

Hazard Guideline No. 2
Hazard Identification and Risk Assessment for Local Authorities

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Auckland Local Authority Hazard Liaison Group

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Executive Summary

This is the second of three guidelines making up a set of “Guidelines for Hazards Management” aimed at assisting local authorities in minimising risks to their communities from hazards.

The guidelines follow the general risk management process outlined in the standard AS/NZS 4360:1999, “Risk management”. Guideline No. 2 provides guidance on establishing a context for risk analysis, identifying risks and carrying out risk analysis and risk evaluation for hazards.

Establishing a context for risk analysis involves i) evaluating strategic and organisational issues that will impact on the risk management process, ii) developing a management plan to guide the rest of the risk management process, iii) and developing draft risk evaluation criteria to set priorities for risk treatment.

Identifying risks involves:

- o identifying the hazards that have the potential to affect communities within the city or district of interest,
- o describing the characteristics of these hazards,
- o assessing the community’s vulnerability to hazards, and
- o identifying risks associated with the hazards.

Risk analysis aims to assign levels of risk to hazards, based on their likelihood and potential consequences.

Risk evaluation uses the information from the risk analysis step to rank risks from greatest to least and to select and prioritise risks for treatment.

The information generated from these processes is used in developing treatment options for risks. Guideline No. 3 provides guidance on mechanisms that can be used to treat risk.



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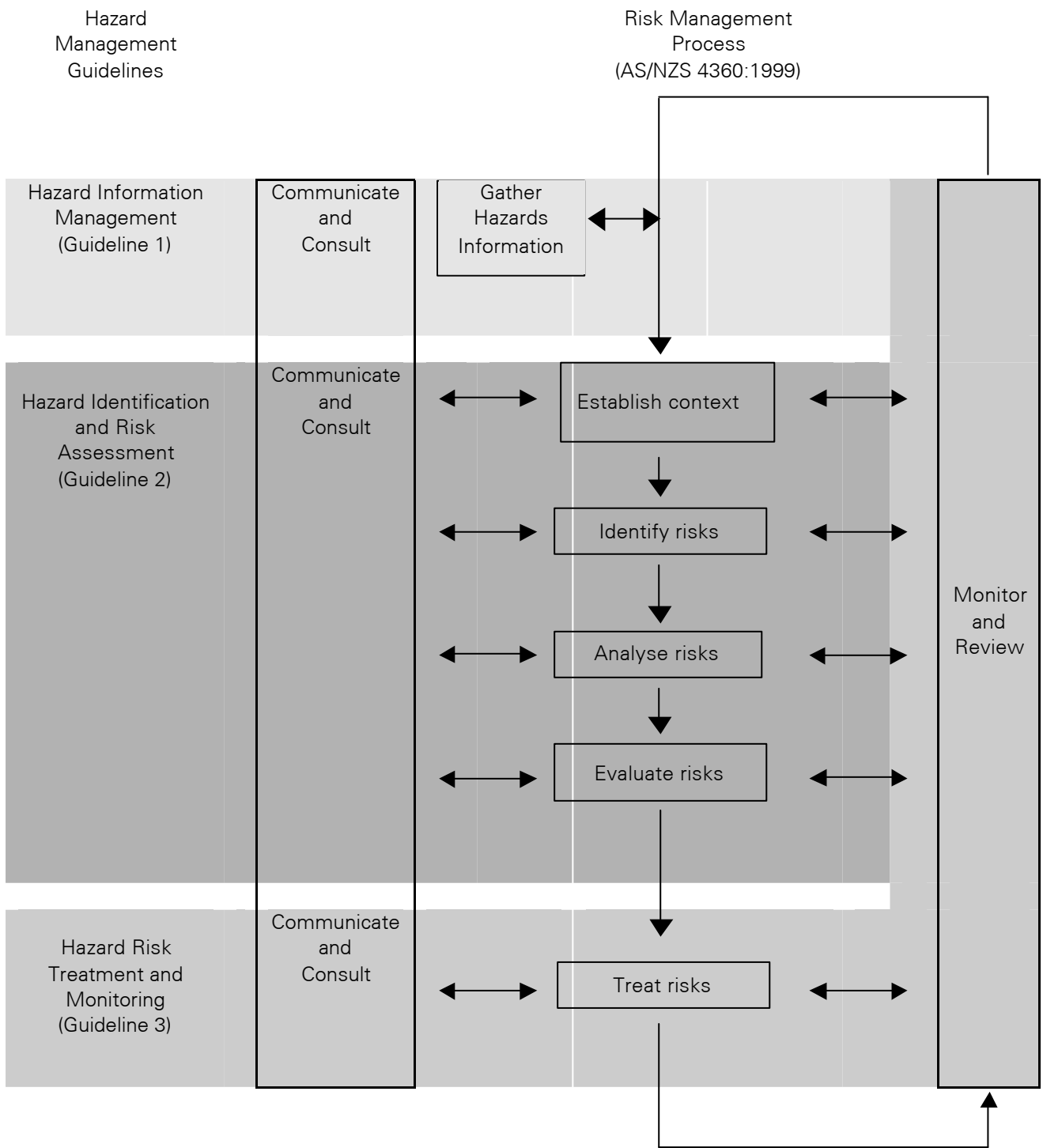


Figure 1: Relationship of the Hazard Guidelines to the Risk Management Process

Diagram adapted from Figure 3.1 in the Australian/New Zealand Risk Management Standard (AS/NZ 4360:1999).

is acknowledged and greatly appreciated.

