

South Australia's Earthquake Risk Assessment process using the National Emergency Risk Assessment Guidelines (Version 1.0, 2011)

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ABSTRACT:

Risks to Australian communities from natural hazards need to be better understood. For this reason the National Emergency Risk Assessment Guidelines were developed as part of the National Emergency Management Committee's implementation of the National Risk Assessment Framework.

The National Emergency Risk Assessment Guidelines provide a consistent risk assessment methodology which improves the quality and comparability of risk assessments across different hazards and locations. The Australian Government requires all States to have completed risk assessments at a State and local level for major hazards by 2015. These assessments must be undertaken using the National Emergency Risk Assessment Guidelines in order to continue to receive natural disaster relief and recovery funding.

This paper discusses the use of the National Emergency Risk Assessment Guidelines in assessing earthquake risks in five of South Australia's Emergency Management Zones. The results of the risk assessments are summarised along with identification of priority risk treatments as recommended by the Zone Risk Study Groups.

Keywords: earthquake hazard risk, earthquake risk assessment

INTRODUCTION

In 2001 a series of workshops held in South Australia identified the need for a more co-ordinated approach to hazard management across government, emergency services and the community. The State Emergency Management Committee subsequently identified ten hazards, added the roles and responsibilities of Hazard Leaders to the State Emergency Management Plan and assigned Hazard Leaders. The Department of Planning, Transport, and Infrastructure accepted the role of Earthquake Hazard Leader. A key requirement of all Hazard Leaders is the development and maintenance of risk assessments for their hazard.

The National Partnership Agreement between the Federal and State Governments includes a requirement that risk assessments be in place at a state and local level for major hazards and that those risk assessments be undertaken in accordance with the National Emergency Risk Assessment Guidelines (NERAG) 2011.

The NERAG was developed for the National Emergency Management Committee with the aim of providing a consistent risk assessment methodology across Australia and thereby improving the quality and comparability of emergency risk assessments. The NERAG was designed for use with any hazard and at all levels of government. The NERAG methodology:

- Uses a scenario based approach;
- Samples risk across a range of credible consequence levels;
- Identifies the current risk under existing controls and residual risk assuming implementation of new risk treatments or control improvements;
- Provides outputs that are comparable across hazards and locations.

In 2011 the South Australian Fire and Emergency Services Commission scoped a Zone Emergency Risk Assessment System (ZERAS) project to help meet the requirements of the National Partnerships Agreement. Zone Emergency Management Project Officers (ZEMPO's) were engaged to assist Hazard Leaders in undertaking risk assessments across South Australia's eleven emergency management zones.

OBJECTIVE

The objective of the Earthquake Hazard Leader was to conduct an assessment of the earthquake risks in priority emergency management zones, using the NERAG, in order to prioritise emergency management efforts through prevention, preparedness, response and recovery activities.

METHODOLOGY

Zone Selection

The Earthquake Hazard Leader firstly determined the emergency management zones in the state where earthquake hazard risk assessments were a priority. The determination was based upon an overlay of known seismic activity with concentrations of population and infrastructure. The selected zones were:

- Northern Adelaide
- Southern Adelaide
- Eastern Adelaide (including the Adelaide Central Business District)
- Western Adelaide Zone
- Limestone Coast (including Mt Gambier)
- Yorke and Mid North (including Port Augusta and Whyalla)

Scope

In accordance with the NERAG the risk assessment considered the possible impact of an earthquake to people, infrastructure, the economy, public administration, social setting and the environment. At the recommendation of the Hazard Leader the risk assessment considered risks from 1 in 1000 year and 1 in 10,000 year earthquake events. These events gave a good range of risks to assess, aligned with the NERAG likelihood table and allowed risk study groups to consider the appropriateness of existing control measures.

Stakeholders

Attendance of relevant stakeholders at the risk workshops was critical to the success of the project. Zone Emergency Management Project Officers engaged with local government and the community to develop stakeholder contacts. Stakeholders were those people or groups that may be affected by the detrimental impacts of an earthquake, who may contribute specialist knowledge to the risk assessment process or who have jurisdictional authority for the earthquake hazard. Stakeholders that participated in the risk assessments included:

- Local Governments represented in each Zone;
- Emergency Services;
- State Government Departments;
- Business representatives;
- Infrastructure owner representatives.

Attendance was taken at all workshops and summarised in the report for each Zone to encourage stakeholder commitment to the process.

Risk Criteria

The standard risk criteria given in the NERAG was used in the risk assessment including the consequence table, likelihood table, risk matrix and evaluation matrices. As per the NERAG methodology the people and economic consequences were revised to suit the specific population and economy of each zone.

Workshops

Typically two workshops were held in each zone to work through the risk assessment process of:

- Establishing the context
- Identifying risks
- Analysing risks
- Evaluating risks
- Treating risks

Establishing the Context

In preparation for the workshops the Zone Emergency Management Project Officer (ZEMPO) and Zone Emergency Management Committee developed the zone context. The zone context included the:

- Councils represented;
- Area and population;
- Public buildings, spaces and events;
- Significant infrastructure;
- Essential services;
- Regional economy.

Workshop 1 Agenda

No.	Item
1	Welcome
2	Emergency Management in South Australia
3	Introduction & responsibilities
4	Establish the earthquake hazard context
5	Activity 1 - Agree risk assessment parameters
6	Activity 2 – Review the bow tie diagram, identify and evaluate controls
7	Activity 3 – Identify zone specific vulnerabilities
8	Activity 4 – Review example risk statements Generate new risk statements Assign controls to risk statements
9	Earthquake scenarios for the zone
10	Risk Analysis and evaluation using the NERAG
11	Activity 5 - Analyse and evaluate the risks
12	Debrief & evaluation
13	Finish

Emergency Management in South Australia

As not all workshop attendees were familiar with emergency management arrangements in South Australia a high level overview was given at the start of the first workshop based upon the State Emergency Management Plan.

Establish the Earthquake Hazard Context

A summary of the earthquake hazard context in South Australia was presented to the risk study group by the Hazard Leader considering;

Earthquake Risk = Hazard x Exposure x Vulnerability - Capacity.

Earthquake hazard context information used to assist the risk assessment was extracted from the South Australian Earthquake Hazard Plan and is not repeated in this paper.

Activity 1 – Agree Risk Assessment Parameters

The risk study group agreed the objective, scope, key elements and justification for the risk assessment as set out in the NERAG.

Activity 2 – Review the Bow Tie Diagram, Identify and Evaluate Controls

A bow tie diagram for the earthquake hazard was drafted prior to the workshop and presented to the risk study group for comment. The purpose of producing the bow tie diagram was to assist the risk study group in conceptualising the sources, controls and impacts of an earthquake incident. The risk study group was required to:

- Identify new controls, particularly at a zone or local government level;
- Rate new controls using the NERAG Control Table;
- Review existing controls and their rating.

