

# Hazard and Risk Analysis: Explanatory Notes 2004

*A supporting document to the Waikato Civil Defence Emergency  
Management Group Plan 2005*

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# 1 Introduction

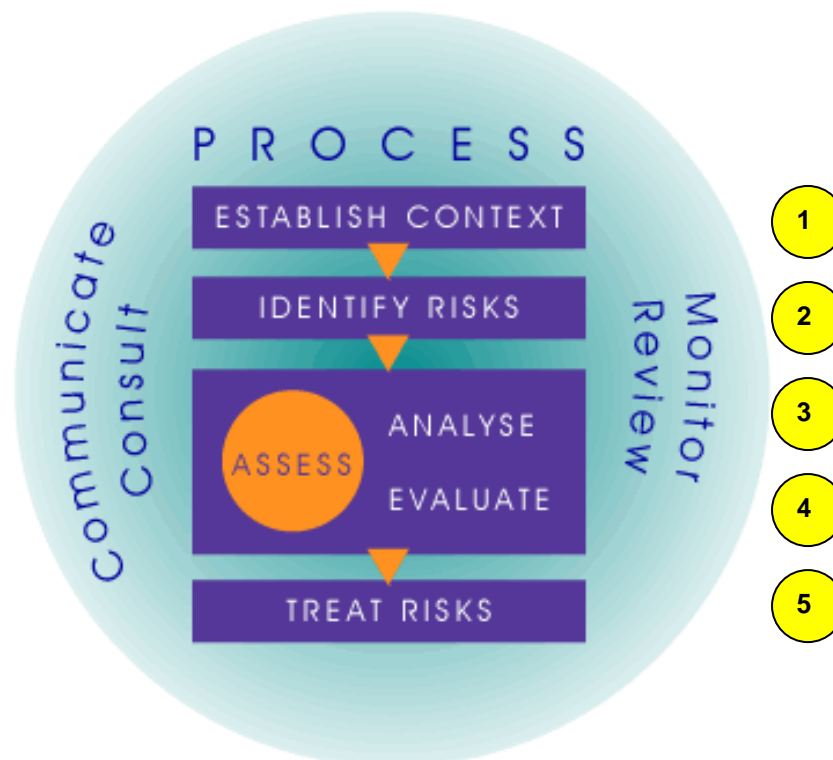
## 1.1 Purpose

The purpose of this report is to document the processes and conclusions for identifying the hazards that are to be addressed by the Waikato Civil Defence and Emergency Management (CDEM) Group. It also outlines the parties consulted through the risk analysis process as part of the development of the CDEM Group Plan. This report is therefore a key supporting document of the CDEM Group Plan.

## 1.2 Hazard and risk analysis process

The purpose of risk management is to clarify and understand the risks we face and how best to manage them.

The requirement to practice sound risk management is implicit throughout the CDEM Act 2002. CDEM Groups are required to apply risk management to their planning and activities. Established best practice is provided by the New Zealand standard *AS/NZS4360:1999 Risk Management* and can be adapted for CDEM planning as follows:



The following steps were undertaken to identify the significant hazards to be addressed in the Waikato CDEM Group Plan, as also outlined in the Directors Guidelines (*Working Together: Developing a CDEM Group Plan, DGL 2/02*).

### 1.2.1 Step One: Establish Context

Context is about defining the parts of the world we own and/or can influence. It helps clarify the bounds of our responsibility. CDEM Group planning occurs within the CDEM Group's strategic, organisational, and risk management context.

### ***Strategic Context***

Strategic context is defined by our by our relationship to our environment. This may include financial, operational, competitive, political (public perceptions/image), social, client, cultural and legal aspects of the CDEM Group members.

Steps that can be used to describe this context include:

- Identifying internal and external stakeholders and their objectives
- Identifying applicable strategic operational plans and reports that define legal, financial, political, social, and cultural obligations
- Describing the physical environment of the CDEM Group and including a map.

### ***Organisational Context***

Organisational context can be established via a concise description of the CDEM Group's proposed structure, personnel and financial resources. Establishing this context will include describing the local authorities and emergency services that comprise the CDEM Group, and their roles.

### ***Risk Management Context***

All CDEM Group members are already applying risk management principles in their respective management of finances, assets and processes. The CDEM Group Plan is therefore just one of many tools in the risk management toolbox.

## **1.2.2 Step Two: Identify the risks**

This step involves identifying the hazards and describing the associated risks. The hazard list is expected to be developed through consultation with the CDEM Group partners – through workshop forums (and/or the opportunity to provide comment on draft lists) and the review of existing plans, lifelines and scientific studies.

## **1.2.3 Step Three: Analyse the risks**

The NZS4360 risk management model was used to gauge the likelihood (levels 1 - 5) and consequences of impact (levels A – E) for each hazard. The 'level of risk' is a combined result of the likelihood (probability of it occurring) and impact (consequence) of each hazard resulting in each hazard having a low, moderate, high, or extreme level of risk. This process involved a high degree of consultation with a wide audience to consider the risks and rank them according to the NZS4360 model.

## **1.2.4 Step Four: Evaluate the risks**

At the completion of the NZS4360 process, a more detailed evaluation of the significant risks was undertaken using the Seriousness, Manageability, and Growth (SMG) model, which was recommended by the Ministry of CDEM to ensure national consistency.

The SMG ratings from 1 to 5 for each aspect of the process are used to give each hazard a refined ranking, with the higher number indicating the more serious risk. This analysis involved input from both the CDEM Coordinating Executive Group (CEG) and advisory groups in the specific workshops help across each Emergency Operating Area (EOA).



## 2 Step 1: Identify the risks

This section presents the list of hazards that were compiled prior to and after the series of EOA Hazard Workshops that were held in 2004 as part of the development of the Strategic Section of the 'Waikato Civil Defence & Emergency Management Group Plan'.

### 2.1 First-Cut Hazard List

This list provided a starting point for discussion and planning with each of the EOA's.

Note that these hazard types are organised into broad hazard groups based on:

- physical process
- inter-relationship between some of the effects and
- formal interaction between this CDEM Act and other legislation, such as the Resource Management Act (RMA), the Building Act (BA) and the Hazardous Substances and New Organisms Act (HSNOA).

The hazards are not arranged in either relative order of importance or level of risk and have been developed using the 'All-Hazards' approach suggested by the Ministry of CDEM in the *Director's Guidelines DGL 2/02: Developing a CDEM Group Plan*.

<b>Natural Hazards – Waikato Region</b>		
<b>Process/Primary Effect</b>	<b>Hazard/Failure Mechanism/Triggers</b>	<b>Hazard Code (future HAZREG)</b>
Inundation	River and Stream Flooding (including floodplain)	N1
	Local surface ponding/saturation	N2
	Landslide dam breaks	N3
	Storm surge/tidal effects (includes seiching)	N4
	Tsunami: far-field generated (includes seiching) near-field generated (includes seiching)	N5
Subsidence	Soil shrinkage/swelling	N6
	Consolidation/compaction	N7
	Karst solutioning and cave systems	N8
Landslip	Deep-seated rock slides	N9
	Flows and lateral spreads (slow = <0.1m/s)	N10
	Flows and lateral spreads (fast = >0.1m/s)	N11
	Rock/soil fall	N12
	Topples	N13
	Complex slope failures (more than one of subsidence, slides, flows, falls and topples)	N14
Earthquake	Liquefaction	N15
	Fault rupture and heave (-ve subsidence and fault offset)	N16
	Ground shaking (distant or local sourced)	N17

<b>Natural Hazards – Waikato Region</b>		
<b>Process/Primary Effect</b>	<b>Hazard/Failure Mechanism/Triggers</b>	<b>Hazard Code (future HAZREG)</b>
Erosion/Deposition	Shallow soil/regolith: – gully, sheet and rill – steep hill country	N18
	Streambank scour	N19
	Stream avulsion	N20
	Shoreline erosion – cliff/headland	N21
	Shoreline erosion – beach/dune	N22
	Alluvion: – Debris fan deposition – Overbank deposition – Accelerated in-filling (including estuaries) – Snow avalanches	N23
Volcanic/Geothermal Activity	Magmatic Eruptions – Ruapehu (or other)	N24
	Ashfall – Ruapehu (or other)	N25
	Ruapehu Lahar	N26
	Mayor Island Activity	N27
	Auckland Volcanic Field	N28
	Other events from TVZ	N29
	Geothermal ground activity: – Eruptions – Subsidence – Movement of hot ground	N30
Severe Storm Events	High winds	N31
	Lightning strikes	N32
	Cyclones or Tornadoes	N33
	Snow storm	N34
	Hailstorm	N35
	Frost	N36
	Fog	N37
Fire (Rural)	Self-igniting, human-induced or peatlands	N38
Space debris (comets and meteorites)	Impact and effects	N39
Drought		N40
Heatwave		N41
Sea Level Rise	*Using IPCC predicted average rate	N42
Climate Change	*Assumes sea level rise will occur regardless of rate of climate change	N43

<b>Technological Hazards – Waikato Region</b>		
<b>Process/Primary Effect</b>	<b>Hazard/Failure Mechanism/ Triggers</b>	<b>Hazard Code (future HAZREG)</b>
Telecommunications System Failure	<ul style="list-style-type: none"> <li>– Telecommunications system (includes landlines, radio frequency repeater networks and cellnets)</li> <li>– Large-Scale ISP/network crash</li> <li>– Local authority (such as EW Hydrotel or computer system)</li> </ul>	T1
Services/Infrastructure Failure	<ul style="list-style-type: none"> <li>– Sewerage</li> <li>– Storm water</li> <li>– Water supply</li> <li>– Gas pipeline</li> <li>– Main SHW bridges</li> <li>– Building collapse (large scale in CBD)</li> </ul>	T2
Electricity Failure	<ul style="list-style-type: none"> <li>– Power Generation (thermal and hydro)</li> <li>– HVAC and HVDC Transmission (includes HVDC Link)</li> <li>– Distribution Networks (includes substations and urban underground and overhead cabling)</li> </ul>	T3
Hazardous Substances Spill	<ul style="list-style-type: none"> <li>– Land – during production, transport, storage, spill or leak (includes disposal of large quantities of contaminated material and gas)</li> <li>– Marine Oil Spills</li> </ul>	T4
Major Transportation Accident	Air	T5
	Shipping	T6
	Rail	T7
	Road	T8
Urban Fire	<ul style="list-style-type: none"> <li>– Post-earthquake</li> <li>– Volcanic-induced</li> <li>– Explosive (gas/petroleum storage facility or generating plant)</li> </ul>	T9
Chronic Evolving Contamination	<ul style="list-style-type: none"> <li>– Contaminated food</li> <li>– Fluoride overdose in water supply</li> </ul>	T10
Ionising Radiation	Discharges with implications	T11
Criminal Acts	<ul style="list-style-type: none"> <li>– Civil Unrest</li> <li>– Vandalism of infrastructure</li> </ul>	T12
Terrorism		T13
Enemy Attack/Invasion		T14
Space Debris	Includes satellites and re-entry vehicles	T15
Financial Crisis	Stock-market Crash	T16
River/Lake Control Structure Failures	Instantaneous failure (due to design, sub-surface or earthquake) of: <ul style="list-style-type: none"> <li>– EW control structures</li> <li>– Tongariro scheme canals</li> <li>– Karapiro</li> </ul>	T17
Mine Subsidence/Tailings Dam Failure	Examples are: <ul style="list-style-type: none"> <li>– Golden Cross Tailings Dam</li> <li>– Waihi (Royal) Underground</li> <li>– Huntly Underground</li> <li>– Rotowaro Opencast</li> </ul>	T18
Air Quality	Monitoring of High Risk Urban Areas	T19

<b>Biological Hazards – Waikato Region</b>		
<b>Process/Primary Effect</b>	<b>Hazard/Failure Mechanism/Triggers</b>	<b>Hazard Code (future HazReg)</b>
Plant Pests	Categories: <ul style="list-style-type: none"> <li>– Eradication</li> <li>– Containment</li> <li>– Surveillance and</li> <li>– Information</li> </ul>	B1
Animal Pests		B2
Human Pandemic	Respiratory Pathogens (e.g. Influenza) Gastro-Intestinal Pathogens Other: <ul style="list-style-type: none"> <li>– Skin puncture source</li> <li>– Meningococcal Virus</li> <li>– Trichonella</li> <li>– Hepatitis B</li> </ul> Imported – Rare (e.g. Anthrax)	B3
Animal Epidemic	Examples are: <ul style="list-style-type: none"> <li>– Brucella Suis</li> <li>– Foot and Mouth</li> <li>– Bovine Spongiform Encephalopathy (BSE)</li> </ul>	B4

## 2.2 Refined Hazard List

The following 'reduced' list of hazard types has been collated using feedback from the three EOA Hazard Workshops (Section 2.2.1), the Strategic Working Party and regional emergency service providers.

This following (refined list takes into account district-specific requirements and feedback, priorities of )risk management from each of those groups and the possibilities of Maximum Likely Events (MLE's) and/or declared emergencies being triggered by these hazards.

Once again, they are not in any order of importance, level of risk or impact.

<b>Process/Primary Effect</b>	<b>Hazard/Failure Mechanism and/or Triggers</b>
Inundation	River and Stream Flooding (including floodplain)
	Local surface ponding/saturation
	Landslide dam breaks
	Storm surge/tidal effects (includes seiching)
	Tsunami: <ul style="list-style-type: none"> <li>– far-field generated (includes seiching)</li> <li>– near-field generated (includes seiching)</li> </ul>
Subsidence	Soil shrinkage/swelling
	Karst solutioning and cave systems
Landslip	Deep-seated rock slides
	Flows and lateral spreads (slow = <0.1m/s)
	Flows and lateral spreads (fast = >0.1m/s)
	Rock/soil fall
	Topples
	Complex slope failures (more than one of subsidence, slides, flows, falls & topples)
Earthquake	Liquefaction
	Fault rupture and heave (-ve subsidence and fault offset)
	Ground shaking (distant or local sourced)
Erosion/Deposition	Shallow soil/regolith: <ul style="list-style-type: none"> <li>– gully, sheet and rill</li> <li>– steep hill country</li> </ul>
	Stream avulsion
	Shoreline erosion – cliff/headland
	Shoreline erosion – beach/dune
Volcanic/Geothermal Activity	Magmatic Eruptions – Ruapehu (or other)
	Ashfall – Ruapehu (or other)
	Ruapehu Lahar
	Mayor Island Activity
	Auckland Volcanic Field
	Other events from TVZ
	Geothermal ground activity: <ul style="list-style-type: none"> <li>– Eruptions</li> <li>– Subsidence</li> <li>– Movement of hot ground</li> </ul>
Severe Storm Events	High winds
	Cyclones or Tornadoes
Fire (rural)	Self-igniting, Human-Induced or Peatlands
Drought	

<b>Process/Primary Effect</b>	<b>Hazard/Failure Mechanism and/or Triggers</b>
Heatwave	
Services/Infrastructure Failure	<ul style="list-style-type: none"> <li>- Sewerage</li> <li>- Storm water</li> <li>- Water supply</li> <li>- Gas pipeline</li> <li>- Main SHW bridges</li> <li>- Building collapse (large scale in CBD)</li> </ul>
Electricity Failure	<ul style="list-style-type: none"> <li>- Power Generation (thermal and hydro)</li> <li>- HVAC and HVDC Transmission (includes HVDC Link)</li> <li>- Distribution Networks (includes substations, urban underground &amp; overhead)</li> </ul>
Hazardous Substances Spill	<ul style="list-style-type: none"> <li>- Land – during production, transport, storage, spill or leak (includes disposal of large quantities of contaminated material and gas)</li> </ul>
Major Transportation Accident	Air, Rail or Road
Urban Fire	<ul style="list-style-type: none"> <li>- Post-earthquake</li> <li>- Volcanic-induced</li> <li>- Explosive (gas/petroleum storage facility or generating plant)</li> </ul>
Terrorism	
Enemy Attack/Invasion	
River/Lake Control Structure Failures	Instantaneous failure (due to design, sub-surface or earthquake) of: <ul style="list-style-type: none"> <li>- EW control structures</li> <li>- Karapiro</li> </ul>
Mine Subsidence/Tailings Dam Failure	Examples are: <ul style="list-style-type: none"> <li>- Golden Cross Tailings Dam</li> <li>- Waihi (Royal) Underground</li> <li>- Huntly Underground</li> <li>- Rotowaro Opencast</li> </ul>
Human Pandemic	Respiratory Pathogens (e.g. Influenza or SARS)
Animal Epidemic	<ul style="list-style-type: none"> <li>- Foot and Mouth</li> </ul>

## 2.2.1 Summary of EOA Workshop Feedback

This section summarises the feedback and comments received during the series of EOA Hazard Workshops which were held in June 2004.

### **Thames Valley EOA**

As a result of discussions and feedback on the refined TVEOA hazard list, it was agreed that “*Electricity Failure*” would be added as a separate risk (Section 4) based on the following scenario:

- Peak season (Dec/Jan)
- 3-4 day disruption
- Coromandel / Hauraki wide
- Declared emergency
- Severe storm?

#### *Reason for inclusion*

It was felt that if an electricity failure event occurred during the peak season, at a time when infrastructure is already stretched, it could pose a real threat to community health by increasing the risk from contamination. Generator availability would also be an issue due to the isolation of many settlements, especially if this occurred during bad weather.

After applying the SMG analysis and the weightings, this risk has been assessed at being the fifth most important risk for the TVEOA (Section 4).

### ***Waikato Valley EOA***

No additional risks were added.

### ***Southern EOA***

As a result of discussions and feedback on the refined SEOA hazard list, it was agreed that “*Electricity Failure*” and “*Services/Infrastructure Failure*” would be added as separate risks (Appendix 4) based on the following scenarios:

#### Services/Infrastructure Failure

- Peak season (summer)
- 1-2 weeks disruption
- Declared emergency
- Cryptosporidium/Algal Bloom/Sewage contamination - Flooding

#### Electricity Failure

- Peak season (winter)
- 3-4 day disruption
- EOA wide
- Declared emergency
- Severe storm?

#### *Reason for inclusion*

It was felt that if an electricity failure event occurred during the peak season, at a time when infrastructure is already stretched, it could pose a real threat to community health by increasing the risk from contamination and due to cold wet weather. Generator availability would also be an issue due to the isolation of many settlements.

In regard to services/infrastructure failure, it was felt that if this occurred during the summer season then it could result in widespread disruption to potable water supplies during a time when the population of the districts swells due to an influx of tourists and visitors. Fresh water would have to be tanked in from other areas. The Taupo water supply system also has no current capacity to treat water for algal blooms and this is becoming an increasing threat on the lake. This scenario would also pose a serious threat to public health.

After applying the SMG analysis and the weightings, these risks have been assessed at being the second and third most important risk for the SEOA respectively (Appendix 4).

## 2.3 EOA Based Hazard Lists

These Emergency Operating Area (EOA-based) hazard lists were produced during and following consultation (as outlined in Section 2.2.1) . They provide a further method to reduce the hazard list for the Waikato CDEM Group to those that (possibly) have measurable impacts and levels of risk. In most cases they are based on recognised and documented hazards and allow each EOA to think about relational levels of risk.

### 2.3.1 Thames Valley Emergency Operating Area (TVEOA)

The district authorities covered by this EOA are Hauraki District Council (HDC), Matamata-Piako District Council (MPDC) and Thames-Coromandel District Council (TCDC)

Hazard Type - Thames Valley EOA	Relative Level of Impact			
	HDC	MPDC	TCDC	Total
River/Stream Flooding and Ponding	14	13	13	40
Storm Surge/Tidal Effect	14	0	13	27
Tsunami	17	0	17	34
Landslip	10	12	10	32
Earthquake	15	15	20	50
Shore Erosion	9	0	13	22
Ashfall - Ruapehu (or other)	10	10	10	30
Mayor Island Activity	15	15	15	45
Severe Storm Events	13	13	13	39
Fire (Rural)	8	8	8	24
Services/Infrastructure Failure	13	13	13	39
Hazardous Substances Spill	8	8	8	24
Terrorism	2	2	2	6
Mine Subsidence/Tailings Dam Failure	5	0	0	5
Human Pandemic	9	9	9	27
Animal Epidemic	11	11	11	33
MLE's identified by this EOA are:	Kerepehi ML			
	Mayor Island eruption			
	Tsunami			
	Combined Event:			
		Flooding/Ponding		
		Waihou/Piako scheme failure		
		Thames coast storm tide (1995 event)		
Events of National Significance:	Terrorism			
	SARs			
	Foot and Mouth			



District	Hazard	Impact	Relative Level of Impact					Each Hazard	Source
			1 (low)	2	3	4	5 (high)		
Hauraki	River/Stream Flooding and Ponding	Human			3				Information from Ron White at TCDC
		Economic			3				
		Social			3				
		Infrastructure			3				
		Geographic		2					
		<b>Total Level of Impact</b>		0	2	12	0	0	
	Storm Surge/Tidal Effect	Human			3				
		Economic			3				
		Social			3				
		Infrastructure			3				
		Geographic		2					
		<b>Total Level of Impact</b>		0	2	12	0	0	
	Tsunami	Human			3				
		Economic				4			
		Social				4			
		Infrastructure				4			
		Geographic		2					
		<b>Total Level of Impact</b>		0	2	3	12	0	
	Landslip	Human			3				
		Economic		2					
		Social	1						
		Infrastructure		2					
		Geographic		2					
		<b>Total Level of Impact</b>		1	6	3	0	0	
	Earthquake	Human			3				
		Economic			3				
		Social			3				
		Infrastructure			3				
Geographic				3					
<b>Total Level of Impact</b>			0	0	15	0	0	15	
Shoreline Erosion	Human		2						
	Economic		2						
	Social		2						
	Infrastructure		2						
	Geographic	1							
	<b>Total Level of Impact</b>		1	8	0	0	0	9	
Ashfall - Ruapehu (or other)	Human		2						
	Economic			3					
	Social		2						
	Infrastructure		2						
	Geographic	1							
	<b>Total Level of Impact</b>		1	6	3	0	0	10	
Mayor Island Activity	Human			3					
	Economic				4				
	Social			3					
	Infrastructure			3					
	Geographic		2						
	<b>Total Level of Impact</b>		0	2	9	4	0	15	
Severe Storm Events	Human			3					
	Economic				4				
	Social				4				
	Infrastructure	1							
	Geographic	1							
	<b>Total Level of Impact</b>		2	0	3	8	0	13	
Fire (Rural)	Human		2						
	Economic		2						
	Social		2						
	Infrastructure	1							
	Geographic	1							
	<b>Total Level of Impact</b>		2	6	0	0	0	8	
Services/Infrastructure Failure									

District	Hazard	Impact	Relative Level of Impact					Each Hazard	Source
			1 (low)	2	3	4	5 (high)		
Matamata-Piako	River/Stream Flooding and Ponding	Human			3				
		Economic			3				
		Social			3				
		Infrastructure		2					
		Geographic		2					
		<b>Total Level of Impact</b>	0	4	9	0	0	13	
	Landslip	Human			3				
		Economic		2					
		Social		2					
		Infrastructure			3				
		Geographic		2					
		<b>Total Level of Impact</b>	0	6	6	0	0	12	
	Earthquake	Human			3				
		Economic			3				
		Social			3				
		Infrastructure			3				
		Geographic			3				
		<b>Total Level of Impact</b>	0	0	15	0	0	15	
	Ashfall - Ruapehu (or other)	Human		2					
		Economic			3				
		Social		2					
		Infrastructure		2					
		Geographic		1					
		<b>Total Level of Impact</b>	1	6	3	0	0	10	
	Mayor Island Activity	Human			3				
		Economic				4			
		Social			3				
		Infrastructure			3				
Geographic			2						
<b>Total Level of Impact</b>		0	2	9	4	0	15		
Severe Storm Events	Human			3					
	Economic				4				
	Social				4				
	Infrastructure	1							
	Geographic	1							
	<b>Total Level of Impact</b>	2	0	3	8	0	13		
Fire (Rural)	Human		2						
	Economic		2						
	Social		2						
	Infrastructure	1							
	Geographic	1							
	<b>Total Level of Impact</b>	2	6	0	0	0	8		
Services/Infrastructure Failure	Human			3					
	Economic				4				
	Social				4				
	Infrastructure	1							
	Geographic	1							
	<b>Total Level of Impact</b>	2	0	3	8	0	13		
Hazardous Substances Spill	Human		2						
	Economic		2						
	Social		2						
	Infrastructure	1							
	Geographic	1							
	<b>Total Level of Impact</b>	2	6	0	0	0	8		
Terrorism	Human	1							
	Economic								
	Social	1							
	Infrastructure								
	Geographic								
	<b>Total Level of Impact</b>	2	0	0	0	0	2		
Human Pandemic									

Information from Ron White at TCDC

District	Hazard	Impact	Relative Level of Impact					Each Hazard	Source
			1 (low)	2	3	4	5 (high)		
Thames Coromandel	River/Stream Flooding and Ponding	Human			3				TCDC/EW joint briefing paper - Natural Hazards in the Thames-Coromandel District and information from Ron White
		Economic			3				
		Social			3				
		Infrastructure	2						
		Geographic	2						
		<b>Total Level of Impact</b>	0	4	9	0	0	13	
	Storm Surge/Tidal Effect	Human			3				
		Economic			3				
		Social			3				
		Infrastructure	2						
		Geographic	2						
		<b>Total Level of Impact</b>	0	4	9	0	0	13	
	Tsunami	Human			3				
		Economic				4			
		Social				4			
		Infrastructure				4			
		Geographic	2						
		<b>Total Level of Impact</b>	0	2	3	12	0	17	
	Landslip	Human			3				
		Economic		2					
		Social	1						
		Infrastructure	2						
		Geographic	2						
		<b>Total Level of Impact</b>	1	6	3	0	0	10	
	Earthquake	Human					5		
		Economic				4			
		Social			3				
		Infrastructure					5		
		Geographic			3				
<b>Total Level of Impact</b>		0	0	6	4	10	20		
Shoreline Erosion	Human			3					
	Economic				4				
	Social	2							
	Infrastructure			3					
	Geographic	1							
	<b>Total Level of Impact</b>	1	2	6	4	0	13		
Ashfall - Ruapehu (or other)	Human		2						
	Economic			3					
	Social	2							
	Infrastructure	2							
	Geographic	1							
	<b>Total Level of Impact</b>	1	6	3	0	0	10		
Mayor Island Activity	Human			3					
	Economic				4				
	Social			3					
	Infrastructure			3					
	Geographic	2							
	<b>Total Level of Impact</b>	0	2	9	4	0	15		
Severe Storm Events	Human			3					
	Economic				4				
	Social				4				
	Infrastructure	1							
	Geographic	1							
	<b>Total Level of Impact</b>	2	0	3	8	0	13		
Fire (Rural)	Human		2						
	Economic		2						
	Social		2						
	Infrastructure	1							
	Geographic	1							
	<b>Total Level of Impact</b>	2	6	0	0	0	8		
Services/Infrastructure Failure									

## 2.3.2 Waikato Valley Emergency Operating Area (WVEOA)

The district authorities covered by this EOA are Waipa District Council (WDC), Otorohanga District Council (ODC), Waitomo District Council (Waitomo DC), Waikato District Council (WDC) and Hamilton City Council (HCC).