1. Introduction

1.1 The Guidelines

This is the second of three guidelines making up a set of "Guidelines for Hazards Management". The guidelines set comprises:

- o Guideline No. 1: Hazard Information Management
- o Guideline No. 2: Hazard Identification and Risk Assessment
- o Guideline No. 3: Risk Treatment and Monitoring for Hazards.

The overarching goal of the guidelines is to minimise the risks to communities and the environment from the effects of a range of hazards, including natural and technological hazards.

The guidelines are intended to provide guidance on how hazard information is managed by Councils, particularly with regard to the application of the Australian/New Zealand Risk Management Standard (4360:1999). The relationship between the guidelines and AS/NZS 4360:1999 is summarised in Figure 1.

Background information on the guidelines including reasons for the guidelines, who the guidelines are for and the relationship of this guideline to Guidelines No. 2 and No. 3 is provided in Introduction to the Guidelines. Definition of terms used throughout the guidelines are also provided in Appendix to the Guidelines.

Parts of the guidelines, particularly Guideline No. 2, use structure and content from the publication Disaster Risk Management (Queensland Department of Emergency Services, 2000). Permission to use this material

1.2 Scope of Guideline No. 2

Guideline No. 2 deals with risk identification and assessment, which includes four main aspects of the hazard risk management process, namely:

- o Establishment of context;
- o Identification of risks;
- o Risk analysis;
- o Risk evaluation.

The guideline has been kept general to allow the principles introduced to be applied to a broad range of hazards (natural, technological and biological hazards) in a variety of locations. It provides guidance on establishing the local context for risk analysis, and on identifying the risks that are likely to be faced by a given community. The guideline also provides processes for analysing and rating risks associated with hazardous events using likelihood and consequences. Finally, the guideline outlines the risk evaluation process, which deals with decisions on which risks should be treated and in what order.

The general structure of each of the main sections of this guideline comprises:

- o The purpose of each step of the process;
- o Goals for each step of the process;
- o Guidance on how to achieve the goals;
- o Specific examples to illustrate the process;
- o Checklists to ensure all aspects of each step of the process have been adequately considered.

1.3 Consultation and Review Process

The development of Guideline No. 2 has included a number of consultative steps, peer reviews, and revisions. It will be reviewed again once Guideline No. 3 is developed and has been in circulation for a year. Details of the consultation and review process are provided at the end of this guideline.

DISCLAIMER

This guideline is intended to provide accurate and adequate information on its subject matter within the limitations of the size and scope of the publication. Nevertheless it has been written and made available on the basis that its authors and publishers exclude any liability to any person or entity for damages in respect of or arising from reliance by any person or entity upon any of the contents of this publication for any purpose.

2. Establish the Context for Risk Management

2.1 Purpose

The purpose of establishing the context is to:

- o Develop a shared understanding of strategic and organisational issues that will impact on the risk management process;
- o Develop a project management plan that will determine the scope of, and provide guidance for the rest of the process;
- o Develop draft evaluation criteria that will be used to decide which risks

are addressed first and to set priorities for risk treatment.

Establish the Context:

This step establishes the strategic, organisational and risk management context in which the rest of the process will take place. Criteria against which risks will be evaluated are established and the structure of the analysis is defined.

(3.2.a. AS/NZS 4360:1999).

2.2 What to do

- o Identify strategic and organisational issues and assess their implications.
- o Establish the management framework.
- o Develop draft risk evaluation criteria.

2.3 How to do it

1 Identify strategic and organisational issues that will influence the project and assess their implications

- o Collect and assimilate relevant information to facilitate an understanding of the issues that will support or impair Local Government's ability to manage community risks.

The required information should:

- o Identify clients and stakeholders;

Relevant legislation includes:

- Policy directives,
- Regional and national hazards management guidelines, e.g. AS/NZS 4360:1999; Legal

Compliance Good Practice for L.I.M.s;

- o The operational environment of local government. Operational responsibilities under the Civil Defence Act and CDEM Bill will need to be considered together with financial factors;
- o Political and economic circumstances, e.g. economic limitations to the amount of risk treatment that can be undertaken;
- o Social and cultural issues, e.g. Tangata Whenua do not wish local government to drain the crater lake on Ruapehu, even though it will reduce the risk of lahar;
- o Existing district, regional and national disaster management arrangements and capabilities;
- o Community perceptions, attitudes and expectations, e.g. Auckland communities generally perceive a lower level of risk than is actually present, and expect that Civil Defence organisations will ensure their welfare during and after an emergency;
- o Relevant legislation, including:
 - The Resource Management Act 1991;
 - The Building Act 1991;
 - The Hazardous Substances and New Organisms Act 1996;
 - The Local Government Official Information and Meetings Act 1987;
 - The Civil Defence and Emergency Management Act 2002;
 - The Forest and Rural Fires Act 1977.

