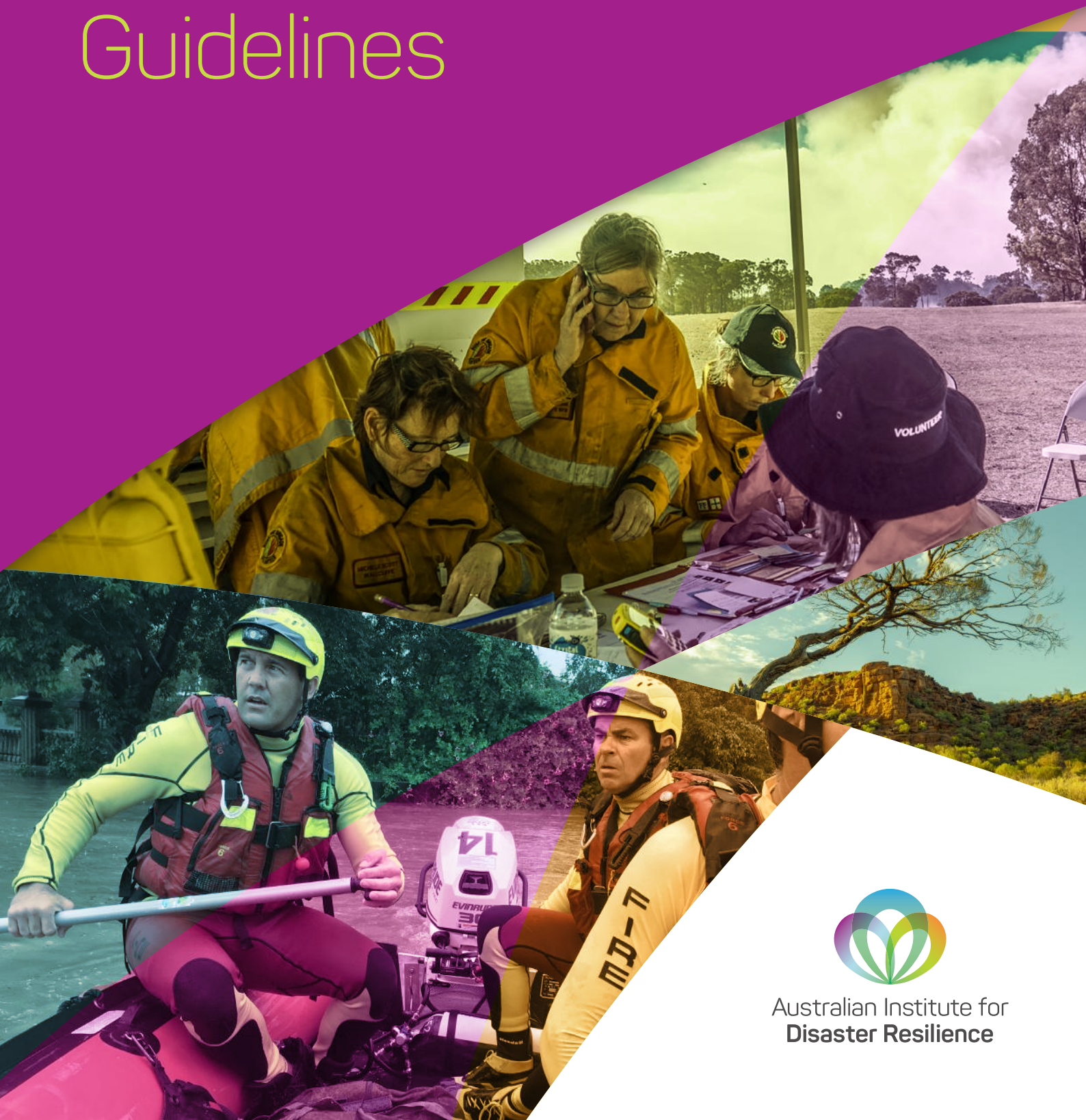


National Emergency Risk Assessment Guidelines



Cover images, clockwise from top: New South Wales Rural Fire Service, Ben Goode (Envato), Queensland Fire and Emergency Services.

AUSTRALIAN DISASTER RESILIENCE HANDBOOK COLLECTION

National Emergency Risk Assessment Guidelines

Second edition 2015 (updated 2020)

Originated as NERAG 2010.

Second edition 2015.



Australian Government
Department of Home Affairs

© Commonwealth of Australia 2020

Published by the Australian Institute for Disaster Resilience.

Copyright

The Australian Institute for Disaster Resilience encourages the dissemination and exchange of information provided in this publication.

The Commonwealth of Australia owns the copyright in all material contained in this publication unless otherwise noted.

Where this publication includes material whose copyright is owned by third parties, the Australian Institute for Disaster Resilience has made all reasonable efforts to:

- clearly label material where the copyright is owned by a third party
- ensure that the copyright owner has consented to this material being presented in this publication.

Wherever a third party holds copyright in material presented in this publication, the copyright remains with that party. Their permission is required to use the material.

All material presented in this publication is provided under a Creative Commons Attribution-NonCommercial 4.0 International Public License, with the exception of:

- the Commonwealth Coat of Arms
- registered trademarks, including
 - Department of Home Affairs logo
 - Australian Institute for Disaster Resilience logo
- materials specifically mentioned as not being provided under a Creative Commons Attribution 4.0 International Public Licence
- content supplied by third parties.



Details of the relevant licence conditions are available on the Creative Commons Attribution 4.0 website (<http://creativecommons.org.au>), as is the full legal code for the CC BY-NC 4.0 license.

Attribution

Where material from this publication is used for any purpose, it is to be attributed to the developer as follows:

Source: *National Emergency Risk Assessment Guidelines* (AIDR 2020).

Using the Commonwealth Coat of Arms

The terms of use for the Coat of Arms are available from the It's an Honour website: <https://www.dpmc.gov.au/government/its-honour>

Contact

Enquiries regarding the content, licence and any use of this document are welcome at:

The Australian Institute for Disaster Resilience
370 Albert St, East Melbourne Vic 3002
Telephone: +61 (0) 3 9419 2388

Disclaimer

The Australian Government Department of Home Affairs and the Australian Institute for Disaster Resilience, in consultation with emergency management professionals and subject matter experts, exercise care in the compilation and drafting of this publication; however, the document and related graphics could include technical inaccuracies or typographical errors and the information may not be appropriate to all situations.

In no event shall the Commonwealth of Australia (acting through the Department of Home Affairs) or the Australian Institute for Disaster Resilience be liable for any damages whatsoever, whether in an action of contract, negligence or other tortious action, arising out of or in connection with the use of or reliance on any of the information in this publication.

Australian Disaster Resilience Handbook Collection

The Australian Disaster Resilience Handbook Collection provides guidance on national principles and practices for disaster resilience.

The Handbook Collection:

- provides an authoritative, trusted and freely available source of knowledge about disaster resilience principles in Australia
- aligns national disaster resilience strategy and policy with practice, by guiding and supporting jurisdictions, agencies and other organisations and individuals in their implementation and adoption
- highlights and promotes the adoption of good practice in building disaster resilience in Australia

- builds interoperability between jurisdictions, agencies, the private sector, local businesses and community groups by promoting use of a common language and coordinated, nationally agreed principles.

The Handbook Collection is developed and reviewed by national consultative committees representing a range of state and territory agencies, governments, organisations and individuals involved in disaster resilience.

The collection is sponsored by the Australian Government Department of Home Affairs.

Access to the Handbook Collection and further details are available on the Australian Disaster Resilience Knowledge Hub: www.knowledge.aidr.org.au/handbooks

Australian Emergency Management Arrangements

Communicating with People with a Disability: National Guidelines for Emergency Managers

Communities Responding to Disasters: Planning for Spontaneous Volunteers

Community Recovery

Evacuation Planning

Health and Disaster Management

Incident Management in Australia

Land Use Planning for Disaster Resilient Communities

Lessons Management

Managing Exercises

Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia

National Emergency Risk Assessment Guidelines

National Strategy for Disaster Resilience: Community Engagement Framework

Public Information and Warnings

Safe and Healthy Crowded Places

Tsunami Emergency Planning in Australia

Acknowledgements

This handbook was made possible through the support of a broad cross-section of the disaster resilience and emergency management sectors in Australia.

AIDR thanks Ed Pikusa, South Australian Department of Environment and Water and Jillian Edwards, Principal, Beyond Business as Usual for revising the handbook.

Contents

Australian Disaster Resilience Handbook Collection	iii
Acknowledgements	iv
Part A: Background to emergency risk assessment	1
1 Introduction	2
1.1 Purpose	2
1.2 Scope	3
1.3 Applying NERAG at different scales	3
1.4 Structure	4
2 Risk management principles, framework and processes	5
2.1 Emergency risk management, risk frameworks and risk assessment	6
2.2 Emergency risk management principles	6
2.3 Establishing a risk management framework	7
2.4 Emergency risk management process	7
2.4.1 Scope, context and criteria	7
2.4.2 Risk identification	9
2.4.3 Risk analysis	9
2.4.4 Risk evaluation	10
2.4.5 Risk treatment	10
2.4.6 Monitoring and review	10
2.4.7 Communication and consultation	10
2.4.8 Recording and reporting	10
2.5 Risk assessment outputs	11
2.6 Initial and detailed assessment	11
Part B: The emergency risk assessment process	13
3 Communication and consultation	14
3.1 Principles and guiding concepts	14
3.2 Communication and consultation processes and planning	15
4 Scope, context and criteria	17
4.1 Defining the scope	17
4.2 External and internal context	17
4.3 Context of the emergency risk assessment process	18
4.3.1 Objectives	18
4.3.2 Responsibilities	18
4.3.3 Scope of risk assessment	18
4.3.4 Stakeholder engagement	20
4.4 Risk criteria	20
4.5 Reporting	20

5 Risk identification	22
5.1 Risk identification techniques	22
5.2 Complexity between risk sources and consequences	22
5.3 Generate risk descriptions	23
5.4 Identify controls	23
5.5 Risk register	23
5.6 Review the risk register	23
6 Risk analysis	25
6.1 Knowledge and expertise relating to risk	25
6.2 Level of existing controls	25
6.2.1 Control strength	26
6.2.2 Control expediency	26
6.2.3 Determining control strength and expediency	26
6.3 Risk criteria	28
6.4 Consequence criteria and levels	28
6.4.1 People consequences	28
6.4.2 Economic consequences	30
6.4.3 Environmental consequences	32
6.4.4 Public administration consequences	36
6.4.5 Social setting consequences	36
6.5 Likelihood level	37
6.6 Risk level	39
6.7 Confidence	41
7 Risk evaluation	44
7.1 Risk priority	44
7.2 Decision point	47
7.3 Risk ranking	48
7.4 Risk register	50
7.5 Detailed risk analysis	51
8 Risk treatment	52
8.1 Risk treatment process	52
8.2 Further analysis for risk treatment	54
8.3 Risk register	54
9 Monitoring and review	55


10 Recording and reporting	56
Part C: Appendices	57
Appendix A: Types of stakeholder engagement	58
Appendix B: Risk register template	60
Appendix C: Control, consequence and likelihood tables	62
Glossary	70
References	76

List of Figures

Figure 1: Principles, framework and process of emergency risk management – (adapted from <i>ISO 31000:2018</i>)	5
Figure 2: <i>ISO 31000:2018 - Principles</i>	8
Figure 3: <i>ISO 31000:2018 - Components of an effective risk management framework</i>	8
Figure 4: The iterative emergency risk management process (adapted from <i>ISO 31000:2018</i>)	8
Figure 5: Initial and detailed risk analysis using NERAG	12
Figure 6: Community Engagement Model	16
Figure 7: Summary scope of risk assessment context	19
Figure 8: Example of reporting template	21
Figure 9: Decision point questions	49
Figure 10: Treatment planning process	53

List of Tables

Table 1: Qualitative descriptors of control strength and expediency	27
Table 2: Level of existing control matrix	27
Table 3: People consequence levels and criteria	29
Table 4: Injury and illness scale	30
Table 5: Economic consequence levels and criteria	31
Table 6: Environmental consequence levels and criteria	33
Table 7: Public administration consequence levels and criteria	36
Table 8: Social setting consequence levels and criteria	38
Table 9: AEP–ARI conversion table	39
Table 10: Likelihood level	40
Table 11: Qualitative risk matrix	40
Table 12: Confidence level descriptions	42
Table 13: Likelihood–consequence confidence matrix	43
Table 14: Priority descriptions	44
Table 15: Priority levels at highest confidence	45
Table 16: Priority levels at high confidence	45
Table 17: Priority levels at moderate confidence	45
Table 18: Priority levels at low confidence	46
Table 19: Priority levels at lowest confidence	46
Table 20: Suggested ranking of risks to guide treatment and further analysis activities	50
Table 21: Types of stakeholder engagement, and example tools and processes	58
Table 22: Risk identification	60
Table 23: Risk analysis	60
Table 24: Risk evaluation	61
Table 25: Qualitative descriptors of control strength and expediency	62
Table 26: Level of existing control matrix	63
Table 27: People consequence levels and criteria	63
Table 28: Injury and illness scale	64
Table 29: Economic consequence levels and criteria	64
Table 30: Environmental consequence levels and criteria	65
Table 31: Public administration consequence levels and criteria	67
Table 32: Social setting consequence levels and criteria	67
Table 33: AEP–ARI conversion table	68
Table 34: Likelihood level	69
Table 35: Qualitative risk matrix	69



Part A: Background to emergency risk assessment

1 Introduction

Risk is defined as ‘the effect of uncertainty on objectives’. Managing risk helps governments, institutions, businesses and communities make good decisions in an environment full of uncertainty. Good risk management identifies and protects what people and society value.

The established international and Australian risk management standard *AS ISO 31000:2018 Risk management - Guidelines (ISO 31000:2018)*, supported by a range of supplementary materials, provide risk managers with principles and general guidance to be considered when developing risk management frameworks and programs.

Using these standards as a guide, a nationally consistent approach to assessing emergency risks was developed and is embodied in the *National Emergency Risk Assessment Guidelines (NERAG)*. It is important to note, NERAG is primarily focused on assessing emergency risks and provides general guidance on management frameworks and approaches.

NERAG was first published in 2010 and endorsed for use by Australian governments by the Council of Australian Governments Standing Council on Police and Emergency Management (now the Ministerial Council for Police and Emergency Management (MCPPEM)) in November 2012. NERAG was re-published in 2015 following a series of reviews based on the learnings from its practical implementation.

Since then NERAG has guided efforts to build capability, harmonise risk assessments and better understand the nature of those hazards that have the potential to cause harm and loss to Australian communities and the economy. As the nation’s risk management capabilities have matured, and with the introduction of the 2015 United Nations *Sendai Framework for Disaster Risk Reduction* (and other global agreements such as the *2030 Agenda for Sustainable Development*) and Australia’s 2019 *National Disaster Risk Reduction Framework* and associated guidance materials, new risk approaches are emerging and strategic objectives are changing. Consequently, the methods and tools used to support risk managers are being updated.

In 2018 a revised version of the ISO 31000:2018 risk management guideline was published, providing more strategic guidance and placing more emphasis on

stronger integration of collaborative risk management into organisations.

This edition of NERAG (Second edition 2015 (updated 2019)) has been refreshed to reflect those changes. Minor revisions have been incorporated, and connections to recently developed guidance materials included where relevant.

1.1 Purpose

In February 2011 the Council of Australian Governments endorsed the *National Strategy for Disaster Resilience (NSDR)*, the first national policy that provided high-level direction and guidance on how to achieve disaster resilient communities across Australia (COAG 2011).

Understanding and reducing risk, and communicating with and educating all sectors of the community about risks, are key drivers for action under the NSDR and allied national, state and local policy initiatives. The Australian Government in partnership with all states and territories sponsored the introduction of NERAG to support this strategic intent.

NERAG’s purpose is to support the achievement of objectives and to:

- create and protect value, and to improve performance and encourage innovation
- provide a whole-of-society, rigorous, customisable, scalable, common approach to emergency risk assessments
- facilitate the creation of a broad knowledge base of those hazards that have the potential to cause most harm
- account for what is being done to mitigate the risks and take harm out of the system
- improve the evidence base on emergency risks and associated varying levels of confidence in assessments.

NERAG provides a method to contextualise, assess and manage emergency risks so that action can be taken and good decisions made to minimise harm and loss when shocks and stresses occur.

The practitioners that use NERAG are likely to be:

- those responsible for developing emergency risk management policy
- those accountable for ensuring risk is effectively managed in a community or organisation
- educators and students in emergency risk management
- specialist risk practitioners who apply the NERAG method
- those who evaluate the effectiveness of emergency risk management practices.

1.2 Scope

Australia's approach to the management of emergencies is guided by a number of high level principles that are intended to provide guidance, flexibility and a broad understanding of the approaches to emergency management. The goal of these principles is to improve and provide consistency in policy and decision making and to support resilience to emergencies and disasters in Australia. For more information see the *Australian Emergency Management Arrangements* (AIDR 2019).

NERAG intentionally supports people whose role encompasses all the dimensions of emergency management and the assessment of emergency events that have the potential to trigger disasters and impose significant social, environmental and economic costs on Australia, including:

- fatalities, injuries and illness
- social and cultural losses
- ecosystem and biodiversity loss
- direct damage to property, infrastructure and facilities
- financial costs and economic losses.

Risks from emergency events are the focus of NERAG. These are events, actual or imminent, that endangers or threatens to endanger life, property or the environment, and requires a significant and coordinated response. NERAG provides a method to assess risks from all hazards and its outputs are intended to help prioritise risk management and mitigation activities.

NERAG is not intended to be used as a method to assess emergency operational response risks nor to present a comparative, multi-hazard understanding of all risks to a community. Separately specific risk assessment techniques are being or have been developed for detailed analysis of individual hazards as they relate to all aspects of safety and wellbeing of communities.

NERAG looks to be complementary to such processes.

Importantly, NERAG does not address systemic (disaster) risks. Systemic risks are risks that could trigger severe instability or collapse of an organisation, industry, economy or system (Australian Government Department of Home Affairs 2019).

NERAG users are encouraged to refer to *ISO 31000:2018* (or the subsequent latest version) and relevant supporting materials for use with this document. The resources available on the Australian Disaster Resilience Knowledge Hub (<https://knowledge.aidr.org.au/resources/handbook-10-national-emergency-risk-assessment-guidelines/>) are an important aid to the application of NERAG.

1.3 Applying NERAG at different scales

NERAG is designed for assessing emergency risks arising from sudden-onset hazards at various scales. It does this by using ratios of loss to quantify consequences relevant to the community of interest.

For example, applying NERAG's economic consequence criteria, a reduction of \$4 billion in economic activity and/or asset value from an emergency event in Sydney would be considered:

- a 'catastrophic' consequence for the City of Sydney
- a 'major' consequence for the state of New South Wales
- a 'minor' consequence for Australia (City of Sydney 2012 & Australian Bureau of Statistics 2012).

This scalable nature of NERAG helps to ensure that the level of risk of an event can be assessed, prioritised, treated and monitored at the appropriate level.

The NERAG risk criteria may not be directly scalable for some risk assessments, particularly with small or regional/rural communities. To address these situations, the NERAG risk criteria provide flexibility by enabling the use of quantitative measures that are generally more applicable for larger scale assessments, and qualitative measures that are more applicable to smaller scale assessments.

For example, when assessing the economic consequences of an emergency event:

- larger scale risk assessments can assess risk based on financial and asset losses as a percentage of the relevant gross product (e.g. gross state product)
- smaller scale risk assessments can assess the impact of the emergency event on significant local industries.

Similarly, assessing people consequences can become problematic for small populations of interest. For example, for a population of less than 15,000, a single death or critical injury would be assessed as a 'catastrophic' consequence, which may distort the outcomes of the risk assessment. In such cases, the risk criteria can be amended to better facilitate an appropriate prioritisation of risks to the community of interest.

Amendments to the risk criteria need to be agreed and documented when establishing the context of the risk assessment to ensure that the resulting assessment is appropriate for the community of interest.

1.4 Structure

NERAG provides a method for undertaking emergency risk assessments, including their preparation, conduct and outputs. This method includes explicit risk criteria and a risk register template to guide consistent recording of assessment results and actions.

NERAG is structured to align broadly with relevant sections of *ISO 31000:2018*.

2 Risk management principles, framework and processes

NERAG aligns to *ISO 31000:2018* structure (Figure 1). Minor adjustments to terminology to contextualise to emergency events have been accommodated and explained in the sections below.

Managing risk is based on the principles, framework and process outlined in this document, as illustrated in Figure 1.