Hazard Type - Waikato Valley EOA	Relative Level of Impact					
	Waipa DC	Oto DC	Waitomo DC	Waikato DC	Hamilton CC	Total
River/Stream Flooding and Ponding	11	17	13	11	13	65
Subsidence (Karst solutioning)	12	8	12	0	0	32
Landslip	13	12	10	0	9	44
Earthquake	12	0	5	10	14	41
Shoreline Erosion	0	14	10	0	0	24
Ashfall - Ruapehu (or others)	11	0	5	10	12	38
Auckland Volcanic Field	0	0	0	10	12	22
Severe Storm Events	13	0	0	9	0	22
Fire (Rural)	7	9	0	0	0	16
Heatwave	0	0	0	0	4	4
Services/Infrastructure Failure	0	0	0	9	0	9
Electricity Failure	13	0	0	13	0	26
Hazardous Substances Spill	9	0	0	0	0	9
Major Transportation Accident (Air)	12	0	0	0	0	12
Terrorism	2	2	2	2	2	10
River/Lake Control Structure Failure	21	0	0	13	0	34
Human Pandemic	0	0	0	11	11	22
Animal Epidemic	0	0	0	11	0	11
MLE's identified by this EOA are:	River flooding; EQ-induced banks down following a 1/500 year event					
	Fault rupture: Kerepehi					
	Wairoa North					
	Volcanic (not specifically within this EOA)					
	River/Lake control structure failure (following EQ)					
	* assumes repeat of 1891 Wairoa fault EQ					
	Electricity Failure (check redundancy with Lifelines Group)					
Events of National Significance:	Terrorism					
	SARs					
	Foot and Mouth					

District	Hazard	Impact	Relative Level of Impact					Each Hazard	Source
			1 (low)	2	3	4	5 (high)		
Waipa	River/Stream Flooding and Ponding	Human		2					
		Economic		2					
		Social		2					
		Infrastructure			3				
		Geographic		2					
		<b>Total Level of Impact</b>		0	8	3	0	0	11
	Subsidence (Karst Solutioning)	Human		2					
		Economic			3				
		Social		2					
		Infrastructure		2					
		Geographic			3				
		<b>Total Level of Impact</b>		0	6	6	0	0	12
	Landslip	Human			3				
		Economic		2					
		Social			3				
		Infrastructure			3				
		Geographic		2					
		<b>Total Level of Impact</b>		0	4	9	0	0	13
	Earthquake	Human			3				
		Economic			3				
		Social		2					
		Infrastructure			3				
		Geographic		1					
		<b>Total Level of Impact</b>		1	2	9	0	0	12
	Ashfall - Ruapehu (or other)	Human			3				
		Economic			3				
		Social		2					
		Infrastructure		1					
Geographic			2						
<b>Total Level of Impact</b>			1	4	6	0	0	11	
Severe Storm Events	Human			3					
	Economic			3					
	Social		2						
	Infrastructure			3					
	Geographic		2						
	<b>Total Level of Impact</b>		0	4	9	0	0	13	
Fire (Rural)	Human		2						
	Economic		2						
	Social		1						
	Infrastructure		1						
	Geographic		1						
	<b>Total Level of Impact</b>		3	4	0	0	0	7	
Electricity Failure	Human			3					
	Economic				4				
	Social				4				
	Infrastructure		1						
	Geographic		1						
	<b>Total Level of Impact</b>		2	0	3	8	0	13	
Hazardous Substances Spill	Human			3					
	Economic		2						
	Social		2						
	Infrastructure		1						
	Geographic		1						
	<b>Total Level of Impact</b>		2	4	3	0	0	9	
Major Transportation Accident	Human			3					
	Economic			3					
	Social			3					
	Infrastructure		2						
	Geographic		1						
	<b>Total Level of Impact</b>		1	2	9	0	0	12	
Terrorism									

Interpretation from Waipa District Plan and information from Chuck Davis

District	Hazard	Impact	Relative Level of Impact					Each Hazard	Source
			1 (low)	2	3	4	5 (high)		
Otorohanga	River/Stream Flooding and Ponding	Human			3				Information from David Hall
		Economic				4			
		Social			3				
		Infrastructure				4			
		Geographic			3				
		<b>Total Level of Impact</b>	0	0	9	8	0	17	
	Subsidence (Karst Solutioning)	Human		2					
		Economic		2					
		Social	1						
		Infrastructure		2					
		Geographic	1						
		<b>Total Level of Impact</b>	2	6	0	0	0	8	
	Landslip	Human			3				
		Economic		2					
		Social		2					
		Infrastructure			3				
		Geographic		2					
		<b>Total Level of Impact</b>	0	6	6	0	0	12	
	Shoreline Erosion	Human		2					
		Economic				4			
		Social			3				
		Infrastructure			3				
		Geographic		2					
		<b>Total Level of Impact</b>	0	4	6	4	0	14	
	Fire (Rural)	Human			3				
		Economic		2					
		Social	1						
		Infrastructure	1						
Geographic			2						
<b>Total Level of Impact</b>		2	4	3	0	0	9		
Terrorism	Human	1							
	Economic								
	Social	1							
	Infrastructure								
	Geographic								
	<b>Total Level of Impact</b>	2	0	0	0	0	2		

District	Hazard	Impact	Relative Level of Impact					Each Hazard	Source
			1 (low)	2	3	4	5 (high)		
Waitomo	River/Stream Flooding and Ponding	Human	1						Waitomo District Plan Section 27.1.5 (note that this does not mention Karst terrain) and information from John Moran
		Economic			3				
		Social			3				
		Infrastructure			3				
		Geographic			3				
		<b>Total Level of Impact</b>		1	0	12	0	0	
	Subsidence (Karst Solutioning)	Human		2					
		Economic			3				
		Social		2					
		Infrastructure		2					
		Geographic			3				
		<b>Total Level of Impact</b>		0	6	6	0	0	
	Landslip	Human	1						
		Economic		2					
		Social		2					
		Infrastructure			3				
		Geographic		2					
		<b>Total Level of Impact</b>		1	6	3	0	0	
	Earthquake	Human	1						
		Economic	1						
		Social	1						
		Infrastructure	1						
		Geographic	1						
		<b>Total Level of Impact</b>		5	0	0	0	0	
	Shoreline Erosion	Human	1						
		Economic			3				
		Social		2					
		Infrastructure		2					
Geographic			2						
<b>Total Level of Impact</b>			1	6	3	0	0	10	
Ashfall - Ruapehu (or other)	Human	1							
	Economic	1							
	Social	1							
	Infrastructure	1							
	Geographic	1							
	<b>Total Level of Impact</b>		5	0	0	0	0	5	
Terrorism	Human	1							
	Economic								
	Social	1							
	Infrastructure								
	Geographic								
	<b>Total Level of Impact</b>		2	0	0	0	0	2	

District	Hazard	Impact	Relative Level of Impact					Each Hazard	Comments
			1 (low)	2	3	4	5 (high)		
Waikato	River/Stream Flooding and Ponding	Human		2					Assumes 58 flood and some overtopping
		Economic			3				
		Social		2					
		Infrastructure		2					
		Geographic		2					
		<b>Total Level of Impact</b>		0	8	3	0	0	
	Earthquake	Human		2					Assumes repeat of 1891 Wairoa Fault quake with possible dam break scenario
		Economic			3				
		Social		2					
		Infrastructure		2					
		Geographic		1					
		<b>Total Level of Impact</b>		1	6	3	0	0	
	Ashfall - Ruapehu (or other)	Human		1					Assumes significant ash cover.
		Economic			3				
		Social		2					
		Infrastructure		1					
		Geographic			3				
		<b>Total Level of Impact</b>		2	2	6	0	0	
	Auckland Volcanic Field	Human		2					Mian effect due to refugee influx from Auckland and Manukau Cities.
		Economic				4			
		Social			3				
		Infrastructure		1					
		Geographic							
		<b>Total Level of Impact</b>		1	2	3	4	0	
	Severe Storm Events	Human		2					
		Economic		2					
		Social		2					
Infrastructure			2						
Geographic			1						
<b>Total Level of Impact</b>			1	8	0	0	0	9	
Services/Infrastructure Failure	Human		2					River water not suitable for drinking supply at Huntly for two weeks. No account taken of impact from Hamilton	
	Economic		2						
	Social		2						
	Infrastructure		2						
	Geographic		1						
	<b>Total Level of Impact</b>		1	8	0	0	0		9
Electricity Failure	Human			3				District-wide for days	
	Economic				4				
	Social				4				
	Infrastructure		1						
	Geographic		1						
	<b>Total Level of Impact</b>		2	0	3	8	0		13
Terrorism	Human		1						
	Economic								
	Social		1						
	Infrastructure								
	Geographic								
	<b>Total Level of Impact</b>		2	0	0	0	0		2
River/Lake Control Structure Failure	Human			3				Assumes repeat of 1891 Wairoa Fault quake with possible dam break scenario	
	Economic				4				
	Social		2						
	Infrastructure		2						
	Geographic		2						
	<b>Total Level of Impact</b>		0	6	3	4	0		13
Human Pandemic	Human		2						
	Economic				4				
	Social			3					
	Infrastructure		1						
	Geographic		1						
	<b>Total Level of Impact</b>		2	2	3	4	0		11
Animal Epidemic									



District	Hazard	Impact	Relative Level of Impact					Each Hazard	Source	
			1 (low)	2	3	4	5 (high)			
Hamilton	River/Stream Flooding and Ponding	Human		2					Blackstock (2002). Hazard Mapping in Hamilton City (Waikato Uni thesis) Table 3.5	
		Economic			3					
		Social			3					
		Infrastructure		2						
		Geographic			3					
		<b>Total Level of Impact</b>		0	4	9	0	0		13
	Landslip	Human		2						
		Economic		2						
		Social		2						
		Infrastructure		2						
		Geographic		1						
		<b>Total Level of Impact</b>		1	8	0	0	0		9
	Earthquake	Human		2						
		Economic			3					
		Social			3					
		Infrastructure			3					
		Geographic			3					
		<b>Total Level of Impact</b>		0	2	12	0	0		14
	Ashfall - Ruapehu (or other)	Human		2						
		Economic		2						
		Social		2						
		Infrastructure		2						
		Geographic					4			
		<b>Total Level of Impact</b>		0	8	0	4	0		12
	Auckland Volcanic Field	Human			3					
		Economic				4				
		Social			3					
		Infrastructure		1						
Geographic			1							
	<b>Total Level of Impact</b>		2	0	6	4	0	12		
Heatwave	Human		2							
	Economic		1							
	Social		1							
	Infrastructure									
	Geographic									
	<b>Total Level of Impact</b>		2	2	0	0	0	4		
Terrorism	Human		1							
	Economic									
	Social		1							
	Infrastructure									
	Geographic									
	<b>Total Level of Impact</b>		2	0	0	0	0	2		
Human Pandemic	Human		2							
	Economic				4					
	Social			3						
	Infrastructure		1							
	Geographic		1							
	<b>Total Level of Impact</b>		2	2	3	4	0	11		

### 2.3.3 Southern Emergency Operating Area (SEOA)

The district authorities covered by this EOA are Taupo District Council (TDC) and South Waikato District Council (SWDC).

Hazard Type - Southern EOA	Relative Level of Impact		
	Taupo DC	SWDC	Total
River/Stream Flooding and Ponding	10	8	18
Tsunami	0	13	13
Earthquake	13	24	37
Ashfall - Ruapehu (or other)	17	21	38
Ruapehu Lahar	15	0	15
Geothermal Ground Activity	16	0	16
Severe Storm Events	8	16	24
Fire (Rural)	8	17	25
Hazardous Substances Spill	8	15	23
Major Transportation Accident (Road)	0	6	6
Terrorism	2	2	4
Landslip	19	0	19
Human Pandemic	9	9	18
Animal Epidemic	11	11	22
MLE's identified by this EOA are:	Volcanic Eruption (1/100 year event)		
	Waihi/Hipaua		
	Earthquake		
	River Flooding		
Events of National Significance:	Ruapehu Lahar		
	Terrorism		
	SARs		
	Foot and Mouth		

District	Hazard	Impact	Relative Level of Impact					Each Hazard Total	Source
			1 (low)	2	3	4	5 (high)		
Taupo	River/Stream Flooding and Ponding	Human	2						Information provided by Richard Balm and Martin Sears
		Economic	2						
		Social	2						
		Infrastructure	2						
		Geographic	2						
		<b>Total Level of Impact</b>	0	10	0	0	0	10	
	Earthquake	Human				4			
		Economic		3					
		Social	2						
		Infrastructure	2						
		Geographic	2						
		<b>Total Level of Impact</b>	0	6	3	4	0	13	
	Landslip (Hipaau)	Human				4			
		Economic		3					
		Social				4			
		Infrastructure				4			
		Geographic				4			
		<b>Total Level of Impact</b>	0	0	3	16	0	19	
	Ashfall - Ruapehu (or other)	Human			3				
		Economic				4			
		Social			3				
		Infrastructure				4			
		Geographic			3				
		<b>Total Level of Impact</b>	0	0	9	8	0	17	
	Ruapehu Lahar	Human			3				
		Economic			3				
		Social			3				
		Infrastructure			3				
		Geographic			3				
<b>Total Level of Impact</b>		0	0	15	0	0	15		
Geothermal Ground Activity	Human		2						
	Economic				4				
	Social				4				
	Infrastructure			3					
	Geographic			3					
	<b>Total Level of Impact</b>	0	2	6	8	0	16		
Severe Storm Events	Human		2						
	Economic		2						
	Social		2						
	Infrastructure	1							
	Geographic	1							
	<b>Total Level of Impact</b>	2	6	0	0	0	8		
Fire (Rural)	Human		2						
	Economic		2						
	Social		2						
	Infrastructure	1							
	Geographic	1							
	<b>Total Level of Impact</b>	2	6	0	0	0	8		
Hazardous Substances Spill	Human		2						
	Economic		2						
	Social		2						
	Infrastructure	1							
	Geographic	1							
	<b>Total Level of Impact</b>	2	6	0	0	0	8		
Terrorism	Human	1							
	Economic								
	Social	1							
	Infrastructure								
	Geographic								
	<b>Total Level of Impact</b>	2	0	0	0	0	2		

District	Hazard	Impact	Relative Level of Impact					Each Hazard	Source
			1 (low)	2	3	4	5 (high)		
South Waikato	River/Stream Flooding and Ponding	Human		2					South Waikato District Council Disaster Recovery Plan and information from Barrie Herlihy
		Economic		2					
		Social		2					
		Infrastructure	1						
		Geographic	1						
		<b>Total Level of Impact</b>		2	6	0	0	0	
	Tsunami	Human			3				
		Economic					5		
		Social			3				
		Infrastructure	1						
		Geographic	1						
		<b>Total Level of Impact</b>		2	0	6	0	5	
	Earthquake	Human					5		
		Economic					5		
		Social					5		
		Infrastructure					5		
		Geographic				4			
		<b>Total Level of Impact</b>		0	0	0	4	20	
	Ashfall - Ruapehu (or other)	Human			3				
		Economic					5		
		Social					5		
		Infrastructure			3				
		Geographic					5		
		<b>Total Level of Impact</b>		0	0	6	0	15	
	Severe Storm Events	Human			3				
		Economic					5		
		Social			3				
		Infrastructure			3				
Geographic			2						
<b>Total Level of Impact</b>			0	2	9	0	5	16	
Fire (Rural)	Human			3					
	Economic					5			
	Social					5			
	Infrastructure					5			
	Geographic				4				
	<b>Total Level of Impact</b>		0	0	3	4	10	17	
Hazardous Substances Spill	Human				4				
	Economic				4				
	Social			3					
	Infrastructure	2							
	Geographic	2							
	<b>Total Level of Impact</b>		0	4	3	8	0	15	
Major Transportation Accident (Road)	Human		2						
	Economic								
	Social	1							
	Infrastructure			3					
	Geographic								
	<b>Total Level of Impact</b>		1	2	3	0	0	6	
Terrorism	Human	1							
	Economic								
	Social	1							
	Infrastructure								
	Geographic								
	<b>Total Level of Impact</b>		2	0	0	0	0	2	
Human Pandemic	Human				4				
	Economic			3					
	Social		2						
	Infrastructure								
	Geographic								
	<b>Total Level of Impact</b>		0	2	3	4	0	9	
Animal Epidemic									



## 2.4 Common Event Scenarios

This section contains the scenarios for each hazard that is common across the three EOAs as a basis for evaluating the risks using the SMG model.

### 2.4.1 Animal Epidemic - Foot & Mouth Disease Outbreak (MLE, National Declared)

**Location:** National

#### Scenario – maximum impact event

A major epidemic of foot-and-mouth disease is dispersed across both islands prior to detection and imposition of movement control restrictions, as occurred in the United Kingdom in 2001. Such an outbreak would require over 5,000 staff within four weeks, with an estimated 300,000 animals requiring slaughter and disposal.

Such an outbreak would overwhelm veterinary and contracted response service suppliers. Recruitment from other sources and international assistance would be urgent and necessary. The New Zealand economy would be in dire straits as all export of animals and animal products would cease and markets would have not yet been reopened. Animal welfare problems would exist as farms would be overstocked with animals for which there is no market and insufficient feed. A reserve bank study in 2002 estimated the cumulative loss in nominal GDP of around \$6 billion after 1 year, and \$10 billion after 2 years for a moderate outbreak of 50 properties. If the outbreak occurred during the peak milk period, the majority of production for 6 weeks would be lost for export trade. Storage capacity constraints would limit salvage of milk. Similarly the impact on the meat industry would last up to 6-12 months for a moderate outbreak. There would be flow on effects in the financial sector (exchange rate shock) with a large initial drop in the NZ dollar in the order of 20% in the first quarter. A net decline of 2.5% in net foreign assets can be expected and additional overseas borrowing of 8 billion dollars would be necessary.

#### Scenario – mid-range event

A number of cases of anthrax are detected on the banks of the Manawatu River, near Foxton. While anthrax is endemic with sporadic incidence in many countries, the disease has not been diagnosed in New Zealand since 1954 and is now treated as exotic. Anthrax affects animals and humans, and may be fatal, so is considered a serious public health risk. An incursion would require significant public communications assuring the safety of the New Zealand meat products. Trade would also be severely affected. Public health officials will be overwhelmed with the demand for information.

In addition to the above hypothetical example, since 2000, MAF has responded to Varroa (bees), Mycoplasma response (dairy), *Brucella suis* (pigs), Parrot Pox (birds) and Postweaning Multisystemic Wasting Syndrome (pigs).

Both scenarios above have been taken from the Ministry of Agriculture and Forestry report titled "Advice to Civil Defence/Emergency Management Groups on Hazard Identification and Emergency Management".

#### **Likelihood**

Foot-and-mouth disease (FMD) has never occurred in New Zealand. New Zealand has some of the strictest import restrictions internationally. FMD is a low probability but high consequence risk for New Zealand due to increased global travel and trade. Recent experiences in Taiwan 1997 (FMD-free since 1929), South Africa 2000 (FMD-free since 1956 in domestic livestock), South Korea 2000 (FMD-free since 1934), Japan 2000 (FMD-free since 1908) and the UK (FMD-free since 1967) underline that the threat of this disease is omnipresent.

Midrange event such as anthrax, formerly present in New Zealand and abundant in other countries or avian influenza with a strain that affects humans have greater probability. There have been six instances of bird flu recently (UK 1996; China 1998, Hong Kong 1997, 1999 and 2003 and the Netherlands 2003). Human-to-human transmission of avian influenzas is thought to be extremely limited. The exact mode of transmission from birds to humans is not known. It is this unknown that results in public concern that would exceed the technical issues.

### ***Growth Statement***

The possibility of introduction of diseases present in the countries of trading partners as well as new and emerging diseases is increasing, due to increased travel and environmental pressures. The possibility of bioterrorist activities targeted at agriculture has also increased significantly, as has response planning and public awareness around this issue.

### ***Consequences (HSEIG)***

#### *Human*

- Public concern and panic are greater than actual human illness or death from zoonotics as a relatively small proportion of the population interact routinely with livestock and poultry.
- Food safety issues will come to the forefront with diseases such as anthrax, bovine spongiform encephalopathy or other transmissible encephalopathies of animals due to the linkage with new variant Creutzfeldt Jakob disease, a degenerative fatal human encephalopathy.
- Other public health priorities also compromised.

#### *Social*

For Foot-and-Mouth Disease:

- 15-20,000 increase in unemployed.
- Reduced household wealth due to drop in exchange rate and investment.
- Loss of ability to work for large portion of the workforce.
- Psychological impacts including fear and confusion, paranoia and other trauma.
- Stigma of biosecurity breakdown placed on those affected.
- Loss of rural community fabric due to devastation of rural economy.

#### *Economic*

For Foot-and-Mouth Disease:

- A loss of GDP \$6 billion in first year; \$10 billion after 2 years.
- 8% drop in export of goods and services in first year.
- Loss would continue because output lowered and exacerbated by slumps in domestic demand and negative reaction of trading partners.
- 20% drop in exchange rate, recovering over ~ 2 1/2 years.
- Reduced overseas and local investment (short term by 20%, longer term 6%).
- Reduced tax revenue \$3.5 billion over 4 years.
- Doubling of net debt (2009/10 projected 12.1%, rises to 25.6%).
- Cost of emergency response to the outbreak = \$200 million includes controlling outbreak & compensating for animals slaughtered.
- Tourism drop could be significant (in the UK during 2001, tourism was impacted 10 times more than the primary production sector).

#### *Infrastructure*

- Challenges on infrastructure are dependent on circumstance. They may include demands on water supply due to the need for cleaning and disinfection for conveyances and for premises decontamination, heavy equipment demands and environmental degradation due to carcass disposal, demand on municipal landfill for disposal of potentially infected material, or biosecure transport of carcasses over public roads to mass burial sites.

### *Geographic*

- Dairy in Waikato, Taranaki, Southland.
- Sheep and beef in South Island - Otago, Southland.
- Poultry and pigs around Auckland and Christchurch.

### **Seriousness statement:**

These events have the potential to severely disrupt society.

### **Current management mechanisms in use**

- MAF Standards, Procedures and Industry specifications.
- MAF contracts with EDR suppliers and expert veterinary services (Massey).
- EDR suppliers' contingency stores.
- Animal Biosecurity Consultative Committee.
- Technical Advisory Group – *ad hoc* multidisciplinary group of experts.
- Domestic and External Security Coordination (DESC) framework.
- Training and exercises.
- Relevant legislation (Biosecurity Act 1993).

### **Response / Actions taken**

#### *Capacity to Respond*

Existing performance standards require:

- Nation-wide investigative capability on 24 hour/365 day standby, with investigation and reporting within 5 hours of any call to the MAF Exotic Disease Hotline (0800 80 9966).
- Capability to manage an outbreak involving 25 Infected Places in the first week, and 10 weekly thereafter, using a three-tier response structure (decision-making, technical management, field operations) aligned with the Coordinated Incident Management System, and operational within 24 hours of a response being called.

The principal roleholders within New Zealand's animal disease response system are:

- MAF Biosecurity Authority.
- MAF National Centre for Disease Investigation, incorporating:
  - New Zealand Animal Health Reference Laboratory
  - Exotic Disease Response Centre.
- AgriQuality New Zealand Ltd.
- Asure New Zealand Ltd.
- Institute of Veterinary, Animal and Biomedical Sciences, Massey University.

Personnel resources within the core exotic disease response capability include:

- Director of Animal Biosecurity, MAF Biosecurity Authority.
- Surveillance and Response Team, MAF Biosecurity.
- Veterinary epidemiologists at MAF National Centre for Disease Investigation (with support staff).
- New Zealand Animal Health Reference Laboratory, a fully functional Physical Containment level 3 laboratory, with associated veterinary and technical staff.

Contracted suppliers to MAF provide:

- Initial Investigating Veterinarians, cross-skilled to fill roles if a response is called.
- Infected Place Managers and Security Officers.
- Tracing Group Managers, Supervisors, and Tracing Officers.
- Field Operations Response Team Headquarters Controllers.



- Cleaning and Disinfection Supervisors, with identified Cleaning and Disinfection sites nationally.
- Liaison Officers for the dairy industry.
- Liaison Officers for the meat processing industry.
- Liaison Officers cross-skilled for the Animal Fibre and Aquaculture industries.

In addition, MAF has supply arrangements that include:

- Institute of Veterinary, Animal and Biomedical Sciences, Massey University.
- Specialist veterinary staff and an agreement for the use of all veterinarians and final year veterinary students during a response.
- 100 private veterinary practitioners nation-wide trained to fill surveillance roles during a response.
- 100 overseas veterinarians, livestock consultants, emergency managers accessed through the International Animal Health Emergency Reserve (Australia, USA, Canada, United Kingdom, Ireland and New Zealand).

Stores are maintained to support veterinary investigative activities, headquarters establishment, cleaning and disinfection activities, and infected place management.

#### *Possible future management mechanisms*

- National emergency management plan.

#### ***Manageability statement:***

Many management mechanisms are in place. These are coordinated centrally by the Chief Technical Officer using procedures described in MAF's documented standards and procedures. Integral to the response is MAF's National Centre for Disease Investigation which becomes the Exotic Disease Response Centre (EDRC) in the event of an incursion response. The EDRC is activated for all incursion responses under MAF jurisdiction. It is well co-ordinated and experienced with contracted supplier organisations. Specific financial appropriation is required for delivery of any response. Obtaining the financial resources may require inter-departmental coordination.

#### ***Issues Arising***

- Coordination of agencies with CDEM at regional and local levels.
- Many animal health issues may instantly become nationally significant event with a single case being recorded (eg. Anthrax, BSE).

## **2.4.2 Hazard – Human Pandemic (MLE, National Declared)**

### ***Description of Event***

This scenario has been developed in consultation with the Waikato District health Board. Pandemics have the potential to cause widespread illness, death and disruption. Factors that need to be present for a pandemic to occur include the emergence of a new viral subtype, the capacity for the virus to spread efficiently from person to person, and being virulent enough to cause disease. The most likely scenario is that of an influenza pandemic. Influenza pandemics are characterised by the spread of a novel type of influenza virus to all parts of the world, causing unusually high morbidity and death for two to three years. Most people are susceptible to influenza.

