Natural Disasters in Tasmania

2012 State Risk Assessment Report Summary

Australian Government

DISASTER RESILIENT AUSTRALIA
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Disclaimer

This document is a condensed summary of the results of the 2012 Tasmanian Natural Disaster Risk Assessment Report.

The assessment was based on data available at the time, validated by emergency management representatives and the opinion of hazard experts. As a consequence there are inherent uncertainties in the assessment. Whilst every effort has been made to ensure the material in this report is accurate, the State Emergency Service provides no warranty, guarantee or representation that material is accurate, complete, up to date, non-infringing or fit for any particular purpose. The use of the material is entirely at the risk of the user. The user must independently verify the suitability of the material for its intended use.

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DISASTER RESILIENT AUSTRALIA

GET READY

1. Introduction

1.1 Overview

This document has been developed to help the Tasmanian community better understand how emergency management decisions are informed in cases of natural disaster.

It is a broad overview of the *2012 Tasmanian State Natural Disaster Risk Assessment.*

The main aim of the risk assessment is to help the Tasmanian community to be better prepared for disaster. It does this through an increased understanding and awareness of the natural disasters that have the most potential to impact the State.

1.2 What is a natural disaster?

In a nationally agreed definition a natural disaster is defined as:

"A serious disruption to a community or region caused by the impact of a naturally occurring rapid onset event that also threatens or causes death, injury or damage to property or the environment; and requires a significant and coordinated multi-agency and community response".

Based on this definition, a natural disaster is an event caused by any one, or a combination, of the following natural hazards:

- bushfire;
- earthquake;
- flood;
- storm;
- cyclone;
- storm surge;
- landslide;
- tsunami;
- meteorite strike; or
- tornado.

1.3 What are Tasmania's natural hazards?

To some degree, the Tasmanian community is potentially exposed to each of the natural hazards listed above. However, Tasmania is likely to have a greater level of exposure to the natural hazards found in Table 1 below:

Table 1: Tasmania's priority natural hazards

Tasmania's Priority Natural Hazards
Bushfire
Flood
Storm
Landslide
Tsunami
Earthquake

These natural hazards are considered a priority for Tasmania because they have the most potential to cause significant impacts for the State. This is supported by the historical events that are reviewed in the individual hazard summaries provided later in this document.

1.4 Other hazards

Other than natural disasters, there are other hazards that have the potential to significantly impact the Tasmanian community, such as threats to biosecurity, energy supply failure and pandemic.

These hazards are addressed in the Tasmanian Emergency Management Plan (TEMP). To view the TEMP and other resources, please refer to the Publications page on the SES website: **www.ses.tas.gov.au**.

The TEMP also defines the responsibilities of Government agencies for each specific hazard type.

2. The risk assessment process

2.1 What is the difference between hazard and risk?

There is an important distinction between hazard and risk. For a hazard to warrant an emergency management response, it must present a risk to something important, such as life or property.

2.2 How are Tasmania's natural disaster risks assessed?

Tasmania uses a nationally agreed methodology for the risk management process, which is shown below:

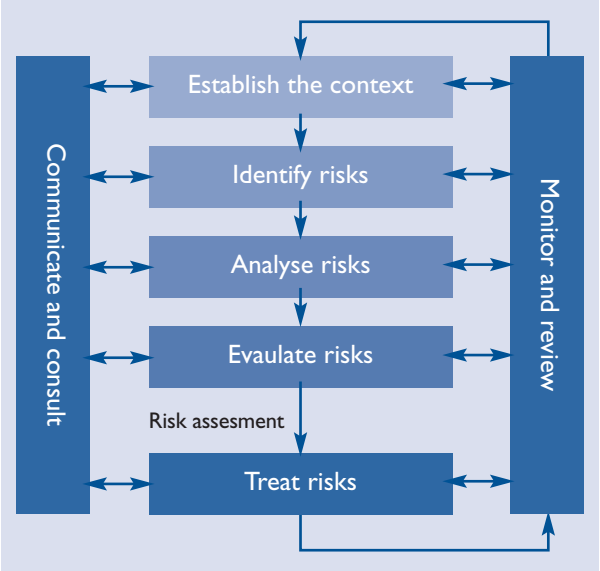


Fig. 1: Risk management process (from National Emergency Risk Assessment Guidelines(NERAG), p.9)

A panel of hazard experts and emergency management representatives from across government identifies priority hazard risks.

The assessment utilises a worst case scenario for each hazard type. The worst case is determined from an analysis of Tasmania's historical experience with natural hazard disasters, current research in relation to Tasmania's changing climate and emerging threats.

2.3 How are the impacts of a disaster assessed?

Once potential worst-case scenarios have been determined, the existing emergency management capability for each priority hazard is assessed. This ensures that the assessment takes into account existing measures that might reduce or mitigate the impact of a natural disaster event. It also allows any current gaps or deficiencies to be identified which helps prioritise areas for research and future mitigation.

The consequences of a natural disaster event are then determined according to its impact across six categories:

People: Considers the number of expected fatalities or injuries. This also includes consideration of the impact on the state's health system to cope.

Environment: Considers the extent of any loss or impairment of ecosystems, flora and fauna.

Economy: Considers the economic impact, in particular the value of assets destroyed or damaged as a result of the disaster event.

Public Administration: Considers the ability of government and authorities to manage the event and maintain public order.

Social Setting: Considers the effect of the event on culturally significant assets, the impact on quality of life and other emotional and psychological impacts.

Infrastructure: Considers the severity of damage or loss of critical infrastructure including roads, utilities and other lifelines.

