TASDRA 2022

Tasmanian Disaster Risk Assessment

Tasmanian Government

Contents

Summary

This 2022 Tasmanian Disaster Risk Assessment (TASDRA) supports better understanding of the disaster risks that could impact Tasmania. TASDRA explores quick-onset disasters Tasmanians must expect. The purpose of TASDRA is to:

- identify ways to prevent such disasters from happening
- explore current arrangements if such disaster scenarios do occur
- identify potential further disaster risk reduction (DRR) measures that build on current arrangements.

Some insights are relevant to specific hazards and others to many disaster scenarios.

Reducing disaster risks increases Tasmanians' collective resilience in the face of future disasters in line with the Tasmanian Disaster Resilience Strategy.

The TASDRA project brought together many areas of expertise and different insights. This assessment updates and extends the 2016 Tasmanian State Natural Disaster Risk Assessment (TSNDRA) to cover extra hazards, exposures and vulnerabilities beyond the 'natural' hazards of bushfire, flood and geological events. Table 1.1 lists the hazards assessed through the TASDRA scenarios and includes a summary of the major insights from exploring each of these scenarios.

Table 0.1: TASDRA scenarios, hazards covered and major insights

Scenario (hazards)	Most significant insights
East Coast tsunami A tsunami originating from an earthquake south of New Zealand impacts the East Coast.	Although an extremely rare event, a major tsunami could cause deaths and damage due to the short warning time and exposure of coastal communities. We cannot prevent tsunamis and so need to prepare to mitigate consequences. This scenario provides insights for other disasters with limited time for warnings. It shows disaster risk assessment should not only focus on exposures and vulnerabilities but also on specific hazards.
'Black January' Dry lightning ignites fires during a drought. Heatwave conditions make the fires difficult to control. Thick smoke extends across the state.	Tasmania is likely to face catastrophic-level bushfire events in coming years. An event such as 'Black January' has a 1:20-50-year likelihood but could become more common due to climate change. There are many measures in place to mitigate bushfires, but they still remain a risk. This scenario highlights the importance of community involvement in reducing risks and being prepared. A bushfire can damage assets and the environment. However, heatwave and smoke exposure are likely to cause most deaths and illness. Heat and smoke have the most impact on the very young and old, those with underlying health concerns, and those less able to access shelter.
East Coast Low An East Coast Low produces a severe storm, coastal storm surge, flooding including debris flow, and causes a landslide, dam failure and an oil spill in northern Tasmania.	An East Coast Low can create a storm causing catastrophic disruption and damage due to cascading consequences. For example, flooding can lead to a dam failure, leading to further flooding. This scenario shows how hazards can interconnect. Consequences can be due to more than one hazard. Tasmania often has storms resulting in floods and other hazards. The state has well-developed response arrangements but the scenario highlights that regular cross-sector exercises help build capabilities. Weather and flood forecasting and communications across agencies and to the public are key. Community awareness of responsibilities and knowledge of what to do in such events remain a concern. This scenario highlights land use planning's role in reducing disaster risks.

Scenario (hazards)	Most significant insights
Respiratory pandemic COVID-19 is under control but a new respiratory disease emerges in Tasmania	TASDRA assesses the risks of future pandemics beyond COVID-19. The Department of Health (DoH) assesses respiratory disease as the most likely to cause a pandemic or epidemic in Tasmania. Public health and other measures used with COVID-19 can reduce risks of future respiratory pandemics. There would be further considerations if the disease was zoonotic (passed between animals and humans).
Biosecurity Example incursions occur in the state: • Foot and mouth disease (FMD) • Avian influenza • Mediterranean fruit fly (Medfly) • Shellfish biotoxins • *Didemnum vexillum*	Tasmania's isolation has protected the state from many biosecurity incursions. However, incursions that can lead to major or catastrophic consequences are likely. Prevention measures and early detection are key. Response actions can be costly and take a long time.
Maritime incident in a port A vessel grounds in the mouth of the Mersey River and closes the Port of Devonport.	This scenario shows how safety regulations and practices reduce risk. Shipping is highly regulated. Lead agency responsibilities are complex in such a scenario, highlighting the need for regular cross-sector exercises. This scenario is unlikely to impact people's safety but could impact the welfare of large animals on the vessel. This scenario explores the implications of a port becoming blocked. Generally, there are contingencies in place for such an event.
Remote transport / hazardous material (HAZMAT) incident A bus crashes with a vehicle carrying HAZMAT in a remote location.	Such complex incidents require regular cross-agency and cross-sector exercises to identify detailed areas of concern. Response resources would be drawn from around the state. Current regulations and associated work practices for transporting HAZMAT are key to reducing risks.
Structural collapse A legacy historic building collapses in a central business district.	While there are national concerns surrounding building standards, Tasmania's building regulations reduce risks more than in many other states. However, in some cases it can be difficult to enforce fire safety regulations.
Major cyber outage The state experiences prolonged internet and telephone outages.	Cyber risks threaten organisations worldwide. Telecommunications providers prevent most of these threats. However, cyber outages can still occur and cause damaging consequences. Organisations and individuals need to be prepared. This assessment highlights the importance of business continuity and contingency planning.

Table 0.2 summarises the maximum likelihood and consequences of the assessed scenarios and associated hazards. Similar scenarios with less consequences can occur more often.

Table 0.2 TASDRA scenario likelihood and consequence summary matrix

Likelihood	Consequence (exposures) Moderate	Consequence (exposures) Major	Consequence (exposures) Catastrophic
Almost every year (>63% AEP - Annual Exceedance Probability)			
1:1-9 years - Very high (>10-63% AEP)	**East Coast Low** – Landslide/ rockfall (slope failure)	'Black January' – Heatwave East Coast Low – Severe storm Coastal storm surge	Major cyber outage
1: 10-99 years - High (>1-10% AEP)	**East Coast Low** – Dam failure (Class C agricultural dam) **East Coast Low** – Oil spill **Marine accident in a port**	**Black January** Smoke exposure **Major traffic incident/HAZMAT** **Structural failure legacy building** **Biosecurity** – Mediterranean fruit fly, Shellfish biotoxins	'Black January' – combined hazards, bushfire East Coast Low – combined hazards, flooding Respiratory pandemic Biosecurity – FMD, avian influenza, Didemnum vexillum
1: 100-999 years Moderate >0.1 – 1% AEP)			
1:1K-9,999 years – Low (>0.01-0.1% AEP)			
1: >10K years (>0.01% AEP)			**East Coast tsunami**

Informing evidence-based risk reduction to protect what we value

TASDRA supports evidence-based decisions to improve disaster resilience in Tasmania, as well as a proactive approach to managing disaster risks. Managing risk means protecting what we value. The assessment raises questions about our individual and collective tolerance for risk. Managing risk means being explicit about how and why we balance competing priorities and the degree to which we are comfortable living with risk.

Recognising and building on current measures

TASDRA concludes that Tasmania has many existing measures in place to mitigate and prepare for disaster risks but identifies some potential areas to further reduce risks. While unfolding disasters grab headlines and attention, one of the state's most significant risks is that a lack of newsworthy stories about DRR measures means existing measures are ignored, discontinued or under-resourced.

Exploring systemic vulnerabilities that increase exposure to disasters

Building on the national work behind the Australian Vulnerability Profile, this assessment explores the issues summarised in Table 0.3. Disaster risk is complex and can involve interconnected vulnerabilities. One of Tasmania's risks in the face of disasters is to not recognise this complexity. Over-simplified assessments can only produce simplistic solutions. Addressing these issues can reduce risk across all types of disasters.

Table 0.3: Key areas to reduce risk/ increase resilience identified through TASDRA

Continuity of supply and access to information and services	Placement and quality of buildings and other assets	Risk ownership and other assets	Governance and collaboration	Individual and community capabilities
Supply chain resilience and protection of significant assets	Strategic land use planning policies	Private and public ownership of risk	Collaborative, integrated and supported decision-making structures	Community engagement
Information and communications	Building regulations and their implementation	Risk reduction/ risk transfer	Agile and integrated plans and planning processes	Support for people at increased risk
Community capacity to cope with supply disruption	Legacy land use and building decisions	Risk information access and awareness	Cross agency/ sector exercises and other learning loops	Animal welfare in disasters

Supporting collaborative action

Disaster resilience and risk reduction is everybody's business. The Tasmanian Government is a primary coordination point and works with other levels of government, sectors and communities to reduce disaster risks across the state. DRR often involves issues that do not fall within the remit of a single agency or even one level of government or sector. This assessment report provides a rich picture of disaster risks affecting Tasmania to support collaborative actions to reduce risks. TASDRA allows relevant parties to see how their actions and risk intersect with others.

Iterative and adaptive risk management

As disaster risk is complex, measures to reduce those risks often require iterative learning cycles across sectors, communities and governments. TASDRA identifies potential measures to inform:

- a renewed State Risk Treatment Register, overseen by the State Emergency Management Committee's (SEMC) Informed Risk Management sub-committee
- municipal risk assessments and risk management plans
- Tasmanian Government agencies' risk management strategies and related initiatives
- the development of further information and advice for the community
- critical infrastructure providers and other large organisations' risk management
- Government, private and not-for-profit organisations supporting Tasmanians before, during or after disaster events.

Proposed measures to further reduce hazard-specific, state-level disaster risk tend to focus on:

- understanding the hazard and related exposures
- preventing the hazard from occurring, where possible
- detection and warnings
- reducing the consequences of the hazard when it occurs, for example, through response and recovery; arrangements and measures to reduce exposure
- community engagement and capacity issues specific to that hazard.

Suggested state-level, cross-hazard, high-priority areas actions to reduce disaster risk include the following.

1. Business continuity and contingency planning, particularly for essential government services but also support for businesses and individuals to cope with disruption, for example, cyber outages.
2. Ensure current strategic land use planning policy development and its implementation reflects disaster risk considerations relating to where and how houses and other assets are built.
3. Regular inter-agency and cross-sector exercising of complex events.
4. Continue support for national-level actions to increase the resilience of critical infrastructure of national significance. Extend to assets of state and local significance as resources allow (local-level assets through municipal risk assessment and management plans (a follow-on project to TASDRA).
5. Explicitly express state-levels of tolerable/accepted risk where possible to guide planning and risk reduction. Such tolerance levels should not only focus on hazards but also exposures and vulnerabilities[1].
6. Review efficacy of existing community communications to increase uptake and engagement.
7. Emergency services work with community service providers to support people at increased risk in disasters in ways that suit those individuals' specific needs (implementation of the People at increased risk in an emergency: A guide for Tasmanian government and non-government community service providers).
8. Consider and pursue measures to reduce legacy risks.
9. Review the suite of state-level plans that sit under the Tasmanian Emergency Management Arrangements (TEMA) to reduce duplication to aid accessibility and increase agility plus clarify some specific areas of responsibility noted in this report.
10. Strengthen cross-agency/sector governance and supporting arrangements.

Part 1 of this report includes an introduction and background information. Parts 2, 3 and 4 outline the TASDRA scenarios and the expected consequences of these scenarios. Part 5 provides a cross-scenario assessment and explores systemic vulnerabilities that can increase exposure to many hazards.

1. Introduction

This Tasmanian Disaster Risk Assessment (TASDRA) explores the quick-onset disaster risks that might impact Tasmania. TASDRA assesses the state's exposure to these disasters then analyses vulnerabilities and capabilities that increase or decrease these risks. Understanding disaster risks is key to reducing them.

Tasmania has many well-developed risk reduction measures and capabilities. However, there is always scope for improvement, particularly in the context of global risk drivers such as climate change.

This TASDRA also highlights the need to be explicit about who owns and is responsible for specific risks, and the degree to which Tasmanians accept risk when balancing other values against the costs to reduce risks. This report is organised in the following way.

- This introductory section provides background information.
- Part 2 explores three scenarios caused by geological events and extreme weather. These scenarios show how hazards often interconnect.
- Part 3 examines biological system risks of future respiratory pandemics and biosecurity incursions. Such scenarios illustrate the importance of preventing such events from occurring where possible.
- Part 4 includes scenarios related to socio-technical system risks including major transport incidents, structural collapse and cyber outages. These scenarios highlight the important role that regulation and compliance, business continuity and contingency planning play in reducing risk.
- Part 5 explores issues raised in many of the scenarios.

The TASDRA report includes three versions:

- A brief project and assessment overview.
- A summarised version, publicly available although intended for those working in emergency management and risk reduction in public, private and NGO sectors.
- An extended version accessible only to key stakeholders, including additional details.

By drawing on collective expertise and perspectives, this assessment provides rich insights into disaster exposures, vulnerabilities and capabilities relevant to Tasmania. TASDRA does not provide information and advice for communities but can inform the development of those resources.

1.1 Why assess disaster risk?

DRR not only reduces the consequences and costs of future disasters, it also supports Tasmania's sustainable development and broader community wellbeing[2]. Without a cross-hazard State Disaster Risk Assessment, Tasmanians' understanding of disaster risks is likely to be disjointed, resulting in gaps and duplicated effort.

1.2 Who is this assessment for?

This assessment aims to inform risk reduction measures that increase Tasmanians' resilience in the face of future disasters. Although intended for their benefit, TASDRA's intended audience is not the general public but decision-makers who can reduce disaster risks for Tasmanian communities.

- At the state-level, this assessment informs a revised Tasmanian Risk Treatment Register[3]. This plan prioritises actions that reduce disaster risks relevant at the state-level to help implement the Tasmanian Disaster Resilience Strategy.
- Tasmanian Government agencies can use the assessment to inform their risk reduction measures.

- Local governments can use TASDRA to help assess local risks and inform municipal emergency management planning.
- Community service providers can use TASDRA to inform their service development and delivery.
- Organisations may use the information to consider their exposures and vulnerabilities in the face of hazards to reduce risks and improve their resilience.
- Researchers may use this information to identify research gaps.

1.3 Context

TASDRA 2022 sits in the context of recent and unfolding catastrophic disaster events, international, national and state frameworks, and new ways of considering disaster risks. TASDRA builds on previous state risks assessments in 2016 and 2012. Each assessment has extended the scope of hazards covered and changed in line with emerging approaches to assessing disaster risk.

1.3.1. DISASTER RISK REDUCTION AND RESILIENCE

Disaster resilience involves working together to reduce disaster risks and prepare for disasters through understanding those risks[4]. Risk assessment supports evidence-based DRR to increase resilience and reduce vulnerability[5].

1.3.2. INTERNATIONAL, NATIONAL AND STATE FRAMEWORKS

Disaster risks need to be managed through integrating actions across communities, sectors and levels of government. While state governments have leading responsibilities, Tasmanian Government agencies need to work together and with others to reduce disaster risks.

Figure 1.1: TASDRA in the context of international, national, municipal, organisational and individual households' risk assessments

TASDRA is guided by and helps implement international, national and state frameworks, including the following:

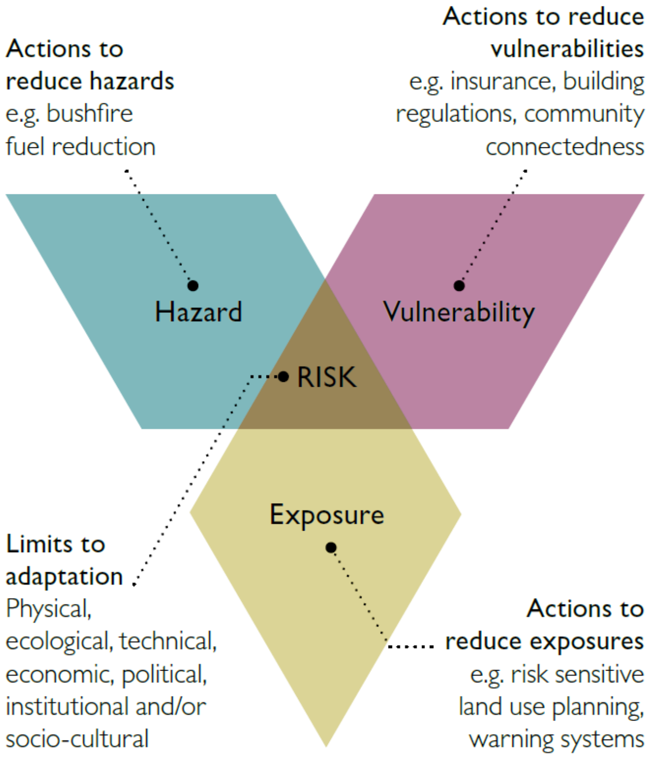
- United Nation's Sendai Framework for Disaster Risk Reduction. The Sendai Framework sits alongside the Paris Agreement on Climate Change and the Sustainable Development Goals to focus on future wellbeing and prosperity in the face of climate change and other global threats
- National Disaster Risk Reduction Framework (NDRRF)
- Tasmanian Disaster Resilience Strategy (2020-2025
- Tasmanian Emergency Management Arrangements (Issue 1 2019) (TEMA)
- Tasmanian Government's State Emergency Management Committee's (SEMC) priorities 2020
- Premier's Economic and Social Recovery Advisory Council's (PESRAC) recommendation on strategic risk management focusing on high-consequence risks to Tasmanian communities.

1.4 Some definitions and key concepts

Disaster risk assessment and approaches to reducing risks are rapidly changing in response to:

- international developments
- recent disaster events in Australia and elsewhere.

Figure 1.2: Risk as the intersection of hazard, exposure and vulnerability, adapted from [https://www.undrr.org/publication/ecosystem-based-disaster-risk-reduction-implementing-nature-based-solutions-0 p 16](https://www.undrr.org/publication/ecosystem-based-disaster-risk-reduction-implementing-nature-based-solutions-0)



The United Nations defines disaster risk as:

> The potential loss of life, injury or destroyed or damaged assets which could occur to a system, a society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity[6].

Contemporary approaches focus on risk as interconnected hazards, exposures and vulnerabilities and consider risks across hazards[7]. Traditionally, risk assessments have centred on specific hazards expressed as 'likelihood X consequence'. The focus was on mitigating risks associated with individual hazards, often by individual organisations. The TASDRA scenario descriptions include a summary assessment covering these areas in line with categories identified in the National Emergency Risk Assessment Guidelines (NERAG) (refer to Appendix 2).

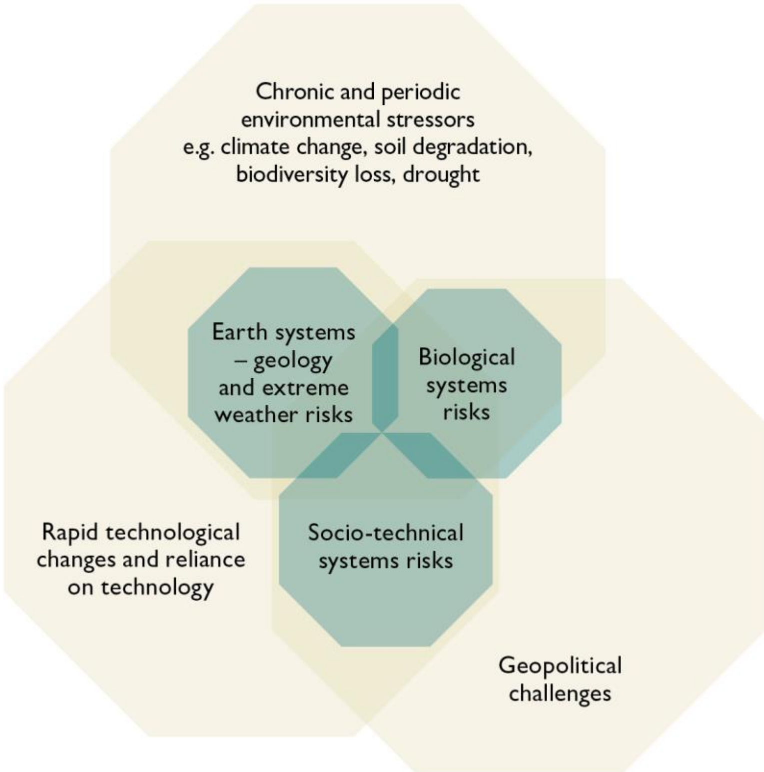
Historically, NERAG provided a well-established and consistent approach to assessing risk in Australia, aligned with international standards ISO 31000 – Risk management 2018 and the national equivalent ANZS 3100. However, NERAG is not intended to provide a comparative, cross-hazard understanding of all risks to a community[8] . Assessing the likelihood X consequence of specific hazards does not provide a rich picture needed for whole-of-society assessments such as TASDRA. Society-wide, cross-hazard assessments such as TASDRA need to recognise that risk can result from compounding stressors that no single organisation can manage[9] (refer to Section 5.2.4). Addressing them relies on systems thinking and iterative, adaptive actions to reduce risk in key areas. Considering interacting hazards, exposures and vulnerabilities introduces complexity[10]. However, this is a more robust lens to understand disaster risk. Part 5 explores these issues in relation to all the TASDRA scenarios.

United Nations guidelines describe disaster risk assessment as:

> A qualitative or quantitative approach to determine the nature and extent of disaster risk by analysing potential hazards and evaluating existing conditions of exposure and vulnerability that together could harm people, property, services, livelihoods and the environment on which they depend[11].

As the area of risk management is rapidly changing, so too is some of the terminology. This assessment uses the term 'measures' or 'disaster risk reduction' (DRR) to refer to actions that reduce risks, in line with the Sendai Framework. These terms replace the terms 'controls' and 'treatments'.

Figure 1.3: Earth system, biological and socio-technical system risks in context



1.4.1. TYPES OF DISASTERS

This assessment avoids categorising disasters as 'natural' or 'man-made'. The distinction between the two is not always clear. TASDRA explores risks relating to the systems that sustain us, including:

- Earth systems – geology and extreme weather
- Biological systems – life systems can also produce pathogens causing pandemics/epidemics, pests and other biosecurity incursions
- Socio-technical systems – major accidents or outages in the infrastructure or technical systems that underpin modern society.

TASDRA's assessment of quick-onset, acute disasters sits in the context of:

- chronic or slow-moving stressors, such as climate change and ecosystem degradation
- periodic slow-onset stressors, for example, drought
- geopolitical acute, periodic or chronic stressors, outside the scope of this assessment12.
- human migration and deployment and geopolitical changes13.

TASDRA sits alongside other risk assessments focusing on climate change risks and other risks to Tasmanian communities. Box 1.1 provides a snapshot of climate change projections for Tasmania.

Box1.1 Climate change projections for Tasmania[14]

Recorded extreme weather events have increased by 90% over the past 20 years worldwide[15]. Climate change influences the frequency, intensity or duration of many weather-related hazards in TASDRA.

Temperature

Global warming is very likely to increase the intensity and frequency of hot extremes[16]. Tasmania's average temperature is expected to increase at least 1.5°C by 2050. The 2021 Intergovernmental Panel on Climate Change (IPCC) report on Climate Change 2021: the physical science basis, suggests there are likely to be more increases. This may involve about a 3°C temperature rise across the state and a more than 4°C rise in alpine regions after 2050[17].

Increased temperatures bring more frequent and longer heatwave events. For example, Launceston is likely to have three times the number of heatwave days by 2070-2099 compared with 1961-1990. The city currently has a severe or extreme heatwave about every two years. By 2100, this is projected to increase to two per year and be of far greater duration[18].

Soil dryness

Soil dryness is likely to gradually increase due to evaporation and reduced rainfall[19]. Increased soil dryness increases bushfire risk. For example, lightning strikes are more likely to ignite a bushfire.

Fire danger

Projected rising temperatures and increased soil dryness will increase bushfire risks across the state's different types of landscapes[20]. By the end of this century, it is highly likely to increase eight-fold[21]. All assessments show fire seasons will be longer, with sharper transitions between winter and summer resulting in a reduction in the length of fire management seasons (late spring and early autumn)[22]. The soil will be drier, the vegetation drier and there will likely be more lightning strikes[23]. Some areas will probably become at risk of bushfires for the first time in thousands of years[24]. There is also increasing risk for human settlements due to a drier landscape more prone to ignite or from smoke from fires in remote areas.

Rainfall

Tasmania is likely to experience less annual rainfall in future. However, this prediction is less certain than projections for temperature, fire danger and soil dryness due to differences between different model outputs. Earlier assessments suggested there will be more rainfall in summer and autumn, less in winter and spring, and minimal change annually[25].

More recent research suggests annual rainfall will gradually decrease, with fewer westerly, rain-bearing fronts moving across the state[26]. Regions over 800 metres high are likely to become even drier[27].

As air temperatures warm, rainfall intensity increases[28]. However, a larger driver of rainfall intensity is the type of weather system. In Tasmania, East Coast Low events typically carry the damaging, high-intensity rainfalls that cause severe flooding [29]. Current modelling does not show these patterns increasing or decreasing but does show these intense events will keep occurring.

Sea level rise

In Tasmania, sea level is expected to rise by 0.8-1.0 m by 2100, exposing some low-lying regions with human and industrial settlements[30]. Local governments responsible for these areas are mindful of this issue and are developing community awareness and management responses. In 2016, the Tasmanian Government engaged CSIRO to develop statewide sea level rise planning allowances to guide new coastal developments. Following this rate of sea level rise, exposed places are projected to see what is now a 1-in-100-year coastal inundation event move towards an event occurring almost every year (annual high tide). However, these at-risk regions are small, well-defined and known by relevant management authorities.

1.5 Our approach to assessing risk

Disaster risk assessment is multidisciplinary. The TASDRA project focused on engaging and collating many different areas of expertise and perspectives. TASDRA is predominantly a qualitative assessment, but uses data, mapping and other quantitative data where possible. The TASDRA assessment is consistent with NERAG, but with modifications to align with emerging national and international approaches. We call our approach NERAG+ (i.e. NERAG plus).

TASDRA centres around exploring a series of different disaster scenarios that could happen in Tasmania. None of these scenarios are likely to happen exactly as described but are examples of possible events. By reducing the risks raised by these scenarios, Tasmania can reduce the risks and be more prepared for other disaster events.

The scenario assessment workshops each involved subject matter experts and key stakeholders from:

- relevant Tasmanian Government agencies
- local government
- Australian Government agencies such as the Bureau of Meteorology (BOM)
- critical infrastructure and service providers
- private sector and industry groups
- not-for-profit organisations.

1.6 Protecting what we value

What can't we do without? What do we need to protect?

These questions drive our assessment and risk management. The answers can differ between people, driven by our individual and collective values[31]. Values can often be in tension and cannot be reconciled – there must be trade-offs[32]. These values underpin risk tolerance levels and they are constantly negotiated and can change over time. What people value, and their risk tolerance, may be different in times of stability and may change during disasters when values that are taken for granted can be threatened[33]. Individually and collectively, we need to be explicit about the choices made to reduce or accept risk and the values that drive those decisions (refer to Section 5.2).

At this state-level assessment, we focus on exposure to, and consequences from, hazards related to:

- people's health, safety and wellbeing
- maintaining the core functions that individuals and communities rely on (such as critical infrastructure and services, essential services)
- economic impacts – direct damage or loss of assets or interrupted business activity plus indirect industry or employment losses
- protecting Tasmania's environment
- community and cultural values, including community displacement, isolation and cohesion plus protection of irreplaceable cultural assets[34].

1.7 Scope

TASDRA focuses on sudden-onset or acute disaster scenarios that would most likely need a state-level response or draw on resources from all regions. The TASDRA scenarios cover the hazards in Table 1.1.