By assessing the controls the risk study group was later able to identify underperforming controls and direct actions for their improvement in the risk treatment plan. The level of control, 1 (lowest), 2 or 3 (highest) was added to the bow tie diagram. A typical bow tie diagram for the earthquake hazard in a South Australian Emergency Management Zone is provided in Appendix A.

Activity 3 – Identify Zone Specific Vulnerabilities

Prior to the workshop the Earthquake Hazard Leader briefly visited the zone, reviewed the draft zone plan, reviewed the zone earthquake context and identified zone specific vulnerabilities. Vulnerability is the set of prevailing conditions which adversely affect an individual, household or community's ability to mitigate, respond to or recover from an earthquake, thereby contributing to the severity of its impact. The risk study group reviewed, amended and added to the zone vulnerabilities identified by the Hazard Leader.

Activity 4 – Review Example Risk Statements, Generate New Risk Statements and Assign Controls

For this part of the workshop the risk study group was divided into three groups. Stakeholders were allowed to choose their preferred group in which to participate. These groupings allowed for a more timely progress through the risk assessment. The groups were:

- People and Social Setting;
- Infrastructure and Environment;
- Economy and Public Administration.

Each group was given a list of example risk statements developed by the Hazard Leader and were asked to revise, add to or delete these statements as they thought necessary. A typical list of risk statements is provided in Appendix B. A Zone Emergency Management Project Officer assisted each group through the process and recorded all decisions.

Earthquake Scenarios for the Zone

As risk assessments using the NERAG rely upon impact scenario information the Earthquake Hazard Leader sourced specific earthquake scenarios for the high priority zones. Risk Frontiers of Macquarie University were engaged to model 1 in 1000 year and 1 in 10,000 year earthquake events and report on:

- People – injuries and deaths;
- Economic impacts – industrial, commercial and residential financial losses;
- Modified Mercalli Intensity map.

The estimates of the parameters for these scenarios were obtained by generating a 50,000 year sample of events based on the statistical earthquake source model developed by Risk Frontiers for QuakeAUS. The sample events were restricted to those with epicentres in the Zone under consideration. As an example the Eastern Adelaide Zone scenario information is shown in the following tables.

Financial Loss Scenarios within Eastern Adelaide Zone Boundaries

Scenario	Residential	Commercial	Industrial	Casualty (Workers Comp.)	Total
1000 yrs ARI	\$2,075M	\$726M	\$6M	\$1M	\$2,808M
10,000 yrs ARI	\$7,154M	\$2,921M	\$8M	\$26M	\$10,109M

Casualty Scenarios within Eastern Adelaide Zone Boundaries

Scenario	Light to Moderate Injuries	Severe Injuries to Death	Total
1000 yrs ARI	18	2	20
10,000 yrs ARI	115	45	160

Each scenario was also benchmarked against an actual event. The particular earthquake events used were:

- Kalgoorlie, Western Australia 2010 – M5.0
- Newcastle, New South Wales 1989 – M5.6
- Christchurch, New Zealand 2011 – M6.3

These events were chosen as benchmarks because they provided:

- Indicative impact information in similar built environments to Adelaide in recent history;
- Numerous photographs to present to stakeholders in workshops to demonstrate earthquake impacts.

Activity 5 - Analyse and Evaluate the Risks

Using the agreed NERAG risk assessment criteria the risk study group analysed each risk statement for the 1 in 1000 year and 1 in 10,000 year earthquake scenarios. At the end of the risk analysis risks were determined as extreme, high, medium or low.

Assess Confidence in the Risk Assessment

As outputs of the risk assessment would be used to determine future actions for earthquake hazard mitigation the risk study group assessed confidence in the risk analysis. Confidence assessment focused upon agreement amongst stakeholders, knowledge of stakeholders and the quality and availability of data and information as it related to the scenarios provided and was rated as low, medium or high.

Evaluate Risk Tolerability

The risk study group used the results of the risk analysis and NERAG risk tolerability matrices to determine whether risks were:

- Tolerable
- Tolerable subject to being as low as reasonably practicable (ALARP)
- Intolerable.

The purpose of doing this was to assist decision-making on which risks required further detailed analysis and/or needed treatment, and the priority for implementation of measures to modify risk.

Workshop 2 Agenda

No.	Item
1	Welcome and introduction.
2	Review the workshop 1 risk analysis and evaluation results.
3	Risk treatment using the NERAG.
4	Activity 6 - Develop treatment strategies (in groups)
5	Completing the earthquake risk assessment.
6	Finish

Review the Workshop 1 Risk Analysis

Following workshop 1 the Hazard Leader updated the risk register in accordance with the outputs of the risk study group. The updated risk register was circulated one week prior to workshop 2. At the start of workshop 2 the Hazard Leader presented the outcomes of workshop 1 to the study group including the highest risks. Risks were prioritized by:

1. Tolerability;
2. Risk Level;
3. Likelihood;
4. Impact Category (people, infrastructure, economy, social setting, public administration and environment).

Activity 6 – Develop Treatment Strategies

For the greatest earthquake risks in the zone the risk study group set about developing risk treatment strategies. Risk treatment aims to determine and implement the most appropriate actions in response to the identified need to treat risks. Once implemented risk treatments become known as controls. In formulating risk treatment objectives for identified risk treatment needs the risk study group:

- Reviewed the bow-tie diagram;
- Considered existing controls needing improvement;
- Reviewed a list of possible new risk treatments provided by the Hazard Leader, refer to Appendix C.
- Brainstormed possible new risk treatment opportunities.

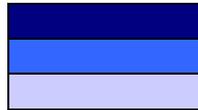
In doing so the risk study group considered options including:

- Avoiding the risk
- Reducing the consequence
- Sharing the risk
- Retaining the risk by informed decision.

To assist in determining which controls required improvement the following table was referred to by the risk study group. This table was sourced from a draft version of the NERAG document. The table was subsequently removed from the final version of NERAG (2011).

Level of Control (assessed using NERAG Control Table)	NERAG Consequence Level				
	Insignificant	Minor	Moderate	Major	Catastrophic
1					
2					
3					

Adequacy rating:



Control adequacy likely to require improvement
Control adequacy may require improvement
Control adequacy likely to be appropriate

Having determined a range of possible risk treatments the risk study team evaluated them to determine those most preferred. This was done through evaluation of the criteria taken from the NERAG including:

- Cost effectiveness;
- Timing;
- Leverage;
- Continuity of effects;
- Effects on the economy;
- Risk creation;
- Risk reduction potential;
- Political acceptability.