While it is not possible to predict when the next influenza pandemic will occur, advance planning can assist in reducing the impact of future events. The National Influenza Pandemic Action Plan ([www.moh.govt.nz](http://www.moh.govt.nz) - publications) provides a framework for preparation and response by the health sector.

**Note:** There is a National Clinical Action Plan for Emerging Infectious Disease under development, which will replace the National Influenza Plan and become the generic national management guidelines for any epidemic or pandemic.

### ***Magnitude of Event:***

Variable

### ***Recurrence Interval:***

It is not possible to predict when the next pandemic will occur or how long it will last. The last true pandemic was in 1968.

### ***Impacts/Consequences***

*Human, may include:*

- High morbidity;
- High death rate, especially in susceptible populations, such as the elderly and the very young;
- Loss of income/ability to support family/whanau;
- Inability to provide key services (emergency services, health, education, transport, and utility) due to absence of workers

*Economic*

- Loss of workers leading to decreased productivity;
- Loss of farm productivity;
- Loss of tourism;
- Loss of export dollars (agricultural and tourism);
- Loss of supply of domestic products;
- Insurance adjustments after event (national implications);
- Health management and other response response costs;
- Loss of overseas investment and business confidence;

*Social*

- Closure/attempted closure of or limitations on places of 'mass gatherings', eg schools, factories, churches, maraes, restaurants, sporting events, etc;
- Limited/curtailed movement around the country;
- Increased unemployment;
- 'siege mentality', especially in smaller communities.
- Sharemarket downturn;
- Exchange rate reduction.

*Infrastructure*

- Loss of infrastructure support services due to loss of personnel;
- Breakdown/failure of key utilities due to the above.

#### *Geographic*

- Contamination and spread of infection
- Isolation of some communities, exacerbated if infrastructure (eg telecommunications, power) fails.

### **2.4.3 Electricity/Services/Infrastructure Failure (Undeclared)**

*Note that the occurrence of this event during the summer season in the TVEOA is likely to raise the level to that of a Declared emergency. This is because during normal operating times the infrastructure supplied by a single feed into the Coromandel Peninsular is already stretched (such as sewerage and stormwater) and additional demand is likely to outstrip contingency availability very quickly. If this event occurs during the holiday season and as a result of a storm event, then supplying backup generators would be problematic and the event is likely to last for a longer period of time.*

#### **Location**

CBD in any Thames Valley EOA, Waikato Valley EOA or Southern EOA town or city.

#### **Description of Event**

This scenario has been based on the “The Auckland Electricity Supply Disruption 1998” report written by the then Ministry of Civil Defence. The event almost resulted in a civil defence declaration for Auckland City Council.

The time is 8am on a Monday morning and suddenly there is widespread electricity failure across the Hamilton CBD. The cause is unknown but it could be as a result from a wind storm, earthquake, volcanic eruption, or simply a technical fault. This event may have also been triggered by tower sabotage.

#### **Magnitude of Event**

Variable

#### **Recurrence Interval**

Unknown

#### **Impacts/Consequences**

##### *Human*

- Safety concerns due to lights out (people using stairs etc)
- Food inadequately cooked (due to failure of electricity during cooking)
- Lack of continuous refrigeration leading to bacterial growth causing food poisoning
- Inadequate lighting to ensure cleanliness of dishes and premises
- Inadequate hot water to sanitise
- Fumes from generators and poor ventilation
- Normally inactive people being subjected to excessive exercise
- Personal hygiene issues (unable to flush toilets, wash clothes, shower etc)
- Potential for legionnaires’ disease due to inadequate water flow
- People stranded in lifts
- Some automatic doors may stay closed trapping people

##### *Economic*

- Loss of business

- Agency response costs
- Loss of Eftpos and ATM transactions
- Delays in any proposed sports fixture (such an international cricket or rugby match - particularly those scheduled at night)
- Loss of products (particularly food)
- Loss of international reputation and effect on tourism
- Looting and vandalism
- Disruption to banking and other financial services
- Insurance adjustments after the event

#### *Social*

- Temporary closures of some retail stores and schools
- Relocating and housing evacuees from downtown hotels and motels and other accommodation services
- Increased requirement for social services (relocation, food, etc)

#### *Infrastructure*

- Traffic lights fail at major intersections
- Replacement cables and other
- Wastewater, water and natural gas reticulation systems rendered inoperable
- Sprinkler and alarm systems deactivated
- Absence of heating and/or air conditioning
- Lifts inoperable
- Shortage of generators
- Disruptions to communications such as email, faxes and phone lines

#### *Geographic*

- Effects on waterways due to sewerage contamination

## **2.4.4 Major Transportation Accident/Hazardous Chemical Spill – Road (Undeclared)**

### ***Location***

Any Waikato town or city.

### ***Description of Event***

This scenario has been based on the “Chemcourier” chemical spill report (Docs #781483).

The incident occurred on Monday 23 September 2001 when two trailers of an articulated truck laden with toxic chemicals and paint burst into flames. The chemicals included formaldehyde, pesticides and a large quantity of paint. A formal report on the incident was written and this can be consulted for further information.

### ***Magnitude of Event***

Variable

### ***Recurrence Interval***

Unknown

## ***Impacts/Consequences***

### *Human*

- Fatalities: up to 5 people during peak traffic times
- Injured pedestrians/bystanders
- Entrapped persons and injuries
- Significant pressure on emergency services
- Toxic fumes may affect residents downwind
- Evacuation and loss of habitable dwellings

### *Economic*

- Closure of major transportation routes
- Closure of businesses
- Agency response costs

### *Social*

- Closure of nearby schools and businesses
- Increased requirement for relocating evacuees (welfare)

### *Infrastructure*

- Fire and structural damage to nearby buildings and/or homes
- Road damage
- Gridlock due to rush hour
- Electricity transmission lines repairs

### *Geographic*

- Fuel and contaminants flow into waterways

## **2.4.5 Fire (Rural) (Declared)**

### ***Location***

Any where in the Waikato Region

### ***Description of Event***

This scenario has based on information contained within the rural fire plans of the region and the National Rural Fire Authority website.

The threat of rural fires is a high probability across most parts of the Waikato region. The areas most at risk are the districts that have both low moisture levels (particularly in the summer) and those with extensive areas of native or exotic forest plantations – such as the Thames-Coromandel, South Waikato, and Taupo Districts.

In this scenario the cause is unknown but it could be either from a lightning strike, arson, or by accidental means (e.g. from a cigarette butt, spark from a train, arcing of high voltage electricity wires, or from a motor vehicle accident). Most likely trigger is tramper carelessness.

A fire has broken out in a Radiata pine plantation about 12km north east of Tokoroa. The blaze is spreading rapidly through large areas of the tinder dry forest due to strong NE winds, high air temperatures, and low humidity. No significant rain has fallen in the area for 5 weeks. The fire is engulfing everything in its path and is out of control.

The fire front is 5 km across and widening and is travelling at 3km/hr. At this rate, it is expected to reach the outskirts of Tokoroa in about 4 hours and the eastern part of town needs to be evacuated immediately. There is very thick smoke blowing across the town affecting residents,

particularly those with respiratory illnesses. The Kinleith Pulp and Paper Mill will possibly be shut down and evacuated as a precaution.

### ***Magnitude of Event***

Variable

### ***Recurrence Interval***

Unknown

### ***Impacts/Consequences***

#### *Human*

- Fatalities & injuries (both to the public and fire fighters)
- Special care for the elderly and disabled or those in special care facilities
- Evacuation and loss of habitable buildings
- Distress to the unpredictable nature of the event and being forced from home (not knowing what to come back to)
- Requirement of psychological support services
- First aid and medical support services

#### *Economic*

- Loss of export earnings (millions of dollars)
- Loss of tourism
- High insurance implications (adjustments likely after the event)
- Loss of primary and secondary production and job losses
- High cost of rebuilding infrastructure
- Huge agency response costs
- Declaration costs

#### *Social*

- Archaeological sites damaged or destroyed
- Closure of schools

#### *Infrastructure*

- Major disruption to transport (road, rail and air)
- Traffic congestion and delays
- Extensive areas of houses, businesses and factories destroyed
- Smoke damage
- Power and telephone lines destroyed (communications disrupted isolating many communities). Major power outages across the district

#### *Geographic*

- Loss of stock and productive land
- Parks and reserves destroyed (including hiking tracks and huts)
- Important ecological sites destroyed
- The fire straddles the boundary of two districts/regions

## 2.4.6 Fire (Rural) (Undeclared)

### ***Location***

Any where in the Waikato Region

### ***Description of Event***

This scenario has based on information contained within the rural fire plans of the region and the National Rural Fire Authority website.

The threat of rural fires is a high probability across most parts of the Waikato region. The areas most at risk are the districts that have both low moisture levels (particularly in the summer) and those with extensive areas of native or exotic forest plantations – such as the Thames-Coromandel, South Waikato, and Taupo Districts.

In this scenario the cause is unknown but it could be from either a lightening strike, arson, or by accidental means (e.g. from a cigarette butt, spark from a train, arcing of high voltage electricity wires, or from a motor vehicle accident).

A fire has broken out in the foot hills of the Coromandel Ranges about 5 km east of Te Puru. The blaze is spreading rapidly through large areas of dry scrub due to strong NW winds, high air temperatures, and low humidity. No significant rain has fallen in the area for 2.5 weeks.

The fire front is 0.5 km across and widening and is travelling at 1km/hr. At this time the fire is not expected to affect Te Puru, unless the wind changes direction to an easterly. It is unlikely that the settlement will need to be evacuated but residents have been put on high alert as a precaution. The Department of Conservation is the lead agency as the affected area is predominantly Crown land.

### ***Magnitude of Event***

Variable

### ***Recurrence Interval***

Unknown

### ***Impacts/Consequences***

#### *Human*

- Injuries (to the fire fighters)
- Potential for evacuation
- Distress due to the unpredictable nature of the event and potentially being forced from home (not knowing what to come back to)
- First aid and medical support services

#### *Economic*

- Loss of tourism
- Insurance implications (adjustments likely after the event)
- Agency response costs

#### *Social*

- Archaeological sites damaged or destroyed
- Closure of school

#### *Infrastructure*

- Disruption to transportation route (state highway 25)
- Traffic congestion and delays
- Smoke damage

#### *Geographic*

- Loss of native plant and animal species
- Increased erosion
- Parks and reserves destroyed (including hiking tracks and huts)
- Important ecological sites destroyed

## **2.4.7 Terrorism**

### ***Assumptions***

Terrorism on a small scale similar to other criminal events such as homicide, and largely dealt with under the emergency services SOP's (with Police as lead agency)

Terrorism MLE for Waikato similar to scenario used in CIMS training (Bomb blast at Farmers Department Store)

MLE for Waikato could lead to a CD declaration, but is unlikely to. Therefore, MLE for this hazard would sit just above declaration point on basis of planning pyramid.

### ***Scenarios***

Two levels considered:

Minor undeclared incident

MLE (Bomb blast)

### **2.4.7.1 Minor Terrorist Incident (Undeclared)**

Minor incident involving individual or small group of individuals attack on individuals/small groups. Scenarios could include water supply destruction/poisoning, light aircraft crash into building, sniper attack or anthrax contamination.

### ***Magnitude of Event***

Small-scale response within emergency services SOP's

### ***Recurrence Interval***

Unknown

### ***Impacts/Consequences***

#### *Human*

- 2-3 dead, a few injuries (1 or 2 serious)

#### *Social*

- National significance
- Emotional impacts to local area
- Need for counselling and ongoing support

#### *Economic*

- Small negative impact on regional reputation and tourism industry (short-term only)



#### *Infrastructure*

- Minor damage to commercial, residential or public infrastructure

#### *Geographic*

- No impact

### **2.4.8 Major Terrorist Incident (MLE)**

Bomb threat and subsequent explosion at Farmers department store from a car bomb. Several deaths, multiple injuries and fire spreading to adjacent shops. Wide blast zone extending to intersections, and significant damage to adjacent buildings. Possible threat of second bomb with an unknown position.

#### ***Magnitude of Event***

Unknown

#### ***Recurrence Interval***

Unknown

#### ***Impacts/Consequences***

##### *Human*

- Multiple deaths (possibly into double figures)
- Multiple injuries
- Widespread distress and uncertainty associated with possible second bomb
- Some evacuations

##### *Social*

- Significant social disruption to Hamilton
- Closure of businesses
- Closure of local roads
- Large requirement for social services (counselling, relocation, food etc)
- Event of national significance

##### *Economic*

- Loss of income and business failures
- Severe damage to buildings
- Loss of tourism
- High health costs
- Major response and recovery costs
- Closure of a portion of city centre

##### *Infrastructure*

- Extensive localised damage to buildings and related services
- Local electricity failure
- Localised damage to water supplies

##### *Geographic*

- Alteration of the cityscape

## 2.5 Thames Valley EOA Event Scenarios

### 2.5.1 Earthquake (MLE)

A fault rupture event similar to the 1987 Edgecumbe earthquake, but centred on the Elstow arm of the Kerepehi Fault. Fault rupture occurred along a 14km length and resulted in a vertical displacement of up to 2m. Due to the type of sediment across the Hauraki plains this causes considerable liquefaction and associated ground movement, with ground shaking occurring during the initial shake for 15 seconds. Peak ground acceleration is high (from 0.2 to 0.5), with some attenuation to the east by the Kaimai and Coromandel ranges and to the west by a low range, which protects (to a degree) Ngaruawahia and Cambridge. However, ground shaking is extensive through to Hamilton City, with damage occurring to older buildings in Te Kauwhata, Huntly and Ngaruawahia. Huntly East Mine collapse has occurred with one shift trapped underground. Ground movement takes out the Kopu Bridge, the Kopu Substation (supplying Thames and the Coromandel Peninsula) and the Waikino Substation (feeding Waihi) has been damaged. Road and rail egress is compromised.

#### ***Magnitude of Event***

ML6.8 with MMX at epicentre.

#### ***Recurrence Interval***

2000-3500 years.

#### ***Impacts/Consequences***

##### *Human*

- Evacuation and loss of habitable dwellings in multiple towns
- Multiple fatalities
- Crush injuries
- Trapped survivors in a number of Thames, Te Aroha, Kopu, Te Kauwhata, Huntly and Ngaruawahia buildings
- Trapped miners in Huntly East Mine
- Mass evacuation and displacement
- Distress and associated suicides and on-going mental health problems
- Removal of local government staff from other districts to assist
- Mobilisation of armed forces, USR, fire and police

##### *Social*

- Closure of schools
- Increased requirement for social services (counselling, relocation, food etc)
- Requirement for increased morgue and autopsy facilities

##### *Economic*

- Loss of income (self-employed)
- Dairy loss due to power and water outage
- Du Pont Chemical factory, Inghams Chickens, Waitoa dairy factory all damaged
- Loss of marine farming due to water contamination from factory effluent ponds and milk discharge from ruptured tanks
- Closure of major transportation routes
- Closure of Huntly East Mine with blockage of main addit to Huntly West
- Loss of tourism
- Loss of export dollars (agricultural, mining and tourism)

- Insurance adjustments after event (national implications) and EQC payouts
- Health costs
- Response costs (food, clothing, shelter, transportation)
- Heavy equipment costs
- Cleanup of sewerage
- Repair of infrastructure, communications and power systems
- Cost of earthworks stabilisation on roadslips

#### *Infrastructure*

- Bridges and approaches destroyed
- Substation at Kopu out of commission (supplies Coromandel Peninsula)
- Substation at Waikino damaged ( supplies Waihi)
- Some communications networks off-line (cellnets down)
- Water supply out of action
- Sewerage lines broken causing some contamination and hence affecting water supplies for Ngaruawahia and Huntly (which have 2 days supply only)
- Larger community buildings collapsed, including council offices at Te Aroha, Thames and Huntly
- Closure of rail link (Kaimai Tunnel)
- Oxidation ponds leaking
- Closure of all roads into and out of the Hauraki basin and across to the Coromandel peninsula
- Thames airport closed, with runway liquefied and uplifted
- Long-term cost and timing of repair to destroyed/damaged infrastructure
- Floodbanks collapsed in places and liquefaction sand boils visible at the base of others
- Some damage to buildings in Hamilton and associated loss of productivity

#### *Geographic*

- Change in riverbed alignment along the Waihou River with flooding of previously dry land
- Wetland contamination
- Effects on aquaculture/marine farming with milk supplied dumped due to lack of power and water supplies

## **2.5.2 Earthquake (Declared)**

Movement along a 2km stretch of the Elstow arm of the Kerepehi Fault, with vertical uplift of 0.9m. Some liquefaction and ground movement across the Hauraki Plains. Peak ground acceleration is 0.2 – 0.3 with some attenuation to the east by the Kaimai and Coromandel ranges and to the west by a low range, which protects (to a degree) Ngaruawahia and Cambridge. Ground movement takes out the Kopu Bridge and the Kopu Substation (supplying Thames and the Coromandel Peninsula). Some damage in Te Kauwahata, Huntly and Ngaruawahia.

#### ***Magnitude of Event***

ML5.5 with MMVII at epicentre

#### ***Recurrence Interval***

<2000 years

#### ***Impacts/Consequences***

##### *Human*

- Evacuation and loss of habitable dwellings in multiple towns
- Multiple fatalities

- Crush injuries
- Trapped survivors in a number of Thames, Te Aroha and Kopu buildings
- Trapped miners in Huntly East Mine
- Mass evacuation and displacement
- Distress and associated suicides and on-going mental health problems
- Removal of local government staff from other districts to assist
- Mobilisation of armed forces, USR, fire and police

#### *Social*

- Closure of schools
- Increased requirement for social services (counselling, relocation, food etc)
- Requirement for increased morgue and autopsy facilities

#### *Economic*

- Loss of income (self-employed)
- Dairy loss due to power and water outage
- Du Pont Chemical factory, Inghams Chickens, Waitoa dairy factory all damaged
- Loss of marine farming due to water contamination from factory effluent ponds and milk discharge from ruptured tanks
- Closure of Huntly East Mine with blockage of main addit to Huntly West
- Closure of major transportation routes
- Loss of tourism
- Loss of export dollars (agricultural and tourism)
- Insurance adjustments after event (national implications) and EQC payouts
- Health costs
- Response costs (food, clothing, shelter, transportation)
- Heavy equipment costs
- Cleanup of sewerage
- Repair of infrastructure, communications and power systems

#### *Infrastructure*

- Bridges and approaches destroyed
- Substation at Kopu out of commission (supplies Coromandel Peninsula)
- Some communications networks off-line (cellnets down)
- Water supply out of action
- Sewerage lines broken causing some contamination and hence affecting water supplies for Ngaruawahia and Huntly (which have 2 days supply only)
- Larger community buildings collapsed, including council offices at Te Aroha and Thames
- Closure of rail link (Kaimai Tunnel)
- Oxidation ponds leaking
- Closure of all roads into and out of the Hauraki basin and across to the Coromandel peninsula
- Thames airport closed, with runway liquefied and uplifted
- Long-term cost and timing of repair to destroyed/damaged infrastructure
- Floodbanks collapsed in places and liquefaction sand boils visible at the base of others

#### *Geographic*

- Change in riverbed alignment along the waihou River
- Wetland contamination
- Effects on aquaculture/marine farming with milk supplied dumped due to lack of power and water supplies

## 2.5.3 Earthquake (Undeclared)

Minor event centered at Elstow, with no loss of life and minor injuries due to falling objects

### ***Magnitude of Event***

ML4.5 with MMV at epicentre

### ***Recurrence Interval***

<2000 years

### ***Impacts/Consequences***

#### *Human*

- Evacuation from some buildings in Thames, Turua, Ngatea and Kerepehi
- Some crush injuries
- Short-term distress

#### *Social*

- Increased requirement for social services (counseling, relocation, food etc)

#### *Economic*

- Loss of income (self-employed)
- Dairy loss due to power and water outage
- Insurance and some EQC payouts
- Health costs
- Response costs (food, clothing, shelter, transportation)
- Repair of infrastructure (minor road and bridge approach works)

#### *Infrastructure*

- Bridges approaches damaged
- Temporary closure of rail link (Kaimai Tunnel) until safety inspection undertaken
- Closure of Kopu Bridge to undertake repairs to approaches
- Some sand boils at base of floodbanks; inspections required

#### *Geographic*

- None

### ***References***

These scenarios were developed with some input from the following sources:

Van Dissen et al. 2003. Illustrations of historic and pre-historic surface rupture of active faults in New Zealand, paper presented at the 2003 Pacific Conference on Earthquake Engineering, Christchurch, New Zealand; Paper #156.

Environment Waikato/GNS. Regional Ground Shaking Risk Zones and Active Fault Lines; GIS map of ground shaking potential for the Waikato Region.

Du Pont Peroxide Limited. 1996. Earthquake at Morrinsville – CD scenario.

Van Dissen et al. 2003. An interim classification of New Zealand's active faults for the mitigation of surface rupture hazard, paper presented at the 2003 Pacific Conference on Earthquake Engineering, Christchurch, New Zealand; Paper #155.

Marks and Larkin, 1996. The seismic response of volcanic sites, a report for EQC, pp.172-173.

Parkin, 1998. The potential impacts of earthquakes, floods and volcanoes in the Waikato Region.

Edbrooke, 2002. Earthquake and Geothermal Hazard Assessment, South Auckland Mens Correctional Facility, PGA figures taken from Fig. 12.

## 2.5.4 Mayor Island Activity (Declared)

### *Location*

TVEOA

### *Description of Event*

This scenario has been primarily based on the following document:

- “Impact of a Volcanic Eruption on Agriculture and Forestry in New Zealand”. MAF Policy Technical Paper 99/2

The worst case scenario is a repeat of the 6340 year B.P. eruption associated with a strong easterly wind. Pyroclastic flows, surges and ballistic blocks would devastate the entire island. Thick ash falls would cover a large part of South Auckland, Waikato, and the Bay of Plenty. Since the Mayor Island magma is exceptionally rich in chlorine and fluorine, the poisoning of stock in ash affected areas may result from any eruption, even in areas where only minor amounts have fallen.

### *Magnitude of Event*

>1.0 km<sup>3</sup>

### *Recurrence Interval*

1:10,000 years

### *Impacts/Consequences:*

#### *Human*

- Deaths and injuries
- Huge impacts to health
- Mass evacuation requirements and dislocation
- Distress and on-going mental health issues
- Damage to residential areas (e.g. roof collapse)

#### *Social*

- Severe disruption to local communities
- Closure of most roads and airports
- Severe trauma and requirement for social services
- Most vehicles inoperable

#### *Economic*

- Huge agency response costs
- Huge clean-up costs (esp. roads)
- Widespread business failures
- Major disruption to primary industries
- Loss of jobs (long term)
- Huge loss of agricultural production (farming/forestry/crops)
- Huge loss of tourism

- Severe damage to residential housing
- Long-term re-instatement of infrastructure

*Infrastructure*

- Severe and widespread damage to roads, sewerage and water systems
- Electricity losses (including Transpower’s national grid network)
- Damage to rail lines and disruption to schedules (passenger and freight)
- Roof collapse of some businesses

*Geographic*

- Impacts on recreational fishing and tourism
- Widespread ash fall impacts – sedimentation, clogging of drains/ivers etc.

## 2.5.5 Mayor Island Activity (Undeclared)

***Location***

TVEOA

***Description of Event***

This scenario has been primarily based on the following document:

- “Impact of a Volcanic Eruption on Agriculture and Forestry in New Zealand”. MAF Policy Technical Paper 99/2

This scenario assumes an eruption associated with a strong easterly wind. Light to moderate ash falls cover a wide area within the TVEOA.

***Magnitude of Event***

0.1 - 1.0 km<sup>3</sup>

***Recurrence Interval***

1:10,000 years

***Impacts/Consequences***

*Human*

- Minor impacts to health
- Minimal distress

*Social*

- Minor disruption to local communities
- Temporary closure of some roads and airports

*Economic*

- Agency response costs
- Clean-up costs (esp. roads)
- Minor disruption to primary production (farming/forestry/crops)

*Infrastructure*

- Moderate damage to roads, sewerage and water systems

*Geographic*

- Minor impacts on recreational fishing and tourism
- Widespread ash fall impacts – sedimentation, turbidity

## 2.5.6 River/Stream Flooding and Ponding

General Note: Three levels of scenarios are applicable based on the wide range of combinations across the 3 EOA's. Two scenarios are applicable for each level within each EOA based on the location of river systems and broad types of events. The following sub-areas have been identified:

- WVEOA: Lower Waikato/Waipā and Mokau/Awakino
- SEOA: South-east Lake Taupo and South Waikato District
- TVEOA: Waihou/Piako and Coromandel

### 2.5.6.1 Waihou/Piako (Undeclared)

Flood event following large storm front or multiple small events moving across the North Island. Flood flows from the Waihou and Piako Rivers and tributaries, with ponding behind floodbanks and control structures. Inundation of low lying unprotected land along the channels of the Waihou and Piako Rivers and some major tributaries.

#### ***Magnitude of Event***

Up to and including a 1/100 year event

#### ***Recurrence Interval***

1/25 - 1/100 years

#### ***Impacts/Consequences***

##### *Human*

- Possible evacuation and displacement of a small number of people
- Some emotional distress among landowners along channels

##### *Social*

- Closure of some roads
- Slightly increased requirement for social services

##### *Economic*

- Loss of farm productivity
- Delays to major transportation routes
- Loss of export dollars (agricultural and tourism)
- Response costs to local authorities
- Repair of infrastructure
- Damage to flood protection schemes

##### *Infrastructure*

- Roads flooded (SH's and local)
- Possible minor electricity failure
- Some communications networks damaged or offline

##### *Geographic*

- Sedimentation
- Erosion exacerbation



## 2.5.6.2 Waihou/Piako – Declared

Flood event following longitudinally extensive storm front moving across the North Island. Flood flows from the Piako and Waihou Rivers and tributaries, with large-scale ponding behind floodbanks and control structures. Failure of drainage pumps and some sections of floodbanks.