Table 0.1: TASDRA scenarios	Hazards included
TASDRA Part 2: Earth systems – geological and extreme weather events	
East Coast tsunami	Tsunami
'Black January'	Bushfire, heatwave, extended bushfire smoke exposure
East Coast Low	Severe storm, flash flooding, riverine flooding, debris flow, landslide, dam failure, coastal storm surge/inundation, rockfall
TASDRA Part 3: Biological systems	
Respiratory pandemic • Pandemic influenza • Novel coronavirus • Zoonotic disease	Pandemic extended from influenza to respiratory generally
Biosecurity incursions • FMD • Avian influenza • Medfly • Shellfish biotoxins • *Didemnum vexillum*	Example biosecurity incursions covering animal disease, pest incursions in land and marine environments impacting both industry and natural values
TASDRA Part 4: Socio-technical systems	
Major maritime incident in a port	Transport accident - maritime
Major traffic incident	Mass-casualty traffic event, hazardous materials
Building collapse	Structural failure
Statewide cyber outage	Focusing on disruption impacts

TASDRA considers several scenarios with compounding or cascading hazards. The scenarios do not cover concurrent emergencies, except to consider the scenario in the ongoing context of COVID-19.

TASDRA 2022 does not include:

- chronic stressors, or risk drivers, such as climate change[35], soil erosion, ecosystem damage or loss, longer-term public health issues, for example, obesity or smoking
- periodic, slow-onset stressors, such as drought
- hazards that do not typically impact Tasmania, such as volcanos, volcanic ash clouds or cyclones

- risks primarily assessed at the national level, such as –
    - space debris and solar storms
    - terrorism/intentional violence, war or other geopolitical risks
    - national level supply chain issues such as finance, fuel supply, medical supplies
- economic, sociopolitical or financial stressors, except as potential consequences of the sudden-onset disasters explored through the scenarios
- earthquake (as Geoscience Australia (GA) was concurrently mapping Tasmania's earthquake risks).

1.7.1. VULNERABILITIES / CAPABILITIES EXPLORED

Building on Profiling Australia's Vulnerability, key areas of systemic vulnerability considered include the following.

1. Continuity of supply and access to information and services
2. Placement and quality of buildings and other assets
3. Risk ownership and transfer
4. Governance and collaboration
5. Individual and community capabilities

Part 5 explores these vulnerabilities in relation to all scenarios.

1.7.2. A THREE-DIMENSIONAL VIEW OF RISK

This assessment builds a three-dimensional view of disaster risk in Tasmania, as summarised in Table 1.2.

Table 1.2: a three-dimensional view of risk in Tasmania

1. Hazards	2. Consequences and exposures	3. Vulnerabilities (capabilities)
• Tsunami • Bushfire/heatwave/smoke exposure • Storm, coastal storm surge, flood, landslide/rockfall, dam failure, oil spill • Pandemic • Biosecurity • Transport/HAZMAT • Structural collapse • Cyber outage	• People's health, safety and wellbeing • Economic • Environment • Core functions • Community and culture	• Continuity of supply and access to information and services • Placement and quality of buildings and other assets • Risk ownership and transfer • Governance and collaboration • Individual and community capabilities

The scenario descriptions in the following sections only describe arrangements specific to that event that build on generic frameworks and arrangements outlined in Box 1.2 below.

Disaster events often produce some similar consequences. For example, they create stress and other mental health concerns. Such common concerns are only mentioned briefly in the scenario descriptions and are explored further across all scenarios in Part 5.

Box 1.2: Frameworks and arrangements for all disaster events

The *Emergency Management Act 2006* provides for a suite of policy functions and powers. There is other legislation covering specific areas, as noted in this report.

The Tasmanian Disaster Resilience Strategy 2020-2025 provides a vision of a more disaster-resilient Tasmania and paths towards that vision.

The Tasmanian Emergency Management Arrangements (TEMA) outlines a consistent, flexible and scalable approach in line with national principles across all types of disaster events. TEMA outlines responsibilities for specific types of emergency events and supporting functions that can cross many or all types of events, for example relief and recovery arrangements.

While everybody has a part to play in reducing disaster risks, TEMA outlines some key coordinating State Government roles and responsibilities. The SEMC oversees policies and capabilities to reduce disaster risks in Tasmania.

Please refer to the TEMA for further details.

2. Earth systems risks – Geological and extreme weather events

Earth's climate, weather patterns and geology sustain life on earth, but can also produce risk. Part 2 includes three disaster scenarios exploring the types of extreme weather and geological events that Tasmania experiences.

- The first focuses on a major tsunami event, a single hazard that could cause catastrophic consequences with very little warning.
- The second 'Black January' scenario explores a major bushfire event driven by heatwave conditions and producing extensive smoke exposure.
- The third scenario describes a major East Coast Low weather system producing a severe storm, coastal storm surge, flooding including debris flow, landslide, dam failure and an oil spill. This scenario explores how hazards can cascade and their consequences compound in the one event.

This assessment does not cover earthquakes as GA was concurrently mapping earthquake hazards for Tasmania. Box 2.1 summarises the 2016 TSNDRA assessment for an earthquake scenario.

All three scenarios in this assessment raise issues that cross many or all disaster scenarios, such as:

- the key role of land use planning and building standards in reducing disaster risks (refer to Section 5.2.2)
- community involvement in mitigating risks (refer to Section 5.2.5)
- extra considerations for those at increased risk during emergencies due to health or mobility issues, language/ learning or other socioeconomic issues (refer to Section 5.2.5)
- the importance of cross-agency and cross-sectoral collaboration and coordination to mitigate risks (refer to Section 5.2.4).

These scenarios highlight the potential weaknesses in a hazard-by-hazard risk assessment and management. They also show that, while reducing the chances of such events occurring is important, we must also prepare for such events.

Box 2.1: 2016 TASDRA earthquake assessment summary

Likelihood	Extremely rare (>10 000 years)
People's health, safety and wellbeing	Moderate
Economic	Major
Environment	Major
Core functions	Major
Community and culture	Moderate

2.1 Tsunami impacting East Coast

A tsunami originating from an earthquake south-west of New Zealand impacts the East Coast of Australia, including Tasmania. The first tsunami wave arrives on a Saturday night and coincides with a high spring tide.

This scenario is a reasonable worst-case tsunami event for Tasmania. Although rare, it would have catastrophic consequences. While Tasmanians cannot prevent such a geological event, they can mitigate some of the risks and prepare.

2.1.1. BACKGROUND AND RATIONALE

Mainland Tasmania and its 334 islands have 4 882 km of coastline. The state's many coastal communities are exposed to a tsunami event. Recent tsunami events in Japan, Indonesia, New Zealand and elsewhere show how destructive large tsunamis can be for modern-day communities. Research has detected unusual wave activity around Tasmania at least 16 times since 1852. This was likely due to a tsunami event[36].

A tsunami is a series of waves due to a sudden displacement of water. They affect coastal areas over several days[37]. Tsunamis are commonly caused by large earthquakes in subduction zones, but can also result from volcanic eruptions, landslides and meteorite strikes[38]. While wind-generated ocean waves only cause movement of water near the surface, a tsunami involves movement of the entire water column from the surface to the sea floor[39].

In the deep ocean, the wave height of a tsunami is usually less than two metres. As a tsunami approaches shallower waters around a coastline, it slows down and grows in height. It may inundate the shore as a wall of water, a steady rise/fall in water level, a fast-moving bore or sometimes large breaking waves. Harbours, bays and lagoons can create a funnelling effect, amplifying the waves and so the impact of the tsunami.

Tasmania has not been significantly impacted by a tsunami in its recent history. However, the subduction zones from Papua New Guinea to New Zealand mean Tasmania can be impacted by tsunamis. GA identified the greatest tsunami risk to Tasmania is likely to be from the Puysegur Trench to the south of New Zealand. The extent of inundation (if any) would depend on:

- the size and type of the earthquake
- the size of the tsunami it generated
- several other factors, including the tide, shape of the seabed and topography of the coastline.

The Puysegur Trench has the shortest tsunami arrival time of about two hours[40]. Other tsunamis may impact Tasmania differently, depending on source location and tsunami approach direction.

Considering a major tsunami event provides insights for other disaster events with little warning. Many of the insights are also relevant to coastal storm surge.

2.1.2. EXAMPLE SIMILAR EVENTS

Event	Date	Trigger	Impact Summary
2012 Puysegur Trench	19 Jan	Magnitude 6.2 earthquake Puysegur Trench	Tide Gauge at Southport recorded 170 mm mean wave height (MWH).
2004 Boxing Day tsunami	26 Dec	Magnitude 9.0 earthquake Indonesia	Tide Gauge at Spring Bay recorded 600 mm MWH
1953 Bridport 'freak wave'	14 Nov	Not known	Freak wave travelled up Brid River, approximately 2.4 m high. Damaged jetty and one child drowned.
1883 Krakatoa eruption	27 Aug	Volcanic eruption Indonesia	Tidal disturbance at the Huon River, up to 900 mm higher.

2.1.3. SCENARIO OVERVIEW

9:00 pm Saturday	**GA registers Mw 8.7 earthquake on the Puysegur subduction zone south-west of New Zealand.**
9:10 pm	GA has warned BOM. BOM/Joint Australian Tsunami Warning Centre (JATWC) assesses earthquake location and size and matches with pre-modelled scenario to determine estimated risk level.
9:20 pm	JATWC issues a bulletin: Tsunami Watch or, if risk is < 90 minutes, a Tsunami Warning.
9:30 pm	Tsunami risk confirmed as it passes by the JATWC dart buoy network. BOM issues tsunami risk to notify relevant agencies and media outlets. Response begins in line with TEMA and Tsunami State Special Emergency Management Plan (SSEMP).
11:00 pm – 12:00 am	First tsunami waves arrive at the coast, with example local impacts as follows. • ~ 7 m waves off Eaglehawk Neck, ~ 5 m at Carnarvon Bay, ~ 4 m at Nubeena • Sand, flooding and washout may compromise Tasman Highway at Eaglehawk Neck • Flooding of properties at Nubeena and Carnarvon Bay, Stewarts Bay • Flooding and damage to Port Arthur Historic Site, strong currents in harbour • Orford – Triabunna - Incoming wave ~ 4 m AMSL • Scamander, St Helens, Bay of Fires: Incoming wave height ~ 5 m (~ 2 m at St Helens) • Hobart Harbour, Central Business District, Self's Point - Wave ~ 3 m above mean sea level
Following 48 hours	Possible further large waves and strong or unusual currents for 2-3 days.

2.1.4. EXPOSURES AND CONSEQUENCES

A tsunami event could cause catastrophic consequences with long-term consequences for the whole state. The following descriptions are from workshop participants plus follow-up specialist input.

People's health, safety and wellbeing

This tsunami event could cause deaths, major injuries or missing people. As the scenario's tsunami first appears on a summer weekend night, there would be many sleeping in isolated coastal campgrounds. While there would be warnings, it can be difficult to know if people receive them and act upon them. People's immediate safety during and immediately after a tsunami will rely on public communications. While digital emergency alerts will reach many people, there are mobile 'black spots' in Tasmania.

Due to Tasmania's geography, people do not have to evacuate far to be safe from a tsunami – 10 m above sea level. There can be recurring tsunami waves and strong, unusual currents for many hours after the initial wave(s). People would not know they should not return to coastal areas until advised.

People at increased risk in a tsunami and other disaster events are covered further in Section 5.2.5.

Economic

A tsunami event such as this scenario could have catastrophic economic consequences. As well as direct tsunami damage to assets, people may not be able to work as they respond to personal impacts. There are likely to be long-term economic impacts statewide, not just in directly impacted areas, for example:

- the event would impact Tasmania's aquaculture and fishing industries
- coastal-based tourism operations may lose assets and the surrounding ecosystems on which their businesses depend
- structural damage of dock areas may impact freight services and organisations that use the port.

Environment

Such a tsunami event is likely to have major environmental impacts on marine and coastal areas.

A tsunami would disturb zinc and lead in the Derwent Riverbed, with contamination spread to surrounding areas. Sewage from wastewater treatment plants, septic systems and waste management disposal may cause contamination and health concerns. There would be large amounts of debris and waste.

Tsunami waves may change seabeds and damage niche habitats via erosion and sediment re-deposition. Tasmania may lose native species due to habitat loss, for example the spotted handfish in the Derwent Estuary. Damage to aquaculture facilities could disperse marine debris, impacting marine wildlife.

Inundation and/or salinity could also damage coastal land habitats, impacting native animals, native vegetation and agricultural land.

Core functions

It is likely there would be major impacts on Tasmania's coastal critical infrastructure and services with budget implications for State and local governments. Examples include the following.

- Emergency, health and community services may not be able to access affected areas. While modelling suggest the Royal Hobart Hospital would not be inundated, there may be access issues.
- Transport routes and access will be compromised in affected areas. Infrastructure will need to be assessed, repaired or replaced to re-establish connections to multiple small coastal communities. Access through Hobart's CBD and the broader southern region may be difficult. A tsunami is unlikely to directly damage the Tasman Bridge but wharves and port operations could be damaged. The waves are unlikely to impact Hobart's airport, despite it being near the coast and low lying. This is because it is protected by sand dunes.
- Sewerage plants and outlets are often near the shoreline and so are exposed. If unable to operate, there may be environmental and health implications. Mains drinking water may need to be boiled due to potential microbiological contamination or not consumed.
- There may be loss of telecommunications and power as the tsunami damages underwater cables and coastal assets.
- Isolated communities may lack supplies and services and would need support. All councils, the Department of State Growth (State Growth) and private providers will need significant surge capacity.

Community and culture

A major tsunami event is likely to have major consequences for Tasmanian communities, culture and cultural heritage. Some of the consequences could include:

- loss of irreplaceable and significant community assets
- disruption to community activities
- displacement, isolation and loss of connection to place.

A major tsunami will disrupt many Tasmanians' recreation pursuits and, in some cases, livelihood. Loss of coastal homes, shacks (holiday homes), marinas, and other assets might mean the loss of a distinctly Tasmanian way of life, at least for a time. People with damaged or destroyed homes may choose not to rebuild or repair due to longer-term climate change sea level rises or safety or the reason for living in the area may be gone. This can change communities.

2.1.5. SYSTEMIC VULNERABILITIES

Some of the themes this scenario helps to uncover are relevant to other disaster scenarios, including:

- warnings to, and evacuation capabilities for, dispersed populations (refer to Section 5.2.3)
- community awareness of risk and risk ownership (refer to Section 5.2.3)
- cross-agency/sector planning, exercising for very rare events (refer to Section 5.2.4)
- coastal land use planning, placement of key assets and infrastructure (refer to Section 5.2.2).

These issues are relevant to many disaster scenarios and they are explored further in Part 5.

2.1.6. ASSESSMENT SUMMARY

There are no changes in the assessment summary since 2016.

Maximum risk level	**High**
Max. consequence	Catastrophic
Analysed scenario	>10k years – Very low
Similar events (less severe, other tsunami sources)	10-99 years – Moderate
Consequences/exposures	
People's health, safety and wellbeing	Catastrophic (no change)
Economic	Catastrophic (no change)
Environment	Major
Core functions	Major
Community and culture	Major
Confidence	High

2.2 'Black January'

It is mid-January during drought conditions. A dry lightning storm ignites a campaign (long-term) fire in the north of the state. There are heatwave conditions across the south and east of the state, and bushfire smoke spreads across Tasmania. An ignition on an extreme hot weather day threatens south of Hobart.

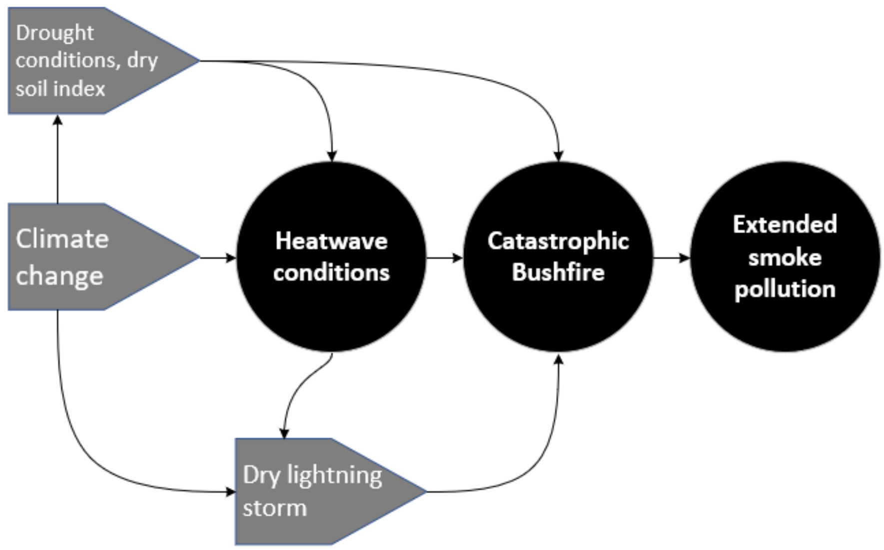


Figure 2.1: 'Black January' interlinked hazards

This scenario shows how disaster events often involve multiple interconnected hazards. This suggests we need to further strengthen governance arrangements around managing multi-hazard events and learn from regular exercises covering multiple hazards.

The scenario also shows that such events need a whole-of-society response. Individuals and communities have active roles in mitigating risks and in knowing what to do when disasters occur. Tasmania has considerable capabilities in bushfire risk reduction and resilience. Current institutional knowledge and skills combine with Tasmanians' lived experience of previous bushfire events. The fact that no deaths occurred in recent bushfires reflects growing resilience in the face of bushfires. However, Tasmanian communities are still vulnerable to bushfires and there is always more that can be done.

2.2.1. RATIONALE AND BACKGROUND

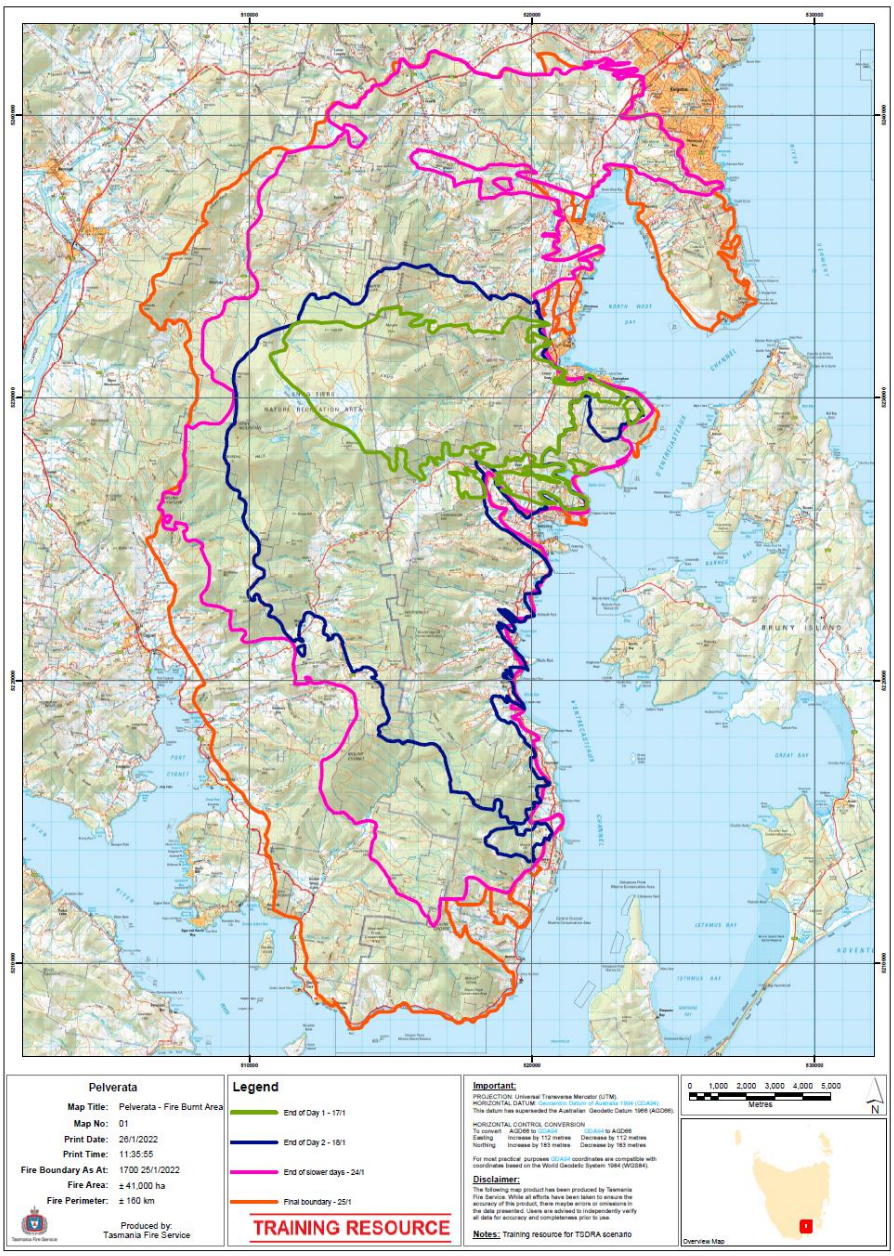
Historical events in Tasmania suggest that a bushfire event such as a 'Black January' scenario is likely to occur. Climate change predictions suggest heatwave and drier conditions producing high bushfire risk conditions could occur more often and with more intensity. Bushfire events are more likely to occur during heatwave events and can produce smoke pollution far from the fire front.

Bushfire

Bushfire in the landscape has a long history in Tasmania, with Aboriginal people using it productively[41]. However, in hot and dry conditions, bushfires can easily become out of control. South-eastern Tasmania historically has had the highest fire danger recorded days and the most significant bushfire events, but many areas of the state are at risk.

The 2016 TSNDRA concluded bushfire was Tasmania's most significant risk. This was based on a 1967-type bushfire scenario, with 39°C maximum temperatures and hot dry winds. This assessment updates the weather conditions to reflect more recent bushfire events in heatwave conditions.

Figure 2.2: Example bushfire spread map for the 'Black January' scenario (source: Tasmania Fire Service)



Tasmania has extended dry periods in summer during an El Niño event. In these times, major fires will burn in all vegetation types. This includes wetter forest types which would not burn in normal conditions. Weather conditions for bushfires are becoming more frequent due to climate change. Bushfires caused by lightning in the Tasmanian Wilderness World Heritage Area (TWWHA) have become more common since 2000[42].

Smoke exposure

Previous assessments only considered smoke as a consequence of bushfires. However, recent events show smoke can impact much wider areas than those directly impacted by bushfire. As climate change likely increases the number and intensity of bushfires, Tasmanians will be exposed to more bushfire smoke[43].

Smoke includes several components. Particulate matter, or PM, is the most relevant for human health[44]. $PM_{2.5}$ is small and can travel deep into the airways and cross into the bloodstream. The higher the concentration, the greater the potential for health outcomes.

Frequent minor to moderate episodes of air pollution generally have greater death and hospitalisation rates than less common and severe short-lived episodes[45]. Smoke from planned burns is common but typically lasts less than 1-2 days. Smoke events from major bushfires are not as common but may be more extreme and last several days or weeks. An example is the smoke exposure to Huon Valley residents during the 2019 fires. The 2019-20 'Black Summer' fires in south-eastern Australia created large-scale, prolonged and extreme smoke pollution. This smoke is estimated to have caused more than 400 deaths[46].

Table 2.1: PM2.5 1 hour average concentration categories and reducing exposure to smoke

Short description	What the conditions are like	What this means
Good	Beautiful	Enjoy the outdoors. Typical background concentrations throughout Tasmania are usually lower than 5.
Fairly good	Generally good, it might appear a little hazy	This could mean air quality is beginning to get worse. Keep an eye on conditions. If the smoke has been much worse and is now improving, this is a good time to open and air your house.
Fairly poor	Smoke can be seen or smelt when $PM_{2.5}$ is over 25	The smoky air could worsen the health of people at higher risk from smoke. People at higher risk from smoke should monitor any health conditions closely and consider taking action to reduce the smoke they breathe.
Poor	The air will be smoky. Distant landmarks may not be visible	The smoky air could worsen the health of people at higher risk from smoke. People at higher risk from smoke should take action to manage any health conditions and reduce the smoke they breathe.
Very poor	It will likely be very smoky and unpleasant for everyone	This represents severe air pollution. People at higher risk from smoke should take action to manage any health conditions and reduce the smoke they breathe (Box 1). People not in high-risk groups should reduce their exposure if practical.
Extremely poor	Visibility is very poor	This represents extreme air pollution. Everyone should take action to reduce the smoke they breathe.

Reducing individual exposure to smoke

- Stay up-to-date about local conditions so you can plan your activities.
- Stay indoors, and close doors and windows.
- Open and ventilate your home when smoky conditions have passed
- Turn your air-conditioner to recirculate.
- Consider using an air cleaner with a HEPA filter. Make sure the cleaner is the right size for the room.
- Exercise in airconditioned facilities rather than outdoors

Heatwave

Heatwaves, or extreme heat events, occur when unusually hot weather for that time of year extends for three or more days. In Australia, heatwaves are measured by comparing:

- the forecast three-day mean daily temperature
- the previous 30-day mean observed temperature
- the location's baseline observed temperature.

Heatwave forecasting depends on location and time of season, making the threshold temperatures experienced in a heatwave varied both across Australia and across the summer season. For more information, refer to BOM's information on understanding heatwaves.

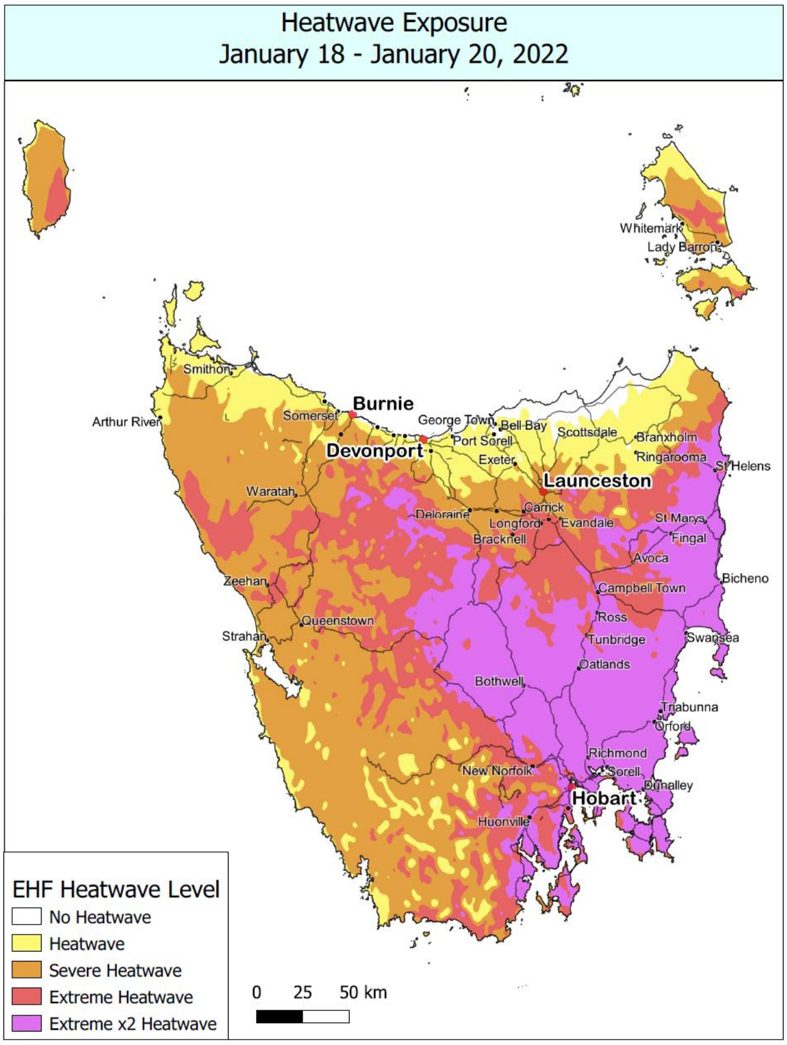
The 2016 TSNDRA assessed heatwave hazard for the first time. Heatwaves cause more deaths in Australia than all other natural hazards combined[47]. Many people are not aware that heatwaves can be a risk in Tasmania.

