ITSU XX

NATIONAL REPORT SUBMITTED BY NEW ZEALAND

A. BASIC INFORMATION

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Emergency Cellular phone:	64 4 473 0021 (National Duty Officer) 64 27 4421236 64 27 4759985

3. Tsunami Advisor(s)

Name:	Tsunami Advisory Group (TAG)
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e-mail Address:	Nil
Emergency Telephone Number:	(Held by Ministry of Civil Defence & Emergency Management (MCDEM))
Emergency Fax Number:	
Emergency Cellular phone:	

4. Emergency Management

In December 2002 the Civil Defence Emergency Management (CDEM) Act came into force. The Act introduced a comprehensive emergency management approach across risk reduction, readiness, response, and recovery (the '4Rs'), as well as integration through the involvement of all sectors and agencies within the wider CDEM community.

One of the key aspects of the nation's improved arrangements is the establishment of regional Civil Defence Emergency Management Groups (CDEM Groups) – consortia of local authorities working in partnership with emergency services (Police, Fire, Health), lifeline utilities and others to deliver emergency management within regional boundaries.

The primary emergency management agency in New Zealand is the Ministry of Civil Defence & Emergency Management (MCDEM) who is responsible for the administration of the CDEM Act.

The National Civil Defence Plan[1] is a requirement of the CDEM Act and determines how New Zealand responds to warnings in relation to pending emergencies. Under this Plan the Director of Civil Defence Emergency Management can issue warnings for all or part of New Zealand in respect of hazards that might lead to, or worsen, a civil defence emergency (including all warnings on tsunami). As part of this responsibility, MCDEM maintains a National Warning System (NWS) for the purpose of the dissemination of national level warnings to local authorities, departments, lifeline utilities and the

[1] The current National Civil Defence Plan is to be replaced by a new National CDEM Plan on 1 July 2006. See Section C par 2.4

public. For this purpose it maintains a 24-hour emergency telephone number (64 4 473 0021), staffed by a rostered duty officer. All calls to this number are connected via a call centre to a call plan rotating among five duty officers.

5. Local and Regional Tsunami Procedures

New Zealand is as much at risk from local tsunami, generated "locally" by earthquakes and/or underwater landslides or volcanoes along our plate subduction zones off eastern New Zealand and southwest of South Island, as it is from "distant" and "regional" tsunami (defined as more than 3 hours travel time and between 1–3 hours travel time respectively). The "local" tsunami hazard is high risk because of the potentially large tsunami wave heights (although over smaller stretches of coastline than "distant" tsunami) and lack of adequate warning. One example is the tsunami that hit the Gisborne region on 25 March 1947, with heights of up to 10 m, probably caused by a combination of fault movement off the coast and an underwater landslide triggered by the earthquake. Unlike remote tsunami, little warning is possible for the pending arrival at the coast because of the close proximity of faulting, the continental plate subduction zone, and volcanoes along our coastline.

Geonet
The GeoNet system is a national geological hazards monitoring and data collection system. Geonet is operated by the Institute of Geological and Nuclear Sciences (GNS) and incorporates dual data centres with duty officers on 20 minute 24/7 response time for earthquakes and volcanic events. At present, GeoNet is four years into a 10-year upgrade plan, and the monitoring system has yet to be fully developed to provide a robust earthquake detection and analysis system, and hence, provide the means to identify potential tsunami generating earthquakes.

The current GeoNet notification to MCDEM is based on the earthquake location and magnitude only[2], a process that usually takes about 20 minutes. In unfavourable circumstances (such as a large earthquake), it can take up to one hour because all earthquake locations must be reviewed by a seismologist to avoid false alarms. This is largely because of the long thin nature of the New Zealand landmass (and hence the geometry of the seismograph network). By definition, local source tsunami arrive at the nearest coast within one hour of generation, but many will arrive sooner, so to be effective, alerts need to be given in less than five minutes.

At present, GeoNet does not have local and regional source tsunami alert capability. When the earthquake locations and magnitudes obtained from the GeoNet national and regional seismograph networks identify off-shore earthquakes, this information is passed to MCDEM as soon as possible by email/fax/SMS/phone.

NIWA tide gauge/sea level recorder network
Currently, the New Zealand network of sea level gauges consists of 20 mainly open-sea gauges operated by the National Institute or Water and Atmospheric Research (NIWA) alone or in combination with other agencies and a number of Port Company/Regional Council gauges. The NIWA sea level gauges, and those funded by contributing agencies are not all necessarily equipped, configured or geographically located for optimal tsunami detection purposes, but do provide valuable information for understanding tsunami impact during and after an event e.g. issuing all-clear bulletins, for calibrating numerical models, and on occasions for confirming a tsunami. The Port Company/Regional Council gauges range from relatively open-sea situations to those along harbours, with the latter likely to be of more limited value for tsunami detection purposes.

Currently, confirmatory sea-level information from the NIWA open-coast sea-level network and also involving gauges operated by port companies, regional councils etc., is provided informally to MCDEM on a best-endeavours basis. NIWA has advised MCDEM on several events in the last few years. Fortunately, these have either occurred in office hours e.g., the M8.1 earthquake north of Macquarie Island on 24 December, 2004 (that only resulted in a small 0.2 m tsunami wave in Foveaux

[2] The 24/7 GNS Duty Team applies the following guideline to recognise potential local source tsunamigenic earthquakes: a shallow event (12 km or less), magnitude 5.5 or above, off the New Zealand coast.