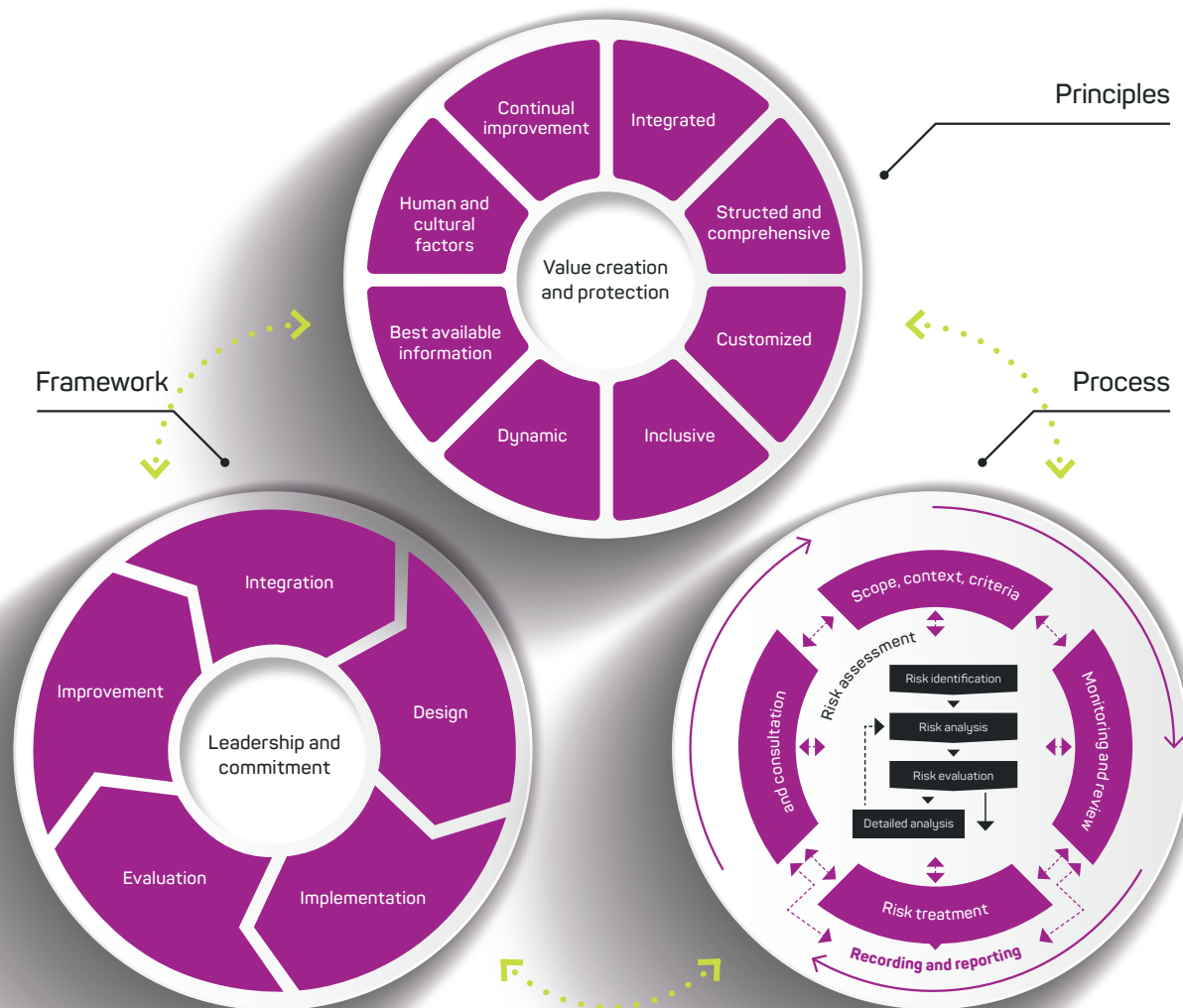


Figure 1: Principles, framework and process of emergency risk management – (adapted from *ISO 31000:2018*)

2.1 Emergency risk management, risk frameworks and risk assessment

NERAG adopts the *ISO 31000:2018* definitions of risk management, risk framework and risk assessment in *ISO Guide 73:2009 Risk management – vocabulary*.

Risk management is coordinated activities to direct and control an organisation with regard to risk, (ISO 2018) which includes:

- establishing the scope, context and criteria
- risk assessment (including identification, analysis, evaluation)
- communication and consultation
- risk treatment
- monitoring and review
- recording and reporting.

For the purposes of NERAG, the term ‘organisation’ is considered in the emergency management context to include Australian, state, territory and local governments, rather than individual agencies or businesses.

A risk management framework is a set of components that provide the foundations and organisational arrangements for designing, implementing, monitoring, reviewing and continually improving risk management throughout the organisation (ISO 2009).

A risk management framework sets the overarching organisational context in which the management of risk is to occur. Such a framework is intended to be embedded within strategic and operational policies and practices and include components such as:

- foundations (risk management policy, objectives, mandate and commitment to manage risk)
- organisational arrangements (implementing plans, relationships, accountabilities, resources, processes and activities)
- continuous improvement (evaluating risk management activities and improving).

Risk assessment deals directly with the specific process of risk identification, analysis, and evaluation, which includes:

- identification - the process of finding, recognising and describing risks (ISO 2009)
- analysis - the process to comprehend the nature of risk and to determine the level of risk (ISO 2009)

- evaluation - the process of comparing the results of risk analysis with risk criteria to determine whether the risk and/or its magnitude are acceptable or tolerable (ISO 2009).

2.2 Emergency risk management principles

A number of principles underpin and support the effective management of risk. These principles are articulated in *ISO 31000:2018* (Figure 2) and are applied to emergency risk management as:

- **creates and protects value** – risk management contributes to the wellbeing, sustainability and resilience of human health, the environment, the economy, public administration and social setting.
- **integrates into all organisational processes** – risk management is a mainstream activity that is integrated into standard business practices of organisations, governments and communities.
- **structured and comprehensive** – results are consistent and comparable.
- **customised** – the framework and process are appropriate to the societal needs, the context and risk profile.
- **inclusive** – includes appropriate and timely involvement of stakeholders, enabling their knowledge, views and perceptions to be considered.
- **dynamic** – risk management anticipates, detects, acknowledges and responds to changes in context and risk profile in an appropriate and timely manner.
- **best available information** – inputs to risk management are based on the best available historic and current information. Risk management explicitly takes into account any limitations and uncertainties associated with such information and expectations. Information should be timely, clear and available to relevant stakeholders.
- **human and cultural factors** – human behaviour and culture significantly influence all aspects of risk management at each level and stage.
- **continual improvement** – risk management is continually improved through learning and experience.

Applying these principles, in concert with those established within *Australia’s Emergency Management Arrangements* (AIDR 2019), is integral to effective emergency risk management.

2.3 Establishing a risk management framework

The purpose of a risk management framework is to assist an organisation integrate risk management into strategic activities, functions and decision-making. The effectiveness of managing risk will subsequently depend on the governance, leadership and commitment of the organisation and support from stakeholders (ISO 2018).

Establishing a risk management framework assists in integrating risk management and its outputs into mainstream governance, business systems and activities. The key components of an effective risk management framework include:

- leadership and commitment to implement risk management
- integrating risk management into the organisation and its context
- designing an appropriate risk management framework
- implement risk management according to the framework
- evaluate the effectiveness of the risk management framework
- improvement and continually adapting the framework to ensure it remains current to the needs of the organisation.

Even the best risk assessment and risk management will be ineffective if it does not form part of a mandated risk management framework. Without such a framework:

- it is difficult to establish a clearly defined and resourced strategic imperative for risk management as an organisational function.
- internal processes for starting and implementing risk management processes are difficult to establish.
- leaders and managers are not empowered or supported to address risk as part of their duties and responsibilities.

In the emergency management context, the organisation that oversees the generation of the framework is likely to be the relevant highest level emergency management body or committee within the risk assessment's context (e.g. for a state-wide risk assessment, the highest level body could be the state emergency management committee or its equivalent).

These bodies and committees, in turn, sponsor (or lead) the emergency risk management process. Relevant jurisdictional arrangements for emergency management are to be used to define who these groups are, how risk assessments will be undertaken, who is accountable for

their delivery, and how the outcomes will be prioritised and acted upon.

Figure 3 shows the relationship between the components of an effective emergency risk management framework. Further details on each component are available in *ISO 31000:2018. ISO/TR 31004:2013 Risk management – guidance for the implementation of ISO 31000* has advice on how to interpret and implement the components of a risk management framework.

2.4 Emergency risk management process

In an emergency management context, risk management is an iterative process that involves dealing with risks to the community arising from emergency events. The process consists of a number of interrelated phases, which are illustrated in Figure 4.

Each phase is summarised in Sections 2.4.1–2.4.7. **Part B** provides more detail for each phase.

2.4.1 Scope, context and criteria

This can be the most important phase of the risk management process; defining the expectations of the risk assessment and its outcomes. This phase also influences which stakeholders should be involved and the evidence or data required.

Scope defines the level at which the risk assessment is being considered (e.g. strategic, operational, program, project or activity), and any issues associated with undertaking the risk assessment. This includes:

- objectives and decisions to be made
- outcomes expected
- time, location, inclusions and exclusions
- tools and techniques of the risk assessment
- resources, responsibilities and records
- relationships with other projects, processes and activities.

Context, both external and internal to an organisation, sets the parameters in which the risk assessment occurs against the objectives of the organisation or community.

Establishing the context is crucial in considering a community's resilience and informing risk treatments that effectively target emergency risk while avoiding the creation of new risks.

For times of deep uncertainty and when information is inexact or absent, scenarios can be an effective technique to support decision making. Scenarios can enhance and enrich understanding of the broader

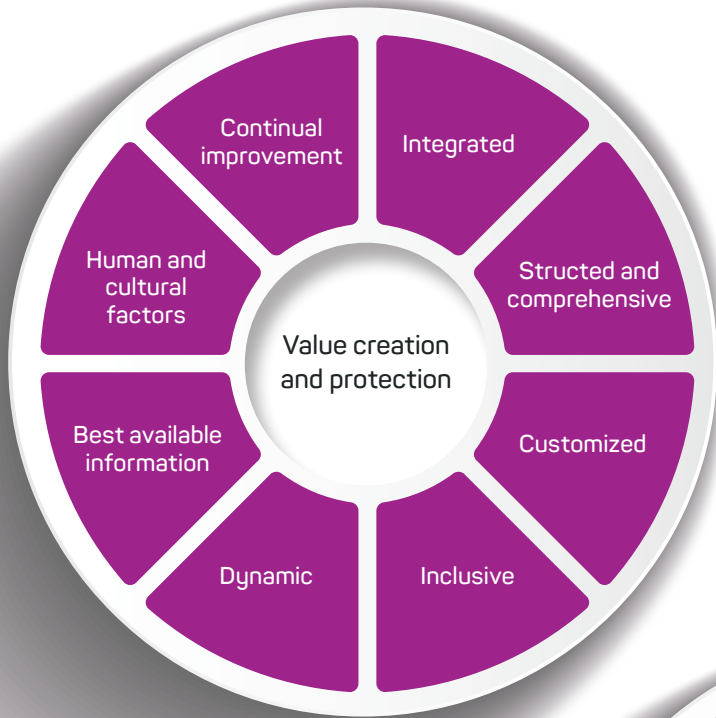


Figure 2: ISO 31000:2018 Risk management - Guidelines - Principles

Figure 3: ISO 31000:2018 - Components of an effective risk management framework

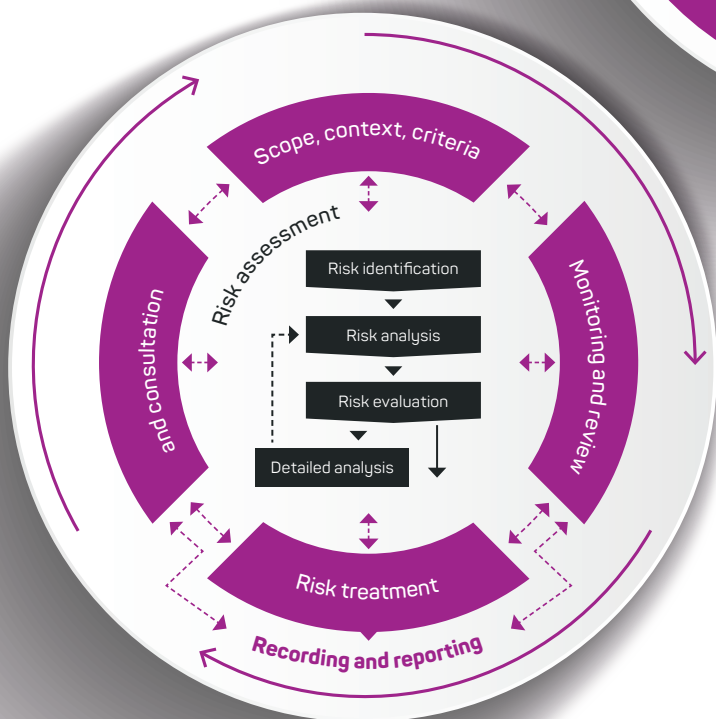
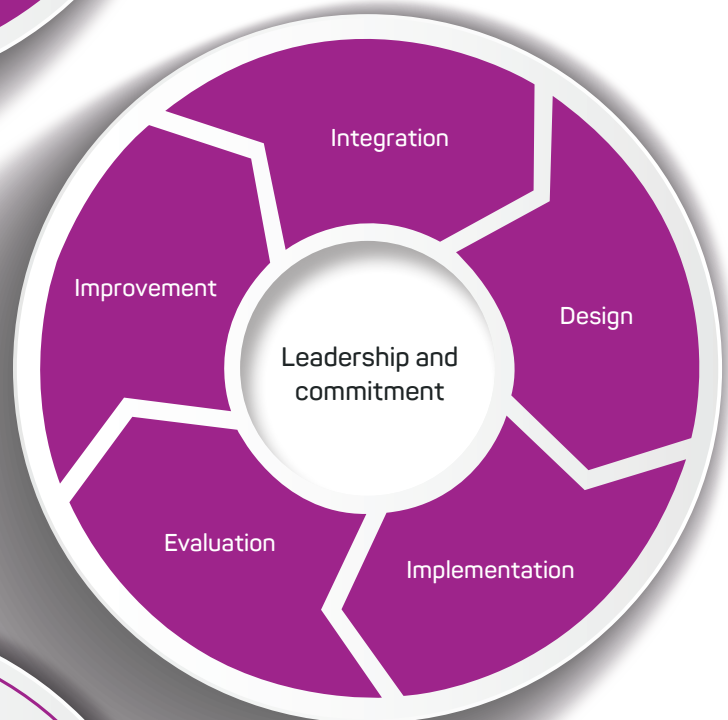


Figure 4: The iterative emergency risk management process (adapted from ISO 31000:2018)

context in which problems need to be solved, strategic objectives developed or modified or common visions identified (Australian Government Department of Home Affairs 2019).

The intent of using scenarios is to balance the resources available for risk assessments by limiting the consideration of all possible risks and focusing on areas of importance and high-stakes strategic and operational decisions.

Scenarios are not the only method for establishing context and assessing risk, other data-driven approaches may be considered. However, for rare events where data is limited, or the events have not occurred previously, a scenario can provide a way to think through the issues and possible outcomes.

For detailed guidance on how to develop and apply different kinds of scenarios for different purposes refer to *Climate and Disaster Risk: what they are, why they matter and how to consider them in decision making. 3 Guidance on Scenarios* (Australian Government Department of Home Affairs 2019)

Finally, the criteria by which risks are to be assessed and evaluated needs to be defined. This process is critical for structuring the risk identification, analysis and evaluation phases.

The NERAG contains many risk criteria, such as definitions of consequence in Section 6.4. However, many of these criteria require some definition within the context of the risk assessment. For example:

- people consequences require a population of interest to be defined (Section 6.4.1)
- economic consequences (Section 6.4.2) require economic data for an area of interest
- business sectors and industries in the area of interest, that may be affected by the emergency event
- environmental consequences (Section 6.4.3) require an understanding of:
 - ecosystems and species in the area of interest, and their level of conservation value at local, state and national levels
 - the 'environmental value' of sites in the eyes of the community, based on their aesthetic and recreational values
- public administration consequences (Section 6.4.4) requires an understanding of the 'core functions' of public services that may be impaired or destroyed by emergency events

- social setting consequences (Section 6.4.5) require an understanding of:
 - community social connectedness that may be damaged by the emergency event
 - objects and events of cultural significance in the community.

The risk assessment process may include one or all of these criteria during the risk assessment, based on the scope, context and available resources.

Defining scope, criteria and context ensures that the approach adopted is appropriate for the organisation or community and its risk profile.

2.4.2 Risk identification

Sources of risk – including hazards, potential impacts, current controls, the associated risks relating to the established context, and elements at risk and their associated consequences – are identified and described on the basis of available information and knowledge, and in consultation and engagement with all relevant stakeholders.

A systematic and comprehensive approach needs to be taken to ensure that no significant risk is excluded. For instance, it is important that a sufficiently comprehensive pool of expertise is assembled to study all significant causes and emergency scenarios because there are many ways an emergency event can occur. This might involve considering historical information or modelling of similar events. Identifying these scenarios can lead to reasonable predictions about current and evolving issues.

At the conclusion of this phase, all risks of interest are identified and recorded.

2.4.3 Risk analysis

Risk analysis is the process through which the level of risk and its characteristics are scrutinised. Information from risk analysis is critical to determine the comparative levels of risk and to help decide priorities for risk treatment. The analysis involves consideration of possible consequences, the likelihood that those consequences may occur and any existing controls that modify the risk. It also provides invaluable information to inform the development of treatment options, if required.

During this phase, the level of confidence in the analysis is determined by considering factors such as the divergence of opinion, level of expertise, and the uncertainty, quality, quantity and relevance of data/information.

At the conclusion of this phase, all identified risks are categorised into risk levels with associated confidence, and statements concerning existing controls are made.

2.4.4 Risk evaluation

During risk evaluation, the level of risk is compared with the risk criteria, which were confirmed when the context was established, to assist in making decisions about the priority of the risk.

Each risk is assigned a priority rating based on its level of likelihood, consequence and confidence, which determines the order in which they are reported and addressed.

The outcomes of the evaluation are categorised for future action, concerning which risks:

- require treatment, and in which order they should be treated
- require further detailed assessment to improve confidence, based on priority, current confidence and whether an improvement would change the management outcome
- do not require further detailed assessment or treatment, with the risk subject to existing controls, and ongoing monitoring and review.

Based on the priority, category and risk level, risks are ranked in order to determine which are to be treated, analysed further and monitored first, second third etc.

2.4.5 Risk treatment

Risk treatment considers the options and, subsequently, selects and assesses measures to reduce risk levels. It includes the preparation and implementation of treatment plans, which allows for new controls to be provided and/or existing controls to be modified. This involves identifying and designing appropriate actions for managing the risks; evaluating and assessing their results or impact; and developing and implementing treatment plans. Treating risks should result in eliminating or reducing any impact on communities while increasing resilience.

It is important to consider all direct and indirect costs and benefits, whether tangible or intangible, and assess them in financial or other terms. More than one option may be considered and adopted either separately or in combination.

Decisions to treat risk may include:

- avoiding, taking, increasing (to pursue an opportunity) or removing the source of the risk
- changing, optimising, sharing or retaining the risk.

Hazard-specific studies can be used to examine treatment options and assess their impacts, costs and benefits as part of emergency risk treatment.

After treatment, residual risks need to be included in regular monitoring and review activities.

Treatment measures can have significant impacts on hazard behaviour, for example fuel reduction in high bushfire risk areas. These impacts need to be well understood to ensure any adverse impacts are carefully considered in decision making.

2.4.6 Monitoring and review

One of the critical factors in risk management is to establish ongoing processes for monitoring and review to confirm the effectiveness of the risk assessment process, and account for changes in complex and evolving circumstances. These activities complete the risk management cycle, so that assumptions, methods, data sources, results and reasons for decisions are subject to regular checks. Regular checks assist in keeping the specified action plans relevant and up to date. Quality assurance processes, including peer review, can support this function.

Monitoring and review should allow consolidation of further information to improve risk assessments, analysis of lessons learned from events, changes to exposure and vulnerability, and changes in the nature (frequency and severity) of hazardous events.

Responsibilities for checking and monitoring should be clearly defined. The agreed processes and outputs of monitoring and review should be recorded and reported, and form an important part of the review cycle for the risk management framework.

2.4.7 Communication and consultation

Communication and consultation are fundamental to the risk management process. It is important that stakeholders are not only kept informed, but are also invited to contribute to the process, to establish a common understanding of how decisions are made.

Communication and consultation with stakeholders should take place before and throughout the process. It is recognised that the type of communication and consultation undertaken differs in emphasis throughout the process and varies in nature for each stakeholder group.

2.4.8 Recording and reporting

The risk management process and its outcomes should be documented and reported through appropriate mechanisms, defined in the risk management framework, and also the scope, context and criteria phase.

Recording and reporting arrangements are necessary to ensure that the outcomes of the risk assessment processes are communicated and available for the process of monitoring and review.

2.5 Risk assessment outputs

Risk assessments are expected to produce:

- a documented risk context, understood by all stakeholders
- a register of identified risks determined by all stakeholders
- an analysis of each risk to determine the level of risk in terms of its likelihood, consequence and confidence
- an evaluation that assigns each risk a priority
- a schedule of prioritised risks recommended for further assessment, treatment or monitoring
- a ranking of risks to guide which ones are to be considered first

2.6 Initial and detailed assessment

NERAG can be used for both initial and detailed assessments of emergency events.

Initial assessment is used to identify and screen risks quickly, and is usually based on qualitative methods and summary information at a broad scale. The intent is to broadly assist in prioritising the hazards and risks for the context of the risk assessment, and to focus on those risks where more detailed assessment is of most benefit. An initial assessment usually has a broader context established, and follows simpler but robust procedures. The purpose of the initial assessment is to ensure that lower priority risks do not have disproportionate amounts of time and effort expended on the assessment process and defining treatments at the expense of higher priority areas.

Detailed assessment focuses on high-priority risks and risks where the potential for treatment has the greatest potential benefits. This involves a more detailed assessment to provide greater confidence than an initial assessment, adjust and validate risk ratings from the initial risk assessment, and guide the planning and implementation of risk treatment strategies. A detailed assessment has a more focused scope and can be informed by the initial assessment. The aim is to gain a more comprehensive understanding of the characteristics of the risk and appropriate treatments.

A detailed assessment is often undertaken for specific hazards and is aimed at gaining a more comprehensive understanding of the risk and recommending appropriate treatments.

Specialist and hazard-specific inputs, analysis of historical impacts or modelling (e.g. Monte Carlo simulation techniques) can support detailed assessments and may also inform initial assessments.

If appropriate, and where sufficient data are available, the initial risk assessment may also use quantitative or semiquantitative information.

Quantitative or semiquantitative information, such as historical impacts or consequences of past emergency events, may be used to inform the risk analysis. Where records are available at an appropriate level of detail and over a sufficient time period, the complete detailed risk assessment may be conducted using quantitative data derived from historical records to inform the risk analysis, including the assessment of likelihood, consequence, confidence, risk level, priority and further action.