Details of the statutory framework are given in Section 5 and Appendix 1 of Introduction to the Guidelines.

2 Establish the Management Framework

- o Develop a project management plan.

The plan should include the following:

- aim, objectives, scope, authority and stakeholders;
- geographic boundaries of the study area;
- time estimates for the project;
- estimated project cost;
- resources required
- roles and responsibilities for tasks; and
- monitoring and review.

Plan development should include consideration of the type of risk analysis to be carried out. The method of risk analysis (e.g. qualitative or quantitative) will depend on a number of factors such as the availability of hazard and risk information, available resources and budget, timeframe, complexity of hazards and the vulnerability of the community.

- o Establish a framework for communicating and consulting with executive management and stakeholders for comments on the plan as well as approvals.
- o Define the roles and responsibilities of various parts of the Council in managing the risk from hazards.

3 Develop Draft Risk Evaluation Criteria

- o Develop draft risk evaluation criteria.

Risk evaluation criteria are a set of factors (limits and thresholds) that are used to determine which hazard events qualify as a risk and subsequently which risks should be dealt with and in which order.

Criteria against which risks will be evaluated are established and the structure of the analysis is defined.

(3.2.a. AS/NZS 4360:1999).

Factors that should be considered when developing risk evaluation criteria include:

- o Human and social factors (e.g. potential loss of life and injury);
- o Built and natural environment (e.g. damage to buildings and infrastructure);
- o Economic loss;
- o Risk frequency;
- o Legal and social justice implications;
- o Political implications;
- o The level by which we can reduce the consequence of an event by managing the risk, i.e. only those hazards that can be effectively managed should be considered priorities for risk treatment;
- o Damage to heritage and ecologically sensitive sites.

Establish the risk evaluation criteria through a broad consultative process with executive management and stakeholders.

Examples of methods for selecting risks for treatment are provided in Section 5 (Table 8).

Risk evaluation criteria established at this stage are treated as draft because they are revisited at the risk evaluation stage of the risk management process (Section 5) once analysis of hazards, community and risks has been completed.

Decisions concerning risk acceptability and risk treatment may be based on operational, technical, financial, legal, social, humanitarian or other criteria. These often depend on the organisations internal policy, goals, objectives and the interests of stakeholders.

Criteria may be affected by internal and external perceptions and legal requirements. It is important that appropriate criteria be determined at the outset.

(4.1.5. AS/NZS 4360:1999).

Abridged examples of risk evaluation criteria

- o Risk that would cause fatality is unacceptable.
- o Risk that would cause substantial damage to buildings or infrastructure is unacceptable.
- o Risk that would cause more than 24 hours disruption to telecommunications, power and water supply is unacceptable.
- o Risk that would cause loss of power to the hospital is unacceptable.

This example does not include the full range of criteria.

2.4 Results

- A shared understanding of the strategic and organisational context for risk management.
- A hazards risk management plan and full project brief.
- A communication and consultation framework.
- Draft risk evaluation criteria.

2.5 Establishing Context Checklist

1 Develop a shared understanding of strategic and organisational issues

- Who are the clients and stakeholders?
- Have you considered all applicable legislation and policy documents?
- What are the political, social, cultural and economic factors that may affect the risk management process?
- What are the existing disaster management arrangements and capabilities?
- What are the operational responsibilities of local government for hazard management?
- What are the expectations of the community?
- What is the community perception and understanding of hazards and risks?

2 Develop a hazards risk management plan and full project brief

- Who are the stakeholders?
- What are the goals, objectives and outcomes of the study?
- What geographic area will be covered by the plan?

- What is the timeframe for the risk management process?
- What resources and budget are available?
- What are the roles and responsibilities of the various parts of the Council in managing the risks from hazards?
- What is the intended scope/ level of comprehensiveness of the plan?
- What is the sequence and timeframe of activities required in the project development?
- What is the date of completion for the first cycle of the project?
- What is the framework for communicating and consulting with community, executive management and stakeholders?

3 Develop draft risk evaluation criteria to provide a starting point for ultimately determining which risks should be dealt with and in what order

- Have you involved executive management and stakeholders in the development of the risk evaluation criteria and included their feedback in the draft?
- Have you considered the following factors for risk acceptability:
 - fatalities and serious injury;
 - loss of income;
 - loss of employment opportunities;
 - possible damage to buildings and infrastructure;
 - damage to significant cultural and heritage sites;
 - damage to ecologically sensitive sites and loss of soil quality;

- possible economic loss;
 - possible political implications;
 - risk frequency;
 - manageability.
- o Have you considered legal and social aspects such as equity and fairness, and possible areas of litigation?

Checklist derived from:

(Queensland Department of Emergency Services, (2000) Disaster Risk Management Guide: A How-to Manual for Local Government. John Garnsorthy & Associates Pty Ltd. Brisbane, pg 8.

3 Identify the Hazards and Risks

3.1 Purpose

The purpose of identifying hazards and risks is to:

- o Identify and describe the hazards that have the potential to affect communities within the city or district of interest;
- o Develop an understanding of the vulnerability of the communities; and
- o Find out what risks the community is facing.