2.2.2. CURRENT ARRANGEMENTS

Scenarios similar to 'Black January' would involve fire response and DoH as lead hazard advisory and response authorities, supported by other agencies in line with TEMA.

Bushfire

Figure 2.3: 'Black January' scenario example Heatwave exposure mapping (G Williamson, UTAS)



Produced by Grant Williamson, University of Tasmania, 2021-05-04

Tasmania Fire Service (TFS), Parks and Wildlife Service (PWS) and Sustainable Timber Tasmania (STT) are Tasmania's bushfire hazard management authorities. Alongside the TEMA, the State Fire Protection Plan (SFPP) outlines arrangements for fire and fire-related hazards.

Smoke exposure

Environment Protection Authority (EPA) Tasmania manages ambient air quality measurements and provides near real-time air quality readings online.

DoH adds to the EPA data and provides information on the potential health impacts of the air quality, and what to do to reduce smoke exposure.

Heatwave

DoH is the response management authority for extreme heat events in Tasmania.

2.2.3. EXAMPLE SIMILAR EVENTS

The scenario used for this assessment is similar to recent events.

- On 13 January 2016, lightning ignited over 80 fires in Tasmania and burnt 125 000 ha[48].
- The Riveaux Road fire of 2019 burnt nearly 64 000 ha in the Huon area of southern Tasmania.

Some other similar historic events include the following.

Event	Area Burnt	Deaths	Estimated cost
Australian mainland 'Black Summer' bushfires 2019-20	24 million ha	33	5 900 buildings including 2 779 homes destroyed, $4.4 billion response costs, $103 billion losses
Dunalley and concurrent bushfires January 2013	20 000 ha	0	$90 million
'Black Saturday' Victorian bushfires 2009	430 000 ha	173	$4.4 billion
'Black Tuesday' Hobart and surrounding areas February 1967	264 270 ha	62 (900 injuries)	$45 million (est $485 million in 2010 terms)

Significant bushfire events in Tasmania in 2013, 2016 and 2019 exposed Tasmanian communities to widespread smoke exposure. Multiple nationwide bushfire events in the 2019-20 summer season affected over 80% of the Australian population and led to above national air quality standards for several weeks.

Severe and extreme heatwaves are rare in Tasmania compared with other states. However, climate change is causing heatwaves to increase in severity. For example, southern Tasmania currently has heatwaves with maximum (minimum) temperatures of around 30°C (13°C). This is projected to increase to 33°C (16°C) by 2050 and 36°C (17°C) by 2090[49].

2.2.4. SCENARIO OVERVIEW

Mid-January	Almost no rain has fallen over Tasmania during the preceding five weeks. All vegetation types, including rainforest and organic soils, are extremely flammable. No further rainfall is forecast.
14 January	A major thunderstorm event ignites 50 bushfires across Tasmania. While TFS, STT and PWS control some fires, many of the fires spread rapidly under warm, windy conditions.
15-16 January	Southwest winds following the dry front present significant fire weather across the state. Smoke from the fires covers Deloraine, Launceston, St Helens and surrounding areas.
17 January	South of Hobart, an undetected lightning ignition, smouldering in forest organic soil, spreads rapidly in a southeast direction.
18 January	Hobart reaches a maximum temperature of 41°C, with NW winds of 40 km/h. Refer to Figure 2.2 Heatwave map January 18-20. The southern fire impacts rural settlements across 20 km. Smoke plumes cover many areas of the state.
19-20 January	Extreme heatwave conditions continue for southern and eastern Tasmania, with temperature maximums of 41°C in the greater Hobart area and along the east coast.
21-24 January	Heatwave conditions ease. The southern fire continues to move slowly south, but makes more significant spread northwards with southerly winds, impacting more rural townships and the outskirts of some suburban areas. Almost all of Tasmania experiences excessive levels of smoke and hazardous air quality. Refer to Figure 2.3 Smoke exposure map for 21-25 January.
25 January	The fires escalate again, impacting further settlements. Extreme levels of smoke continue across major population centres.

2.2.5. EXPOSURES AND CONSEQUENCES

The consequences of a major bushfire similar to this scenario would be catastrophic, but most deaths and injuries would be due to heatwave or smoke conditions.

People's health, safety and wellbeing

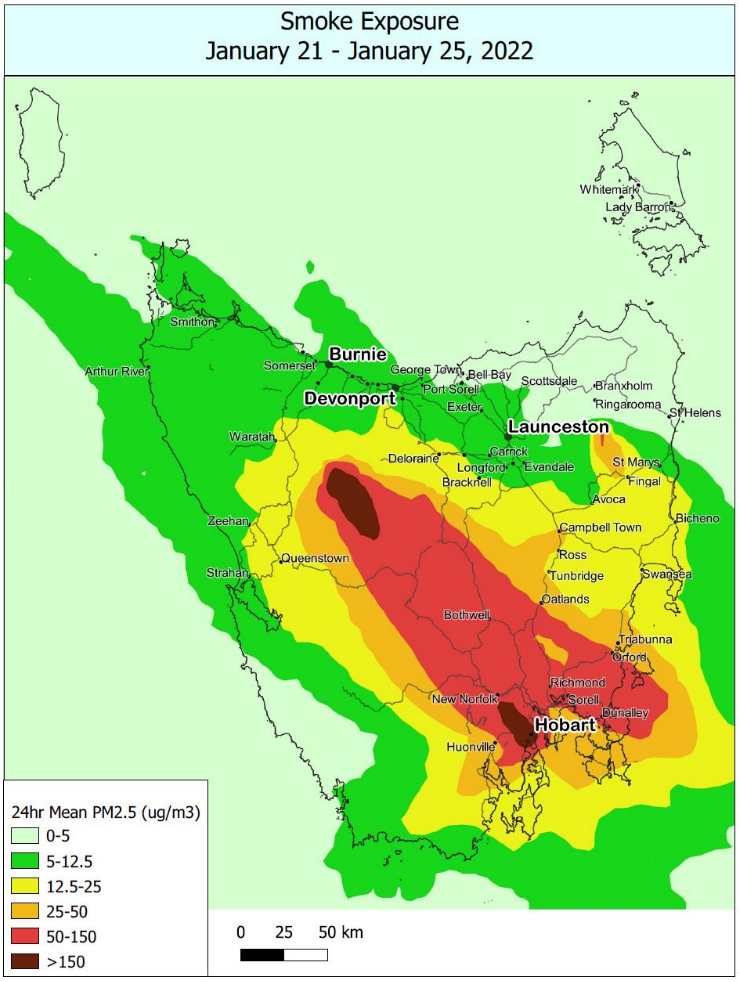
Such a scenario is likely to result in deaths, and serious illness or injuries – mainly due to heatwave and smoke impacts rather than the direct result of bushfires. Most people move away from the direct impacts of bushfires, but heatwave and smoke exposure can be widespread.

A major bushfire event is likely to cause deaths and injuries, isolation and displacement plus secondary health consequences, particularly if people stay rather than evacuate. Some people may put their safety at risk to protect their animals or valued crops.

Those evacuated will need to be accommodated and supported. Poor temporary or replacement housing itself can impact on people's health and wellbeing. Bushfires, smoke and heat alone or combined can be traumatic. There are likely to be flow-on physical and mental health issues, as with all disaster events.

Bushfire smoke can affect communities well away from the fire front and many more people than the fire itself. Smoke can exacerbate existing health issues. Very young and elderly people plus pregnant women and their unborn children are at higher risk.

Figure 2.4: 'Black January' scenario example smoke exposure mapping
(G Williamson, UTAS)



Produced by Grant Williamson, University of Tasmania, 2021-05-10

Heatwaves increase death and illness:

- through direct impacts such as heatstroke and dehydration
- by exacerbating existing health conditions[50].

Heatwaves affect individuals differently, due to health, demographic and social factors. For example:

- heatwaves can trigger stress and anxiety, leading to increased social and domestic violence or other wellbeing issues[51]
- some medications are less effective in heat, specifically those for mental health conditions
- parents or carers may need information or support to ensure the wellbeing of those in their care
- schools and childcare centres may need to provide specific support to some children
- some people may be less able to understand what they need to do in extreme temperatures.

People living in regions with socio-economic disadvantage tend to be at higher risk. About half of Tasmanian homes do not have air conditioning[52]. Some people may not use air conditioning due to real or perceived financial reasons. Most Tasmanian buildings were designed for cooler rather than hot conditions. Workshop participants considered community 'cooler spaces' as in some other states. This may include private and public buildings such as libraries, cinemas and shopping centres.

Many Tasmanians are lucky to have access to nearby waterways to paddle, swim and cool down. While these do not have the same risks as water sources in Northern Australia, there are drowning risks. People tend to drink more alcohol on hot days, further increasing drowning risks.

People at increased risk due to personal circumstances

Visitors and some members of the community are likely to be at increased risk due to having less ability to access information, or health or mobility issues. Refer to Section 5.2.5. and these examples.

- Travellers or transient populations, such as those living in campervans, cars or who are homeless or living in tents, are more exposed to smoke as well as heat.
- For homeless people, issues associated with increased exposure to smoke and heat need to be considered alongside other issues they may face.
- Many outdoor workers may be able to organise their work to avoid extreme heat or smoke. However, this can be difficult in many circumstances. Smoke warnings and timely advice are critical.

Economic

While heatwave and smoke would likely produce moderate state-level economic consequences, a major bushfire event could produce catastrophic economic consequences. Based on previous events, directly impacted areas may lose 80% of houses and other built assets.

Bushfires directly impact agriculture, aquaculture, forestry, tourism and other local industries. As well as a loss of local and export markets, there will be tourism impacts. The loss of natural values can mean less reason to visit. This would impact on many small local businesses. The economic consequences of such a bushfire scenario are likely to unfold over a very long time, and not just in directly impacted areas.

If directly impacted areas have residents who commute to major centres, there will be impacts on those major centres. Those who live in the area and rely on internet and phone coverage to do business may not be able to do so for some time. Investment in local small businesses is likely to be diverted to rebuilding assets.

Heatwaves also cause losses in productivity and export income; however, the overall economic consequences are moderate. Continued bushfire smoke may mean that tourists cancel their plans. Some fruit crops, especially grapes, can become unpalatable when exposed to smoke and become unsaleable[53].

Environment

As well as damaging natural values through burning, a major bushfire can lead to water quality issues, flooding, erosion and other secondary environmental consequences. Smoke impacts air quality and, like heatwaves, may impact animals in the same way as humans; however, there is little research to confirm this.

Bushfires can damage natural values, some for a long time or permanently.

- Alpine, remnant rainforest and some other ecosystems do not recover well from bushfire events.
- A major bushfire event may threaten some species, for example wombats and Tasmanian devils. There will be a loss of habitat for many species.
- There may be increased weeds and pests. New revegetation is likely to be more fire resistant and increase future fire risks. Major bushfires can change ecosystems.

- Natural values in and around towns, such as parks and gardens, may also be damaged, leading to a loss of community hubs such as sporting and recreation facilities.
- Organic peat soils may burn for some time, with further effects to local ecosystems.
- There will be a loss of carbon stores, contributing to further climate change.

Water quality for people, primary industry and ecosystems will be an issue. Vegetation loss after bushfires can lead to erosion, debris flow and downstream impacts in coastal and maritime areas when it rains.

The broader impacts of extended smoke exposure on Tasmania's environment are not well known. Smoke may impact fauna in the same manner as humans.

The 2016 TSNDRA assessed the environmental impacts of heatwaves as minor. This assessment's workshop found little evidence to change this assessment but noted a need for more information.

Core functions

This scenario would disrupt critical infrastructure and services, primarily due to the bushfires but also due to hot and smoky conditions. Bushfires could disrupt, for example:

- transport infrastructure and public transport, leaving some communities isolated
- distributed power and communications assets
- potable water supplies as fire destroys tanks and ash or fire retardants contaminate the water.

Heatwaves and extended smoke can impact critical services such as transport and power and places extra demands on health services.

While Tasmania has energy capacity to meet growing demand, shortages in 2016 showed the impacts that long-term heat and drought can have on the state's energy sources. If heatwaves in mainland Australia result in rolling blackouts, Tasmanians may also have blackouts due to those heatwaves.

Some roads may be susceptible to bleeding/melting of the bitumen during days of extreme heat, causing traffic delays. Smoke can also decrease visibility on roads and influence flight paths of commercial aircraft.

Both heatwave and smoke events significantly increase demands on health services, including ambulance services and hospital emergency departments. For example, ambulance dispatches increase by 34% during extreme heatwaves. Exposure to smoke from landscape fires has a substantial healthcare burden[54]. In Tasmania, smoke from bushfires and planned burns increased health care costs more than $16 million per year, due to premature deaths, increased hospital admissions and emergency presentations[55]. These estimates doubled in the extreme smoke years of 2016 and 2019.

Community and culture

A major bushfire could have moderate impacts on communities and cultural assets. Bushfires may damage or destroy irreplaceable cultural, heritage and community assets and networks, impacting community values and networks. Loss of community hubs, such as sporting and recreation grounds, local shops or other gathering places, schools or other centres, can impact on community connectedness, social capital and sense of place. Community networks may change as key people may move out of the community.

Smoke and heatwave events would rarely cause long-lasting disruption or damage. Smoke exposure can disrupt outdoor activities. This is especially critical for outdoor sporting events, such as athletics carnivals or fun runs. Heatwaves have minor impacts on community activities.

2.2.6. SYSTEMIC ISSUES

This scenario assessment explores the issues faced by people who are at increased risk due to:

- age, reduced mobility, or underlying health issues
- learning, literacy or language issues
- homelessness/transiency
- outdoor working conditions.

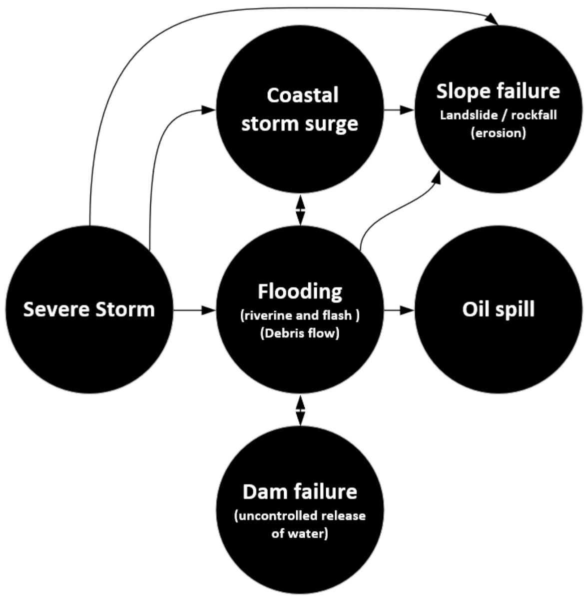
Many issues for these groups are relevant to other disasters. The 'Black January' scenario highlights that broader community engagement and involvement in reducing risks and preparing is key (Refer to Section 5.2.5).

2.2.7. ASSESSMENT SUMMARY

	Bushfire	**Heatwave**	**Smoke exposure**	**'Black January' (hazards combined)**
Maximum risk level	Extreme	Extreme	Extreme	Extreme
Maximum consequence	Catastrophic	Major	Major	Catastrophic
Likelihood of a scenario like this occurring	High – 1:10-99 years	Very high – 1:1-9 years (was 1:10-99 year in 2016, increased due to climate change projections)	High – 1:10-99 years	High – 1:10-99 years
Likelihood of similar events	High – 1:10-99 years (less serious events 1:1-9 years)	Same	Very high – 1:1-9 years	Very high – 1:1-9 years
People's health, safety and wellbeing	Major	Major	Major	Catastrophic[56]
Economic	Catastrophic	Moderate	Moderate	Catastrophic
Environment	Major	Minor (note lack of evidence)	Minor (note lack of evidence)	Major
Core functions	Moderate	Moderate[57]	Moderate	Major
Community and culture	Moderate	Minor	Minor	Moderate
Average confidence	High	High	Moderate	High

2.3 East Coast Low

Figure 2.5 Interlinked hazards caused by an East Coast Low



A severe East Coast Low produces damaging winds and heavy rain with the potential for thunderstorms. There is riverine flooding plus coastal storm surge, debris and debris flow. Uncontrolled release of water from a dam leads to flash flooding. Such an event can damage infrastructure, which can cause further consequences such as an oil spill, for example. These hazards interconnect and show why assessing hazards individually is of less value than considering interdependent hazards, exposures and vulnerabilities.

Tasmania regularly experiences East Coast Lows. This scenario is based on the 2016 Northern Tasmanian floods and 1929 Launceston floods, with slightly more severe weather conditions.

2.3.1. BACKGROUND AND RATIONALE

The most damaging and costly severe weather events in Tasmania since European settlement have been East Coast Lows. This event is considered the 'reasonable worst-case scenario' for such an event.

Severe storm

Tasmania's maritime climate often produces severe storms. Different parts of the state tend to be more exposed to different types of weather systems.

East Coast Lows are intense low-pressure systems that occur off the east coast of Australia[58]. They can occur at any time of the year but are more common in autumn and winter. They often produce heavy rain and gale-force winds south of the low's centre. East Coast Lows can intensify rapidly, and it can be difficult to predict where rain and wind will impact[59]. BOM has recorded on average 10 'significant impact' East Coast Lows a year since 1973 for Australia. There is no evidence of a trend[60].

BOM defines a weather event as severe when there is/are:

- sustained winds of gale force (63 km/h) or more
- wind gusts of 90 km/h or more (100 km/h or more in Tasmania)
- very heavy rain that may lead to flash flooding
- abnormally high tides (or storm tides) expected to exceed highest astronomical tide
- unusually large surf waves expected to cause dangerous conditions on the coast
- widespread blizzards in Alpine areas[61].

The 2016 severe storm assessment considered a westerly frontal system which tends to more impact unsettled and sparsely populated areas.

Coastal storm surge

Coastal storm surge is the temporary or permanent flooding of coastal land caused by a weather event. Permanent loss of land due to erosion can occur slowly or be rapid-onset. Coastal storm surge consequences would be similar to a tsunami, but with less damage and loss of life due to longer warning times and differing wave energy.

Many coastal areas in Tasmania are susceptible to temporary inundation due to storm surge and abnormally high tides. Large low-pressure systems, such as an East Coast Low, can temporarily raise ocean levels by tens of centimetres[62]. High winds can push water against the coast and increase waves. Low lying areas around rivers are particularly prone to inundation as coastal storm surge meets riverine flooding. Modelling suggests Tasmania's north coast is the area most susceptible to storm tide damage. Climate change is projected to amplify coastal inundation as global sea levels rise[63]. Other factors contributing to storm surge include:

- high tides
- waves, including wind waves and swell
- longer-term weather trends
- coastline geometry (bathymetry) and geomorphology/erosion
- rainfall [64].

Riverine and flash flooding

Flooding occurs frequently in Tasmania, with severe events often linked to an East Coast Low. Floods are often widespread and cause significant damage. Since European settlement there have been about 78 flood-related deaths in Tasmania[65]. Estimated costs relating to recent major Tasmanian flooding events are:

- 2011 floods - $24 million
- 2016 floods - $180 million
- 2018 Southern Tasmanian Extreme Weather Event (STEWE) - $135 million[66].

Flash flooding is rapidly rising flooding that occurs within six hours of rain. It can occur anywhere but flows into and contributes to riverine flooding. Flash flooding may be due to intense bursts of rainfall, for example during a thunderstorm. These may be quite localised and difficult to predict. Uncontrolled release of dam water can also cause flash flooding.

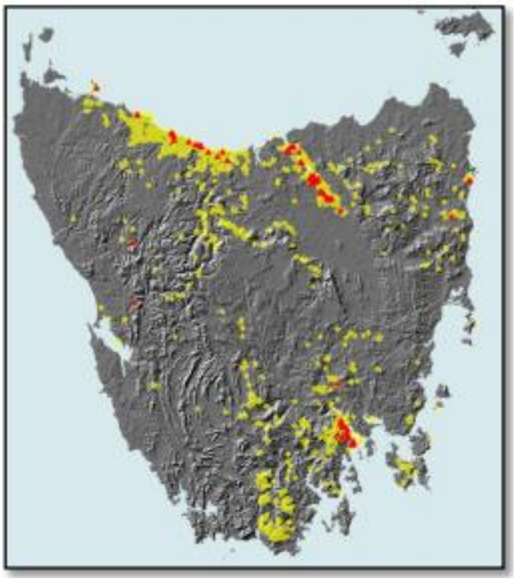
Debris and debris flow

Most floods include debris that can cause damage or block critical infrastructure. For example, in the 2016 floods, debris closed the Port of Devonport for three days. Land clearing in river catchments can exacerbate flooding and debris. Some waterways in urban areas have measures to catch debris.

Although the 2016 TSNDRA assessed debris flow as part of the landslide risk assessment, it is now linked with flooding risks, being a consequence of heavy rainfall. It can damage houses, agricultural land and other assets. Debris flows can change the path of waterways and damage ecosystems and are the most lethal form of slope failure in Australia[67]. There have been significant debris flows in Tasmania. One in Humphreys rivulet in 1872 impacted the then sparsely populated Glenorchy area. Hobart is exposed to debris flow due to nearby hills and mountains. The Hobart City Council recently commissioned a report to better understand debris flow risks around Kunanyi / Mount Wellington[68].

Slope failure - Landslide, rockfall

Figure 2.6: Map of known landslip areas Source: MRT



Landslide is the movement of earth, rock or debris down a slope. It is sometimes termed 'slope failure'. With its hilly, mountainous topography, Tasmania is prone to landslides, particularly in the north-west. Quick-onset slope failures tend to be a consequence of either heavy rainfall or a geological event. Slope failure has caused deaths in Tasmania along transport routes and in mines. For example, a bus crash at Dove Lake in 2001 due to a rockslide caused three deaths and many injuries. These and the 1997 Thredbo disaster illustrate the need to understand this hazard.

Mineral Resources Tasmania (MRT) maps known areas susceptible to movement to inform land development, use and zoning. This includes over 2 700 landslide occurrences. Red areas on the map in figure 2.6 show where landslides have caused damage. For further information, refer to MRT's website.

Dam Safety Emergency (uncontrolled release of water)

Tasmania has over 7 000 registered dams including those for:

- farming and irrigation
- hydroelectricity
- mine tailings/waste
- urban water storage.

There are also likely another 8 000 or more unregistered dams[69].

A dam breach may happen over a long time or in minutes, depending on the dam type and surrounding soil and geology[70]. The Australian National Committee on Large Dams Incorporated (ANCOLD) Dam Safety Guidelines categorise dams according to severity of damage should the dam fail, and the size of the dam. Regulations for specific dams depend on this categorisation. Larger and potentially more dangerous dams (class A dams) must have dam safety management plans[71]. These are primarily hydro-electricity and water storage dams managed by Hydro Tasmania, TasWater, and Tasmanian Irrigation's risk management plans. The example dam explored in this scenario is a class C one, with the potential to cause major, although not extreme, consequences should it fail.

An uncontrolled release of dam water becomes a flash flooding event downstream, generally with little warning. Such flash flooding may cause cascading dam failures downstream.

Relevant legislation includes the *Water Management Act 1999*, and *Water Management (Safety of Dams) Regulations 2015*. Under this legislation, the Minister must:

- keep a register of dams
- develop standards relevant for ensuring dam safety
- ensure compliance with those standards.

The Marine and Water Division of the Department of Natural Resources and Environment Tasmania (NRE Tas) fulfils these roles. Responsibilities for dam safety are complex and should be further clarified in the TEMA.

The 2016 assessment included a very rare but catastrophic dam safety emergency as part of an earthquake assessment (Refer to Box 2.2). This assessment's scenario focuses on a more likely smaller uncontrolled release of water from a farm dam. While dam safety emergencies can occur due to engineering failures or seismic activities, they are most often linked with heavy rain events, such as in this scenario.

Oil spills

Oil spills can have devastating environmental impacts. Oil can coat marine life, damaging their insulation and waterproofing and poison animals that ingest it. It can also damage coastal and marine flora and ecosystems. This scenario included a burst fuel pipeline crossing a river due to debris.

Box 2.2: 2016 TASDRA assessment summary of a class 'A' dam failure triggered by an earthquake

Likelihood	Extremely rare (>10 000 years)
People's health, safety and wellbeing	Major
Economic	Catastrophic
Environment	Catastrophic
Core functions	Major
Community and culture	Major

NRE's [Tasmanian Marine Oil and Chemical Contingency Plan (TasPlan)]() and its associated arrangements cover preventing and responding to oil spills in marine environments.

Current arrangements

Table 2.2 provides an overview of the current lead agencies for such a scenario, noting in some agency responsibilities need to be further clarified in the next version of TEMA.

Table 2.2 Lead agency for an East Coast Low scenario

Hazard	Advisory agency	Prevention	Preparedness	Response
Severe storm	State Emergency Service (SES)	SES	SES	SES
Coastal storm surge	NRE Tas Marine Resources Division (fisheries) and Natural Cultural Heritage Division	SES	Department of Justice (Land Use Planning)	SES
Riverine and flash flooding	SES	Councils	SES	SES
Debris flow (only advisory agency covered by TEMA)	State Growth MRT		Councils	SES
Landslide/rockfall (TEMA only covers advisory agency)	State Growth MRT	Councils/ State Growth	Councils	
Dam safety (uncontrolled release of water)	NRE Tas Agriculture and Water	NRE Tas Marine and Water (land owners)	NRE Tas Marine and Water	TasPol (Flooding: SES)
Oil spill	Environment Protection Authority (EPA)	Operators	NRE Tas EPA	NRE Tas EPA TFS, TasPorts

2.3.2. EXAMPLE SIMILAR EVENTS

Tasmania regularly experiences severe storm, flooding and related extreme weather and cascading impacts. Here are a few examples, with a more comprehensive list in Appendix 4.

Year	Date	Description	Hazard
2018	May	STEWE. Significant riverine flooding and overland flows in greater Hobart, Kingston and Blackmans Bay. There was more than $135 million in damages.	Severe storm, riverine and flash flood, debris flow
2016	June 27-31 July	Major flooding in the Forth, Mersey, South Esk, North Esk and Derwent River Basins caused three fatalities and more than $180 million in damage. The main street of Latrobe flooded. One dam failed and several others overtopped, resulting in embankment damage.	Severe storm, flooding, dam safety emergency
2005		Leaks appeared on the newly constructed Blackman Dam in the Southern Midlands, a 'C' class dam. Due to potential risks, the township of Tunbridge was evacuated.	Dam safety emergency
1995	July	Bulk carrier Iron Baron grounded near the mouth of the Tamar River, spilling about 300 tonnes of heavy fuel, killing up to 30 000 penguins[72].	Oil spill
1994		One of several storms closing the South Arm Road near Lauderdale. Another in 1991 washed debris across the road[73].	Coastal storm surge
1929	4-6 April	The most disastrous floods in northern and eastern Tasmania. Fourteen people died at Derby in the Briseis Dam failing[74]. Eight died near Ulverstone when a truck plunged into the flooded Gawler River. Considerable portions of Longford and Launceston flooded. About 4 500 people in Launceston evacuated. The Duck Reach Power Station and Cataract Gorge suspension bridge were washed away.	Severe storm, flooding, dam safety emergency

2.3.3. SCENARIO OVERVIEW

A deep East Coast Low hits Northern Tasmania causing catastrophic damage through high winds, heavy rainfall, flooding and cascading hazards.