Evaluation involved assigning a score of 1, 2 or 3 to each of the above criteria based upon the following table.

Rating	Description
1 Low	Poorly designed risk treatment for the criteria being considered, introduces new negative risks, negative economic impact, negative environmental impacts.
2 Med	Largely a correctly designed risk treatment for the criteria being considered, no new risks introduced, no economic or environmental impacts.
3 High	Well designed risk treatment for the criteria being considered, positive economic impacts, positive environmental impacts.

The criteria of continuity of effects, cost effectiveness and risk reduction potential were given twice the weighting of other criteria in determining an overall weighted average score for each proposed risk treatment.

Completing the Earthquake Hazard Risk Assessment

Assuming that the risk treatments identified by the risk study group had been implemented and existing controls improved the Hazard Leader reassessed the greatest risks to determine the level of residual risk. This hypothetical residual risk rating was recorded in the risk register for the top ten risks and circulated to the risk study group for comment before finalisation of the report. Risk treatment plans were developed for each zone by the Earthquake Hazard Leader.

RESULTS

Across the five South Australian Zones in which risk assessments using the NERAG have been undertaken to date there were naturally some variations in outcomes and some zone specific risks. An overall analysis of the outcomes across the five zones found the following risks to consistently be of greatest concern.

1. Damage to residential buildings and contents which are uninsured or underinsured which in turn will cause unrecoverable financial loss.
2. Damage to unreinforced masonry commercial and industrial buildings (particularly adjacent footpaths) which in turn causes loss of life and serious injuries to people.
3. Damage to commercial and retail buildings and interruption to those businesses (loss of people, equipment, stock, ICT systems, essential services, third party suppliers) which in turn causes unrecoverable financial loss.
4. Damage to education buildings which in turn will cause loss of life and serious injuries to people.
5. Damage to manufacturing and industrial buildings and interruption to those businesses (loss of people, equipment, stock, ICT systems, essential services, third party suppliers) which in turn causes unrecoverable financial loss.
6. Damage to premises, stock, or essential services and branding/image which in turn interrupts business in the tourism sector and causes unrecoverable financial loss.
7. Damage to buildings housing mass gatherings / public assembly which in turn will cause loss of life and serious injuries to people.
8. Damage to hospitals and healthcare facilities (including: water, power, gas, ICT interruption) which in turn will stress the health system.
9. Damage to aged care buildings which in turn causes elderly persons to be displaced.
10. Damage to non-structural items (ceilings, partitions, bookshelves, light fittings) which in turn will cause loss of life and serious injury to people.

Zone specific risks of note included:

1. Damage to Central Business District multistorey buildings constructed prior to earthquake standards which in turn will cause large loss of life and serious injuries to people.
2. Damage to wastewater treatment plants which in turn will cause loss of service.
3. Damage to port and airport facilities which in turn will cause loss of service and unrecoverable financial loss.
4. Damage to large gas and fuel storages causing an explosion and/or fire which in turn will cause loss of life and serious injuries to people.
5. Damage to major food storage and distribution warehouses including racking and refrigeration which in turn will cause loss of service.

Across the five South Australian Zones in which risk assessments were undertaken there were some slight variations in the recommended risk treatments to suit local conditions however the following risk treatments were consistently found to be highest in priority:

1. Implementation of an all hazards community education campaign to build resilience to the impacts of disasters including emergency plans and kits.
2. Seismic assessment of places of public assembly where significant loss of life may occur due to structural failure.
3. Inclusion of seismic assessment and where necessary upgrade of heritage facades as part of grant funding to private owners of heritage listed buildings.
4. A lifelines study to examine vulnerabilities and interdependancies of essential services in the zone with a view to retrofitting critical systems where necessary.
5. Development of a state Mass Casualty Plan.
6. Consideration of façade safety in an earthquake as part of licensing footpaths for commercial use.

7. Reduce the level of underinsurance by residential building owners through provision of education, tools and advice.
8. Promotion of business continuity planning to business.
9. Clarification in the National Construction Code of approvals required to be in place to re-enter potentially damaged buildings following a major earthquake as well as demolition protocols.
10. Seismic assessment of government buildings having a post disaster function.
11. Establishment of a system whereby drawings of significant buildings are available remotely to engineers involved in building safety assessments following an earthquake.
12. Promotion of the drop, cover, hold safety message across the community.
13. Training of all fire wardens in earthquake safety and evacuation procedures and holding of annual earthquake evacuation drills.
14. Ensuring critical infrastructure owners have high quality business continuity plans in place.
15. Promotion to business of the benefits of a range of insurance products.
16. Holding of further earthquake exercises.

Other risk treatments of note were:

- Improve confidence in the risk assessment and planning for an earthquake response by undertaking more detailed scenario analysis of various earthquake impacts on the Adelaide CBD.
- Educating homeowners about the safety risks of old chimneys in earthquakes and severe storms and providing advice around removal, replacement or strengthening of chimneys.
- The teaching and practise of earthquake safety (Drop, Cover, Hold) and evacuation procedures in schools.
- Development of a practical guideline document dealing with restraint of services, ceilings and non-structural parts and components for earthquake forces for use by tradespeople.
- Development of a Disaster Waste Management Plan which includes maximising the recycling of waste materials where practical.

The following risk treatments were identified as being relevant to local government:

- Review of business continuity plans and exercising of them annually.
- Assisting in development of the Zone Emergency Management Plan and holding of zone emergency exercises.
- Investigation of business continuity planning of third party suppliers to local government.
- Review of cost recovery arrangements for uninsured assets vulnerable to damage from earthquake and other hazards.
- Investigate existing document management systems with the aim of providing easy access to structural drawings of significant buildings to structural engineers undertaking post disaster building safety evaluation.

IMPLEMENTATION OF RISK TREATMENTS

The Earthquake Hazard Leader will now progress implementation of the priority risk treatments through work with relevant stakeholders as resources permit. The Hazard Leader is currently:

- In the process of agreeing a memorandum of understanding with the Australian Red Cross to promote earthquake awareness as part of their REDiPlan community emergency preparedness training.

- Meeting with the South Australian Fire and Emergency Services Commission and fellow Hazard Leaders on development of an all hazards community resilience building website and campaign.
- Providing specific earthquake preparedness information in Local government offices and Service SA centres.
- Continuing to implement the policy of seismic assessment and where necessary upgrading of State government buildings undergoing significant refurbishment or redevelopment

In addition a State Mass Casualty Plan is nearing completion and a working group is being formed to review post disaster waste management arrangements.

CONCLUSION

The opportunity to undertake earthquake hazard risk assessments has proved invaluable in:

- Raising general awareness of the earthquake hazard and the damage earthquakes can cause amongst local government, emergency services, government departments, business and infrastructure owners.
- Identifying through a rigorous process priority risk treatments for government to progress over time in order to improve planning and preparation for a damaging earthquake in South Australia.