Risk assessment for emergency events can be categorised in general terms by the complexity of the study and its focus. The complexity can range from simple qualitative approaches, used mainly for screening purposes, to detailed quantitative models involving higher order spatial data analyses and impact modelling. The context of the risk assessment will determine which type of methodology is most appropriate as supporting evidence for risk analysis.

Figure 5 illustrates the two assessment pathways (initial or detailed)

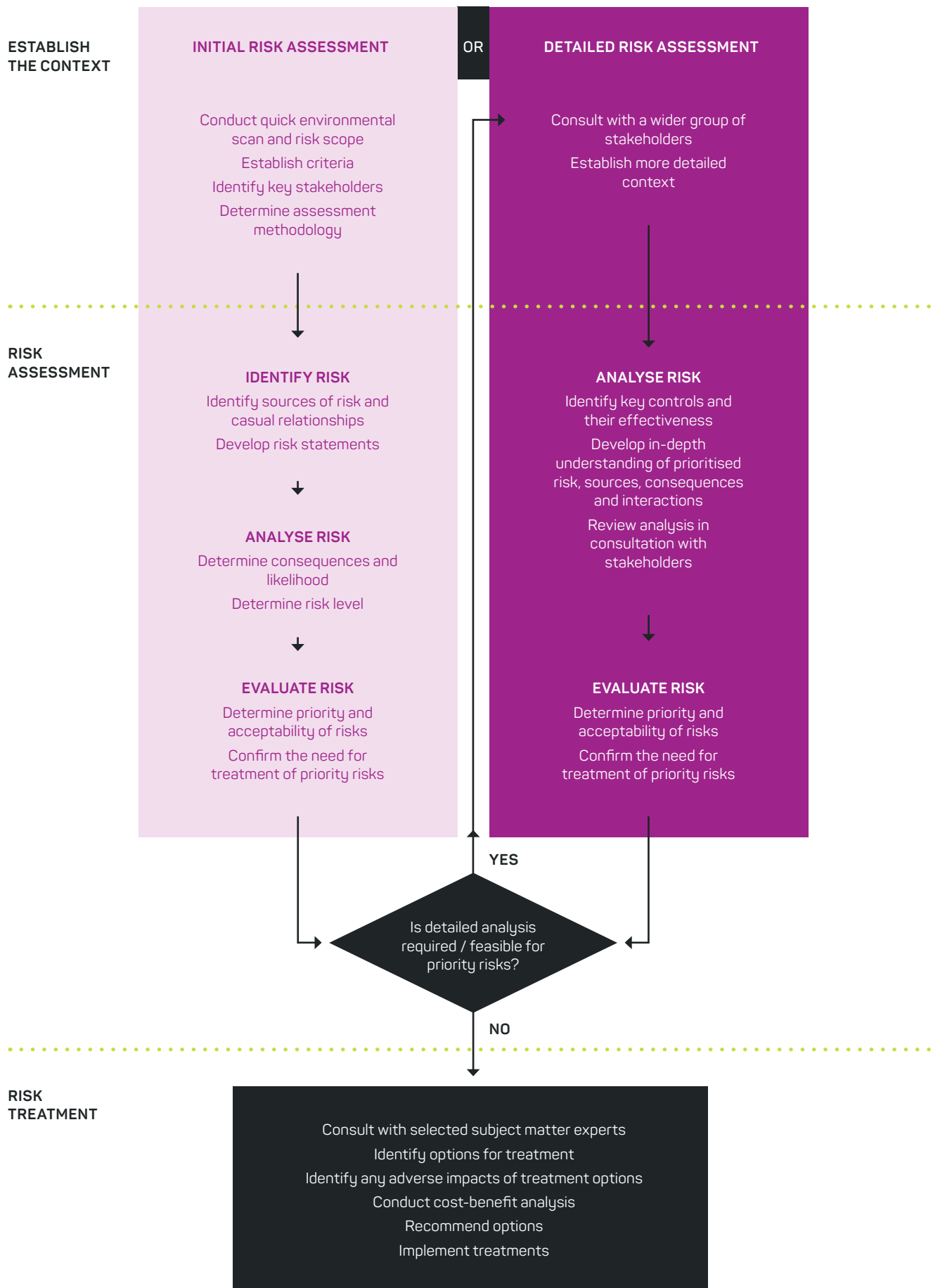


Figure 5: Initial and detailed risk analysis using NERAG



Part B: The emergency risk assessment process

3 Communication and consultation

Emergency risk management takes place in a social and political context, and involves an extensive range of stakeholders. Each stakeholder or stakeholder group may have different knowledge, understanding and views on risk. Effective risk management requires the sharing of information and perspectives on risk, with the goal of achieving a better allocation of scarce resources to achieve community and societal objectives. This is particularly the case when dealing with low-probability, high-consequence events, which are not amenable to typical statistical analysis. In most cases, risk treatments will depend on the willingness of organisations and community members to commit resources (time, money, assets or labour) to managing risk.

There are a number of different methods of engagement with stakeholders to ensure a thorough and appropriate risk assessment is undertaken. *AS/NZS HB 327:2010 Communicating and consulting about risk* describes theories of communication and consultation, and *HB 89-2013 Risk management – guidelines on risk assessment techniques* describes some methods of communication to support risk assessment techniques.

Whichever techniques are used, a communication plan should be prepared during the scope, context and criteria phase of the risk assessment to ensure that appropriate consultation takes place (see Section 4).

Risk assessment is a critical process in building understanding and a commitment to act. Effective communication and consultation underpin every aspect of the process, including the technical aspects of risk assessment. Even when risk can be managed through direct treatments, such as legislation and regulation, their effectiveness still largely depends on stakeholder support and acceptance. Ideally, this should occur before the risk assessment process starts.

Effectively involving stakeholders is complex, and requires a long-term commitment to build and maintain relationships. Organisations must be clear about:

- the purpose of their engagement (recognising that the purpose may change during different phases of the risk assessment process)
- what the engagement aims to achieve
- the degree of influence stakeholders are able to have.

Being transparent about the engagement and decision-making process is essential for establishing and maintaining trust.

It is essential that all relevant stakeholders are identified and engaged as part of the risk assessment process.

Scanning the environment is also essential. Being clear about what engagement is already happening in other organisations with the community and targeted stakeholders, and whether your engagement could dovetail into theirs, will potentially minimise consultation fatigue.

Communicating and consulting:

- helps establish the context appropriately
- ensures that the interests of stakeholders are understood and considered
- helps ensure that the risks are adequately identified
- brings different areas of expertise together for analysing risks
- enhances perspectives on risk
- ensures that different views are appropriately considered when assessing and evaluating risks
- secures endorsement and support for implementing a treatment plan.

3.1 Principles and guiding concepts

Principle 1: Communicating and consulting with external and internal stakeholders should take place during all phases of the risk management process.

Relationship building should begin before any formal start of the risk assessment process. Plans for communication and consultation should be developed at an early phase. These should address issues relating to the risk itself, its sources, its consequences and the measures being taken to treat it. Effective external and internal communication and consultation are essential to ensure that stakeholders, including those accountable for implementing risk management, understand the basis on which decisions are made and the reasons why particular actions are required.

Principle 2: Perceptions of risk can vary due to differences in priorities, needs, experience, assumptions, concepts and concerns of stakeholders. As their views can have a significant impact on the decisions made, stakeholders' perceptions should be considered in the decision-making process. Through conversation and dialogue, which are a part of a consultation process, perceptions can change. Risk perception is not static.

Principle 3: Communication and consultation should facilitate respectful, truthful, relevant, accurate and understandable exchanges of information, taking into account information validity, confidentiality and integrity.

Principle 4: Communication and consultation activities should be planned and documented with the stakeholders as part of the risk management development and reporting processes.

A communication and consultation plan appropriately supports this. *AS/NZS HB 327:2010 Communicating and consulting about risk* recommends that such a plan:

- identifies key stakeholders
- specifies the communication objectives, the information requirements and the means of meeting them
- provides and collates information
- integrates the elements of the plan to provide appropriate information flows at each of the phases of the risk management process
- facilitates monitoring and review, including of the communication and consultation activity itself to ensure it met the objectives described in the context.

3.2 Communication and consultation processes and planning

It is critical for the ongoing credibility of the risk assessment, and trust in the agencies and individuals, that communication and consultation are undertaken with integrity and sensitivity to the people and the processes involved. Communication and consultation for the risk assessment should be identified and planned. This requires an understanding of the context and the purpose of the engagement.

The *National Strategy for Disaster Resilience Community Engagement Framework* (AIDR 2013) provides guidance for planning communication and consultation processes for the risk assessment.

This framework is circular to show that one engagement approach is not necessarily better than any other, and that different approaches are legitimate depending on the purpose and context of a particular situation (see Figure 6). Good engagement practice relies on choosing the right approach or combination of approaches for engagement in different situations.



Figure 6: Community Engagement Model

Source: National Strategy for Disaster Resilience: Community Engagement Framework (AIDR 2013)

4 Scope, context and criteria

Before starting a risk assessment process, the scope and context of the risk assessment need to be established. This will allow a jurisdiction, organisation or community to articulate its objectives and define the parameters to be taken into account when undertaking a risk study and formulating actions to address those risks.

This part of the process aims to ensure a common understanding of the expectations, purpose and objectives, responsibilities, stakeholders, criteria and reporting for the risk study before starting the assessment.

The highest level of consistency and comparability across emergency risk assessments, localities, jurisdictions and hazards is also achieved by adopting common risk criteria such as:

- death of, or injury or illness to, people
- loss in economic activity and/or asset value and/or negative effect on important industries in the economy
- loss of species and/or landscapes and/or environmental values in the environment
- loss or destruction of community wellbeing, and/or loss or destruction of culturally important objects and activities in the social setting
- inability of governing bodies to deliver their core functions

These criteria are detailed in the consequence tables in Section 6.4.

Any temptation to rush this phase of the risk assessment process should be resisted. Establishing the scope and context is fundamental, and treating this phase superficially could lead to inappropriate treatment options and adverse feedback from stakeholders.

4.1 Defining the scope

The scope defines the expectations and level of the risk assessment process, whether, for example it is high level

and strategic, or more operational, looking at specific mitigation investment options.

The scope of the risk assessment should be defined and documented by the sponsors. Scope considerations include:

- the objectives of the organisation that the risk assessment contributes to
- the decision being made that the risk assessment will inform
- outcomes expected from the process
- time and location of risk assessment phases, particularly those that involve multiple stakeholders, reporting deadlines and critical decisions relating to the risk assessment
- specific inclusions and exclusions (e.g. types of consequence that are to be used and not used)
- tools and techniques to be included
- sources of evidence, data and technical expertise to be accessed
- resources to be used
- responsibilities of parties involved in the risk assessment
- records to be kept, reports to be produced and who they are to be provided to
- relationships with any other projects, processes and activities.

4.2 External and internal context

The context, both internal and external, is relevant to the organisation seeking to achieve its objectives and those of relevant stakeholders. While risk management is an organisation's responsibility, risk assessment should not be undertaken in isolation from key stakeholders.

In understanding the context, the sponsors of the risk assessment (such as the emergency management committees at national, state, regional or local level) need

to consider the external and internal contexts, including legal responsibilities, geography, climate, population, industries, essential services and critical infrastructure. *ISO 31000:2018* section 5.4.1 provides a list of factors that can be included (but not limited to) when establishing the internal and external context.

The external context can include:

- the cultural, social, political, legal, regulatory, financial, technological, economic and competitive environments, whether international, national, regional or local
- key drivers and trends that impact on the objectives of the organisation or jurisdiction
- relationships with, and perceptions and values of, external stakeholders.

The internal context can include:

- governance, organisational structure, roles and accountabilities
- policies and objectives, and the strategies that are in place to achieve them
- capabilities, understood in terms of resources and knowledge (e.g. capital, time, people, processes, systems and technologies)
- information systems, information flows and decision-making processes (both formal and informal)
- relationships with, and perceptions and values of, internal stakeholders
- the organisation's culture
- standards, guidelines and models adopted by the organisation
- the form and extent of contractual relationships.

Some practitioners may have difficulty describing their external and internal contexts. To aid in establishing the context, a checklist is available on the Australian Disaster Resilience Knowledge Hub (<https://knowledge.aidr.org.au/resources/handbook-10-national-emergency-risk-assessment-guidelines/>) that provides prompts to cover all of the issues and assets relevant to generating emergency risks at the national, state, regional and local levels.

Many of the internal and external context factors may have been defined as part of developing the risk management framework (Section 2.3). In establishing the context, these factors can then be applied to the specific risk assessment to be undertaken.

4.3 Context of the emergency risk assessment process

The following items are recommended as the minimum requirements for establishing the context of an emergency risk assessment.

4.3.1 Objectives

It is not possible to manage risk without a clear understanding of the objectives that the risk will affect. A common understanding of the objectives to be supported by the risk assessment is paramount in ensuring that all relevant risks are captured.

Confirming objectives supports other aspects of the context-setting phase, including defining the scope, identifying stakeholders, developing risk scenarios and determining particular parameters to be used for risk criteria.

Emergency management is generally concerned with the societal objectives of:

- protecting life, livelihood, property, economic activity and the environment
- continued functioning of essential services and systems that support these (e.g. power, water, transportation systems, ecosystems)

One or more objectives relevant to the specific jurisdiction undertaking the risk assessment need to be described.

4.3.2 Responsibilities

The responsibilities for, and within, the risk assessment need to be defined, and should be based on the accountabilities described in the risk management framework. The person, group or organisation sponsoring and implementing the risk assessment needs to be defined. Also, the decision makers who consider the outcomes of the risk assessment need to be identified.

4.3.3 Scope of risk assessment

The scope of the risk assessment needs to be adequately considered to address the defined objectives. The data, stakeholders and process for risk assessment will be dependent on the defined scope.

The resources required to undertake the risk assessment process appropriately are also dependent on the scope. A broader scope and more complex risk assessment will necessarily require additional information; greater stakeholder participation and engagement; and additional meetings, workshops or associated assessment processes.

Managing risks from emergencies can involve multiple hazards, so the scope needs to address the range of hazards for a single event or multiple events, the relevant community (including its geographical and jurisdictional boundaries) and timelines.

The scope of the risk assessment can be summarised as follows:

- the source(s) of risk (hazard) to be considered, such as seismic events, severe weather events, outbreaks of disease or similar hazards that cause emergencies.
- the emergency event(s) to be considered, such as earthquakes, floods, storms, bushfires, or human or animal diseases.
- the consequence categories that reflect community viewpoints and values, categorised under people, economy, environment, public administration and social setting. There is no requirement to use all consequence categories. Where appropriate, specific items relevant to the risk assessment context (e.g. communities, industries and assets) should be described.

Summarising the risk assessment scope in this manner makes it easier to construct conceptual risk profiles and identify risks.

A risk assessment can be conducted on a single or multiple emergency events or hazards.

In all-hazards assessments, a range of emergency events and as many hazards as possible should be considered during the scoping stage. This all-hazards approach can be important for determining which hazards generate the most significant risks. It can also give insight into how one hazard generates risks in other areas (e.g. floods and storms can cause human disease). Using a range of scenarios, rather than a single hazard, and their associated impacts can be useful at the early phase to help identify significant risks.

An initial risk assessment may have a broad context and focus on multiple hazards as a way to 'screen' risks. This may then be followed by more focused assessments to prioritise the risks that are most important.

Conversely, a risk assessment may be concerned with only one hazard. The sponsors of the risk assessment will need to approve the scope of the assessment(s), based on the best way to meet the objectives.

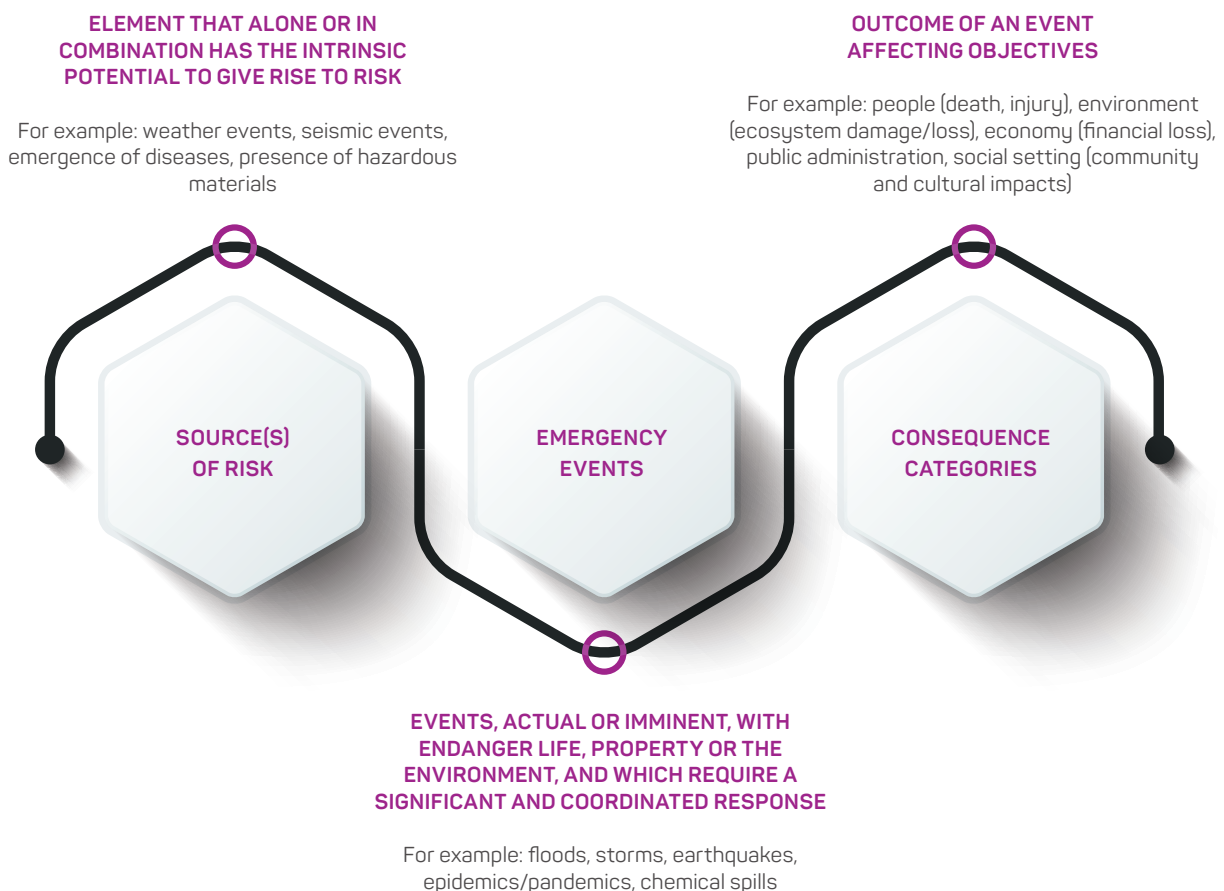


Figure 7: Summary scope of risk assessment context

A summary scope of the risk assessment context is depicted in Figure 7.

4.3.4 Stakeholder engagement

As described in Section 3, the context needs to include a communication and consultation plan that describes how the identified stakeholders will be informed, involved, consulted and engaged throughout the risk assessment process.

Stakeholders should be identified, as well as their relative importance to the risk assessment, to ensure that all stakeholders are accounted for in the process – by being actively involved, consulted with or informed of the risk assessment process and its findings.

Stakeholders should be actively involved in both establishing the context and in the subsequent risk assessment to ensure that all relevant aspects of the risk assessment are addressed, and to ensure support for the outputs and commitment to further action.

4.4 Risk criteria

NERAG provides criteria for use in emergency risk assessments to assign:

- consequence level (from insignificant to catastrophic)
- likelihood level (extremely rare to almost certain)
- risk level (very low to extreme)
- confidence level (lowest to highest).

Risk criteria help make judgements about which risks need to be treated. The criteria should reflect community viewpoints and common values, and give consideration to social, environmental and humanitarian factors.

Risk criteria should be confirmed in the context-definition phase so that they are not unduly influenced or skewed by outcomes from later phases. However, further development and refinement may take place when particular risks are identified and as risk analysis techniques are chosen.

Risk criteria should be monitored and reviewed regularly to make sure they remain relevant.

Some interpretation of criteria may be required, particularly regarding the scalable parameters (e.g. economy and people consequences for the area being assessed). These need to be interpreted while establishing

the context, and agreed upon and documented before the assessment commences.

4.5 Reporting

The basis for decisions that define or confirm the objective, scope, stakeholders and risk criteria of the risk assessment need to be documented to ensure that the process is transparent and credible. It will also identify the underpinning assumptions and context, so that later decisions and judgements can be made in the full knowledge of what may have changed over time.

Once established, the context needs to be communicated to and understood by all parties so that the process yields the desired outputs. On this basis, the process for risk assessment can be prepared, and the relevant data collected and reviewed to determine potential impacts.

Figure 8 shows an example of a reporting template.

Context

Objectives

To conduct an assessment of the risks to the South Australian community from the hazard of earthquake so mitigation efforts can be prioritised and scoped.

Responsibilities

- This risk assessment is part of the South Australian State Risk Assessment, conducted under the auspices of the State Emergency Management Committee.
- The South Australian Earthquake Hazard Leader has responsibilities to conduct this assessment as part of its broader role of coordinating state-wide preparedness to earthquake under the State Emergency Management Plan.
- The South Australian Emergency Management Office is assisting the hazard leader by facilitating the risk assessment process, under its responsibilities to consider earthquake as one of several hazards under the South Australian State Risk Assessment.
- Other agencies are being invited to participate in the risk assessment as a contribution based on their responsibilities in governance or emergency management, including:
 - control agency (SA Police)
 - seismology expertise (Geoscience Australia, the State Seismologist)
 - functional services (e.g. health, engineering, transport, emergency relief, public information)
 - specialist support services (e.g. urban search and rescue, state recovery office)
 - other stakeholders as described in the Communication and Consultation Plan.