Time	Late April, Northern Tasmania
Thursday	An East Coast Low forms off the NSW Central Coast, BOM provides heads-up briefing to SES and multi-state public messaging.
Saturday	BOM's forecast models show it is likely the low will bring significant severe weather and rainfall to Tasmania. BOM and SES issue joint media releases and hold a joint press conference.
Sunday	BOM monitors the situation. The rainfall, strong winds, abnormally high tides and dangerous surf intensify at 6:00 am on Sunday morning and persist for 48 hours. The East Coast Low brings heavy 48-hour rainfall totals across the North and North West coast of Tasmania.
Monday	Flood peaks arrive at the lower reaches of most catchments between Monday morning and Tuesday morning. Flood levees in Launceston and Longford are closed prior to the forecast peaks. Many roads are closed due to flooding, storm debris, rockfalls, and landslips for between one day and several weeks. There is widespread localised flooding and storm damage across the North and North West.
Wednesday	Lower South Esk flood peak reaches Launceston in the early morning before sunrise. Longford flood levees are reopened in the early morning.
Friday	Flood levees in Launceston are reopened.

2.3.4. EXPOSURES AND CONSEQUENCES

Consequences of an East Coast Low may be due to one of more of the hazards involved. The insights below are from workshop participants unless otherwise referenced.

People's health, safety and wellbeing

An East Coast Low can lead to deaths and health issues related to one or more hazards. All hazards can cause stress, anxiety and aggravate mental health issues, particularly if people are isolated or displaced.

A severe storm can cause death or major injuries, through:

- lightning strikes, hail
- flash flooding/storm water drainage overflow (drowning)
- high winds – flying or moving objects
- falling trees or branches
- injuries due to repairing accommodation in extreme weather (for example, from a roof or ladder)
- high surf and dangerous seas leading to risks for boats, those near the coast and keen surfers
- wet or icy roads.

Workshop participants noted people can be complacent about the dangers of severe storms. There can be unrealistic expectations that emergency services can protect people who place themselves in danger unnecessarily. Trying to cross flood waters is the main cause of flood-related deaths in Tasmania[75]. Animals may also drown and ensuring their safety can also put people's lives at risk. Early warnings provide time to take actions to prevent deaths of people and animals. BOM and SES provide storm and flood warnings in as timely a manner as possible. However, people may not hear the warnings or act on them.

Such an event is likely to displace many people due to one or several of the hazards involved. It may be difficult to access health and other services if needed. Evacuation centres would likely be in use for longer periods, increasing risks of communicable disease[76].

Coastal storm surge or flooding may overwhelm sewerage works, leading to public health concerns. Floodwater may carry contaminants, animal carcasses and objects that could injure people.

If a person's home sits on landslide-prone areas, their life could be at risk. Slope failure may also cut their access route for some time. If a dam safety emergency released large volumes of water across a road or highway, people may be killed or injured.

The oil spill in this scenario would be unlikely to impact human health.

There would be some people at increased risk due to their personal circumstances. This is an issue crossing most disaster scenarios – refer to Section 5.2.5. It can be difficult for emergency services to identify and so help those who need it most under tight time pressures.

Core functions

The hazards associated with an East Coast Low can interrupt many essential services. Traffic management will be a major consideration and many transport routes may need to be cleared, repaired or replaced. This scenario's flood waters could divide Launceston into three. Smaller settlements are also likely to have trouble accessing supplies and services. Some may need to evacuate. While State Growth has temporary bridges, they take time to set up, and use would need to be prioritised. They are of less use for wide river crossings. New transport infrastructure is built to national standards intended to withstand adverse conditions but may still be temporarily closed. Road and bridge repairs after the 2016 floods alone cost $13 million. Loss of transport routes impacts economic and community activities.

One or several hazards may cut power, water and telecommunications. Such an event would need a cross-agency region-wide response.

Dam safety emergencies can result in flash flooding. In this explored scenario, the event would block the highway with debris, damage rail-line ballast, and a train if passing at the time.

Economic

Such an event would have immediate and long-term economic impacts similar to the 2016 Northern Tasmanian floods. Most economic costs of severe storms are due to consequential hazards, such as flooding and coastal storm surge. The event would disrupt many businesses, some more than others.

Flooding would cause significant uninsured losses. Floodwaters could disrupt much of the economic activity in the area, particularly primary producers. Depending on the time of year, crops may be lost or significantly damaged, or it may not be possible to harvest, process, pack or transport produce. If landslides block road access to dairy farms, milk companies may not be able to collect supplies. A major flood event would result in loss of agricultural income and seasonal employment. Flooding often results in stock loss and damage to farming infrastructure, such as pumps and irrigation assets.

Such an event can also impact other primary industries such as forestry and aquaculture. Emerging forestry plantations could be susceptible to damage. Flood contaminants may damage aquaculture produce.

Such an event could close other businesses due to:

- direct flooding impacts
- the inability for staff to get to work
- the loss of transport routes or services.

A dam safety emergency could interrupt the transport of essential goods via road or rail. The farms and property impacted may also lose production if land or other assets are damaged.

Environment

As severe storms regularly affect Tasmania, the natural environment is relatively resilient to them. Most environmental damage would be due to cascading hazards, such as:

- fire caused by lightning
- fish die-offs due to storm water runoff (flooding)
- beach or coastal erosion due to coastal storm surge
- landslides or rockfall
- 'Natech' hazards, such as oil spills (i.e. industrial hazards caused by natural events)
- large-scale animal carcass health and environmental impacts and disposal.

Floodwater contaminants and floating debris can be dangerous for stock, pets and wildlife. An extensive flooding event may threaten some species, such as the burrowing crayfish[77]. Debris may wash downstream, impacting low-lying land and coastal areas. Flooding may change the course of a waterway or produce major scouring/ riparian damage along riverbanks. Debris and debris flows can damage agricultural land and river ecosystems. Flooding can cause erosion, particularly in cleared areas. There is a risk that landowners will try to remediate erosion in ways that could cause further damage. Willow roots and other vegetation and debris can clog waterways, contributing to flood damage. Vegetation management along waterways can reduce flooding risks.

Coastal storm surge may destroy some flora and fauna due to damage and salinity. Erosion may lead to shoreline regression. Sand dunes, lagoons and marshes can form natural buffers. Green infrastructure, such as vegetation, and careful remediation, can help mitigate erosion.

Sewage overflow, other flood contaminants and the large amount of waste produced by flood clean-ups also can impact local environments. Carcass disposal may not be possible until waters have receded.

Uncontrolled release of water from a dam becomes a flash flood. Environmental damage would depend on the dam type and location. Tailings dams tend to create more damage[78].

Penguin rookeries and other wildlife downstream from the scenario's oil spill would be impacted.

Community and culture

As many of the hazards in this event would close roads, many households and communities could become isolated. There are likely to be many people displaced.

Given northern Tasmania's history of flooding, many communities will be more resilient to events such as this scenario. The workshop highlighted the importance of communities understanding and mitigating their flood risks. However, day-to-day activities will be disrupted. Flooding and storm events generally cancel or postpone community events, such as markets, festivals and sporting events. Given Tasmania's changeable weather, outdoor events are planned with the possibility of bad weather in mind. Councils require event coordinators to have basic emergency management plans.

Tree falls, flooding or another hazard can damage or destroy cultural assets, such as historic highland huts. The impacted areas include Tasmanian Aboriginal cultural and historical heritage assets.

Such an event can impact a community's social capital. An oil spill could lead to a loss of confidence in the petroleum industry.

2.3.5. SYSTEMIC ISSUES

Major issues identified through this scenario are similar across many hazards and include:

- community risk mitigation practices and resilience, including contingency planning
- public communications and warnings
- inter-agency coordinated risk mitigation and effective response plans, including evacuation plans and plans for isolated communities
- flood and dam failure hazard-specific measures.

2.3.6. ASSESSMENT SUMMARY

There are no changes from the 2016 hazard assessments unless otherwise stated. The most significant changes since the 2016 assessment include the following.

- The severe storm assessment changes from a westerly front scenario to an East Coast Low scenario, impacting more communities.
- Debris flow in the flood assessment, not with landslides as in 2016.
- Slow-moving landslides are now out of scope.
- The class of dam explored is less consequential than 2016 but is more likely to fail.
- TSNDRA 2016 did not include an oil spill.

These changes result in some differences in consequence assessment, noted below.

	Severe storm	**Coastal storm surge**	**Flooding**	**Landslide/ rockfall**	**Dam failure ('C' class)**	**Oil spill (NEW)**	**East Coast Low**
Notes	2016 - westerly storm front		Debris flow with flood not landslide as per 2016	2016 included debris flow	2016 part of earthquake assessment A class dam	Not covered in 2016	Sum of individual hazards
Maximum risk level	Extreme	Extreme	Extreme	High (was extreme)	Medium	Medium	Extreme
Maximum consequence	Major	Major	Major (was catastrophic)	Moderate (was catastrophic based on debris flow)	Moderate (was catastrophic for A class dam)	Moderate	Major
Likelihood of a scenario like this occurring	Very high – 1:1-9 years	Very high – 1:1-9 years (was high 1:10-99 years	Very high – 1:1-9 years	Very high – 1:1-9 years (was 1:1year based on long term landslides – out of scope	High – 1:10-99 years (was 1:1K-10K years due to A class dam)	High – 1:10-99 years	High – 1:10-99 years
Likelihood of similar events	Almost certain 1:1 year	Almost certain 1:1 year	Very high – 1:1-9 years	Almost certain 1:1 year	High – 1:10-99 years	High – 1:10-99 years	High – 1:10-99 years
People's health, safety and wellbeing	Major	Major	Major (was Catastrophic > 54 deaths unlikely)	Moderate	Moderate (was major –A class dam)	Insignificant	Major
Economic direct and indirect	Major (was moderate based on westerly front scenario.[79]	Major	Major	Moderate	Moderate (was catastrophic - A class dam)	Minor (well established arrangements)	Major
Environment	Minor	Moderate	Major	Insignificant	Moderate (was catastrophic)	Moderate (well established controls)	Major
Core functions	Moderate (was minor for westerly front)	Moderate (was minor, increased impacts on major routes)	Major	Insignificant	Moderate (was major)	Minor (Alternative routes/stored fuel available)	Major
Community and culture	Minor	Moderate	Major	Insignificant	Minor	Insignificant	Major
Average confidence	High	High	High	High	Moderate	High	High

3. Biological systems

Biological hazards are organic in origin or conveyed by biological vectors[80]. This can include any life form that can cause harm, for example, viruses, bacteria, insects or other invasive species.

Most risk assessments focus on biological hazards to human health, such as disease. Tasmania's unique natural values and pest/disease-free status supporting many areas of primary industry mean that other biosecurity incursions can cause significant damage to the state. Part 3 focuses on respiratory pandemics, then example biosecurity incursions, that could threaten Tasmanians.

Predicting the probability and scale of consequences of future biological hazards is extremely difficult[81]. Biological risks can be endemic, or always locally present, but they tend to cause less harm if people are immune or they are part of a balanced ecosystem[82]. As ecosystems are damaged worldwide and biodiversity lost, new zoonotic diseases are increasingly emerging[83].

Disease can be spread by:

- water and food
- vector transmission, for example, mosquitos, ticks or animals spreading the disease (zoonotic)
- air-born respiratory illnesses
- other infections spread by blood or other bodily fluid[84].

Internationally, there are monitoring and surveillance systems to track biological incursions, particularly for human health. While food-borne illnesses and antibiotic-resistant pathogens are an increasing issue in developed nations[85], this risk assessment focuses on respiratory pandemic illnesses. DoH deem these to be the most likely and consequential for Tasmania.

About 20% of the world's vegetated areas have shown persistently reducing productivity and more than half the world's ecosystems are viewed as in decline[86]. Climate change allows species to spread into new areas, and pathogens to change their behaviour, spread or scale of impact. Almost all new or re-emerging diseases come from animals[87]. Rapidly growing cities and modern rapid transportation and global distribution networks drive disease transmission and the spread of pests and other biosecurity incursions[88].

3.1 Respiratory pandemic

This assessment looks beyond the current COVID-19 pandemic to consider other disease outbreaks that cause pandemics or epidemics. This assessment does not cover continuing COVID-19-related measures to reduce risk but considers measures relating to potential future respiratory pandemics.

TASDRA 2022 broadens the 2016 influenza pandemic risk assessment to cover plausible respiratory pandemic scenarios. It is difficult to predict when and how pathogens might emerge to cause pandemics; however, pandemics are likely to continue to pose potentially catastrophic risks for Tasmania.

The public health measures used for COVID-19 would help mitigate the spread of future pandemics. Given Tasmanians' current awareness of pandemic public health measures, the state is better placed to deal with another pandemic. It is likely that the same or similar public health measures would reduce risks associated with future diseases that are transmissible between humans.

A 'reasonable worst-case scenario' may involve a zoonotic disease where humans can contract a disease from animals, which then mutates to sustained human-to-human spread with severe disease outcomes. In this scenario, existing measures may need to be modified for a joint public health/biosecurity response. Refer to Section 3.2.3 focusing on the biosecurity risk implications from avian influenza.

3.1.1. BACKGROUND AND RATIONALE

A pandemic is classically defined as

> An epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting many people[89].

This assessment considers the following questions.

- What needs to change from the 2016 TSNDRA influenza pandemic assessment to encapsulate a broader understanding of respiratory pandemic risks?
- Do the policies, protocols, and arrangements developed for COVID-19 provide a sound foundation for Tasmania to respond to future pandemics? What gaps exist and how might these be addressed?

Assessing respiratory pandemic risks during COVID-19

The COVID-19 pandemic created challenges for undertaking a state-level risk assessment, but it also provided the chance to incorporate preliminary lessons identified. The risks and challenges associated with the COVID-19 pandemic have been, and will continue to be, explored through:

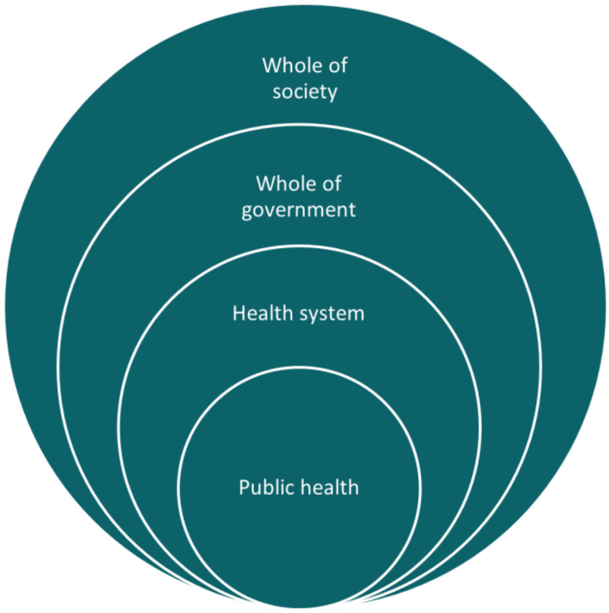
- ongoing planning and lessons management activities through the COVID-19 Coordination Centre and the various Emergency Operations Centres
- the work of PESRAC providing insights into the impacts of the COVID-19 pandemic on Tasmanians
- Response reviews, such as the Independent Review of the Response to the North-West Tasmania COVID-19 Outbreak).

Future risks relating to COVID-19 are outside the scope of this assessment. However, policies, systems, and other arrangements developed for COVID-19 would help to reduce the risks of future pandemics, if they can be easily reinstated.

TSNDRA 2016 and the foundational plans that supported the initial response to COVID-19 focused on public health and the health system as the areas leading the response. COVID-19 has highlighted that pandemics have broad ramifications that involve society as a whole. COVID-19 plans and arrangements recognise that DoH - and the public health measures recommended by them - are core to pandemic-related risk reduction. However, the measures fit within a wider health system, a whole-of-government approach, and whole-of-society actions (refer to Figure 3.1).

Disease risks faced by Tasmania

Figure 3.1: Pandemics demand a whole of society approach



Pandemics can occur unpredictably[90]. It is not possible to estimate intervals between pandemics or the nature of the response required. It will differ, based on many factors, including:

- how easily the disease transmits between people (transmissibility)
- attack rates (the number of people who became ill divided by the number of people at risk for the illness)
- disease severity
- population size
- geographic area of spread.

Modern transportation availability and speed make it easier for infectious diseases to spread quickly. There are always newly emerging, as well as existent but evolving, diseases with pandemic potential. Local, national and international networks share information to help keep track of emerging threats.

Current arrangements

As defined in TEMA:

- the Department of Health (DoH) is the SEMC Hazard Advisory Agency and Response Management Authority for pandemic (influenza)
- the Department of Premier and Cabinet (DPAC) is the preparedness management authority, enabling whole-of-government preparedness
- other government agencies have supporting functions and responsibilities, as outlined in TEMA and relevant SSEMPs
- the *Public Health Act 1997* provides the statutory remit for public health emergencies, such as pandemics, including the specific and key role for the Director of Public Health.

3.1.2. EXAMPLE SIMILAR EVENTS

Event	Date	Impact Summary
COVID-19	2020-	Underway. As of 4 April 2022 there were 6.2 million reported deaths directly due to the disease worldwide.
H_1N_1 Influenza pandemic	2009	Estimated 284 000-575 000 deaths worldwide with an estimated infection rate of 24% and a mortality rate of 0.02% of those infected.
SARS (SARS-CoV-1)	2003	With a 9% mortality rate, SARs (Sudden Acute Respiratory Syndrome) killed at least 774 people worldwide. The mortality rate for people over 60 years was almost 50%.
Hong Kong flu	1968-70	Estimated 1-4 million deaths worldwide. A second wave caused more deaths than the first wave.
Spanish influenza	1918-19	Estimated 20-50 million deaths worldwide (more than World War I); significant community, social and economic disruption.

3.1.3. SCENARIOS

More information was provided at the workshop.

SCENARIO 1: Pandemic influenza

Assumption: COVID-19 is well managed in Tasmania with high vaccination coverage, rapid control of infrequent cases, and limited public health measures.

There are outbreaks of a new influenza A subtype H3N2 in many countries. The disease causes mild to moderate disease in humans, with most deaths amongst the elderly.

It is being reported that there has been significant antigenic shift in the Influenza A subtype H3N2 internationally. These reports identify that it is causing mild to moderate disease in humans, with most deaths occurring in the elderly population, and clusters are occurring in a large number of countries globally. The source is unknown.

Current data from other Australian states and territories is noting a trend in the reporting of influenza-like illnesses that is tracking similarly to 2017 (when Australia's influenza season saw the highest levels of activity since the 2009 pandemic year). The projection is for a 'bad influenza season' that exceeds the 5-year average for case notifications.

Key characteristics of H3N2:

- Mild to moderate clinical severity
- Most deaths being recorded in elderly populations
- Case fatality rate 0.1%
- Clinical treatment options - to be identified, potentially antivirals
- Transmission route is respiratory. major route via droplet with some minor transmission via aerosol route
- Time-to-vaccine development is 6-12 months.

A family travelling around Tasmania have been diagnosed with H3N2. Added complexities include:

- What if the case fatality ratio was higher - 1% and 3%?
- What if children are most affected by the disease?

SCENARIO 2a: Novel Coronavirus – Moderate to severe disease outbreak

Assumption: There are no simultaneous pandemic illnesses; COVID-19 is adequately controlled with no ongoing public health measures.

A novel coronavirus is detected and spreads in Tasmania. There are reports of similar clusters appearing in a number of locations globally.

SCENARIO 2b: Zoonotic pandemic

What if common wild or domestic animals were impacted? What if they could spread the disease?

3.1.4. EXPOSURES AND CONSEQUENCES

Pandemics can cause catastrophic numbers of severe illnesses and deaths. There can also be major economic and community consequences along with impacts on the core functions on which communities rely. The following observations are from workshop discussions and notes, unless otherwise stated.

People's health, safety and wellbeing

The extent of health impacts from a pandemic depends on many factors, including:

- the nature of the disease and how quickly it spreads
- individuals' physical and social vulnerabilities and attributes
- the capacity of the health system to respond.

The Norwegian Disaster Risk Assessment[91] included a similar influenza pandemic scenario which assumed:

- 25% of the population become unwell
- 3% require admission to hospital
- 25% of those admitted need Intensive Care support
- 0.5% die from the illness.

The assessment based on these assumptions concluded the Norwegian health system would not cope.

Using these same assumptions for Tasmania's population of 540 000 would translate to the equivalent of:

- 135 000 Tasmanians becoming unwell
- 4 050 individuals requiring admission to hospital
- 1 000 people requiring intensive care
- 675 Tasmanians succumbing to their illness and dying.

For Tasmania, NERAG classifies a disaster with more than 54 deaths or major illnesses that require hospitalisation as catastrophic.

The measures in place to manage COVID-19 in scenario one would also help to reduce influenza and other respiratory disease risks. Public health controls would be tightened or relaxed, depending on:

- the characteristics of the disease
- the secondary consequences of these controls on people's lives and the economy.

Australia's previous experiences show how various intervention measures can minimise the direct health impacts of a pandemic. They include, for example:

- contact tracing
- physical distancing
- travel restrictions.

Such risk reduction measures become more important if the disease is more severe or transmits more quickly, placing greater stress on the health system.

Secondary health and wellbeing consequences attributable to respiratory pandemics and the measures taken to reduce associated risk may include the following.

- Increased mental health and social issues.
- Enforced isolation can lead to further issues that can also have flow-on negative health, safety, and wellbeing outcomes, such as increases in –
    - online gambling
    - drug/alcohol consumption
    - family violence.
- Rising rates of burn-out amongst staff, leading to increased sick leave in key areas.

- Pandemics can increase unemployment and the loss of regular income can have significant flow-on effects for individuals, families, and communities.
- A decrease in diagnoses of other health conditions and injuries.
- Pandemic restrictions, such as physical distancing, can be difficult for homeless people, or those with inadequate housing, with consequential health and wellbeing impacts.
- Higher levels of absenteeism.
- Conspiracy theories can also produce secondary health, safety, and wellness consequences.
- Food security and other supply concerns, with associated anxiety for vulnerable populations such as the elderly or those with limited mobility.
- Language, literacy, digital literacy, and digital access become more vital than usual for ensuring health, safety, and wellbeing during a pandemic.

Time to develop vaccines will vary based on the pathogen involved. Influenza vaccines tend to take less time to develop than those for new diseases. Vaccination rates, complicated by vaccine hesitancy, influence the degree to which a community is protected against a respiratory pandemic.

Public and political risk tolerance influence the public health measures used to control a pandemic.

Tasmania's ocean 'moat' means the state can more easily control the entry of communicable illnesses – if they are brought by humans or via human means of transport. Scenario 2 explores the consequences of a potential zoonotic disease or if a disease emerges in Tasmania. Some public health controls used to limit disease spread between humans could be less effective if the disease is zoonotic. The response management and the degree to which spread can be controlled would depend on the animals and disease involved. A serious zoonotic disease would likely involve a joint public health/biosecurity response.

As most pandemic diseases originate elsewhere, Tasmanian health services use international and national information and learnings to reduce risks. This would not be the case if the disease emerges in the state.

Community and Culture

A pandemic can have significant impacts on community values and ties. It can reinforce cohesion and connections or contribute to isolation and dislocation. This impact can change cultures and the values placed on cultural assets, both positively and negatively.

Greater levels of isolation and disconnection can have major impacts on communities as pandemics may be prolonged events. This may weaken the connections between people and impact their emotional and mental wellbeing.

Responses to mitigate pandemic risks may lead to greater demands on social and other support services.

An effective pandemic response relies on individuals and communities complying with measures to reduce risks. This relies on social cohesion and trust in authorities. The demands, consequences, uncertainties, and fears associated with pandemics put this social cohesion and trust to the test.

Pandemics can further exacerbate pre-existing inequalities[92]. As PESRAC reports observed, the COVID-19 pandemic has economically impacted some groups more, such as women, the young and those with less secure employment, and this could lead to long-term increased inequalities[93].

Core functions

Pandemics can overwhelm health systems and other core functions, supply chains and access to essential goods and services. If key staff from critical infrastructure and service providers cannot work, it can become difficult to deliver or maintain essential services.

Business continuity and contingency planning is vital to ensure the consistent provision of essential services.

An uncontained pandemic may rapidly overwhelm acute and primary healthcare systems. Public health measures protect health systems by delaying or spreading out the impact of the disease. The systems can then provide care to those who are sick from the pandemic disease while also providing other essential health services. Some outpatient clinic services may be closed or modified. The clinical composition, complexity and volume of patients coming to emergency departments may change. Increased workloads and exposure to the disease can lead to stresses and anxieties for frontline staff. Measures to reduce risks are key for reducing risks to frontline health workers.

Residential aged care facilities have protocols for preventing or limiting the spread of communicable diseases, such as stopping or limiting visitors.

If a pandemic resulted in many deaths in Tasmania, morgue and funeral services may be under pressure. Tasmania's Mass Casualty Management Arrangements and Multiple Fatality Management Plan address this.

The impacts of a pandemic on the supply of critical utilities such as water, power, fuel, and telecommunications, are similar to that of any organisation. Access to specialist maintenance staff or contractors based elsewhere can be an issue for ensuring ongoing supply.

Pandemics can affect supply chains. When travel becomes restricted it may become more difficult to source key supplies. This can lead to hoarding of supplies. Refer to Section 5.2.1.

Clear, accurate, timely, and regular internal and public-facing communications are core to preventing, preparing for, responding to, and recovering from a pandemic as well as to manage expectations. Barriers to accessing information can impact on people's safety and wellbeing – refer to Section 5.2.1. Public demand for this information can be irregular and delivery relies on accessible surge capacity. The Public Health Hotline, for example, has intense demands at times. Internal communications are key as government agencies need to work closely together and with external organisations and communities. Section 5.2.4 explores communications issues across all disaster scenarios.

In most disaster events, schools and other educational institutions can close for days or weeks without major consequences. However, they become essential during prolonged disaster events such as pandemics, partially as they enable parents to continue working. Some families need support to provide home schooling. Online education means that schooling can continue, albeit with some challenges.

COVID-19 has shown that a pandemic increases demand on emergency services to support planning, logistics, and other consequence management areas. Surge capacity is an issue for most disaster events, but particularly for those that last a long time, such as pandemics.

Pandemics can impact any concurrent events, for example, a flood or fire event where people need to be evacuated. Tasmanian emergency services have considered these risks in the COVID-19 context.

Additional core functions for zoonotic disease

If a pandemic involves transmission via animals, then biosecurity and veterinary services become important. There would be a concurrent interrelated public health and biosecurity response. Both would need coordination and resourcing. The implications of such an event should be explored.