### ***Magnitude of Event***

>100 year event

### ***Recurrence Interval***

Between 1/100 – 1/500 years

### ***Impacts/Consequences***

#### *Human*

- Evacuation and loss of habitable dwellings
- Flooding of commercial buildings
- Possible drownings
- Injuries
- Substantial evacuation and displacement
- Distress and on-going mental health problems
- Removal of local government staff from other districts to assist

#### *Social*

- Significant social disruption
- Closure of schools
- Temporary closure transportation links
- Increased requirement for social services (counselling, relocation, food etc)

#### *Economic*

- Loss of income (self-employed)
- Large loss of farm productivity
- Loss of marine farming due to sewerage contamination
- Closure of major transportation routes
- Loss of tourism
- Loss of export dollars (agricultural and tourism)
- Insurance adjustments after event (national implications)
- Health costs
- Response costs (food, clothing, shelter, transportation)
- Heavy equipment costs
- Cleanup of sewerage
- Repair of infrastructure

#### *Infrastructure*

- Bridges and approaches washed out
- Substation at Kopu out of commission (supplies Coromandel Peninsula)
- Some communications networks off-line
- Some water supplies inoperable
- Sewerage lines broken and some washed away, localised contamination
- Community centres flooded (alternate evacuation centres required)
- Temporary closure of rail link (Kaimai Tunnel)
- Long-term cost of repair to destroyed/damaged infrastructure

### *Geographic*

- Loss of stock and agricultural land
- Wetland contamination
- Effects on aquaculture/marine farming

## **2.5.6.3 Waihou/Piako (MLE)**

Flood event following extensive storm fronts over a long duration moving across the North Island. Huge flood flows from the Piako and Waihou Rivers and tributaries, with catastrophic failure of all river flood protection scheme structures. Widespread inundation of land throughout the Lower Piako and Waihou Rivers and all major tributaries.

### ***Magnitude of Event***

>1/500 year event

### ***Recurrence Interval***

>1/500 years

### ***Impacts/Consequences:***

#### *Human*

- Mass evacuation and loss of habitable dwellings (displacement)
- Flooding of major urban and rural areas
- Deaths (drowning)
- Extensive injuries
- Widespread distress and on-going mental health problems
- Removal of local and central government, volunteer, army staff to assist

#### *Social*

- Significant social disruption
- Closure of schools
- Closure of transportation links
- Large requirement for social services (counselling, relocation, food etc)

#### *Economic*

- Widespread loss of income and business failures
- Huge loss of farm productivity
- Severe damage to and closure of major transportation routes
- Loss of tourism
- Huge loss of export dollars (agricultural and tourism)
- Large insurance adjustments after event (national implications)
- Very high health costs
- Major response and recovery costs (food, clothing, shelter, transportation)

#### *Infrastructure*

- Total failure of flood protection schemes
- Extensive damage to all transportation links
- Some communications networks off-line
- Electricity failure
- Water supplies inoperable
- Widespread sewerage contamination
- Community centres flooded (alternate evacuation centres required)

#### *Geographic*

- Loss of stock and agricultural land
- Wetland contamination
- Damage to rural landscape

### **2.5.6.4 Coromandel (Undeclared)**

Flood event following large storm front or multiple small events moving across the North Island. Flood flows from streams and rivers throughout the Coromandel Peninsula (particularly Western). Inundation of low lying land along the channels of the rivers and streams.

#### ***Magnitude of Event***

Up to a 1/50 year event

#### ***Recurrence Interval***

1/10 - 1/50 years

#### ***Impacts/Consequences***

##### *Human*

- Possible loss of life and injuries
- Closure of roads
- Evacuations in advance of event

##### *Social*

- Temporary closure of some roads
- Emotional trauma to community already impacted by flooding (greater need for social services)
- Large requirement for volunteer labour

##### *Economic*

- Costs of damage to infrastructure
- Insurance flow-on effects
- Clean-up costs to Councils

##### *Infrastructure*

- Damage to residential houses and properties
- Damage to some businesses
- Roads flooded (local)
- Damage to electricity and water supplies

#### *Geographic*

- Erosion and siltation

### **2.5.6.5 Coromandel (Declared)**

Flood event following large storm front or multiple small events moving across the North Island. Large flood flows from streams and rivers throughout the Coromandel Peninsula (particularly Western). Inundation of low lying land along the channels of the rivers and streams.

#### ***Magnitude of Event***

1/100 year event

### ***Recurrence Interval***

1/100 years

### ***Impacts/Consequences***

See *Weather Bomb scenario and associated damage ("The Weather Bomb 21 June 2002, Final Technical Report, 2202/10", Environment Waikato publication).*

## **2.5.6.6 Coromandel (MLE)**

Flood event following large storm front or multiple small events moving across the North Island. Huge flood flows from streams and rivers throughout the Coromandel Peninsula (particularly Western). Inundation of low lying land along the channels of the rivers and streams.

### ***Magnitude of Event***

>1/100 up to 1/500 year event

### ***Recurrence Interval***

1/100 – 1/500 years

### ***Impacts/Consequences***

*Weather Bomb scenario scaled up by a factor of 1.5 – 2.*

## **2.5.6.7 Distal Tsunami (Declared)**

### ***Location***

East Coast of the Coromandel Peninsula

### ***Description of Event***

This scenario has been based on the following documents:

- "Joint Tsunami Research Project: Stage 1". A report written by GeoEnvironmental Consultants for Environment Waikato and Environment BOP
- "The response of New Zealand waters to the Peru tsunami of 23 June 2001". A report written by Derek Goring (NIWA scientist)
- General information available on NIWA's website.

A large earthquake off the Peruvian coast triggers a tsunami that travels westwards across the Pacific. The Pacific Tsunami Warning Centre (PTWC) in Hawaii estimates that the tsunami will arrive in New Zealand waters in 15 hours time. Maximum wave heights are expected to be up to 6m. Areas most at risk are the beachside settlements on the Bay of Plenty and Coromandel coastlines. The time-scale of the waves will be between 2 and 20 minutes and persist for more than 20 hrs after the arrival of the first waves.

Harbours, estuaries, coastal wetlands and river mouths will be particularly vulnerable to the tsunami's impacts. Immediately prior to the arrival of the tsunami there will be an extreme reduction in coastal water levels followed by a sudden surge of water that

could inundate areas up to 100m inland. The local offshore bathymetry will govern the extent of the severity of the damage at each location.

### ***Magnitude of Event***

Unknown

### ***Recurrence Interval***

1,000 years

### ***Impacts/Consequences***

#### *Human*

- Mass evacuation and displacement
- Loss of habitable dwellings
- Drownings and other fatalities
- Injuries
- Distress and ongoing mental health problems
- Removal of local government staff from other districts/regions to assist

#### *Economic*

- Loss of income (self-employed)
- Loss of employment and business
- Agency response costs
- Loss of tourism
- Re-building of residential suburbs and business zones
- Health costs
- Fishing industry downturn
- Loss of export earnings
- Insurance adjustment after the event
- Heavy equipment costs
- Declaration costs (e.g. food, clothing, shelter, transportation etc)

#### *Social*

- Closure of schools and support services
- Increased requirement for counselling, relocation, etc

#### *Infrastructure*

- Saltwater intrusion/contamination
- Water supply out of action
- Extensive damage to coastal structures (e.g. wharves, boat ramps, navigational equipment)
- Sewerage lines broken (widespread contamination of sewerage)
- Community centres flooded (alternative evacuation centres required)
- Roads, bridges and approaches washed out
- Closure to main transport routes

#### *Geographic*

- Extensive damage to the coastline
- Change in stream and estuary mouth geometry
- Loss of stock and agricultural land
- Wetland contamination
- Effects on aquaculture and marine farming

## 2.5.6.8 Distal Field Tsunami (Undeclared)

### ***Location***

East Coast of the Coromandel Peninsula

### ***Description of Event***

This scenario has been based on the following documents:

- “Joint Tsunami Research Project: Stage 1”. A report written by GeoEnvironmental Consultants for Environment Waikato and Environment BOP
- “The response of New Zealand waters to the Peru tsunami of 23 June 2001”. A report written by Derek Goring (NIWA scientist).
- General information available on NIWA’s website.

A large earthquake off the Peruvian coast triggers a tsunami that travels westwards across the Pacific. The Pacific Tsunami Warning Centre (PTWC) in Hawaii estimates that the tsunami will arrive in New Zealand waters in 16.5 hours time. Maximum wave heights are expected to be up to 4m. Areas most at risk are the beachside settlements on the Bay of Plenty and Coromandel coastlines. The time-scale of the waves will be between 2 and 20 minutes and persist for more than 15 hrs after the arrival of the first waves.

Harbours, estuaries, coastal wetlands and river mouths will be particularly vulnerable to the tsunami’s impacts. Immediately prior to the arrival of the tsunami there will be an extreme reduction in coastal water levels followed by a sudden surge of water that could inundate areas up to 50m inland.

### ***Magnitude of Event***

Unknown

### ***Recurrence Interval***

500 years

### ***Impacts/Consequences***

#### *Human*

- Precautionary evacuation
- Potential loss of habitable dwellings
- Minor flooding of commercial buildings
- Drownings
- Injuries

#### *Economic*

- Loss of tourism
- Health costs
- Insurance adjustment after the event
- Heavy equipment costs
- Minimal agency response costs

#### *Social*

- Closure of schools and support services
- Increased requirement for counselling, relocation, etc
- Minor disruption to daily activities

#### *Infrastructure*

- Saltwater intrusion/contamination
- Water supply may be out of action in some areas
- Minor damage to coastal structures (e.g. wharves, boat ramps, navigational equipment)
- Sewerage lines broken

#### *Geographic*

- Erosive damage to coastline
- Change in stream and estuary mouth geometry

### **2.5.6.9 Local Tsunami (MLE)**

#### ***Location***

East Coast of the Coromandel Peninsula

#### ***Description of Event***

This scenario has been based on the following documents:

- “Joint Tsunami Research Project: Stage 1”. A report written by GeoEnvironmental Consultants for Environment Waikato and Environment BOP
- “The response of New Zealand waters to the Peru tsunami of 23 June 2001”. A report written by Derek Goring (NIWA scientist).
- General information available on NIWA’s website.

Without warning, a ML7.1 offshore earthquake occurs just off the Coromandel coastline generating a catastrophic 10-15m high tsunami. The event is over within 15 minutes. Areas most at risk from this scenario are those beachside settlements closest to the earthquake’s epicentre.

Harbours, estuaries, coastal wetlands and river mouths within the vicinity of the epicentre would have suffered extensive damage with wave run up inundating areas up to 1 km inland.

#### ***Magnitude of Event***

1,000 years

#### ***Recurrence Interval***

Unknown

#### ***Impacts/Consequences***

##### *Human*

- Mass evacuation and displacement (post event)
- Loss of habitable dwellings
- Extensive flooding of commercial buildings
- Drownings and other fatalities
- Widespread injuries
- Distress and ongoing mental health problems
- Removal of local government staff from other districts/regions to assist

### *Economic*

- Loss of income (self-employed)
- Loss of employment
- Loss of tourism
- Huge agency response costs
- Loss of productive land
- Re-building of residential suburbs and business zones
- Loss of regional productivity
- Health costs
- Fishing industry downturn
- Insurance adjustment after the event
- Heavy equipment costs
- Declaration costs (e.g. food, clothing, shelter, transportation etc)

### *Social*

- Closure of schools and support services
- Increased requirement for counselling, relocation, etc

### *Infrastructure*

- Saltwater intrusion/contamination
- Water supply out of action
- Extensive damage and/or total destruction to coastal structures (e.g. wharves, boat ramps, navigational equipment)
- Sewerage lines broken (widespread contamination of sewerage)
- Community centres flooded (alternative evacuation centres required)
- Roads, bridges and approaches washed out
- Closure to main transport routes

### *Geographic*

- Extensive damage to the coastline within immediate vicinity of earthquake's epicentre
- Change in stream and estuary mouth geometry
- Wetland contamination
- Effects on aquaculture and marine farming

## **2.5.6.10 Electricity/Services/Infrastructure Failure (Undeclared)**

### ***Location***

CBD in any Thames Valley EOA or Waikato Valley EOA town or city

### ***Description of Event***

This scenario has been based on the "The Auckland Electricity Supply Disruption 1998" report written by the then Ministry of Civil Defence. The event almost resulted in a civil defence declaration for Auckland City Council.

The time is 8am on a Monday morning and suddenly there is widespread electricity failure across the Hamilton CBD. The cause is unknown but it could be as a result from a wind storm, earthquake, volcanic eruption, or simply a technical fault.

### ***Magnitude of Event***

Variable

### ***Recurrence Interval***

Unknown



## ***Impacts/Consequences***

### *Human*

- Safety concerns due to lights out (people using stairs etc)
- Food inadequately cooked (due to failure of electricity during cooking)
- Lack of continuous refrigeration leading to bacterial growth causing food poisoning
- Inadequate lighting to ensure cleanliness of dishes and premises
- Inadequate hot water to sanitise
- Fumes from generators and poor ventilation
- Normally inactive people being subjected to excessive exercise
- Personal hygiene issues (unable to flush toilets, wash clothes, shower etc)
- Potential for legionnaires' disease due to inadequate water flow
- People stranded in lifts
- Some automatic doors may stay closed trapping people

### *Economic*

- Loss of business
- Agency response costs
- Loss of Eftpos and ATM transactions
- Delays in any proposed sports fixture (such an international cricket or rugby match - particularly those scheduled at night)
- Loss of products (particularly food)
- Loss of international reputation and effect on tourism
- Looting and vandalism
- Disruption to banking and other financial services
- Insurance adjustments after the event

### *Social*

- Temporary closures of some retail stores and schools
- Relocating and housing evacuees from downtown hotels and motels and other accommodation services
- Increased requirement for social services (relocation, food, etc)

### *Infrastructure*

- Traffic lights fail at major intersections
- Replacement cables and other
- Wastewater, water and natural gas reticulation systems rendered inoperable
- Sprinkler and alarm systems deactivated
- Absence of heating and/or air conditioning
- Lifts inoperable
- Shortage of generators
- Disruptions to communications such as email, faxes and phone lines

### *Geographic*

- Effects on waterways due to sewerage contamination

## **2.5.6.11 Landslip**

### ***Scenario 1 – Maximum Likely Event (MLE)***

It is unlikely that a landslip event will precipitate an MLE and this scale of event has not been calculated.

## ***Scenario 2 – Declared Emergency***

It is also unlikely that a landslip event will precipitate a declared emergency and this scale of event has not been calculated.

## ***Scenario 3 – Undeclared Emergency***

Landslip of volcanic material blocking SH25 on the western coastline of the Coromandel peninsular just north of Ruamahunga. This has also meant that the western end of the Tapu-Coroglen Road is only accessible from the northern end of the western peninsular. The event was initiated by high a severe and sustained rainfall event. Several vehicles were involved in the slip and one fatality was reported. Logging trucks have been re-routed via the Coromandel-Whitianga road, with southern access via the Kopu-Hikoai road. This increases demand at the Kopu Bridge.

### ***Magnitude of Event***

Unknown due to limited data history

### ***Recurrence Interval***

Unknown

### ***Impacts/Consequences***

#### *Human*

- Two cars buried in slip material and another 3 pushed aside
- 1 death in one vehicle
- several people injured
- St. Johns Regional Ambulance Service required
- Distress caused by detour at slip site
- Assistance from Fire Service, Police and works construction personnel

#### *Social*

- Support for families affected
- Support for works and police personnel
- Closure of SH25 creates on-going distress at lengthy delays for several weeks

#### *Economic*

- Rescue services (USR, Fire and helicopter)
- Temporary closure of main road transportation route
- Insurance adjustments after event (national implications for transportation costs)
- Health and social services costs
- Response costs (food, accommodation for rescue services etc, transportation)
- Heavy equipment costs for removal of debris and recovery of vehicles
- Cost of infrastructure repair (road)
- Cost of flying-in and supporting the families of tourists involved in event (dead and injured)
- Possible loss of tourism dollars
- Cost of re-routing forestry trucks and of increased maintenance cost to those eastern roads now with increased truck numbers

#### *Infrastructure*

- Road blockage at SH25

#### *Geographic*

- Re-activation of landslip scarp possible
- Redistribution of failed slip material required (Resource Consent implications)

## 2.5.6.12 Storm Surge and Tidal Effect (Declared)

### ***Location***

Firth of Thames

### ***Description of Event***

This scenario has been based on the following documents:

- “Coastal Flooding Hazard in the Waikato Region”, Environment Waikato Technical Report 99/07. Prepared by Jim Dahm
- Cyclone Drena Event Report (Docs #450578)
- Report on Cyclone Drena from the MetService (Docs #450577).

A storm of tropical origin is tracking very slowly southwards into the Tasman Sea and is bringing with it gale force winds, heavy rain and low atmospheric pressure. MetService has issued a Severe Weather Warning stating that rainfall in excess of 250mm could fall over parts of Northland, Auckland, Coromandel, and the Bay of Plenty. An advisory for “Abnormally High Sea Water” has also been issued for the Firth of Thames. Wave heights within the Firth are averaging 4m. Northerly winds of 90 km/hr with gusts up to 130 km/hr are currently being experienced in exposed areas.

As a result, many coastal settlements on the Firth of Thames between Kaiaua and Waikawau Bay have been severely inundated by high sea levels caused by the combination of a high spring tide and storm surge.

### ***Magnitude of Event***

100 years

### ***Recurrence Interval***

1%

### ***Impacts/Consequences***

#### *Human*

- Evacuation and loss of residential buildings
- Flooding of commercial buildings
- Drownings
- Injuries
- Mass evacuation and displacement
- Distress and on-going mental health problems
- Removal of local government staff from other districts to assist

#### *Economic*

- Loss of income (self-employed)
- Loss of marine farming and aquaculture due to either sewerage contamination or wave damage
- Response and declaration costs
- Huge agency response costs
- Cleanup of sewerage and debris
- Welfare costs (food, clothing, shelter, transportation, etc)
- Loss of tourism
- Insurance adjustments after the event
- Health costs
- Heavy equipment costs

- Repair of infrastructure
- Social
- Closure of schools
- Increased requirement for social services (counselling, relocation, etc)

#### *Infrastructure*

- Bridges and approaches washed out
- Wharves, jetties, boat ramps damaged and/or washed away or silted up
- Major transportation routes closed due to damage caused by erosion and undermining (state highway 25)
- Some community networks offline
- Community Centres flooded (alternative evacuation centres required)
- Major electricity outages due to toppling of poles and possible inundation of substations
- Storm water pipes broken (some washed away)
- Water supply out of action
- Saltwater intrusion/contamination

#### *Geographic*

- Loss of foreshore (chronic erosion)
- Change in stream mouth geometry
- Effects on aquaculture and marine farming

### **2.5.6.13 Storm Surge and Tidal Effect (Undeclared)**

#### ***Location***

Mercury Bay

#### ***Description of Event***

This scenario has been based on the following documents:

- “Coastal Flooding Hazard in the Waikato Region”, Environment Waikato Technical Report 99/07. Prepared by Jim Dahm
- Cyclone Drena Event Report (Docs #450578)
- Report on Cyclone Drena from the MetService (Docs #450577).

A deep low pressure frontal system is moving slowly towards the northern parts of New Zealand in a southeast direction. MetService has issued an advisory for “Abnormally High Sea Water” for the east coast of the Coromandel Peninsula warning that gale force winds, high seas and low atmospheric pressure are likely to produce elevated sea levels. Rainfall could be in the order of 150mm over a 24 hour period. The worst affected areas will be those settlements in the north, particularly around Mercury Bay.

#### ***Magnitude of Event***

20 years

#### ***Recurrence Interval***

5%

#### ***Impacts/Consequences***

#### *Human*

- Minor flooding of commercial and residential buildings

#### *Economic*

- Cleanup of sewerage and debris
- Repair of infrastructure
- Minimal agency response costs

#### *Social*

- Temporary closures of some retail stores and schools
- Minor disruption to daily activities

#### *Infrastructure*

- Temporary closure of main transportation route (state highway 25)
- Minor damage to storm water pipes
- Some coastal structures such as wharves, jetties, and boat ramps damaged and/or silted up
- Roads damaged due to erosion and undermining

#### *Geographic*

- Change in stream mouth geometry
- Loss of some foreshore areas (erosion)

### **2.5.6.14 Shoreline Erosion (Undeclared)**

#### ***Assumptions***

Includes cyclical storm damage, but not Tsunami damage

Excludes coastal flooding impacts (?)

Both WVEOA and TVEOA scenarios would be similar in effects, but TVEOA consequences would be substantially higher

Erosion scenarios are very unlikely to lead to a CD declaration.

Flood event following very large storm front moving across the North Island. Storm surge elevates waves producing severe erosion within 30m of the shoreline.

#### ***Magnitude of Event***

>1/100 year

#### ***Recurrence Interval***

>1/100 year

#### ***Impacts/Consequences***

##### *Human*

- Possible deaths and injuries
- Considerable stress and anxiety among coastal communities
- Evacuations and displacement of beach front residents

##### *Social*

- Closure of many beach front roads
- Emotional trauma to community
- Huge requirement for volunteer labour

### *Economic*

- Costs of damage to residential homes
- Clean-up costs to residents and Councils

### *Infrastructure*

- Large-scale damage to residential houses and properties
- Large-scale damage to businesses
- Roads damaged – some severely (local and SH)
- Damage to electricity supply lines

### *Geographic*

- Large scale deformation of the shoreline

## **2.5.6.15 Mine Subsidence/Tailings Dam Failure (Undeclared)**

### ***Location***

Golden Cross and Martha Mine Tailings Dams (Hauraki District)

### ***Description of Event***

This scenario has been based on information supplied by the Special Projects Manager (Resource Use Group, Environment Waikato).

A catastrophic collapse of any one of the mine tailings dams results in release of water and mine tailings. The flow path from the Golden Cross mine would be down the Waitekauri valley to the Ohinemuri River at the confluence adjacent to state highway 2. A number of flow paths could occur from failure of the Martha dams.

This scenario has been based on a 2m section of the Elstow arm of the Kerepehi Fault rupturing resulting in a significant earthquake. A heavy rain event is unlikely to have much an effect on the dams since they're designed to take a very significant rainfall event. The Martha dams in particular have almost no catchment. Overtopping isn't as big an issue as structural damage, resulting in release of the contents.

### ***Magnitude of Event***

Triggered by an earthquake ML6.5 with MMVIII at epicentre and/or a 1:500 year storm event

### ***Recurrence Interval***

1200-4200 years (Kerepehi Fault)  
Unknown (for a severe cyclonic storm)

### ***Impacts/Consequences***

#### *Human*

- Fatalities (from river users, motorists trapped by debris or in vehicles which are affected by damaged bridges, and people working on the sites and adjacent properties)
- Injuries
- Damage to homes/businesses
- Distress

#### *Economic*

- Loss of international reputation
- Loss of tourism

- Agency response costs
- Loss of employment
- Closure of main transport route
- Insurance adjustment after event
- Response costs
- Repair of infrastructure, including reinstating the tailings dam
- Heavy equipment costs

*Social*

- Increased requirement for social services (counseling, relocation, food, etc)
- Minor disruption to daily activities

*Infrastructure*

- Damage to road and other services (e.g. power and telecommunications)
- Water supplies out of action
- Bridges and approaches washed out
- Damage to tailings dams

*Geographic*

- Scouring of the river banks (including tributaries)
- Ongoing environmental impacts primarily relating to water quality
- Loss of stock and agricultural land
- Temporary impact on trout and native fish species

## 2.6 Waikato Valley EOA Event Scenarios

### 2.6.1 Major Transportation Accident – Air (Undeclared)

#### Location

Hamilton International Airport

#### Description of Event

This scenario has been based on the Hamilton Airport Emergency Plan.

A fully laden Boeing 737 crashes shortly after take off from Hamilton International Airport. Debris, damages and fires are spread over a 3km radius centred around the southern end of the main runway. As a result, most of the passengers and crew were killed instantly and the few people that did survive are seriously injured.

#### ***Magnitude of Event***

Variable

#### ***Recurrence Interval***

Unknown

#### ***Impacts/Consequences***

##### *Human*

- Passenger and crew fatalities: up to 200 people
- On ground fatalities: up to 10 people in their cars on state highway 21
- Severe pressure on emergency, health and mortuary services
- Displacement

##### *Economic*

- Negative impact upon regional reputation and tourism industry
- Downturn in airport business
- Closure of major transportation routes
- Repair of infrastructure
- Agency response costs

##### *Social*

- Severe psychological impacts due to the loss of life and random nature of the incident
- Political impacts of adverse international media pressure, loss of international reputation and tourism

##### *Infrastructure*

- Potential fire spread
- Runway repairs
- State highway repairs and car accidents and gridlock due to rush hour
- Electricity transmission lines repairs

##### *Geographic*

- Rural fire
- Loss of agricultural land (if outside airport perimeter)
- Fuel and contaminants flow into waterways



## 2.6.2 Earthquake

Note that the Kerepehi Fault failure scenarios developed for Thames Valley EOA show that some impact will be felt within the Waikato Valley EOA, so the MLE developed for TVEOA has been included here as Scenario 3. However, the impacts and consequences shown here are only those experienced within the Waikato Valley EOA and inter-agency response will play a large role in that particular scenario. Scenario 2 looks at the Wairoa North Fault as the trigger, which is unlikely to affect the Thames Valley EOA.

### **Scenario 1 (MLE)**

It is unlikely that an earthquake on either of the closest active faults will precipitate an MLE and this scale of event has not been calculated.

#### Scenario 2 (Declared)

Rupture of the Wairoa North fault situated along the western edge of the Hunua Ranges. This fault has 3 segments and has been characterised by 2 fault rupture events. The maximum event is highlighted in this scenario. As well as impacting the Hamilton CBD, northeastern suburbs and Morrinsville Road there is also likely to be an overflow of displaced persons from Auckland. However a rupture of SH1 at the Bombay Hills is also possible, so this evacuation is not modelled.

#### **Magnitude of Event**

ML7.1 ±0.3 (likely felt intensity in Hamilton of MMVII)

#### **Recurrence Interval**

42 900 years.