Scope

The risk assessment will consider scenarios of earthquakes of various magnitudes centred on the City of Adelaide and surrounding Greater Adelaide area. The magnitude of the earthquakes will be based on historic events, geology of the Greater Adelaide area, and expert advice and modelling from Geoscience Australia and the South Australian State Seismologist.

It will consider the possible consequences on people, economy, public administration and social setting to the community of South Australia.

Supporting evidence and expertise

Studies/modelling used as supporting evidence for the risk assessment.

Communication and consultation

Method of consultation to be used (e.g. workshop, interviews).

Stakeholders

Agencies are being invited to participate in the risk assessment as a contribution based on their responsibilities in governance or emergency management, and/or their involvement in likely scenarios, including:

- control agency (SA Police)
- seismology expertise (Geoscience Australia, the State Seismologist)
- functional services (e.g. health, engineering, transport, emergency relief, public information)
- specialist support services (e.g. Urban Search and Rescue, State Recovery Office)
- other agencies with interest of expertise of relevance to the scenario (e.g. local government, utilities)
- other stakeholders as described in the Communication and Consultation Plan.

Risk criteria

People: Population of 1.63 million people

Economy: Gross state product of \$80 billion

Public administration: Core functions include executive government, maintenance of law and order via a police force, maintenance of hospital services

Social setting: Culturally important events include the Adelaide Festival, Fringe Festival and associated events in first half of year

Reporting

Risk assessment report will be provided to:

Earthquake Hazard Leader to form the Earthquake Hazard Plan.

The SA Emergency Management Office to form part of the State Risk Assessment .

The State Risk Assessment, including this and other hazards, will be reported to the State Emergency Management Committee.

Figure 8: Example of reporting template

5 Risk identification

The aim of risk identification is to generate a comprehensive list of risks based on the risk sources, emergencies and consequence categories that were defined in scope, context and criteria phase (Section 4).

Comprehensive identification of risks is critical. If an important risk is missed at this phase, it will not be considered later in the risk assessment process.

All significant sources of, and consequences from, the identified risks need to be considered:

- Identified risks should include all risks of relevance to the emergency scenario being considered, regardless of who controls and influences the risk, or the source of risk. Even those risks where the source is not immediately evident should be considered.
- Identified risks need to consider the broadest range of potential consequences. This includes cascade, cumulative and 'knock-on' effects (see Section 5.2).

Ideally, risk identification is facilitated by communication and consultation with stakeholders. Open inclusion of stakeholders allows consideration of different perspectives and experiences, and significantly contributes to gaining a holistic understanding of the risk, which can then be scrutinised during the risk analysis.

Relevant available information should be used to describe the nature of the sources to be addressed (leading to one or more emergency events) and their possible consequences.

5.1 Risk identification techniques

In identifying risks, it is important to choose a method that reveals the interrelationship between sources of risk and consequences, and associated controls in place. The technique chosen should be suitable for the risk management framework, context, stakeholders and emergency event(s) being considered.

Hazard-specific studies (e.g. flood mapping and modelling) can be key sources of information that can guide the identification and analysis of emergency risks.

SA/SNZ HB 89:2013 Risk management – guidelines on risk assessment techniques describes techniques suitable for the risk identification process.

5.2 Complexity between risk sources and consequences

In risk identification, allowances may need to be made for the potential complexities between sources of risk and possible consequences from emergency events. In particular, the knock-on effects from disruption to essential services from emergency events can lead to significant secondary impacts. For example:

- interruptions to electricity supplies can cause economic losses due to disruption of financial services and telecommunications, and additional deaths and injuries/illnesses may occur due to disruption to air conditioning during a heatwave.
- disruption to water supplies and/or sanitation services can render otherwise undamaged homes uninhabitable, causing isolation and displacement.
- interruptions in road transport can delay emergency services, increasing the impacts of death and injury due to an increase in ambulance response times.

It is recommended that owners and operators of infrastructure services and other important functions be included as part of establishing the context and identifying risks. Disruption to these services and functions can be included in the broader consideration of impacts to people, the economy, the environment, public administration and the social setting.

In many scenarios, a prolonged infrastructure disruption may be the cause of the most significant consequence.

5.3 Generate risk descriptions

A risk description, also known as a risk statement, as described in *ISO Guide 73:2009 Risk management – vocabulary*, is a structured statement linking one or more sources of risk to a consequence. It contains the following parts:

- the source of risk
- the emergency event that emerges from the source of risk
- the consequences that result from the emergency event occurring
- any causal links between the source, event and consequence that are relevant to the risk description
- where relevant, temporal factors of the event. This describes whether the event is a current possibility or something that may happen in future. This may, for example, predict risks for proposed assets, the effects of climate change or other future events that may alter the risk profile.

The general structure of a risk description is: 'There is the potential that [source of risk] [temporal factors of the risk, if required] will result in [emergency event] that, in turn, will cause [consequences]'. For example:

- There is the potential that heavy rainfall will result in flash flooding that, in turn, will damage buildings.
- There is the potential that a large seismic event will result in ground shaking that, in turn, will cause loss of life and injury.
- There is the potential that an outbreak of foot-and-mouth disease in Australia will result in livestock being destroyed that, in turn, will affect the agricultural sector and national economy.

The risk description can be as broad or as specific as the scope and context of the risk assessment requires. Where they are relevant to the context, risk descriptions can describe consequences that occur directly or indirectly from the emergency event, as well as knock-on effects.

Risk descriptions need to be produced for all interrelationships between the source(s) of risk and consequences as defined in the established context.

For each identified risk description, a number of risk scenarios can be separately identified for assessment, considering a variety of events. For natural hazard events (e.g. storms, floods, bushfires, earthquakes), a single identified risk may have several risk descriptions identified with increasing consequences (and presumably decreasing likelihoods).

5.4 Identify controls

For each risk description, relevant prevention, preparedness, response and recovery controls need to be identified. These are the controls that are currently in place for that risk and have an effect in reducing the level of risk – that is, reducing the severity or likelihood of defined consequences occurring as a result of the emergency event.

Treatment options that have been identified, but not implemented, in previous risk studies may be identified during this phase and recorded (including relevant information on their current status and impediments to implementation) to inform risk treatment planning.

5.5 Risk register

A risk register is the record of information about identified risks and represents the tangible output of the risk assessment process. The risk register is where the results of risk identification, analysis and evaluation are recorded.

The sample risk register in Appendix B can be adopted as a template.

It is recommended that each risk on the risk register is individually identified with a code or number, using an identifier system. In this system, an alphanumeric identifier is assigned to each risk, consisting of two letters to identify the community or area, two digits to identify the nature of the source of risk and two (or more) digits to identify the sequential position of the risk on the register. Other signifiers, such as the year of the risk assessment, may also be useful.

5.6 Review the risk register

Reviewing the risk register at the end of this phase seeks to ensure that all relevant risks have been identified. To verify this phase, the following questions should be asked:

- Have all trivial issues been screened out?
- Have duplicate risks been drawn together?
- Have prevention/preparedness controls been identified for all sources of risk?
- Have response/recovery controls been identified for all consequence categories?

Steps to identifying risk:

1. Choose a risk identification technique that meets the context and needs of the risk assessment.
2. Based on the established context, construct causal links between sources of risk, emergency events and consequences.
3. Document existing controls relating to the risks.
4. Identify generic risks linking sources of risk, emergency events and consequences.
5. Determine one or more risk descriptions for each generic risk based on, for example, the increasing size of emergency events or other criteria relevant to the established context.
6. Document the above information in a risk register.
7. Review the risk register to ensure all relevant risks have been identified to satisfy the objectives of the risk assessment, consider that all appropriate risks have been included, remove unnecessary duplicates and ensure that controls have been appropriately documented.

6 Risk analysis

Risk analysis is the second phase of the risk assessment process. This phase examines each identified risk and uses evidence about that risk to determine the risk level. The risk level is derived from the:

- consequence – the outcome of an event at the current level of control described as the consequences to people, the economy, the environment, public administration and the social setting
- likelihood – the chance of the consequences of the event happening given the current level of control.

Risk analysis provides the basis for risk evaluation, further analysis (if required) and risk treatment. To do this, the uncertainties surrounding the likelihood and consequence levels need to be described. Temporal factors of the risk and consequence may also need to be described. Some risks can occur at any time, while others emerge over time. Other risks may only arise during certain periods of the day, or the consequences of some risks may be higher during particular periods. These factors affect the priority and treatment options for the risk.

To analyse emergency risks:

1. collate relevant knowledge and expertise for each risk description determined during the risk identification phase
2. consider one or more emergency events for each general risk description
3. examine the strength and expediency of existing controls in place in terms of reducing the likelihood or severity of the consequences for the emergency event
4. determine the consequence level and likelihood level of each risk, using the consequence and likelihood criteria
5. determine a risk level for each risk based on the consequence and likelihood levels
6. determine a confidence level in the analysis of the risk based on the uncertainties of knowledge and opinion used to assess the consequence, likelihood and risk levels.

6.1 Knowledge and expertise relating to risk

The first step in risk analysis is to determine what is known about the risk to support an understanding of consequence and likelihood. This can include:

- historical data of previous events and the likelihood of their occurrence
- modelling of events
- assessments of likely consequence resulting from events.

Expert opinion can also be used in addition to data, information and modelling to interpret the evidence in the context of the risk being considered.

Ideally, evidence and expertise are investigated, collated and engaged as part of establishing the context for the risk assessment, and are readily available when required at this phase.

6.2 Level of existing controls

As described in Section 5.4, emergency risks generally have one or more controls in place. These controls are intended to modify the risk by reducing the likelihood of the consequences.

The level of control should be determined to identify which controls are effective, the conditions under which they are overwhelmed and their expediency to implement. This guides future discussions on risk evaluation (Section 7) and treatment (Section 8).

Overall, there may be a large number of identified controls for a particular risk. However, not all controls are equally effective in reducing risk; some controls are more important than others. Key controls are a class of controls or group of controls that are believed to be maintaining an otherwise intolerable risk at a tolerable level (*AS HB 158:2010 Delivering assurance based on ISO 31000:2009 - Risk management - Principles and guidelines*).

Key controls are of primary importance to the risk being analysed, as their failure to operate makes a material difference to the risk level. For example:

- A flood levee protecting a town is a key control for flood risk, as it prevents flooding up to the height of the levee. For floods above the height of the levee, it ceases to protect the town and therefore ceases to be a key control.
- Building codes for storms (high winds), earthquakes and bushfires are key controls, as the amount of damage from an emergency is highly dependent on whether the event exceeds the limitations of the building code or not.
- For viruses that infect humans, such as influenza, vaccine production following outbreak of the virus is a key control, as production of a vaccine has a material effect on the extent of infection, and resulting consequences.
- The capabilities of emergency response resources are a key control for those events where emergency response resources make a material difference to the consequences of an emergency, such as bushfires.

6.2.1 Control strength

When they operate, some controls will be more effective than others at preventing the risk or mitigating its impacts. Control strength refers to the ability of the control, or group of controls, to achieve its objective if it operates as intended and when required. In short, how well will the control reduce the risk? For example:

- A well-designed, constructed and maintained flood levee has a high control strength for floods below its design level, as it prevents flooding as designed.
- A warning and evacuation plan for flooding has a lower control strength, as homes will be inundated and damage/disruption will still occur, and not everyone will necessarily respond as needed to minimise death and injury consequences.
- Weather forecasts are of little control strength in preventing emergencies by themselves. However, a well-integrated group of controls that includes forecasts, intelligence gathering, public warnings and response services may have an increased strength in the prediction, warning and response to weather-related emergencies.

6.2.2 Control expediency

Some controls, while available and possible to use, are difficult to implement due to cost, regulatory burden or community acceptability. Control expediency refers to the ability of the control to be used/deployed readily and the control's acceptability to stakeholders. In short, how easily can the control be activated and used? For example:

- Forced evacuations are a very effective control to protect people, but are difficult to implement in practice. Therefore, the expediency of forced evacuations is relatively low.
- Standstill protocols for foot-and-mouth disease are effective in reducing the spread of the disease, but are very damaging to economic activity and can be met with a high level of community resistance. Therefore, the expediency for these protocols is relatively low.
- Weather warnings are regularly published, distributed broadly and relatively well understood. Therefore, the expediency of these controls is relatively high.
- House-to-house door knocking requires significant resources, but is relatively well understood and regularly implemented. Therefore, the expediency of these controls is medium.

6.2.3 Determining control strength and expediency

A multi-criteria analysis method is used to rate controls. Table 1 provides generic qualitative descriptors of levels of control. Note that a single control may have different levels of strength and expediency. The levels of control should reflect the judgement of relevant stakeholders participating in the risk assessment.

The criteria strength and expediency are each rated from very low to high. These criteria reflect how well the control is able to modify the risk and the ease of implementing the control. The level of control may be applied to individual controls or groups of controls, as relevant to the context and to the judgement of stakeholders participating in the risk assessment process.

Following the analysis of each control or group of controls to determine their strength and expediency, an overall level of control can be derived using Table 2.

As described in Section 1, a single identified risk may have several risk descriptions, reflecting different magnitudes of an emergency event. In general, it is expected that the level of control would be higher for small events that are within everyday experience, and decrease as events become larger and the controls are progressively less effective.

At the end of this step, the level of control should be recorded on the risk register for each scenario the control relates to.

Table 1: Qualitative descriptors of control strength and expediency

LEVEL	CONTROL STRENGTH	CONTROL EXPEDIENCY
HIGH	Control is highly effective in reducing the level of risk	The control is frequently applied. A procedure to apply the control is well understood and resourced. The cost of applying the control is within current resources and budgets.
MEDIUM	Control is effective in reducing the level of risk	The control is infrequently applied and is outside of the operators' everyday experience. The use of the control has been foreseen and plans for its application have been prepared and tested. Some extraordinary cost may be required to apply the control.
LOW	Control has some effect in reducing the level of risk	The control is applied rarely and operators may not have experience using it. The use of the control may have been foreseen and plans for its application may have been considered, but it is not part of normal operational protocols and has not been tested. Extraordinary cost is required to apply the control, which may be difficult to obtain.
VERY LOW	Control has almost no effect in reducing the level of risk	Application of the control is outside of the experience and planning of operators, with no effective procedures or plans for its operation. It has not been foreseen that the control will ever need to be used. The application of the control requires significant cost over and above existing resources, and the cost will most likely be objected to by a number of stakeholders.

Table 2: Level of existing control matrix

CONTROL STRENGTH ^a	CONTROL EXPEDIENCY ^b			
	VERY LOW	LOW	MEDIUM	HIGH
HIGH	Low	Medium	Medium	High
MEDIUM	Low	Medium	Medium	Medium
LOW	Very low	Low	Medium	Medium
VERY LOW	Very low	Very low	Low	Low

a How well does the control reduce the risk?

b How easily can the control be activated and used?

6.3 Risk criteria

Risk analysis assigns each risk on the risk register a level in accordance with the NERAG risk criteria, including any interpretations agreed to in the established context. This is done through assigning a consequence level and likelihood level for each risk. The consequence and likelihood levels are then combined to derive an overall risk level.

To help ensure that emergency risk assessments are conducted in a nationally consistent manner, NERAG uses standardised descriptions of consequence and likelihood levels (Appendix C).

For each risk, it is necessary to:

- assume that the emergency event/scenario described for the risk occurs with all current controls in place.
- determine a consequence level for the risk, with an agreed understanding of the modifying effects of the controls in place, and record the level on the risk register, using the consequence table relevant to the risk (Tables 3–8; e.g. people, economy, social setting).
- determine a likelihood level based on the chance of the emergency event occurring and causing the described consequence, with an agreed understanding of the modifying effects of the controls in place, and record the level on the risk register, using the likelihood table (Table 10).
- determine the risk level using the qualitative risk matrix (Table 11) and record the level on the risk register.
- determine the level of confidence (Table 13) in the assessment and record it on the risk register

6.4 Consequence criteria and levels

A consequence level needs to be determined for each risk description for the emergency events identified in Section 5, assuming that the emergency event has occurred with all current controls in place.

Organisations may, through the context they have established, elect to adopt a selection of the most significant consequence criteria that are relevant to the risks being assessed and that can be estimated with confidence.

The same emergency event may produce more than one consequence. If the event produces more than one consequence across criteria within the same category (e.g. death and injury in the people consequence), the highest consequence level should be used. If the event produces more than one consequence across different categories (e.g. people and economy consequences),

each consequence needs to be expressed separately in the risk register.

Consequences can also be affected by temporal factors. For example, an earthquake impacting a central business district during working hours (when the area is most heavily populated) is about one-third of the likelihood of it occurring at other times of the day. Any modifications to account for temporal factors must be described in the established context and risk description.

A logarithmic scale is used for consequence levels, because the consequences of emergency events can cover several orders of magnitude.

6.4.1 People consequences

The people consequences describe deaths and injuries as a direct result of the emergency event, relative to the population being considered under the established context. Information on population in Australia is generally accessible through the census data held by the Australian Bureau of Statistics (ABS).

Some modification to the baseline census population may be adopted if there is a known change in population at certain times that has a material effect on the consequence level. For example:

- central business districts of major cities have higher populations during business hours
- some regional centres have higher populations due to seasonal tourism or other factors.

If modified populations based on temporal factors are to be used, then the likelihood of the event may be modified to reflect the modified population. All such modifications, with evidence and assumptions of the effects on likelihood, need to be described when establishing the context and in the risk description.

The people criteria used to derive a consequence level are shown in Table 3. Each criterion is described briefly to help practitioners determine a consequence level.

When calculating the number of deaths or injuries or illness per population, numbers should be rounded to the nearest whole. For example, if considering deaths from an emergency event as a proportion of a population of interest of:

- 250,000 people
 - 25 deaths or more would be considered a catastrophic consequence
 - 3 deaths or more (rounded up from 2.5) would be considered major
 - 1 or 2 deaths would be considered a moderate consequence
- 3,200,000 people

Table 3: People consequence levels and criteria

LEVEL	CRITERIA	
	DEATH	INJURY OR ILLNESS
CATASTROPHIC	Deaths directly from emergency greater than 1 in 10,000 people for population of interest	Critical injuries with long-term or permanent incapacitation greater than 1 in 10,000 people for population of interest
MAJOR	Deaths directly from emergency greater than 1 in 100,000 people for population of interest	Critical injuries with long-term or permanent incapacitation greater than 1 in 100,000 people for population of interest, or Serious injuries greater than 1 in 10,000 people for population of interest
MODERATE	Deaths directly from emergency greater than 1 in 1,000,000 people for population of interest	Critical injuries with long-term or permanent incapacitation greater than 1 in 1,000,000 people for population of interest, or Serious injuries greater than 1 in 100,000 people for population of interest
MINOR	Deaths directly from emergency greater than 1 in 10,000,000 people for population of interest	Critical injuries with long-term or permanent incapacitation greater than 1 in 10,000,000 people for population of interest, or Serious injuries greater than 1 in 1,000,000 people for population of interest
INSIGNIFICANT	Deaths directly from emergency less than 1 in 10,000,000 people for population of interest	Critical injuries less than 1 in 10,000,000 people for population of interest, or Serious injuries less than 1 in 1,000,000 people for population of interest, or Minor injuries to any number of people

- 320 deaths or more would be considered a catastrophic consequence
- 32 deaths or more would be considered a major consequence
- 3 deaths or more (rounded down from 3.2) would be considered a moderate consequence
- 1 or 2 deaths (i.e. less than 3) would be considered a minor consequence.

Deaths and injuries or illnesses should only be counted if they are caused by the emergency event. Deaths and injuries or illnesses that would have occurred irrespective of the emergency event should not be included in these calculations. Some judgement and consensus across stakeholders may be needed to set appropriate limits on these calculations. For example:

- A pandemic virus could take several months to move through the population. As a result, deaths, injuries and illnesses caused by the virus throughout that period would be included in the analysis.
- An extended heatwave is likely to lead to excess deaths. These premature deaths would be included in the analysis.

Death

The scenario needs to predict the number of deaths that occur in the risk description using historical data and/or modelling. The number derived from these data or the modelling should then be compared to the thresholds in Table 3 to determine the consequence level.

Where applicable, the evidence assigning the consequence level should define the assumptions used in describing the number of deaths.

Injury or illness

Injury or illness is the non-lethal damage or harm done to a person’s physical or mental capacity as a result of the emergency. Injury or illness may be caused by:

- non-lethal physical trauma
- non-lethal mental trauma
- illness from bacteria, viruses or other pathogens.

The risk event/scenario needs to predict the number and severity of injuries or illnesses that occur in the risk description using historical data and/or modelling. The number derived from these data or the modelling should then be compared to the thresholds described in Table 3 to determine a consequence level

Injury or illness level is based on descriptors from the Hazus method developed by the Federal Emergency Management Agency (United States), as described in Table 4.

The descriptors of injury and illness are characterised by the level of medical treatment required. The examples in Table 4 relate to physical trauma only. If required, the context of the risk assessment should provide mental trauma and illness descriptors that match the severity descriptions based on medical treatment required.

Table 4: Injury and illness scale

INJURY SEVERITY	DESCRIPTION
FATAL	Mortally injured, is certain to lead to death regardless of available treatments Counted among deaths, not injuries
CRITICAL	Injuries that pose an immediate life-threatening condition if not treated adequately and expeditiously Examples include uncontrolled bleeding, a punctured organ, other internal injuries, spinal column injuries or crush syndrome
SERIOUS	Injuries requiring a greater degree of medical care and use of medical technology such as X-rays or surgery, but not expected to progress to life-threatening status Examples include full thickness burns across a large part of the body or partial thickness burns to most of the body, loss of consciousness, fractured bones, dehydration or exposure
MINOR	Injuries requiring basic medical aid that could be administered by paraprofessionals, which would require bandages or observation Examples include a sprain, a severe cut requiring stitches, a minor burn (partial thickness on a small part of the body) or a bump on the head without loss of consciousness

6.4.2 Economic consequences

Economic consequences include financial and economic losses resulting directly from damage due to the emergency event. The economic criteria are shown in Table 5.