Economic

As COVID-19 has shown, pandemics have broad economic consequences. The disease itself, public health measures and fear around the disease can impact businesses and supply chains in many industries. Business and industry support is critical. Along with healthcare and public health costs, this support can impact the state's economy. There are also financial implications for local governments as their income is reduced. If the pandemic originates, or is seen to originate in Tasmania, this could impact the state's reputation, with flow-on ramifications to the tourism and export markets. If the pandemic has zoonotic associations, there could be major implications for related industries.

Environment

Pandemic impacts on the environment tend to be insignificant and would be nuanced. However, if the pandemic included zoonosis, there could be significant environmental implications. These would depend on the disease, the animal and the event response. A zoonotic pandemic may mean there is a need to manage wildlife reservoirs.

3.1.5. SYSTEMIC ISSUES

Workshop participants considered what successful management of pandemic risk might look like. Table 3.1 summarises their observations, broadly themed.

Table 3.1: Attributes of successful pandemic management

Success looks like…				
Disease contained	Economy thriving/ rebounding	Brand Tasmania survives	Business as usual	Healthy and happy community
That success relies on…				
Community support for the response	Clear public communications	Investment in preparedness	Coordinated response/recovery	Health system able to meet demands
That success relies on…				
Trust, transparency, evidence-based decisions	Accessible information	Fit-for-purpose emergency management (EM) arrangements	Government agency goal alignment	Real-time continuous improvement
That success relies on…				
Knowledge, skills and experience	Resourcing	Roles/functions clearly defined and exercised	Collaborative actions	Real-time lessons incorporated

3.1.6. ASSESSMENT SUMMARY

	2016 TSNDRA	Influenza pandemic	Novel coronavirus	Zoonotic pandemic
Maximum risk level	Extreme	Extreme	Extreme	Extreme
Maximum consequence	Catastrophic	Catastrophic	Catastrophic	Catastrophic
Maximum likelihood	High – 1:10-99 years	High – 1:10-99 years	High – 1:10-99 years	High – 1: 10-99 years
People's health, safety and wellbeing	Catastrophic	Catastrophic	Catastrophic	Catastrophic
Economic direct[94]	Moderate	Catastrophic	Catastrophic	Catastrophic
Environment	Insignificant	Insignificant	Insignificant	Major
Core functions	Major	Major	Major	Major
Community and culture	Minor	Major	Major	Major
Average confidence	Highest	High	High	High

3.2 Biosecurity incursions

Tasmania faces many different biosecurity incursions. This assessment uses five biosecurity incursions as exemplars to explore consequences and potential measures relevant to many other biosecurity incursions in both land and marine environments.

1. FMD
2. Avian influenza (zoonotic)
3. Medfly
4. Shellfish biotoxins
5. *Didemnum vexillum* ('carpet sea-squirt')

This assessment explores the consequences of each of these example incursions before considering issues and measures crossing all or most of them. The scenarios are examples for discussion purposes only.

Rationale

This is the first time the Tasmanian Disaster Risk Assessment includes biosecurity. Tasmania has too much to lose from biosecurity incursions to not consider the very likely risks. Globalisation and increased movement of people and goods means biosecurity incursions are rising[95]. Climate change can increase the potential spread of pests and disease, with the state and its surrounding waters becoming more habitable for species that previously would not have survived[96]. Peri-urban farming, high-intensity farming methods and free-range farming can all change the biosecurity risks profile. Biosecurity incursions can be difficult to detect and manage, particularly in cases where treatment options are limited.

Biosecurity protects public health, Tasmanian industries and the state's environment from the negative impacts of pests and diseases. Many of the state's valuable export markets rely on the state's pest/disease-free status. The state must remain vigilant against potential incursions from the mainland as well as from overseas. Biosecurity incursions can also move within the state[97].

Current arrangements

The Tasmanian *Biosecurity Act 2019* introduced strengthened controls. NRE TASThe Biosecurity Tasmania Division of NRE Tas oversees biosecurity incursions from prevention through to response and recovery. They are progressively implementing the Act across sectors. The Biosecurity Emergencies State Special Emergency Management Plan outlines measures to reduce risks in line with national arrangements. Intergovernmental arrangements support a coordinated approach to biosecurity issues impacting multiple states. Biosecurity Tasmania focuses on incursions with the greatest potential to cause harm. They work with industry to decide the highest risk areas while considering risks across all industries, sectors and communities. Often, incursions impact on one specific industry or local area.

3.2.1. EXAMPLE SIMILAR EVENTS

Incursion type	Trigger and impact summary
Insect pest	A complex combination of factors including treatment failures resulted in Queensland Fruit Fly incursions in Northern Tasmania in 2018-2019. The successful response was the largest biosecurity response in Tasmania's history[98].
Shellfish biotoxins due to algal bloom	*G. catenatum* alga appeared in Tasmanian waters about 1973. Since then, blooms have reoccurred in the Huon River, D'Entrecasteaux Channel, and the Derwent River. Events are more common in autumn but sometimes occur in spring and when water temperature is over 14°C[99]. There is one documented case of serious poisoning resulting in hospitalisation in Tasmania in 2011 and anecdotal reports of other cases in the 1980s and 1990s[100].
Animal disease	An FMD outbreak in the United Kingdom in 2001 caused an estimated $AUD 19 billion in losses and the death or destruction of about 6 million animals. Similar outbreaks in South Korea, Japan and Taiwan since 2001 have produced similar scale losses[101].
Animal disease	African Swine Fever emerged in Timor-Leste, detected in September 2019. It is highly contagious and can have a case fatality rate of 100%.
Plant pest	Citrus canker affects citrus plants causing the leaves to drop and unripe fruit to fall. Any infected trees have to be destroyed. Citrus canker has been found in Australia more than once before, and each time it was eradicated after years of effort. The most recent invasion occurred in April 2018, in Darwin and northern Western Australia. A nationally coordinated response meant that in April 2021 citrus canker was officially declared eradicated from Australia.
Environmental pest	Imported fire ant (*Solenopsis invicta)* was first detected in Brisbane in 2001, triggering a national cost-shared eradication program. The fire ant is listed as a key threatening species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
Plant pest	The grape phylloxera (*Daktulsphaira vitifoliae*) destroys grapevines by eating the roots. It has the potential to devastate vineyards and wreak economic devastation on rural communities. The pest is present in eight quarantine zones on mainland Australia.
Plant pest	Little cherry virus 2 (LChV2) is a plant virus that affects the overall health of a cherry tree and results in fruit that is small, poorly coloured and lacking flavour. LChV2 was detected in Tasmania in 2014 and has since been found in Victoria. The virus might have been in Australia for more than 35 years and could be widespread. As a result, and based on scientific evidence, it is considered that LChV2 can't be eradicated from Australia.
Aquatic disease	Abalone viral ganglioneuritis (AVG) is a viral disease that affects the nervous system of abalone. The mucus from abalone is thought to be the main vector in which the disease can spread. The first reported case of AVG in Australia was detected in waters off the Victorian coast in 2006. Tasmania's wild abalone fishery is the biggest in the world, with around 25% of the world annual harvest. It also supports a very active recreational fishery, involving around 12 500 people. Apart from the environmental consequences, an outbreak of AVG in Tasmania could also have a major impact on the economy and on recreational opportunities.
Aquatic disease	Pacific Oyster Mortality Syndrome (POMS) was first seen in Australia in NSW in 2010. Since then, movement restrictions have been in place to reduce the risk of spread to other areas. The POMS virus was first detected in Tasmania when it caused high mortalities at an oyster lease in late January 2016. NRE Tas continues to work with the oyster industry to assist it to recover from this disease event and develop options for the future.

3.2.2. FOOT AND MOUTH DISEASE

FMD is one of the most serious livestock diseases. It affects cloven-hoofed animals such as cattle, sheep, goats, deer and pigs. Human infections are very rare and do not result in serious disease. It is a highly contagious animal disease that would have severe consequences if introduced into Tasmania. The state would need to eradicate FMD to secure international market access for animal products. Exploring FMD provides insights for other animal disease outbreaks.

FMD is in many parts of the world. There are seven serotypes of the virus dominating in different parts of the world. Vaccination for one serotype, though, will not protect against infection with another serotype.

Vaccines can protect against FMD but may not prevent infections or disease spread. FMD control involves:

- destruction of infected animals
- movement control
- complementary control measures such as cleaning and disinfection.

Timing	Scenario overview
June	A large sheep property in the Midlands straddling the highway is handling sheep for routine husbandry and sales including via Powranna saleyards and across the Strait for slaughter. The low level of lameness detected is thought to be footrot following wet weather.
Early July	FMD is identified in transported animals to the mainland. The wide points of contact and transport spread FMD across Tasmanian dairy and beef industries and feral fallow deer populations. The mainland is also impacted. Tasmania declares an immediate 3-day livestock standstill ('lockdown') under s163 of the *Biosecurity Act 2019*. Tracing and surveillance investigates the full extent of spread.
Mid July	The Tasmanian Premier declares a State of Emergency. Treatment/culling of animals begins.

National Ausvetplan manuals and documents, including one specifically for FMD, complement generic biosecurity arrangements to guide response actions.

FMD Consequence summary

People's health, safety and wellbeing

FMD has minor direct human health impacts but the destruction of many animals and associated stresses can have mental and other secondary health and wellbeing impacts for farmers and their communities.

Such disease outbreaks can produce animal welfare issues. For example, animals may be stuck in transit. Farmers may lack access to feed. Many animals are likely to be humanely destroyed to stamp out the disease. Identifying competent slaughter persons at short notice will be an issue. Dairy cows may not be milked, potentially leading to mastitis. It may be difficult to comply with animal welfare standards during such an outbreak.

Economic

If not contained early, the economic consequences could be catastrophic. An outbreak would result in loss of markets for several years. It has been estimated a multi-state outbreak would result in losses of between $49.3 billion and $51.8 billion expected over 10 years. 99% would be due to direct economic costs, the remaining 1% being for disease control costs[102].

The FMD response would be prolonged and resource intensive but necessary. The destruction, disposal, and decontamination would be complex. An FMD outbreak impacts not only the farmers directly involved, but also downstream processing and consumers. The economic impacts are likely to be devastating for individual farmers, allied businesses such as feed suppliers, and their local communities. The extent to which these impacts affect the whole state depends on the extent and length of the outbreak. A disease outbreak may also impact on valuable bloodlines, with longer-term impacts. Sourcing replacement livestock can be problematic after a large outbreak response.

Environmental

Large-scale destruction of animals can have flow-on environmental consequences. FMD can remain infective in the environment for several weeks and possibly longer in, for example, soil, manure and dried animal secretions, straw, hair and leather[103]. Ungrazed pastures can lead to increased weeds, invasion of deer, rabbits or wallabies and increased fire risks. There may need to be ongoing monitoring of feral deer, goat and pig populations.

Core functions

The transport standstill may lead to shortages in some foodstuffs, particularly milk. The outbreak would most impact livestock and rural transporters as they cannot move between properties. Farmers may not be able to source feed for their animals without this transport.

Community and culture

A severe disease outbreak can isolate people as they work to contain the disease. As well as physical disconnections, the event may affect social and community connections[104]. The disease and associated control measures may result in some community conflict, highlighting different values. For example, unpleasant images of destroyed livestock on social media can damage industries' social licence.

3.2.3. AVIAN INFLUENZA (ZOONOTIC)

Avian influenza, also known as bird flu, is a variety of influenza adapted to birds. It is highly contagious from bird to bird. All commercial, domestic and wild birds are susceptible, but outbreaks occur more frequently in chickens and turkeys. Many wild birds, such as geese, ducks, swans and seabirds, can carry the virus but generally do not show signs of the disease. There are many strains of avian influenza but the highly pathogenic avian influenza (HPAI) is the most serious. It spreads quickly and can cause severe disease and many deaths in commercial poultry flocks. If an exotic strain of avian influenza were to enter or a local strain emerge and become pathogenic in commercial poultry in Australia, it could be devastating. In 2003, the Netherlands culled over 30 million birds to eradicate the disease, costing more than $252 million[105].

HPAI circulates in waterfowl, such as ducks, geese, and swans, throughout the world. However, the waterfowl that are the most common hosts of the virus in other parts of the world do not migrate to Australia. There is a small risk that a locally circulating low pathogenic strain will become a virulent HPAI strain. There have been outbreaks of HPAI on mainland Australia in recent years. These were eradicated before the disease could spread. Tasmania monitors low pathogenic avian influenza viruses related to those that caused outbreaks on mainland Australia. Bird flu causing human deaths in other countries has not been detected in Australia, for example, H5N1 emerging in South-East Asia in 2003 and H7N9 emerging in China in 2013[106]. A national surveillance program monitors potential outbreaks.

Timing	Scenario overview
Late September	A wet spring has spread wild waterfowl across Tasmania. A small free range commercial layer flock reports a sudden increase in their chickens dying. Samples taken by Biosecurity Tasmania staff return a positive result for Influenza A. Following tests confirm H5 HPAI.
Early October	As Biosecurity Tasmania staff prepare to manage the destocking of this property following AUSVETPAN guidance, a large commercial cage and free-range layer producer reports a catastrophic increase in mortality in caged and free-range layers. The producer is surrounded by small hobby farms, many of whom have free ranging poultry and wetlands attracting many wild waterfowl. Some hobby farmers have heirloom chickens of high financial value. There is a local practice of dropping excess roosters into roadside areas and rubbish dumps. A local wildlife park specialising in raptors has been feeding spent hens from the layer farm to the raptors. They report several of their raptors have suddenly died.

Avian influenza consequence summary

While many of the consequences are similar to FMD, the disease may be difficult to control if in wild birds. Depending on the strain, it may have direct human health impacts.

People's health, safety and wellbeing

Bird flu has the potential to mutate to a form that can be transmitted to humans; however, as of mid-2021, this is unlikely[107]. When it does arise, some avian influenza viruses cause high death rates in humans. People are most likely to catch it through close contact with infected birds or their droppings. On rare occasions, the virus can then pass from human to human and be the cause of a human pandemic if there is sustained transmission. If this occurred, there would need to be a joint public health/biosecurity response (Refer to Section 3.1 - Respiratory pandemic).

Economic

Depending on the nature and spread of the disease, there could be major or catastrophic economic impacts. Similar to FMD, producers will lose their flocks and income as the exposed birds in a restricted area need to be destroyed. There would be restrictions on moving poultry and poultry products. As products are destroyed, there may be a shortage of eggs and chicken meat. There could be lost export income. If the disease is zoonotic, this would impact on Tasmania's tourism industry. Post-event, stock prices may skyrocket as producers restock.

Environmental

With the potential to cause illness and death in native and migratory birds, avian influenza could result in a loss of species and consequential impacts on surrounding ecosystems. Biosecurity Tasmania would need to sample wildfowl for a long time to monitor spread. Wild bird populations could be a reservoir for the disease. Depending on the disease, it may impact some threatened native species. Infected birds may die near water sources and contaminate irrigation and drinking supplies.

If domestic animals were involved, people might choose to dump their animals in bushland to reduce the threat to themselves or "save" the animal from culling. This might lead to increased feral populations, causing ecosystem damage and further disease spread.

If the pandemic included zoonosis, environmental implications would depend on the disease, the animal and the event response. Biosecurity Tasmania would be responsible for sampling suspect animals and making recommendations. There may be "vigilante" killing of suspect animals.

Core functions

The impacts of avian influenza are similar to FMD as farm-related transport is stopped. Destroying animals, decontamination and preventing access and movement and surveillance would be resource intensive. There would be staff and supply chain impacts.

Community and culture

The consequences for communities would be similar as with FMD. People would experience fear, loss and grief. There may be some community negative perceptions about the poultry industry. There would be impacts on pet birds and backyard poultry owners and the sharing of produce.

3.2.4. MEDITERRANEAN FRUIT FLY (MEDFLY)

The Mediterranean fruit fly (Medfly) (*Ceratitis capitata)*, is one of the most destructive agricultural pests worldwide, causing severe degradation in more than 200 types of fruit and vegetables. Medfly is in parts of Western Australia. Fruit export to key fruit fly sensitive markets in Asia alone in 2015-16 was $36.6 million.

As of mid-2021, there were multiple Medfly outbreaks in South Australia, some of which have continued into a second year. There are concerns about consequences if Medfly were to become permanently established in South Australia, increasing the risk of outbreaks in the eastern states, including Tasmania.

Depending on the size and location of the outbreak, eradication would include:

- destroying infested fruit
- spot baiting
- cover sprays in commercial orchards
- movement controls
- potentially the use of Sterile Insect Technique (SIT).

Timing	Scenario overview – an example developed for discussion purposes only
Late March	Medfly is detected in traps in a Hobart suburb. Investigations reveal that a resident returned from Perth in November without declaring some home-grown oranges. The resident had discarded the oranges in their compost pile after finding live larvae in them.
Early April	The initial outbreak area (1.5 km radius circle) encompasses 2 500 residential blocks, but additional detections the following week expand the outbreak area to a 3 km radius circle, encompassing 10 000 residential blocks. Climate forecasts predict a warm autumn and winter, increasing the chance the flies will survive.

Consequence summary

People's health, safety and wellbeing

Medfly does not directly impact human health. However, there may be reduced fruit consumption as food supply chains are disrupted and local crops destroyed. Some of the control measures could restrict movement and the resulting stresses would have some secondary wellbeing consequences.

Economic

Pests such as Medfly reduce fruit yields and lead to a loss of market access. Primary producers would have increased production costs, which could make them economically unviable. There are also secondary losses to supporting businesses such as sprayers, contractors, fruit pickers, and packers. Other local businesses may also be impacted, for example, tourism and food outlets. Many farms rely on farmgate sales, and these may be limited.

A loss of fruit fly sensitive markets for one year would have moderate economic impacts for the state. If the incursion cannot be controlled within a year, there could be major economic losses. If an outbreak is not contained, the long-term costs could impact key industries' viability.

Environmental

There would be minor environmental impacts from Medfly incursions due to the chemicals to control them and fruit disposal. There is no evidence of Medfly displacing native species; however, there are few studies.

Core functions

Insect pests such as Medfly do not disrupt core functions, aside from tying up resources due to response.

Community and culture

While state-level community and cultural impacts would be minor, some communities focus on fruit production and local impacts would be greater. Local farmers markets and other community-based means to distribute food would be affected.

3.2.5. SHELLFISH BIOTOXINS

Filter feeding shellfish (for example, oysters, mussels, scallops and clams) consume microscopic plants called phytoplankton or algae for food. Some of these algae produce natural chemicals that shellfish are insensitive to but can be toxic to humans. High doses accumulate in shellfish tissues, leading to potentially fatal biotoxin poisoning. Some algal species' blooms lead to harmful concentrations of such biotoxins in shellfish.

Tasmania has had unprecedented bloom events in the last decade. For example, there was an *Alexandrium* (Dinophyceae) bloom along the east coast in 2012. This was previously a low biotoxin risk area. The bloom had major impacts on the local oyster, mussel, scallop and rock lobster industries. Four people were hospitalised from eating wild shellfish. An international shellfish product was recalled, with losses of more than $23 million to the local economy. Since 2012, Tasmania has experienced blooms annually, closing shellfish growing areas. Given rising water temperatures around Tasmania's East Coast due to climate change, these events are likely to become more common and prolonged.

As well as the generic biosecurity emergency management arrangements, NRE Tas has a Shellfish Biotoxin Management Plan *(2019)*. This is primarily based on analysing shellfish for biotoxins and aims to:

- identify biotoxin risks which may impact on commercially harvested shellfish in a timely manner
- meet the food safety standards needed for market access and to protect seafood consumers
- increase industry members' awareness of biotoxin risk, to help implement control measures[108].

Timing	Scenario overview
Late November	A family of tourists get Paralytic Shellfish Poisoning (PSP) after eating shellfish at a large restaurant in Hobart. One member of the family is in intensive care.
Early December	Biosecurity Tasmania find that an algal species, previously unseen in Tasmania, bloomed after heavy rain affected the East Coast. Shellfish grown in that region may need to be recalled.

Consequence summary

People's health, safety and wellbeing

If not detected early, this event could result in illnesses or deaths. While commercial shellfish producers regularly monitor for biotoxins and other contaminants, people may gather and eat wild shellfish along shorelines. Public Health issue warnings against eating shellfish when biotoxins are detected but visitors may be unaware of the risks. There are permanent wild shellfish warning signs around Tasmania for the ongoing risk of potential illness from eating wild shellfish.

Economic

Tasmania's international export income from abalone, molluscs and rock lobster alone in 2018-19 was $96.3 million[109]. Contamination with shellfish biotoxins would mean this produce cannot be sold or exported, with impacts on employment in these industries. There would also be impacts for restaurant and tourism businesses and impacts for Tasmania's pristine and clean reputation. Previous events have resulted in moderate financial impacts for the state. If not contained or algal blooms become more common and extensive due to warming waters, these impacts could have major state economic impacts.

Environmental

There is little known research on the environmental impacts of shellfish biotoxins.

Core functions

Shellfish biotoxins have insignificant impacts on the core functions on which Tasmanians rely. Once established, algal blooms are difficult to control. Response focuses on monitoring and warnings to reduce health impacts.

Community and culture

Many Tasmanians have close connections to coasts through fishing, coastal walking and other activities. Aboriginal people have traditionally gathered shellfish to eat. Shellfish biotoxins mean such activities can become dangerous.

3.2.6. DIDEMNUM VEXILLUM (CARPET SEA SQUIRT)

Didemnum vexillum (*D. vexillum*) is a marine invertebrate that can form thick encrusting mats, in some places over 95% of the seabed, to:

- overgrow rocks, gravel, and artificial structures such as boats and aquaculture equipment
- smother marine and coastal organisms, such as sessile invertebrates (such as oysters), algae, and seagrass
- change the composition of the seafloor community
- produce a toxic substance which discourages predators and prevents the larvae of other species from settling on it.

Tasmania has native *Didemnum* species that do not normally cause concern. However, there are two exotic species in other areas of Australia and New Zealand. *D. vexillum* has spread internationally in temperate climates and is expected to be introduced to Australia[110].

Currently, the Australian Government manages biosecurity for above-water surfaces and ballast water on international marine vessels entering Australian ports. Clearance inspections do not normally include hull biofouling. There are currently no formal regulations requiring hull inspection under the Tasmanian Biosecurity Act, although the operators do have a legislated duty of care.

Timing	Scenario overview
November	A Tasmanian company imports a work barge from New Zealand. On arrival in Hobart, the barge undergoes Australian quarantine clearance. The barge is at Hobart port for two weeks. The barge is moored close to an international Antarctic supply ship, contracted to visit Macquarie Island during its first trip of the season. Some cruise ships also visit the port.
December	The barge is moved to D'Entrecasteaux Channel. Recreational boaters regularly transit the area before travelling to the southwest of Tasmania, including Bathurst Harbour. Vessels owned by the barge operator regularly move between the company's assets.
March	Fish farm divers report unusual growths hanging from the polar circles and mooring lines of cages. The cages themselves are free of these growths, but these are regularly cleaned by robotic remotely operated vehicles that blast biofouling from the nets. Inspection of the barge also finds large areas of growth, considered to be a *Didemnum* species.

Response arrangements

Eradication is almost impossible once established. Mechanical removal is not effective. Generally, eradication of marine pests is impractical and expensive. Therefore, biosecurity measures must concentrate on:

- early detection prior to establishment
- limiting spread of those marine pest species that have established.

Appropriate vessel ballast water management and biofouling can prevent introductions. General management procedures may include assessing vessel risks before arrival. Ballast water may be treated prior to discharge or exchange in low-risk areas. Additional management options for biofouling include:

- effective antifouling coating
- in-water inspection for high-risk vessels
- approved in-water cleaning practices where required.

Biosecurity measures at boat maintenance facilities, such as slipways, and public education, can also reduce spread of established species.

Consequence summary

People's health, safety and wellbeing

D. vexillum is not likely to have direct impact on human health, safety and wellbeing.

Economic

D. vexillum or similar species could threaten Tasmanian aquaculture industries and alter habitats that various fisheries rely on[111].

Environmental

If not controlled, *D. vexillum* could result in major environmental consequences. Research elsewhere suggests such an incursion will alter invertebrate and fish communities, with native populations displaced or lost[112]. Bird species may lose important food sources[113]. In-water treatments could reduce water quality.

Core functions

D. vexillum can impact wharves, sewerage outlets and other infrastructure in marine environments. Removal increases maintenance costs. Measures to prevent spread may impact maritime freight pathways.

Community and culture

If not controlled, such incursions could detract from popular activities such as recreational fishing and vessel movement between affected and non-affected areas.

3.2.7. COMMON ISSUES ACROSS SCENARIOS

Although very different, the biosecurity incursion case studies examined show the potential extent of biosecurity incursions and some common issues across them. NRE Tas's website includes lists of notifiable plant and animal diseases and pests that could cause significant consequences if introduced to the state. There are also other harmful incursions that will continue to emerge.

The costs and damages from high-impact pests, diseases and infestations justify early monitoring and surveillance plus early and quick response actions. Biosecurity response can be costly, time-consuming, difficult, may result in negative impacts themselves and involve long-term recovery.

People's health, safety and wellbeing

Biosecurity incursions can cause major illness and death[114]. Two of the examples here have the potential to cause direct fatalities, one through disease spread (avian influenza) and one through poisoning (Shellfish biotoxins). Internationally, on average five new diseases emerge each year and on average, three of them are zoonotic[115]. As novel pests or diseases, access to testing and medical advice is essential.

Like all disasters, biosecurity incursions can result in stress leading to mental and other health concerns.

Economic

Biosecurity incursions can have major or catastrophic industry impacts, depending on the nature and extent of the incursion. As well as potentially bankrupting primary producers and limiting export income to the state, biosecurity incursions can impact supply chains and whole communities. Some of the impacts may be longer term. For example, otherwise valuable land may not be able to be used for some time. Biosecurity incursions damage Tasmania's brand. Some control measures, such as chemical sprays, can impact on organic farms' status, and their potential future earnings. A biosecurity event may affect industries' social licence to operate. For example, some may view the necessary large-scale slaughter of animals as a reflection on that industry.

Due to the time and effort needed, the resources involved in responding to a major biosecurity incursion can be considerable. These include direct resourcing for response plus costs to government for compensation and relief/recovery plus lost opportunities and growth. For example, the Queensland Fruit Fly response cost about $12.1 million. However, controlling the incursion means Tasmanian fruit growers can continue to export an estimated $20.3 million of produce to fruit fly sensitive markets every year[116].

Environmental

Some biosecurity incursions can cause catastrophic environmental impacts by displacing local species and changing Tasmania's unique habitats. Past introduction of diseases, weeds and pests have shown this can happen, for example, rabbits, gorse, phytophthora, amongst many others. Response measures for many incursions can also have environmental impacts, for example, the use of chemicals and disposal of animal carcasses, and increased waste disposal of PPE and other equipment.

Land-based biosecurity incursions are of concern and spread amongst birds and insects can be difficult to monitor and control. However, marine biosecurity incursions are particularly concerning. Marine biosecurity incursions are less understood, can easily spread unnoticed, and can often be more difficult to control.

Core functions

Biosecurity incursions tend to not directly impact on the critical infrastructure and services on which Tasmanian communities rely, aside from tying up resources for response and recovery.

Community and culture

Biosecurity prevention and control measures can impact people's daily activities. Biosecurity incursions may threaten our valued pets and other animals. Tasmanians value sharing produce through community networks, farmers markets and the like. Biosecurity risks can limit these community connections.