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Strait), or the events resulted in no major consequences even though outside normal office hours e.g., the M7.2 Fiordland earthquake (21 August 2003) and the 26 December 2004 Sumatra mega-tsunami, which was tracked by NIWA staff the following day. During the Macquarie tsunami event, MCDEM, Environment Southland and PTWC were provided with hourly updates and plots, using the Dog Island sea-level gauge in Foveaux Strait until the threat subsided.

PTWC
Tsunami Bulletins for large local or regional earthquakes are also received by MCDEM from the PTWC.

MCDEM
The MCDEM duty officers receive the information from GeoNet, NIWA and PTWC via fax, email, and when significant also telephone. GeoNet and PTWC information is also received via SMS. PTWC fax messages go to Airways Corporation via the AFTN network and MetService in NZ via the WMO network (see par 6 below). These agencies confirm with MCDEM that the particular information was received.

MCDEM considers all tsunami related information in order to decide whether a warning is required or not. It may consult with its scientific advisors in this regard. The duty officers also have Internet access through which they can verify or check information received through one of the above means. In the event of a warning being passed, onward transmission is via the National Warning System, which utilises the Telecom service, electronic fax and a text SMS service. More detailed information regarding the National Warning System is covered in the Narrative Section (section C par 1.3.2).

The distance off shore of any local tsunami generating source and the tsunami speed of travel combine to give very little time for meaningful warnings to the first impact areas. Proper public education is therefore acknowledged to be a critical preparedness measure for local source tsunami and is included in the MCDEM Public Education Strategy.

6. Distant Tsunami Procedures

Tsunami Bulletins
Tsunami bulletins, originating from the PTWC, are sent to the MCDEM by fax and email The email goes to goes all the duty officer's work addresses as well as to their cell phones in the form of a SMS message. The Manager Readiness and the EM Planner - Intelligence also receive bulletins via their home faxes.

The PTWC also fax tsunami bulletins through the Airway Fixed Traffic Network (AFTN) network to Airways Corporation, Christchurch. In all cases, the AFTN Supervisor phones the MCDEM duty officer (via the MCDEM 24 hr emergency number) to advise that a bulletin has been received and checks that it has been received by MCDEM. The MCDEM call centre (who connects the call from Airways Corporation with the MCDEM duty officer) also Email the duty officers' cell phones to confirm which duty officer is dealing with the tsunami information.

To cover any breakdown in transmission over this network, the PTWC also transmits faxes via the World Meteorological Organisation's (WMO) Global Telecommunications System (GTS) to NZ MetService, which is New Zealand's weather forecasting service. The MetService duty forecaster responds by calling the MCDEM duty officer using the same contact procedure as for MetService Severe Weather Warnings. This ensures that all of the duty officers receive emails at work and to their cell phones from PTWC and emails from the MCDEM call centre. It also ensures that the Manager Readiness and EM Planner – Intelligence receive faxes from PTWC, Airways and MetService as well as phone contact.

B. SUMMARY

Through the Civil Defence Emergency Management (CDEM) legislation of 2002, New Zealand has been maintaining its tsunami mitigation arrangements in 2004 by following the underlying CDEM approach of addressing the 4 R's of Reduction, Readiness, Response and Recovery. These arrangements were strengthened by:

- The development and adoption of 16 new CDEM Group plans;
- the drafting of a new National CDEM Plan (the National and CDEM Group plans are requirements of the CDEM legislation);
- reviewing and improving the national warning system;
- increased government funding for public education programmes; and
- continued tsunami monitoring and development/research in the scientific field led by the Institute of Geological and Nuclear Sciences (GNS) and the Institute of Water and Atmospheric Research (NIWA).

As the responsible agency for the passing and dissemination of tsunami warnings, the Ministry of Civil Defence & Emergency Management (MCDEM) conducted four tests of the national warning system and also did four updates of its address lists for the dissemination of warnings. In addition work has been initiated to strengthen procedures with radio and TV broadcasters for the purpose of warnings.

A total of 36 tsunami bulletins or information alerts were received by MCDEM in 2004 from alert notification systems, which include PTWC, GeoNet and NIWA. Two tsunamis were recorded in New Zealand during 2004 (both in December) but none was significant enough to warrant any official response.

The 26 December 2004 Indian Ocean tsunami has however, as elsewhere in the world, placed new emphasis on the issue of tsunami risk and preparedness in New Zealand. The New Zealand Government has recognised the country's vulnerability to tsunami and subsequently commissioned two important strands of work to improve New Zealand's understanding of the risk and its capabilities to deal with that risk more effectively. The two strands of work are:

- A report on the risk of tsunami for New Zealand, the consequences, and New Zealand's preparedness to deal with them. This work is being led by the Ministry of Civil Defence & Emergency Management (MCDEM) and the report is due in December 2005.

- Improvements to the system of sea level gauges in New Zealand to allow better detection and confirmation of tsunamis through a purpose-built tsunami detection and warning system based on seismic stations (via GeoNet) and strategically-placed sea-level gauges. This work is being led by Land Information NZ (LINZ).

Increased funding to GeoNet to increase seismic detection and analysis represents a further step to improve tsunami monitoring and detection capability in New Zealand.