Table 5: Economic consequence levels and criteria

LEVEL	CRITERIA	
	LOSS IN ECONOMIC ACTIVITY AND/OR ASSET VALUE	IMPACT ON IMPORTANT INDUSTRY
CATASTROPHIC	Decline of economic activity, and/or Loss of asset value greater than 4% of gross product produced by the area of interest	Failure of a significant industry or sector in area of interest as a direct result of emergency event
MAJOR	Decline of economic activity, and/or Loss of asset value greater than 0.4% of gross product produced by area of interest	Significant structural adjustment required by identified industry to respond and recover from emergency event
MODERATE	Decline of economic activity, and/or Loss of asset value greater than 0.04% of gross product produced by area of interest	Significant industry or business sector is significantly impacted by the emergency event, resulting in medium-term (i.e. more than one year) profit reductions directly attributable to the event
MINOR	Decline of economic activity, and/or Loss of asset value greater than 0.004% of gross product produced by area of interest	Significant industry or business sector is impacted by the emergency event, resulting in short-term (i.e. less than one year) profit reductions directly attributable to the event
INSIGNIFICANT	Decline of economic activity, and/or Loss of asset value less than 0.004% of gross product produced by area of interest	Inconsequential business sector disruption due to emergency event

Loss in economic activity and asset value

This criterion relates to reduced economic activity and asset losses as a result of the emergency event. As part of the established context of the risk assessment, the gross product of the area of interest needs to be determined. This may be the gross product of the nation (gross domestic product), the state or territory (gross state product or GSP), or a portion of the GSP for a region or locality (sometimes known as the gross regional product).

The ABS publishes the value of economic activity at the state/territory and national level. There are organisations that derive similar figures for regions and local government areas, such as the Australian Local Government Association in its annual State of the Regions report (<https://alga.asn.au/category/publications-and-submissions/state-of-the-regions/>).

Dollar-value financial loss can be measured in the following terms:

- direct and indirect
- tangible and intangible.

The *Disaster Loss Assessment Guidelines* provides guidance on determining such losses. Given the uncertainties around intangible costs, risk assessments using this methodology should only include direct and indirect tangible losses. Intangible costs and losses can be incorporated into other consequences (e.g. social setting and public administration), as appropriate.

Loss in economic activity and asset value is expressed as a percentage of gross product from insignificant (less than 0.004 per cent) to catastrophic (4 per cent or more). As part of the established context of the risk assessment using this criterion, the decline in economic activity and loss in asset value needs to be calculated. This can include:

- loss in business activity due to disrupted supply chains, disruption to services that support economic activity (e.g. transport, electricity) or a loss of markets due to disruption by the emergency.
- the cost to buildings, contents, infrastructure, business inventory and other associated objects that are destroyed or impaired by an emergency. Such value is embodied principally in physical assets, as opposed to non-physical assets (e.g. financial assets).

The aggregated loss figure (economic loss plus asset loss) is then assigned a consequence level based on the ranges relative to the gross product for the area of interest.

Industry loss

This criterion relates to significant industries that are impacted by the emergency event. The consequence may, for example, occur as the result of damage to a production facility or supply chain, impairment of a workforce or access to a market being cut off.

If this criterion is used, the significant industry sectors or facilities (e.g. factories, mines, irrigation districts) must be described as part of the established context of the risk assessment.

This criterion is intended to be of particular relevance for:

- regions or areas where the viability of the local economy is highly dependent or co-dependent upon a particular industry or facility.
- particular emergency events that can impact on a specific industry (e.g. a supply chain disruption impacts on manufacturing, or a pest species incursion impacts on agricultural crops).

Criteria by which the impairment and collapse of the industry would occur also need to be documented. This may include, for example, the destruction of a particular facility or disruption to critical supply chains through destruction of transport corridors. Consequences may also result from the emergency event impacting the markets that the industry services. For example, the destruction of agricultural land may impact the viability of businesses servicing these areas. Such effects should be well understood if they are to be used as part of the risk assessment.

Assessments of larger areas and broader consequences where multisector impacts occur may be better incorporated into the risk assessment using the broader economic and asset value losses criterion.

6.4.3 Environmental consequences

Environmental consequences include loss of species and landscapes, and loss of environmental value, as a result of the emergency event. The environmental consequence criteria are shown in Table 6.

Table 6: Environmental consequence levels and criteria

LEVEL	CRITERIA	STATE OR NATIONAL RISK DESCRIPTION	REGIONAL RISK DESCRIPTION	LOCAL RISK DESCRIPTION
CATASTROPHIC	Loss of species and/or landscapes	Permanent destruction of an ecosystem or species recognised at the national level	Permanent destruction of an ecosystem or species recognised at the national or state level, and/or	Permanent destruction of an ecosystem or species recognised at the local, regional, state or national level, and/or
			Severe damage to or loss of an ecosystem or species recognised at the national level	Severe damage to or loss of an ecosystem or species recognised at the national or state level, and/or Significant loss or impairment of an ecosystem or species recognised at the national level
	Loss of environmental value	Permanent destruction of environmental values of interest	Permanent destruction of environmental values of interest	Permanent destruction of environmental values of interest
MAJOR	Loss of species and/or landscapes	Severe damage to or loss of an ecosystem or species recognised at the national level, and/or	Permanent destruction of an ecosystem or species recognised at the local/regional level, and/or	Minor damage to ecosystems or species recognised at the national level, and/or
		Permanent destruction of an ecosystem or species recognised at the state level	Severe damage to or loss of an ecosystem or species recognised at the state level, and/or or Significant loss or impairment of an ecosystem or species recognised at the national level	Significant loss or impairment of an ecosystem or species recognised at the state level, and/or Severe damage to or loss of an ecosystem or species recognised at the local or regional level
	Loss of environmental value	Severe damage to environmental values of interest	Severe damage to environmental values of interest	Severe damage to environmental values of interest

LEVEL	CRITERIA	STATE OR NATIONAL RISK DESCRIPTION	REGIONAL RISK DESCRIPTION	LOCAL RISK DESCRIPTION
MODERATE	Loss of species and/or landscapes	Significant loss or impairment of an ecosystem or species recognised at the national level, and/or Severe damage to or loss of ecosystems and species recognised at the state level, and/or Permanent destruction of an ecosystem or species recognised at the local or regional level	Minor damage to ecosystems and species recognised at the national level, and/or Significant loss or impairment of an ecosystem or species recognised at the state level, and/or Severe damage to or loss of ecosystems and species recognised at the local/regional level	Minor damage to ecosystems and species recognised at the state level, and/or Significant loss or impairment of an ecosystem or species recognised at the local or regional level
	Loss of environmental value	Significant damage to environmental values of interest	Significant damage to environmental values of interest	Significant damage to environmental values of interest
MINOR	Loss of species and/or landscapes	Significant loss or impairment of an ecosystem or species recognised at the local and state levels, and/or Minor damage to ecosystems or species recognised at the national level	Significant loss or impairment of an ecosystem or species recognised at the local and regional levels, and/or Minor damage to ecosystems and species recognised at the state, local or regional level	Minor damage to ecosystems and species recognised at the local or regional level
	Loss of environmental value	Minor damage to environmental values of interest	Minor damage to environmental values of interest	Minor damage to environmental values of interest
INSIGNIFICANT	Loss of species and/or landscapes	Minor damage to an ecosystem or species recognised at the local or regional scale	No damage to ecosystems at any level	No damage to ecosystems at any level
	Loss of environmental value	Inconsequential damage to environmental values of interest	Inconsequential damage to environmental values of interest	Inconsequential damage to environmental values of interest

Notes:

1. 'Ecosystem' includes the plant, animal and other species of that ecosystem, as well as the air, water and soil upon which those species depend.
2. 'Environmental value' includes environmental goods and services, including aesthetic and recreational facilities and resources.
3. 'Permanent destruction' means the pre-emergency condition has been lost. Although some degree of restoration may be possible, the pre-emergency condition cannot be restored.
4. 'Severe damage' means the ecosystem or species requires a major program of interventions and recovery to restore it to health. The asset or species has been or is likely to be permanently altered from its original state by the emergency event.
5. 'Significant loss or impairment' means the ecosystem or species requires a diversion of resources to manage their recovery from damage by the emergency event.
6. 'Minor damage' means the ecosystem or species is able to recover fully, with minimal or no intervention.

Species and landscape loss

Environmental consequences include the destruction and degradation of environmental assets (and their processes and structures), and/or species extinction and habitat range reduction.

In the emergency risk assessment scope and context, environmental assets are ecosystems and conservation values recognised through legislation and policy, and species indigenous to those ecosystems that have legislative- or policy-derived conservation statuses. Assets also include processes that support the survival, abundance and evolutionary development of species and communities.

Environmental value can be ranked objectively by considering threatened ecosystems or taxa listings, including the World Heritage List, *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (including Australia's international agreements on migratory species), the *International Union for Conservation of Nature 2001 Red List*, and state or territory legislation and policy.

The scope, context and criteria of the risk assessment needs to identify key ecosystems within the area of interest and the known types of event that would cause these assets to be degraded or destroyed. Environmental consequences occur when an ecosystem is damaged or impaired by the emergency event. The two metrics defining the consequence are the degree of permanent or long-term damage, and the relative importance of the environmental asset.

The degree of damage (relative to the species population or landscape in the area of interest) is categorised as follows:

- **Permanent destruction** – the permanent loss of a species or ecosystem, or the potential for ongoing impacts leading to permanent loss. Rehabilitation efforts will need to focus on land stability and the amelioration of environmental risks, and outcomes may include novel ecosystems and options for land conversion to alternative stable-state uses that may or may not maintain values of the original ecosystem.
- **Severe damage or loss** – requires a major program of interventions and recovery for the asset to return to a steady stable state. A return to the original ecosystem is unlikely, given that single or multiple thresholds of irreversibility have been transgressed. The asset or ongoing processes have been, or are likely to be, permanently altered from their original state by the emergency event, and alternative options must be explored for the return of indigenous asset values.
- **Significant damage or loss** – diversion of existing resources to manage recovery and/or repopulation of ecological assets in the short term would create a high likelihood of a return to a pre-existing

ecosystem. Areas of significant impairment may include cases described as minor, but where longer timeframes for recovery are required; where significant areas of the ecosystem (or the species' best remaining habitat) are affected; or where there is a level of uncertainty about full recovery.

- **Minor damage** – no permanent loss likely. Unassisted recovery to a pre-existing state is likely within a short-term timeframe, and without the assistance of current programs and resources that manage the reserves and species. Typically, the scale of impact would be insufficient to disrupt the ecosystem or species within local area with a high degree of ex situ and in situ resilience evident. The area affected would generally be less than 1 per cent of the ecosystem or best remaining habitat of the species.

The relative importance of the environmental asset in question is often based on the level at which the asset is classified (regional, state, national or international).

The context of the risk assessment will define the consequence level. For example, permanent loss of a species within a region is potentially catastrophic for a regional risk assessment, but would attract a lower consequence level at the state and national levels if the species still exists in other areas. Evidence regarding the emergency event and the potential consequence on the ecological asset needs to be described, along with any available evidence about the degree of ecological harm, and the activities required to restore and recover ecological function (if possible).

Loss of environmental value

Environmental consequences can also relate to the utility value, including aesthetic and recreational values gained from environmental assets, in addition to their ecological value. The loss of environmental assets can be important to particular communities. Such assets need to be defined when establishing the context.

Loss of environmental value is distinct from losses in species or landscape, in that it is a community-focused view of the environment. For example, an artificial waterbody may have little ecological value, but be important to a community for its visual and recreational values. These ecosystem services gained from environmental assets are to be considered in parallel with the loss of species or landscapes.

Such environmental values, and the source of that value, should be defined in the established scope, context and criteria.

6.4.4 Public administration consequences

Public administration consequences are concerned with the impact of the emergency event on the delivery of core functions of the governing bodies for the community.

The scope, context and criteria of the risk assessment should define the relevant core functions to be assessed, including the:

- governing bodies of relevance to the emergency event, at the local, state or territory, and national levels
- degree to which the emergency event can affect the delivery of services to the population in question
- core functions that are provided by the governing bodies – these are services that may, if disrupted, cause significant additional personal hardship, economic costs or other increased consequences
- degree to which non-emergency service governing bodies will become absorbed into the emergency response, in addition to any reduction in service directly related to the emergency event
- potential consequence of this service reduction on the lives of the affected community, resulting in community dissatisfaction in the response, relief and recovery services for the event.

For example, the destruction of a telephone exchange in a regional area may be of relatively minor economic cost, but the resulting disruption to local retail, banking and government services through a loss of internet access may lead to a higher consequence for public administration due to disruption of food supply, emergency services and so on.

The public administration criteria are shown in Table 7. Each criterion is described briefly to assist practitioners in determining a consequence level.

Table 7: Public administration consequence levels and criteria

LEVEL	CRITERIA
CATASTROPHIC	Governing bodies are unable to deliver their core functions
MAJOR	Governing bodies encounter severe reduction in the delivery of core functions Governing bodies are required to divert a significant amount of available resources to deliver core functions or seek external assistance to deliver the majority of their core functions
MODERATE	Governing bodies encounter significant reduction in the delivery of core functions Governing bodies are required to divert some available resources to deliver core functions or seek external assistance to deliver some of their core functions
MINOR	Governing bodies encounter limited reduction in delivery of core functions
INSIGNIFICANT	Governing bodies' delivery of core functions is unaffected or within normal parameters

6.4.5 Social setting consequences

Social setting consequences are concerned with the effect on communities from the emergency event, as distinct from the individual impacts assessed in the people criteria.

The consequences of an emergency event can impact the community as a whole. For example, loss of shops, schools, retail and community events for a prolonged period can lead to people moving away or seeking support elsewhere. This leads to the diffusion of community activities of a local area, a breakdown of community organisations and structures, and a permanent reduction in the community.

Measuring consequences to social setting is complex, and recognised to be difficult to reduce to quantifiable metrics. It is, however, an important factor when considering emergency risks. The criteria reflect the social consequences of emergency events by assessing:

- the ability of a community to support itself without the need for substitute arrangements being put in place
- the destruction of culturally important objects or the loss of culturally important events.

The criteria used are surrogates for social setting, and are a balance between accounting for social setting in risk assessments and having a simple, assessable indicator to measure the consequence. Any consequences to be considered must be directly related to the emergency event.

It is recognised that communities can respond to emergencies in different ways, based on recent experiences and other factors. The scope, context and criteria of the risk assessment needs to determine:

- the community of interest and any psychosocial features of that community that may indicate vulnerability to the emergency events being considered
- any losses in community services that can affect the community and the degree to which the community will be affected
- significant objects of cultural significance – national, state and local heritage listings may provide useful data for post-European settlement sites and objects, and Aboriginal heritage registers may provide useful data for Aboriginal sites and objects
- significant cultural events that, if they were affected or cancelled, may result in a consequence on the community of interest.

The social setting criteria are shown in Table 8. Each criterion is described briefly to assist practitioners in determining a consequence level.

6.5 Likelihood level

After determining a consequence level for each risk description, the likelihood level of that consequence occurring needs to be assessed.

The likelihood level reflects the probability of both:

- the emergency event, and
- the estimated consequences occurring as a result of the event (e.g. deaths, damage).

In some cases, where the level of a control(s) has been assessed as low or very low, the likelihood of the emergency event may be very similar to the likelihood of the consequence, and may therefore be used as an estimate.

Using only an emergency event to estimate likelihood needs to be justified, and the assessment of confidence relating to that risk needs to reflect the uncertainties that this introduces. If the risk is identified as of sufficient priority to warrant further action, then these assumptions may need to be revisited.

NERAG uses annual exceedance probability (AEP), or the chance of the event occurring once in a year, to determine likelihood, expressed as a percentage.

Likelihood is based on probability and can be expressed in various ways, such as recurrence intervals, exceedance probabilities, return periods, probabilities or frequencies.

NERAG uses annual exceedance probability (AEP), or the chance of the event occurring once in a year, to determine likelihood, expressed as a percentage.

The use of the term 'return period' such as 'one in 100 years' can lead to confusion, as it implies that after an event occurs, it will be 99 years until it occurs again. This is an incorrect assumption. It is more accurate to say that the event has a one per cent chance of occurring each year, with the implication that such an event can occur in any year.

Average recurrence interval (ARI) is another common expression of a return period. ARI is a statistical estimate of the average period of time (usually in years) between occurrences of an event of given scale.

Table 9 illustrates the difference between AEP and ARI.

Table 8: Social setting consequence levels and criteria

LEVEL	CRITERIA	
	LOSS OF COMMUNITY WELLBEING	LOSS OF CULTURALLY IMPORTANT OBJECTS AND ACTIVITIES
CATASTROPHIC	The community of interest's social connectedness is irreparably broken, such that the community ceases to function effectively, breaks down and disperses in its entirety	Widespread and permanent loss of objects of identified cultural significance Permanent cancellation of a major culturally important community activity
MAJOR	The community of interest's social connectedness is significantly broken, such that extraordinary external resources are required to return the community to functioning effectively, with significant permanent dispersal	Widespread damage or localised permanent loss of objects of identified cultural significance Temporary cancellation or significant delay to a major culturally important community event
MODERATE	The community of interest's social connectedness is broken, such that community requires significant external resources to return the community to functioning effectively, with some permanent dispersal	Damage or localised widespread damage to objects of identified cultural significance Delay to a major culturally important community event
MINOR	The community of interest's social connectedness is damaged, such that community requires some external resources to return the community to functioning effectively, with no permanent dispersal	Damage to objects of identified cultural significance Delay to or reduced scope of a culturally important community event
INSIGNIFICANT	The community of interest's social connectedness is disrupted, such that the reprioritisation/reallocation of existing resources is required to return the community to functioning effectively, with no permanent dispersal	Minor damage to objects of identified cultural significance Minor delay to a culturally important community event

Table 9: AEP–ARI conversion table

ANNUAL EXCEEDANCE PROBABILITY (AEP)	AVERAGE RECURRENCE INTERVAL (ARI)
99.995% per year	0.1 year (average 10 events per year)
87% per year	0.5 year (average 2 events per year)
63% per year	1 year (average 1 event per year)
20% per year	5 years (average 1 event per 5 years)
10% per year	10 years (average 1 event per 10 years)
5% per year	20 years (average 1 event per 20 years)
2% per year	50 years (average 1 event per 50 years)
1% per year	100 years (average 1 event per 100 years)
0.5% per year	200 years (average 1 event per 200 years)
0.2% per year	500 years (average 1 event per 500 years)
0.1% per year	1000 years (average 1 event per 1000 years)
0.01% per year	10,000 years (average 1 event per 10,000 years)
0.001% per year	100,000 years (average 1 event per 100,000 years)
0.0001% per year	1,000,000 years (average 1 event per 1,000,000 years)

Note: At the time of publishing this revised 2015 Edition, contemporary research promotes the use of Annual Exceedance Probability displayed as a percentage.

The descriptors for likelihood levels (e.g. likely, rare) are used in the context of emergency risk assessment and are not intended to be equivalent to the everyday language use of these terms, which may consider probabilities of these terms to be higher than described below. A logarithmic scale is used for likelihood levels, because the probability of emergency events can cover several orders of magnitude (Table 10).

Determining a likelihood level for each scenario is a four-step process:

1. For each scenario used in the risk assessment, determine an AEP and corresponding likelihood level from Table 10.
2. Consider the level of controls currently in place, and any differences between the controls (and their effects) that existed during historical events and those that exist for the scenarios under analysis. If current controls are so different from those in the scenario (i.e. enough to make a material difference to the likelihood level), the likelihood should be adjusted accordingly.
3. Consider any temporal factors contributing to the consequence (e.g. time of day, major events). If temporal factors have a material effect on likelihood, then adjust the level accordingly.
4. Consider any material changes in exposure that may affect the likelihood level (e.g. population movements, ageing populations). If changes in exposure have a material effect on likelihood, then adjust the level accordingly.

The process of describing and determining likelihood level needs to be documented as part of the risk analysis process. This is so that when the risk register is reviewed or when the risk is assessed again, the assumptions, evidence and judgements can similarly be reviewed with any new evidence. Uncertainties and assumptions made during this process also need to be documented, as they can affect the description of confidence associated with the risk assessment (described in Section 6.7).

6.6 Risk level

At this phase, each risk should have consequence and likelihood levels assigned.

The qualitative risk matrix (Table 11) combines the consequence and likelihood levels to determine the risk level, which ranges from very low to extreme. The risk level of each risk is to be recorded in the risk register.

If a range of consequences have been identified for a particular risk (e.g. increasing severities of flood, storm, bushfire or earthquake), with associated likelihood and consequence levels, the resulting risk levels can be shown pictorially as a plot, overlain on the risk matrix. Examples of this approach can be found on the Australian Disaster Resilience Knowledge Hub.

If historical data of notable events have been used to inform the risk analysis before undertaking the risk assessment, these data could be shown with the identified and analysed risks for illustration.

To present a plot for a set of risks, plot points on the matrix based on the agreed consequence and likelihood levels. The extent of reporting should be defined by the

Table 10: Likelihood level

LIKELIHOOD	ANNUAL EXCEEDANCE PROBABILITY (AEP)	AVERAGE RECURRENCE INTERVAL (ARI) (INDICATIVE)	FREQUENCY (INDICATIVE)
Almost certain	63% per year or more	Less than 1 year	Once or more per year
Likely	10% to <63% per year	1 to <10 years	Once per 10 years
Unlikely	1% to <10% per year	10 to <100 years	Once per 100 years
Rare	0.1% to <1% per year	100 to <1000 years	Once per 1000 years
Very rare	0.01% to <0.1% per year	1000 to <10,000 years	Once per 10,000 years
Extremely rare	Less than 0.01% per year	10,000 years or more	Once per 100,000 years

Table 11: Qualitative risk matrix

LIKELIHOOD	CONSEQUENCE LEVEL				
	INSIGNIFICANT	MINOR	MODERATE	MAJOR	CATASTROPHIC
ALMOST CERTAIN	Medium	Medium	High	Extreme	Extreme
LIKELY	Low	Medium	High	Extreme	Extreme
UNLIKELY	Low	Low	Medium	High	Extreme
RARE	Very low	Low	Medium	High	High
VERY RARE	Very low	Very low	Low	Medium	High
EXTREMELY RARE	Very low	Very low	Low	Medium	High

risk framework and context. For example, a flood risk assessment may include a plot of increasing economic damage for increasing magnitudes of flooding.