The table below shows the way these impact categories are assessed relative to a potential worst-case natural disaster event in Tasmania:

Table 2: Consequence assessment criteria (adapted from NERAG)

Level	People Fatalities per head of population	Environment	Economy % of Tasmanian annual GDP	Public Admin. Capacity of government	Social Setting	Infrastructure
Catastrophic	1:10,000	Loss of eco-systems	>3%	Unable to manage	All deeply affected	Long-term failure
Major	1:100,000	Severe impairment	1-3%	Struggle to cope	Most deeply affected	Mid to long-term failure
Moderate	1:1M	Significant impairment	0.3-1%	Diversion from policy	Some deeply affected	Mid-term failure
Minor	Serious Injuries	Isolated damage	0.1-0.3%	Some disturbance	Reduced services	Short to mid-term failure
Insignificant	Minor Injuries	Little damage	<0.1%	Copes fine	Little to no impacts	Short term failure

2.4 How is the likelihood of a disaster determined?

Likelihood refers to 'the chance of something happening'. The likelihood rating refers not only to the expected frequency of an event but also the chance of it having an impact on something. Historical data and scientific modeling is used to inform estimates of likelihood where possible.

The chance of an event occurring can be expressed in different ways. Table 3 shows the levels of likelihood used for this risk assessment and what that means in terms of average recurrence.

By combining the consequence and likelihood ratings an overall risk rating can be determined. This risk rating is expressed as High, Medium or Low.

Table 3: Likelihood assessment criteria (adapted from NERAG)

Likelihood Level	Average Recurrence Interval
Almost Certain	< 3 years
Likely	3 – 30 years
Possible	31 – 300 years
Unlikely	301 – 3,000 years
Rare	3,001 – 30,000 years
Very Rare	30,001 – 300,000 years
Almost Incredible	> 300,000 years

3. What are Tasmania's most significant natural disaster risks?

Table 4 below summarises the results of the 2012 Tasmanian State Natural Disaster Risk Assessment.

Table 4: Tasmania's Natural Disaster Risk Register 2012 (summarised and condensed)

Natural Disaster Risk Scenario	Overall Consequence	Overall Likelihood	Overall Risk Rating
Bushfire	CATASTROPHIC	POSSIBLE-LIKELY	HIGH
Flooding	CATASTROPHIC	POSSIBLE	HIGH
Flash Flooding	MODERATE	LIKELY	HIGH
Private Dam Failure (Cascading)	MAJOR	UNLIKELY	MEDIUM
Severe Storm	MODERATE	LIKELY	MEDIUM
Earthquake with major dam failure	CATASTROPHIC/MAJOR	RARE	MEDIUM
Debris Flow Landslide	CATASTROPHIC/MAJOR	UNLIKELY	MEDIUM
Earthquake near major city eg Hobart, Launceston	MAJOR/MODERATE	UNLIKELY	MEDIUM-LOW
Tsunami	MAJOR	RARE	MEDIUM-LOW
Sudden Landslide	MODERATE	POSSIBLE	LOW

Bushfire and Flooding are identified as Tasmania's most significant natural hazard risk types. Bushfires generally have greater consequences in the southeast of the State, whereas flooding is generally more frequent with greater consequences in the northeast and northwest.

Severe Storms were also found to pose potential risks in Tasmania. While the island is not exposed to cyclonic winds, it has experienced destructive localised tornadoes in the past. Tasmania is exposed to frequent storm and severe wind events, which generally have minor localised impacts.

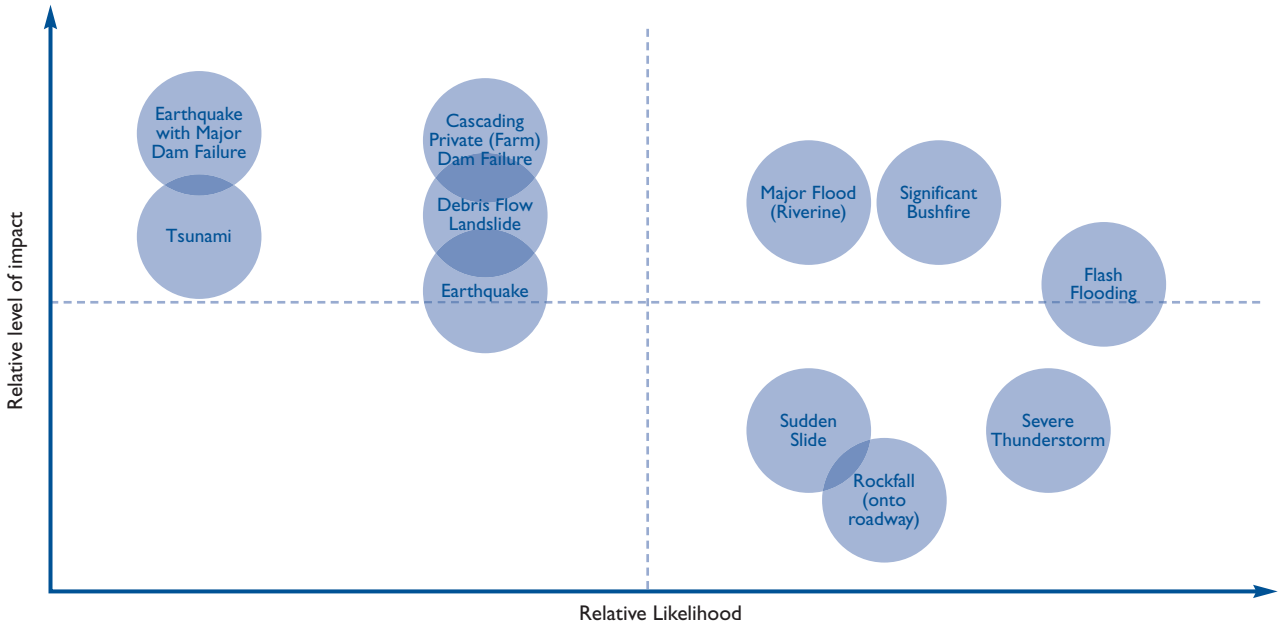
Low to medium risks were identified when assessing worst-case scenarios for earthquake, tsunami and fast moving landslide events.