The contribution of the Earthquake Hazard Leader to the South Australian Zone Emergency Risk Management System was recognised at a State level with a Certificate of Appreciation in the 2013 Resilient Australia Awards.

REFERENCES

- Emergency Management Australia (2011) National Emergency Risk Assessment Guidelines.
- Government of South Australia, (2013). Earthquake Hazard Plan 2013/14 V3.3
- Government of South Australia, (2012/13). Earthquake Hazard Zone Risk Assessment Reports (Northern Adelaide, Southern Adelaide, Eastern Adelaide, Western Adelaide, Limestone Coast) V1.0

Appendix A – Example Bow Tie Diagram for the Earthquake Hazard in a Zone in South Australia

Objective: Conduct an assessment of the risks to the Zone from an earthquake in accordance with the NERAG in order to prioritise emergency management efforts through PPRR.

Scope: The assessment will address the risks of an earthquake to the Zone and consider possible impacts to people, the environment, the economy, public administration, social setting and infrastructure

Source	Prevention and Preparedness Controls										Emergency	Response and Recovery Controls										Impacts		
Ground Shaking	NSDR CIRS EM Act SEMP EMC SEMC Advisory Groups ZEMC's	Hazard Leader & Hazard Plan	SAPOL Earthquake Plan	Functional Service Plans	National Construction Code	Earthquake Design Code	Material Design Standards	Builders Licensing	Dangerous Substances Act	Dangerous Substances Regulations	Earthquake Emergency	State Co- ordinator Control Agency SRO SEC	Ambulance & First Aid FS	Health & Medical FS	Public Information FS	Fire FS	Urban Search & Rescue	Public Hospitals	Private Hospitals	Mutual Aid	International Assistance	People - Personal Health and Safety		
		NATCAT DISPLAN	Earthquake Exercises	CBRN Subcommittee & Plan	Escape of HAZMAT Hazard Leader	EPA Industry Separation Distances	Land Use Planning	DECD BCP	Tertiary Institutions BCP	Childrens Centres BCP			Building Safety Assessment	Casualty Information Centre	Disaster Victim ID	Temporary Mortuary Facilities	Alert SA Website - Public Info.	HAZMAT Response	NATCAT DISPLAN				Local Govt Dangerous Buildings Control	Local Gov't Environmental Health Officers
		Child Protection Legislation	First Aid Training	SA Earthquake Inquiries Taskforce	First Aid Training	Australian Earthquake Engineering Society		Building Fire Safety Committees	Local Gov't Immunisation Services	Local Gov't Environmental Health Officers														
Ground Shaking	NSDR CIRS EM Act SEMP EMC SEMC Advisory Groups ZEMC's	Hazard Leader & Hazard Plan	SAPOL Earthquake Plan	Functional Service Plans	Building Code / National Construction Code	Earthquake Design Code	Material Design Standards	Builders Licensing	Seismic Upgrade of State Gov't Buildings	NATCAT DISPLAN	Earthquake Emergency	State Co- ordinator Control Agency SRO SEC	Ambulance & First Aid FS	Health & Medical FS	Public Hospitals	Private Hospitals	Mutual Aid	GP Services	Pharmacies	Federal Dept for Health & Ageing (DOHA)	Hospital Business Continuity Plans	People - Health System		
		Hospital Business Continuity Plans	Federal Dept for Health & Ageing (DOHA)																					
Ground Shaking	NSDR CIRS EM Act SEMP EMC SEMC Advisory Groups ZEMC's	Hazard Leader & Hazard Plan	SAPOL Earthquake Plan	Functional Service Plans	National Construction Code	Earthquake Design Code	Material Design Standards	Builders Licensing	NATCAT DISPLAN	SEMP Evacuation Guidelines	Earthquake Emergency	State Co- ordinator Control Agency SRO SEC	Emergency Relief FS	Police FS	Logistics FS	Agriculture & Animal Services FS	Transport FS	State Emergency Information Call Centre Capability	Emergency Relief Centres	NGO assistance to Relief Centres		People - Displaced Persons		
		Rapid Damage Assessment Plan	Displaced Persons Accommod'n Support Plan	SA Vet Plan (SAVEM)	Federal Dept for Health & Ageing (DOHA)	Redcross REDiPlan							Local Government EM Plans	National Registration System (NRIS)	Emergency Financial Assistance	SA Health Mental Health Teams	Interpreter Services	Community Recovery Package	Vet Emergency Response	Federal Dept for Health & Ageing (DOHA)				
Ground Shaking	NSDR CIRS EM Act SEMP EMC SEMC Advisory Groups ZEMC's	Hazard Leader & Hazard Plan	SAPOL Earthquake Plan	Functional Service Plans	CBRN Subcommittee & Plan	Escape of HAZMAT Hazard Leader	EPA Industry Separation Distances	Dangerous Substances Act	Dangerous Substances Regulations	Aust Marine Safety Authority Chemplan	Earthquake Emergency	State Co- ordinator Control Agency SRO SEC	Engineering FS	Health & Medical FS	HAZMAT Response	DPTI Oil Spill Response	Natural Resource Management Boards	Environment Protection Agency					Environment	
		Aust Marine Safety Authority Oil Spill Plan	Escape of HAZMAT Hazard Leader	Land Use Planning	Environment Protection Legislation & Licences				Local Gov't Waste Contracts	Local Gov't Environmental Health Officers											Local Gov't Waste Contracts	Local Gov't Environmental Health Officers		
Ground Shaking	NSDR CIRS EM Act SEMP EMC SEMC Advisory Groups ZEMC's	Hazard Leader & Hazard Plan	SAPOL Earthquake Plan	Functional Service Plans	National Construction Code	Business Continuity Planning - State Gov't	BCP - Essential Services	BCP - Private Business	Critical Infrastructure Support Group	Natural Disaster Relief and Recovery Arrangements	Earthquake Emergency	State Co- ordinator Control Agency SRO SEC	Assistant State Co-ordinator - Recovery	SRC - Finance Sub- Committee	Engineering FS	Public Information FS	Rapid Damage Assessment	State Emergency Relief Fund	Natural Disaster Relief and Recovery Arrangements	State Government Reinsurance - SAICORP	Insurance - Business Premises	Economy		
		Rapid Damage Assessment Plan	SA Earthquake Inquiries Taskforce					BCP - Local Government	ZEMC Plan	Local Government EM Plans					Insurance - Business Interruption	Insurance - Residential Home & Contents	Insurance - Loss of Attraction				Local Government Insurance		Local Government Disaster Fund	