Plots of risks can be useful in visualising the risk profile, as well as for identifying outliers in risk levels. Such outliers may prompt a review of the data that led to the particular risk level or the identification of particular weaknesses in controls.

The risk level, together with the confidence in the overall assessment process and other factors, will determine the need for additional detailed assessment and inform the treatment of risks.

All identified and analysed risks should be evaluated.

6.7 Confidence

The outputs generated by the risk assessment are used to determine possible action. Before decisions are made, however, the study team needs an indication of the robustness of the risk assessment approach. To achieve this, the level of confidence in the risk assessment process is used to identify and communicate uncertainty.

Assessing confidence helps to avoid misleading results, because influences in the process (e.g. subjective perceptions or lack of data) can be identified and addressed. Assessing confidence also addresses decision makers' concerns for whether there is a need for more detailed risk assessment.

Confidence refers to the:

- reliability, relevance and currency of the evidence used to support the consequence and likelihood assessments
- use of appropriate expertise as part of the risk assessment process to assign the consequence and likelihood levels
- level of agreement between stakeholders.

Confidence must be assessed at least once for each risk assessed. Confidence assessments can refer to the risk level, or independently to the likelihood and consequence levels. Accordingly, there are two options assessing confidence:

- a single overall confidence assessment
- separate confidence assessments of likelihood and consequence, which can then be used to derive an overall confidence level.

Table 12 describes levels of confidence. To assist in confidence assessments, a descriptor has been added.

The levels for each of the above confidence criteria will help rate confidence in the overall risk assessment process and determine where improvements in confidence could be made.

Confidence levels are to be recorded in the risk register.

Single overall confidence assessment

To determine a confidence level using the risk rating, a separate assessment is made for supporting evidence, expertise and participant agreement. Each assessment is then rated using the criteria in Table 12 and the lowest rating of the three assessed confidence levels determines the overall confidence rating in the risk.

Separate confidence assessments of consequence and likelihood

To determine a confidence level separately for the consequence and likelihood levels, separate assessments are made for supporting evidence, expertise and participant agreement against the consequence and likelihood levels. Each assessment is then rated using the criteria in Table 12 and the lowest rating of the three assessed confidence levels for each of the consequence and likelihood levels are combined using Table 13 to determine the overall confidence level for the risk.

Table 12: Confidence level descriptions

CONFIDENCE LEVEL	DESCRIPTOR	SUPPORTING EVIDENCE	EXPERTISE	PARTICIPANT AGREEMENT
HIGHEST	Assessed likelihood, consequence or risk is easily assessed to one level, with almost no uncertainty	<p>Recent historical event of similar magnitude to that being assessed in the community of interest</p> <p>Quantitative modelling and analysis of highest quality and length of data relating directly to the affected community, used to derive results of direct relevance to the scenario being assessed</p>	<p>Risk assessment team contains relevant and demonstrated technical expertise in the field being assessed, and experience in data and/or modelling of direct relevance to the scenario being assessed, and</p> <p>Technical expertise is highly influential in the decisions of the risk assessment team</p>	Agreement among participants on the assessment of levels of likelihood, consequence or risk
HIGH	Assessed likelihood, consequence or risk has only one level, but with some uncertainty in the assessment	<p>Recent historical event of similar magnitude to that being assessed in a directly comparable community of interest</p> <p>Quantitative modelling and analysis uses sufficient quality and length of data to derive results of direct relevance to the event being assessed</p>	<p>Risk assessment team contains relevant technical expertise in the field being assessed, and experience with data and/or modelling relating to the event being assessed, and</p> <p>Technical expertise is highly influential in the decisions of the risk assessment team</p>	Disagreement on only minor aspects, which have little effect on the assessment of levels of likelihood or consequence
MODERATE	Assessed likelihood, consequence or risk could be one of two levels, with significant uncertainty	<p>Historical event of similar magnitude to that being assessed in a comparable community of interest</p> <p>Quantitative modelling and analysis with reasonable extrapolation of data required to derive results of direct relevance to the event being assessed</p>	<p>Risk assessment team contains relevant technical expertise in the field being assessed, and experience in data and/or modelling of relevance to the event being assessed, and</p> <p>Technical expertise is used by the risk assessment team</p>	Disagreement on significant issues, which would lead to different levels of likelihood or consequence depending on which argument was followed

CONFIDENCE LEVEL	DESCRIPTOR	SUPPORTING EVIDENCE	EXPERTISE	PARTICIPANT AGREEMENT
LOW	Assessed likelihood, consequence or risk could be one of three or more levels, with major uncertainty	Some comparable historical events through anecdotal information Quantitative modelling and analysis with extensive extrapolation of data required to derive results of relevance to the event being assessed	Risk assessment team contains technical expertise related to the field being assessed Technical expertise is taken into account by the risk assessment team	Disagreements on fundamental issues relating to the assessment of likelihood or consequence, which would lead to a range of rating levels
LOWEST	Assessed likelihood, consequence or risk could be one of four or more levels, with fundamental uncertainty	No historical events or quantitative modelled results to support the levels	No relevant technical expertise is available to the team for analysis	Fundamental disagreement on levels of likelihood, consequence or risk, with little prospect of agreement

Table 13: Likelihood–consequence confidence matrix

CONFIDENCE IN LIKELIHOOD	CONFIDENCE IN CONSEQUENCE				
	LOWEST	LOW	MODERATE	HIGH	HIGHEST
HIGHEST	Moderate	Moderate	High	Highest	Highest
HIGH	Moderate	Moderate	Moderate	High	Highest
MODERATE	Low	Moderate	Moderate	Moderate	High
LOW	Lowest	Low	Moderate	Moderate	Moderate
LOWEST	Lowest	Lowest	Low	Moderate	Moderate

7 Risk evaluation

Risk evaluation is the third phase of the risk assessment process.

Risk evaluation helps to decide which risks may require further detailed assessment or treatment, and prioritises measures to reduce risk levels.

7.1 Risk priority

The outcome of the risk evaluation process is to assign a priority to each risk, based on the risk level and confidence associated with that risk. The priority is a level from 1 (highest priority, requiring the highest level of attention) to 5 (lowest priority, requiring monitoring and maintenance of existing controls).

Prioritisation of risks guides practitioners and sponsors to the order in which risks need to be addressed. The response to a level of priority is to:

- improve the confidence level of the risk (if possible) through research, further expert opinion or further studies (Section 6.7)
- treat the risk by taking action to reduce the likelihood or consequence of the risk (Section 8)
- monitor and review the risk as part of the ongoing risk management process (Section 9).

General descriptors for each priority are included in Table 14 but should be described more fully in the framework and context of each risk assessment.

Priority is determined by:

- the risk level (higher risk level leads to higher priority)
- the level of confidence (lower confidence leads to higher priority).

The level of confidence in the risk assessment (Section 6.7) is used to select the table that is used to determine priority. For example, a risk with a major consequence and rare likelihood that has been assessed with the highest level of confidence would result in a risk priority of 3. If the same risk was assessed with a low level of confidence, the result would be a priority of 2. The higher priority at low confidence reflects the lesser degree of robustness in the assessment at lower confidence levels.

Table 14: Priority descriptions

PRIORITY	GENERAL DESCRIPTOR: ACTION PATHWAY
1	Highest priority for further investigation and/or treatment, and the highest authority relevant to context of risk assessment must be formally informed of risks. Each risk must be examined, and any actions of further investigation and/or risk treatment are to be documented, reported to and approved by that highest authority.
2	High priority for further investigation and/or treatment, and the highest authority relevant to context of risk assessment should be formally informed of risks. Further investigations and treatment plans should be developed.
3	Medium priority for further investigation and/or treatment. Actions regarding investigation and risk treatment should be delegated to appropriate level of organisation, and further investigations and treatment plans may be developed.
4	Low priority for further investigation and/or treatment. Actions regarding investigation and risk treatment should be delegated to appropriate level of organisation, and further investigations and treatment plans may be developed.
5	Broadly acceptable risk. No action required beyond monitoring of risk level and priority during monitoring and review phase.

The following matrices (Tables 15–19) are used to determine the level of priority, based on the level of overall confidence for the risk, and the likelihood and consequence levels.

Table 15: Priority levels at highest confidence

LIKELIHOOD	CONSEQUENCE				
	INSIGNIFICANT	MINOR	MODERATE	MAJOR	CATASTROPHIC
ALMOST CERTAIN	4	4	3	2	1
LIKELY	5	4	4	2	2
UNLIKELY	5	5	4	3	2
RARE	5	5	5	3	3
VERY RARE	5	5	5	4	3
EXTREMELY RARE	5	5	5	4	4

Table 16: Priority levels at high confidence

LIKELIHOOD	CONSEQUENCE				
	INSIGNIFICANT	MINOR	MODERATE	MAJOR	CATASTROPHIC
ALMOST CERTAIN	4	3	2	1	1
LIKELY	4	4	3	2	1
UNLIKELY	5	4	3	2	2
RARE	5	5	4	3	2
VERY RARE	5	5	4	3	3
EXTREMELY RARE	5	5	5	4	3

Table 17: Priority levels at moderate confidence

LIKELIHOOD	CONSEQUENCE				
	INSIGNIFICANT	MINOR	MODERATE	MAJOR	CATASTROPHIC
ALMOST CERTAIN	3	3	2	1	1
LIKELY	4	3	2	1	1
UNLIKELY	4	4	3	2	1
RARE	5	4	3	2	2
VERY RARE	5	5	4	3	2
EXTREMELY RARE	5	5	4	3	3

Table 18: Priority levels at low confidence

LIKELIHOOD	CONSEQUENCE				
	INSIGNIFICANT	MINOR	MODERATE	MAJOR	CATASTROPHIC
ALMOST CERTAIN	3	2	1	1	1
LIKELY	3	3	2	1	1
UNLIKELY	4	3	2	1	1
RARE	4	4	3	2	1
VERY RARE	5	4	3	2	2
EXTREMELY RARE	5	5	4	3	2

Table 19: Priority levels at lowest confidence

LIKELIHOOD	CONSEQUENCE				
	INSIGNIFICANT	MINOR	MODERATE	MAJOR	CATASTROPHIC
ALMOST CERTAIN	2	2	1	1	1
LIKELY	3	2	1	1	1
UNLIKELY	3	3	2	1	1
RARE	4	3	2	1	1
VERY RARE	4	4	3	2	1
EXTREMELY RARE	5	4	3	2	2

7.2 Decision point

At this phase, the process has generated a comprehensive risk register, which has undergone scrutiny during the analysis and review during the evaluation. A decision is now required on whether any further action is to be taken for each risk. The following issues need to be considered in relation to each risk, taking into account any external factors that could have affected the assessment and the confidence level:

- the urgency of risk treatment (i.e. whether there is sufficient time to undertake further detailed analysis)
- whether the confidence level of the risk can realistically be improved
- whether an improvement in confidence through further investigation or research would result in a different priority
- whether a different priority would change the management response.

Further analysis should be considered if:

- the proposed treatment may have an adverse effect on the behaviour of the hazard, which may result in increases in risk in areas beyond the influence of the treatment and, potentially, result in a different decision being made. For example, an increase in risk due to a treatment option may result in the need for trade-offs in treatment, redesign of treatment or compensatory measures to address these increases in risk
- it will increase the confidence in the risk assessment and, potentially, result in a different decision being made.

At the end of this phase, each evaluated risk is assigned to one of the following categories:

- **Category 1: Risks requiring treatment (with confidence to determine treatment objectives).** For these risks, the risk assessment is completed because they are required to be treated and the information contained in the risk register provides guidance to determine treatment objectives.
- **Category 2: Risks requiring further analysis and subsequent re-evaluation.** For these risks, the risk assessment continues in the form of a revised baseline assessment or a detailed assessment, which will then lead to a re-analysis and re-evaluation of the risk.
- **Category 3: Risks (currently) requiring ongoing monitoring and maintenance of existing controls.** These risks will be subject to monitoring and review during the ongoing risk management process.

To make a decision on further actions for each risk, the following questions need to be answered.

1. Does the risk need to be treated urgently?

The time and expense required to undertake further analysis may be outweighed by the urgency to treat the risk. If this is the case, then the urgency for treatment is documented and the risk categorised as if its confidence cannot be improved. Note that risks that are broadly acceptable (Priority 5) do not need to be treated urgently.

No: If the risk does not need to be treated urgently, then question 2 should be answered.

Yes: If the risk needs to be treated urgently, then question 1.1 should be answered (see Figure 10).

1.1. Will the treatment alter the behaviour of the hazard and could this have adverse consequences outside the treated area?

Treatments can have adverse effects on the behaviour of the hazard, which may result in increases in risk in areas beyond the influence of the treatment. Such impacts may result in a different decision being made.

No: If the treatment does not alter the behaviour of the hazard, then further analysis is not required and the risk is to have a treatment plan considered (Category 1).

Yes: If the treatment alters the behaviour of the hazard and this has adverse consequences outside the treated area, then question 2 should be answered.

2. Can the confidence level of the risk be reasonably improved?

The confidence level for risks will not always be able to be improved to the highest level, particularly for low-probability, high-consequence events with limited supporting information. A judgement regarding the highest level of confidence that can reasonably be achieved is a necessary step. This determines whether the level of confidence can be improved or not.

Yes: If the confidence level of the risk can be reasonably improved, then question 3 should be answered.

No: If the confidence level of the risk cannot be reasonably improved, then further analysis is not required and the risk is categorised as follows:

- If the risk has a priority of 1–4, then a treatment plan should be considered (Category 1).
- If the risk has a priority of 5, then no treatment needs to be considered (Category 3).

3. If the confidence level of the risk were improved, would the priority be affected?

A simulation can be done using the priority tables to determine whether the priority would improve with an improved confidence.

Yes: If the priority level of the risk would be affected, then question 4 should be answered.

No: If the priority level of the risk would not be affected, then further analysis is not required and the risk is categorised as follows:

- If the risk has a priority of 1–4, then a treatment plan should be considered (Category 1).
- If the risk has a priority of 5, then no treatment needs to be considered (Category 3).

4. If the confidence of the risk were improved, would a different decision be made regarding its treatment and management?

The judgement to be made here is whether a different course of action (in priority and risk treatment) would result from further analysis. This is a 'reality check' question that determines whether the time and expense of further analysis is justified.

Yes: If a different decision would be made, then further analysis is warranted (Category 2).

No: If a different decision would not be made, then further analysis is not required and the risk is categorised as follows:

- If the risk has a priority of 1–4, then a treatment plan should be considered (Category 1).
- If the risk has a priority of 5, then no treatment needs to be considered (Category 3).

Figure 10 illustrates the decisions that determine risk categorisation.

7.3 Risk ranking

When the risk assessment is complete (identification, analysis and evaluation), it is generally desirable to rank risks so the risk assessors understand which risks should be considered first, second third etc for treatment planning and/or further assessment

The agency or organisation with responsibility for the risk assessment has primary responsibility to determine which risks need to be addressed in what order, if any.

The suggested process for ranking risk is:

1. Rank risks by Priority (Priority 1 is the highest, 5 is the lowest)

2. Within each of the 5 levels of Priority, rank by Category (Category 1 is highest priority, to treat risks, etc)

3. Within each 3 Categories, rank by risk level (Extreme risk is the highest, Very Low Risk is the lowest)

The possible combinations of Priority, Category and Risk Level in the sections above results in a total of 27 possible rankings of risk, as shown in Table 20 below.

If necessary, within each of the rankings, it may be necessary to rank one type of consequence over another. For example, in an emergency management context, an organisation may choose to prioritise risks to People for treatment over risk to the Environment.

These rankings are intended only as a guide to prioritise actions. The organisation undertaking the risk assessment may wish to undertake actions in a different order as they decide to be appropriate.

If there are a large number of risks, lower ranks could also be disregarded to allow an organisation to focus on the higher ranking ones.

For example, Priority 4 and 5 Risks, and/or Low and Very Low Risks, could be disregarded to allow a focus on the Priority 1 and 2, Extreme, High and Medium risks, if the organisation decides it is appropriate.

Where an organisation makes decisions to address certain risks over others, these decisions, and the reasoning behind them, should be documented and reported to assist in future monitoring and review of the risk assessments.

The possible combinations of Priority, Category and Risk Level in the sections above results in a total of 27 possible rankings of risk, as shown in Table 20 below.

If necessary, within each of the rankings, it may be necessary to rank one type of consequence over another. For example, in an emergency management context, an organisation may choose to prioritise risks to People for treatment over risk to the Environment.

These rankings are intended only as a guide to prioritise actions. The organisation undertaking the risk assessment may wish to undertake actions in a different order as they decide to be appropriate.

If there are a large number of risks, lower ranks could also be disregarded to allow an organisation to focus on the higher ranking ones.

For example, Priority 4 and 5 Risks, and/or Low and Very Low Risks, could be disregarded to allow a focus on the Priority 1 and 2, Extreme, High and Medium risks, if the organisation decides it is appropriate.

Where an organisation makes decisions to address certain risks over others, these decisions, and the reasoning behind them, should be documented and

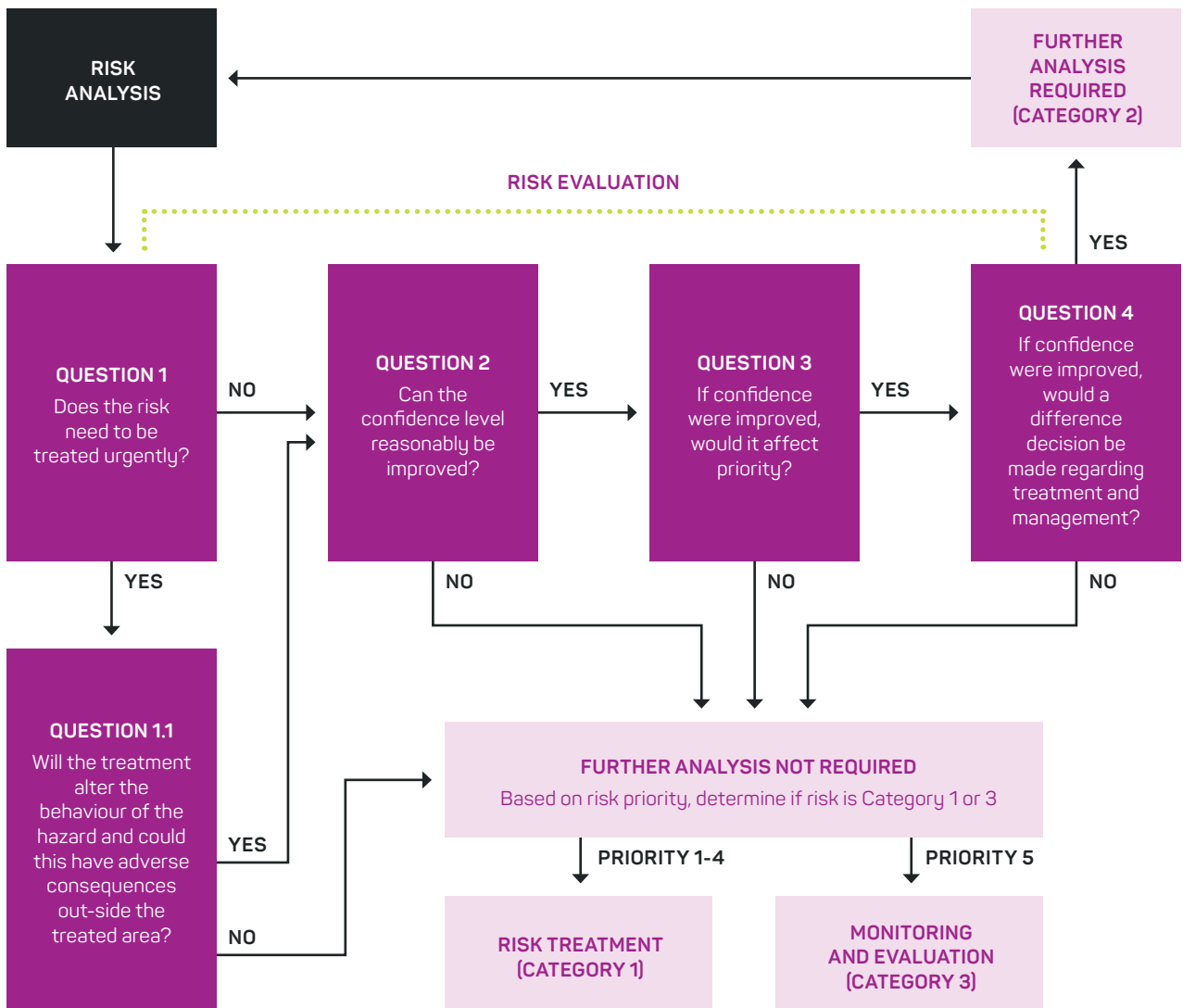


Figure 9: Decision point questions

Table 20: Suggested Ranking of Risks to guide treatment and further analysis activities

PRIORITY	CATEGORY	RISK LEVEL	RANKING
1	1	Extreme	1
1	1	High	2
1	2	Extreme	3
1	2	High	4
2	1	Extreme	5
2	1	High	6
2	1	Medium	7
2	2	Extreme	8
2	2	High	9
2	2	Medium	10
3	1	High	11
3	1	Medium	12
3	1	Low	13
3	2	High	14
3	2	Medium	15
3	2	Low	16
4	1	High	17
4	1	Medium	18
4	1	Low	19
4	1	Very Low	20
4	2	High	21
4	2	Medium	22
4	2	Low	23
4	2	Very Low	24
5	3	Medium	25
5	3	Low	26
5	3	Very Low	27

reported to assist in future monitoring and review of the risk assessments.