Earthquakes are rare to unlikely but have catastrophic potential. Tsunamis are also rare but a worst-case event would have major impacts. Landslides are frequent and have caused a significant amount of property damage in Tasmania over many years, but the majority of those landslide events do not pose a threat to life nor require an emergency response. However, some types of fast moving landslide events do also occur in Tasmania and potentially pose a threat to life.

Figure 2 (see over page) depicts each of the identified risks according to their relative likelihood and impact. Further detail in respect to each priority hazard is provided in the next section of this report.

Looking at this diagram, the risks that reside in the upper right quadrant warrant greater attention as they represent high impact risks that also have a high likelihood of occurrence, relative to the other disaster risks.

Figure 2. Natural Disaster Risks in Tasmania (based on the expected worst case scenario)



Relative Impact and Likelihood of Natural Disasters in Tasmania

4. How are risks treated?

Risk treatment is where strategies are developed in order to:

- Avoid, share or retain the risk (eg: insurance, recovery assistance)
- Remove the hazard (source of risk)
- Reduce the likelihood of the event occurring
- Reduce the consequences if the event occurs.

Under Tasmania's emergency management framework, specific risk management responsibilities are outlined at three levels - municipal, regional and state.

Most risks associated with natural hazards are managed at the Local Government level, with emergency management committees responsible for identifying, assessing, treating and managing risks. These committees maintain risk registers and emergency management plans that are required to be reviewed every two years.

At the regional level, the Regional Emergency Management Committee (REMC) has responsibility for research, risk assessment and risk reduction in partnership with State Government and relevant local authorities.

At the State Government level, the State Emergency Management Committee (SEMC) has responsibility for emergency management arrangements and strategies. The 2012 Tasmanian State Natural Disaster Risk Assessment and its findings are therefore the responsibility of this Committee.

As a product of the 2012 Tasmanian State Natural Disaster Risk Assessment, risk treatment strategies have been identified for each of the priority hazards, which if implemented, aim to reduce the level of overall risk. As part of its responsibilities, the SEMC monitors and reviews the implementation of the risk treatment strategies by relevant agencies and authorities.

Tasmania's emergency risk management framework ensures that all efforts are made to keep natural disaster risks in Tasmania at a level that is as low as reasonably practicable. A second edition of the state risk assessment will also be undertaken. This is scheduled to occur between 2013 and 2017.

A major project is presently underway within Tasmania which is reviewing and consolidating land use planning schemes to improve consistency in the way hazards, including natural hazards, are mitigated through development and use of land.

In addition to the responsibilities of the State and Local Governments, it is important to consider that communities have a role to play in mitigating risks.

This includes individuals taking steps to understand the risks that may affect them and ensuring that they take action to protect themselves, their assets and their livelihoods.

Risk management strategies include the need to empower individuals and communities to exercise choice and take responsibility and therefore become more resilient.

5. Hazard summaries

Summaries of each of the identified priority natural hazard types are provided in this section. Each section includes a description of the hazard, previous significant events, current management arrangements and information on where to get further information.

5.1 Bushfire

In human and economic terms bushfire has been the most costly natural disaster hazard in Tasmania's history. Bushfires have claimed more lives than any other natural hazard, and carry an average annual cost of $11.2M.

The bushfires that swept through Hobart and surrounding areas on Tuesday 7 February 1967 resulted in the deaths of 62 people. Until the Black Saturday bushfires in Victoria in 2009, this was the highest number of fatalities from bushfire in a single day experienced in Australia.

Bushfires in Tasmania are most commonly associated with dry conditions during summer and autumn. Peak bushfire danger periods vary according to the rainfall distribution over spring to autumn. Large differences in rainfall distribution across the State affect when and where bushfires occur. Tasmania is considered periodically vulnerable to bushfire due to the level of vegetation cover across the State, the unique population spread and the relationship between high rainfall/low evaporation on fuel loads.

Whilst bushfires can, and do impact all over the state, the south east of the state remains at most risk of a catastrophic bushfire. Emergency management capabilities and arrangements have improved significantly since 1967, however Tasmania continues to experience similar weather conditions as were experienced at that time. Increases in population, particularly in rural areas and the 'urban fringe' have led to an increased level of exposure to bushfire hazard.

Many recent fire events were identified that had the potential to cause significant impact on the Tasmanian community. These fires may have been more damaging were it not for favourable weather changes and/or the effectiveness of our response to the event.

5.1.1 Previous significant bushfires

The most significant bushfire events experienced in Tasmania in recent history are listed in the table below:

Table 5: Significant Fire Events in Tasmania's History

Event	Date	Area Burnt (ha)	Mortality Rate	People Injured	Estimated Cost	NERAG Risk Rating
Black Tuesday, Hobart & Surrounding Area Fires	Feb 1967	264270	**1.7 deaths per 10,000 people** 62 dead (Pop: 375,397)	900	$45M (1967) $485M (2010 with inflation)	CATASTROPHIC/ POSSIBLE
Mt Wellington & Hobart Region Fires	Dec 1897	N/K	**0.4 deaths per 10,000 people** 6 dead (Pop: 161,629)	N/K	Likely to have been $47.3M-$141.9M in todays terms	CATASTROPHIC[25]/ POSSIBLE
Huon - Port Cygnet Fires	Jan 1854	N/K	**1.6 deaths per 10,000 people** 14 dead (Pop: 88,752)	10	Likely to have been $14.2-$47.3M in todays terms	CATASTROPHIC/ POSSIBLE

5.1.2 How are bushfire risks managed?

In Tasmania, three major agencies provide fire services. They are the Tasmania Fire Service (TFS), Parks and Wildlife Service (PWS) and Forestry Tasmania (FT). These agencies have cooperative arrangements in place for multi-agency response.