3.2 What to do

- o Identify the hazards;
- o Describe and analyse the hazards;
- o Identify gaps in knowledge and understanding of hazards;

- o Identify and describe the important elements of the community and environment;
- o Identify and analyse the vulnerability of the communities to the hazards;
- o Establish risks

3.3 How to do it

1 Identify the hazards

- o Adopt an established definition of "hazard" (refer to Section 6 of Introduction to the Guidelines).

Natural Hazards:

- o Coastal Hazards (beach and cliff erosion; storm surge, locally and distantly generated tsunami);
- o Cyclones and severe storms (high winds and rain);
- o Drought (water supply and agricultural drought);
- o Earthquake;
- o Fire (urban fire; wildfire)
- o Flooding;
- o Land instability (subsidence, slipping, landslides);
- o Tornado
- o Volcanic eruptions (both from the Auckland Volcanic Field and distant eruptive centres);

Technological Hazards:

- o Infrastructure failure;
- o High pressure gas mains;
- o Contaminated sites (uncertified fill);
- o Hazardous substances;
- o Computer systems failure;
- o Major accident (aircraft, dam failure, ship).

Biological Hazards:

- o Disease amongst people, animals or plants);

Civil/Political Hazards:

- o Terrorism;
- o Civil unrest.

A decision must be made as to what hazards (in addition to “natural hazards”) will be assessed. This may mean expressly excluding some types of hazards, such as those covered by Occupational Safety and Health legislation.

Details on the potential sources of information that can be used to identify hazards are outlined in Section 2 of Guideline No. 1.

Information on hazards can be obtained from a variety of sources, and these are discussed in Guideline No. 1, Section 2.3.

What can happen:

The aim is to generate a comprehensive list of events, which might affect... [the community]. These are then considered in more detail to identify what can happen.

(4.2.2. AS/NZS 4360:1999).

2 Describe and Analyse the Hazards

- o Describe the hazards.

Hazard properties to be examined should include:

- o Probability of occurrence or likelihood of hazard occurring;
- o Magnitude;
- o Area affected;
- o Duration of hazard impact;
- o Speed of onset.

Primary hazards may trigger secondary hazards. Breaking the hazard up into its component parts may assist analysis. For instance a tropical cyclone may include high wind gusts, storm surge, and major flooding. Consideration of the individual elements may lead to a better understanding of the overall hazard.

Abridged example of hazard description

The Waihaha River has a catchment area of two thousand square kilometres. In the past thirty years there have been two separate occasions when the town has been flooded to the extent that approximately seventy percent of the buildings have been flooded above floor level. Both of the floods have been estimated as one in one hundred year events. Once flood levels have peaked, the town has remained inundated for three days before levels have dropped to the extent where clean-up operations could commence. Serious flooding can occur with less than half a day’s warning. No formal studies have been undertaken into the flooding in the Waihaha River system.

3 Identify gaps in knowledge and understanding of hazards

- o Identify any gaps in knowledge or understanding about the hazard and its consequences.

A basic understanding of the hazard likelihood and consequence is required to undertake risk assessment (Sections 4 and 5). Analysis and description of hazards may be difficult due to limited expert knowledge, inexact modelling techniques, and limited availability of information. Consequently, in some cases it may be necessary to fill some of these gaps (with further studies/investigation) before continuing into a full risk analysis and evaluation.

4 Identify and analyse the important elements of the community and environment

- Describe the community and the environment that hazards may impact upon.
- Consider the physical, social and economic components of the community:
- Physical Environment, including buildings and infrastructure that provide for the movement of people, goods and services (hospitals, telecommunications, power, water supply and sewerage networks, buildings etc), and the natural environment (water bodies, ecosystems etc);
- Social Environment, consider vulnerable sectors of the community, the distribution of population, impact upon social structures e.g. school systems, whanau groupings and maraes etc; and
- Economic Environment, identify and describe industries that significantly contribute to the districts economic well being e.g. manufacturing, agricultural etc.

Abridged example of community description

The district has one hundred thousand residents. About ten thousand tourists visit the district every year. Approximately one third of the permanent population is above fifty years old. There are six retirement villages concentrated in the two main centres.

Many houses in the district are quite old and are generally lowset and have timber construction. Many of them are not insured.

Electric power distribution infrastructure is quite old, with overhead wiring. Supply is from the national grid.

The economy of the district is dominated by farming and tourism.

5 Identify and analyse the community's vulnerability

- o Consider what makes elements of the community and environment vulnerable.

Susceptibility and resilience to hazards determine the vulnerability of the community. Vulnerability includes the ability to anticipate and cope with hazardous events as well as the capacity to recover from disasters. Vulnerability is dependent on the capacity of physical, social, economic and political structures to cope with and recover hazardous events.

Certain groups in society, economic activities and physical structures are especially vulnerable to hazardous events. The level of vulnerability depends on both the characteristics of the community and the nature of the hazards. Vulnerability information is important for assessing the likely consequences of an event.