Systemic issues

Workshop groups considered what success looks like across the five scenarios. Given the range of the biosecurity incursions examined, their answers were consistent and centred around the following themes.

- Minimal spread, minimal losses, happy industry players and communities
- Cross-government coordination
- Incursions prevented, detected early and limited
- Response is effective and proportionate to the consequential risks
- Government, industry, community collaborative actions in reporting and response
- Reliable information and detailed risk understanding
- Continuous review and learning

These signs and indicators of success reflect the importance of collaborative actions to prevent incursions and quick and early response to incursions.

3.2.8. ASSESSMENT SUMMARY

(Not assessed in 2016)

	Foot and mouth disease	**Avian influenza (zoonotic)**	**Mediterranean fruit fly**	**Shellfish biotoxins**	***Didemnum vexillum***
Maximum risk level	Extreme	Extreme	High	High	Extreme
Maximum consequence	Catastrophic	Catastrophic	Major	Major	Catastrophic
Likelihood of a scenario like this occurring	High – 1:10-99 years	High – 1:10-99 years	Very high – 1:1-9 years	Very high – 1:1-9 years	High – 1:10-99 years
Likelihood of similar events	African Swine fever – Very high	Other zoonotic disease – Moderate	Other damaging insect pests – Very high	Very high	Similar pest incursions Very high
People's health, safety and wellbeing	Minor	Major-Catastrophic, depending on the disease	Insignificant	Moderate, if detected early	Insignificant
Economic direct and indirect	Catastrophic	Catastrophic	Major	Major	Major
Environment	Moderate	Moderate	Minor	Moderate	Catastrophic
Core functions	Moderate	Moderate	Insignificant	Insignificant	Minor
Community and culture	Moderate	Moderate	Minor	Minor	Insignificant
Average confidence	Moderate	Moderate	Moderate	Moderate	Moderate

4. Socio-technical systems risks

Socio-technical systems refer to the interlinked human, cultural and technical elements that shape and are shaped by people's actions. Like the earth's systems of climate, weather and geology, and biological systems, socio-technical systems can also include hazards and risks. Part 4 explores four disaster scenarios primarily induced by human actions.

- The first outlines a major maritime incident in a port, and the impact on supply chains.
- The second focuses on a remote major transport incident involving hazardous material.
- The third explores the role regulations play in making structures safe through structural failure of legacy commercial accommodation buildings.
- The fourth examines the potential implications of a major cyber outage.

Together, these scenarios illustrate the following.

- Legislation, regulations, quality standards and their implementation can be key measures to reduce risks, potentially in the long term.
- Efficiency pressures often shape supply chain and information communications technology networks; however, their resilience can rely on strategic redundancies and contingencies.
- As with other disaster scenarios, these types of disaster need a whole-of-society approach.
- Such scenarios can be complex. They should be regularly exercised across agencies and sectors to identify detailed issues and gaps.

Today's rapid technological advances and our reliance on them underpin Tasmanian communities, but they are also a source of vulnerability. Part 5 explores these vulnerabilities in more detail across scenarios.

4.1 Maritime incident in a port

The Spirit of Tasmania grounds in the mouth of the Mersey, blocking access to the port of Devonport.

This scenario highlights the importance of existing strong safety measures such as legislation, regulations, standards and practices, plus industry training and accreditation. It also shows how government agencies need to work together and with others such as port operators and shipping companies. Such collaboration needs to be practised through regular exercises and plan reviews.

4.1.1. BACKGROUND AND RATIONALE

Shipping routes are important for an island state. About 99% of Tasmania's freight transits through a Tasmanian port[117]. Tasmania has four major ports at Devonport, Burnie, Bell Bay and Hobart, plus managed and cargo ports on the Bass Strait Islands and at Port Latta. TasPort's Port Master Plan 2018 currently guides investment in Tasmania's ports.

While maritime safety is generally a national-level responsibility, incidents near or in ports are a state-level issue. Ports are high-risk environments for large ships because they can include:

- challenging environmental conditions
- narrow transits
- limited under-keel clearance
- the potential for interactions with infrastructure such as cranes and wharfs.

A grounding event creates logistical challenges, particularly if there are passengers and livestock, cars, trucks, freight and caravans onboard. Even with modern forecasting and navigation aids, extreme weather, tides and currents can provide challenges. While training and accreditation plus vessel operator policies and procedures help manage safety issues, human error can occur.

The Spirit of Tasmania (SoT) are two 28 000 tonne, 194 m roll-on roll-off vessels that transport passengers and freight between Melbourne and Devonport. Each vessel can carry 1 400 passengers and 500 standard vehicles[118]. Replacement vessels are planned to have capacity for an additional 160 000 passengers a year[119].

Current arrangements

The Australian Maritime Safety Authority (AMSA) and Maritime and Safety Tasmania (MAST) manage relevant legislation, regulation, standards and accreditation for the shipping industry, including:

- *Navigation Act 2012* (AMSA)
- *Maritime Safety (Domestic, Commercial) National Law Act 2012* (MAST)
- *Marine and safety (pilotage and navigation) Regulations 2017* (MAST)
- *Marine and safety (General) Regulations 2013* (MAST)
- marine orders (various) (MAST)
- National Standards for Commercial Vessels.

Workshop participants noted industry operators generally comply with these risk reduction measures. Participants noted that standards for international shipping have improved over recent years as national regulatory bodies work towards consistent international standards. Changing legislation and regulation generally takes considerable time; however, standards are regularly reviewed.

Under TEMA, MAST is responsible for emergency prevention and preparedness. AMSA and MAST run safety programs and participate in international maritime organisations. Tasmania Police (TasPol) is lead agency for response. The vessel operator and TasPorts also have key roles. The vessel operator is responsible for vessel safety and removal of passengers in an emergency. TasPorts is responsible for safety within ports.

TasPorts manages and track vessels to minimise risks. For example, vessels must comply with speed limits within port areas. Many vessels must have a local pilot or be towed. Many ports have restrictions on berthing vessels in extreme weather and limits on the class of vessels allowed to enter. Weather forecasts and meteorological modelling aid navigation to reduce risks. These models consider vessels' size and shape, providing useful information to ships' crews. TasPorts have risk management and emergency response plans which are regularly exercised. Workshop participants noted more cross-sector exercises would benefit all parties and the state.

State Growth has roles such as:

- monitoring critical freight and logistics services to assess emerging supply and demand impacts, including points of supply chain vulnerability
- liaising with asset owners and service providers to identify priorities and support measures
- advising on relevant relief and recovery matters.

Workshop discussions highlighted that some responsibilities could cause confusion if such an event occurred. Lead agency responsibilities may move between the vessel owners, TasPorts and Tasmania Police. This is a complex response situation which Tasmanians have rarely had to respond to.

4.1.2. EXAMPLE SIMILAR SCENARIOS

Ship	Location and Summary
Ever Given, 2021	The Ever Given is a 399 m container ship with a deadweight tonnage of almost 200 000 tonnes. On the 23 March 2021, it grounded in the Suez Canal. The ship blocked the channel for six days before eight tugs re-floated it. Canal authorities seized it and demanded the owners pay $900 million in damages. The incident blocked hundreds of ships from passing through the canal.
Pasha Bulker, 2007	The Pasha Bulker is a Panamax bulk carrier with a deadweight of almost 77 000 tonnes. It planned to enter Newcastle Port to load coal. With a gale warning issued on the 7 June 2007, most ships went to sea to ride out the storm. On 8 June, the Pasha Bulker grounded on Nobbys Beach in Newcastle. The grounding seriously damaged the Pasha Bulker. Its condition deteriorated while it remained on the beach. The ship was re-floated on 2 July.
Iron Baron, 1995	The Iron Baron was a bulk carrier carrying manganese ore that grounded on Hebe Reef in the approaches to the Tamar River in July 1995. The vessel lost 325 tonnes of heavy fuel oil. The ship was re-floated on the 16 July and moved to anchorage. The incident created a major oil spill of an estimated 325 tonnes of heavy bunker fuel. In 2005, a 10-year post-mortem reflection on the incident estimated penguin fatalities at 25 000. The badly damaged ship was scuttled.

4.1.3. SCENARIO OVERVIEW

1900	SoT Departs Melbourne. Conditions are rough but not extreme.
0535	SoT prepares to enter the port of Devonport.
0536	The winds increase from the North West, swinging around to the west at times. This pushes the ship towards the eastern side of the channel.
0539	The bridge team struggles for control of the ship in the high winds but maintains the ship within the channel. A critical engine alarm sounds and the SoT loses power to both engines. The rudder locks hard to port. The captain asks for the anchor to be let go.
0541	The SoT runs aground with its bow facing Roundhouse Park near high tide. The ship's stern drifts across the channel to the east, pushed by the wind. It now completely blocks the channel. Initial observations and soundings indicate that hull integrity is maintained.

4.1.4. EXPOSURES AND CONSEQUENCES

Based on the SoT's hull and the sandy bottom of the river, there would likely be minimal damage to the vessel. TasPorts reported the vessel would most likely be re-floated after some delay, then towed to port. There it would remain until repaired or a decision made as to its fate.

While less likely, the workshop also considered the consequences if the ship was structurally damaged and in danger of breaking up. The focus would then be on evacuating people. It is unlikely that larger animals and freight could be saved. If the vessel grounded in a different location the consequences would differ. Exercising can help identify specific issues of concern for various scenarios.

People's health, safety and wellbeing

Passengers and crew would not be in immediate danger in the explored scenario. The vessel would likely slide and stop rather than crash on the sandy riverbed. However, there may be minor injuries plus stress-related health concerns. A decision to evacuate people from the vessel would depend on the vessel's condition. If the vessel is safe, it may be easier to keep passengers on board until the vessel can be brought alongside a wharf. If people stay on board, the boat needs to be resupplied.

Core functions

While Devonport is a busy port, most vessels could use alternative ports with additional freight trucking. Freight companies' capacity would become limited. State Growth is currently mapping the transport/freight consequences of a port closure. The other SoT would be in Melbourne and can provide extra sailings and there are plans to enable the SoT vessels to use Burnie Port if needed.

Economic

The direct and indirect state-level economic impact of this event would be moderate. Provided the SoT was undamaged, the vehicles inside are unlikely to be damaged. Bass Strait's notorious conditions mean the SoT crew ties down vehicles for crossings. In the short-term there could be delays in the delivery of fresh or refrigerated freight. Trapping of vessels within the port would financially impact the companies involved.

In the medium term, the incident would impact Tasmania's in and outbound freight; however, there are alternative ports for most vessels. Due to increased demand on the other ports, there may be a need to prioritise freight in and out of the state, delays and increased costs. The second SoT can complete twice-daily runs to keep up with demand if needed.

There would likely be local economic impacts to the Devonport area, with fewer people and less freight transiting. The event may trap commercial fishing and other vessels in or out of the port.

Environment

Assuming the grounding did not significantly damage the ship's hull, the environmental impacts of this scenario would be minimal. The Mersey River is not a pristine natural environment with significant natural values. This scenario would cause channel silting or riverbank erosion so the channel may need to be dredged. A similar event in another location could have moderate or major environmental consequences. If the incident was during a flooding event with extensive debris from upstream, there could be flooding risks to Devonport.

While there may be a fuel spill, workshop participants thought this unlikely. There may be spillage, sewage and waste management issues. The vessel owners would bear financial costs for such pollution. The East Coast Low scenario includes an oil spill from a pipeline (refer to Section 2.3.1).

The plight of animals on board the vessel was a significant discussion topic. Accessing and feeding small animals would not be difficult. It would be harder to access and extract larger animals in horse floats or stock trucks. Guidelines for transporting livestock over Bass Strait, developed to ensure animals do not suffer, may be difficult to implement.

Community and culture

There would be minimal disruptions or damage to cultural events or assets from such an event.

4.1.5. SYSTEMIC ISSUES

Workshop participants considered what success looks like to identify systemic issues.

- Shipping industry risk management
- Flexible, well-understood and practised emergency response arrangements
- Communications, information sharing and situational awareness
- Contingency plans for alternative processes/routes/ports

4.1.6. SUMMARY OF ASSESSMENT

Summary of assessment	**Medium**
Maximum risk level	**Medium**
Maximum consequence	**Moderate**
Likelihood of a scenario like this occurring	1:100-999 years
Likelihood of similar events	1:10-99 years
People's health, safety and wellbeing	Minor
Economic direct and indirect	Moderate
Environment	Minor
Core functions	Moderate
Community and culture	Insignificant
Average confidence	Moderate

4.2 Remote traffic/ HAZMAT incident

A tourist bus collides with a truck carrying HAZMAT in a remote location.

This scenario highlights how regulations and other current control measures mitigate the risk of major traffic and HAZMAT disasters occurring. Such a scenario would be likely without such current measures.

4.2.1. BACKGROUND AND RATIONALE

Heavy vehicles use Tasmania's roads for passenger transport, freight, industry supply and tourism. Local communities, businesses and Tasmania's economy rely on these transport routes for access to hazardous material.

Despite a wide range of road safety initiatives, 36 people died on Tasmanian roads in 2020 and there were 284 serious injuries[120]. In 2019, bus crashes killed 20 people in Australia. Traffic crashes in Australia hospitalise about 260 bus occupants each year (2013-2018). Of these, around 22% have high threat to life injuries[121]. Traffic incidents involving HAZMAT are rare, but possible.

Legislative context and responsibilities

State Growth oversees road safety measures, with TasPol enforcement powers helping to implement them. Transport and Safety Investigation Unit inspectors and the National Heavy Vehicle Regulators also reduce safety risks on Tasmanian roads. Tasmania's road safety measures align with the National Road Safety Strategy and the work of the Australian Transport Safety Bureau. Relevant legislation includes the:

- *Traffic Act 1925*
- *Passenger Transport Services Act 2011*
- *Vehicle and Traffic Act 1999*
- *Heavy Vehicle National Law (Tasmania) Act 2013,*
- *Criminal Code Act 1924.*

Related measures to proactively prevent risks include:

- Road Safety Standards, road safety awareness programs
- research, development and implementation of road-related policy and legislation
- the Motor Accident and Insurance Board (MAIB)
- international driver identification conditions/driving tests
- road reports and maintenance by State Growth and local councils
- road planning, land use planning, road design protocols/standards
- road signage, lines and other traffic facilities.

TasPol is the response management agency for traffic incidents, as outlined in the Transport Crash SSEMP.

Storage and transport of HAZMAT is also tightly regulated in Tasmania, as described in the Hazardous Materials Emergencies (HAZMAT) SSEMP. Relevant legislation includes the:

- *Dangerous Goods (Road and Rail Transport) Act 2010*
- *Dangerous Substances (Safe handling) Act 2005* and associated regulations
- *Work Health and Safety Act 2012.*

There are many regulations and standards on storing and transporting HAZMAT. The Australian Code for the Transport of Dangerous Goods by Road & Rail covers issues such as:

- substance classification, marking and placarding
- packaging and bulk containers
- vehicle requirements, segregation and stowage
- safety equipment and procedures during transport emergencies
- documentation.

These standards do not cover the transport of:

- explosives – refer to the Australian Code for the Transport of Explosives by Road and Rail
- radioactive materials – refer to the Code of Practice for the Safe Transport of Radioactive Materials
- infectious materials – refer to DoH
- waste products and other environmentally HAZMAT – refer to EPA guidance.

WorkSafe Tasmania works with operators storing and transporting HAZMAT to mitigate risks in line with this legislation. TFS is the response management authority for a HAZMAT incident unless the incident is deemed to be deliberate. In this case, TasPol is the response management authority.

As outlined in TEMA:

- the EPA is responsible for managing an environmental pollution incident
- TasWater (with input from DoH) is responsible for assessing impact on drinking water catchments and required action.

4.2.2. EXAMPLE SIMILAR EVENTS

Incident	Location and Summary
Kempsey bus crash, 22 December 1989	Two full Denning Landseer tourist coaches collided on the Pacific Highway at Clybucca Flat, 12 km north of Kempsey, New South Wales. It remains the worst road accident in Australia. 35 people died and 41people were injured.
Train derailment 9 November 2014	A train with two locomotives and 25 wagons carrying 50 containers derailed near Colebrook, injuring the driver. The crash damaged 16 containers. The containers were on their sides close to a creek and some carried dangerous goods. One locomotive also leaked diesel fuel.

4.2.3. SCENARIO OVERVIEW

18 August 10:40	A truck carrying HAZMAT travels south on the Murchison Highway. A tourist bus travels northbound on the Murchison Highway towards Tullah.
10:44	Both vehicles cross into the opposite lane as they try to correct their position on a bridge. The vehicles clip each other around the centre of the bridge.
10:45	The crash dislodges the shipping container from the truck. The container hangs over the side of the bridge. The container is dented but the crash has not breached its integrity. The truck has spilt diesel across the road.
10:49	The truck driver is injured but rings Triple Zero. At this stage s/he does not know there are 12 fatalities and 14 seriously injured people on the bus.

4.2.4. EXPOSURES AND CONSEQUENCES

Such a traffic incident would be a major disaster due to deaths and injuries. Workshop participants agreed it is possible but unlikely that large amounts of HAZMAT could be leaked in this scenario.

People's health, safety and wellbeing

This scenario's traffic crash alone has major consequences for people's health, safety and wellbeing. As the event is in a remote area in winter, there are further hypothermia risks. The Mass Casualty Management Arrangements provides for Ambulance Tasmania support options to increase surge capacity, such as Medical Assistance Teams, GP Assist and St Johns Ambulance. First responders would triage injured people at the crash site. Transport logistics would depend on access, hospital capacity and the injuries. The North-West Regional and Mersey Community hospitals would activate their mass casualty plans.

Victims would need to be identified and families notified. Language or cultural misunderstandings may impact on response and people's health and safety. As well as basic needs such as food and water, DoH/Communities Tasmania may need to arrange social workers, interpreters to assist and also involve non-government organisations.

First responders may not be aware of the HAZMAT risks involved. The extent of harm caused by any hazardous material would depend on:

- the amount involved
- the duration of exposure
- how the exposure occurred, for example, via ingestion, on skin
- individuals' attributes, such as age, gender, size, diet, family traits, lifestyle and state of health.

Those licensed to transport HAZMAT take measures to reduce risks. Such measures include, for example, limits on the amount transported and prescribed storage containers. Small leakages are more likely in such a traffic crash scenario. While less dangerous, these smaller leaks may be harder to detect.

HAZMAT risks could mean that response is slower due to extra safety measures. The response team need access to technical expertise to assess risks. Diesel or liquid fuel from vehicles could also cause concerns.

The incident is likely to close the road for some time. People may wait in their vehicles for some time. They may need advice and assistance to avoid possible hypothermia and other health and wellbeing risks.

Economic

Response direct costs would be significant due to the scale, complexity and remoteness of the event. Closing the main route to the West Coast could disrupt heavy vehicle businesses, freight and logistics and all businesses across the region. Although direct impacts on tourism may be less due to the winter (non-tourist season) timing of the scenario, there may be longer-term impacts to business and tourism throughout the West Coast.

Environment

HAZMAT leakage could be catastrophic for the surrounding environment and people at or around the incident site; however, there are strong safety regulations for transporting HAZMAT that substantially reduce the likelihood of significant HAZMAT incidents.

Core functions

The scale and remoteness of such an incident would pose response challenges. The Tasmanian Government's new emergency services radio network, TasGRN, has been planned to provide improved communications coverage in remote areas, with mobile units for any areas not currently covered.

Road closures could impact local supply chains and access to services.

Community and culture

With their main access route closed, already remote West Coast communities could become more isolated for a short time. A HAZMAT leak may close a popular fishing location, impacting on tourism and leisure activities.

4.2.5. SYSTEMIC ISSUES

This scenario highlighted the importance of road safety and HAZMAT safety regulations and compliance. Without such measures, such an incident would be more likely and have greater consequences. Response operations for such an event would involve multiple agencies and impact the local community, illustrating the importance of collaboration, communications and regular cross-agency exercising of such events. Such issues are common to many scenarios and are examined further in Part 5.

4.2.6. ASSESSMENT SUMMARY

	Major traffic incident	**HAZMAT incident**	**Traffic/HAZMAT incident**
Maximum risk level	**High**	**High**	**High**
Maximum consequence	**Major**	**Major**	**Major**
Likelihood of a scenario like this occurring	1:10-99 years	1:10-99 years	1:10-99 years
Likelihood of similar events	1:1-9 years	1:10-99 years	1:10-99 years
People's health, safety and wellbeing	Major[122]	Major/Catastrophic if HAZMAT leaked	Major
Economic direct and indirect	Minor[123]	Minor	Minor
Environment	Minor	Moderate (Major if HAZMAT leaked)	Moderate
Core functions	Minor[124]	Minor (Major if HAZMAT leaked	Minor
Community and culture	Insignificant	Insignificant	Insignificant
Average confidence	High	Medium	Medium

4.3 Structural failure

A legacy historic building providing accommodation collapses in a central business district.

This assessment reflects the importance of building and other regulations to ensure people's safety. As the risks associated with legacy buildings show, decisions made today can increase or decrease risk for many decades to come. While risk tolerance levels need to be balanced against other drivers such as growth, safe buildings support sustainable long-term development. New developments need to take into consideration the community's long-term tolerance for risk and the role that structures can play in keeping people safe.

Tasmania's regulations for new or modified structures are strong and reduce risks. Historic or legacy buildings are of most concern at the state-level.

4.3.1. BACKGROUND AND RATIONALE

While structural failure is often the cascading effect of another event, for example, a fire or transport crash, it can also be due to structural integrity issues. Building standards can also help ensure people's safety when extreme or unexpected events threaten. Other reasons for including structural failure in TASDRA include the following.

- Tasmania has had past events involving structural collapse and events elsewhere indicate structural collapse can cause significant loss of life and damage. For example, in 2017, the London Grenfell tower fire claimed 72 lives, while the 2021 Florida tower collapse killed 98 people.
- Tasmania has an SSEMP covering structural collapse. This SSEMP focuses on Urban Search and Rescue (USAR) response. The focus of emergency management is shifting from reacting to emergencies when they occur (response/recovery) to proactively managing emergency risks through preparation and particularly prevention.
- There are significant concerns and current movements nationally regarding building standards and issues in the building industry that can lead to emergency situations, as outlined in the 2018 report, Building confidence: Building Ministers' Forum Expert Assessment.

While there are national concerns around building safety, Tasmania's legislation and regulations are more recently reviewed. Tasmania's building regulations align with the National Construction Code (NCC) for new buildings. The NCC outlines minimum performance requirements for the safety, health, amenity, accessibility and sustainability of buildings. Relevant Tasmanian legislation includes the following Acts.

- *Building Act 2016* – categorises building work based on risk and requires that all new building work, including modifications and additions to existing buildings, comply with the minimum requirements of the NCC
- *Occupational Licensing Act 2005* – sets the licensing framework for Tasmanian building practitioners.

DPAC is the lead agency responsible for large-scale demolition and clean-up, if needed.

Building surveyors must ensure building design and construction complies with the *Building Act 2016* and the NCC during construction. The Director of Building Control in the Department of Justice's Consumer Building and Occupational Services (CBOS) division audits building surveyors and permit authorities and oversees the administration of the Building Act. CBOS investigates issues as they come to light, audits building surveyors and provides information and education as resources allow.

Structures that fail during construction are major work health and safety concerns. Workplace health and safety legislation covers building site safety issues.

In Tasmania, building architects and designers must specify the materials to be used in the build. These cannot be substituted without approval by the designer and building surveyors. While it can be difficult to check the manufacturing of materials from oversees, standards help to ensure the quality of products.

Regulations require all structures to be fully assessed if modifications alter more than 50% or when the structure's use changes from one classification to another.

While Tasmania's regulation covering new buildings is relatively strong compared with most other states, there are some gaps in compliance and some loopholes. For example, a building may be given an occupier certificate subject to developing a fire evacuation plan but may operate for years without the required plan. There are measures to work through such issues; however, they are cumbersome.

Building surveyors, permit authorities or the Director of Building Controls can cancel occupancy permits if:

- the building is being used for a purpose other than that stated on the occupancy permit
- the building is unsafe or unfit for occupancy
- the building is a danger or unhealthy to occupants.

A council General Manager may issue an emergency order if a building poses a risk to life. This order can cover compulsory evacuation and can stop any work on the structure. Most structural safety issues are of local relevance only. This state-level risk assessment acknowledges the key role that local councils play in most issues surrounding structural failures which do not warrant a state-level response.

Legacy structures

Legacy buildings pose the greatest risk of disasters in Tasmania. Tasmania's building standards for fire safety have been progressively introduced since 1975. Structures built before then do not meet current standards. Retrospective compliance with the NCC would be prohibitively expensive; however, many states require aged care and childcare facilities to upgrade to current safety standards.

Focusing on accommodation buildings

Structural failures often involve sufficient warnings so buildings can be evacuated and there is minimal to no loss of life. Workshop discussions concluded that older buildings providing accommodation to large numbers of people in city centres are of greatest concern at the state-level. Some buildings may not have been substantially modified for many years. Workshop participants noted that, while master builders have been informed of these concerns, hoteliers and accommodation providers may not be aware of the risks.

Building standards would never be able to withstand all possible hazards. However, building standards need to reflect an agreed level of tolerable risk.

Response arrangements

TasPol is the response management authority for structural collapse. The Structural Collapse SSEMP primarily focuses on USAR.

4.3.2. EXAMPLE SIMILAR EVENTS

Event	Date	Trigger	Impact Summary
Hobart Rivulet and Building Collapse	July 2016	Building works/heavy rain	The Hobart Rivulet wall collapsed into the adjoining construction site for the Myer development in Murray Street, Hobart. Several tenancies of the Cat and Fiddle Arcade collapsed or partially collapsed into the rivulet and adjoining construction site.
Sydney Building Collapse	April 2014	Explosion	An explosion caused a residential building to collapse in Rozelle, Sydney, killing three people.
Hobart Myer fire	September 2007	Fire	Building fire, exact cause unknown, destroyed an historic building in Hobart's CBD.
Devonport silo collapse	October 1994	New use of an existing structure	An elevated silo containing 40 tonnes of cement collapsed, killing one person. While the silo had been used for storing concrete for many years, it had not been designed for that purpose.
Newcastle Earthquake Workers Club	December 1989	Earthquake	An earthquake measuring 5.6 on the Richter Scale struck, killing 13 people, including nine at the Newcastle Workers Club.
Tasman Bridge collapse	January 1975	Maritime accident	12 lives lost and City of Hobart divided, causing economic and social disruption.
Mt St Canice, Sandy Bay	1974	Boiler explosion	A newly installed boiler at the Mount St Canice Convent exploded, killing eight and injuring 17 people.

4.3.3. SCENARIO 1: HISTORIC BACKPACKER PUB

An historic pub on a busy urban intersection serves meals and provides backpacker accommodation.

Sunday 2:00 am	A fire starts in the kitchen after it has closed. There are 87 people in the hostel from interstate and overseas, plus the onsite night manager and her partner.
3:30 am	A battery-operated smoke alarm goes off in one of the backpacker dormitories and wakes some guests. In the ensuing chaos, only 42 guests make it out of the building before the fire brigade arrives. The night manager directs many to safety before the fire takes hold.
3:45 am	The fire brigade arrives and works to extinguish the fire. The fire is burning strongly through the building's old timber internal walls. Firefighters are only able to locate and save another 14 people before the building becomes too dangerous to enter and collapses.

4.3.4. SCENARIO 2: HOTEL COLLAPSE

A reinforced concrete hotel built in the 1960s is in the heart of one of Tasmania's larger cities.