C. NARRATIVE

1. NEW ZEALAND CAPABILITIES IN RELATION TO TSUNAMI MITIGATION

1.1 GeoNet

The GeoNet system is a national geological hazards monitoring and data collection system. Geonet is operated by the Institute of Geological and Nuclear Sciences (GNS) and incorporates dual data centres with duty officers on 20 minute 24/7 response time for earthquakes and volcanic events. At present, GeoNet is four years into a 10-year upgrade plan, and the monitoring system has yet to be fully developed to provide a robust earthquake detection and analysis system, and hence, provide the means to identify potential tsunami generating earthquakes. GeoNet does not currently have dedicated local and regional source tsunami alert capability. The following apply in this regard:

Local Sources
When the earthquake locations and magnitudes obtained from the GeoNet national and regional seismograph networks identify off-shore earthquakes, this information is passed to MCDEM as soon as possible by email/fax/phone. Currently no information of tsunamigenic potential of any earthquake is supplied to the GeoNet web site or any other agencies, but this could be implemented when threshold levels and protocols are agreed upon.

The current GeoNet notification to MCDEM is based on the earthquake location and magnitude only[3], a process that usually takes about 20 minutes. In unfavourable circumstances (such as a large earthquake), it can take up to one hour because all earthquake locations must be reviewed by a seismologist to avoid false alarms. This is largely because of the long thin nature of the New Zealand landmass (and hence the geometry of the seismograph network). By definition, local source tsunami arrive at the nearest coast within one hour of generation, but many will arrive sooner, so to be effective, alerts need to be given in less than five minutes.

GeoNet's local earthquake detection system might also detect large submarine and coastal landslides that occur spontaneously, that is, not in association with earthquakes. However, as seismograph records of landslides are usually very different from those of earthquakes, they may not trigger an alert to the Duty Seismologist. Even if an alert was triggered and the landslide was able to be located, there are no means known to be available at present, nationally or internationally, to relate seismographic signals to landslide parameters such as volume, depth, etc, which are the important parameters to determine their tsunamigenic potential. The occurrence of a landslide within the seismic signal of an earthquake would be difficult to distinguish.

GeoNet does not monitor volcanic unrest along the Kermedec Ridge. However, prior to volcanic events, there will probably be precursory seismic and volcanic activity over months, weeks and days, which will be monitored by volcanologists at GeoNet and others. As with landslides, there are no means at the time of the event to relate seismographic signals to relevant parameters such as eruption volume, to tsunamigenic potential.

Regional Sources
Alerts for regional source tsunamigenic earthquakes, within 1-3 hours tsunami travel time, can afford to be only a little slower than those for local earthquakes. GeoNet's current capacity to accurately determine location and magnitude of potential regional source tsunamigenic earthquakes, that is, those in tectonically active regions to the north and south of New Zealand (New Hebrides arc, Tonga Trench, Kermedec and Macquarie Ridge areas) is poor. Large earthquakes at locations north of 30ºS and south of 50ºS are not routinely determined. Capacity to better locate these events and determine their magnitudes would be improved by stations on the Chatham Islands, possibly other islands, and exchange of both seismic and tide-gauge data with Australia, and the Pacific Island nations, as well as the better earthquake magnitude determination techniques. Some data is currently being exchanged

[3] The 24/7 GNS Duty Team applies the following guideline to recognise potential local source tsunamigenic earthquakes: a shallow event (12 km or less), magnitude 5.5 or above, off the New Zealand coast.

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with Australian seismologists on an informal basis, and discussions have been underway for two years about the exchange of data in the south-west Pacific, and some data is now exchanged on an informal basis.

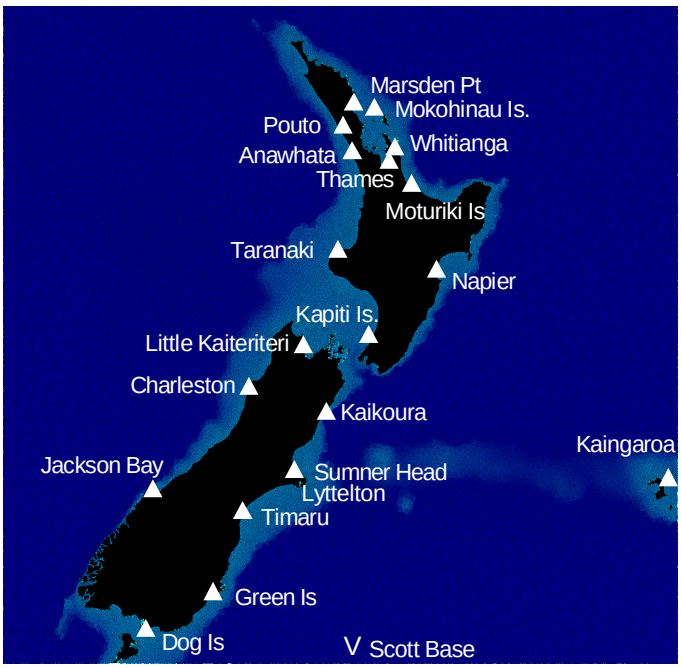
Discussion on the establishment of a South West Pacific Tsunami Warning System have been ongoing for several years, particularly since the ICG/ITSU conference in Wellington in 2003. The 2004 Sumatra tsunami had added impetus to these discussions, in which GeoNet has participated.