#### **Impacts/Consequences**

##### *Human*

- Evacuation of the CBD between the Waikato River and Alexandra Street
- Loss of a dozen habitable dwellings in the CBD and several in the northern suburbs of Pukete and St. Andrews
- 4 fatalities in the CBD
- Crush injuries
- Trapped survivors in the CBD
- Short-term distress and associated on-going mental health problems
- Mobilisation of CD personnel, USR, fire and police

##### *Social*

- Increased requirement for social services (counselling, some relocation, food, temporary shelter etc)

##### *Economic*

- Loss of income (self-employed and CBD businesses)
- Insurance adjustments after event (national implications) and EQC payouts
- Health costs
- Response costs (food, shelter, transportation)
- Heavy equipment costs for excavations
- Cleanup of sewerage
- Repair of infrastructure, communications and power systems in CBD

#### *Infrastructure*

- Some communications networks off-line (cellnets down) in CBD and northern suburbs
- Water supply out of action in CBD and Pukete
- Sewerage lines broken causing large-scale contamination in CBD
- Damage to small sections of rail-line between Hamilton and Auckland north of the city
- Oxidation pond outflow at Pukete leaking
- Long-term cost and timing of repair to destroyed/damaged infrastructure
- Site inspection and surveillance of flood control structures along the Waikato River required

#### *Geographic*

- None

### **Scenario 3 (Declared)**

A fault rupture event similar to the 1987 Edgecumbe earthquake, but centred on the Elstow arm of the Kerepehi Fault. Fault rupture occurred along a 14km length and resulted in a vertical displacement of up to 2m. Due to the type of sediment across the Hauraki plains this causes considerable liquefaction and associated ground movement, with ground shaking occurring during the initial shake for 15 seconds. Peak ground acceleration is high (from 0.2 to 0.5), with some attenuation to the east by the Kaimai and Coromandel ranges and to the west by a low range, which protects (to a degree) Ngaruawahia and Cambridge. However, ground shaking is extensive through to Hamilton City with damage to the CBD and northeastern suburbs. Ground movement takes out the Kopu Bridge, the Kopu Substation (supplying Thames and the Coromandel Peninsula) and the Waikino Substation (feeding Waihi) has been damaged. Road and rail egress from Hamilton to the Hauraki Plains and Morrinsville is compromised.

#### ***Magnitude of Event***

ML6.8 with MMX at epicentre.

#### ***Recurrence Interval***

2000-3500 years

#### ***Impacts/Consequences***

##### *Human*

- Evacuation of the CBD between the Waikato River and Alexandra Street
- Loss of a dozen habitable dwellings in the CBD and several in the northeastern suburbs of Hamilton City (Flagstaff and St. James Park)
- 2 fatalities in the CBD
- Crush injuries
- Trapped survivors in the CBD
- Short-term distress and associated on-going mental health problems
- Mobilisation of CD personnel, USR, fire and police

##### *Social*

- Increased requirement for social services (counselling, some relocation, food, temporary shelter etc)

##### *Economic*

- Loss of income (self-employed and CBD businesses)

- Dairy loss due to power and water outages at Gordonton
- Insurance adjustments after event (national implications) and EQC payouts
- Health costs
- Response costs (food, shelter, transportation)
- Heavy equipment costs for excavations
- Cleanup of sewerage
- Repair of infrastructure, communications and power systems in CBD

#### *Infrastructure*

- Some communications networks off-line (cellnets down) in CBD and eastern suburbs
- Water supply out of action in CBD, Flagstaff and St. James Park
- Sewerage lines broken causing large-scale contamination in CBD
- Damage to small sections of rail-line between Hamilton and Auckland north of the city
- Oxidation pond outflow at Pukete leaking
- Closure of Morrinsville Road east of Silverdale Road
- Access into the Hauraki Plains limited
- Long-term cost and timing of repair to destroyed/damaged infrastructure
- Site inspection and surveillance of flood control structures along the Waikato River required

#### *Geographic*

- None

#### **References**

These scenarios were developed with some input from the following sources:

Van Dissen et al. 2003. Illustrations of historic and pre-historic surface rupture of active faults in New Zealand, paper presented at the 2003 Pacific Conference on Earthquake Engineering, Christchurch, New Zealand; Paper #156.

Environment Waikato/GNS. Regional Ground Shaking Risk Zones and Active Fault Lines; GIS map of ground shaking potential for the Waikato Region.

Du Pont Peroxide Limited. 1996. Earthquake at Morrinsville – CD scenario.

Van Dissen et al. 2003. An interim classification of New Zealand's active faults for the mitigation of surface rupture hazard, paper presented at the 2003 Pacific Conference on Earthquake Engineering, Christchurch, New Zealand; Paper #155.

Marks and Larkin, 1996. The seismic response of volcanic sites, a report for EQC, pp.172-173.

Parkin, 1998. The potential impacts of earthquakes, floods and volcanoes in the Waikato Region.

Edbrooke, 2002. Earthquake and Geothermal Hazard Assessment, South Auckland Mens Correctional Facility, PGA figures taken from Fig. 12.

Blackstock. 2002. Hazard Mapping in Hamilton City, New Zealand. MSc thesis for Waikato University.

Fellows. 1996. Preliminary Paleoseismic Assessment of the Wairoa North Fault. Report for ARC.

McQuarrie. 2002. Details taken from the Wairoa fault investigation for Watercare - Cosseys Dam (email reply stored as DOCS # 726798).

### 2.6.3 Ashfall (Ruapehu or other)

Scenario based on IGNS ash fall maps, D Parkin report, MAF Policy Technical Paper – Impact of a Volcanic Eruption on Agriculture and Forestry in New Zealand Scenarios for WVEOA and SEOA, noting that effects will be far worse for SEOA dependent on the distance from the source

Three scenarios considered:

- Minor eruption 1/20 year event
- Undeclared 1/50 year event
- 1/10,000 year event? – MLE

#### 2.6.3.1 Minor Eruption (Undeclared)

Minor eruption from central volcanic plateau volcano. Considered by Waikato Valley EOA and Southern EOA.

##### ***Magnitude of Event***

Minor eruption

##### ***Recurrence Interval***

Every 20 years

##### ***Impacts/Consequences***

###### *Human*

- Slight health effects possible

###### *Social*

- Minor disruption to daily activities

###### *Economic*

- Agency monitoring costs
- Potential for airport closures
- Changes to aircraft flight paths (causing delays)
- Loss of tourism (ski operators impacted)

###### *Infrastructure*

- Possible damage to roads, sewerage and water systems (minor)
- Minor clogging of air filters

###### *Geographic*

- N/A

#### 2.6.3.2 1/100 year event (Declared)

1995/96 Ruapehu scenario.

##### ***Magnitude of Event***

1/100 year event

### ***Recurrence Interval***

As above

### ***Impacts/Consequences***

#### *Human*

- Health effects from ashfall inhalation

#### *Social*

- Disruption to daily activities
- Temporary closure of roads/airports

#### *Economic*

- Agency response costs
- Clean-up costs (esp. roads)
- Some loss of business income
- Loss of agricultural and horticultural production

#### *Infrastructure*

- Possible damage to roads, sewerage and water systems (minor)
- Possible damage to water supplies, sewerage reticulation

#### *Geographic*

- Impacts to trout fishery (Tongariro)

### **2.6.3.3 1/10,000 year event (MLE)**

Large volcanic eruption from the central plateau produces large ash falls (assume 10 times the depths shown on the Lifelines hazard maps). Declared emergency and likely event of national significance.

### ***Magnitude of Event***

1/10,000? year event

### ***Recurrence Interval***

As above

### ***Impacts/Consequences***

#### *Human*

- Deaths and injuries
- Huge impacts to health in Turangi, Taupo and probably the wider region
- Mass evacuation requirements and dislocation
- Distress and on-going mental health issues
- Damage to residential areas (e.g. roof collapse)

#### *Social*

- Severe disruption to local communities
- Closure of most roads and airports
- Severe trauma and requirement for social services

#### *Economic*

- Huge agency response costs
- Huge clean-up costs (esp. roads)

- Widespread business failures
- Major disruption to primary industries
- Loss of jobs (long term)
- Huge loss of agricultural production (farming/forestry)
- Huge loss of tourism
- Severe damage to residential housing
- Long-term re-instatement of infrastructure

#### *Infrastructure*

- Severe and widespread damage to roads, sewerage and water systems
- Electricity losses (including Transpower's national grid network)
- Damage to rail lines and disruption to schedules (passenger and freight)
- Huge disruption to state highway traffic and possible damage to roads near the vent and adjacent to any waterway vulnerable to a lahar or pyroclastic flow
- Roof collapse of some businesses

#### *Geographic*

- Impacts on trout fishery (Tongariro and Taupo)
- Widespread ash fall impacts – sedimentation, clogging of drains/rivers etc.

## **2.6.4 Severe Storm Event**

### ***Assumptions***

Includes direct impacts only such as wind, lightning and rain, but excludes flow-on effects such as flooding

Two levels considered:

- 1/100 year storm event (undeclared)
- >1/100 year event (possible declaration)

### **2.6.4.1 1/100 year storm event (undeclared)**

Flood event following large storm front moving across the North Island. Storm produces high winds, intense rain and lightning. Impacts include fallen trees, damage to roofs and power lines, lightning strikes, damage to residential and commercial property.

#### ***Magnitude of Event***

1/100 year

#### ***Recurrence Interval***

1/100 year

#### ***Impacts/Consequences***

##### *Human*

- Possible injuries
- Some anxiety

##### *Social*

- Temporary closure of some roads
- Some loss of agricultural productivity

##### *Economic*

- Costs of damage to residential homes and businesses (limited)
- Small clean-up costs to residents and Councils

#### *Infrastructure*

- Damage to residential houses and properties
- Damage to some businesses
- Roads damaged (local and SH)
- Electricity failure (localised)
- Damage to water supply and sewerage systems

#### *Geographic*

- Widespread temporary deformation of the regional landscape

### **2.6.4.2 >1/100 year event (Declared)**

Flood event following very large storm front moving across the North Island. Storm surge elevates waves producing severe erosion within 30m of the shoreline.

#### ***Magnitude of Event***

>1/100 year

#### ***Recurrence Interval***

>1/100 year

#### ***Impacts/Consequences***

##### *Human*

- Possible deaths and injuries (limited)
- Stress and anxiety among communities
- Evacuations and displacement (limited)

##### *Social*

- Temporary closure of some roads
- Large loss of agricultural productivity

##### *Economic*

- Loss of income
- Business failure (limited)
- Costs of damage to residential homes and businesses (high)
- Large clean-up costs to residents and Councils

##### *Infrastructure*

- Widespread damage to residential houses and properties
- Damage to many businesses
- Roads damaged (local and SH)
- Electricity failure (localised)
- Damage to water supply and sewerage systems

##### *Geographic*

- Widespread deformation of the regional landscape

### **2.6.5 River/Stream Flooding and Ponding**

General Note: Three levels of scenarios are applicable based on the wide range of combinations across the 3 EOA's. Two scenarios are applicable for each level within each EOA based on the location of river systems and broad types of events. The following sub-areas have been identified:

- WVEOA: Lower Waikato/Waipā and Mokau/Āwakino
- SEOA: South-east Lake Taupo and South Waikato District
- TVEOA: Waihou/Piako and Coromandel

### 2.6.5.1 Lower Waikato/Waipā (Undeclared)

Flood event following large storm front or multiple small events moving across the North Island. Flood flows from the Waikato and Waipā Rivers and tributaries, with ponding behind floodbanks and control structures. Inundation of low lying unprotected land along the channels of the Waipā and Lower Waikato Rivers and some major tributaries.

#### ***Magnitude of Event***

Up to and including a 1/100 year event

#### ***Recurrence Interval***

1/25 - 1/100 years

#### ***Impacts/Consequences***

##### *Human*

- Possible evacuation and displacement of a small number of people
- Some emotional distress among landowners along channels

##### *Social*

- Closure of some roads
- Slightly increased requirement for social services

##### *Economic*

- Loss of farm productivity
- Delays to major transportation routes
- Loss of export dollars (agricultural and tourism)
- Response costs to local authorities
- Repair of infrastructure
- Damage to flood protection schemes

##### *Infrastructure*

- Roads flooded (SH's and local)
- Possible minor electricity failure
- Some communications networks damaged or offline

##### *Geographic*

- Sedimentation
- Erosion exacerbation

### 2.6.5.2 Lower Waikato/Waipā (Declared)

Flood event following longitudinally extensive storm front moving across the North Island. Large flood flows from the Waikato and Waipā Rivers and tributaries, with extensive ponding behind floodbanks and control structures. Inundation of low lying



unprotected land along the channels of the Waipa and Lower Waikato Rivers and some major tributaries. This event is similar to the 1958 event, with ponding times increased due to flood protection structures impounding water and failure of some structures (rated at 1%AEP).

### ***Magnitude of Event***

>1/100 year event

### ***Recurrence Interval***

Between 1/100 – 1/500 years

### ***Impacts/Consequences***

#### *Human*

- Evacuation and loss of habitable dwellings
- Flooding of commercial buildings
- Possible drownings
- Injuries
- Substantial evacuation and displacement
- Distress and on-going mental health problems
- Removal of local government staff from other districts to assist

#### *Social*

- Huntly physically isolated, along with the western side of Ngaruawahia Significant social disruption
- Much of Turangawaiwai Marae flooded
- Evacuation in Ngaruawahia and Huntly in progress
- Closure of schools
- Temporary closure transportation links
- Increased requirement for social services (counselling, relocation, food etc)

#### *Economic*

- Loss of income (self-employed)
- Large loss of farm productivity
- Closure of major transportation routes
- Loss of tourism
- Loss of export dollars (agricultural and tourism)
- Insurance adjustments after event (national implications)
- Health costs
- Response costs (food, clothing, shelter, transportation)
- Heavy equipment costs
- Cleanup of sewerage
- Repair of infrastructure

#### *Infrastructure*

- Partial failure of flood protection schemes, and total failure in areas with <1/100 year design standard
- Failure of some Huntly structures and flooding of 1% AEP protected areas in Huntly North and West
- Damage to State Highway 1
- Damage to main trunk railway line
- Some communications networks off-line
- Main fibre-optic through Huntly damaged
- Some water supplies inoperable
- Sewerage lines broken and some washed away, localised contamination

- Community centres flooded (alternate evacuation centres required)

#### *Geographic*

- Loss of stock and agricultural land
- Wetland contamination
- Damage to rural landscape

### **2.6.5.3 Lower Waikato/Waipā (MLE)**

Flood event following extensive storm fronts over a long duration moving across the North Island. Huge flood flows from the Waikato and Waipā Rivers and tributaries, with catastrophic failure of all river flood protection scheme structures. Widespread inundation of land throughout the Lower Waikato and Waipā Rivers and all major tributaries. This event exceeds the 1958 event, with ponding times increased due to flood protection structures impounding water and failure of all 1% AEP rated structures.

#### ***Magnitude of Event***

>1/500 year event

#### ***Recurrence Interval***

>1/500 years

#### ***Impacts/Consequences***

##### *Human*

- Mass evacuation and loss of habitable dwellings (displacement)
- Flooding of major urban and rural areas
- Deaths (drowning)
- Extensive injuries
- Widespread distress and on-going mental health problems
- Removal of local and central government, volunteer, army staff to assist

##### *Social*

- Significant social disruption
- Closure of schools
- Closure of transportation links
- Large requirement for social services (counselling, relocation, food etc)

##### *Economic*

- Widespread loss of income and business failures
- Huge loss of farm productivity
- Severe damage to and closure of major transportation routes
- Loss of tourism
- Huge loss of export dollars (agricultural and tourism)
- Large insurance adjustments after event (national implications)
- Very high health costs
- Major response and recovery costs (food, clothing, shelter, transportation)

##### *Infrastructure*

- Total failure of flood protection schemes
- Extensive damage to State Highway 1 and main trunk railway line
- Some communications networks off-line
- Main fibre-optic cable damaged
- Electricity failure
- Water supplies inoperable

- Widespread sewerage contamination
- Community centres flooded (alternate evacuation centres required)

*Geographic*

- Loss of stock and agricultural land
- Wetland contamination
- Damage to rural landscape

#### **2.6.5.4 Mokau/Awakino (Undeclared)**

Flood event following large storm front or multiple small events moving across the North Island. Flood flows from the Mokau and Awakino Rivers and tributaries. Inundation of low lying unprotected land along the channels of the Mokau and Awakino Rivers and some tributaries.

***Magnitude of Event***

Up to a 1/100 year event

***Recurrence Interval***

1/25 - 1/100 years

***Impacts/Consequences***

*Human*

- Inconvenience to small number of residents and road users

*Social*

- Closure of some roads including SH 3

*Economic*

- Slight loss of farm productivity
- Delays to major transportation routes
- Possible repair of infrastructure

*Infrastructure*

- Roads flooded (SH's and local)

*Geographic*

- N/A

#### **2.6.5.5 Mokau/Awakino (Declared)**

Large flood event following large storm front or multiple small events moving across the North Island. Large flood flows from the Mokau and Awakino Rivers and tributaries. Inundation of low lying unprotected land along the channels of the Mokau and Awakino Rivers and tributaries.

***Magnitude of Event***

>1/100 year event

***Recurrence Interval***

>1/100 years

## ***Impacts/Consequences***

### *Human*

- Evacuation of Mokau/Awakino communities and loss of habitable dwellings
- Possible drownings and injuries
- Removal of local government staff from other districts to assist

### *Social*

- Social disruption to small communities
- Closure of schools
- Some distress
- Temporary closure of transportation links
- Some requirement for social services (counselling, relocation, food etc)

### *Economic*

- Small loss of income (self-employed)
- Minor loss of farm productivity
- Closure of major transportation routes
- Some response costs (food, clothing, shelter, transportation)

### *Infrastructure*

- Some damage to State Highway 3
- Damage to main trunk railway line
- Possible damage to electricity and communications networks
- Possible damage to water supplies and sewerage reticulation
- Community centres flooded (alternate evacuation centres required)

### *Geographic*

- N/A

## **2.6.6 Landslip**

### ***Scenario 1 (MLE)***

It is unlikely that a landslip event will precipitate an MLE and this scale of event has not been calculated.

### ***Scenario 2 (Declared)***

It is also unlikely that a landslip event will precipitate a declared emergency and this scale of event has not been calculated.

### ***Scenario 3 (Undeclared)***

Landslip above SH1 at Mercer triggered by a seismic event at Kerepehi. The main highway is blocked, as is the Main Trunk rail line to/from Auckland. Several cars have been buried and one person is confirmed dead, with others trapped and requiring urgent medical attention and rescue services. Delays are likely, with all traffic being diverted out around Pukekawa, and the road will be closed for 3 or 4 weeks while debris is removed, slope stabilisation work occurs and the main trunk rail line is repaired.

### ***Magnitude of Event***

Unknown due to limited data history

### ***Recurrence Interval***

Unknown

### ***Impacts/Consequences***

#### *Human*

- Two cars buried in slip material and another 3 pushed aside
- 1 death in one vehicle
- several people injured
- St. Johns Regional Ambulance Services required
- Distress caused by detour at slip site
- Assistance from Fire Service, Police and works construction personnel

#### *Social*

- Support for families affected
- Support for works and police personnel
- Closure of SH1 bypass and on-going distress at lengthy delays for several weeks

#### *Economic*

- Rescue services (USR, Fire and helicopter)
- Temporary closure of main road transportation route
- Temporary closure of main trunk rail link
- Insurance adjustments after event (national implications for transportation costs)
- Health and social services costs
- Response costs (food, accommodation for rescue services etc, transportation)
- Heavy equipment costs for removal of debris and recovery of vehicles
- Cost of infrastructure repair (road and rail)
- Cost of flying-in and supporting the families of tourists involved in event (dead and injured)
- Possible loss of tourism dollars

#### *Infrastructure*

- Road blockage at Mercer on SH1
- Rail blockage at same site

#### *Geographic*

- Re-activation of landslip scarp possible
- Redistribution of failed slip material required (Resource Consent implications)

### ***References***

These scenarios were developed with some input from the following sources:

Blackstock. 2002. Hazard Mapping in Hamilton City, New Zealand. MSc thesis for Waikato University.

## **2.6.7 Shoreline Erosion, West Coast (Undeclared)**

A storm of tropical origin passes over the southern areas of the North Island bringing with it severe westerly gales, low barometric pressure, and high waves. As a result, there is localised flooding due to storm surge and severe erosion has occurred at most of the west coast beaches including Port Waikato, Raglan, Aotea, Kawhia, Awakino, and Mokau.

### ***Magnitude of Event***

>1/100 year

### ***Recurrence Interval***

>1/100 year

### ***Impacts/Consequences***

#### *Human*

- Possible deaths and injuries
- Considerable stress and anxiety among coastal communities
- Evacuations and displacement of beach front residents

#### *Social*

- Closure of many beach front roads
- Emotional trauma to community
- Huge requirement for volunteer labour
- Loss of homes

#### *Economic*

- Costs of damage to residential homes
- Clean-up costs to residents and Councils

#### *Infrastructure*

- Large-scale damage to residential houses and properties
- Large-scale damage to businesses
- Roads damaged – some severely
- Damage to electricity, water, and sewerage supply lines
- Damage to wharves, jetties, boat ramps, moorings, and navigational aids

#### *Geographic*

- Large scale deformation of the shoreline

## **2.6.8 River/Lake Control Structure Failure (Declared)**

### ***Location***

Karapiro Dam, Waikato River

### ***Description of Event***

This scenario has been based on the Karapiro Dam Break Analysis report (written by Works Consultancy Services in 1989 and Hugh Blackstock's Waikato University Thesis "Hazard Mapping in Hamilton City, New Zealand" which was completed in 2002). The worst case scenario was determined to be one in which a strong earthquake caused the gravity abutments to slide leading to a catastrophic collapse of the arch section of the dam.

Potentially 14,000 people are vulnerable based on their location in a meshblock area which will be partially or fully inundated by floodwaters caused by the failure of the Karapiro Dam. The number of people affected or injured will depend on the event's timing (e.g. there are usually more people out and about during the day than at night).

The dam break report indicates that Cambridge would escape inundation in the event of a dam break flood wave due to the attenuating influence of a couple of severe channel restrictions upstream. Between Cambridge and Hamilton, the sides of the river

cutting are sufficiently high to contain a dam flood wave except in the vicinity of the Narrows. Several low spots along both banks of the river between Cobham Bridge and Claudelands Bridge in Hamilton will be inundated during the passage of a dam break flood wave and these are identified on inundation maps.

Downstream of Hamilton to Horotiu Bridge the river cutting will continue to confine a dam break flood wave. Beyond Horotiu Bridge the river starts to flow through fairly flat country and the banks appear to be high enough to also prevent any overbank flow.

### ***Magnitude of Event***

500 years

### ***Recurrence Interval***

Unknown

### ***Impacts/Consequences***

#### *Human*

- Evacuation and loss of habitable buildings (e.g. Ann Street and Awatere Avenue)
- Flooding of commercial buildings (e.g. Grantham Street)
- Drownings
- Injuries
- Removal of local government staff from other districts to assist

#### *Economic*

- Loss of income
- Huge agency response costs
- Loss of power generation
- Closure of major transportation routes
- Water supply out of action (Hamilton and Cambridge)
- Response costs
- Cleanup of sewerage
- Repair of infrastructure
- Declaration costs

#### *Social*

- Increased requirement for social services (counselling, relocation, etc)
- Loss of international reputation and tourism

#### *Infrastructure*

- Collapse of dam
- Some bridges in Cambridge and Hamilton would be submerged. This includes the state highway 1 at Cambridge which would be under water by about 10 m
- Some bridges would be totally destroyed
- Low-lying roads flooded (possible damaged)
- Rail services could be disrupted if the rail bridge is damaged and/or weakened
- Water supply intakes damaged (or closed as a precaution)
- Many storm water pipes damaged
- Disruption to natural gas supplies in Hamilton City due to the bridges being damaged
- Wharves, boat ramps, and river pathways damaged or destroyed
- About 4% of Hamilton land parcels will be affected by flooding (or 1400 properties)

#### *Geographic*

- Flooding of homes in Jellicoe Street, Ann Street, Awatere Avenue and possibly a retirement complex off River Road (adjacent to the Flagstaff sewer bridge)

- Pollution of water ways from sewage contamination and hazardous substances storage
- Backflow of flood waters up gullies
- Wetland contamination (Lower Waikato)
- Scouring and erosion of the river bed and banks
- Undermining of banks could threaten properties due to a mass movement event

## 2.6.9 Auckland Volcanic Field (Undeclared)

### *Location*

Any WV EOA town or city.

### *Description of Event*

This scenario has been based on information supplied by the Auckland Regional Council Hazard Management Programme and the Auckland Volcanic Contingency Plan.

In the event of a local eruption within the Auckland Volcanic Field, it is likely that within a 5 km radius of the volcanic vent people will need to be evacuated reasonably quickly. In the worst case scenario, this may equate to 225,000 people. Apparently past evidence has indicated that about 80% of people find their own place to stay (with family and friends), which means that Auckland would need to find beds for around 45,000 people.

Statistics provided by the Ministry of Tourism show that Auckland provided guest accommodation for around 5.2 million people (counted for each night they stay) from the year November 02 to October 03. Assuming they were only ever 90% full, it can be estimated that Auckland has about 15,800 guest beds available on any one night (a shortfall of about 30,000).

However, some of these beds will be filled by people that want to stay in Auckland, despite the volcanic eruption (such as media and scientists), so it is assumed that only 90% of beds are available for Civil Defence Emergency Management purposes. This leaves Auckland with about 14,250 beds. In this case, the Auckland Civil Defence Emergency Management Group would look to other parts of New Zealand to host the 30,000 evacuees.

On this basis, Hamilton and other major Waikato towns such as Te Awamutu, Taupo, Cambridge, Thames, Huntly, Tokoroa, Te Kuiti, and Otorohanga would be expected to accommodate up to 50% of the people requiring evacuating (about 15,000) due to it being the closest region.

### *Magnitude of Event*

500 years

### *Recurrence Interval*

Unknown

### *Impacts/Consequences*

#### *Human*

- Special care for the elderly and disabled or those in special care facilities
- Distress after being forced from home (not knowing what to come back to)
- Requirement psychological support services
- First aid and medical support services



#### *Economic*

- Costs to upgrade and/or repair services such as water and sewerage reticulation
- Response of local authorities to manage evacuation process
- Huge Welfare costs (e.g. clothing, accommodation and catering)
- Huge agency response costs

#### *Social*

- Increased requirement for social services (counselling, relocation, food, etc)
- Accommodation facilities stretched

#### *Infrastructure*

- Strain on city services such as water and sewage which could lead to breakdowns
- Increased traffic volumes on both city roads and state highway 1 to Auckland
- Jamming of landline and mobile phone networks

#### *Geographic*

- Increased traffic volumes on both city roads and state highway 1 between Hamilton and Auckland

## **2.6.10 Heatwave (Undeclared)**

### ***Location***

Hamilton City

### ***Description of Event***

This scenario has been based on Hugh Blackstock's Waikato University thesis titled "Hazard Mapping in Hamilton City, New Zealand".

A heatwave is defined as "those temperatures that hover 10 degrees or more above the average high temperature for the region, last for a prolonged period of time, and are often accompanied by high humidity. For Hamilton, these are peak daily temperature that occur for seven days or more in a row over 30 degrees celsius.

### ***Magnitude of Event***

100 years

### ***Recurrence Interval***

1%. Note there have been no heatwave events recorded since 1970, however with the onset of global warming it is reasonable to suppose that heatwaves may increase in frequency.