Ground Shaking	NSDR CIRS EM Act SEMP EMC SMC Advisory Groups ZEMC's	Hazard Leader & Hazard Plan	SAPOL Earthquake Plan	Functional Service Plans	National Construction Code	Business Continuity Planning - State Gov't	BCP - Essential Services	Continuation of Executive Gov't Plan	Seismic Upgrade of State Gov't Buildings	NATCAT DISPLAN	State Co-ordinator Control Agency SRO SEC	Public Information FS	Comm's FS	Government Radio Network	Volunteer Registration System VERIS	Donated Goods Policy							Public Administration
		Exercises	Hazard Plans						BCP - Local Government	ZEMC Plan													
Ground Shaking	NSDR CIRS EM Act SEMP EMC SMC Advisory Groups ZEMC's	Hazard Leader & Hazard Plan	BCP - Non-government organisations	Community Education							State Co-ordinator Control Agency SRO SEC	Assistant State Co-ordinator - Recovery	Emergency Relief FS	Public Information FS	SA Health Mental Health Teams	Volunteer Registration System VERIS	Non-government organisations	Community Groups					Social Setting
						Local Government Emergency Management Plans	Local Government Animal Management	Local Government Volunteers	BCP - Local Government	ZEMC Plan								Local Government Emergency Management Plans	Local Government Infrastructure Repairs	Local Government Community Grants	Local Government Community Services		
Ground Shaking	NSDR CIRS EM Act SEMP EMC SMC Advisory Groups ZEMC's	Engineering FS Plan	BCP - Essential Services	Mutual Aid Agreements	Exercises	Critical Infrastructure Group	Heavy Plant & Equipment Register	Trusted Info Sharing Network CI Groups	Land Use Planning	Aust. Drinking Water Guidelines	State Co-ordinator Control Agency SRO SEC	Engineering FS	SA Water Repairs / Workarounds	Water Restrictions	SES FS	Logistics FS	Health & Medical FS	Public Information FS					Infrastructure - Water, Sewer & Stormwater
		SA Water Temporary Water Supply Plan	SA Water Dam Upgrade Program	SA Water Dam Burst Maps	SA Water Dam Management & Drawdown Procedures	ICOLD & ANCOLD Dam Guidelines	SA Water Maintenance/ Replacement Program	ESCOSA Licensing - Water & Sewerage	Local Government Stormwater Mgt Plans	Local Government S/W Design and Maintain			Australian Standards										
Ground Shaking	State EM Arrangements	Engineering FS Plan	BCP - Essential Services	Mutual Aid Agreements	Exercises	Critical Infrastructure Group	Heavy Plant & Equipment Register	Trusted Info Sharing Network CI Groups	Land Use Planning	Australian Standards	State EM Arrangements	SA Power Networks Repairs / Workarounds	Electranet Repairs / Workarounds	Support Agency - DMITRE	DMITRE Power Shortage Mgmt Plan	Engineering FS	Logistics FS	Health & Medical FS	Public Information FS				Infrastructure - Power
Ground Shaking	State EM Arrangements	Engineering FS Plan	BCP - Essential Services	Mutual Aid Agreements	Exercises	Critical Infrastructure Group	Heavy Plant & Equipment Register	Trusted Info Sharing Network CI Groups	Land Use Planning	Australian Standards	State EM Arrangements	Origin,Epic,Sa ntbs,SEAGAS Repairs / Workarounds	Support Agency - DMITRE	DMITRE Gas Shortage Mgmt Plan	Engineering FS	MFS	Logistics FS	Health & Medical FS	Public Information FS				Infrastructure - Gas
Ground Shaking	State EM Arrangements	Engineering FS Plan	BCP - Essential Services	Mutual Aid Agreements	Exercises	Critical Infrastructure Group	Heavy Plant & Equipment Register	Trusted Info Sharing Network CI Groups	BCP - OCIO	Australian Standards	State EM Arrangements	Telstra,Optus, Vodafone Repairs / Workarounds	Support Agency - OCIO	Engineering FS	Comm's FS								Infrastructure - ICT
Ground Shaking	NSDR CIRS EM Act SEMP EMC SMC Advisory Groups ZEMC's	Transport FS Plan	BCP - Essential Services	Mutual Aid Agreements	Exercises	Critical Infrastructure Group	Heavy Plant & Equipment Register	Trusted Info Sharing Network CI Groups	Land Use Planning	State Gov't Bridges Seismic Assessment & Upgrade	State Co-ordinator Control Agency SRO SEC	Transport FS	Police FS	Engineering FS	DPTI Traffic Management Centre								Infrastructure - Transport
		State Gov't Bridges Inspection & Maintain Program	BCP - Public Transport	National Road & Bridge Design Standards	Rail Legislation & Standards							Local Government Asset Mgt Plans											
Ground Shaking	NSDR CIRS EM Act SEMP EMC SMC Advisory Groups ZEMC's	Engineering FS Plan	BCP - State Government	Exercises	Rapid Damage Assessment Plan	Heavy Plant & Equipment Register	Seismic Upgrade of State Gov't Buildings	Land Use Planning	Material Design Standards	Builders Licensing	State Co-ordinator Control Agency SRO SEC	Engineering FS	State Emergency Service Shoring	MFS	Urban Search & Rescue	Building Safety Assessment	Support Agency - DPTI						Infrastructure - Buildings
		National Construction Code	Earthquake Design Code	SA Development Act	SA Earthquake Inquiries Taskforce				BCP - Local Government	Local Government Asset Mgt Plans										Local Govt Dangerous Buildings Control	Local Gov't Engineers & Building Surveyors	Local Government Infrastructure Repairs	

Earthquake Emergency

APPENDIX B – Example Earthquake Hazard Risk Statements

Note: the below statements can and should be repeated where secondary earthquake hazards pose additional risks such as liquefaction, landslides, rockfall, fire, fault rupture, tsunami and dam failure.