Mitigation activities may include:

- Fuel reduction activities;
- Fire education programs;
- Protection of vulnerable critical infrastructure such as power supply, water supply and sewerage treatment plants;
- Well-developed processes and resources for managing significant bushfires;
- Emergency response capability maintained.

5.1.3 Where do I go for further information on bushfire risk mitigation?

For information on how to reduce bushfire risk, the TFS has several informative bushfire safety publications. To view these, please refer to the Publications page on the TFS website: www.fire.tas.gov.au.

The TFS bushfire safety program 'Prepare-Act-Survive' can also be found on the TFS website.

5.2 Flooding

Tasmania supports 12% of Australia's freshwater resources in an area of less than 1% of the total Australian land area. The state has extensive river and stream systems with approximately 150,000 kilometres of waterways. The two major river systems in Tasmania are the Derwent and the South Esk. There are many smaller systems, especially in the western region, which flow to the west coast.

Tasmanian rivers and catchments are subject to flooding following heavy rainfall events, or after a period of more than a few days heavy rain in one area. Catchment behaviours are sometimes difficult to predict, with some river systems able to cope with heavy rainfall events depending on precisely where the rain falls. Communities downstream of large catchments are exposed to flooding from time to time, particularly those situated in floodplains.

Tasmania is exposed to major consequence flooding, particularly in the north east of the state. There has been a noticeable increase in the frequency of short duration, but intense rainfall events in recent years. This is supported by climate change observations and predicted future models.

There are now more effective emergency management arrangements and levee systems in the north of the state that lessen the impact from major flooding, but if the event was significant enough it would test those mitigation and response arrangements.

There is also the potential for damage to property and loss of life arising from a cascading dam failure upstream of communities. Further analysis of this risk is being undertaken in order to increase awareness and inform people who may be at risk.

Flash flooding is also associated with heavy rainfall and presents its own unique risks. Flash flooding is difficult to predict and often arrives without warning. It is exacerbated by blocked drainage systems and so can be more serious in built-up urban areas. Further analysis of this risk is also being undertaken and Tasmania SES is presently developing awareness programs.

5.2.1 Previous significant floods

The most significant flooding event in Tasmania was the widespread flooding that affected the northeast and parts of the northwest in April 1929 and resulted in 22 deaths. More than 500mm of rain fell over 3 days, resulting in flooding to most rivers. Launceston was flooded and approximately 4500 people were temporarily displaced. While many parts of the north were flooded, the most significant impacts occurred in Derby, where the failure of the Briseis Dam resulted in 14 people being killed, and in Gawler, 8 people died when a truck crossing a flooded bridge was swept away.

In 2011 there was a series of floods that impacted mostly in the north east of Tasmania during the months of January, March and August. In isolation, each of these floods had only relatively minor impacts, however the cumulative effect of these floods increased the overall impact on local communities. The resulting damage to local infrastructure and property from the 2011 floods resulted in assistance from the Commonwealth, highlighting the state level significance of these events.

A list of the most significant previous flooding events is provided below:

Table 6: Significant Flood Events in Tasmania

Event	Year	Persons Killed, Injured or Displaced	Properties Damaged	Estimated Cost	NERAG Risk Rating
Statewide Flooding	1929	22 died. 4500 evacuated in Launceston	1000 homes damaged. Duck Reach Power Station washed away. Cataract Gorge bridge washed away. Many roads and rail bridges destroyed.	Substantial	CATASTROPHIC/ POSSIBLE
Derwent River and Statewide Flooding	1960	650 people homeless at New Norfolk	12 homes inundated at Macquarie Plains. Lyell and Lachlan River Bridges washed away. Record losses in Hobart with Hobart Rivulet flooded.	546000 pds ($13.6M in 2010 terms)	MODERATE/ POSSIBLE
NE & NW Floods	Jan 2011	Nil	Several roads and bridges damaged. Over 100 dams overtopped. 10 dams failed. Crops destroyed.	$24M	MINOR*/LIKLEY
NE & NW Tasmania Floods	Mar 2011	Nil			
NE & NW Tasmania Floods	Aug 2011	Nil			

**Each individual event caused Minor consequences. Cumulative effect would be Moderate.*

5.2.2 How are flood risks managed?

For riverine flooding, the SES is the designated SEMC Advisory Agency under the Tasmanian Emergency Management Plan. The Department of Primary Industries, Parks, Water and the Environment (DPIPWE) is the state's regulatory authority in respect to flooding of dams. Local councils are responsible for prevention and mitigation activities, including risk assessments, however SES often takes a leadership role in respect to coordinating effort in flood risk mitigation.

Mitigation activities may include:

- Land use planning strategies;
- Community awareness programs; encouraging individual awareness and preparedness;
- Flood levees;
- Monitoring systems;
- Flood response plans;
- Flood evacuation plans;
- Emergency response capability maintained.

5.2.3 Where do I go for further information on flood risk mitigation?

For further information on how to prepare, respond to and recover from floods, refer to the SES website: www.ses.tas.gov.au.

The SES FloodSafe brochure can be accessed via the Public Safety Advice page on the website.