Examples of vulnerability related elements are proximity to a hazardous area, good or poor access to emergency services, and to what degree existing control measures (put in place to lessen the effects of a possible hazardous event) will assist the community to cope with and recover from the impact of hazards.

- o Collect all possible vulnerability information.

Consider seeking information from:

- o LIMs and PIMs;

- Census data, for demographics and economics;
- Hazard registers;
- Emergency services for information on location on key police, fire or ambulance operation centres. These groups can be accessed through the Co-ordinating Executive Group for the Civil Defence Emergency Management Group of which each Auckland Territorial Authority is a member;
- Lifeline utility service providers or the Auckland Engineering Lifelines Group for information on location and vulnerability of lifeline services, etc;
- District Health Boards for information on key medical care centres and pharmacies;
- Auckland Regional Council technical publications.
- Concentrate the vulnerability assessment on those parts of the community and environment that are more susceptible and less resilient to hazards.

In doing the analysis, consider both the characteristics of the community and the nature of the hazards.

Abridged example of a description of community vulnerability

About one quarter of the population in the district has low resilience to flood hazard mainly due to their economic situations. People who live in retirement villages and nursing homes are highly vulnerable.

The district is not a self-sufficient community. It depends heavily on the outside for its food and energy. Such dependence decreases community resilience.

The buildings, which provide shelter to the community, vary in their vulnerability. Approximately eighty percent of all buildings are residential. There is a significant business centre situated in the flood prone area. About one thousand low-level buildings are situated in the flood prone area. Critical facilities, including ambulance and fire stations, are also situated in the flood prone area.

- Rate the vulnerability of different community components for each type of hazard. For example, assess the number of houses that are vulnerable to excess ground shaking based on the year and type of construction. I.e. Single storey weather board homes have low vulnerability.
- Analyse the vulnerability of the community using a method consistent with the available information.

In most cases the information available for vulnerability analysis is likely to lack precision and detail thus a general qualitative analysis will be appropriate.

An example of a simple vulnerability analysis, which links vulnerable elements of the community with specific hazards is shown in Table 1.

Special attention should be focused on critical facilities and engineering lifelines. These include emergency response agencies (fire, police and ambulance emergency operation centres, food distribution networks fuel depots, medical care systems and emergency shelters). Engineering lifelines include transport, power, water supply sewerage and telecommunications. An example of a qualitative analysis of vulnerability of engineering lifelines is provided in Table 2

Table 1 Examples of Community Vulnerability Elements Versus Specific Hazards

Element of the Community	Cyclone	Flood	Earthquake	Landslide
Suburban, high level income households	High vulnerability	Low vulnerability	Medium to High vulnerability	High vulnerability of developments on high slope areas
Outlying settlements, low level income	High vulnerability	High vulnerability of developments on low level areas	High vulnerability	High vulnerability of areas of the escarpment
Local economic production	Medium to High vulnerability	Low vulnerability of water damage to business operation	High vulnerability of all business and industry	No apparent vulnerability of business and local industry
Lifelines	High vulnerability of all lifelines	High vulnerability of all lifelines	High vulnerability of all lifelines	High vulnerability of all lifelines
Critical facilities	Medium vulnerability	Low vulnerability	High vulnerability of most of critical facilities	Some facilities may be vulnerable
Response and recovery capability	Counter disaster plan needs to be improved	Counter disaster plan needs to be improved	Counter disaster plan needs to be improved	Counter disaster plan needs to be improved
Current mitigation	Cyclone warning system in place	Flood warning system in place. Appropriate floodplain maps prepared. A designated flood level established	No appropriate warning system. Building codes in place	No appropriate warning system.

Table 2 Qualitative Analysis of Vulnerability of Engineering Lifelines

Natural Hazard	Vulnerable Component(s)	Effects	Interdependent Lifeline/s	Vulnerability of Components	Consequences to the Community
Telecommunications					
Flood	Telephone exchange	Flooded	Electricity supply	Can be completely damaged	<ul style="list-style-type: none"> o Total loss of communication facilities; Loss of electricity supply due to loss of control facilities
Road Transport					
Flood	<ul style="list-style-type: none"> o Bridges o Cuttings o Underpasses o Part of roads 	<ul style="list-style-type: none"> o Flooded o Landslip o Flooded o Flooded 	<ul style="list-style-type: none"> o Supply of other lifelines not immediately dependent; o Restoration of other lifelines immediately dependent 	<ul style="list-style-type: none"> o Road system can be damaged; o Components can be partially damaged 	<ul style="list-style-type: none"> o Closed to traffic; o Disruption in food, fuel, medical supplies; o Disruption to emergency services



6 Identify Risks

Once the vulnerability of the community and environment has been analysed, the risks can be identified. Risk is dependent upon the likelihood of harmful consequences, which arise from the interaction of hazards, community and the environment. Risk is a combination of hazard and vulnerability.

Tools and Techniques:

Approaches used to identify risks include checklists, judgements based on experience and records, flow charts, brainstorming, systems analysis, scenario analysis and systems engineering techniques.

The approach used will depend on the nature of the activities under review and the types of risk.

(4.2.4. AS/NZS 4360:1999).