Risk Statements - People

There is a potential that ground shaking resulting from a (*insert earthquake ARI*) earthquake will cause damage to:

- Commercial and industrial buildings (inc. heritage & unreinforced masonry buildings adjacent footpaths) in the zone which in turn will cause loss of life and serious injuries to people.
- Childcare, preschools, primary, secondary and tertiary schools and education buildings in the zone which in turn will cause loss of life, serious injuries to people.
- Non-structural items (ceilings, partitions, bookshelves, lightfittings etc.) in buildings which in turn will cause loss of life and serious injuries to people.
- Residential buildings in the zone which in turn will cause loss of life and serious injury to people.
- Buildings housing mass gatherings/public assembly which in turn will cause loss of life and serious injury to people.
- Healthcare facilities (Hospitals, GP Clinics etc) in the zone which in turn will stress the health system.
- Emergency services buildings and equipment in the zone which in turn delays or prevents response resulting in increased loss of life.
- Residential nursing homes & retirement villages in the zone which in turn will cause elderly people to be displaced.
- Residential buildings in the zone which in turn will cause large numbers of people to be displaced.
- Hotel/motel/backpacker and other accommodation buildings in the zone which in turn will cause large numbers of people to be displaced.
- Essential services (water, sewer, power, comms, food, fuel, ICT, money) in the zone which in turn will cause physical impact to the community (water, air, food borne diseases) including to vulnerable persons (eg: those reliant upon medical equipment/care inc. aged care & disabled).
- and interruption to carer and home support services (Royal District Nursing Society, Meals on Wheels, etc) which in turn impacts on the health of people in the zone who rely upon such assistance.
- Natural gas pipelines in the zone resulting in fires and release of hazardous substances which in turn will cause loss of life and serious injuries to people.
- or rupture of a pipe or valve fitting to a large LPG container in the zone resulting in an explosion (BLEVE) which in turn will cause loss of life and serious injuries to people.
- Bulk fuel storage tanks in the zone their pipes or valves resulting in a fuel fire which in turn will cause loss of life and serious injuries to people.
- Bulk chemical storage tanks, piping, valves and racks in the zone resulting in a chemical fire which in turn will cause loss of life and serious injuries to people.
- Grain storage and handling facilities which in turn gives rise to and ignites a grain dust cloud causing an explosion and loss of life and serious injuries to people.

- Chlorine containers in the zone which in turn will cause a toxic plume and loss of life and serious injuries to people.
- Buildings and products containing asbestos (roof and wall linings etc) which in turn will cause loss of life and serious injuries to people.
- Essential services to hospitals and health services (water, sewer, power, gas, ICT) which in turn stresses the health system.

There is a potential that an aftershock following a (*insert earthquake ARI*) earthquake will cause additional damage to buildings in the zone which in turn will cause loss of life and serious injuries to people.

Risk Statements - Economy

There is a potential that ground shaking resulting from a (*insert earthquake ARI*) earthquake will cause damage to:

- Premises, equipment, stock or essential services in the manufacturing / industrial sector which in turn causes unrecoverable financial loss, business failures and loss of employment.
- Premises, equipment, stock or essential services in the retail and wholesale trade sector which in turn causes unrecoverable financial loss, business failures and loss of employment.
- Premises, equipment, stock, essential services or supply chain in the transport & storage sector which in turn causes unrecoverable financial loss, business failures and loss of employment.
- Local government infrastructure (offices, libraries, recreation centres, community centres, bridges, roads, stormwater, stormwater harvesting) in the zone which in turn causes unrecoverable financial loss.
- Residential buildings and contents which in turn causes unrecoverable financial loss.
- Transport routes (eg. Port River Expressway) which in turn causes unrecoverable financial loss, business failures and loss of employment.
- Premises, equipment, stock or essential services which in turn interrupts business in the Tourism sector including sporting events and festivals and causes unrecoverable financial loss, business failures and loss of employment.
- The runways, taxiways, buildings, equipment or essential services at the Airport which interrupts its operations (incl. international, domestic and freight) and in turn causes unrecoverable financial loss, business failures and loss of employment.
- Container handling facilities at the port (incl. cranes, wharves, container stacks) which in turn causes unrecoverable financial loss, business failures and loss of employment.
- Bulk fuel offloading facilities at the port which in turn causes unrecoverable financial loss, business failures and loss of employment.
- Bulk grain loading facilities at the port which in turn causes failure of produce delivery, unrecoverable financial loss, business failures and loss of employment.
- Infrastructure, equipment, or essential services which in turn interrupts business at shipbuilding and maintenance facilities which in turn causes unrecoverable financial loss.
- Bulk fuel storage facilities at the port which in turn causes unrecoverable financial loss, business failures and loss of employment.

- Buildings and their security systems such that they are vulnerable to theft which in turn causes unrecoverable financial loss.
- Schools and childcare facilities which in turn causes employees with parenting responsibilities to be absent from work and unrecoverable financial loss to business.

Risk Statements – Infrastructure

There is a potential that ground shaking resulting from a (*insert earthquake ARI*) earthquake will cause damage to:

- Power stations and/or their fuel supply which in turn causes loss of electricity supply to the national grid and loss of service.
- The electricity transmission system (substations, transformers, switchboards, bushes) in the zone which in turn causes loss of electricity supply to the national grid and loss of service.
- Electricity transmission towers in the zone which in turn causes loss of electricity supply to the national grid and loss of service.
- Underground electricity cables which in turn causes loss of service to the zone community.
- Electricity infrastructure which in turn causes failure of sewerage and potable water pumping stations.
- Electricity infrastructure which in turn causes failure of fuel pumping at service stations.
- Wastewater treatment plants which in turn causes failure of sewer drainage services.
- Water distribution (local network) infrastructure in the zone which in turn causes failure of service delivery.
- The desalination plant which in turn causes failure of potable water delivery.
- Stormwater drainage infrastructure in the zone which in turn causes failure of service.
- Wastewater drainage infrastructure in the zone which in turn causes failure of service.
- Roadway structures (bridges, culverts, cuttings and embankments) in the zone which in turn causes closure of part of the state transport network.
- Road pavements in the zone which in turn causes closure of part of the local council road network.
- Local and interstate passenger and freight rail infrastructure in the zone which in turn causes failure of service delivery.
- Mobile communication infrastructure or very heavy use of mobile communication in the zone which in turn causes failure of service delivery.
- Landline (copper network) communication infrastructure (incl exchanges) in the zone which in turn causes failure of service delivery.
- The optical fibre network (incl. NBN) networks and service providers which in turn causes failure of service delivery. (web access for government and businesses including banking operations)
- The government radio network (GRN) which in turn causes failure of service delivery.
- Natural gas distribution infrastructure in the zone which in turn causes failure of service delivery.

- Major intrastate/interstate gas pipelines which in turn causes failure of service delivery including power generation.
- Runways, taxiways, buildings, equipment or essential services at the airport which interrupts its operations (incl. international, domestic and freight) and in turn causes failure of service delivery.
- Bulk fuel offloading facilities at the port which in turn causes failure of fuel delivery.
- Fuel storage tank farms which in turn causes failure of fuel supply to the zone community.
- Port cargo handling facilities which in turn affects supply of service to the zone community.