5.3 Storms

Tasmania lies in the 'Roaring 40s' belt of westerly airflow. The principal characteristic of the Tasmanian climate is the interaction between prevailing westerly wind and the mountain ranges near the west coast and the central plateau. The cycle of westerly winds is a key driver of the seasonal rainfall pattern, especially in the western and central regions of Tasmania. These persistent westerly systems are related to features of the general circulation of the atmosphere in the southern hemisphere and mean Tasmania is regularly subjected to storms and severe weather.

Storms affect all parts of Tasmania but different areas of the state experience different storm scenarios. The north east of the state is exposed to east coast lows as well as westerly frontal systems and sometimes fronts that move up from the south. The south east is reasonably protected from the prevailing westerlies due to the mountain ranges in the west. The west and north west coasts are particularly exposed to the prevailing storm weather.

Weather systems known as 'East Coast Lows' often bring intense rainfall and strong winds, however the state risk assessment identified the highest storm risk is likely to come from a broad-scale front moving in from the west bringing severe thunderstorms with the potential for tornado winds. In such a scenario one to two deaths are likely, and there would also be significant damage to properties.

Whilst power failure is common in storm events, this generally causes short-term disruption only. Tasmania's energy sector maintains excellent levels of redundancy to ensure business continuity.

5.3.1 Previous significant storms

Storms are frequent but usually of low impact. The list of recent significant storm events includes:

- **March 1980 (Hobart)** - Several houses unroofed and 2 houses totally destroyed. Gale force winds ruined 50% of the apple export crop.
- **November, 1992 (Smithton)** - Extensive damage to a dozen homes and local infrastructure when a tornado cut inland of Smithton. Wind gusts were recorded up to 280 kmh.
- **December, 2001 (Launceston)** - Tornadoes believed to be present in the storm that damaged 114 houses in the Launceston suburb of Summerhill. Emergency Services workers from across the state were deployed to assist with temporary repairs. The total estimated damage bill was $2M.
- **June, 2003 (Hobart)** - A young girl was tragically killed by a falling branch at Waterworks Reserve during a gusty wind event in Hobart.
- **April 2008 (Tasmania)** - An overnight event that wreaked havoc across Tasmania, damaging over 1000 houses and leaving 65,000 customers without power for less than a day (1000 more than a day). This also caused:
  - Short term closure of tourism sites.
  - Roads closed for short term.
  - Gusts recorded up to 177 kmh.
  - $2M in damage claims by RACT and similar rates for other insurers.
  - $1M repair costs reported by Aurora.
- **April 2009 (North Coast)** - A line of severe thunderstorms swept over North Coast producing several tornadoes, including wind gusts recorded at second highest ever - 195 km/h (Scottsdale). Some damage to houses at Boat Harbour, near Wynyard. The worst part of the storm missed major towns.

5.3.2 How are storm risks managed?

The Bureau of Meteorology maintains a national weather warning service. The Bureau has a well-established and developed process for issuing storm and severe weather warnings that is used by the public and by various agencies.

SES is the designated SEMC Advisory Agency under the Tasmanian Emergency Management Plan. Local councils are responsible for prevention and mitigation activities, including risk assessments; however SES often take a leadership role in respect to coordinating effort in storms risk mitigation.

Mitigation actions may include:

- Land use planning
- Building standards
- Community awareness programs encouraging individual awareness and preparedness
- Maintenance of infrastructure
- Protection of vulnerable critical infrastructure such as power lines
- Emergency response capability maintained

5.3.3 Where do I go for further information on storm risk mitigation?

For further information about storms and how to prepare for, respond to and recover from storm events, refer to the SES StormSafe brochure, available on the Public Safety Advice page on the SES website: **www.ses.tas.gov.au**.

The Emergency Management Australia website also has useful information: **www.em.gov.au**.

5.4 Earthquake

Tasmania is vulnerable to intra-plate earthquakes. An intraplate earthquake is one that occurs within a tectonic plate, whereas an interplate earthquake is one that occurs at a plate boundary. Whilst not being as common, major earthquakes with magnitudes of 7.0 or more are known to occur in intra-plate regions.

There are only a few faults in Tasmania that have been identified as having evidence for relatively recent activity. Most have not been studied in detail, but several geological studies have been undertaken in respect to the Lake Edgar Fault, which is located 80kms west of Hobart and has been shown to have moved at least three times in the last 60,000 years with the last movement around 18,000 years ago, causing earthquakes with a magnitude of around 7.0 on each occasion.

Although Tasmania has not experienced any previous earthquakes that are considered to have had a significant impact, it is clear that Tasmania has an earthquake risk. Current earthquake research, the existence of known recently active faults, and the lessons learned following intra-plate region earthquakes in other parts of the world demonstrates the potential for a major earthquake to impact Tasmanian communities.

The nature of the soils in some areas may increase the susceptibility to shaking as a result of an earthquake – some parts of Launceston have been identified with these soils.

5.4.1 Previous earthquakes

While instrumentally recorded seismicity is low for Tasmania, there is evidence that Tasmania has previously experienced earthquakes up to 7.0 in magnitude.

Geoscience Australia has records of 46 earthquakes above magnitude 3.0 in Tasmania since the late 1800's, including earthquakes that caused building damage in Launceston, and other smaller earthquakes felt in populated areas.

Table 7 represents an analysis of all previously recorded earthquakes with a magnitude greater than 3.5 in Tasmania.

5.4.2 How are earthquake risks managed?

Mineral Resources Tasmania (MRT) is a division of the Department of Infrastructure, Energy and Resources (DIER). Under the Tasmanian Emergency Management Plan, MRT has responsibility for advice to SEMC, and is also the lead management authority in respect to prevention and mitigation. Under current arrangements the SES has responsibility for preparedness activities, and Tasmania Police takes the lead for response to earthquake events.