### ***Impacts/Consequences***

#### *Human*

- Fatalities from heat stroke (particularly children, the elderly, and those with sickness)
- Drownings (as people take to the water)
- Heat disorders such as cramps, exhaustion and stroke
- Psychological effects from heat stress (decrease in tolerance)
- General Discomfort

#### *Economic*

- Increased electricity costs
- Agency response costs
- Health costs
- Agency response costs
- Loss of stock and farm productivity
- Loss of crops
- Loss of vegetation (e.g. grass)

#### *Social*

- Closure of schools and some businesses
- Job losses (particularly in the agricultural and horticultural sector)
- Minor disruption to daily activities

#### *Infrastructure*

- Increased demand for electricity due to pressure on air conditioning and refrigeration units
- Water shortages (as consumption exceeds supply)
- Some appliances overheat and in some cases result in fires
- Widespread computer and online services disrupted
- Buckling of railway lines
- Road damage (due to the bitumen melting)
- Morgue facilities for the dead

#### *Geographic*

- Extreme rural fire risk
- Influx of residents and tourists to the beaches

## **2.6.11 Subsidence (Karst Solutioning)**

### ***Scenario 1 (MLE)***

It is unlikely that an event involving karst subsidence will precipitate an MLE and this scale of event has not been calculated.

### ***Scenario 2 (Declared)***

It is unlikely that an event involving karst subsidence will precipitate a declared emergency and this scale of event has not been calculated.

### ***Scenario 3 (Undeclared)***

Following an earthquake trigger event of Karst subsidence and collapse event at Waitomo's Gardners Gut Cave, with a group of international recreational cavers. 2 deaths (one from hypothermia) and 5 injured, with cave entrance closed and the involvement of Mine Rescue, Caving Rescue and the St. Johns Regional Ambulance Service required. Damage to the entrance and cave is unlikely to be repairable and an alternative access was required to get to those people trapped. Access to the cave in the past has been uncontrolled and managed by the Department of Conservation.

#### ***Magnitude of Event***

Unknown due to limited data history

#### ***Recurrence Interval***

Unknown

## ***Impacts/Consequences***

### *Human*

- 2 deaths
- 5 injured and 6 others trapped
- Police, Mine Rescue, Caving Rescue, St. Johns Regional Ambulance Service and Fire Services involvement

### *Social*

- Recovery/support services for rescue personnel and those trapped
- On-going support for tour operator involved

### *Economic*

- Cost of supporting rescue personnel for 22 hours
- Families of those killed flown in from overseas
- Loss of revenue from future adventure caving operations

### *Infrastructure*

- No infrastructure loss

### *Geographic*

- Closure of public access to Gardners Gut Cave. Note that this cave has been heavily used by cavers, recreational groups and commercial adventure tourist operators.

## ***References***

These scenarios were developed with some input from the following sources:

Australasian Cave and Karst Management Association. 1998. The physical impacts of recreational users in caves: methods currently in use for assessing recreational impacts in two New Zealand caves - Cave and Karst Management in Australasia XII; Conference Proceedings. pp.47-54.

Jennings. 1987. Karst Geomorphology.

DoC. 2002. Land Use in Karst Terrain: review of impacts of primary activities on temperate karst ecosystems.

## 2.7 Southern EOA Event Scenarios

### 2.7.1 Geothermal Ground Activity

#### ***Scenario 1 (MLE)***

It is unlikely that a geothermal event will precipitate an MLE and this scale of event has not been calculated.

#### ***Scenario 2 (Declared)***

Geothermal eruption and crater development across the new SH1 bypass at Broadlands, Taupo, following widening of lanes and construction work. Crater has created a sink-hole across the width of the highway, disrupting services run parallel to the carriageway.

#### ***Magnitude of Event***

Unknown due to limited data history

#### ***Recurrence Interval***

Unknown

#### ***Impacts/Consequences***

##### *Human*

Evacuation and loss of habitable dwellings along highway corridor

- Destruction of some commercial buildings servicing tourism industry
- Loss of life and mass injuries – tourist bus plus three cars and one truck
- Evacuation and recovery from site
- Distress for tour operators, families of tourists overseas (communications etc) and rescue workers (on-going mental health issues due to nature of event)
- Assistance from USR and Fire services plus air appliances

##### *Social*

- Closure of SH1 bypass, with increased traffic flow through Taupo township
- Increased requirement for social services, autopsy services and morgue space
- Recovery/support services for survivors
- Contamination of Waipahihi Stream has significance for iwi in terms of cross-contamination of mahinga kai (food gathering areas)

##### *Economic*

- Rescue services (USR, Fire and helicopter)
- Loss of income (from tourism)
- Closure of main transportation route
- Loss of export dollars (tourism)
- Insurance adjustments after event (national implications)
- Health and social services costs
- Response costs (food, accommodation for rescue services etc, transportation)
- Heavy equipment costs for recovery of bus, truck, cars, bodies and construction of safety bunding around site
- Cleanup costs for sewerage and contaminated land
- Cost of infrastructure repair (sewerage, stormwater, gas, communications, power and water lines)

- Cost of flying-in and supporting the families of tourists involved in event (dead and injured)

#### *Infrastructure*

- Natural Gas pipeline breached and contaminated
- Sewerage spill due to line breakage with associated contamination of land and other services
- Some communications networks off-line
- Power supply to the southern end of Taupo township interrupted
- Water supply out of action; re-routing due to take a week assuming a safe corridor around the site is found
- Stormwater culverts and lines destroyed for 500m
- Long-term cost of repair to destroyed/damaged infrastructure that cannot immediately be replaced (due to increased risk to construction crews) – alternative routing required

#### *Geographic*

- Loss of some agricultural land
- Waterway contamination (Waipahihi Stream and Lake Taupo)
- Increase in size of this part of the Broadlands geothermal area and possible future protection as a significant feature

### **Scenario 3 (Undeclared)**

Geothermal eruption at Oraki Korako following increased ramping rate of river leaves some features exposed. Explosion takes out the Oraki Korako Lodge and two tourist-venture boats, but there are no fatalities or injuries.

#### ***Magnitude of Event***

Unknown due to limited data history

#### ***Recurrence Interval***

Unknown

#### ***Impacts/Consequences***

##### *Human*

- Evacuation of Oraki Korako Lodge and camping grounds
- No loss of life or injuries
- Distress for tour operators

##### *Social*

- Recovery/support services for local community
- Contamination of river (acidification)
- Possible loss to iwi in terms of contamination of mahinga kai

##### *Economic*

- Fire services and CD personnel
- Immediate loss of income (from tourism) – closure of lodge and camping ground and restrictions on public access to Oraki Korako
- Long-term loss of export dollars (tourism)
- Insurance adjustments after event
- Cost of investigations on site safety

##### *Infrastructure*

- No infrastructure loss

### *Geographic*

- Closure of public access to Oraki Korako
- Possible waterway contamination

### **References**

These scenarios were developed with some input from the following sources:

Ron Keam [in discussion]  
The University of Auckland  
Phone +64 9 373-7599 extension 87931  
EMail r.keam@auckland.ac.nz

Katherine Luketina [in discussion]  
Environment Waikato  
Phone (64) (7) 856 0555 ext 8770

Proposed District Plan Changes 2003 [in submission]  
State Highway Designation  
Taupo District Council

## **2.7.2 Earthquake**

### **Scenario 1 (MLE)**

A fault rupture event on the Ngangiho Fault trending northeast from Whakaipo Bay. Fault rupture occurred along a 6km length and resulted in a vertical displacement of up to 1.5m. Liquefaction was minimal and occurred within the pumicious alluvium at the edges of Whakaipo Bay, Whangamata Bay and in Kinloch. However ground shaking was attenuated (intensified) within the Mapara Valley and affected all dwellings, Mapara Road and all reservoirs between Tukairangi Road and Whangamata Road as far north as Poihipi Road. Peak ground acceleration is high (from 0.4 to 0.6). Severe shaking was felt as far away as Cambridge and Hamilton, although damage to infrastructure has been limited within Taupo itself to the Taupo CBD, the northeastern end of the Taupo seismic zone and includes Atiamuri, Whakamaru and Tokoroa. Damage has occurred at Kinleith, with evacuation of staff taking place. Activation of the Waihi Hill and slope instability/failure has occurred, blocking SH41 at Hipaua.

*Note that limited information on fault characterisation is available on this (and many) of the faults associated with the Taupo fault zone.*

#### ***Magnitude of Event***

ML6.3 with MMX at epicentre.

#### ***Recurrence Interval***

–  $\leq$ 2000 years

#### ***Impacts/Consequences***

##### *Human*

- Mass evacuation and displacement in Kinloch, Waihi and Acacia Bay
- Isolated evacuations and displacement in Aratiatia, Whakamaru, Tokoroa and Waihi
- Site evacuation at Kinleith Mill and NZ Forest Products site in Taupo

- Some 'triggered' health issues due to high rate of retired people living in the area e.g. heart-related illness
- Multiple fatalities in Kinloch, Waihi, Acacia Bay, Tokaanu and Taupo (6 dead)
- Crush injuries associated with falling masonry and objects
- Trapped survivors in Kinloch and Tokaanu
- Distress and associated suicides and on-going mental health problems
- Removal of local government staff from other districts to assist
- Mobilisation of armed forces, USR, fire, police and St. Johns Ambulance Services

#### *Social*

- Increased requirement for social services (food/refreshment support for rescue/recovery personnel, counselling, shelter for displaced persons, doctors visits after the event, District Health Nurse etc)
- Closure of schools for two days in Taupo and Tokoroa including kohanga reo
- Increased requirement for social services (counselling, relocation, food etc)
- Requirement for increased morgue and autopsy facilities in Taupo

#### *Economic*

- Loss of income (self-employed)
- Loss of power to golf courses within the valley
- Dairy loss due to power and water outage
- Insurance and some EQC payouts
- Health costs
- Response costs (recovery and transportation)
- Repair of infrastructure
  - Roothing - Kinloch Road, Whangamata Road, Whakaroa Road, Mapara Road and Poihipi Road as well as SH41 at Waihi
  - Water supplies – Aratiatia, Kinloch, Acacia Bay, Waihi and parts of Taupo
- Loss of export dollars (agricultural and tourism)
- Insurance adjustments after event (national implications) and EQC payouts
- Heavy equipment costs for demolition and rebuilding works
- Cleanup of sewerage from effluent ponds in Kinloch and Taupo
- Cost of immediate earthworks stabilisation on roadslips

#### *Infrastructure*

- Reservoir in Kinloch requiring site inspection for safety purposes
- Roothing repairs (immediate for safety purposes and then long-term for continued use), including closure of SH41 for up to 3 weeks
- Some communications networks off-line (cellnets down)
- Kinloch and Acacia Bay water supply out of action
- Sewerage lines broken in Kinloch and Taupo
- Some damage to Taupo airport with flights available from helicopters only
- Long-term cost and timing of repair to destroyed/damaged infrastructure
- Safety inspections and surveillance of Aratiatia and Whakamaru hydro power plant and structures
- Some damage to buildings in Tokoroa and associated loss of productivity
- Damaged to plant at Kinleith

#### *Geographic*

- Benched rise in lake edge at Whakaipo bay
- Lake Taupo contamination from sewerage and sediment flow into lake at top end
- Large sediment loading at Tokaanu

### **Scenario 2 (Declared)**

A fault rupture event on the Ngangiho Fault trending northeast from Whakaipo Bay. Fault rupture occurred along a 2km length and resulted in a vertical displacement of up to 0.9m. Ground shaking was attenuated (intensified) within the Mapara Valley and

affected some dwellings and Mapara Road. Moderate shaking was felt as far away as Taupo and Tokoroa, although damage to infrastructure has been limited to Taupo CBD and the northeastern end of the Taupo seismic zone.

### ***Magnitude of Event***

ML5.2 with MMVI at epicentre

### ***Recurrence Interval***

1000-1500 years

### ***Impacts/Consequences***

#### *Human*

- Minor evacuation and displacement in Kinloch and Acacia Bay
- Site evacuation until safety review completed at Kinleith Mill
- Some 'triggered' health issues due to high rate of retired people living in the area e.g. heart-related illness
- Crush injuries associated with falling masonry and objects
- Mobilisation of USR, fire, police and St. Johns Ambulance Services

#### *Social*

- Increased requirement for social services (food/refreshment support for rescue/recovery personnel, counselling, doctors visits, District Health Nurse etc)
- Closure of schools for half a day in Taupo and Tokoroa including kohanga reo

#### *Economic*

- Loss of income (self-employed)
- Loss of power to golf courses within the valley
- Dairy loss due to power and water outage
- Insurance and some EQC payouts
- Health costs
- Response costs (recovery and transportation)
- Repair of infrastructure
  - Roothing - Mapara Road
  - Water supplies – Kinloch and Acacia Bay and parts of Taupo
- Loss of export dollars (agricultural and tourism)
- Insurance adjustments after event (national implications) and EQC payouts
- Heavy equipment costs for demolition and rebuilding works
- Cleanup of sewerage in Kinloch

#### *Infrastructure*

- Reservoir in Kinloch requiring site inspection for safety purposes
- Roothing repairs (immediate for safety purposes and then long-term for continued use)
- Some communications networks off-line (cellnets down)
- Kinloch, Acacia Bay and parts of Taupo's water supply out of action
- Sewerage lines broken in Kinloch and Taupo
- Safety inspections and surveillance of Aratiatia and Whakamaru hydro power plant and structures

#### *Geographic*

- Benched rise in lake edge at Whakaipo bay



### **Scenario 3 (Undeclared)**

Minor event centred at Kinloch on the Whangamata Fault, with no loss of life and minor injuries in Kinloch due to falling objects

#### **Magnitude of Event**

ML4.1 with MMV at epicentre

#### **Recurrence Interval**

100-200 years

#### **Impacts/Consequences**

##### *Human*

- Evacuation from some buildings in Kinloch
- Some 'triggered' health issues due to high rate of retired people living in the area e.g. heart-related illness
- Short-term distress

##### *Social*

- Increased requirement for social services (counselling, doctors visits, District Health Nurse)

##### *Economic*

- Loss of income (self-employed)
- Loss of power to golf courses within the valley
- Dairy loss due to power and water outage
- Insurance and some EQC payouts
- Health costs
- Response costs (recovery and transportation)
- Repair of infrastructure (minor road works)

##### *Infrastructure*

- Mapara Road damaged
- Reservoir in Kinloch requiring site inspection for safety purposes

##### *Geographic*

- Benched rise in lake edge at Whakaipo bay

#### **References**

These scenarios were developed with some input from the following sources:

Van Dissen et al. 2003. Illustrations of historic and pre-historic surface rupture of active faults in New Zealand, paper presented at the 2003 Pacific Conference on Earthquake Engineering, Christchurch, New Zealand; Paper #156.

Environment Waikato/GNS. Regional Ground Shaking Risk Zones and Active Fault Lines; GIS map of ground shaking potential for the Waikato Region.

Van Dissen et al. 2003. An interim classification of New Zealand's active faults for the mitigation of surface rupture hazard, paper presented at the 2003 Pacific Conference on Earthquake Engineering, Christchurch, New Zealand; Paper #155.

Parkin, 1998. The potential impacts of earthquakes, floods and volcanoes in the Waikato Region.

Edbrooke, 2002. Earthquake and Geothermal Hazard Assessment, South Auckland Mens Correctional Facility, PGA figures taken from Fig. 12.

TDC, EW and GNS. 2003. Geological Hazards; Poster for Secondary Schools.

### 2.7.3 Ashfall (Ruapehu or other)

Scenario based on IGNS ash fall maps, D Parkin report, MAF Policy Technical Paper – Impact of a Volcanic Eruption on Agriculture and Forestry in New Zealand Scenarios for WVEOA and SEOA, noting that effects will be far worse for SEOA dependent on the distance from the source

Three scenarios considered:

- Minor eruption 1/20 year event
- Undeclared 1/50 year event
- 1/10,000 year event? – MLE

#### 2.7.3.1 Minor Eruption (Undeclared)

Minor eruption from central volcanic plateau volcano. Considered by Waikato Valley EOA and Southern EOA.

##### ***Magnitude of Event***

Minor eruption

##### ***Recurrence Interval***

Every 20 years

##### ***Impacts/Consequences***

###### *Human*

- Slight health effects possible

###### *Social*

- Minor disruption to daily activities

###### *Economic*

- Agency monitoring costs
- Potential for airport closures
- Changes to aircraft flight paths (causing delays)
- Loss of tourism (ski operators impacted)

###### *Infrastructure*

- Possible damage to roads, sewerage and water systems (minor)
- Minor clogging of air filters

###### *Geographic*

- N/A

#### 2.7.3.2 1/100 year event (Declared)

1995/96 Ruapehu scenario

### ***Magnitude of Event***

1/100 year event

### ***Recurrence Interval***

As above

### ***Impacts/Consequences***

#### *Human*

- Health effects from ashfall inhalation

#### *Social*

- Disruption to daily activities
- Temporary closure of roads/airports

#### *Economic*

- Agency response costs
- Clean-up costs (esp. roads)
- Some loss of business income
- Loss of agricultural and horticultural production

#### *Infrastructure*

- Possible damage to roads, sewerage and water systems (minor)
- Possible damage to water supplies, sewerage reticulation

#### *Geographic*

- Impacts to trout fishery (Tongariro)

### **2.7.3.3 1/10,000 year event (MLE)**

Large volcanic eruption from the central plateau produces large ash falls (assume 10 times the depths shown on the Lifelines hazard maps). Declared emergency and likely event of national significance.

### ***Magnitude of Event***

1/10,000? year event

### ***Recurrence Interval***

As above

### ***Impacts/Consequences***

#### *Human*

- Deaths and injuries
- Huge impacts to health in Turangi, Taupo and probably the wider region
- Mass evacuation requirements and dislocation
- Distress and on-going mental health issues
- Damage to residential areas (e.g. roof collapse)

#### *Social*

- Severe disruption to local communities
- Closure of most roads and airports
- Severe trauma and requirement for social services

### *Economic*

- Huge agency response costs
- Huge clean-up costs (esp. roads)
- Widespread business failures
- Major disruption to primary industries
- Loss of jobs (long term)
- Huge loss of agricultural production (farming/forestry)
- Huge loss of tourism
- Severe damage to residential housing
- Long-term re-instatement of infrastructure

### *Infrastructure*

- Severe and widespread damage to roads, sewerage and water systems
- Electricity losses (including Transpower's national grid network)
- Damage to rail lines and disruption to schedules (passenger and freight)
- Huge disruption to state highway traffic and possible damage to roads near the vent and adjacent to any waterway vulnerable to a lahar or pyroclastic flow
- Roof collapse of some businesses

### *Geographic*

- Impacts on trout fishery (Tongariro and Taupo)
- Widespread ash fall impacts – sedimentation, clogging of drains/streams etc.

## **2.7.4 Severe Storm Event**

### ***Assumptions***

Includes direct impacts only such as wind, lightning and rain, but excludes flow-on effects such as flooding

### ***Scenarios***

Two levels considered:

- 1/100 year storm event (undeclared)
- >1/100 year event (possible declaration)

### **2.7.4.1 1/100 year storm event (Undeclared)**

Flood event following large storm front moving across the North Island. Storm produces high winds, intense rain and lightning. Impacts include fallen trees, damage to roofs and power lines, lightning strikes, damage to residential and commercial property.

### ***Magnitude of Event***

1/100 year

### ***Recurrence Interval***

1/100 year

### ***Impacts/Consequences***

#### *Human*

- Possible injuries
- Some anxiety

#### *Social*

- Temporary closure of some roads
- Some loss of agricultural productivity

#### *Economic*

- Costs of damage to residential homes and businesses (limited)
- Small clean-up costs to residents and Councils

#### *Infrastructure*

- Damage to residential houses and properties
- Damage to some businesses
- Roads damaged (local and SH)
- Electricity failure (localised)
- Damage to water supply and sewerage systems

#### *Geographic*

- Widespread temporary deformation of the regional landscape

### **2.7.4.2 >1/100 year event (Declared)**

Flood event following very large storm front moving across the North Island. Storm surge elevates waves producing severe erosion within 30m of the shoreline.

#### ***Magnitude of Event***

>1/100 year

#### ***Recurrence Interval***

>1/100 year

#### ***Impacts/Consequences***

##### *Human*

- Possible deaths and injuries (limited)
- Stress and anxiety among communities
- Evacuations and displacement (limited)

##### *Social*

- Temporary closure of some roads
- Large loss of agricultural productivity

##### *Economic*

- Loss of income
- Business failure (limited)
- Costs of damage to residential homes and businesses (high)
- Large clean-up costs to residents and Councils

##### *Infrastructure*

- Widespread damage to residential houses and properties
- Damage to many businesses
- Roads damaged (local and SH)
- Electricity failure (localised)
- Damage to water supply and sewerage systems

### *Geographic*

- Widespread deformation of the regional landscape

## **2.7.5 River/Stream Flooding and Ponding**

General Note: Three levels of scenarios are applicable based on the wide range of combinations across the 3 EOA's. Two scenarios are applicable for each level within each EOA based on the location of river systems and broad types of events. The following sub-areas have been identified:

- WVEOA: Lower Waikato/Waipā and Mokau/Awakino
- SEOA: South-east Lake Taupo and South Waikato District
- TVEOA: Waihou/Piako and Coromandel

### **2.7.5.1 Southeast Lake Taupo (Undeclared)**

Flood event following large storm front or multiple small events moving across the North Island. Flood flows from the Tauranga-Taupo and Tongariro Rivers and tributaries. Inundation of low lying unprotected land along the channels of the Tauranga-Taupo and Tongariro Rivers and tributaries.

#### ***Magnitude of Event***

Up to a 1/100 year event

#### ***Recurrence Interval***

1/25 - 1/100 years

#### ***Impacts/Consequences***

##### *Human*

- Inconvenience to small number of residents and road users

##### *Social*

- Temporary closure of some roads including SH 1

##### *Economic*

- Slight loss of farm productivity
- Delays to major transportation routes
- Possible repair of infrastructure

##### *Infrastructure*

- Roads flooded (SH's and local)

##### *Geographic*

- N/A

### **2.7.5.2 Southeast Lake Taupo (Declared)**

Flood event following longitudinally extensive storm front moving across the North Island. Large flood flows from the Tauranga-Taupo and Tongariro Rivers and tributaries, with ponding behind floodbanks and control structures. Inundation of low lying unprotected land along the channels of the Tauranga-Taupo and Tongariro Rivers and some major tributaries.

### ***Magnitude of Event***

>1/100 year event

### ***Recurrence Interval***

Between 1/100 – 1/500 years

### ***Impacts/Consequences***

#### *Human*

- Some evacuations in urban areas and loss of habitable dwellings
- Flooding of small number of commercial buildings
- Possible drownings and injuries (limited)
- Distress and on-going mental health problems
- Removal of local government staff from other districts to assist

#### *Social*

- Social disruption in urban areas
- Possible closure of schools
- Temporary closure of transportation links
- Increased requirement for social services (counselling, relocation, food etc)

#### *Economic*

- Some loss of income (self-employed)
- Some loss of farm productivity
- Closure of major transportation routes
- Some loss of tourism
- Response costs (food, clothing, shelter, transportation)
- Possible cleanup of sewerage
- Repair of infrastructure

#### *Infrastructure*

- Partial failure of flood protection schemes, and total failure in areas with <1/100 year design standard
- Damage to State Highway 1
- Some communications networks off-line
- Possible damage to water supplies and sewerage treatment

#### *Geographic*

- Damage to urban and rural landscape

## **2.7.6 South Waikato District (Undeclared)**

Flood event following large storm front or multiple small events moving across the North Island. Flood flows from the Whakauru, Mangatapu, Pokaiwhenua and Oraka Streams. Inundation of low lying unprotected land along the channels of the Whakauru, Mangatapu, Pokaiwhenua and Oraka Streams.

### **Magnitude of Event**

Up to a 1/100 year event

### **Recurrence Interval**

1/25 - 1/100 years

## ***Impacts/Consequences***

### *Human*

- Inconvenience to small number of rural and urban residents and road users

### *Social*

- Temporary closure of some roads.

### *Economic*

- Slight loss of farm productivity
- Possible repair of infrastructure

### *Infrastructure*

- Roads flooded (local)

### *Geographic*

- N/A

## **2.7.7 South Waikato District (Declared)**

Flood event following large storm front or multiple small events moving across the North Island. Flood flows from the Whakauru, Mangatapu, Pokaiwhenua and Oraka Streams. Inundation of low lying unprotected land along the channels of the Whakauru, Mangatapu, Pokaiwhenua and Oraka Streams.

### ***Magnitude of Event***

1/100 year event

### ***Recurrence Interval***

1/100 years

### ***Impacts/Consequences***

#### *Human*

- Some evacuations in urban areas and loss of habitable dwellings
- Flooding of small number of commercial buildings
- Possible injuries (limited)
- Some stress
- Removal of local government staff from other districts to assist

#### *Social*

- Social disruption in urban areas
- Possible closure of schools
- Temporary closure of road links
- Increased requirement for social services (counselling, relocation, food etc)

#### *Economic*

- Some loss of income (self-employed)
- Some loss of farm productivity
- Closure of some road routes
- Some loss of tourism
- Response costs (food, clothing, shelter, transportation)
- Possible loss of water supply and cleanup of sewerage
- Repair of infrastructure



#### *Infrastructure*

- Communications networks possibly off-line (local)
- Possible damage to electricity supply
- Possible damage to water supplies and sewerage treatment

#### *Geographic*

- Damage to urban and rural landscape

## **2.7.8 South Waikato District – MLE**

Flood event following large storm front or multiple small events moving across the North Island. Huge flood flows from the Whakauru, Mangatapu, Pokaiwhenua and Oraka Streams. Inundation of low lying unprotected land along the channels of the Whakauru, Mangatapu, Pokaiwhenua and Oraka Streams.

#### ***Magnitude of Event***

1/500 year event

#### ***Recurrence Interval***

1/500 years

#### ***Impacts/Consequences***

##### *Human*

- Evacuations of major urban areas and loss of habitable dwellings
- Flooding of large numbers of commercial buildings
- Possible deaths and injuries
- Stress
- Removal of local government staff from other districts to assist

##### *Social*

- Social disruption in urban areas
- Closure of schools
- Closure of road links
- Increased requirement for social services (counselling, relocation, food etc)

##### *Economic*

- Large loss of income (self-employed)
- Large loss of farm productivity
- Closure of numerous roads (including SH's)
- Some loss of tourism
- Response costs (food, clothing, shelter, transportation)
- Loss of water supplies and clean-up of sewerage
- Repair of infrastructure

##### *Infrastructure*

- Communications networks possibly off-line (local)
- Extensive damage to electricity supplies
- Extensive damage to water supplies and sewerage treatment

##### *Geographic*

- Damage to urban and rural landscape

## 2.7.9 Ruapehu Lahar (Declared)

Scenario based on DOC reports and lahar risk assessment report

Only one scenario considered

Event will probably lead to a declared emergency, but is an event of national significance

Lahar following release of water from the Ruapehu Crater Lake after erosion and pore water pressure lead to total failure of the tephra rim. "Probable" event involves releasing ~1.3 million m<sup>3</sup> of water (bulking to ~6 million m<sup>3</sup> lahar) down the Whangaehu River.