2a Monday 5 March	Staff and guests notice that cracks in the building have grown substantially along the south side of the building. There are 76 guests, along with 4 security personnel and 8 staff.
6 March	The local council's General Manager calls in structural engineers to assess the situation.
7 March	The cracks continue to extend, and plaster is coming off in some places where the walls are moving. Engineers assess that the building is not safe and needs to be evacuated and demolished. The General Manager issues an emergency order to evacuate the building.
Evening 7 March	The building is evacuated and alternative accommodation found. The major thoroughfare near the building is closed off due to the danger of collapse, causing traffic blockages around the city at peak times. Nearby homes and offices are evacuated.
Saturday 21 March	The building is demolished. It takes six weeks to clear the debris, including asbestos, in line with relevant legislation and regulations.
2b Monday 5 March	While there is minor cracking in the building's concrete, engineers have assessed it is not of major concern.
Friday 20 March 3:00 am	Following heavy rain, one side of the building collapses with little warning. 48 people evacuate but there are still missing people.
5:00 am	TFS USAR teams arrive within two hours, secure the site and begin to look for survivors. The surrounding areas are evacuated due to asbestos dust risks plus risks the remaining parts of the building may collapse. The nearby major traffic route is also closed. They find 10 survivors, some with serious injuries.
22 March	Interstate USAR teams join the response effort to back up local resources as the rescue response continues for 10 days. They find two more survivors.
Friday 23 March 4:00 pm	The Premier declares there are likely no more survivors. There are still 28 people missing. Rescuers will continue to work through the site to retrieve their remains for the next two weeks. Removal of some debris, particularly asbestos, has begun.
Friday 30 March	Plans are made to demolish the remainder of the building. The surrounding areas remain cleared. Site clean-up and debris removal takes a further six weeks.

4.3.5. EXPOSURES AND CONSEQUENCES

Workshop participants agreed consequences from the scenarios involving little warning would be similar. The scenario with enough warning to evacuate people would probably not need a state-level response.

People's health, safety and wellbeing

Safety measures can make the difference between a catastrophic disaster and a minor or insignificant one. The quick-onset incidents could cause a major loss of life plus injuries. If there are warning signs of an imminent collapse and the building can be evacuated, then there may be minimal or no loss of life.

A building collapse can also cause secondary health issues. For example, concrete and cement dust particles can cause or exacerbate respiratory issues that may not materialise until later. Associated trauma may require intervention and assistance from social workers/psychological experts. Backpackers or international travellers with limited English may need assistance.

Economic

Such events would be catastrophic for the property owners and surrounding businesses and property owners, but moderate for the state.

Core functions

Depending on the building's location, the event may cause other disruptions. For example, it may block major transport routes or access to services and businesses.

Environment

Many of Tasmania's older buildings have asbestos. This would need to be managed due to risks to human health. The clean-up phase would need to assess the building and demolition material at the site.

Community and culture

The loss of a valued historic building is a loss to the community. As both buildings in the scenarios are near the centre of a city, there would be some disruption to activities due to transport delays.

4.3.6. SYSTEMIC ISSUES

Workshop participants noted there is a constant tension between safety regulations and pressures to ease 'red tape' for development. Land use and building standards are some of the most effective ways to reduce risks for many different hazards. As the risks associated with Tasmania's historic buildings show, the decisions made when they were built or updated leave a risk legacy for many years to come.

4.3.7. ASSESSMENT SUMMARY

	Structural failure of an inner-city legacy building providing accommodation
Maximum risk level	High
Maximum consequence	Major
Likelihood of a scenario like this occurring	High 1:10-99 years
Likelihood of similar events	High 1:10-99 years
People's health, safety and wellbeing	Major (likely 5-54 deaths)
Economic direct and indirect	Moderate
Environment	Minor
Core functions	Moderate – but depends on building's location
Community and culture	Minor
Average confidence	Moderate

4.4 Major Cyber Outage

This assessment focused on what could happen if Tasmania lost internet services for an extended period. The assessment was not for technical specialists, but for managers delivering services to the community. This assessment does not examine the reasons for the scenario outage. It may be due to physical infrastructure or technical problems. Workshop participants included:

- business owners of key government services
- local government representatives
- representative IT managers and specialists
- telecommunications provider representatives.

Workshop participants identified some detailed areas to further consider. While the focus of this risk assessment was on the delivery of public services, the scenario highlights that all individuals, businesses and organisations should take measures to reduce the risks of cyber outages and have practised contingencies in place for when they do occur.

4.4.1. BACKGROUND

Australians are increasingly relying on digital services in their everyday lives. In November 2020:

- 92.3% of Australians browsed online and 86.6% used streamed online content
- 92% of adult Australians can be reached on a digital device, 87% of them on a mobile device
- on average, adults spent 96 hours a month on a digital device, 76 hours on mobile ones[125].

Australians increasingly access services as well as information online. As well as using email, web browsing, watching videos and accessing news:

- 83% shopped online, 42% worked from home and 33% studied from home
- 36% had a telehealth consult and 10% had a legal/financial or other online consultation[126].

Many governments have adopted a "digital by default" position, where service delivery is primarily online, where possible. As well as enabling 24/7 access to the public, online service delivery can provide significant efficiency gains[127]. Tasmania's Our Digital Government strategy supports State Government service delivery online, including a "cloud-first" policy and a cybersecurity program that prioritises critical asset protection.

There are many benefits to digital technologies and the services and connections they enable; however, without effective risk reduction measures, they can create vulnerability. Digital service chains are interdependent, fluid, complicated and often opaque[128]. They cross state and international borders and may be outside the control of the Tasmanian or Australian governments[129]. They also change rapidly as new technology comes online, companies are bought/sold and suppliers switched[130].

Current arrangements

Under National Arrangements:

> A cyber security incident is a single or series of unwanted or unexpected cyber security events that have a significant probability of compromising an organisation's business operations. Cyber security incidents can impact the confidentiality, integrity or availability of a system and the data that it stores, processes or communicates[131].

In Tasmania, DPAC is the lead agency for cyber risk prevention, preparedness and response and recovery at the state-level.

Australian telecommunications carriers have risk management plans aligned with national requirements. The Australian Government's Cyber and Infrastructure Security Centre works with industry and state governments to protect critical infrastructure of national significance. This implements Australia's Cyber Security Strategy 2020 and the Security Legislation Amendment (Critical Infrastructure) Bill 2020.

The Australian *Telecommunications Act 1997* and associated regulations includes measures to reduce risks. Telecommunication providers assist with digital communications continuity in line with this legislation and the *Emergency Management Act 2006*, as directed by the State Controller.

4.4.2. EXAMPLE SIMILAR EVENTS

Public media regularly report the impacts of cyber outages. Below are a few examples.

Event	Date	Trigger	Impact Summary
Australia-Singapore cable outage	1 August 2021	Internet cable physically cut	Australian Federal Police investigating how this essential cable was cut 18km off Perth[132].
Widespread website outages	9 June 2021	Technical problems from third-party servers	Prevented access to UK government sites, Amazon, PayPal, major news outlets and other websites[133].
Belgian Government online service outages	May 2021	Cyber attack	A Denial-of-Service attack led to widespread service disruptions including public services delivered online, such as COVID-19 vaccination bookings[134].
Victorian hospitals hit by ransomware	October 2019	Ransomware attack	Blocked access to key systems, including finance management, booking systems and scheduling. Hospitals disconnected systems to help limit spread[135].
WannaCry on UK National Health System hospitals	May 2017	Ransomware attack	Cancelled appointments and disarray, cancelling of all non-urgent operations. The attack also infected more than 45 000 computers across the world[136].
Basslink cable cut	March 2016	Physical outage	A cut cable led to internet speeds reducing from 50Mbps to 1Mbps at peak times[137].

4.4.3. EXPOSURES AND CONSEQUENCES

Scenario workshop discussions revealed that without the many available measures to reduce risk, a major cyber outage could have catastrophic consequences by impacting the information and communications systems on which people rely. Measures such as business continuity planning reduce the consequences of cyber outages.

Core functions

Internet and digital telephone networks and services have become critical to modern society[138]. Without contingency plans in place, example consequences could include the following.

- The extent of the cyber outage would not be clear for many without clear public messaging. Many people depend on social media and may become frustrated when they cannot access it. Many households no longer have non-digital means to access public radio.
- Lack of internet access significantly impacts banking and online payment services.
- Modern supply chains rely on information systems and telecommunications to manage distribution.
- Supply chains also rely on effective transport systems. Traffic lights would gradually become unsynchronised. Many drivers rely on online maps to navigate.
- An internet outage can increase the consequences of a concurrent emergency event.
- There are likely to be cascading impacts. For example, a lack of access to weather information can impact on many industries and individuals' lives.
- E-services may not be able to function as needed. For example, pharmacists could have difficulties sourcing and dispensing medications.

People's health, safety and wellbeing

By impacting on the services that are vital for Tasmanians' health, safety and wellbeing, a major cyber outage could cause deaths, injuries and illness if mitigation measures are not in place.

Community and culture

People could be confused and frustrated and there will be temporary loss of social connectedness.

Economic

Businesses are likely to lose revenue due to interrupted services[139]. If they do not have contingencies in place, businesses may not be able to make sales or order supplies. There may be reputational damage to Tasmania's brand. There would likely be substantial losses for many tourism operators and the industry.

Environment

Such a scenario would have minor environmental consequences.

4.4.4. ASSESSMENT SUMMARY

	Assessment
Maximum risk level	Extreme
Maximum consequence rating	Catastrophic
Event likelihood	High-1:1-9 years
People's health, safety and wellbeing	Catastrophic
Economic direct and indirect impact	Major, based on pandemic business outage impacts
Environmental impact	Minor
Core functions	Major
Community and culture	Major, due to loss of connectedness
Average confidence	Low

5. Cross-scenario assessment

Reducing hazards and exposures is important. However, in contemporary approaches to risk management, they are only a first step[140]. There are also vulnerabilities that drive risk across many disaster scenarios.

Considering risks across scenarios and hazards helps to reveal the systemic nature of disaster risk and prioritise actions to minimise them. It is also important as sometimes measures to reduce risk against one hazard may increase the risks associated with other hazards. For example, reducing forest cover may decrease bushfire risks, but increase flooding risks[141].

Part 5 draws together the TASDRA scenario assessments to compare their potential consequences/exposures and likelihood and explore the vulnerabilities that increase exposure to hazards. This provides a three-dimensional view of the disaster risks that Tasmanian communities face. The five areas of systemic vulnerability explored are:

- continuity of supply and access to information and services
- placement and quality of buildings and other assets
- risk ownership and transfer
- governance and collaboration
- individual and community capability.

These themes build on work to develop Profiling Australia's Vulnerability, recognising that many of the issues facing Tasmania are similar to other Australian states and territories. Section 5.2 explores these areas in relation to the TASDRA scenarios after Section 5.1 compares the TASDRA scenarios' consequences and likelihood.

5.1 Scenario comparison

Comparing the TASDRA scenarios helps to identify which risk reduction measures should be prioritised. Figure 5.1 summarises the scenarios' consequences across the five key areas examined. Appendix 1 defines these consequence classifications. Table 5.1 lists the scenarios with predicted moderate, major or catastrophic consequences.

Table 5.1: Scenarios with potential major or catastrophic consequences

	Major consequences	Catastrophic consequences
People's health, safety and wellbeing	'Black January' – bushfire, heatwave, smoke East Coast Low – severe storm, coastal storm surge, flooding, hazards combined Biosecurity – avian influenza Traffic/HAZMAT - Major traffic incident Structural collapse legacy building	Respiratory pandemic (all types) East Coast tsunami 'Black January' (hazards combined) Major cyber outage (without contingency plans)
Economic	East Coast Low – severe storm, coastal storm surge, flooding Biosecurity – Medfly, Shellfish biotoxins, *Didemnum vexillum* Major cyber outage	East Coast tsunami 'Black January' – bushfire, hazards combined East Coast Low – combined hazards Respiratory pandemic (all types) Biosecurity – FMD, avian influenza
Environment	East Coast tsunami 'Black January' – bushfire, hazards combined East Coast Low – flooding, hazards combined Respiratory pandemic – zoonotic	Biosecurity - *Didemnum vexillum*

	Major consequences	Catastrophic consequences
Core functions	East Coast tsunami 'Black January' – hazards combined East Coast Low – flooding, all hazards Respiratory pandemic – all	
Community and culture	Respiratory pandemic – all	

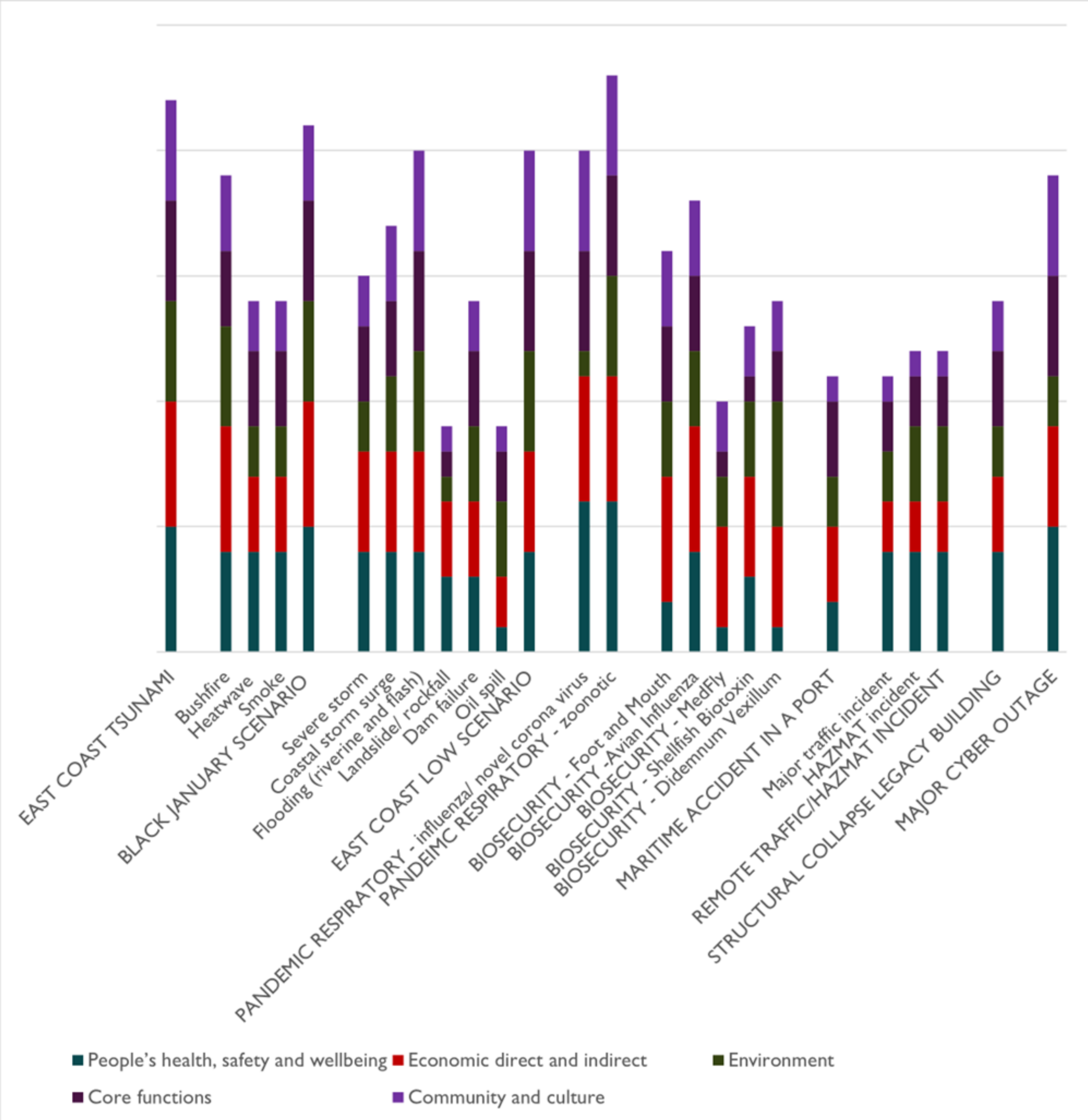


Figure 5.1 Comparison of consequences across TASDRA scenarios

Table 5.2 shows standard classifications for hazard risk. The likelihood labels indicate the probability of the event occurring in a person's maximum lifespan (100 years)[142]. Assessing likelihood is problematic but can help assess priorities to reduce risk[143]. TASDRA assesses the likelihood of that scenario or a similar one occurring and the chance of a similar event also likely to cause harm or damage. Likelihood is only an estimate of the probability of the explored scenario occurring with the expected consequences.

Table 5.2: Cross-hazard likelihood and consequence matrix

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain every year	Medium	Medium	High	Extreme	Extreme
Very high 1-<9 years	Low	Medium	High	Extreme	Extreme
High 10-< 99years	Low	Low	Medium	High	Extreme
Moderate 100-<999 years	Very low	Low	Medium	High	High
Low 1K-<10K years	Very low	Very low	Low	Medium	High
Very low >=10K years	Very low	Very low	Low	Medium	High

Table 5.3 shows TASDRA scenarios and hazards mapped against the NERAG likelihood/consequence matrix, using the highest level of assessed consequence. The spread of these scenarios against this matrix shows that the TASDRA project has reviewed high-consequence disaster scenarios that are likely to occur within a person's lifetime (100 years) or less in most cases.

Table 5.3 TASDRA scenario likelihood and consequence summary matrix

Likelihood	Consequence (exposures)		
	Moderate	Major	Catastrophic
Almost certain			
Very high 1:1-<10 years	East Coast Low - Landslide/ rockfall (slope failure)	'Black January' - Heatwave East Coast Low - Severe storm Coastal storm surge	Major cyber outage
High 1: 10-<100 years	East Coast Low - Dam Failure (Class C agricultural dam) East Coast Low - Oil spill Marine accident in a port	'Black January' - Smoke exposure Major traffic incident/HAZMAT Structural failure legacy building Biosecurity - Medfly, Shellfish biotoxins	'Black January' - combined hazards, Bushfire East Coast Low – combined hazards, Flooding Respiratory pandemic Biosecurity – FMD, avian influenza, Didemnum vexillum
Moderate 1:101-<1K years			
Low 1:1K-<10K years			
Very low 1:>=10K years			East Coast tsunami

5.2 Systemic vulnerabilities/capabilities

Defining risk as consequence x likelihood results in narrower definitions of risk, and therefore tends to produce narrower measures to treat them. A broader understanding of risk that incorporates issues of vulnerabilities can inform broader and smarter ways to mitigate risk[144]. To reduce risk, we need to understand shared and individual vulnerabilities that increase Tasmanians' exposure to hazards[145].

Exploring the scenarios in this assessment has often raised similar issues across scenarios. Such issues can be indicative of systemic vulnerabilities. If Tasmania can improve capabilities in these areas, the state can reduce risks and be more prepared for any disasters, including those not explored through this assessment.

Vulnerability is:

> The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, community, assets or systems to the impacts of hazards[146].

Vulnerability is the flip side of resilience – we are all resilient and vulnerable in the face of disasters in differing measures[147]. Improving capabilities is key to reducing individual and collective vulnerability. For example, all the TASDRA scenario workshops highlighted a need for regular cross-sector exercises.

Disasters tend to expose, and potentially amplify, systemic vulnerabilities[148]. Vulnerability is a way to express and explore the problems systems may have:

- when exposed to sudden stressors
- in resuming their functions afterwards (recoverability)
- the way these systems can reduce or increase exposures and individual vulnerabilities in the face of potential hazards[149].

Focusing on vulnerability recognises that risk can result from complex systems that are difficult to understand. There may be ambiguous goals fed by multiple legitimate perspectives. This issue is not unique to Tasmania[150] and so we can draw on work from elsewhere. Table 5.4 outlines common vulnerabilities that scenario discussions highlighted, as they align with key issues identified by Profiling Australia's Vulnerability. The following sections examine these themes with reference to the TASDRA scenarios.

Table 5.4: Key areas of systemic vulnerability/capability identified through TASDRA

1. Continuity of supply and access to information and services	2. Placement and quality of buildings and other assets	3. Risk ownership and other assets	4. Governance and collaboration	5. Individual and community capabilities
Supply chain resilience and protection of significant assets	Strategic land use planning policies	Private and public ownership of risk	Collaborative, integrated and supported decision-making structures	Community engagement
Information and communications	Building regulations and their implementation	Risk reduction/ risk transfer	Agile and integrated plans and planning processes	Support for people at increased risk
Community capacities to cope with supply disruption	Legacy land use and building decisions	Risk information access and awareness	Cross agency/ sector exercising and other learning loops	Animal welfare in disasters

This section will discuss each of these in relation to the TASDRA scenarios to identify and explore cross-hazard issues that often underpin Tasmanians' exposure to disaster risk. Table 5.5 summarises how some of the TASDRA scenarios involve these systemic vulnerabilities.

Table 5.5 Systemic vulnerabilities and the TASDRA scenarios

Continuity of supply and access to information and services	Major and prolonged cyber outage – lack of access to information and flow-on impacts to supply chains Pandemic – unavailability of staff and restrictions on movement East Coast Low (combined hazard consequences) – transport route disruption leading to localised supply chain issues, loss of critical infrastructure 'Black January', Tsunami – combined hazard consequences – as per East Coast Low Remote major traffic incident/HAZMAT – disruption to major transport route
Placement and quality of buildings and other assets	East Coast Low (all hazards) – placement of buildings and communities plus building regulations in high-risk areas such as floodplains and exposed coastal areas Tsunami – As per East Coast Low, for coastal areas 'Black January' – As per East Coast Low, for bushfire-prone areas; building quality to reduce heatwave and smoke exposure Structural failure of legacy accommodation buildings – safety issues around legacy structures that do not comply with modern safety standards
Risk ownership and transfer (more complex and/or opaque risk ownership)	Cyber outages – complexities of risk ownership, expectations of continuous supply vs reasonable expectations of telecommunications supply during sudden shocks Biosecurity incursions – key roles of industry and communities in preventing, monitoring and tracing incursions 'Black January'/East Coast Low/Tsunami – land use planning-related risks Structural failure in legacy accommodation building Dam failure – responsibilities across private and public sectors Tsunami – warnings for very quick-onset disasters, warnings systems and information across most disaster scenarios Maritime accident in a port – joint private/public sector response
Governance and collaboration	Pandemic – whole-of-government and whole-of-society impacts of public health measures and a pandemic itself; the potential for a joint public health/biosecurity event Major cyber outage – broadscale impacts and the role of all organisations in reducing risks of such events happening and having contingencies for when they do occur Biosecurity – long-term nature and high resource requirements of response, required involvement from industry and community Structural failure in legacy accommodation building
Individual and community capability development	Major cyber outage – lack of detailed knowledge on exposure can be a key vulnerability; individual and organisations' capacities and actions can help reduce risks Biosecurity – integral role of industry and communities in preventing and responding to many biosecurity incursions Pandemic – People's roles in implementing public health measures to reduce risks Tsunami – capacity to be warned and take action for a very quick-onset event where there is generally limited lived experience Bushfire/flood/storm – well established measures and programs in place and in constant further development, focus on those with specific increased risks in partnership with community service providers

5.2.1. ACCESS AND SUPPLY OF ESSENTIAL INFORMATION, GOODS AND SERVICES

Tasmanian communities rely on:

- supply chain resilience and protection of critical infrastructure assets
- information and communications
- community capacities to cope with supply disruption and access key information.

These interlinked systems of technologies, processes, information, plus people's skills and knowledge span organisations and jurisdictions.

Supply chains and critical infrastructure and services

Core function reliability was a key part of the TASDRA scenario assessments. All TASDRA scenarios tied up resources. Some scenarios had the potential to damage infrastructure or disrupt services, such as the 'Black January' and East Coast Low scenarios. The major cyber outage scenario highlighted our increasing dependence on internet-based services. Some other jurisdictions treat supply failures as disaster events and scenarios to explore in their own right[151].

Communities rely on access to markets, reliable supply chains and working logistical systems. These systems are complex, and their maintenance often relies on detailed immediate information or access to specialist skills or knowledge.

The design, or organic development of such systems across organisations and sectors increases or reduces Tasmania's and other jurisdictions' vulnerability in the face of disasters. In stable times, our supply chains are driven by business demand and economic efficiency values. There can be little system redundancy and these supply chains are increasingly vulnerable[152].

System redundancies and ensuring alternative solutions can help to ensure ongoing supply. For example, the Maritime Accident in a Port scenario illustrated that alternative ports, two SoT vessels and identified alternative freight transport routes mean the statewide impacts on supply chains can be minimised. Further state-level contingency planning for critical supply chains has the potential to reduce the consequences across many types of disaster events.

Information and communications

Access to the key information Tasmanians need centres around three key areas:

- creating needed data and information
- sharing information internally across government
- public information, meeting diverse needs.

This includes:

- the medium (technological systems)
- the messaging (information content)
- people skilled in communications suitable for purpose[153].

All these areas can be a source of vulnerability due to reasons such as:

- barriers to sharing information due to privacy, liability, competitive advantage, devaluation of property or technical constraints
- siloed organisations
- a lack of systems and structures to support interoperability of people, technology and functions[154].

All scenario assessments identified effective internal and public communication as key issues, as they are in all disaster events. The issues are multifaceted and complex but are reduced through a variety of measures. Current example measures underway to reduce risks relating to communications include:

- the implementation of the TasGRN radio network
- the redevelopment of TasALERT as a single point of truth for disaster information
- the current implementation of the Australian Fire Danger Warning System
- emergency operations information system (WebEOC) ongoing development and implementation.

Such initiatives cross multiple organisations and help to address some complex issues. Reviewing and client testing such developments will be key to their further development.

Often people expect information to be highly contextualised for their specific circumstances. It can be difficult to meet individuals' differing needs and abilities (refer to Section 5.2.5).

Community capacity to cope with disruption and access key information

Australians assume reliable supplies, and this makes them vulnerable[155]. Some jurisdictions and suppliers make it clear that citizens or clients need to be able to cope without critical services for up to three days.

With over half of Tasmanians having low literacy skills, increasing numbers of locals and visitors speaking languages other than English, and uneven digital and information literacy across communities, many of the TASDRA scenario assessments identified there are significant barriers to accessing key information before, during and after events. While there needs to be a single point of truth, it needs to be conveyed through a variety of media to reach Tasmanians with diverse needs. Workshop participants identified that information before, during and after disasters should be coordinated and integrated, and presented in ways that suit the needs of the intended audiences rather than the providers of the information.

5.2.2. PLACEMENT OF COMMUNITIES AND ASSETS

Current development of strategic planning policies covering land use plus their implementation provide the opportunity to greatly reduce future disaster risks. How and where we build homes and other assets is one of the most effective ways to reduce disaster risks and increase disaster resilience[156]. Many of the scenarios explored through this assessment show that land use planning decisions made many years ago shape risk exposures today. Decisions made today will determine how well Tasmania can cope with and adapt to extreme events in future decades, perhaps centuries. Land and building investments today will most likely need to cope or adapt to climate risks within the lifetime of those investments[157].The 'Black January bushfire', East Coast Low flooding and Tsunami scenarios highlight the need for strategic land use planning considerations to guide how much and what sort of development is allowed in exposed areas such as near the bush, rivers and the coast.