Geoscience Australia also plays a pivotal role in earthquake risk mitigation, providing an earthquake research, monitoring and analysis capability.

Mitigation of earthquake risk is predominantly through compliance with appropriate building design standards.

In addition there are other tools in use, which help with understanding the hazard, such as seismic monitoring and fault studies.

Power stations and some major industrial machinery have earth movement sensors and will shut down when tremors are felt.

5.4.3 Where do I go for further information on earthquake risk mitigation?

For further information on how to prepare for, respond to and recover from earthquakes, refer to the Earthquake Action Guide on the Public Safety Advice page on the SES website: www.ses.tas.gov.au.

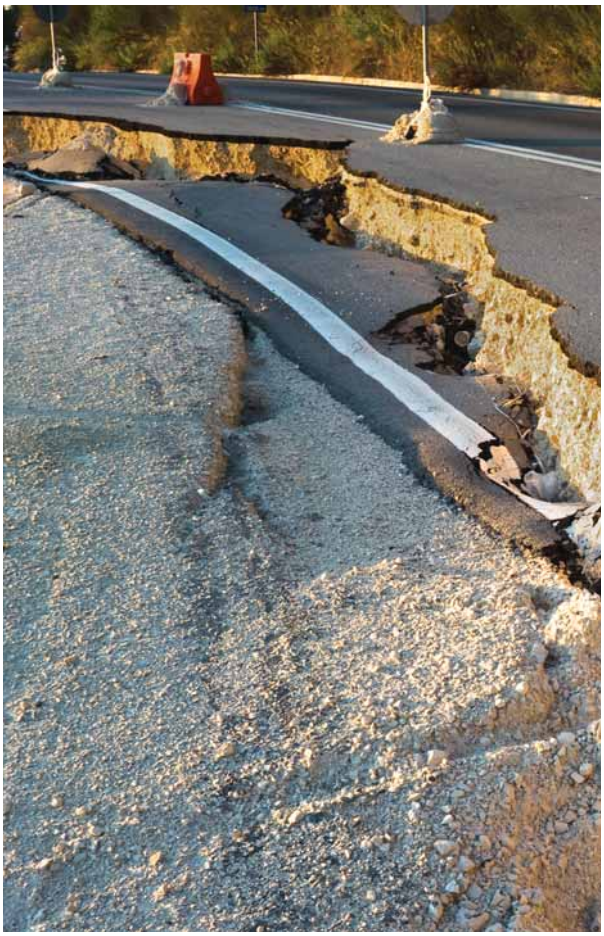


Table 7: Significant Earthquake Events in Tasmania

Event	Year	Magnitude	Depth (kms)	Impact Summary	Potential NERAG Risk Rating
Mole Creek 2004	2004	4	10	Mole Creek. Felt in other NW towns as well as Hobart.	Insignificant
Lake Sorell 2002	2002	4.3	10	Lake Sorell. Felt widely in Tasmania.	Insignificant
Launceston 1997	1997	4.2	5	Launceston. Felt widely throughout Tasmania.	Insignificant
Earthquake in NE Tasmania	1928	5.4	10	Severe shaking felt at Fingal and Midlands, where articles dislodged from shelves.	Insignificant
Earthquake off Port Arthur	1927	4.3	10	Articles on shelves in Port Arthur displaced. Felt in Hobart.	Insignificant
Lake Edgar 2000	2000	3.5	12	Small quake recorded at Lake Edgar fault.	Insignificant
Lake Edgar (18000 yrs ago)	N/K	6.8-7.0	N/K	N/K – Last major movement of this fault line.	Insignificant
West Coast 1924	1924	5.2	0	Magnitude determined from isoseismal map.	Insignificant
Queenstown 1908	1908	5	0	Magnitude determined from isoseismal map.	Insignificant
Tasman Sea Earthquake Swarm	1883-1892	6.9	N/K	Epicentre of swarm was east of Flinders Island. Buildings damaged at Launceston during 1884.	Insignificant
East of Flinders Island earthquake	1929	5.0 - 5.6	10	Damage to Launceston Hospital, a church and other houses in that area. Impacts in Hobart - rattling of windows & tremors felt.	Minor

5.5 Landslide

Landslide is generally defined as the movement of earth, rock or debris down a slope, and can also be referred to as 'slope failure'. Landslide research recognises five distinct types of landslide that present a risk to communities.

The five main types, all known to occur in Tasmania, are as follows:

- Slides (Shallow and Deep-Seated)
- Flows (Debris and Earth)
- Falls (Rock, Earth, Debris)
- Topples
- Spreads

Slides involve movement of material along recognisable shear surfaces or zones and are usually considered within two categories – shallow and deep-seated. Shallow slides are more common than deep-seated and more frequently associated with property damage. Larger deep-seated slides are more easily recognised and are generally slow-moving with impacts realised over a longer term.

Flows refer to the movement of earth or debris in a fluid motion and are generally associated with heavy rainfall. An initial shallow slide can develop into a rapid flow if there is excess water on the ground. A debris flow occurs when rocks and other debris mix with water and flow down a slope until it meets some type of barrier or the slope flattens out.

Falls and topples involve a detachment and rapid movement of earth from a steep slope, are short in duration but can cause significant damage to anything located downslope of the earth movement location. Large rock falls can sometimes produce an avalanche effect.

The precise impact of a fall or topple will depend on what happens to be in that location at the time of the event. These sorts of events generally present risk on steep slopes and cliffs, which are prevalent across the Tasmanian landscape.