### ***Magnitude of Event***

~1/50 year

### ***Recurrence Interval***

~1/50 year

### ***Impacts/Consequences***

#### *Human*

- Possible deaths or injuries (probability is .04% of 1 death with mitigation measures in place)

#### *Social*

- Temporary closure of some roads
- Temporary closure of railway line
- Closure of recreational walking tracks
- Possible damage to recreational fishing

#### *Economic*

- Response costs
- Possible loss of tourism

#### *Infrastructure*

- Potential damage to road and rail bridges
- State Highways potentially damaged
- Possible damage to power pylons
- Possible damage to timber mill
- Possible damage (limited) to Rangipo Power Station

#### *Geographic*

- Impacts on trout fisheries
- Erosion, scouring (localised)

## 2.7.10 Landslip – Hipaua and Waihi

### **Scenario 1 (MLE)**

It is unlikely that a landslip event at this site will precipitate an MLE and this scale of event has not been calculated.

## Scenario 2 (Undeclared)

It is also unlikely that a landslide event at this site will precipitate an undeclared emergency and this scale of event has not been calculated.

## Scenario 3 (Declared)

Landslip across SH41 triggered by a high-rain storm event. The main highway is blocked, Braxmere Lodge is taken out and damage to Waihi Marae has occurred. Several cars have been buried and one person is confirmed dead, with others trapped and requiring urgent medical attention and rescue services. Long delays in clearing SH41 are likely, as the road itself has been ripped away, along with culverting from the Waimatai Valley. Local workers, including medical and emergency services staff, have to be ferried across Lake Taupo by boat. Long-term slope stabilisation work is also required.

### ***Magnitude of Event***

As large as the 1910 event

### ***Recurrence Interval***

13% probable before 2009, 65% probable before 2049

### ***Impacts/Consequences***

#### *Human*

- Two cars buried in slip material and another 3 pushed aside
- 1 death in one vehicle on SH41
- 2 deaths at Braxmere Lodge
- several people injured in vehicles on SH41
- several people trapped in Braxmere Lodge
- St. Johns Ambulance Services required
- Distress caused by detour at slip site
- Assistance from Fire Service, Police and works construction personnel

#### *Social*

- Support for families affected (including tourists)
- Support for works and police personnel
- Closure of SH41 bypass and on-going distress at lengthy 'alternate' route usage

#### *Economic*

- Rescue services (USR, Fire and helicopter)
- Closure of SH41 will affect transportation across the central North Island (cartage and/or construction industries)
- Cost of alternative transportation across Lake Taupo for locals
- Availability of emergency services and medical personnel will be affected (with Taupo staff living on the western side of Lake Taupo)
- Insurance adjustments after event (national implications for transportation costs)
- Health and social services costs
- Response costs (food, accommodation for rescue services etc, transportation)
- Heavy equipment costs for removal of debris and recovery of vehicles
- Cost of infrastructure repair
- Cost of flying-in and supporting the families of tourists involved in event (dead and injured)
- Possible loss of tourism dollars through losses at Braxmere Lodge and those blocked from travelling along SH41

### *Infrastructure*

- Road blockage at on SH41
- Loss of culvert(s) under SH41 at Waimatai and/or Omoho Valley
- Loss of Braxmere Lodge and jetty beside lodge
- Possible road and building damage to Waihi Marae
- Power supply at risk (Transpower high-tension towers)

### *Geographic*

- Re-activation of landslip scarp possible
- Redistribution of failed slip material required (Resource Consent implications)

### **References**

These scenarios were developed with some input from the following sources:

Hegan, B. 2003. Landslide Risk from the Hipaua Geothermal Area, Lake Taupo, New Zealand. Presented at the Copy of the paper presented at the International Conference on Fast Slope Movements - Prediction and Prevention for Risk Mitigation, Sorrento, Italy, May 11th-13th 2003. (EW DOCS # 817759.

Cooper, L. 2002. Hipaua Steaming Cliffs and Little Waihi Landslide in 'Tephra'. MCDEM.

EW File # 30 03 09

EW File # 30 03 10

## **2.8 Hazards Not Considered**

Through the process of consultation and feedback a number of hazards have been selectively removed from the lists considered in the previous sections. The reasons for exclusion are detailed below:

<b>Hazard</b>	<b>Reasons for Exclusion</b>
Landslide dam breaks	No sites identified with a high enough level of risk to infrastructure or people to warrant inclusion.
Soil shrinkage/swelling	Level of risk from this hazard is extremely low and highly unlikely to lead to threat to/loss of life
Consolidation/compaction	Level of risk from this hazard is extremely low and highly unlikely to lead to threat to/loss of life
Shallow soil/regolith erosion	Level of risk from this hazard is extremely low and highly unlikely to lead to threat to/loss of life. This problem is mitigated with riparian planting and sustainable land management.
Streambank scour	Not significant enough for consideration.
Stream avulsion	Considered as a by-product of inundation in extreme conditions.
Alluvion	Considered as a by-product of inundation in extreme conditions.
Magmatic eruption – Ruapehu (or other)	Direct effects from this event are considered to have minimal effects on habitable dwellings and risks to life. However, the main effects of an eruption (ashfall) are considered separately.
Other events from TVZ	Not enough information is available to make a judgement on this hazard, although existing research results show that the recurrence interval for many events is long and reduces the risk.

Space debris	Not considered as the level of risk from this event is very minimal.
Drought	Not considered as the level of risk from this event is very minimal.
Sea level rise	While the cumulative effects of sea level rise over (say) 100 years is likely to be extensive, the real-time rise in sea level does not pose a significant threat to life. Current district and regional planning practices within the Waikato region are taking long-term SL rise into account.
Climate change	Similar situation to SL rise
Telecommunications system failure	The communications networks are varied enough (with land-lines, cell nets, satellite and RF) to provide overlap in services and redundancy during CD emergencies.
Major transportation accident - shipping	This is likely to be handled by Oil Spill Response teams and the Maritime Safety Authority. None of the EOA's within the region considered the risk or recurrence interval high enough for consideration.
Major transportation accident - road	Most accidents are not considered large enough to warrant any CD involvement. Those requiring CD intervention are likely to involve a large hazardous spill and are covered under that hazard.
Urban fire	These events are primarily handled by the Fire Service and even larger CBD events are unlikely to warrant CD involvement or mobilisation.
Chronic evolving contamination	Not considered as the level of risk from this event is very minimal.
Ionising radiation	Not considered as the level of risk from this event is very minimal.
Criminal acts	Not considered as the level of risk from this event is very minimal, with first response being from NZ Police.
Enemy attack/invasion	While the impact of this event may be high the likelihood is very minimal. An event of this nature would be handled primarily by Central Government and the armed forces and is beyond the scope of CDEM planning.
Space debris	Not considered as the level of risk from this event is very minimal.
Financial crisis	Not considered as the level of risk from this event is very minimal.
Air quality	Not considered as the level of risk from this event is very minimal. Current monitoring and planning processes at regional and district level are reducing the impacts of poor air quality.
Plant pests	Not considered as the level of risk from this event is very minimal.
Animal pests	Not considered as the level of risk from this event is very minimal.

There were also a few hazards that were identified by the individual EOA's during consultation, but were dropped from the scenarios (Section 2) and the 'Level of Risk' evaluations (section3). The reasons for this are as follows:

<b>Hazard</b>	<b>EOA</b>	<b>Reasons for Exclusion</b>
Ashfall – Ruapehu (or other)	Thames Valley	This was excluded during the scenario writing phase as it was discovered the likely effects on that area would be minimal.
Severe Storm Events	Thames Valley	Excluded due to the facts that severe storm events occur regularly within this area, but the effects of those storms are developed as scenarios within other hazard scenarios (such as storm surge/tidal effects, flooding, shoreline erosion, services/infrastructure failure and tsunami)
Tsunami	Southern	Excluded as the effects would be indirect and involve a number of displaced persons (accommodation etc) rather than direct and CD-declaration type effects.

### **3 Analyse the Risks**

The risks associated with the identified hazards have been assessed and the results are presented in the following tables.

### 3.1 Risk Analysis Matrix – Level of Risk

The following matrix has been modified from the original suggested in the Directors Guideline DGL 2/02 (page 28). The original matrix was heavily weighted towards the two extremes of events (Extreme and Low), which tends to make the gradient between those two extremes overly steep.

Likelihood	Consequences				
	1 Insignificant	2 Minor	3 Moderate	4 Major	5 Catastrophic
<b>A</b> Almost Certain	Moderate	High	Very High	Extreme	Extreme
<b>B</b> Likely	Low	Moderate	High	Very High	Extreme
<b>C</b> Possible	Low	Moderate	Moderate	High	Very High
<b>D</b> Unlikely	Very Low	Low	Moderate	High	Very High
<b>E</b> Rare	Very Low	Very low	Low	Moderate	High



## 3.2 Risk Categorisation

Following the identification of scenarios applicable to each EOA, each of those scenarios was subjected to a risk analysis using the Level of Risk Matrix (Figure ??) based on the Director's Guidelines (DGL 2/02 page 28) but modified specifically for this region. In determining the likelihood and consequences of each event the scenarios were assessed objectively in terms of HESIG (as per DGL 2/02 page 22) and included criteria such as threat to life, geographic and human extent of consequences, political and economic implications.

EOA	Hazard Scenario	MLE	Declared	Undeclared	Comments
Common	Animal Epidemic	High – C4	-----	-----	
Common	Human Pandemic	High – C4	-----	-----	
Common	Major Transportation Accident (Road)	-----	-----	High – A2	These two events can be combined for scenario development purposes.
Common	Hazardous Substances Spill	-----	-----		
Common	Fire (Rural)	-----	High – C4	Moderate – A1	
Common	Terrorism	Moderate – E4	-----	Moderate – C2	
Thames Valley	Earthquake	High – C4	Moderate – C3	Moderate – C2	
Thames Valley	Mayor Island Activity	-----	Moderate – E4	Moderate – D3	Ashfall
Thames Valley	River/Stream Flooding and Ponding	Very High – D5	High – D4	High – A2	Waihou/Piako
Thames Valley	River/Stream Flooding and Ponding	High – C4	High – B3	High – A2	Coromandel
Thames Valley	Tsunami	-----	Very High – D5	Moderate – C3	Distal

<b>EOA</b>	<b>Hazard Scenario</b>	<b>MLE</b>	<b>Declared</b>	<b>Undeclared</b>	<b>Comments</b>
Thames Valley	Tsunami	High – E5	-----	-----	Local
Thames Valley	Services/Infrastructure and Electricity Failure	-----	-----	Moderate – C3	
Thames Valley	Landslip	-----	-----	Moderate – C2	
Thames Valley	Storm Surge/Tidal Effect	-----	High – C4	High – A2	
Thames Valley	Shoreline Erosion	-----	-----	High – A2	
Thames Valley	Mine Subsidence/Tailings Dam Failure	-----	-----	Low – D2	
Waikato Valley	Major Transportation Accident (Air)	-----	-----	Moderate – B2	
Waikato Valley	Earthquake	-----	Moderate – C3	Moderate – D3	
Waikato Valley	Ashfall – Ruapehu (or other)	High – C4	Moderate – C3	Moderate – B2	
Waikato Valley	Severe Storm Events	-----	High – B3	High – A2	
Waikato Valley	River/Stream Flooding and Ponding	High – C4	High – B3	High – A2	Waikato River
Waikato Valley	River/Stream Flooding and Ponding	-----	Low – D2	Moderate – A1	Mokau/Awakino
Waikato Valley	Services/Infrastructure and Electricity Failure	-----	-----	Moderate – C3	
Waikato Valley	Landslip	-----	-----	Low – C1	

<b>EOA</b>	<b>Hazard Scenario</b>	<b>MLE</b>	<b>Declared</b>	<b>Undeclared</b>	<b>Comments</b>
Waikato Valley	Shoreline Erosion	-----	-----	Moderate – A1	
Waikato Valley	River/Lake Control Structure Failure	-----	Moderate – E4	-----	
Waikato Valley	Auckland Volcanic Field	-----	-----	Low – D2	
Waikato Valley	Heatwave	-----	-----	Very Low – E2	
Waikato Valley	Subsidence (Karst Solutioning)	-----	-----	Low – D2	
Southern	Geothermal Ground Activity	-----	High – D4	Low – D2	
Southern	Earthquake	High – D4	Moderate – D3	Low – C1	
Southern	Ashfall – Ruapehu (or other)	High – C4	Moderate – C3	Moderate – B2	
Southern	Severe Storm Events	-----	High – B3	High – A2	
Southern	River/Stream Flooding and Ponding	-----	Low – D2	Low – B1	Southeastern Lake Taupo (Turangi and Tauranga-Taupo)
Southern	River/Stream Flooding and Ponding	-----	Moderate – C2	Moderate – A1	South Waikato District
Southern	Ruapehu Lahar	-----	Moderate – A1	-----	
Southern	Landslip	-----	Extreme – A4	-----	Hipaua/Waihi

### 3.3 EOA-Based Levels of Risk

The following are the hazards ranked according to the level of risk determined in the previous risk analysis matrix. *The driving variable needs to be determined i.e. likelihood versus consequences.*

#### 3.3.1 Thames Valley EOA

Hazard Scenario	Level of Risk	MLE/Declared/ Undeclared	Likelihood/ Consequences
River/Stream Flooding and Ponding (Waihou/Piako)	Very High	MLE	D5
Tsunami (Local)	Very High	D	D5
Animal Epidemic	High	MLE	C4
Human Pandemic	High	MLE	C4
Major Transportation Accident (Road) /Hazardous Substances Spill	High	U	A2
Fire (Rural)	High	D	C4
Earthquake	High	MLE	C4
River/Stream Flooding and Ponding (Waihou/Piako)	High	D	D4
River/Stream Flooding and Ponding (Waihou/Piako)	High	U	A2
River/Stream Flooding and Ponding (Coromandel)	High	MLE	C4
River/Stream Flooding and Ponding (Coromandel)	High	D	B3
River/Stream Flooding and Ponding (Coromandel)	High	U	A2
Tsunami (Local)	High	MLE	E5
Storm Surge/Tidal Effect	High	D	C4
Storm Surge/Tidal Effect	High	U	A2
Shoreline Erosion	High	U	A2
Fire (Rural)	Moderate	U	A1
Earthquake	Moderate	D	C3
Earthquake	Moderate	U	C2
Mayor Island Activity	Moderate	D	E4
Mayor Island Activity	Moderate	U	D3
Tsunami (Distal)	Moderate	U	C3
Services/Infrastructure and Electricity Failure	Moderate	U	C3
Landslip	Moderate	U	C2
Terrorism	Moderate	MLE	E4
Terrorism	Moderate	U	C2
Mine Subsidence/Tailings Dam Failure	Low	U	D2

### 3.3.2 Waikato Valley EOA

Hazard Scenario	Level of Risk	MLE/Declared/ Undeclared	Likelihood/ Consequences
Animal Epidemic	High	MLE	C4
Human Pandemic	High	MLE	C4
Major Transportation Accident (Road) /Hazardous Substances Spill	High	U	A2
Fire (Rural)	High	D	C4
Ashfall – Ruapehu (or other)	High	MLE	C4
Severe Storm Events	High	D	B3
Severe Storm Events	High	U	A2
River/Stream Flooding and Ponding (Waikato River)	High	MLE	C4
River/Stream Flooding and Ponding (Waikato River)	High	D	B3
River/Stream Flooding and Ponding (Waikato River)	High	U	A2
Major Transportation Accident (Air)	Moderate	U	B2
Fire (Rural)	Moderate	U	A1
Earthquake	Moderate	D	C3
Earthquake	Moderate	U	D3
Ashfall – Ruapehu (or other)	Moderate	D	C3
Ashfall – Ruapehu (or other)	Moderate	U	B2
River/Stream Flooding and Ponding (Mokau/Awakino)	Moderate	U	A1
Services/Infrastructure and Electricity Failure	Moderate	U	C3
Shoreline Erosion	Moderate	U	A1
River/Lake Control Structure Failure	Moderate	D	E4
Terrorism	Moderate	MLE	E4
Terrorism	Moderate	U	C2
River/Stream Flooding and Ponding (Mokau/Awakino)	Low	D	D2
Landslip	Low	U	C1
Auckland Volcanic Field	Low	U	D2
Subsidence (Karst Solutioning)	Low	U	D2
Heatwave	Very Low	U	E2

### 3.3.3 Southern EOA

Hazard Scenario	Level of Risk	MLE/Declared/Undeclared	Likelihood/Consequences
Landslip	Very High	D	A4
Animal Epidemic	High	MLE	C4
Human Pandemic	High	MLE	C4
Major Transportation Accident (Road) /Hazardous Substances Spill	High	U	A2
Geothermal Ground Activity	High	D	D4
Earthquake	High	MLE	D4
Ashfall – Ruapehu (or other)	High	MLE	C4
Severe Storm Events	High	D	B3
Severe Storm Events	High	U	A2
Fire (Rural)	High	D	C4
Fire (Rural)	Moderate	U	A1
Earthquake	Moderate	D	D3
Ashfall – Ruapehu (or other)	Moderate	D	C3
Ashfall – Ruapehu (or other)	Moderate	U	B2
River/Stream Flooding and Ponding (South Waikato)	Moderate	D	C2
River/Stream Flooding and Ponding (South Waikato)	Moderate	U	A1
Ruapehu Lahar	Moderate	D	A1
Terrorism	Moderate	MLE	E4
Terrorism	Moderate	U	C2
Geothermal Ground Activity	Low	U	D2
Earthquake	Low	U	C1
River/Stream Flooding and Ponding (Southeastern Lake Taupo (Turangi and Tauranga-Taupo))	Low	D	D2
River/Stream Flooding and Ponding (Southeastern Lake Taupo (Turangi and Tauranga-Taupo))	Low	U	B1

## 4 Evaluate the Risks

Prior to commencing the SMG analysis (risk evaluation), EMO staff took the opportunity to review the process outlined in the Directors Guidelines. EMO staff felt that the suggested weightings did not reflect the level of importance of each risk factor. For example, human impacts (deaths and injuries) are given equal weighting to geographic (environmental) impacts in the Guidelines, even though the long-term effects of deaths and injuries are more financially and socially relevant than (say) a fault rupture across farmland. Infrastructure impacts also have the potential to act as amplifiers to human impacts and vice versa (in the case of Human Pandemic). As a result of this, there have been changes to the weighting of impacts, which are explained later in this section

The draft risk evaluation has been developed using the following information:

- Original figures developed by the EOA's
- Hazard scenarios
- Risk Analysis
- Historical and recent events (where possible)
- General knowledge and experience and
- Information from research undertaken by CRI's and tertiary institutions.

The SMG Model can be briefly explained as follows:

### 4.1 Seriousness

***“The relative impact in terms of people and/or dollars”.***

For each seriousness categories, a rating of 1 to 5 has been assigned. These numbers equate to risk descriptors of insignificant (1), minor (2), moderate (3), major (4) and catastrophic (5).

The seriousness categories are:

- Human (deaths and injuries)
- Social (disruption to normal social function and recovery)
- Economic (total dollar costs for all categories)
- Infrastructure (buildings, structures, utilities)
- Geographic (impact on environment, topography & natural resources)

Note that while the human category looks at the immediate and short term effects of human disruption and death, the social category is used to evaluate long term effects and strategies. This is especially significant when considering events like Animal Epidemic, where life is not directly threatened, but where an increase in mental disorders and suicide may be noticed within the farming and support services communities.

### 4.2 Manageability

***“The relative ability to reduce the risk (through managing the hazard or the community or both)”.***

This category includes both a measure of how difficult the hazard's risks are to address and a measure of the level of cross-sector management effort being applied to hazards across the 4Rs. There are nine combinations of difficulty and effort if each is assigned

a three level weighting (low, medium, or high) which can be grouped into a five level rating system as shown in the following table:

Management Difficulty	Current effort (4R's)	Rating
Low	High	1
Low	Medium	2
Medium	High	
Medium	Medium	3
High	Low	
Low	Low	4
Medium	High	
High	Medium	
High	Low	5

Rating descriptors were then developed as described below:

Current Management Difficulty(\*indicates the rating score):

- Low (4-6\*): Risk easily identified and few challenges posed in addressing
- Medium (7-9\*): Risk not always identified and there are challenges in addressing
- High (10-12\*): Hard to define and very difficult to manage.

Level of Effort being applied (using a worked example):

4R	Low (1)	Medium (2)	High (3)	
Reduction	✓			
Readiness		✓		
Response			✓	
Recovery		✓		
<b>TOTAL</b>	<b>1</b>	<b>4</b>	<b>3</b>	<b>8</b>

(\*Numbers presented are examples only).

In this case, the risk would be assigned a medium rating due to its score of eight.

## 4.3 Growth

***“The rate at which the risk will increase (through an increase in the probability of the event occurring, an increase in the exposure of the community, or a combination of the two)”.***

There are nine combinations of probability rise and community exposure if each is assigned a three level weighting (low, medium, or high), that can be grouped into a five level rating system as shown in the following table:



Rise in event occurrence	Changing community exposure	Rating
Low	Low	1
Low	Medium	2
Medium	Low	3
Medium	Medium	
High	Low	
Low	High	4
Medium	High	
High	Medium	
High	High	5

As with manageability, this step was taken further by modifying the rating system to align it with the EMO's overall understanding of the risk. The rating descriptors used are as follows:

**Rise in Event Occurrence (Hazard-based):**

- Low: Slow/no rise, extent of hazard unlikely to increase
- Medium: Expect some rise over time
- High: Highly unlikely to increase in occurrence

**Changing Community Exposure (People-based):**

- Low: Little/no rise, assumes limited population growth/expansion of development in hazardous areas
- Medium: Some rise, assumes moderate population growth/expansion of development in hazardous areas
- High: High probability of rise, assumes large population growth/expansion of development in hazardous areas

As an example (and using the table on Page 32 of the Directors Guidelines\* for scoring), a risk with a rating of "Low" for event occurrence and a rating of "Medium" for community exposure would equate to an overall rating score of 2. On the other hand, a risk with a rating of "High" for event occurrence and a rating of "Medium" for community exposure would equate to an overall rating score of 4.

The raw ratings (risk evaluation results) for each EOA are tabulated in Appendix 10

The raw ratings tables were then used as a basis for applying the weightings (multipliers), those being:

Overall Weighting (SMG):	Seriousness (S)	= 60%	<u>Multiplier</u> 0.6
	Manageability (M)	= 20%	0.2
	Growth (G)	= 20%	0.2
Seriousness Weighting:	Human	= 25%	0.25
	Social	= 25%	0.25
	Economic	= 20%	0.2
	Infrastructure	= 20%	0.2
	Geographic	= 10%	0.1

The weighted ratings are also tabulated in Appendix 10, however one worked example is shown below:

Risk	Scenario	S					Sub-Total S	Total S	M	G
		H	S	E	I	G				
Overall multiplier								0.6	0.2	0.2
Seriousness multiplier		0.25	0.25	0.2	0.2	0.1				
Ashfall Ruapehu Raw Score	MLE	1	2	3	2	1	-	9	2	1
Ashfall Ruapehu Weighted Score	MLE	0.25	0.5	0.6	0.4	0.1	1.85	1.11	0.4	0.2

The Emergency Management Office selected the very high, high and declared hazards from Appendix 8 and treated these for risk using the abbreviated SMG model (as modified by the MCDEM).

One of the items highlighted by the Strategic Working Party was whether various weightings would greatly affect the priority listing (order) of hazards. To determine the effect of altering ratios, three ratio 'splits' were undertaken. The initial version used a 40/40/20 split, with 40% Seriousness, 40% Manageability and 20% Growth. The same set of hazards were then assessed again using a 60/20/20 split and a 50/30/20 split. The end result showed that the 60/20/20 weighting was more accurate and produced a priority list that was more acceptable to the EOA representatives. The effect on the overall positioning of hazards, in priority order, was minimal.

Further workshops with each EOA produced an amended list for each, with minor changes made to the raw ratings, providing a more realistic priority list for each. One addition for the TVEOA and the SEOA was the inclusion of Electricity Failure, while the Services/Infrastructure Failure scenario was also added to the SEOA. As these effect more than one EOA, the additions have been included in the 'Common' set of scenarios in Appendix 5. The raw ratings tables below have an initial grade for each Seriousness category; Human, Social, Economic, Infrastructure and Geographic. Initial grades have also been allocated to Manageability and Growth.

The initial grades are then subjected to a 60/20/20 multiplier, giving the final weighted ratings and providing the basis for prioritising risk within each EOA.