1.2 NIWA

The National Institute of Water and Atmospheric Research (NIWA) research is targeted at pinpointing geological features like previous seabed slumping, landslides and faulting on the ocean floor that may potentially cause a tsunami, and then how and where the resulting tsunami would propagate to the coast. The marine geological work is lead by Dr Phil Barnes of NIWA. Dr. Roy Walters is leading the work on developing a high-resolution computer model RiCOM to simulate the behaviour of sediment-water mixtures in an underwater landslide or an underwater seafloor rupture and the ensuing tsunami as it propagates to the coast including inundation of coastal land.[4]

New Zealand has a network of 20 high-quality, open-coast, sea level stations sited at strategic locations around the country. The recorders routinely sample at five or one-minute intervals. For the latter, 1-minute averaged measurements are stored in a "tsunami" ring-buffer, where the latest 72 hours of data are continuously stored. All the instruments have cell phone telemetry and are polled daily to retrieve the sea-level data that is used for analysis of seiche, tides, storm surges and long-period sea-level fluctuations. In the event of a tsunami, recorders can be interrogated manually to download the tsunami ring-buffer, although there is no present capacity to operate the system in near real time. This network is currently coordinated by NIWA. Further information is available through Dr Rob Bell. Figure 1 lists the current sea level gauges in NZ.

Open-Coast Sea-Level Recorder Network



[4] Courtesy Dr Roy Walters NIWA (http://www.niwa.co.nz/rc/prog/chaz/news/tsunami)) r.walters@niwa.co.nz

Figure 1: New Zealand's current sea-level recorder sites (Courtesy of NIWA - http://www.niwa.co.nz/services/sealevels)

Currently, confirmatory sea-level information from the NIWA open-coast sea-level network and also involving gauges operated by port companies, regional councils etc., is provided informally to MCDEM on a best-endeavors basis. NIWA has advised MCDEM on several events in the last few years (see Section A.5).

These informal systems currently relied on to provide scientific support and tsunami detection to MCDEM have largely been developed on the initiative of scientists e.g., the development and operation of an open-coast sea-level network by NIWA with multiple uses, and building inter-personnel relationships across the emergency-management sector. However, no formal service agreements exist to underpin these informal arrangements. This raises issues about responsibility, liability, timeliness, operational procedures, availability of staff, and just as important, what the expectations are of how each party will respond and what is to be delivered or exchanged and to what specification.

1.3 End-to-End Early Warning System for Tsunami

1.3.1 Alert Notification Systems

NZ (MCDEM) depends on the individual and collective capabilities of the PTWC, GeoNet and NIWA for continuous monitoring, detection, analysis and alert notification in relation to tsunami. Formal arrangements exist in this regard with PTWC and GeoNet (described under 'Basic Information' elsewhere in this document).

1.3.2 National CDEM Warning System

The National CDEM Warning System provides a framework for the dissemination of National Warning Messages by MCDEM that can apply to any type of threat to selective or inclusive audiences.

MCDEM maintains a 24 hours National Duty Officer system to receive alert notifications from the respective monitoring agencies (par 1.4.1). National Warning Messages can be issued at the direction of the National Controller or the Director of CDEM when a warning of danger to the public or property is necessary, or when requested by another warning agency. A National Warning Message is issued by default to the CDEM Sector (local authorities, emergency services and certain others) by fax, email and SMS alert. Recipients in turn respond by acknowledging receipt and activation of their own arrangements to disseminate or act further upon the particular information. National Warning Messages can be extended to radio and television for public broadcast. Clear guidelines are given to media organisations on the priority and the broadcast frequency required for particular warnings. (MCDEM is currently in the process of developing a new memorandum of understanding with Radio NZ and the Radio Broadcasters Association (representing commercial broadcasters) following which the same will be done for TV).

Effective delivery of National Warning Messages is highly dependent on the application of uniform procedures and communication systems. There is a requirement on all recipients to comply with certain minimum standards in order to minimize the potential of failure. (It is recognised that the delivery of warnings is subject to a degree to functional public telecommunication systems). Broadening the dissemination of national warning messages to all government agencies and lifeline utilities is currently limited by the lack of arrangements to comply with the minimum standards (by those agencies).

The National CDEM Warning System does not include or prescribe the actions required in response to national warning messages. It however depends on the responsibility of national and local government bodies to maintain systems to receive, disseminate, and respond to warning information generated through the National CDEM Warning System.

The NWS is tested four times per year. Tests are conducted unannounced and at irregular times. Each test is followed by a formal report that is sent to all participants.

In addition, a "National Contact List for Emergencies" is maintained. The list is sent to all civil defence offices on a quarterly basis to be checked for changes and updates. The list contains the contact particulars of the civil defence officers, controllers and alternative controllers at all councils as well as addresses for the dissemination of warning messages.

1.3.3 Local Warning Systems

There is a requirement upon departments, Civil Defence Emergency Management (CDEM) Groups (regional consortia of CDEM stakeholders), local authorities, emergency services, lifeline utilities and others under the CDEM Act 2002 to maintain systems for the dissemination of or reaction to warning related information.

CDEM Groups maintain local level CDEM Plans that include provision for local warning systems. Local warning systems can be activated either in response to national warning messages or in response to localized threats and are aimed at reaching local communities. They entail a mix of signposts, siren systems, local radio broadcasts and in rural areas more informal door-to door or telephone warning procedures.