A spread refers to a slope failure or displacement of earth on a relatively flat or level area of land. Spreads can occur anywhere across Tasmania but have been noticeable in several areas of the northwest landscape. Spreads are typically very slow moving and so present a risk to property but not necessarily human life.

Where a slope failure event involves either a combination of types or transition from one landslide type to another, it is referred to as a complex or transitional landslide event. An example is the 1872 event in Humphrey's Rivulet, Glenorchy, where it is believed an initial debris flow created a debris dam in the rivulet, which then burst and created a flash flood comprising water, earth and debris.

These different types of landslide can occur anywhere across Tasmania but have been particularly noticeable in several areas of the north-west landscape and the Tamar Valley, as well as specific areas in and around Hobart, Launceston and St Helens.

5.5.1 Previous significant landslides

Mineral Resources Tasmania (MRT), a division of the Department of Infrastructure, Energy and Resources (DIER) has evidence of over 150 buildings in Tasmania that have been damaged or destroyed by landslide since the 1950's. As shown in the below table, this figure includes 125 residential premises, with the majority of the damage recorded in the areas of Lawrence Vale (Launceston), Beauty Point, Rosetta and Taroona.

Limitations in the reporting and recording process for landslide damage suggest the figures are probably higher. In addition to building damage, it is acknowledged that damage to infrastructure has occurred throughout Tasmania over many years.

The majority of the landslide damage is caused by slow moving slides, which generally do not pose a threat to life. The types of landslide that are most likely to pose a threat to life are the sudden impact, fast moving types: Sudden slides (shallow or deep-seated), Debris flows or Earth flows, and Falls or Topples (rock, earth or debris). These are often associated with periods of heavy rainfall and prolonged wet periods.

Large, sudden impact landslide events are relatively uncommon in Tasmania, particularly in populated areas. One significant example of such an event occurred in 1872 at Humphreys Rivulet, Glenorchy, where a large slide occurred on the flanks of Mt Arthur and the subsequent debris flow and flood travelled a total distance of about 8.5km, from Mt Arthur to the River Derwent.

5.5.2 How are landslide risks managed?

Mineral Resources Tasmania (MRT) has primary responsibility for management of landslide and other geological hazards from a state research and policy development perspective. Under the Tasmanian Emergency Management Plan, DIER is the designated SEMC Advisory Agency for landslides, with MRT specifically responsible for prevention and mitigation. Local council has responsibility for landslide preparedness predominantly as a result of its role in land use planning and development approval.

It is noted that landslide risk in Tasmania is generally mitigated through controls associated with land use and development. A major project is presently underway within Tasmania, which is reviewing and consolidating land use planning schemes to improve consistency in the way hazards such as landslide are mitigated through development and use of land.

Table 8: Significant Landslide Events in Tasmania

Event	Date	Buildings Destroyed, Demolished or Damaged	People Injured	Potential NERAG Risk Rating
Landslide Damage (State Total)	1950-Present	Total of 150 buildings damaged, including 125 houses, 76 of which have been destroyed or demolished.	Nil	MODERATE
Humphreys Rivulet Debris Flow Event	1872	Several houses and farms destroyed or damaged. Bridges damaged. Many buildings and properties inundated, likely due to debris dam failure.	Nil*	MODERATE
Lawrence Vale Landslide Area	1950-Present	43 houses destroyed, demolished or removed due to extensive damage.	Nil	MINOR
Beauty Point Landslides	1950-Present	15 houses & a police station destroyed/ demolished. 13 houses damaged and a further 15 moved. Streets and roads requiring repair.	Nil	MINOR
Taroona Landslides	1950-Present	10 houses damaged, 1 demolished. Damage to school and local infrastructure.	Nil	MINOR

**One person was drowned in associated flooding not directly caused by the flow of debris*

Other activities currently undertaken to mitigate landslide risk include:

- Landslide research, mapping and zoning;
- Known landslide monitoring – eg Taroona;
- Management of proclaimed landslip zones;
- Plantations and vegetation planted to stabilise land;
- Community awareness programs;
- Emergency response capability maintained.

5.5.3 Where do I go for further information on landslide risk mitigation?

For further information on landslides, refer to the information in the 'Geological Hazards' section of the Mineral Resources Tasmania website **www.mrt.tas.gov.au**

The Emergency Management Australia website also has some useful publications: **www.em.gov.au**.

5.6 Tsunami

A tsunami is a series of waves generated by sudden movement of the sea floor, usually as a result of an earthquake. Volcanic eruptions, landslides and meteorite strike can also cause tsunamis. Tsunamis are different to wind-generated ocean waves, which cause movement of water near the surface. A tsunami involves movement of water from the sea floor to the surface.

In a deep ocean the wave height of a tsunami is rarely higher than 1 metre and it travels very fast, up to speeds of 950 kmh. As the tsunami leaves deeper water and approaches the shallower waters around a coastline, the leading edge slows down whilst the back keeps moving. In effect the water bunches up creating a wall of water that can be quite destructive. Harbours, bays and lagoons can create a focusing effect and amplify the effect of the tsunami.

Tsunami risk is generally associated with large earthquakes that primarily occur where two tectonic plates move towards each other and one is pushed downward beneath the other (this is called subduction). While Tasmania has not been significantly impacted by a tsunami in its recent history, its proximity to the subduction zones that stretch from Papua New Guinea to New Zealand give rise to the potential for tsunami activity, particularly along the east coast.

Research into tsunami activity in Tasmania indicates that unusual wave activity has been detected around the coastline on at least sixteen occasions since 1852, and that this activity is likely to have been associated with a tsunami event. Geoscience Australia has identified the greatest tsunami risk to Tasmania is likely to be from the Puysegur Trench area off the south coast of New Zealand, an active region for earthquakes.