## 4.4 TVEOA Ratings

### 4.4.1 Raw Rating – 60/20/20

Risk	Scenario	S					M	G
		H	S	E	I	G		
Tsunami (Local)	MLE	5	5	5	5	5	5	3
Earthquake	MLE	4	4	4	4	3	4	4
River/Stm Flooding	MLE	4	4	4	4	4	3	3
Tsunami (Distal)	D	3	3	3	3	4	4	3
Electricity Failure*	D	2	3	3	3	1	4	4
River/Stm Flooding (W/P)	MLE	2	4	4	4	3	2	3
Mayor Island Activity	D	2	3	4	4	3	3	2
Human Pandemic	MLE	4	4	4	3	1	2	3
Earthquake	D	3	3	3	3	2	3	2
River/Stm Flooding	D	3	3	3	3	3	2	2
Animal Epidemic	MLE	1	3	5	2	1	3	3
Storm Surge	D	3	2	2	2	1	2	3
River/Stm Flooding	D	1	3	3	2	1	2	2
Fire (Rural)	D	2	1	3	1	1	1	2
Major Transportation Accident (Road)	U	2	1	1	1	1	1	3
River/Stm Flooding	U	1	2	2	1	1	1	1
Storm Surge	U	1	1	1	1	1	1	2
Shoreline Erosion	U	1	1	1	1	1	1	2
River/Stm Flooding	U	1	1	2	1	1	1	1

\* added to the list following workshop feedback

### 4.4.2 Weighted Rating – 60/20/20

Risk	Scenario	S	M	G	Total	Priority
Tsunami (Local)	MLE	3	1	0.6	4.6	1
Earthquake	MLE	2.34	0.8	0.8	3.94	2
River/Stm Flooding	MLE	2.4	0.6	0.6	3.6	3
Tsunami (Distal)	D	1.86	0.8	0.6	3.26	4
Electricity Failure*	D	1.53	0.8	0.8	3.13	5
Human Pandemic	MLE	2.1	0.4	0.6	2.86	6
River/Stm Flooding (W/P)	MLE	2.04	0.4	0.6	3.04	7
Mayor Island Activity	D	1.89	0.6	0.4	2.89	8
Earthquake	D	1.74	0.6	0.4	2.74	9
Animal Epidemic	MLE	1.5	0.6	0.6	2.58	10
River/Stm Flooding	D	1.8	0.4	0.4	2.6	11
Storm Surge	D	1.29	0.4	0.6	2.29	12
River/Stm Flooding	D	1.26	0.4	0.4	2.06	13
Fire (Rural)	D	0.99	0.2	0.4	1.59	14
Major Transportation Accident (Road)	U	0.75	0.2	0.6	1.55	15
River/Stm Flooding	U	0.87	0.2	0.2	1.27	16
Storm Surge	U	0.6	0.2	0.4	1.2	17=
Shoreline Erosion	U	0.6	0.2	0.4	1.2	17=
River/Stm Flooding	U	0.72	0.2	0.2	1.12	18

## 4.5 WVEOA Ratings

### 4.5.1 Raw Rating – 60/20/20

Risk	Scenario	S					M	G
		H	S	E	I	G		
Ashfall Ruapehu	MLE	1	2	3	2	1	2	1
Animal Epidemic	MLE	1	4	5	1	1	3	3
Human Pandemic	MLE	4	4	4	1	1	2	3
Major Transportation Accident (Rd)	U	2	1	1	1	1	1	2
Fire (Rural)	D	2	1	3	1	1	1	2
Earthquake	D	2	3	3	3	1	4	2
River/Lake Control St. Failure	D	2	2	4	4	2	1	1
River/Stm Flooding	MLE	3	4	4	4	4	4	3
River/Stm Flooding	D	2	2	2	1	2	2	2
River/Stm Flooding	U	1	1	1	1	1	1	1
Severe Storm	D	2	2	2	2	4	2	3
Severe Storm	U	1	1	1	1	2	1	3

### 4.5.2 Weighted Rating – 60/20/20

Risk	Scenario	S	M	G	Total	Priority
River/Stream Flooding	MLE	2.25	0.8	0.6	3.65	1
Human Pandemic	MLE	1.86	0.4	0.6	2.86	2
Earthquake	D	1.53	0.8	0.4	2.73	3 =
Animal Epidemic	MLE	1.53	0.6	0.6	2.73	3 =
Severe Storm	D	1.32	0.4	0.65	2.32	4
River/Lake Control Structure Failure	D	1.68	0.2	0.2	2.08	5
River/Stream Flooding	D	1.08	0.4	0.4	1.88	6
Ashfall Ruapehu	MLE	1.11	0.4	0.2	1.71	7
Fire (Rural)	D	0.99	0.2	0.4	1.59	8
Severe Storm	U	0.66	0.2	0.6	1.46	9
Major Transportation Accident (Road)	U	0.75	0.2	0.4	1.35	10
River/Stream Flooding	U	0.6	0.2	0.2	1	11

## 4.6 SEOA Ratings

### 4.6.1 Raw Rating – 60/20/20

Risk	Scenario	S					M	G
		H	S	E	I	G		
Earthquake	MLE	4	4	4	3	2	5	3
Services/Infrastructure*	D	3	3	4	4	2	3	3
Electricity Failure*	D	3	3	4	4	2	2	3
Ashfall Ruapehu	MLE	3	3	4	3	3	3	2
Human Pandemic	MLE	4	4	4	1	1	2	3
Landslip/Hipaua	D	4	2	2	3	2	3	3
Geothermal Ground	MLE	2	2	2	2	2	3	4
River/Strm Flooding	MLE	3	3	3	3	1	2	2
Animal Epidemic	MLE	1	3	3	1	1	3	3
Severe Storm	D	2	2	2	2	3	2	3
Major Transport Accident (Road)	U	2	1	1	1	1	3	3
River/Strm Flooding	D	2	2	2	2	1	2	2
Fire (Rural)	D	2	1	4	2	1	1	2
Severe Storm	U	1	1	1	1	2	1	3
Ruapehu Lahar	D	1	1	2	2	1	1	2

\* added to the list following workshop feedback

### 4.6.2 Weighted Rating – 60/20/20

Risk	Scenario	S	M	G	Total	Priority
Earthquake	MLE	2.16	1	0.6	3.76	1
Services/Infrastructure*	D	1.98	0.6	0.6	3.18	2
Electricity Failure*	D	1.98	0.4	0.6	2.98	3
Ashfall Ruapehu	MLE	1.92	0.6	0.4	2.92	4
Human Pandemic	MLE	1.86	0.4	0.6	2.86	5
Landslip/Hipaua	D	1.62	0.6	0.6	2.82	6
Geothermal Ground	MLE	1.2	0.6	0.8	2.6	7
River/Strm Flooding	MLE	1.68	0.4	0.4	2.48	8
Animal Epidemic	MLE	1.14	0.6	0.6	2.34	9
Severe Storm	D	1.26	0.4	0.6	2.26	10
Major Transport Accident (Road)	U	0.75	0.6	0.6	1.95	11
River/Strm Flooding	D	1.14	0.4	0.4	1.94	12
Fire (Rural)	D	1.23	0.2	0.4	1.83	13
Severe Storm	U	0.66	0.2	0.6	1.46	14
Ruapehu Lahar	D	0.84	0.2	0.4	1.44	15

# 5 Management and/or Mitigation Data

This appendix contains a collation of all relevant hazard-specific mitigation documents that are likely to be required and/or consulted during a disaster or hazard event. They include mitigation plans, technical reports, research material and public consultation papers. The list combines documents created by regional and territorial authorities, the appropriate site determinant business (such as TransPower) and those developed by Central Government. Sets of documentation are laid out according to hazard type (Natural, Technological and Biological) as well as generic CD and EM documents that apply to various hazards.

## 5.1 Generic Hazard Mitigation Documents

<b>Generic Hazard Mitigation/Control Documentation</b>		
<i>National Level</i>	<i>Regional Level</i>	<i>Territorial/Local Level</i>
<b>National CD Plan</b>	<b>EW Regional CD Plan</b>	<b>Various District CD Plans</b>
The Insurance Emergency Plan 1993		
Du Pont - Transportational Emergency Code 1988 (for Hazardous Chemicals)		

## 5.2 Natural Hazard Mitigation Documents

<b>Natural Hazard Types</b>			
<b>Hazard Type</b>	<b>Mitigation/Control Documentation</b>		
	<b>National Level</b>	<b>Regional Level</b>	<b>Territorial/Local Level</b>
River and Stream Flooding	Resource Management Act 1991 MfE – Floodplain Management Planning Guidelines	Environment Waikato Documentation: Regional Plan and Strategic Plan Project Watershed Flood Risk Mitigation Plan Flood Hazard Identification Reports and Maps (in progress) Environmental Guidelines for Land Management (in progress) AM Plan: Land Drainage 2000 Flood Warning Procedures Manual 2001 EMO Duty Roster and Contact List EW Asset Management Plans: Lower Waikato Waipa Control Scheme AMP Piako River Scheme AMP Waihou Valley Scheme AMP Lower Tongariro River Natural Hazard Plan (Draft)	The Building Act 1991 Regional and Territorial combined flood management plans: Te Awamutu FMP Huntly FMP Thames FMP
Local surface ponding	Resource Management Act 1991 MfE – Floodplain Management Planning Guidelines	Environment Waikato Documentation: Regional Plan and Strategic Plan Project Watershed Flood Risk Mitigation Plan Flood Hazard Identification Reports and Maps (in progress) Environmental Guidelines for Land Management (in progress) AM Plan: Land Drainage 2000 Flood Warning Procedures Manual 2001 EMO Duty Roster and Contact List Coastal Flooding Risk Mitigation Strategy EW Asset Management Plans: Lower Waikato Waipa Control Scheme AMP Piako River Scheme AMP Waihou Valley Scheme AMP Lower Tongariro River Natural Hazard Plan (Draft)	The Building Act 1991 Regional and Territorial combined flood management plans: Te Awamutu FMP Huntly FMP Thames FMP
Landslide dam breaks	The dam break is not directly re-cognised, but the event that created the dam and the effects of failure are covered in the Resource Management Act 1991	Not covered directly	

<b>Natural Hazard Types</b>			
<b>Hazard Type</b>	<b>Mitigation/Control Documentation</b>		
	<i>National Level</i>	<i>Regional Level</i>	<i>Territorial/Local Level</i>
Storm surge/tidal effects	Resource Management Act 1991 NZ Coastal Policy Statement	EW Documentation: Regional Plan Coastal Plan Coastal Flooding Risk Mitigation Strategy Flood Warning Procedures Manual 2001 EMO Duty Roster and Contact List Coromandel Beaches: Coastal Hazards and Development Setback Recommendations (Full Technical Report 02/06 and Summary Report) Joint EW and EBOP Tsunami Research Project (2002-2003)	Indirectly covered in the Building Act 1991
Tsunami	Resource Management Act 1991 NZ Coastal Policy Statement	EW Documentation: Regional Plan Coastal Plan Coastal Flooding Risk Mitigation Strategy Flood Warning Procedures Manual 2001 EMO Duty Roster and Contact List Coromandel Beaches: Coastal Hazards and Development Setback Recommendations (Full Technical Report 02/06 and Summary Report) Joint EW and EBOP Tsunami Research Project (2002-2003)	Indirectly covered in the Building Act 1991
Seiching	NZ Coastal Policy Statement	EW Coastal Flooding Risk Mitigation Strategy EW Coastal Plan Joint EW and EBOP Tsunami Research Project (2002-2003)	
Soil shrinkage/swelling	Indirectly covered in the Resource Management Act 1991	EW – Environmental Guidelines for Land Management (in progress)	Indirectly covered in the Building Act 1991
Consolidation/compaction	This is not directly recognised, but the effects of failure are covered in the Resource Management Act 1991	Not directly covered	
Karst systems	This is not directly recognised, but the effects of failure are covered in the Resource Management Act 1991	EW Regional Plan	
Deep-seated rock slides	Resource Management Act 1991	EW Regional Plan	Building Act 1991
Flows and lateral spreads (slow = <0.1m/s)	Resource Management Act 1991 Soil Conservation and Rivers Control Act 1941	EW Regional Plan	Building Act 1991



<b>Natural Hazard Types</b>			
<b>Hazard Type</b>	<b>Mitigation/Control Documentation</b>		
Flows and lateral spreads (fast = >0.1m/s)	Resource Management Act 1991 Soil Conservation and Rivers Control Act 1941	EW Regional Plan	Building Act 1991
Rock/soil fall	Resource Management Act 1991	EW Regional Plan	Building Act 1991
	<i>National Level</i>	<i>Regional Level</i>	<i>Territorial/Local Level</i>
Topples	Resource Management Act 1991	EW Regional Plan	Building Act 1991
Complex Slope Failures	Resource Management Act 1991	EW Regional Plan	Building Act 1991
Liquefaction	Resource Management Act 1991	EW Regional Plan	
Fault rupture and heave	Resource Management Act 1991	EW Regional Plan	
Ground shaking	Resource Management Act 1991	EW Regional Plan	
Shallow soil/regolith	Resource Management Act 1991 Soil Conservation and Rivers Control Act 1941	EW Regional Plan EW – Environmental Guidelines for Land Management (in progress)	Building Act 1991
Streambank scour	Resource Management Act 1991 MfE – Floodplain Management Guidelines Soil Conservation and Rivers Control Act 1941	EW Regional Plan	Building Act 1991
Stream avulsion	Resource Management Act 1991 MfE – Floodplain Management Guidelines Soil Conservation and Rivers Control Act 1941	EW Regional Plan	Building Act 1991
Shoreline erosion: cliff/headland beach/dune	Resource Management Act 1991 NZ Coastal Policy Statement	EW Documentation: Regional Plan Coastal Plan Coastal Flooding Risk Mitigation Strategy Coastal Erosion Risk Mitigation Strategy for the Waikato Region Flood Warning Procedures Manual 2001 EMO Duty Roster and Contact List Coromandel Beaches: Coastal Hazards and Development Setback Recommendations (Full Technical Report 02/06 and Summary Report) Fragile: A Guide to Waikato Dunes Joint EW and EBOP Tsunami Research Project (2002-2003)	Building Act 1991

<b>Natural Hazard Types</b>			
<b>Hazard Type</b>	<b>Mitigation/Control Documentation</b>		
	<i>National Level</i>	<i>Regional Level</i>	<i>Territorial/Local Level</i>
Alluvion	MfE – Floodplain Management Guidelines Soil Conservation and Rivers Control Act 1941	EW Project Watershed EW Asset Management Plans: Lower Waikato Waipa Control Scheme AMP Piako River Scheme AMP Waihou Valley Scheme AMP Lower Tongariro River Natural Hazard Plan (Draft)	Building Act 1991
Ruapehu - Magmatic Eruptions	Resource Management Act 1991	EW Regional Plan EW Volcanic Risk Mitigation Plan	Building Act 1991
Ruapehu - Ashfall	Resource Management Act 1991	EW Regional Plan EW Volcanic Risk Mitigation Plan	Building Act 1991
Ruapehu - Glacier burst (lahar)	Resource Management Act 1991	EW Regional Plan EW Volcanic Risk Mitigation Plan	Building Act 1991 Genesis Power: Lahar Flows and the Impact of Genesis Operations on the Flows in the Tongariro River Ruapehu District Council (Lead Agency): Ruapehu Lahar Contingency Plan [No EW Involvement]
Tongariro/Ngauruhoe	Resource Management Act 1991	EW Regional Plan EW Volcanic Risk Mitigation Plan	Building Act 1991
Auckland Volcanic Field	Resource Management Act 1991	EW Regional Plan EW Volcanic Risk Mitigation Plan	Building Act 1991
Other events from TVZ	Resource Management Act 1991	EW Regional Plan EW Volcanic Risk Mitigation Plan	Building Act 1991
Geothermal ground and activity	Resource Management Act 1991	EW Regional Plan Geothermal Vegetation of the Waikato Region 2002 (Wildland Consultants)	Building Act 1991
High winds	Resource Management Act 1991 MetService Severe Weather Warning System (email and fax) Soil Conservation and Rivers Control Act 1941	EW Regional Plan NZ Fire Service	NZ Fire Service
Lightning strikes	Not recognised	NZ Fire Service	NZ Fire Service
Cyclones or Tornadoes	MetService Severe Weather Warning System (email and fax)	EW Documentation: Regional Plan Coastal Plan Flood Warning Procedures Manual 2001 EMO Duty Roster and Contact List EW/Metservice Regional Weather Website	

<b>Natural Hazard Types</b>			
<b>Hazard Type</b>	<b>Mitigation/Control Documentation</b>		
	<i>National Level</i>	<i>Regional Level</i>	<i>Territorial/Local Level</i>
Snow storm	MetService Severe Weather Warning System (email and fax)	EW Documentation: Regional Plan Coastal Plan Flood Warning Procedures Manual 2001 EMO Duty Roster and Contact List EW/Metservice Regional Weather Website	
Hailstorm	Not Recognised	Not recognised	
Frost	Not Recognised	Not recognised	
Fire (Rural)	Resource Management Act 1991 National Rural Fire Authority: Rural Fire Management Code of Practice Rural Fire Management Directory NZ Forest Owners Association: Operational and Strategic Guidelines for Fire Management (not dated)	Waikato Regional Rural Fire Committee DoC Fire Depot (Rotorua)	DoC Fire Depot (Rotorua)* NZ Fire Service* *Both utilising the Rural Fire Management Code of Practice
Space debris (comets and meteorites)	Not Recognised (but measures would probably be picked up by NASA as per Space Junk)	Not Recognised	
Drought	Resource Management Act 1991	EW Regional Plan and Strategic Plan EW Water Shortage Risk Mitigation Plan	
Heatwave	Not recognised	EW Heatwave Chart (DOCS # 757989)	
Sea Level Rise	Ratification of the Kyoto Protocol via LGNZ and Central Government NZ Climate Change Programme (MfE) NZ Coastal Policy Statement	EW Documentation: Regional Plan and Strategic Plan Coastal Plan Coastal Flooding Risk Mitigation Strategy Coastal Erosion Risk Mitigation Strategy Flood Warning Procedures Manual 2001 EMO Duty Roster and Contact List Coromandel Beaches: Coastal Hazards and Development Setback Recommendations (Full Technical Report 02/06 and Summary Report) Fragile: A Guide to Waikato Dunes Ratification of the Kyoto Protocol via EW Climate Change Group/ Preferred Policy Option	Indirectly via the Building Act 1991
Climate Change	Ratification of the Kyoto Protocol via LGNZ and Central Government NZ Climate Change Programme (MfE)	EW Regional Plan	

## 5.3 Technological Hazard Mitigation Documents

<i>Technological Hazard Types</i>			
<i>Hazard Type</i>	<i>Mitigation/Control Documentation</i>		
	<i>National Level</i>	<i>Regional Level</i>	<i>Territorial/Local Level</i>
Telecommunications System Failure		Telecom Civil Defence and Emergency Plan 1991	
Services/Infrastructure Failure		Natural Gas Corporation Bay of Plenty Emergency Plan 1990 Emergency Plan for High Pressure Gas Pipelines 1998	NZ Forest Products Kinleith Site Emergency Plan 1985
Electricity Failure	TransPower: Transline High Level Contingency Plan Substation Transformer Replacement Contingency Plans	TransPower: Transline High Level Contingency Plan Substation Transformer Replacement Contingency Plans Electricity Industry Emergency Contact List May 2000 Genesis: Huntly P/Station First Response Manual (Disaster Recovery Plan) Huntly P/Station Emergency Operating Guidelines Huntly P/Station Resource Manual Tokaanu Emergency Guidelines – Dam Break, Volcanic Eruption, Lahar and Earthquake Analysis' The Lines Company Limited – Contingency Plan  CE Energy – No contingency/disaster recovery plans (includes Kuratau Dam)	Taupo Lake Control Structure: Dam Break Assessment (EW Library) Karapiro Dam: Report on Dam Break Analysis 1989 Supplement to Karapiro Dam Break Analysis 1990 (EW Library) Maraetai: Report on Dam Break Analysis (EW Library) Ohakuri Dam Break Floodwave – Impact on Maraetai, Waipapa, Arapuni and Karapiro Dams (EW Library)

**Technological Hazard Types**

<b>Hazard Type</b>	<b>Mitigation/Control Documentation</b>		
	<i>National Level</i>	<i>Regional Level</i>	<i>Territorial/Local Level</i>
Hazardous Substances Spill	MfE Guidelines for the Disposal of Hazardous Wastes ERMA HSNO Act enforcement via: Ministry of Consumer Affairs Land Transport Safety Authority Police Civil Aviation Authority Maritime Safety Authority Ministry of Health Note: The list of accredited agencies from the ERMA website states that these agencies are "...not accredited by ERMA".	EW Ready Response: Duty Roster (DOCS # 751867) Duties and Procedures (DOCS # 609919) MOU with Spill Response Limited Ready Response Staff Manual (ad hoc document) EW RIG Non-fire response advice (using EPA's CAMEO software) EW Technical Report 1997/09 Transport of Hazardous Substances in the Waikato Region NZ Fire Service	District Council Dangerous Goods Officers? Tier 1 Oil Spill Plans
Major Air Accident	Civil Aviation Authority (CAA) National Rescue Co-ordination Centre (NRCC) Airport Rescue Fire Services	Airport Rescue Fire Services Response as requested via the CAA NRCC; may include response from: NZ Police RNZ Navy, Air force or Army Land Search and Rescue	Response as requested via the CAA NRCC; may include response from: NZ Police RNZ Navy, Air force or Army Land Search and Rescue
Major Shipping Accident	Maritime Safety Authority: Maritime Transport Act Accident Investigation Division Safe Ship Management System Search and Rescue via the CAA National Rescue Co-ordination Centre (NRCC)	Response as requested via the CAA NRCC; may include response from: NZ Police RNZ Navy, Air force or Army Land Search and Rescue	Response as requested via the CAA NRCC; may include response from: NZ Police RNZ Navy, Air force or Army Land Search and Rescue
Major Rail Accident	TranzRail Occurrence Management Manual Q320 Crisis Management Plan Q370 Amicus Recovery Procedures R020	NZ Police NZ Fire Service	NZ Police NZ Fire Service
Major Road Accident	Land Transport Safety Authority: Land Transport Act 1998 Traffic Regulations 1976 Road Safety Advertisement and Enforcement Campaign	EW Waikato Regional Land Transport Strategy NZ Police NZ Fire Service Transit NZ West Waikato Emergency Procedures Manual 2000 and State Highway Emergency Phone Number List for Region 3	NZ Police NZ Fire Service
Urban Fire	N/A	NZ Fire Service	NZ Fire Service

**Technological Hazard Types**

<b>Hazard Type</b>	<b>Mitigation/Control Documentation</b>		
	<i>National Level</i>	<i>Regional Level</i>	<i>Territorial/Local Level</i>
Chronic Evolving Contamination	MfE Guidelines for the Disposal of Hazardous Wastes ERMA: Guide to the HSNO Act for Enforcement Agencies Technical Guides ER-TG-03-1 7/00, ER-TG-01-1 9/99 and ER-TG-02-1 1/00.	Health Waikato Limited (HWL) Action Plan (in progress) EW RUG - Ready Response Manual (Covers point-source, but not diffuse)	
Ionising Radiation	National Radiation Laboratory - Radiation Protection Act: Licence List Codes of Practice Contingency Plan National Emergency Response (in conjunction with NZ Fire Service)	NZ Fire Service – initial response Then via NRL Emergency Response Pager (with 24hr emergency response capability) National Emergency Response Plan	NZ Fire Service – initial response Then via NRL Emergency Response Pager (with 24hr emergency response capability) National Emergency Response Plan
Criminal Acts	NZ Police – Initial Response NZ Army	NZ Police – Initial Response NZ Army	NZ Police – Initial Response NZ Army
Space Debris	NASA Safety Standard 1740.14 Guidelines and Assessment Procedures for Limiting Orbital Debris	NZ Fire Service – Initial Response	NZ Fire Service – Initial Response
Financial Crisis	Central Government	N/A	N/A
River/Lake Control Structure Failures	Dam Inventory – Ministry of Commerce 1994 (EW Library) NZ Dam Safety Guidelines 2000 (NZSOLD)	EW Regional Plan EW Asset Management Plans: Lower Waikato Waipa Control Scheme AMP Piako River Scheme AMP Waihou Valley Scheme AMP	Genesis Tongariro Scheme Emergency Guidelines (for Volcanic Eruption, Lahar Flow and Earthquake) Mighty River Power (documents available from EW Library, DOCS filing or AM Group): Taupo Lake Control Structure: Dam Break Assessment Karapiro Dam: Report on Dam Break Analysis 1989 Supplement to Karapiro Dam Break Analysis 1990 Maraetai: Report on Dam Break Analysis Ohakuri Dam Break Floodwave – Impact on Maraetai, Waipapa, Arapuni and Karapiro Dams

<b>Technological Hazard Types</b>			
<b>Hazard Type</b>	<i>Mitigation/Control Documentation</i>		
	<i>National Level</i>	<i>Regional Level</i>	<i>Territorial/Local Level</i>
Golden Cross Tailings Dam	N/A	EW, Hauraki DC and Coeur Gold management divested via Golden Cross Trust	EW, Hauraki DC and Coeur Gold management divested via Golden Cross Trust Potential Chemical Impacts (DOCS # 146885) Coeur Gold Tailings Dam Inundation Study (DOCS # 144472)
Waihi (Royal) Underground	EQC and MfE involvement		Ditto

<b>Technological Hazard Types</b>			
<b>Hazard Type</b>	<b>Mitigation/Control Documentation</b>		
	<i>National Level</i>	<i>Regional Level</i>	<i>Territorial/Local Level</i>
Huntly Underground	N/A	N/A	Solid Energy Emergency Response Procedures: Priority recovery and fires Mines Rescue Team NZ Fire Service
Rotowaro Opencast	N/A	N/A	Solid Energy - ?? OSH - Highwall stability? Natural Gas – Pipeline runs along beside the highwall
Air Quality	MfE – Ambient Air Quality Guidelines	EW Air Quality Monitoring Report * *Identifies Taupo, Te Kuiti, Tokoroa and Hamilton as risk sites – air quality management research is currently underway	
Mangatangi Dam (Watercare)			
Upper Mangatawhiri (Watercare)			



## 5.4 Biological Hazard Mitigation Documents

<b>Biological Hazard Types</b>			
<b>Hazard Type</b>	<b>Mitigation/Control Documentation</b>		
	<b>National Level</b>	<b>Regional Level</b>	<b>Territorial Level</b>
Plant Pests	MaF Pest Risk Analysis MaF National Pest Plant Accord MaF Plants Biosecurity Index	EW Regional Policy Statement 2000 EW Regional Pest Management Strategy, 2001-2002 EW Proposed Waikato Regional Pest Management Strategy, 2002-2007	
Animal Pests	MaF Pest Risk Analysis National Possum Control Agencies Strategy	EW Regional Policy Statement 2000 EW Regional Pest Management Strategy, 2001-2002 EW Proposed Waikato Regional Pest Management Strategy, 2002-2007 EW Aerial Standard Operating Procedures	
Human Epidemic	ERMA Guide to the HSNO Act for Enforcement Agencies ERMA Technical Guides ER-TG-03-1 7/00, ER-TG-01-1 9/99 and ER-TG-02-1 1/00. MaF Exotic Disease Response MoH National Influenza Pandemic Plan	Health Waikato Limited (HWL) Action Plan (in progress) OSH Enforcement for workplace environments Health Funding Authority – Major Incident and Response Plan for the Waikato, Bay of Plenty, Taranaki and Tairāwhiti Regions 1999	NZ Post - Responding to suspected anthrax in letters or parcels (Lead agency – Police)
Animal Epidemic	ERMA Guide to the HSNO Act for Enforcement Agencies ERMA Technical Guides ER-TG-03-1 7/00 and ER-TG-01-1 9/99. MaF Exotic Animal Response MaF Exotic Disease Response	MaF Enforcement (under the Biosecurity Act 1993) OSH Enforcement for workplace environments	