7.4 Risk register

The completed risk register gives a summary of all the decisions taken during the risk management process. It describes which risks require the most critical attention and a recommended approach for further action.

For each risk, the complete risk register should include:

- a description that links a risk source to a consequence
- a statement of what controls are in place for that risk to prevent or mitigate its effects, and the adequacy and effectiveness of those controls (from very low to high)
- a consequence level (from insignificant to catastrophic)
- a likelihood level (from extremely rare to almost certain)
- a risk level (from very low to extreme)
- an overall confidence level for the risk (from lowest to highest)
- a priority for the risk (from priority 1 to priority 5)
- the risk type that recommends next steps following the risk assessment
 - Category 1: risk treatment planning needs to be undertaken
 - Category 2: further analysis of the understanding of the risk is recommended to improve confidence
 - Category 3: the risk is subject to ongoing monitoring and maintenance of existing controls.
- an indicative ranking of the risks to guide the order in which risks are to be addressed.

7.5 Detailed risk analysis

ISO 31000:2009 Risk management – principles and guidelines points out that 'in some circumstances, the risk evaluation may lead to a decision to undertake further analysis'.

Detailed analysis should be conducted on risks for which the analysis to date does not provide sufficient information for a reasonable decision to be made on the risk level or the efficacy of proposed treatment strategies, or where the risk treatment has the potential to have adverse effects on hazard behaviour that need to be considered in decision making. These are Category 2 risks in the decision point phase of the risk evaluation process (Section 7.2).

Detailed analysis may involve examining and researching a few key risks, or initiating a new risk assessment with a more focused context.

It is more likely that semi-quantitative or quantitative methods may be used at this phase, particularly if the treatments being considered are either expensive or will have a large, broad community impact.

Quantitative or semi-quantitative information, such as historical impacts or consequences of past emergency events, may be used to inform the risk analysis. Where records are available at an appropriate level of detail and for a sufficient time period, the detailed risk assessment may be conducted using quantitative data derived from historical records to inform the risk analysis, including the assessment of likelihood, consequence, confidence, risk level, priority and further action.

Hazard-specific assessment processes can be used to undertake detailed assessment, with the aim of improving confidence in a future assessment of the consequences and/or likelihood of the emergency event using the NERAG.

The results from the detailed assessment feed into risk assessments, with confidence levels that are potentially improved. After considering the further analysed risks, the risk study team finalises the assessment of the relevant risk(s) by re-evaluating them.

The re-evaluation of the risk(s) should include specialists in detailed assessment to compare the two sets of results. Re-analysis and re-evaluation of the risk(s) must be recorded in the risk register.

8 Risk treatment

When the risk assessment is completed, decisions on what to do about the risks need to be made. Compared with risk assessment, treating the risks is a related but distinct process and needs to be incorporated into the risk management framework. This section provides an indicative approach to risk treatment.

While the NERAG provides guidance as to the priority and need to treat risks, decision makers are responsible for treatment planning and would normally use their own relevant decision-making framework (refer to Section 2.3).

8.1 Risk treatment process

Risk treatment aims to determine and implement the most effective action(s). A risk treatment, in essence, results in the partial or complete removal of a risk source or some improvement in the controls to reduce the level of risk.

To ensure that the causes of the risks are treated, rather than just the symptoms, a comprehensive understanding of the risks, and the limits of efficiency and effectiveness of any treatment measures is required. Hence, information gathered and considered during the risk assessment process will have implications for risk treatment.

In general, a four-step process, outlined below, is used for risk treatment.

1. Formulating risk treatment objectives for identified risk treatment needs

Determine a risk-based objective of the treatment – for example, to reduce the risk to a certain level. In practice, achieving such objectives will require removing hazards or improving risk controls. This may consider:

- scenario dynamics as developed in the risk identification phase
- control opportunities (implementation of new controls or improvements to existing ones) considered during risk analysis and risk evaluation
- risk categorisation during the risk evaluation.

2. Identifying and developing options for risk treatment

To meet the objective, a series of options can be considered and can include one or more of:

- avoiding the risk
- removing a risk source
- changing the likelihood of
 - an initiating event or source of risk happening
 - a hazard affecting elements at risk
 - consequences occurring should a source of risk cause a hazard to affect elements at risk
- sharing the risk
- retaining the risk by informed decision.

3. Evaluating risk treatment options

Determine a method for evaluating the treatment options. This could be based on:

- performing a first-pass cost-benefit analysis (refer to *SA/SNZ HB 89:2013 Risk management – guidelines on risk assessment techniques*)
- considering treatment effectiveness and any limitations
- assessing impacts of treatments on hazard behaviour and the management of these
- revisiting and/or extending risk analysis
- accepting any residual risks and what to do about them

In general, the selection of treatment options will be based on the trade-off between the level of risk and the cost of reducing the risk, using a variety of tools and subsequent sensitivity tests. Where the treatment options are expensive, difficult or lengthy to implement, or not popular with the local community, further detailed analysis of treatment options to achieve the desired modification or reduction of risk should be considered.

In treatment planning, careful consideration should be given to the potential secondary or consequential impacts of treatment options.

4. Developing the risk treatment plan and acceptance of residual risks

The purpose of the treatment plan is to document how the chosen options will be implemented. The treatment plan should include:

- details on why particular treatments were selected
- anticipated benefits from treatment actions
- proposed actions
- resource requirements
- responsibilities
- timing and schedule
- performance measures
- residual risks and the recommended management approach
- reporting and monitoring requirements.

Figure 10 describes the treatment planning process.

An important and discrete step in the treatment planning process is to assign responsibility for risk treatment actions. This may require direct bilateral consultation and negotiation between responsible entities. Example criteria for assessing risk treatment options can be found at the Australian Disaster Resilience Knowledge Hub.

The risk treatment process is described in detail in *AS/NZS ISO 31000:2009 Risk management – principles and guidelines* and *SA/SNZ HB 436:2013 Risk management guidelines - Companion to AS/NZS ISO 31000:2009*.

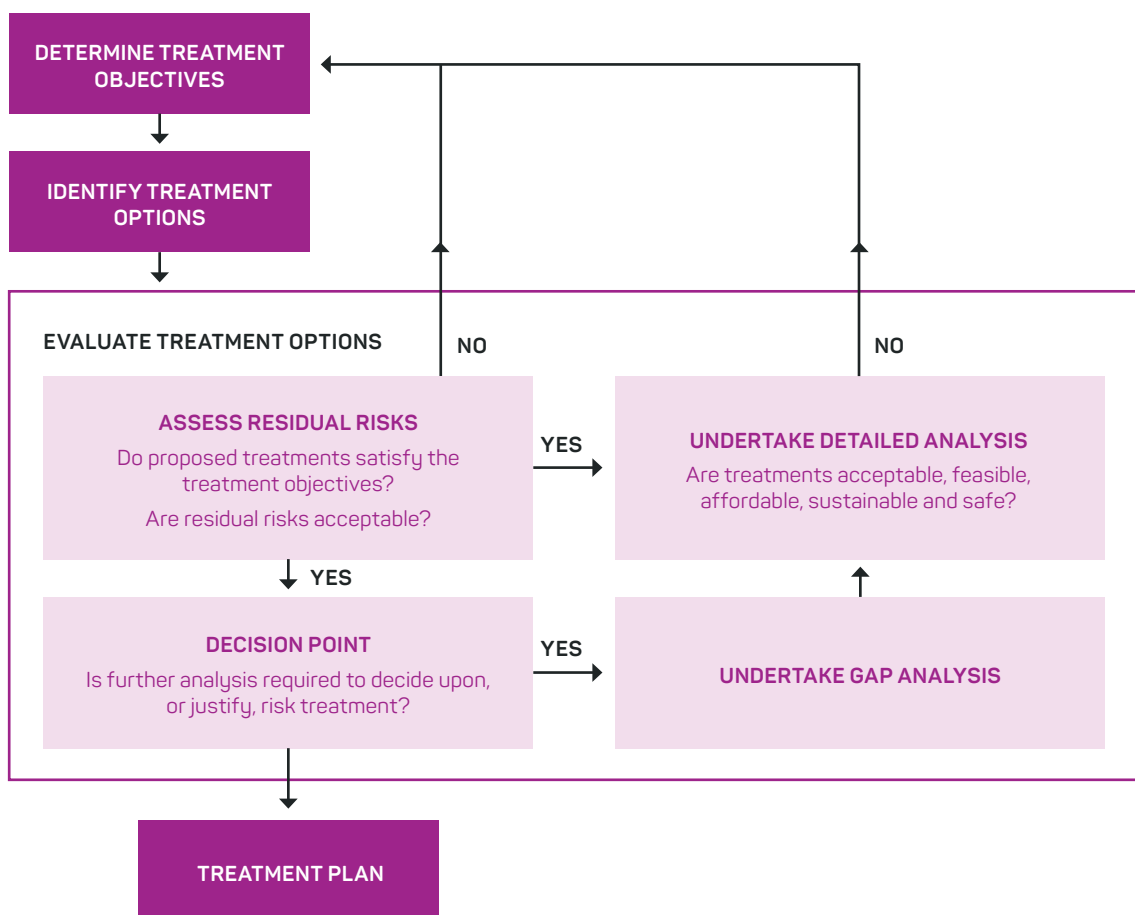


Figure 10: Treatment planning process

8.2 Further analysis for risk treatment

In planning a further analysis for risk treatment, a gap analysis is normally conducted to highlight deficiencies in information upon which to make a decision. This is particularly the case when treatment options have economic, financial, project or political implications.

The intent of a detailed analysis is to support decision making and to ensure that the benefit to the community outweighs the costs (this is a fundamental principle). Treatment of the risk should also be proportional to that risk. A sensitivity check on selected options will identify the most effective treatments and provide a degree of confidence in treatment decisions.

For government agencies, there may be state and national requirements that will influence the development of a planned detailed analysis of risk treatment options.

A number of quantitative approaches exist to assist in detailed analysis of risk treatment options, including:

- regulatory impact assessments
- cost–benefit analyses
- business compliance costs measurements
- effects on competition assessments

Detailed advice on some of these quantitative approaches is included in the appendixes to Best practice regulation: a guide for ministerial councils and national standard setting bodies (COAG 2007).

8.3 Risk register

A summary of any treatment plans, or at least the options for treatment, should be recorded on the risk register.

9 Monitoring and review

As part of the risk management process, a timeline for monitoring and reviewing the outcomes of the process need to be programmed, and responsibilities defined. These need to be included in all elements of the risk management framework.

The nature of emergency risk changes over time. This includes shifting of priorities, perception and culture. As a result, the risk assessment needs to be updated regularly to ensure that it is current and the recommended priorities remain relevant.

The monitoring and review process should be documented as part of reporting the risk register and risk management plan, including:

- ensuring the identified controls are operating effectively and adequately, and have not changed over time
- ensuring the best and most up-to-date available information is used as evidence for the likelihood, consequence and confidence levels
- incorporating information from emergency events that may have occurred since the last risk assessment
- accounting for changes in the context of the risk assessment
- identifying and accounting for emerging risks.

10 Recording and reporting

As part of the risk management process, all outcomes need to be documented, and reported to the organisation through mechanisms defined during the scope, context and criteria phase to:

- communicate the outcomes of the risk management process across the organisation and stakeholders
- provide information to support decision making
- improve risk management activities and the risk management framework
- provide a record for future monitoring and review.



Part C: Appendices

Appendix A: Types of stakeholder engagement

Table 21: Types of stakeholder engagement, and example tools and processes

PROCESS	GOAL: INFORMATION	GOAL: PARTICIPATION	GOAL: CONSULTATION	GOAL: COLLABORATION	GOAL: EMPOWERMENT
DESCRIPTION	<p>Sharing information between stakeholders to come to a mutual understanding</p> <p>Everyone is informed and able to take responsibility for decisions and actions</p>	<p>Building connected networks and relationships, ownership and trust through active involvement</p>	<p>Sharing information, questions or positions to obtain ideas, feedback, knowledge or an understanding of objectives and expectations</p>	<p>Partnering to support action, including developing alternatives and identifying a preferred solution</p>	<p>Partnering to understand risk, accept responsibility and implement initiatives</p>

PROCESS	GOAL: INFORMATION	GOAL: PARTICIPATION	GOAL: CONSULTATION	GOAL: COLLABORATION	GOAL: EMPOWERMENT
YOUR PROMISE	<p>You will keep stakeholders informed during the identified phase of the process</p> <p>The information you share will be relevant, accurate, targeted, credible and consistent</p> <p>The information you share is broadly accessible and provided through a variety of channels</p> <p>You will not expect stakeholders to respond unless they wish to</p> <p>Key messages are repeated</p>	<p>You will provide the opportunity to actively involve stakeholders in actions that potentially affect or interest them</p> <p>You will create a variety of ways in which stakeholders can be involved</p> <p>Stakeholders will have opportunities to connect with each other</p> <p>You will provide opportunities for stakeholders to remain involved</p>	<p>You will ask for feedback, and listen to and acknowledge stakeholder ideas and concerns</p> <p>You will allow sufficient time for stakeholders to consider an issue and provide input</p> <p>You will keep stakeholders informed</p> <p>Stakeholders' feedback will be considered in your decisions and actions</p> <p>You will communicate how stakeholder input influenced decisions and actions</p>	<p>You will seek involvement of all who are affected by or interested in an issue</p> <p>You will come to a shared understanding about situations and issues</p> <p>You will seek participants' active involvement in creating solutions</p> <p>You will come to a shared agreement with participants about the way forward</p>	<p>You will create the space for joint action and inclusion</p> <p>You will embrace participants' active involvement</p> <p>You will create the space for embedding sustainable practice</p> <p>You will support capacity building among participants</p>
EXAMPLE TOOLS AND PROCESSES	<p>Fact sheets</p> <p>Interactive video display kiosks</p> <p>Media release</p> <p>Public meeting</p>	<p>Field trip</p> <p>Focus groups</p> <p>Mind mapping</p> <p>Scenario testing</p> <p>World café</p>	<p>Brainstorming</p> <p>Briefings</p> <p>Focus groups</p> <p>Submissions</p> <p>Surveys</p>	<p>Appreciative enquiry</p> <p>Mind mapping</p> <p>Scenario testing</p> <p>Workshops</p>	<p>Deliberative democracy processes</p> <p>Gallery walk</p> <p>Scenario testing</p> <p>Workshops</p>

Appendix B: Risk register template

Date: [insert date]

Objective: [insert objective]

Scope: [insert scope]

Risk: [fill out Tables 21–23]

Table 22: Risk identification

RISK NO.	RISK DESCRIPTION (Section 5.3)	SOURCE OF RISK (Section 5.2 and 5.3)	CONSEQUENCE CATEGORY (Section 6.4)	PREVENTION AND PREPAREDNESS CONTROLS (Section 5.4)	RESPONSE AND RECOVERY CONTROLS (Section 5.4)
1					
2					
3.1					
3.2					

Table 23: Risk analysis

RISK NO.	LEVEL OF PREVENTION AND PREPAREDNESS CONTROL(S) (Section 6.2)	LEVEL OF RESPONSE AND RECOVERY CONTROL(S) (Section 6.2)	CONSEQUENCE LEVEL (Section 6.4)	LIKELIHOOD LEVEL (Section 6.5)	RISK LEVEL (Section 6.6)	CONFIDENCE LEVEL (Section 6.7)
1						
2						
3.1						
3.2						

Table 24: Risk evaluation

RISK NO.	RISK PRIORITY (SECTION 7.1)	RISK CATEGORY (SECTION 7.2)	TREATMENT PLAN(S) (SECTION 8) (IF APPLICABLE)
1			
2			
3.1			
3.2			

Appendix C: Control, consequence and likelihood tables

Controls

Table 25: Qualitative descriptors of control strength and expediency

LEVEL	CONTROL STRENGTH	CONTROL EXPEDIENCY
HIGH	Control is highly effective in reducing the level of risk	<p>The control is frequently applied.</p> <p>A procedure to apply the control is well understood and resourced.</p> <p>The cost of applying the control is within current resources and budgets.</p>
MEDIUM	Control is effective in reducing the level of risk	<p>The control is infrequently applied and is outside of the operators' everyday experience.</p> <p>The use of the control has been foreseen and plans for its application have been prepared and tested.</p> <p>Some extraordinary cost may be required to apply the control.</p>
LOW	Control has some effect in reducing the level of risk	<p>The control is applied rarely and operators may not have experience using it.</p> <p>The use of the control may have been foreseen and plans for its application may have been considered, but it is not part of normal operational protocols and has not been tested.</p> <p>Extraordinary cost is required to apply the control, which may be difficult to obtain.</p>
VERY LOW	Control has almost no effect in reducing the level of risk	<p>Application of the control is outside of the experience and planning of operators, with no effective procedures or plans for its operation.</p> <p>It has not been foreseen that the control will ever need to be used.</p> <p>The application of the control requires significant cost over and above existing resources, and the cost will most likely be objected to by a number of stakeholders.</p>

Table 26: Level of existing control matrix

CONTROL STRENGTH ^a	CONTROL EXPEDIENCY ^b			
	VERY LOW	LOW	MEDIUM	HIGH
HIGH	Low	Medium	Medium	High
MEDIUM	Low	Medium	Medium	Medium
LOW	Very low	Low	Medium	Medium
VERY LOW	Very low	Very low	Low	Low

a How well does the control reduce the risk?

b How easily can the control be activated and used?

Consequences

Table 27: People consequence levels and criteria

LEVEL	CRITERIA	
	DEATH	INJURY OR ILLNESS
CATASTROPHIC	Deaths directly from emergency greater than 1 in 10,000 people for population of interest	Critical injuries with long-term or permanent incapacitation greater than 1 in 10,000 people for population of interest
MAJOR	Deaths directly from emergency greater than 1 in 100,000 people for population of interest	Critical injuries with long-term or permanent incapacitation greater than 1 in 100,000 people for population of interest, or Serious injuries greater than 1 in 10,000 people for population of interest
MODERATE	Deaths directly from emergency greater than 1 in 1,000,000 people for population of interest	Critical injuries with long-term or permanent incapacitation greater than 1 in 1,000,000 people for population of interest, or Serious injuries greater than 1 in 100,000 people for population of interest
MINOR	Deaths directly from emergency greater than 1 in 10,000,000 people for population of interest	Critical injuries with long-term or permanent incapacitation greater than 1 in 10,000,000 people for population of interest, or Serious injuries greater than 1 in 1,000,000 people for population of interest
INSIGNIFICANT	Deaths directly from emergency greater than 1 in 10,000,000 people for population of interest	Critical injuries less than 1 in 10,000,000 people for population of interest, or Serious injuries less than 1 in 1,000,000 people for population of interest, or Minor injuries to any number of people

Table 28: Injury and illness scale

INJURY SEVERITY	DESCRIPTION
FATAL	Mortally injured, is certain to lead to death regardless of available treatments Counted among deaths, not injuries
CRITICAL	Injuries that pose an immediate life-threatening condition if not treated adequately and expeditiously Examples include uncontrolled bleeding, a punctured organ, other internal injuries, spinal column injuries or crush syndrome
SERIOUS	Injuries requiring a greater degree of medical care and use of medical technology such as X-rays or surgery, but not expected to progress to life-threatening status Examples include full thickness burns across a large part of the body or partial thickness burns to most of the body, loss of consciousness, fractured bones, dehydration or exposure
MINOR	Injuries requiring basic medical aid that could be administered by paraprofessionals, which would require bandages or observation Examples include a sprain, a severe cut requiring stitches, a minor burn (partial thickness on a small part of the body) or a bump on the head without loss of consciousness

Table 29: Economic consequence levels and criteria

LEVEL	CRITERIA	
	LOSS IN ECONOMIC ACTIVITY AND/OR ASSET VALUE	IMPACT ON IMPORTANT INDUSTRY
CATASTROPHIC	Decline of economic activity, and/or Loss of asset value greater than 4% of gross product produced by the area of interest	Failure of a significant industry or sector in area of interest as a direct result of emergency event
MAJOR	Decline of economic activity, and/or Loss of asset value greater than 0.4% of gross product produced by area of interest	Significant structural adjustment required by identified industry to respond and recover from emergency event
MODERATE	Decline of economic activity, and/or Loss of asset value greater than 0.04% of gross product produced by area of interest	Significant industry or business sector is significantly impacted by the emergency event, resulting in medium-term (i.e. more than one year) profit reductions directly attributable to the event
MINOR	Decline of economic activity, and/or Loss of asset value greater than 0.004% of gross product produced by area of interest	Significant industry or business sector is impacted by the emergency event, resulting in short-term (i.e. less than one year) profit reductions directly attributable to the event
INSIGNIFICANT	Decline of economic activity, and/or Loss of asset value less than 0.004% of gross product produced by area of interest	Inconsequential business sector disruption due to emergency event

Table 30: Environmental consequence levels and criteria

LEVEL	CRITERIA	STATE OR NATIONAL RISK DESCRIPTION	REGIONAL RISK DESCRIPTION	LOCAL RISK DESCRIPTION
CATASTROPHIC	Loss of species and/or landscapes	Permanent destruction of an ecosystem or species recognised at the national level	Permanent destruction of an ecosystem or species recognised at the national or state level, and/or Severe damage to or loss of an ecosystem or species recognised at the national level	Permanent destruction of an ecosystem or species recognised at the local, regional, state or national level, and/or Severe damage to or loss of an ecosystem or species recognised at the national or state level, and/or Significant loss or impairment of an ecosystem or species recognised at the national level
	Loss of environmental value	Permanent destruction of environmental values of interest	Permanent destruction of environmental values of interest	Permanent destruction of environmental values of interest
MAJOR	Loss of species and/or landscapes	Severe damage to or loss of an ecosystem or species recognised at the national level, and/or Permanent destruction of an ecosystem or species recognised at the state level	Permanent destruction of an ecosystem or species recognised at the local/regional level, and/or Severe damage to or loss of an ecosystem or species recognised at the state level, and/or Significant loss or impairment of an ecosystem or species recognised at the national level	Minor damage to ecosystems or species recognised at the national level, and/or Significant loss or impairment of an ecosystem or species recognised at the state level, and/or Severe damage to or loss of an ecosystem or species recognised at the local or regional level
	Loss of environmental value	Severe damage to environmental values of interest	Severe damage to environmental values of interest	Severe damage to environmental values of interest

LEVEL	CRITERIA	STATE OR NATIONAL RISK DESCRIPTION	REGIONAL RISK DESCRIPTION	LOCAL RISK DESCRIPTION
MODERATE	Loss of species and/or landscapes	<p>Significant loss or impairment of an ecosystem or species recognised at the national level, and/or</p> <p>Severe damage to or loss of ecosystems and species recognised at the state level, and/or</p> <p>Permanent destruction of an ecosystem or species recognised at the local or regional level</p>	<p>Minor damage to ecosystems and species recognised at the national level, and/or</p> <p>Significant loss or impairment of an ecosystem or species recognised at the state level, and/or</p> <p>Severe damage to or loss of ecosystems and species recognised at the local/regional level</p>	<p>Minor damage to ecosystems and species recognised at the state level, and/or</p> <p>Significant loss or impairment of an ecosystem or species recognised at the local or regional level</p>
	Loss of environmental value	Significant damage to environmental values of interest	Significant damage to environmental values of interest	Significant damage to environmental values of interest
MINOR	Loss of species and/or landscapes	<p>Significant loss or impairment of an ecosystem or species recognised at the local and state levels, and/or</p> <p>Minor damage to ecosystems or species recognised at the national level</p>	<p>Significant loss or impairment of an ecosystem or species recognised at the local and regional levels, and/or</p> <p>Minor damage to ecosystems and species recognised at the state, local or regional level</p>	Minor damage to ecosystems and species recognised at the local or regional level
	Loss of environmental value	Minor damage to environmental values of interest	Minor damage to environmental values of interest	Minor damage to environmental values of interest
INSIGNIFICANT	Loss of species and/or landscapes	Minor damage to an ecosystem or species recognised at the local or regional scale	No damage to ecosystems at any level	No damage to ecosystems at any level
	Loss of environmental value	Inconsequential damage to environmental values of interest	Inconsequential damage to environmental values of interest	Inconsequential damage to environmental values of interest

Notes:

1. 'Ecosystem' includes the plant, animal and other species of that ecosystem, as well as the air, water and soil upon which those species depend.
2. 'Environmental value' includes environmental goods and services, including aesthetic and recreational facilities and resources.
3. 'Permanent destruction' means the pre-emergency condition has been lost. Although some degree of restoration may be possible, the pre-emergency condition cannot be restored.
4. 'Severe damage' means the ecosystem or species requires a major program of interventions and recovery to restore it to health. The asset or species has been or is likely to be permanently altered from its original state by the emergency event.
5. 'Significant loss or impairment' means the ecosystem or species requires a diversion of resources to manage their recovery from damage by the emergency event.
6. 'Minor damage' means the ecosystem or species is able to recover fully, with minimal or no intervention.