Inconsistencies in relation to the systems and procedures applied for warnings at local level are considered to be a current weakness. This issue is expected to be one of the findings to be addressed as a result of the Tsunami Preparedness Report currently in progress (par 2.2).

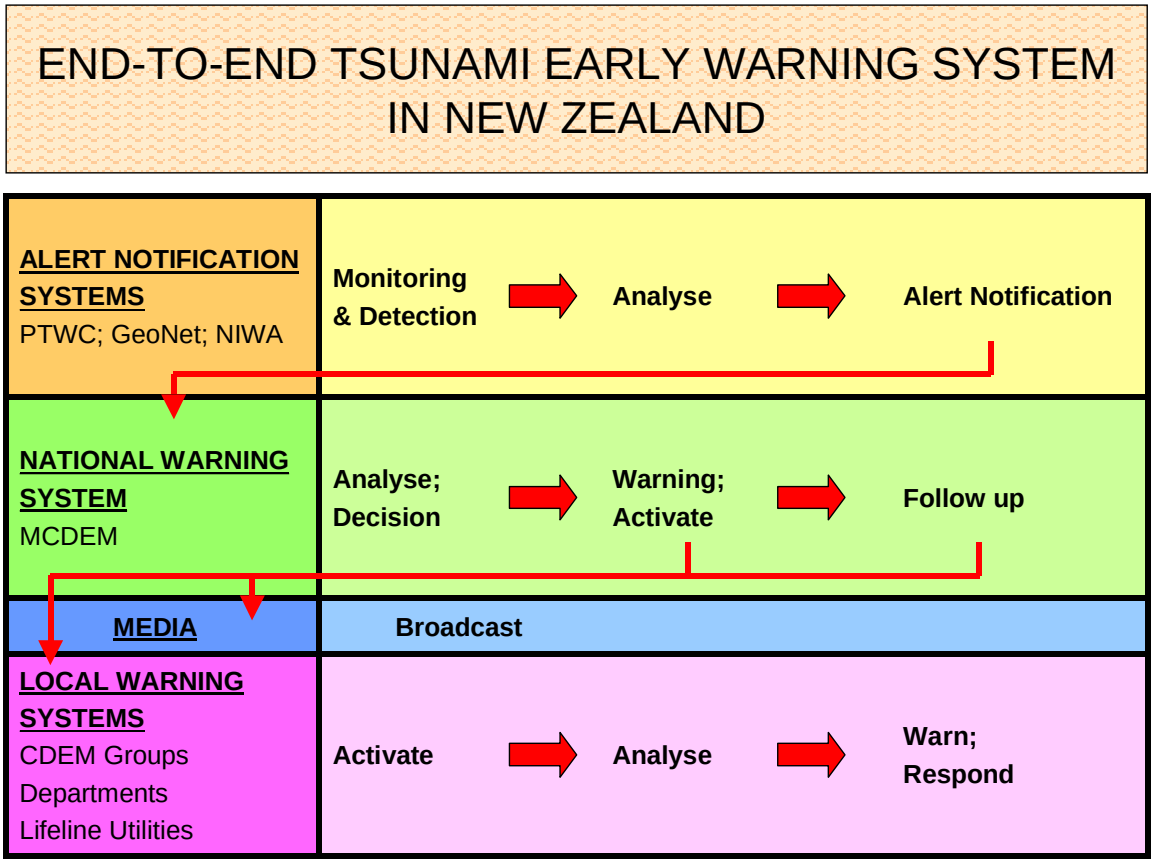


Figure 2: End-To-End Tsunami Early Warning System in New Zealand

2. ENHANCEMENTS IN RELATION TO TSUNAMI MITIGATION

2.1 GeoNet

The NZ Earthquake Commission Board has recently given approval for increased funding to support the completion of GeoNet's development and a new work plan was established in mid-2005. When complete and fully implemented, GeoNet will be equipped with the sensors and real-time analysis and communications capability that are necessary to implement a more comprehensive tsunami alert system based on the identification and characterisation of large earthquakes off the New Zealand coast. GeoNet could make a major contribution to the detection of local and regional tsunamigenic earthquakes, and provide data for the Pacific-wide tsunami detection system.

To improve the robustness of the local source earthquake tsunami alerts, the gaps in the GeoNet National Seismic Network need to be filled, and more route diversity needs to be added to the data communications network to prevent outages (such as a satellite failure) leaving us blind. Methods of rapid (less than 5 minutes) automatic earthquake location and size estimation need to be developed so that very fast alerts of possible tsunami-causing earthquakes can be given. The seismic information needs to be supplemented by real-time sea level data around the New Zealand coast and offshore islands, and plans are in progress to achieve this. This, when combined with pre-computed models will confirm a tsunami has happened and provide alerts for regions of New Zealand distant from the source of the tsunami within a timescale that might allow a warning to be disseminated.

2.2 Tsunami Risk and Preparedness Report

The 26 December 2004 Indian Ocean tsunami caused the New Zealand Government to directly consider the risk that tsunami posed to New Zealand. The Ministry of Civil Defence Emergency Management (MCDEM) is leading a government-funded initiative to develop a national picture of the risk of tsunami for New Zealand, the consequences, and New Zealand's preparedness to deal with them.

The project comprises two reports, a Science Report and a Preparedness Report. MCDEM has contracted the Institute of Geological and Nuclear Sciences (GNS) to gather and consolidate all current and historic knowledge of distant, regional and local tsunami, and identify the risk nationally and to communities. In the process GNS are required to consult within the New Zealand scientific and CDEM sectors and to have the Science Report peer reviewed internationally.