Earthquakes occur in the Puysegur Trench quite frequently but do not always result in a tsunami. If a tsunami were to be generated from this location it would approach Tasmania across the Tasman Sea. The extent of inundation would depend on the size of the earthquake, the size of the tsunami it generated and several other factors including the shape of the seabed and topography of the coastline.

5.6.1 Previous significant tsunamis

While research is continuing with the aim of determining the extent of Tasmania's historical exposure to tsunami, Tasmania has not experienced a significant tsunami in recent times. Due to the lack of historical records, unusual wave activity and tide gauge recordings are used to reflect tsunami history in the table over page.

5.6.2 How are tsunami risks managed?

SES and the broader Department of Police and Emergency Management have responsibility for tsunami mitigation, preparedness and response under present emergency management arrangements.

The Joint Australian Tsunami Warning Centre (JATWC) has responsibility for issuing tsunami warnings. The standard defined for the Australian Tsunami Warning System is to provide a minimum of 90 minutes warning to Australian coastal communities for tsunami generated earthquakes occurring on tectonic plate boundaries in the Indian, Pacific and Southern Oceans. The JATWC is able to issue initial tsunami warning bulletins within 30 minutes of the origin time of earthquakes within the Australian region.

It should be noted that the Puysegur Trench has the shortest tsunami arrival time under the JATWC estimates. It is presently estimated that it would take a tsunami from that zone approximately 2 hours from the time of the earthquake to arrive on the coastline of Tasmania. This gives DPEM and other emergency services approximately 90 minutes to respond to the initial threat.

Based on existing modelling, it is recognised that any inundation to occur would be in populated areas that have already been identified as susceptible to storm surge and sea level rise.

Mitigation activities may include:

- Tsunami inundation modelling
- Tsunami detection buoys between Tasmania and New Zealand;
- Tsunami monitoring and warning service;
- Seismic monitoring
- Community awareness programs

5.6.3 Where do I go for further information on tsunami risk mitigation?

People in low lying coastal areas are at greater risk of tsunami and other coastal inundation events. Understanding and awareness of how to plan, prepare for and respond to an event can reduce its impact.

For further information, refer to the SES website: www.ses.tas.gov.au

Table 9: Significant Tsunami Events in Tasmania

Event	Date	Trigger	Origin	Impact Summary	Potential NERAG Risk Rating
2012 Puysegur Trench	19-Jan	Magnitude 6.2 earthquake	Puysegur Trench	Tide Gauge at Southport recorded 170mm MWH.	INSIGNIFICANT
2004 Puysegur Trench	22-Nov	Magnitude 7.3 earthquake	Puysegur Trench	N/K	INSIGNIFICANT
2007 Puysegur Trench	30-Sep	Magnitude 7.4 earthquake	Puysegur Trench	Tide Gauge at Triabunna recorded 200mm fluctuations. Reports from St Helens, Spring Bay & Fortescue estimates 300-350mm	INSIGNIFICANT
2009 Puysegur Trench event	15-Jul	Magnitude 7.9 earthquake	Puysegur Trench	NZ shifted 30cm closer to AUS. 12cm at Spring Bay tide gauge, Southport recorded 55cm. First Tsunami warning issued from new Joint Australian Tsunami Warning Centre (JATWC).	INSIGNIFICANT
2004 Macquarie Island event	23-Dec	Magnitude 8.1 earthquake	Macquarie Island	Tide Gauge at Spring Bay recorded 150mm MWH	INSIGNIFICANT
1989 Macquarie Island event	23-May	Magnitude 8.1 earthquake	Macquarie Island	Various Tide Gauges showed fluctuations up to 300mm	INSIGNIFICANT
2004 Boxing Day Tsunami	26-Dec	Magnitude 9.0 earthquake	Indonesia	Tide Gauge at Spring Bay recorded 600mm MWH	INSIGNIFICANT
1960 Chile event	22-May	Magnitude 9.5 earthquake	Chile	Tide Gauge at Hobart recorded MWH of 460mm. Surges in NW.	INSIGNIFICANT
1953 Bridport 'freak wave'	14-Nov	N/K	Bridport	Freak wave observed travelling up Brid River, approx 2.4m high. Damaged jetty and one child on beach was drowned.	MODERATE
1858 Earthquake, Tasmania	5-Feb	N/K	New Town Bay	Tidal ebb and flow noted at New Town Bay.	INSIGNIFICANT
1883 Krakatoa eruption	27-Aug	Volcanic eruption	Indonesia	Tidal disturbance observed at the Huon River, up to 900mm higher.	INSIGNIFICANT

6. Other hazards

There are many other hazards that impact Tasmania from time to time. Information on all of Tasmania's hazards emergency management arrangements can be found within the Tasmanian Emergency Management Plan, available on the Publications page on the SES website: **www.ses.tas.gov.au**

For general advice on hazards and risk awareness, please visit the Emergency Management Australia website: **www.em.gov.au**.

7. Conclusion

Natural disasters will continue to occur. How we cope as individuals and governments is reliant upon our knowledge of these hazards and the impacts that they may have. By systematically working through a risk assessment and management process we can understand the nature and extent of the risk and therefore have some control over their impacts.

For governments, this better understanding of risk can help in prioritising the use of limited funds and resources in the most effective way to lessen the consequences and help build resilience.

For individuals, understanding the nature of the hazards and the potential impacts will allow them to share in the responsibility for preparing for, responding to and recovering from disasters.

Disaster resilience is a joint responsibility of government, business, the non-government sector and individuals. By working together with a shared sense of responsibility and focus our efforts will be far more effective.

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