Table 31: Public administration consequence levels and criteria

LEVEL	CRITERIA
CATASTROPHIC	Governing bodies are unable to deliver their core functions
MAJOR	Governing bodies encounter severe reduction in the delivery of core functions Governing bodies are required to divert a significant amount of available resources to deliver core functions or seek external assistance to deliver the majority of their core functions
MODERATE	Governing bodies encounter significant reduction in the delivery of core functions Governing bodies are required to divert some available resources to deliver core functions or seek external assistance to deliver some of their core functions
MINOR	Governing bodies encounter limited reduction in delivery of core functions
INSIGNIFICANT	Governing bodies' delivery of core functions is unaffected or within normal parameters

Table 32: Social setting consequence levels and criteria

LEVEL	CRITERIA	
	LOSS OF COMMUNITY WELLBEING	LOSS OF CULTURALLY IMPORTANT OBJECTS AND ACTIVITIES
CATASTROPHIC	The community of interest's social connectedness is irreparably broken, such that the community ceases to function effectively, breaks down and disperses in its entirety	Widespread and permanent loss of objects of identified cultural significance Permanent cancellation of a major culturally important community activity
MAJOR	The community of interest's social connectedness is significantly broken, such that extraordinary external resources are required to return the community to functioning effectively, with significant permanent dispersal	Widespread damage or localised permanent loss of objects of identified cultural significance Temporary cancellation or significant delay to a major culturally important community event
MODERATE	The community of interest's social connectedness is broken, such that community requires significant external resources to return the community to functioning effectively, with some permanent dispersal	Damage or localised widespread damage to objects of identified cultural significance Delay to a major culturally important community event

MINOR	The community of interest's social connectedness is damaged, such that community requires some external resources to return the community to functioning effectively, with no permanent dispersal	Damage to objects of identified cultural significance Delay to or reduced scope of a culturally important community event
	The community of interest's social connectedness is disrupted, such that the reprioritisation/reallocation of existing resources is required to return the community to functioning effectively, with no permanent dispersal	Minor damage to objects of identified cultural significance Minor delay to a culturally important community event

Likelihoods

Table 33: AEP–ARI conversion table

ANNUAL EXCEEDANCE PROBABILITY (AEP)	AVERAGE RECURRENCE INTERVAL (ARI)
99.995% per year	0.1 year (average 10 events per year)
87% per year	0.5 year (average 2 events per year)
63% per year	1 year (average 1 event per year)
20% per year	5 years (average 1 event per 5 years)
10% per year	10 years (average 1 event per 10 years)
5% per year	20 years (average 1 event per 20 years)
2% per year	50 years (average 1 event per 50 years)
1% per year	100 years (average 1 event per 100 years)
0.5% per year	200 years (average 1 event per 200 years)
0.2% per year	500 years (average 1 event per 500 years)
0.1% per year	1000 years (average 1 event per 1000 years)
0.01% per year	10,000 years (average 1 event per 10,000 years)
0.001% per year	100,000 years (average 1 event per 100,000 years)
0.0001% per year	1,000,000 years (average 1 event per 1,000,000 years)

Table 34: Likelihood level

LIKELIHOOD	ANNUAL EXCEEDANCE PROBABILITY (AEP)	AVERAGE RECURRENCE INTERVAL (ARI) (INDICATIVE)	FREQUENCY (INDICATIVE)
ALMOST CERTAIN	63% per year or more	Less than 1 year	Once or more per year
LIKELY	10% to <63% per year	1 to <10 years	Once per 10 years
UNLIKELY	1% to <10% per year	10 to <100 years	Once per 100 years
RARE	0.1% to <1% per year	100 to <1000 years	Once per 1000 years
VERY RARE	0.01% to <0.1% per year	1000 to <10,000 years	Once per 10,000 years
EXTREMELY RARE	Less than 0.01% per year	10,000 years or more	Once per 100,000 years

Table 35: Qualitative risk matrix

LIKELIHOOD	CONSEQUENCE LEVEL				
	INSIGNIFICANT	MINOR	MODERATE	MAJOR	CATASTROPHIC
ALMOST CERTAIN	Medium	Medium	High	Extreme	Extreme
LIKELY	Low	Medium	High	Extreme	Extreme
UNLIKELY	Low	Low	Medium	High	Extreme
RARE	Very low	Low	Medium	High	High
VERY RARE	Very low	Very low	Low	Medium	High
EXTREMELY RARE	Very low	Very low	Low	Medium	High

Glossary

All-hazards approach

Dealing with all types of emergencies or disasters, and civil defence, using the same set of management arrangements.

Source: *Australian Emergency Manual 3: Australian emergency management glossary*

Annual exceedance probability (AEP)

The likelihood of an emergency event of a given size or larger occurring in a given year, usually expressed as a percentage.

Source: *Managing the Floodplain (AIDR 2017)*

Average recurrence interval (ARI)

A statistical estimate of the average period (usually in years) between the occurrence of an emergency event of a given size or larger.

The ARI of an emergency event gives no indication of when an emergency event of that size will next occur.

Source: *Managing the Floodplain (AIDR 2017)*

Communication and consultation

Continual and iterative processes that an organisation (or government) conducts to provide, share or obtain information, and to engage in dialogue with stakeholders regarding the management of risk.

Notes:

- The information can relate to the existence, nature, form, likelihood, significance, evaluation, acceptability and treatment of risk management.
- Consultation is a two-way process of informed communication between an organisation (or jurisdiction) and its stakeholders on an issue before making a decision or determining a direction on that issue. Consultation is
 - a process that affects a decision through influence rather than power
 - an input to decision making, not joint decision making.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Community preparedness

The degree of plans in place by communities, households and individuals that, when implemented, can reduce the adverse effects of emergency events.

Source: *Community Recovery (AIDR 2018)*

Confidence

The trustworthiness or reliability of the evidence that supports risk assessments.

Source: *Adapted from Macquarie dictionary online*

Consequence

The outcome of an event that affects objectives.

Notes:

- An event can lead to a range of consequences.
- A consequence can be certain or uncertain, and can have positive and negative effects on objectives.
- Consequences can be expressed qualitatively or quantitatively.
- Initial consequences can escalate through knock-on effects.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Control

A measure that is modifying risk.

Notes:

- Controls include any process, policy, device or action that modifies risk.
- Controls may not always exert the intended or assumed modifying effect.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Control expediency

The ability of the control to be used or deployed readily, and the level of acceptability to the stakeholders and community.

Source: *National Emergency Risk Assessment Guidelines*

Control strength

The ability of the control (or group of controls), when operating as intended and when required, to achieve its control objective.

Source: *National Emergency Risk Assessment Guidelines*

Disaster

A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic or environmental losses and impacts.

Source: *United Nations Office for Disaster Risk Reduction (UNDRR)*

Emergency

An event, actual or imminent, which endangers or threatens to endanger life, property or the environment, and which requires a significant and coordinated response. Note, there are jurisdictional legislative variations.

Source: *AIDR Glossary 2019*

Emergency management

A range of measures to manage risks to communities and the environment; the organisation and management of resources for dealing with all aspects of emergencies. Emergency management involves the plans, structures and arrangements which are established to bring together the normal endeavours of government, voluntary and private agencies in a comprehensive and coordinated way to deal with the whole spectrum of emergency needs including prevention, response and recovery (COAG 2011)

Source: *AIDR Glossary 2019*

Event

Occurrence or change of a particular set of circumstances.

Notes:

- An event can be one or more occurrences, and can have several causes.
- An event can consist of something not happening.

- An event can sometimes be referred to as an 'incident' or 'accident'.
- An event without consequences can also be referred to as a 'near miss', 'incident', 'near hit' or 'close call'.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Exposure

The elements within a given area that have been, or could be, subject to the impact of a particular hazard.

Note: Exposure is also sometimes referred to as the 'elements at risk'.

Source: *Geoscience Australia, 'Risk and impact analysis'*³

Hazard

A source of potential harm or a situation with a potential to cause loss.

A potential or existing condition that may cause harm to people, or damage to property or the environment.

A source of risk.

Source: *Australian Emergency Manual 3: Australian emergency management glossary*

Impact

To have a noticeable or marked effect on.

Source: *Macquarie online dictionary*

Key control

A control (or group of controls) that is believed to be maintaining an otherwise intolerable risk at a tolerable level.

Source: *Standards Australia HB 158:2010 Delivering assurance, based on ISO 31000:2009 Risk management – principles and guidelines*

Level of risk (or risk level)

Magnitude of a risk or a combination of risks, expressed in terms of the combination of consequences and their likelihood.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

³ *Geoscience Australia, 'Risk and impact analysis'*

Likelihood

Chance of something happening.

Note: In risk management terminology, 'likelihood' is used to refer to the chance of something happening, whether defined, measured or determined objectively or subjectively, qualitatively or quantitatively, and described using general terms or mathematically (such as a probability or a frequency during a given time period).

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Mitigation

Measures taken in advance of a disaster that aim to decrease or eliminate the disaster's impact on society and the environment.

Source: *AIDR Glossary 2013*

Monitoring

Continual checking, supervising, critically observing or determining the status to identify change from the performance level required or expected.

Note: Monitoring can be applied to a risk management framework, risk management process, risk or control.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Non-routine emergencies

These events are generally anticipated and may have generic plans, but they stretch the emergency system and require some shifts in operational procedures and thinking.

Source: *Handmer J & Dovers S 2007, The handbook of disaster and emergency policies and institutions*

Preparedness

Arrangements to ensure that, should an emergency occur, all the resources and services that are needed to cope with the effects can be efficiently mobilised and deployed.

Source: *Australian Emergency Manual 3: Australian emergency management glossary*

Prevention

Regulatory and physical measures to ensure that emergencies are prevented or their effects mitigated.

Source: *Australian Emergency Manual 3: Australian emergency management glossary*

Probability

Measure of the chance of occurrence expressed as a number between 0 and 1, where 0 is uncertainty and 1 is absolute certainty.

Note: See note in Likelihood.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Recovery

The coordinated process of supporting affected communities in the reconstruction of the built environment, and restoration of emotional, social, economic, built and natural environment wellbeing.

Source: *Community Recovery (AIDR 2018)*

Relief

The provision of immediate shelter, life support and human needs of persons affected by an emergency. It includes the establishment, management and provision of services to emergency relief or evacuation centres.

Source: *AIDR Glossary 2013*

Residual risk

Risk remaining after risk treatment.

Notes:

- Residual risk can contain unidentified risk.
- Residual risk can also be known as 'retained risk'.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Response

Actions taken in anticipation of, during and immediately after an emergency to ensure that its effects are minimised, and that people affected are given immediate relief and support.

Source: *AIDR Glossary 2013*

Review

Activity undertaken to determine the suitability, adequacy and effectiveness of the subject matter to achieve established objectives.

Note: Review can be applied to a risk management framework, risk management process, risk or control.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Risk

The effect of uncertainty on objectives.

Notes:

- An effect is a deviation from the expected – positive and/or negative.
- Objectives can have different aspects (e.g. financial, health, safety, environmental goals) and can apply at different levels (e.g. strategic, organisation wide, project, product, process).
- Risk is often characterised by reference to potential events and consequences, or a combination of these.
- Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated likelihood of occurrence.
- Uncertainty is the state (complete or partial) of deficiency of information relating to understanding or knowledge of an event, its consequence or likelihood.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Risk analysis

Process to comprehend the nature of risk and determine the level of risk.

Notes:

- Risk analysis provides the basis for risk evaluation and decisions about risk treatment.
- Risk analysis includes risk estimation.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Risk assessment

Overall process of risk identification, risk analysis and risk evaluation.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Risk criteria

Terms of reference against which the significance of a risk is evaluated.

Notes:

- Risk criteria are based on organisational (or jurisdictional) objectives, and external and internal context.
- Risk criteria can be derived from standards, laws, policies and other requirements.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Risk description

Structured statement of risk usually containing four elements: sources, events, causes and consequences.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Risk evaluation

Process of comparing the results of risk analysis with risk criteria to determine whether the risk and/or its magnitude is acceptable or tolerable.

Note: Risk evaluation assists in the decision about risk treatment.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Risk identification

Process of finding, recognising and describing risks.

Notes:

- Risk identification involves the identification of risk sources, events, their causes and their potential consequences.
- Risk identification can involve historical data, theoretical analysis, informed and expert opinions, and stakeholders' needs.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Risk management

Coordinated activities of an organisation or a government to direct and control risk.

The risk management process includes the activities of:

- communication and consultation
- establishing the context
- risk assessment, which includes
 - risk identification
 - risk analysis
 - risk evaluation
- risk treatment
- monitoring and review.

Source: *Adapted from ISO Guide 73:2009 Risk management – vocabulary*

Risk management framework

Set of components that provide the foundations and organisational arrangements for designing, implementing, monitoring, reviewing and continually improving risk management throughout the organisation.

Notes:

- The foundations can include the policy, objectives, mandate and commitment to manage risk.
- The organisational (or jurisdictional) arrangements include plans, relationships, accountabilities, resources, processes and activities.

The risk management framework is embedded within the organisation's (or jurisdiction's) overall strategic and operational policies and practices.

Source: *Adapted from ISO Guide 73:2009 Risk management – vocabulary*

Risk register

A table, list or other representation of risk statements describing sources of risk and elements at risk with assigned consequences, likelihoods and levels of risk. Risk registers are produced by risk assessment processes, summarising the outputs of these processes to inform decision making about risks. Risk registers record the identification, analysis and evaluation of emergency risks.

Source: *Australian Government (unpublished), Risk registers and risk communication to promote disaster resilience*

Risk reporting

Communication intended to inform particular internal or external stakeholders by providing information regarding the current state of risk and its management.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Risk source

An element which, alone or in combination, has the intrinsic potential to give rise to risk.

Note: A risk source can be tangible or intangible.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Risk statement

See *Risk description*

Risk tolerance

Organisation's (or jurisdiction's) or stakeholder's readiness to bear the risk after risk treatment to achieve its objectives.

Note: Risk tolerance can be influenced by legal or regulatory requirements.

Source: *Adapted from ISO Guide 73:2009 Risk management – vocabulary*

Risk treatment

Process to modify risk.

Notes:

- Risk treatment can involve
 - avoiding the risk by deciding not to start or continue with the activity that gives rise to the risk
 - taking or increasing risk to pursue an opportunity
 - removing the risk source
 - changing the likelihood
 - changing the consequences
 - sharing the risk with another party or parties (including contracts and risk financing)
 - retaining the risk by informed decision.
- A risk treatment that deals with negative consequences is sometimes referred to as 'risk mitigation', 'risk elimination', 'risk prevention' and 'risk reduction'.

Source: *ISO Guide 73:2009 Risk management – vocabulary*

Routine emergencies

These are reasonably well defined events and the likelihood of their occurrence – but not the precise timing – is understood. There is general agreement on what the problem is and on what should be done. In most developed and many developing countries, these emergencies are well coped with.

Source: *Handmer J & Dovers S 2007, The handbook of disaster and emergency policies and institutions*

Systemic (disaster) risk

Systemic risk refers to the threat that individual failures, accidents, or disruptions present to a system through processes such as contagion. The notion of systemic risk refers to the risk or probability of breakdowns in an entire system, as opposed to the breakdown of individual parts or components³³. Systemic risks are interconnected with non-linear cause-effect relationships.

Source: *Australian Government 2019, Guidance for Strategic Decisions on Climate and Disaster Risk*

Stakeholder

A person, group of people or organisation that can affect, be affected by or perceive themselves to be affected by a decision or activity.

Note: A decision maker can be a stakeholder.

Source: *Adapted from ISO Guide 73:2009 Risk management – vocabulary*

Vulnerability

The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards.

Source: *United Nations office of Disaster Risk Reduction (UNDRR)*

References

Australian Bureau of Statistics 2012, 5220.0 *Australian National Accounts: State accounts 2011–12*, <https://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5220.02011-12?OpenDocument>

Australian Government Department of Home Affairs 2019, *Climate and Disaster Risk: What they are, why they matter and how to consider them in decision making. 2 Guidance on Governance*, <https://knowledge.aidr.org.au/media/7258/02-governance-guidance-strategic-decisions-climate-disaster-risk.pdf>

Australian Government Department of Home Affairs 2019, *Climate and Disaster Risk: What they matter and how to consider them in decision making. 3 Guidance on Scenarios*, <https://www.aidr.org.au/media/6932/04-scenarios.pdf>

Australian Institute for Disaster Resilience 2019, *Australian Emergency Management Arrangements Handbook*, www.knowledge.aidr.org.au/resources/handbook-9-australian-emergency-management-arrangements/

Australian Institute for Disaster Resilience 2002, *Disaster Loss Assessment Guidelines*, <https://knowledge.aidr.org.au/media/1967/manual-27-disaster-loss-assessment-guidelines.pdf>

City of Sydney 2012, *The city at a glance*, <https://www.cityofsydney.nsw.gov.au/learn/research-and-statistics/the-city-at-a-glance>

Council of Australian Governments 2011, *National Strategy for Disaster Resilience*, Canberra.

Council of Australian Governments 2014, *Best Practice Regulation: A guide for Ministerial Councils and National Standard Setting Bodies*, <https://www.pmc.gov.au/resource-centre/regulation/best-practice-regulation-guide-ministerial-councils-and-national-standard-setting-bodies>

Emergency Management Australia 2004, *Emergency risk management applications guide (Manual 5)*, <https://knowledge.aidr.org.au/media/1975/manual-5-applications-guide.pdf>

International Organization for Standardization 2009, ISO Guide 73:2009 *Risk management – vocabulary*, Geneva, Switzerland.

International Organization for Standardization 2013, ISO/TR 31004:2013 *Risk management – guidance for the implementation of ISO 31000*, Geneva, Switzerland.

International Organization for Standardization and Standards Australia 2018, *Risk management - Guidelines, AS/ISO 3100*, NSW.

Standards Australia 2010, AS HB 158:2010 *Delivering assurance based on ISO 31000:2009 - Risk management - Principles and guidelines*, Sydney, NSW.

Standards Australia & Standards New Zealand 2013, SA/SNZ HB 436:2013 *Risk management guidelines – companion to AS/NZS ISO 31000:2009*, Sydney, NSW & Wellington, New Zealand.

Standards Australia & Standards New Zealand 2013, SA/SNZ HB 89:2013 *Risk management – guidelines on risk assessment techniques*, Sydney, NSW & Wellington, New Zealand.

Standards Australia & Standards New Zealand AS/NZS HB 327:2010 *Communicating and consulting about risk*, Sydney, NSW & Wellington, New Zealand.



Australian Institute for
Disaster Resilience

www.aidr.org.au

Australian Institute for Disaster Resilience
Knowledge Hub

www.knowledge.aidr.org.au