The second part of the project, the Tsunami Preparedness Report, will use the information from the Science Report to review New Zealand's national and regional preparedness for distant, regional and local tsunamis. It will look at the current national and regional arrangements for responding to tsunami warnings, compare them against internationally recognised best practice and make recommendations for improvements.

The two reports were to be presented to the New Zealand Cabinet by 30 September 2005 but New Zealand is currently going through a general election so the report date has been deferred until December 2005.

The two reports are intended to give a single integrated view of the risk of tsunami in New Zealand. It is the first time this has been done for tsunami at the national level. It is believed that the project will provide the basis for significant local, regional and national planning, and will help identify the communities that are well prepared and those whose emergency preparedness and response plans need further development.

The reports, when issued, will be available on MCDEM website www.civildefence.govt.nz.

2.3 Improved Tsunami Detection

In considering the December 26 2004 tsunami in the Indian Ocean the NZ government also noted that improvements are desirable to the system of sea level gauges in New Zealand to allow better detection and confirmation of tsunamis. It subsequently directed the development of a purpose-built tsunami

detection and warning system based on seismic stations (via GeoNet) and strategically-placed sea-level gauges (being coordinated by Land Information NZ or LINZ). The project manager of the sea-level component of the tsunami warning system is Russell Turner from LINZ (rturner@linz.govt.nz).

LINZ are coordinating the development of the project in discussion with representatives from all sectors likely to be involved, including LINZ's advisors, NIWA, GeoNet (GNS), W. de Lange (University of Waikato), MORST, MCDEM, and CDEM Groups. Active discussions are being held with Australian counter-parts in the Bureau of Meteorology and GeoScience Australia to ensure projects on each side of the Tasman track along similar lines with at least the capacity to exchange compatible data-streams from each other's seismic and sea-level stations and associated warning bulletins. Discussions will also be held with other SW Pacific agencies and PTWC on similar technical issues.

The primary objectives are to:

a) Identify improvements that can be made to NZ's system of sea level gauges to improve its ability to detect and monitor tsunamis and thereby increase NZ's tsunami preparedness, and

b) develop a high level implementation plan that identifies and provides for the changes required to the New Zealand system of sea level gauges.

The essential components for an improved system have been identified as:

- **Data Supply** – authoritative measurement of sea levels and the transmission of data from each recorder into a data processing and dissemination centre (through the internet)

- **Development and Maintenance of Real-Time Data Processing Tools** – provision of the software that processes the raw data in real time.

- **Data Processing, Transfer, and Archiving Activity**– transition from raw to processed data, their transfer to the Internet, and periodic archiving both in NZ and internationally.

- **Information Generation Tools** – provision of the tools required for transforming data into information.

- **Information Generation** – the transformation of data into information that is digestible by non-specialists and the presentation of that information in numerical and pictorial form.

- **Warning and watch bulletins** – from the information, produce succinct but clear messages (bulletins) to the emergency management authorities (primarily MCDEM) throughout an event. MCDEM in turn will be responsible for and control the issue of any warnings.

2.4 New National Civil Defence Emergency Management (CDEM) Plan

A new National Civil Defence Emergency Management (CDEM) Plan (a requirement of the CDEM Act 2002) is currently in proposed form and becomes operative on 1 July 2006. The purpose of the Plan is to set out how government will manage a national emergency and how it supports CDEM Groups in their management of local events. It will replace the current National Civil Defence Plan[5]. The new National CDEM Plan is the result of a collaborative[6] planning process and gives effect to obligations under the CDEM Act.

[5] National Civil Defence Plan, May 2002 (Amendment 14)

[6] Contributors include: CDEM Groups, MCDEM, DIA, DPMC, MOH & health Sector, NZ Police, NZ Fire Service, NZ Defence, MAF, MSD, HNZ, CYFS, IRD, MinEd, EQC, MetService, some CRI's (GNS/GeoNet, NIWA), some NGO's (NZ red Cross), Salvation Army, Victim Support, National Lifelines)
Active supporters include: Treasury, MoT, MFAT, MoRST

The new National CDEM Plan is a schedule to an Order-in-Council made by the Governor General. As a statutory regulation it will have greater standing than the current National Civil Defence Plan.

Both the (current) National Civil Defence Plan and the (new) National CDEM Plan state or provide for:

- Hazards and risks to be managed at the national level (including tsunami);
- Management necessary at the national level in readiness and response to emergencies related to these hazards and risks.

Within the current and new national plans there are certain national functional plans, among them plans in relation to warning systems, public information, mass evacuation[7], welfare, recovery, etc. Under the plan for warning systems MCDEM is responsible for the maintenance of a National Warning System (see par 1.3.2). It also identifies the agencies responsible for the issue of warnings in relation to specific hazards. MCDEM is responsible for warnings in relation to distant source tsunami and a collective responsibility is carried between MCDEM and CDEM Groups for warnings on regional and local source tsunami.

The (new) National CDEM Plan also identifies the requirement for additional planning to manage the consequences of specific hazards or class of hazards through the development of contingency plans. The (current) National Civil Defence Plan already contains contingency plans for government continuity, volcanic eruption and a large earthquake in a metropolitan area. These contingency plans, are to be reviewed for the purpose of the (new) National CDEM Plan. No contingency plan exists for tsunami, but one is planned for the (new) National Civil Defence Plan.

