, Positive, Expression, Standing up is good, Appearance, Everything must say LEADER
- People latch onto words like "volcano", "one hour", and lose the rest of the message
- Unless Civil Defence can have more control over the media, or presence on the media from the beginning, they can expect to have very little effect later as/when an emergency is declared

Volcanic Hazard Knowledge

Participants had little current knowledge about the volcanic hazard e.g. Most thought Auckland volcanoes are extinct. Most people believe NZ is safe, as we don't have many disasters or those we do have don't have long term consequences. Large scale events happen to other country's not here. They had more of an idea about earthquakes and applied this concept of a sudden wide scale devastating event to the volcanoes. This confusion between earthquakes and volcanoes means that people:

- Will panic and evacuate very early
- Don't understand that earth tremors are a warning of an eruption
- Don't understand that they will get warning of a volcanic eruption

- Don't understand that they will get time to get away[6]

Phoenix Research suggests that people from lower socio-economic groups are likely to flee earlier as they have less responsibilities.

Civil Defence as a Leader

Everyone had some idea of what Civil Defence does, but they had little idea who they are and often not where they are. This is because Civil Defence are largely untried in Auckland and because their leader does not have a public presence. This is a crucial issue. How can people follow and trust Civil Defence when their lives are at stake when they don't know who they are? In emergencies, it is utterly vital that Civil Defence must act as fast as possible to create a familiar face, a true leader, for people to follow.

Their expectations of the ideal Civil Defence Leader was that they were male, quasi military, young, physically fit, authoritative, confident, demands attention, honest, charismatic, smart, respond quickly as situation changes and has the ability to take charge of the situation.

Response to PIM within the Exercise

The communications and presence that Civil Defence provided in Ruaumoko fell short of the expectations of all of the participants. The lack of leadership was primarily in not telling people what to do from the beginning and not being visible at all. In particular:

- People were very anxious after reading the releases and didn't understand a lot of the information and what it meant for them.
- People thought that the directives given by CDEM were sometimes useful, but far too late.
  - Statements like "Civil Defence is reaching a stage of evacuation" would've created chaos, as they did not know what to do and felt the situation was far too urgent for them to be coming back in an hour to confirm.
  - Statements like "listen to the police" were unhelpful as they had no idea how to contact the police.
- Nobody had 'got' the idea that parts of Auckland would be safe. In their minds, volcanoes are huge and devastating, and so no one is safe and everyone should leave.
- People had unrealistic expectations of help on the road; for example free petrol along the way, facilities e.g. portaloos every 5km along the way, free money if you run out
- All people except one had a car or had borrowed transport to evacuate.
- While evacuated from Auckland and when returning and resettling, people wanted more acknowledgement of their loss and hardships.

Evacuation

- People choose to go somewhere familiar e.g. family, friends.
- People unrealistically thought that their hosts would be happy to have them for weeks if necessary. No one spoke of going to a central point like a school.
- Lower socio-economic groups did not know where to go (having not been out of Auckland), and so would "just go" with no planned destination.
- People understand they need food and water but not so much that they need a plan. They also had no concept of what it would be like to be in a disaster.

[6] CDEM need to be aware that Aucklanders know what it takes to get out of Auckland because of peak holiday traffic experiences, and how one accident on the motorway can lead to a huge tail back. One of their concerns is not just 'getting out of Auckland', but getting out before others, before traffic is so clogged that they can't get away, so they will tend to leave before any official evacuation.

- People's expectations of being away from Auckland were very short and unrealistic. They particularly can't grasp that utilities may be damaged and how this will negatively impact their lifestyle
- People need to see what has happened to their home and their street to move on within themselves to what to do next. Therefore Civil Defence ideally need to liaise with other organisations to give accurate visuals street by street to help them to adjust to loss and change, for example, one person suggested updated Google Earth.
- People want information and directives on the following:
  - Routes
  - Where to go/Where not to go to be safe
  - How long to pack for
  - Buses, trains should be free and frequent and plentiful - some even suggested planes should be available
  - Traffic updates on the radio – all stations on the hour and half hour, always finishing with when the next update will be

Returning and Resettling

Whether people return or not is dependent on how many of their needs are being well met where they are. It is also somewhat dependent on their life stage. To come back they need a significant gravitational pull of some kind, e.g. job, family, business.

People expect that the clean up and rebuilding will happen in a few weeks. They have very high expectations of help.

Response to Auckland Volcanic Hazards DVD

People's overall impression about the DVD was that largely the information was there, but some bits were incomplete or confusing e.g. People could not connect the rolling gas clouds which were very powerful and scary, with a limited impact zone. The clouds suggested total and widespread devastation. There needs to be more visuals showing limited zones and what these look like, and how the clouds run themselves out.

They found some of the directives conflicting e.g. People were confused about what to do with ash. Some of the narration said stay indoors, but then said it made driving difficult and you had to get it off your roof. They want to know the specifics of; if this happens, do this, if that happens do that.

They need more help to make their plan "real" by expanding the action plan section with more lists and directions to websites etc... People needed the specifics of what to do in different situations e.g. when do I pack, when do I stay indoors, what is my "take with me list"

They felt it was not presented in an appropriate manner, an "ordinary" documentary is associated with "nice to know" issues, but this was seen as vital, life-saving information and should therefore be presented with an urgent tone. They also wanted it to be more personal, like the Leader of CDEM was directly addressing them, straight out of the picture (like newsreaders). This would make it "real" and tell them how their daily life would be different.

It was noted that this is an ideal opportunity to introduce the head of Civil Defence and get people familiar with him in advance because people's comments were "there was no personality for civil defence, no clear leader", "Who are these authorities" they asked, "How do I know that I can trust them?" - consequently, people did not feel reassured.

Appendix 6: List of Acronyms

ACDEMG	Auckland Civil Defence Emergency Management Group
ARC	Auckland Regional Council
ATM	Automatic Teller Machine
AVF	Auckland Volcanic Field
AVSAG	Auckland Volcanic Science Advisory Group
ARWAG	Auckland Regional Welfare Advisory Group
CDEM	Civil Defence Emergency Management
CEG	(CDEM Group) Co-ordinating Executive Group
DESG	Domestic and External Security Group (within DPMC)
DESC	(System of) Domestic and External Security Co-ordination
DHB	District Health Board
DPMC	Department of the Prime Minister & Cabinet
ODESC	Officials Domestic and External Security Co-ordination committee
ECI	Exercise Co-ordinating Instruction
EFTPOS	Electronic Funds Transfer at Point of Sale
EGI	Exercise General Instruction
EOC	Emergency Operations Centre
GDP	Gross Domestic Product
GEOC	(CDEM) Group Emergency Operations Centre
GIS	Geographic Information System
LUC	Lifeline Utilities Co-ordinator
MCDEM	Ministry of Civil Defence & Emergency Management
MoH	Ministry of Health
MoT	Ministry of Transport
NCMC	National Crisis Management Centre
NESO	National Energy Sharing Organisation
NWRCG	National Welfare Recovery Co-ordination Group
PIM	Public Information Management
SAB	Science Alert Bulletin
SAG	Scientific Advisory Group
SAL	Scientific Alert Level
SOP	Standard Operating Procedure
TA	Territorial Authority
TEMCG	Transport Emergency Management Co-ordination Group
TRT	Transport Response Team (operational team of the Transport Emergency Management Co-ordination Group)