- Generate risk statements that reflect the relationship between each hazard and each element of the vulnerable community or environment.

Abridged example of risk statements

There is a risk of loss of life and injury if a one in one hundred year flood occurs.

There is a risk that a one in one hundred year flood may directly affect approximately 5000 people.

There is a risk that a one in one hundred year flood may destroy the majority of housing stock.

3.4 Results

- A description of hazards that have the potential to affect communities within the city or district.
- A description of the community and environment.
- A description of community vulnerability.
- A list of community risks.

3.5 Risk Identification Checklist

1 Identify hazards

Have you listed all hazards that have the potential to affect your Council's city or district for which territorial authorities have statutory responsibilities, such as:

- Natural Hazards;
- Technological Hazards;
- Biological Hazards;
- Civil/Political Hazards.

2 Analyse and Describe Hazards

- What is the chance of occurrence of each hazardous event?
- How often can it occur?
- What can the magnitude and length of each hazardous event be?
- How rapidly can it occur and what warning would you have?
- What areas can be affected?
- Have you considered secondary hazards that could be triggered by primary hazards?

3 Identify gaps in knowledge and understanding of hazards

- o Have you identified gaps in knowledge or understanding about the hazard and its consequences?
- o Must any of these gaps be filled before risk analysis and evaluation proceeds?

4 Identify and describe the important elements of the community and environment

Have you described the major characteristics of the community and environment such as:

- o The size, distribution and age of the population?
- o Public health and disabilities?
- o Capabilities of individuals to undertake appropriate protective behaviour?
- o Critical facilities (medical and emergency services, fire and police stations)?
- o Engineering facilities (transport, power and water supply, sewerage and telecommunications)?
- o Buildings?
- o Economic production?
- o Response and recovery capability? and
- o Items of environmental and cultural significance?

5 Describe and analyse the community's vulnerability

What makes the community more or less vulnerable? For example:

- o What is the proximity to hazards?

- o Will some people need financial assistance?
- o What is the level of access to emergency services?
- o What is the level of awareness?
- o What is the level of mobility should evacuation be necessary?
- o Are the engineering services robust or frail?
- o Have the existing response and recovery plans been tested, and are they adequate?
- o Do the buildings provide protection from hazards?

6 Identify Risks

- o Have you identified all credible risks?
- o Have you described each risk in such a manner that treatment priorities and treatment requirements can be determined?
- o Have you summarised risks as concise risk statements?

Checklist derived from:

Queensland Department of Emergency Services (2000) Disaster Risk Management Guide: A How-to Manual for Local Government John Garnsorthy & Associates Pty Ltd. Brisbane pg 11.

4 Analyse the Risks

4.1 Purpose

- o To assign levels to risks

4.2 What to do

- o Determine the likelihood and consequences of each hazardous event; and

- o Assign risk levels to each risk based on likelihood and consequences.

The risk analysis process systematically uses available information to determine how often specified hazard events may occur and the magnitude of their likely consequences. The information generated from this process will be used for risk evaluation and prioritising risks.

When analysing the consequences of a particular risk, consider the existing risk treatment mechanisms that are in place. For example, the consequences of a volcanic eruption in Auckland are significantly reduced as the Auckland Volcano-Seismic Monitoring Network should provide sufficient warning to allow evacuation of high-risk communities.

Risk Analysis:

Risk analysis involves consideration of the sources of risk, their consequences and the likelihood that those consequences may occur. Factors which affect consequences and likelihood may be identified. Risk is analysed by combining estimates of consequences and likelihood in the context of existing control measures.

(4.3.1. AS/NZS 4360:1999).

4.3 How to do it

- 1 Determine and rate the likelihood of occurrence of each hazardous event

Consequences and Likelihood:

To avoid subjective biases the best available information sources and techniques should be used when analysing consequences and likelihood. Sources of information may include the following: past records, relevant

experience, relevant published literature, research and specialist and expert judgements.

(4.3.3. AS/NZS 4360:1999).

Use hazards information sources and procedures identified during the Guideline No.1 process to obtain information on likelihood of occurrence.

- o Allocate likelihood of occurrence ratings

Likelihood of occurrence ratings are provided in Table 3. For example, the return period for movement on the fault line is 2000 years. The event may occur only in exceptional circumstances.

If the return period of a particular hazard is unknown, estimate the return period and describe the likelihood qualitatively using words such as "almost certain" and "likely" (refer to Table 3). Whenever possible, the confidence placed on estimates of likelihood rating should be included.

Table 3 Likelihood Ratings for Risk Assessment

Likelihood rating	Hazard Return Period (years)
Almost Certain	0 – 5
Likely	6 – 19
Possible	20 – 99
Unlikely	100 – 999
Rare	≥ 1000

Note: As a comparison, the probability of a hazard with a 100-999 year return period occurring in any 70 year period is 50% to 7% and the probability of a hazard with a ^a1000 year return period occurring in any 70 year period is <7%.

Consequences and Likelihood:

The magnitude of consequences of an event, should it occur, and the likelihood of the event and its associated consequences, are assessed in the context of the existing controls. Consequences and likelihood are combined to produce a level of risk. Consequences and likelihood may be determined using statistical analysis and calculations. Alternatively where no past data are available, subjective estimates may be made which reflect an individual's or group's degree of belief that a particular event or outcome will occur.