2.5 Improvement of the National Warning System

MCDEM engaged in a project to review and improve the procedures and capabilities of the National Warning System in 2004. Areas that were identified for improvement included:

- Revised Standard Operating Procedures, including clear minimum standards for participation (completed).
- Review and implement better communication systems for the receipt of alerts and dissemination of national warnings (in process).
- Review memorandums of understanding with public broadcasters (in process).
- Review and formalise arrangements with scientific advisors (tba.).

[7] The National Civil Defence Plan does not deal with mass evacuation whereas the new National CDEM Plan does.

3. INFORMATION ON TSUNAMI OCCURRENCES IN NEW ZEALAND

Two tsunamis affected New Zealand in the 2004-year.

Event #1
24 Dec 2004 – M8.1 north of Macquarie Island

Earthquake of M8.1 that occurred at 02:58 NZST on 24 Dec 2004 (14:58 UTC 23 Dec 2004) at approx. 50.24°S, 160.13°E (west of Auckland Islands & north of Macquarie Island)

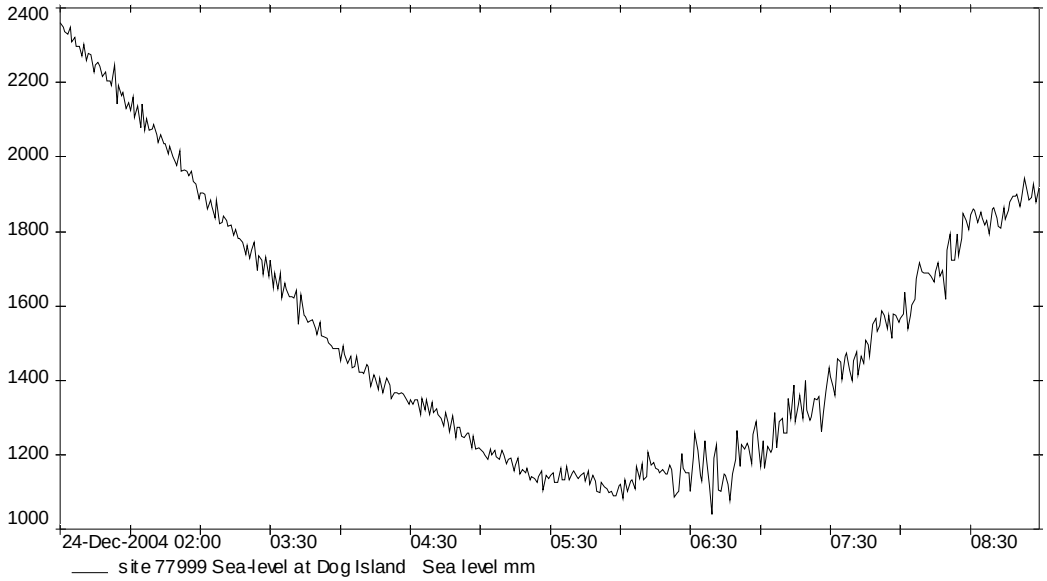


Figure 3: Plot from the 1-minute "tsunami ring-buffer" (without the tide removed) from Dog Island sea-level gauge (situated offshore from Bluff Harbour, in Foveaux Strait at 46.652° S 168.412° E) in NZ Standard Time (NZST or UTC+12).

The small tsunami arrived at Dog Island around low tide just after 06:00 (NZST), which is just over 3 hours after the earthquake. The largest wave height (crest-to-trough) was 0.2 m between 06:30 and 06:40 NZST. Another 0.2 m wave height was registered at 08:20 NZST. The tsunami was also registered on the Jackson Bay gauge operated by National Tidal Centre (Adelaide). The all-clear was given later in the morning.

Event #2
26 December 2004 - M9.3 The Great Sumatra-Andaman Tsunami

This mega-tsunami first reached NZ about 16-17 hours after the M9.3 earthquake. The largest wave height recorded in NZ was at Timaru where an individual wave reached nearly 1 m. The smallest wave heights were recorded at Scott Base (Ross Sea, Antarctica) and in the wave shadow in NE New Zealand (Bay of Plenty and Auckland coast).

See web site for details: http://www.niwa.co.nz/rc/prog/chaz/news/sumatra or via the NOAA site: http://www.pmel.noaa.gov/tsunami/sumatra20041226.html

The following plots show the de-tided signals recorded by the New Zealand gauges, firstly the one-minute "tsunami-enabled" gauges and secondly the sea level gauges that sample at 5-minute intervals. Sites are shown in Figure 1.