Risk Statements – Social Setting

There is a potential that ground shaking resulting from a (*insert earthquake ARI*) earthquake will cause:

- Damage to art galleries, museums, libraries, statues, monuments and local government buildings in the zone which in turn causes loss of objects of cultural significance.
- Damage to churches & places of worship in the zone which in turn will cause the loss of objects of cultural significance.
- Damage to churches & places of worship in the zone which in turn will cause emotional and psychological impact to the community.
- Loss of loved ones, loss of home, loss of employment, a feeling of loss of control over one's life which in turn will cause psychological impact on the community.
- Impact to the community which in turn will cause long term psychological impact to responders (emergency workers, relief & recovery workers, volunteers)
- Damage to residential dwellings in the zone which in turn causes widespread displacement of companion animals resulting in emotional impact to the community.
- Damage to community buildings (sports clubs, theatres in the zone, licensed premises or public places of entertainment, shopping centres) which in turn impacts upon community emotional and psychological wellbeing.
- Damage to local heritage listed buildings which in turn will impact upon the community's emotional and psychological wellbeing.
- Damage to existing social service providers in the zone (NGO's, Lions, Rotary, Salvation Army, volunteer org's) which in turn will impact upon the community's emotional and psychological wellbeing.
- Disruption of existing health, education and other support services which in turn will impact upon the community's emotional and psychological wellbeing.
- Damage to buildings and their security systems leading to increased levels of theft and criminal activity which in turn impacts the community's emotional and psychological wellbeing.

Risk Statements – Public Administration

There is a potential that ground shaking resulting from a (*insert earthquake ARI*) earthquake will cause:

- Damage to local government offices, facilities and equipment which in turn will affect the government's ability to help manage local impacts while maintaining critical services.
- Impact to service providers (such as NGOs, meals on wheels) in the zone upon which state and local government rely for assistance in managing the event and providing public support functions.
- Damage to Zone emergency response buildings and equipment which in turn affects the governing bodies ability to manage the event.
- Damage to public information distribution systems in the zone which in turn affects the governing body's ability to provide public information.
- Impacts to employees and volunteers of Local Government such that they cannot attend work which in turn effects the ability of Local Government to manage local impacts while maintaining critical services.
- Damage to ICT infrastructure which in turn affects the ability of local government to manage local impacts while maintaining critical services.
- '000' and emergency services telephone systems to be severely congested affecting the ability of government to manage the event and public unrest.

Risk Statements – Environment

There is a potential that ground shaking resulting from a (*insert earthquake ARI*) earthquake will cause damage to:

- The built environment such that demolition generates significant waste to be disposed of which in turn causes environmental damage. (air, land, water, flora, fauna)
- The built environment such that demolition generates hazardous waste (asbestos, oils, petroleum products etc.) to be disposed of which in turn causes environmental damage. (air, land, water, flora, fauna)
- Waste management infrastructure and systems for kerbside and industrial waste disposal in the zone which in turn causes environmental damage. (air, land, water, flora, fauna)
- Wastewater drainage infrastructure in the zone which in turn causes environmental damage (air, land, water, flora, fauna)
- Wastewater treatment plants which in turn causes environmental damage.
- Bulk fuel stores which in turn causes environmental damage.
- Bulk chemical stores which in turn causes environmental damage.
- Transport infrastructure (bridges, roads) which in turn causes the spill of hazardous materials being transported and environmental damage.

APPENDIX C – Example Risk Treatments

Risk Treatment Example	Description
Emergency Services / Emergency Management Building Review	Undertake a review of the structural and functional adequacy of buildings in the zone having a post disaster function considering all relevant hazard scenarios. Where inadequacies are revealed institute appropriate measures. Also consider essential services or backups to them for such buildings.
Dangerous buildings policy - footpaths	Assess and where necessary upgrade buildings having suspended awnings or parapets or other projections likely to be dangerous to the public in an earthquake where part of the footpath has been licensed for commercial or other use.
Dangerous buildings policy - public assembly	Assess and where necessary upgrade places of public assembly where significant loss of life may occur due to structural failure in an earthquake.
Heritage building maintenance & upgrade	Include requirements around assessment and seismic upgrading of heritage listed buildings and/or their facades as part of government grant funding to private owners of heritage listed buildings.
Lifelines Study	Evaluate essential service vulnerabilities, redundancies and interdependancies. Retrofit critical systems where necessary to maintain minimum standards/maximum acceptable interruption times.
Land use planning	Adopt land use planning that incorporates earthquake hazard risk mitigation strategies including liquefaction risk.
Promote mitigation research	Promote and support research on strategies and techniques to easily and cost effectively mitigate non-structural and structural hazards.
Education of Structural Engineers	Undergraduate programs should include earthquake engineering, masonry construction and quality management.
Education of Architects and Engineers	Undergraduate programs should highlight consideration of earthquake loads across all disciplines, architecture, mechanical engineering, electrical engineering, hydraulic engineering etc.
Education of tradespersons	Trade courses in masonry construction should consider basic structural engineering aspects associated with masonry construction and requirements of the Masonry Code.
Restrain or protect objects of significant cultural or financial value to the community.	Identify objects of significant cultural or financial value to the community and assess the vulnerability of their current storage/display arrangements for the earthquake hazard. Where identified as necessary install earthquake specific restraints. Educate curators and staff on options for proper restraint of objects.
Post disaster provisions in the Building Act / Legislation.	Clarify powers, responsibilities and approvals required to manage buildings and their reoccupation following a major earthquake. Empower local government to enforce compliance with structural safety requirements, in particular where public safety is considered by council to be at risk. Establish uniform policies on demolition and rebuilding, include special requirements for heritage listed buildings.
Education in schools	Teach and practise earthquake safety and evacuation procedures in schools.
Community education - general resilience.	Create and distribute information to build community resilience on an all hazards basis including how to create emergency plans and emergency kits and promote being self sufficient for at least 72 hrs without power, water, electricity or extra food in the event of a disaster. Include promotion of insurance, regularly checking policies to avoid underinsurance and learning first aid.