(4.3.2. AS/NZS 4360:1999).

are outputs of the processes outlined in Section 3.

The consequences column should take account of and document existing risk treatment mechanisms that reduce the potential consequences e.g. Auckland Volcano- Seismic Monitoring Network.

2 Determine and rate the consequences for each risk of a hazardous event

The scoping and analysis of vulnerable elements of the community and environment carried out as part of the hazard identification process (Section 3) are used as input for this part of risk analysis.

- o Determine the consequences of each risk of a hazardous event on the community and environment.

The results can be documented in a risk consequences summary table, which lists in a concise way the following information for each risk:

- o Name of hazard;
- o Name of vulnerable element;
- o Risk statement;
- o Consequences;

An example of such a table is presented as Table 4.

The hazard, vulnerable element, and risk statement information in the table



Table 4 Risk Consequences Summary

Hazard	Vulnerable Element	Risk	Consequences	Rating
Flood (likelihood)	People	There is a risk that approximately 5,000 people may be directly affected by flood.	<ul style="list-style-type: none"> o There may be loss of life and injury. o People may be homeless. o People may need to be evacuated o Many people may suffer from post-disaster psychological trauma. o There may be long-term economic hardship for families. 	Moderate

Source: Queensland Department of Emergency Services (2000) Disaster Risk Management Guide: A How-to Manual for Local Government. John Garnsorthy & Associates Pty Ltd. Brisbane pg 12

- o A range of consequences can be examined for varying levels of a hazardous event.

For example, different flood levels (e.g. 50 year and 100 year return period floods) and the consequences for the community of each can be examined.

- o Determine a consequences rating for each risk.

Complete Table 4 by assigning a consequences rating to all risks using the qualitative consequences rating table (Table 5).

Table 5 Consequences Ratings for Risk Assessment

Descriptor	Description
Insignificant	No fatalities, no injuries, low financial loss, little disruption to community, no measurable impact on environment.
Minor	Small number of injuries, no fatalities, first aid treatment required, some displacement of people (very short period of time e.g. 24 hours), some personal support required, some damage, some disruption (short period of time), small impact on environment with no lasting effects, some financial loss.
Moderate	Medical treatment required, no fatalities, some hospitalisation, displacement of people (very short period of time e.g. 24 hours), personal support satisfied through local arrangements, localised damage which is rectified by routine arrangements, normal community functioning with some inconvenience, some impact on environment with no long term effects or small impact on environment with long term effects, significant financial loss.
Major	Extensive injuries, fatalities, significant hospitalisation, large number displaced (more than 24 hours duration), external resources required for personal support, significant damage that requires external resources, community only partially functioning, some services unavailable, some impact on environment with long term effects, significant financial loss – some financial assistance required.
Catastrophic	Large numbers of severe injuries, large numbers requiring hospitalisation, general and widespread displacement for extended duration, significant fatalities, extensive personal support, extensive damage, community unable to function without significant support, significant impact on environment and/or permanent damage, huge financial loss – unable to function without significant support.

Source: Queensland Department of Emergency Services (2000) Disaster Risk Management Guide: A How-to Manual for Local Government. John Garnsworthy & Associates Pty Ltd. Brisbane

3 Review and update risk statements

Review the risk statements developed as part of the Risk Identification part of Section 3. Modify and add to the statements where necessary.

4 Obtain a rating (level) for each risk of a hazardous event

Rate each risk using the likelihood and consequences ratings and the risk rating matrix (Table 6).

Since some of the estimates made in determining likelihood and consequences may be imprecise, the assessment team should not blindly follow results produced by the table, but should look for anomalies in the results. If major anomalies are found, the scales and descriptors used for the likelihood and consequences ratings should be re-examined.

Table 6 Risk Rating Matrix

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	High	High	Extreme	Extreme	Extreme
Likely	Moderate	High	High	Extreme	Extreme
Possible	Low	Moderate	High	Extreme	Extreme
Unlikely	Low	Low	Moderate	High	Extreme
Rare	Low	Low	Moderate	High	High

Source: AS/NZS 4360:1999

5 Summarise the risk analysis results

Summarise the risk analysis results in table form (refer to Table 7).

The risk analysis summary is very important because it brings together the information in a concise format that allows it to be communicated to stakeholders and used for decision making.

Table 7 Risk Analysis Results Summary

Hazard	Risk	Risk Treatment Measures in Place	Likelihood Rating	Consequence Rating	Risk Rating
Flood (likelihood)	There is a risk that approximately 5000 people may be directly affected by flood.	Nil	Possible	Catastrophic	Extreme

Source: Queensland Department of Emergency Services (2000) Disaster Risk Management Guide: A How-to Manual for Local Government John Garnsorthy & Associates Pty Ltd. Brisbane pg 12

4.4 Results

A risk summary containing:

- o Assigned likelihood and consequences for each risk.
- o Assigned levels of all risks.