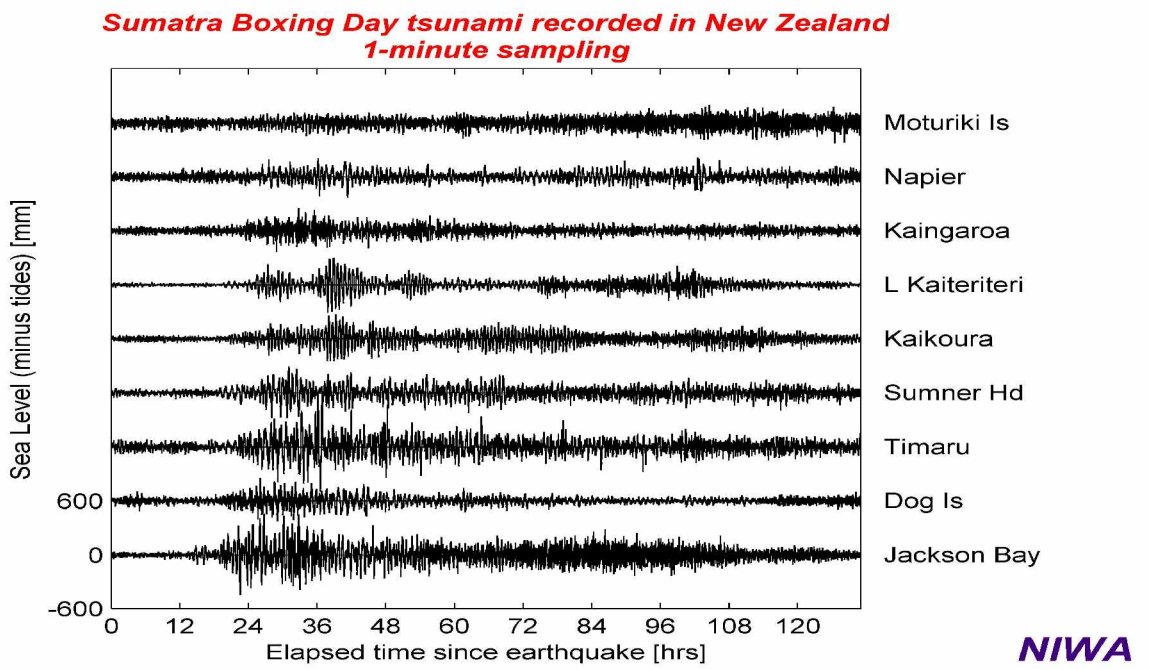


Figure 4: **Sumatra Boxing Day Tsunami recorded in New Zealand 1-minute sampling**

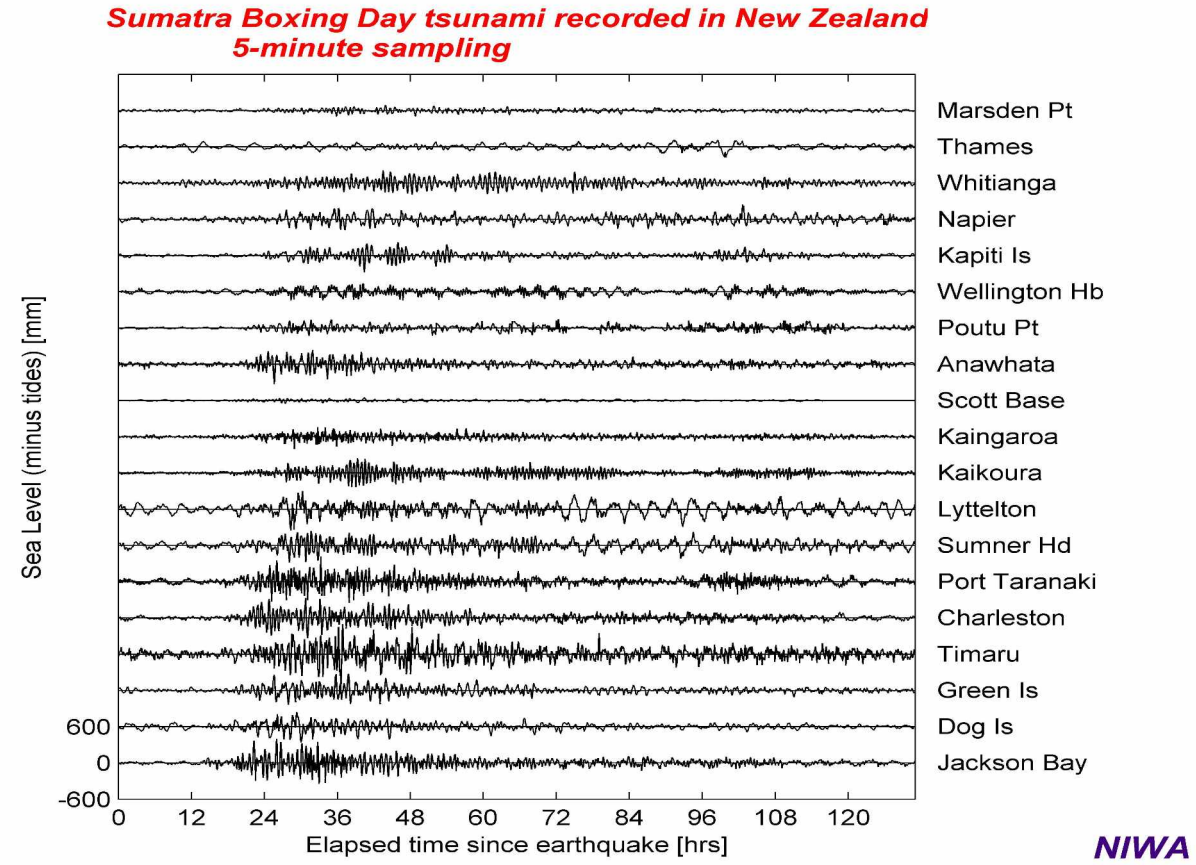


Figure 5: **Sumatra Boxing Day Tsunami recorded in New Zealand 5-minute sampling**

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