Risk Treatment Example	Description
Evacuation Drills	Hold earthquake evacuation drills annually similar to fire evacuation drills, include information on earthquake evacuation as part of all fire warden training.
Promote business continuity planning to private business	Provide simple and clear tools and proforma's for business to undertake business continuity planning and promote such products on an all hazards basis. Engage private businesses in emergency management planning and exercises.
Mutual aid agreements	Review the adequacy of existing mutual aid agreements and what other mutual aid agreements would be beneficial, promote the establishment of those additional agreements.
Knowledge of liquefaction risk	Improve our knowledge of liquefaction risk through investigation and mapping and publish results.
Media protocols	Establish earthquake event media protocols. Information sources include seismologists and knowledgeable emergency operations centre officials who can provide appropriate and relevant guidance.
Structural drawing availability	Establish a system whereby the structural drawings of significant buildings are available remotely to engineers involved in building safety assessments following an earthquake.
Mass Casualty Plan	Develop a plan in conjunction with stakeholders to cover the management of a mass casualty incident on an all hazards basis.
Aged care evacuation protocols	Assist aged care home owners and managers in the developing an all hazards evacuation or evacuation plan for disasters. Build resilience of aged care homes to self manage disasters as far as practicable.
Vulnerable persons considerations	Determine how best to identify and record the location of vulnerable persons in the community so as to provide additional checks and where necessary assistance to them following a disaster.
Alternative port / airport emergency plans	Develop an emergency plan for alternative port or airport facilities in case the primary facilities are badly damaged.
Mental health program	Provide a community wide information campaign aimed at addressing depression and mental health issues following a disaster with advice on how to overcome problems and where to seek help if needed.
Business Recovery Planning	Business recovery assistance planning including consideration of wage subsidies, rates deferment, tax incentives, temporary accommodation, legal and financial advice and business recovery centres.
Disaster Waste Management Plan	Plan for the disposal of large volumes of disaster generated waste including recycling as much as possible
Earthquake hazard knowledge management system	Establish a repository of all information and research relevant to the earthquake hazard and planning for it.
All Hazards Information & Community Resilience Building Arrangements	Develop arrangements with key stakeholders to display and promote information on: South Australian disasters, Hazards in South Australia, Being better prepared for all hazards, then hold school group tours, hold community and business education events, promote volunteering etc.
Develop plans and templates for CALD community communication.	Develop plans and templates for Culturally and Linguistically Diverse Communities (CALD) to assist in preparedness and post disaster communication.

Risk Treatment Example	Description
Develop protocols for emergency payments.	Develop protocols for abnormal payments needing urgent decisions in emergency situations.
Guideline document on restraint of non-structural parts and components	Translate the requirements of AS1170.4 Section 8 into practical details suitable for use by tradespeople.
Storage Racking Design Update	Review the outcomes of investigations into storage racking failures in Christchurch and implement relevant recommendations for design changes/alterations in Australia.
Education about safety of chimneys and incentives to remove them.	Provide advice to the community on the risks from old chimneys in both storm and earthquake events. Investigate incentives for removing unused chimneys from residential properties in particular.
Facilitate Business Recovery	Reduce planning barriers to business innovation. Suspend "red tape" and where reasonable regulations for a period during and immediately following the earthquake to encourage business recovery initiatives and a 'can do' attitude. A priority is to enable businesses to continue to operate. Appoint case managers / business facilitators to work through issues that prevent businesses reopening.
Monitor critical economic indicators across industry sectors to inform recovery work.	Monitor economic performance of industry sectors in areas affected by the disaster. On the basis of results ensure timely interventions to assist where warranted.

Appendix D – Example Completed NERAG Risk Register

No.	Risk Statement	Source	Impact Category	Level of existing PP controls		Level of existing RR controls		Consequence	Likelihood	Risk	Confidence level	Tolerability	Treatment Objectives	Treatment Options	Accept/Reject	Residual Consequence	Residual Likelihood	Residual Risk
1 EX.EQ. 29	There is the potential that ground shaking resulting from a 1:1000yr earthquake will cause damage to residential buildings and contents which in turn will cause <u>unrecoverable financial loss</u> .	Earthquake	Economy	Building Code of Australia	3	Insurance - House and Contents	2	Catastrophic	Unlikely	High	Moderate	Tolerable Subject to ALARP (2)	By 2033 reduce financial losses after insurance caused by a moderate earthquake to less than 5% of total losses for residential building owners.	Community education on earthquake hazard and mitigation measures including chimney removal.	Accept	Major	Unlikely	Medium
				Community Education	1	Building Safety Assessments	1							Advice to homeowners to avoid under - insurance	Accept			
				Land Use Planning	1	Community Recovery Package	2							Improve training and systems for damage assessment	Accept			
						Insurance Council of Australia	2							Promote research into cost effective structural mitigation techniques	Accept			
						Recovery Centres	2							Review education of trades and professionals to ensure compliance with earthquake code	Accept			
						State Recovery Committee (SRC)	2							Develop hazard information materials for CALD communities	Accept			
														Clarify insurance industry capacity to respond to disasters.	Accept			
2 EX.EQ. 26	There is the potential that ground shaking resulting from a 1:1000yr earthquake will cause damage to premises, equipment, stock or essential services in the Retail, Wholesale, Commercial trade sector which in turn causes <u>unrecoverable financial loss, business failures and loss of employment</u> .	Earthquake	Economy	BCP - Commercial Business	1	Building Safety Assessments	1	Catastrophic	Unlikely	High	Moderate	Tolerable Subject to ALARP (2)	By 2033 reduce financial losses to commercial, retail and wholesale businesses such that business failures and loss of employment are not widespread.	Promote business continuity planning, provide tools and educate businesses on developing plans.	Accept	Major	Unlikely	Medium
						Community Recovery Package	2							Improve training and systems for damage assessment	Accept			
						Insurance – Premises/Equip/Stock	2							Promote the benefits of insurance to businesses	Accept			
						Insurance - Business Interruption	1							Incorporate lessons from Christchurch in business recovery planning.	Accept			
						Engineering FS	2							Assess seismic safety of buildings housing mass gatherings or adjacent public spaces	Under further review.			
						Fire FS	2							Undertake a lifelines study to identify seismic vulnerabilities.	Under further review.			
														Review education of trades and professionals to ensure compliance with earthquake code	Accept			
3 EX.EQ. 01	There is a potential that ground shaking resulting from a 1:1000yr earthquake will cause damage to commercial and industrial buildings (inc. heritage & unreinforced masonry buildings adjacent footpaths) in the zone which in turn will cause <u>loss of life and serious injuries</u> to people.	Earthquake	People	BCP - Hospitals	2	Ambulance & First Aid FS	2	Major	Unlikely	Medium	Low	Tolerable Subject to ALARP (2)	By 2033 reduce the likelihood of fatalities and serious injuries to people from earthquake damage to commercial and industrial buildings.	Educate the community on the "Drop, Cover, Hold" safety action	Accept	Major	Unlikely	Medium
				Building Code of Aust	2	Casualty Information Centre (CIC)	2							Hold earthquake exercises with Functional Services and Zones	Accept			
				Community Ed Campaign	1	Disaster Victim Identification	3							Train fire wardens in earthquake evacuation drills.	Accept			
				Earthquake Exercises	1	Fire FS (Urban & Rural)	2							Promote first aid training in the community.	Accept			
				Earthquake Design Code	2	Government Radio Network	2							Assess seismic safety of buildings housing mass gatherings or adjacent public spaces	Under further review.			
				Evacuation Drills	1	Health & Medical FS	2							Develop a State Mass Casualty Plan	Accept			
				Structural Design Codes	2	Hospitals (state)	2							Develop hazard information materials for CALD communities	Accept			