The risk summary is the pivotal document in the risk management process. It brings together information developed in the previous steps in a concise format that allows it to be communicated to stakeholders and executive management for decision making.

4.5 Risk Analysis Checklist

- o Have you analysed all the risks identified in Section 3 and assigned appropriate levels of likelihood and consequences?
- o Are the risk statements and assumptions developed in the previous steps accurate enough, or do they need to be modified?
- o Have you established the level of each risk?

- o Have executive management and stakeholders seen and commented on the risk summary?

Checklist derived from:

Queensland Department of Emergency Services (2000) Disaster Risk Management Guide: A How-to Manual for Local Government John Garnsorthy & Associates Pty Ltd. Brisbane pg 13.

5. Evaluate the Risks

5.1 Purpose

To rank the risks from greatest to least so that a priority for treatment can be assigned.

In the risk analysis stage, each risk has been assigned a rating (level) based on likelihood and consequences. Now, it is necessary to compare the levels of risks with the risk evaluation criteria. This leads to decisions on which risks should be treated and in what order (risk prioritisation).

Risk Evaluation:

Risk evaluation involves comparing the level of risk found during the analysis process with previously established risk criteria.

(4.4. AS/NZS 4360:1999).

stage of “Establishing the Context” (Section 2).

Although the criteria have already been established, risk analysis will have provided additional information that should be considered. Reassessment will ensure that the criteria are up to date, accurate and capture all major issues that should be taken into account in risk prioritisation. It is advisable to obtain executive management agreement upon the revised risk evaluation criteria.

5.2 What to do

- o Prioritise the risks from greatest to least.

5.3 How to do it

1 Rank all risks according to rating

Rank the risks from greatest to least according to the risk ratings in the risk analysis summary table (Table 7).

2 Compare risks with risk evaluation criteria

- o Reassess the risk evaluation criteria that were developed in the final

- o Select and prioritise the risks for treatment using the updated risk evaluation criteria.

There are a number of different methods that can be used for selecting risks for treatment. The method of risk selection that is most appropriate for the individual Council situation should be adopted. This may be one of the examples outlined in Table 8 below or, alternatively, a different system that has been specifically tailored for a Council’s needs.

Table 8 Examples of Methods for Selecting Risks for Treatment

Method	Description/Comments
Acceptable/Unacceptable	Class risks as acceptable or unacceptable based on risk evaluation criteria such as potential loss of life, damage to buildings and infrastructure, economic loss, legal and social justice implications e.g. risks that cause fatality or severe injury are unacceptable. Treatment options assessment is based on unacceptable risks only (in risk rating order).
Cut-off Based on Risk Rating	Assess treatment options for only those risks with moderate or higher risk rating.
Cut-off Based on Budget	Assess treatment options for as many risks as can be covered by the available budget, commencing at the highest risk and working towards the lowest risk.

Notes: 1. A combination of the above risk selection methods could be adopted.
 2. Risk treatment is an iterative process. Risks not on the list for treatment initially are likely to become priority once higher rating risks are treated (adopt a lower rating).

Prioritisation may include further evaluation to rank risks that attain the same rating.

Risk Evaluation:

The output of a risk evaluation is a prioritised list of risks for further action.

(4.4. AS/NZS 4360:1999).

3 Summarise risk evaluation

- o Document all risks selected for treatment in priority order. At this stage the future focus should be on these risks.

The risks not being considered for treatment need to be documented as any of these may become unacceptable in the future. All risks need to be included in future disaster risk management cycles.

Risk Evaluation:

If the resulting risks fall into the low or acceptable risk category, they may be accepted with minimal further treatment. Low and accepted risks should be monitored and periodically reviewed to ensure they remain acceptable. If risks do not fall in to the low or acceptable risk category, they should be treated using one or more of the options considered in the risk treatment section.

(4.4. AS/NZS 4360:1999).

5.4 Results

- o A prioritised list of all risks for treatment arranged from greatest to least.
- o Documentation of all risks

5.5 Risk Evaluation Checklist

- o Are you satisfied that the reviewed risk evaluation criteria are accurate and capture all major issues that should be taken into account in risk prioritisation?
- o Have you selected the risks that will be assessed for treatment?
- o Have you ranked the risks in order of priority for treatment?
- o Have you sought feedback on the results of this step of risk management from executive management and stakeholders?

Checklist Derived From:

Queensland Department of Emergency Services (2000) Disaster Risk Management Guide: A How-to Manual for Local Government. John Garnsorothy & Associates Pty Ltd. Brisbane pg 14



Consultation and Review Process

The development of Guideline No. 2 has included a number of consultative steps, peer reviews, and revisions. It will be reviewed again once Guideline No. 2 and 3 are developed and have been in circulation for a year.

- Scoping Document endorsed by ARC and Hazards Liaison Group November 2001
- Draft of Guideline No. 2 for internal review within the Councils February 2002
- Final Draft Guideline No. 2 July 2002
- Implementation of Guideline No. 2 August 2002 – July 2003
- Survey of Implementation (Guideline No.'s 1, 2 and 3) August 2003 (scheduled)
- Final Revision (Guideline No. 1, 2 and 3) September 2003 (scheduled)