For land use planning policies and their implementation to reduce disaster risks, there should be:

- understood and agreed levels of risk tolerance
- accessible information about known risks impacting on specific areas of land
- policy implementation and compliance.

Information on the current Tasmanian Planning Reforms or the Tasmanian Disaster Resilience Strategy's Background and supporting information provide an overview of Tasmania's land use planning frameworks related to disaster resilience covering policies, strategies and plans guiding land use, including:

- relevant legislation such as the Tasmanian *Land Use and Planning Approval Act 1993*
- the Resource Management and Planning System (RMPS).

This section examines:

a. The key role of strategic land use policies in reducing future disaster risks
b. Planning and building regulations and their implementation
c. Legacy land use and building decisions that create risk.

Managing risk through strategic land use planning policy

State-level strategic planning policies are currently under development, overseen by an Interdepartmental Committee. A [Scoping paper for draft TPPs] (Tasmanian Planning Policies) has been consulted which identifies disaster risk considerations as key topics for new Tasmanian Planning Policies to address, along with other values such as:

- environmental protection
- heritage protection
- liveability
- sustainable development[158].

The new planning policies and their implementation provide a significant opportunity for the state to manage future risks while facilitating Tasmania's demographic, social and economic growth.

- Planning regulations are only able to control the location, use and form of new use and development. There is limited land use planning policy or regulation to address legacy risks.
- Currently, planning focuses on statutory tools, such as planning scheme provisions, codes and overlays, to modify normally allowed land use and development. Planning controls only consider the risk on the individual site without considering the broader context, so it is difficult to reject developments. This can lead to development in high-risk areas where legacy decisions about development potential did not adequately address hazards. The intention is that higher-level spatial considerations in the new Tasmanian Planning Policies will help avoid new developments in high-risk areas.
- The landowner or occupier is responsible for maintenance in accordance with the permit conditions. This may require:
  - reducing vegetation fuel loads to minimum fuel conditions
  - keeping drains clear of debris.

  The policies lose effectiveness, and the developments increase their exposure to hazards if the owner does not maintain the land in accordance with the permit. Councils (or state agencies like TFS) may, however, monitor compliance to the permit conditions and issue abatement notices where breaches become unacceptable. However, local government typically have a limited capacity to assess or check compliance with hazard codes.
- Land use planning works in tandem with other measures to reduce system risks rather than considering hazards in isolation. For example, the new Tasmanian Planning Policies can specify that land allocation for development in the planning scheme should use flood exposure mapping to manage future exposure.
- Levees can protect an area from floods to a defined level where the benefit of continued use outweighs the cost of flood protection. The use of levees needs planning controls to manage the residual risk. For example, the Launceston flood levees are only a part of Launceston's flood defences, along with other measures such as restricted planning rights. These levees have justified their expense by mitigating flood damage[159].
- However, developments behind levees are problematic and risk failure. Such infrastructure can also transfer or increase the risk to other areas[160]. Historically, the ownership of, and provisions for maintenance for, defensive infrastructure like levees have been poorly defined.
- Levees should only be considered for existing communities and assets, not as risk reduction measures for future developments where possible unless overriding public benefits are evident.

Clear and agreed risk tolerance levels

Effective land use planning for DRR relies on understood and accepted risk tolerance levels.

This includes individuals' acceptance of risk for their homes and the willingness of the general community to underwrite decisions of others that lead to increased risk[161] (refer to Section 5.2.3). The Tasmanian Planning Scheme provides guidance on the characteristics of risk tolerance for some hazards (refer to Table 5.7).

Table 5.7: Tasmanian Planning Scheme's guidance on the characteristics of risk tolerance, subject to advice from relevant regulatory bodies

Hazard	Mapping	Characteristics of tolerable risk
Flooding	Various	Floor heights above 1% AEP (1:100 years) or highest known flood Regulate below 1% AEP or highest known flood Some integration with building standards
Coastal inundation	Statewide hazard bands	Habitable floor above 1% AEP in 2100, allow use/development based on susceptibility, don't increase impact on neighbours No new development in high, no subdivisions in medium/high, no coastal defences on actively mobile landforms Integrated with building standards
Coastal erosion	Statewide hazard bands	Allow use/development based on susceptibility, don't increase impact on neighbours, no new development in high, no subdivisions in medium/high, no coastal defences on actively mobile landforms Integrated with building standards
Landslide	Statewide hazard bands	Allow use/development based on susceptibility Manage groundwater and intervention on slope, 1:10 000 risk to life for a building development, integrated with building standards
Bushfire	Bushfire-prone area	In a bushfire-prone area, a design of FDI 50 requires: • BAL 19 construction and hazard protection for new subdivision • BAL 29 construction and hazard protection for existing lots • access and water supply for bushfire purposes • defendable space based on construction standard • limits to placement of hazardous or vulnerable uses • integrated with building standards

Nature-based solutions (blue green infrastructure for DRR)

Land use planning can include nature-based solutions (green/blue infrastructure) as a cost-effective way to reduce risks and increase built environment resilience[162]. Many local governments use foreshore and flood-prone areas for parkland, playgrounds, sportsgrounds and nature reserves to reduce exposure and provide everyday recreational and environmental benefits. Blue/green infrastructure, such as wetlands, sand dunes and other ecosystems can buffer communities and assets against disasters[163]. Cost-benefit studies in other countries show blue/green infrastructure such as mangroves can have significant costs-benefits compared with grey infrastructures such as dykes[164]. Nature-based solutions also provide many co-benefits, such as supplying wood, fish and native habitats plus protection against salinity[165]. Green and blue infrastructure in urban areas can also mitigate risks associated with pandemics as people gain health benefits from access to green spaces during lockdown periods[166]. For example, sand dunes protect Hobart's airport from coastal storm surge and tsunamis.

Buildings as hazards and shelter from hazards

The quality and suitability of buildings and other structures is also critical for reducing risk. There are established building regulations in Tasmania for new developments, although there are some potential areas for improvement around compliance. The safety of legacy buildings remains a concern and require decisions about risk acceptance if the risks are not going to be reduced.

Buildings can not only be a source of hazard but can protect people from hazards, for example, in bushfire-prone areas. There are currently fewer regulations about avoiding building in such areas. However, the new Tasmanian Planning Policies may consider this potential measure to reduce risk.

Heatwave and smoke exposure are two hazards where homes and other buildings can provide shelter and protect people's health and wellbeing. However, Tasmanian infrastructure, houses, schools and other public buildings are generally not built for high heat. Many Tasmanians live in housing lacking insulation. Many older houses also do not provide protection from intense smoke events. High efficiency particulate air (HEPA) filters and air conditioning in public buildings can provide shelter, including at evacuation centres, libraries, schools, childcare, health and aged care facilities. Safe public spaces, such as libraries and shopping centres, often provide heatwave shelter in other states[167]. Tasmania's library network provides safe public spaces in cold or wet conditions but is often less able to provide shelter from extreme heat or smoke.

Managing legacy risks

Tasmanians have inherited a legacy of:

- coastal shacks (holiday homes), roads, housing developments and other assets in exposed coastal areas that are at risk of tsunamis, storm surge, coastal erosion and climate change induced sea level rise
- many houses and other assets in high bushfire risk areas
- urban development in floodplains
- buildings in areas at risk of landslides or other slope failures.

Legacy assets in coastal areas, high bushfire risk areas, landslide risk zones and flood plains can place Tasmanians at risk. Adaptation may involve:

- defending current settlements – for example, building levees
- accommodating, for example, changing buildings to cope with periodic flooding
- retreating[168].

Our legacy of development in bushland, for example, is managed through significant investment in bushfire fighting capacity, and programs like bushfire-ready neighbourhoods, community bushfire planning, the fuel reduction program, and the building bushfire (planning development controls for new development). These can all involve costly and difficult decisions, which highlights the importance of land use planning today to reduce tomorrow's disaster risks[169]. Retrospective adaptation measures need to consider local conditions but are likely to become an increasing issue with the growing impacts of climate change.

5.2.3. RISK OWNERSHIP AND TRANSFER

The TASDRA scenarios often raised questions around risk ownership, transfer and responsibilities, underpinned by questions around risk tolerance, acceptance and associated values. For example:

- Who owns the risk when it may be the result of a stream of legacy decisions by multiple players?
- How do they know they own the risk and have responsibilities for it?
- Should risk owners always be those impacted by those risks?
- What is the role of government in regulating or supporting individual or private sector risk management?
- From a whole-of-community perspective, how can we ensure we reduce risks rather than just shift them around between players?
- What role can government play in ensuring individuals and others understand relevant risks so they can effectively consider and address them?

Such questions have no simple solutions. Answers rely on understood and agreed values and risk tolerances. The assessment focuses on three key areas that can help to reduce this systemic vulnerability:

a. private and collective (public) ownership of disaster risk
b. focusing on risk reduction rather than simply transferring risk ownership
c. risk information access.

The Tasmanian Government has key roles in providing risk information and in helping to determine risk ownership issues. These issues crossed many of the TASDRA scenarios.

Private and collective risks

Often those who cause or increase the risks are not the ones impacted by it. Risk ownership is often transferred to individuals, organisations and insurers who are often less able to pay for recovery[170].

The details of shared risk responsibilities can be vague, particularly in strategic areas of risk reduction[171]. Risk ownership and responsibilities for avoiding risks or treating them and the concept of 'shared responsibility' is complex. This assessment aligns with the Tasmanian Disaster Resilience Strategy, recognising that disaster resilience is everybody's business. While the Tasmanian Government has key roles, all Tasmanians play a part in reducing risks, for example, by maintaining their homes.

Box 5.1: Example - Who owns the disaster risks associated with a building and is responsible for reducing these risks?

- The property owner (purchaser)?
- The property developer?
- The builder?
- The tenants?
- State and local governments due to land use planning decisions?
- The regulators, for example, building regulators, if the regulations are not adequate or complied with?
- The hazard management authority – unable to effectively respond?
- The community – recovery costs?
- Future generations left with legacy? ?decisions from today?

These shared responsibilities are defined in legislation and associated regulations for many areas such as hazardous materials, building and transport safety. In other areas, risk ownership is not well-defined. Responsibilities around legacy risks or risks transferred through commercial transactions can be unclear.

Market-based risk management is where individuals and communities balance the benefits and costs and define their own risk tolerances. In relation to property-based risks, this would mean:

- all risk costs are clearly incorporated into the purchase price of a property and its maintenance
- landowners take responsibility for and can afford mitigating risks and recovery from disasters
- costs for the wider community would be understood and accepted by the broader community[172].

However,

> Residents are not always aware of the risks associated with the purchase of a property, the risks associated with a property may change over time, and there may be barriers for families wanting to move their investment to manage their exposure. There are also few (if ever) circumstances in which residents can expose themselves to a natural hazard without attracting some potential costs for the broader community[173].

Individuals' choices about their own risk tolerances are intertwined with broader public risks[174]. Processes for asset planning, approvals and ownership transfer can create vulnerability[175].

Government has a role to play when landowners cannot reasonably be informed of the costs and benefits of the property being transferred. Decisions made by state and local authorities may be opaque or based on inadequate information and responsibilities for any later disasters are difficult to assign[176].

The dam safety emergency explored through the East Coast Low scenario highlighted the many competing values and issues surrounding DRR and risk ownership. A dam may pose risks to land downstream and decrease that land's value. The risk profile for pre-existing dams may change due to downstream development. Developments upstream may change the hydrology impacting a dam. In such cases, who is responsible for managing the risks:

- the developers of the land where their actions impact on others exposure to risk?
- the people who buy the land, who may or may not be aware of these developments' impacts?
- council or state government regulators who approve the development?

The general principle that owning the land means owning the risk means current and future developers or landowners are responsible for past local government or state government decisions. The TASDRA workshops uncovered several areas where specific responsibilities need to be reviewed and negotiated.

Managing risk ownership by transferring ownership

For individuals, households and organisations, measures to reduce risk often involve shifting the burden to others. Legacy risks can involve a stream of decisions by multiple players with differing values and levels of risk understanding and tolerance. These may not reflect broader community values but are underwritten by the community during and after disasters as taxpayers fund response and recovery. Many TASDRA scenarios raised the issue of legacy risks from previous land developments, investments in information systems or infrastructure.

A lack of transparency about risk, its ownership and its transfer can reinforce disadvantage[177]. If risk ownership issues are not openly considered, Tasmanian communities collectively own those risks as they pay for response and recovery through resources and losses.

Many TASDRA scenarios identified insurance, insurability and the affordability of insurance as both a means to reduce individual and business risks, and as a source of potential risk. While the Tasmanian and

Australian governments encourage property insurance uptake, there are complex issues involved. Large-scale disaster events in Australia during 2020, including bushfires, floods and the pandemic, have stretched the insurance industry and highlighted questions around insurability and the extent to which insurance can be used to manage risks[178]. Homes and other assets in high-risk areas may become uninsurable and unsaleable, a cost burden to their owners even when disasters do not occur[179].

Community awareness of risk and risk ownership

If individuals have a role in reducing the risks that affect them, they need to understand those risks. Risk awareness underpins active community engagement in DRR and shared responsibilities. While there is a general principle that property owners own the risks associated with a property, this is not straightforward if people are not informed about the risks associated with that property.

The disclosure of hazards exposure data enables people to make informed decisions. Not providing risk information can become a risk in itself, unless there are specific security considerations which mean that revealing it could increase the likelihood of an event[180].

5.2.4. WORKING TOGETHER TO REDUCE RISKS/GOVERNANCE

DRR is a rapidly changing area that requires collaborative efforts across agencies and sectors. Disaster resilience relies on institutional structures, frameworks and processes to implement measures to reduce risk. This itself can be a cause of vulnerability or capability[181]. Three key issues examined here are:

a. collaborative, integrated and supported decision-making structures
b. agile and integrated plans and planning processes
c. cross-agency/sector exercising and other learning loops.

These issues align with recent event review and royal commission recommendations as such systemic issues are common across disaster events and jurisdictions.

a. Collaborative and integrated decision-making structures

Many of the risks TASDRA identifies are beyond the remit or resourcing of a single organisation, or even a single level of government[182]. Decisions made in siloes can ignore cross-sector interdependencies and disaster impacts[183]. Disaster risk management that is not collaborative, integrated or forward looking could be one of Tasmania's most significant potential risks.

Disaster risks are increasingly systemic. However, governance and approaches to managing them can become more fragmented if agencies and organisations focus only on their areas of remit. Cross-agency and cross-sector actions are under-resourced[184]. Disaster risks are uncertain, ambiguous and often complex but risk governance practices often treat them as if they were simple[185].

While risk is generally and appropriately managed at as local a level as possible, this decentralisation can lead to an over-focus on preparedness and recovery[186]. Decentralised approaches mean that no one level of government has the authority or resources to address complex risks and their socio-economic, political cultural and regulatory drivers[187]. The Tasmanian Government has key roles in reducing risks including:

- facilitating cooperation and information sharing amongst sectors
- providing financial and technical support to understand risks
- stimulating discussion on community levels of tolerable risk and the values to be protected
- building capabilities
- developing policy, planning and regulatory frameworks to support DRR[188].

These capabilities do not sit comfortably within any single agency, sector nor level of government.

Several TASDRA scenarios raised issues relating to governance. Disaster risk management issues seem to be common across Australia. Some nationally identified issues include the following.

- Decisions across governments and sectors can increase risks that neither emergency services nor local government can influence, yet they must respond to them.
- Climate and DRR investments are generally fragmented.
- Uncoordinated policy and frameworks shaping DRR, climate change adaption, environmental management, land use planning, industry and state development and sustainability development can produce weak mandates and incentives for investing in DRR.
- Current tools to guide DRR actions, such as cost-benefit analyses, do not diagnose or support complex decisions and investments. Conventional methods to assess risk tend to narrowly define risk and so produce a narrow array of options to reduce risks[189].
- Attributes of government agencies, such as:
  - short time horizons and a lack of systems perspective in decision-making
  - inflexible structures preventing learning and adaptation
  - practices focusing on avoiding blame or litigation rather than learning for continuous improvement
  - information based on vulnerable technologies or not trusted[190].

Effective DRR requires resourced functions, structures and networks that combine the efforts of multiple agencies and sectors and navigate webs of interconnected risks[191].

The Australian Government's Guidance on governance for climate and disaster risks recommends collective impact initiatives driven by five key ingredients. Table 5.8 lists these and relevant actions in Tasmania.

Table 5.8: Collective impact ingredients and current Tasmanian measures

Key ingredients for collective impact initiatives[192]	Tasmanian measures
A common vision and agenda	Tasmanian Disaster Resilience Strategy underpinned by the SEMC Strategic Directions Framework, annual action planning
A shared measurement system	Disaster Resilience Monitoring and Evaluation Framework
Mutually reinforcing activities- collective action recognising outcomes cannot be achieved in isolation	Tasmanian Emergency Management Arrangements
Continuous communications	SEMC and related governance arrangements
Identify boundary-spanning organisations	

b. Agile and integrated plans and planning processes

Risk management and emergency management planning needs to be agile and integrated. TEMA forms the cornerstone of what is meant to be an integrated suite of plans and arrangements. Those working in emergency management across hazards need to be familiar with many plans including large amounts of duplicated text. While each plan is designed to stand alone, there is scope to improve information and communications across agencies and sectors. Due to the duplication between plans, the existing suite of plans cannot be agile, and is possibly less effective as it is less accessible. This is a source of risk as relevant people are less aware of key information and plans are less able to be adapted. Several TASDRA scenario workshops highlighted the accessibility and integration of plans as a potential source of risk.

c. Cross-agency/sector exercising and other learning loops

All TASDRA scenarios raised the need for regular cross-agency and cross- sector exercises to explore detailed issues and provide learning opportunities and capability development. In some cases, workshop participants recommended communities should also be involved. Exercises can be a significant risk reduction measure and a lack of them can be a source of risk.

5.2.5. COMMUNITY AND INDIVIDUAL VULNERABILITIES

All TASDRA scenario workshops identified community and individual capabilities and engagement as key to reducing risk. While easy to state, these are complex issues that deserve unbundling.

- What do we mean by community engagement and capability development?
- What does it mean for state-level actors and risk management?
- What specific responsibilities do members of the community have to reduce risks themselves (refer to Section 5.2.3 regarding risk ownership)?
- Who should be expected to be able to reduce risks themselves?
- Who needs to be supported, and how?

This section focuses on three areas of community and individual vulnerability:

a. community engagement and capability development generally
b. support for people at increased risk due to their personal circumstances
c. people's relationship with animals and animal welfare.

All disasters tend to cause stress and can create or exacerbate mental and physical health issues because of their potential to do harm, disrupt daily life, and isolate or dislocate people. While support for people during and after events is necessary, community engagement and capability development can help mitigate such mental health risks and facilitate a community-led approach to disaster prevention, preparedness and recovery. Such capability development can mean less people need health, psychological and other support during and after events, so those who do need it are more able to access that support.

Community engagement and capability development

Communities that are well-connected tend to cope better with, adapt to and recover from disasters[193]. Helping people to reduce their risks can reduce risks at the state-level. All TASDRA scenario workshops identified community capability development as a key area for risk reduction.

What community engagement and capability development means and how it can be pursued involves a complex array of issues and potential approaches. Some specific issues and potential measures include:

- knowing more about specific local community needs (community profiling) to suit local needs
- community involvement in planning and exercising
- identifying people at increased risk in an acute emergency situation (vulnerable people), to be able to assist them to evacuate
- how to raise awareness of risks and community members' roles in reducing risks
- business and industry risk awareness, management and preparedness
- public and industry as active participants in measures to reduce risks, for example, biosecurity and pandemic.

Currently, actions focusing on community engagement in risk reduction tend to be:

- locally based
- hazard specific
- on a project-by-project basis.

The SEMC's Community Resilience and Capacity sub-committee plus DPAC's Recovery Partner's Network focus on supporting community resilience. However, there is no agency remit for community resilience across hazards. This means Tasmanian Government initiatives relating to community resilience only focus on specific areas where agencies have existing responsibilities or specific client groups.

Support for people at increased risk due to their circumstances

TASDRA workshop participants often identified the need to better understand specific individual and community needs to reduce disaster risks. The heatwave, smoke exposure and pandemic scenarios particularly focused on groups that are more vulnerable to these hazards. Most disaster scenarios revealed that reducing disaster risks should involve making sure people have access to key information in ways that suit them, and providing support relevant to individuals' health, mobility and other constraints.

There are almost as many different reasons for individuals to be at increased risk in the face of disasters as there are individuals. Some common reasons for people being at increased risk in disasters include:

- health and mobility constraints
- language, learning and information access issues (refer to Section 5.2.1)
- lack of awareness and complacency – for example, visitors and transient populations
- poverty and/or socio-economic factors.

These characteristics do not define people and their lack of capacity; they only reflect an increased likelihood that they may need additional or specific support before, during or after a disaster event. The guide for community service providers, People at increased risk in an emergency provides further information.

In most cases, support for people with specific needs due to their health or other circumstances is best provided by their existing support networks, using information and resources provided by emergency services. These existing networks are best placed to provide specific support relevant to people's needs.

Workshop participants raised the issue of sharing information from health and community service providers about people at increased risk, for example, in a flooding event. While there are personal information protection policies, legislation allows for information sharing if a person's life could be in danger. Participants noted a lack of agreed and understood protocols in this area.

Those with mobility or significant health issues may understand the dangers but lack the physical ability to act. Many people with significant health issues are resilient and would take measures to limit their exposure to disaster events. Often the best way to get information to people is through their existing networks so their specific needs can be integrated with their other needs and support.

Visitors or people who have recently moved to the area are potentially at higher risk. They often lack local knowledge and a plan about what to do in the case of a disaster event and lack local social networks. Many Tasmanian coastal or highland communities have a small permanent population and a transient population of visitors, shack owners and seasonal workers. Tasmania's tourist population in summer tends to include many elderly people. Travellers with existing health conditions may not have access to their regular health providers if problems occur. Tourists are often in rural and remote areas where health services tend to be more thinly spread and so less accessible.

Disasters discriminate in the same ways that societies discriminate against people[194]. Disasters tend to affect people with less wealth, social connections and engagement with their local communities and economies. People can become caught in cycles of compounding vulnerability[195]. Managing risk can reinforce or help resolve social inequalities.

Animals and their welfare

Animals, their welfare and our connections with valued pets, livestock and wild animals is a theme that came through many of the disaster scenarios. Tasmanians' relationships with animals can both increase and decrease risks associated with disasters. Some of the issues raised during workshops included the following.

- Tasmanians care for animals and their welfare. Disasters can cause harm to animals as well as humans. Animal welfare issues cause stress and anxiety for many Tasmanians, who may put themselves at risk to care for their animals in disaster events.
- Evacuating animals adds complications – it can contribute to egress route problems. Transporting and accommodating evacuated animals can sometimes be difficult.
- Farm and other infrastructure loss, such as fencing burnt through bushfires or shelter or pasture lost through flooding, can lead to longer-term animal welfare issues.
- Livestock losses in flooding events are an economic risk as well as an environmental risk when disposal of livestock/animal carcasses is considered.

While this assessment has primarily focused on human health, safety and wellbeing, workshop participants noted risks related to animal welfare should also be an area of focus.

5.3 Conclusions

TASDRA has examined disasters during a time of great changes in the fields of risk assessment and management. This has led to project complexities, but these changes provide a richer picture of disaster risks relevant to Tasmania. TASDRA has explored hazard exposures, vulnerabilities, plus issues such as risk tolerances, ownership and the values that underpin risk assessment and management.

One of Tasmania's risks in the face of disasters is to not recognise and so oversimplify this complexity. Oversimplified assessments only produce simplistic solutions and are unlikely to significantly reduce risk.

We chose the TASDRA scenarios because they had:

- the potential to cause catastrophic consequences
- were likely to occur within a person's lifetime
- could provide rich insights into Tasmania's disaster risks.

However, some scenarios are less likely or would have less serious consequences than anticipated. For example, current safety regulations reduce the likelihood and consequences of incidents such as the maritime accident and a HAZMAT event. Such assessments show we should not forget existing measures to reduce risk when other values are considered (for example 'cutting red tape').

Major disaster risks have constantly been in news stories and our lives over recent years as Tasmanians and others have faced the acute stresses of multiple hazards. TASDRA workshop participants considered what a 'best-case' disaster event celebrated in the media could look like for each of the examined scenarios to help identify potential measures to reduce risks. In fact, avoided or minimised disaster events are rarely considered newsworthy. As observed by the work underpinning Profiling Australia's Vulnerability,

> Mitigation and planning actions bring their own rewards in times of disasters; however, if the stories are not told and celebrated, and stories of loss, blame and daring acts of heroism dominate, it means that forethought, anticipation and preparedness are less visible and perceived to be more dull and less worthy of attention[196].

The TASDRA scenario assessments highlight many hazard-specific measures to reduce risk in place or underway. There is always scope for improvement but just focusing on hazard-based risks is unlikely to greatly reduce state-level risks. We need to focus on more deep-seated issues that are often complex and cross hazards. Given projections for climate change and other chronic stresses, many systems may not be able to continue delivering the outcomes people value if we do not reduce risks where we can[197].

Associated with this report is a list of proposed measures that can build on current measures to further reduce disaster risk in Tasmania. This list forms the basis of a renewed State Risk Treatment Register, overseen by SEMC's Informed Risk Management sub-committee and supported by SES. Some of the proposed measures fall within the remit of a single agency, while others currently sit across or between agency responsibilities. Many of the proposed measures involve supporting or working with communities or other sectors to collaboratively reduce disaster risk.

Proposed measures to further reduce hazard specific state-level disaster risk tend to focus on:

- understanding the hazard and related exposures
- preventing the hazard from occurring, where possible
- detection and warnings
- reducing the consequences of the hazard when it occurs, for example, through response and recovery arrangements and measures to reduce exposure
- community engagement and capacity issues specific to that hazard.

Suggested state-level, cross-hazard highest priority areas to reduce disaster risk include the following.

1. Encouraging business continuity planning, particularly for essential services
2. Strategic land use planning policy development and implementation
3. Regular cross-agency / sector exercising of complex events
4. Supporting the resilience of critical infrastructure of state as well as national significance
5. Facilitating community engagement and actions to reduce risks
6. Supporting people at increased risk in a disaster
7. Consider measures to reduce legacy risks
8. Review TEMA and the associated state-level plans to reduce duplication, improve accessibility and agility, and clarify some detailed areas of responsibility
9. Strengthen cross-agency/ sector governance and their supporting arrangements
10. Consider updating climate change projections for detailed hazard risk assessments.
11. Strengthen cross-agency/sector governance and supporting arrangements.

Disaster risk is complex and so is its reduction. It involves many parties working together through iterative learning processes to reduce disaster risks. TASDRA 2022 contributes to these streams of decisions by providing richer views on risk to uncover potential measures that build on existing ones.

6. Appendixes

Appendix 1: Acronyms and Glossary

ACRONYMS

Acronym	Description
AEP	Annual exceedance probability
AFAC	Australian and New Zealand National Council for Fire and Emergency Services
AMSL	Above mean sea level
AT	Ambulance Tasmania
BAL (rating)	Bushfire attack level – measurement of a home's exposure to bushfire ember attack
BAU	Business as usual
BCP	Business Continuity Plan(ning)
BOM	Bureau of Meteorology
BT	Biosecurity Tasmania (NRE Tas)
CBD	Central business district
CBOS	Consumer Building and Occupational Services
DoH	Department of Health (Tasmania)
DoJ	Department of Justice
DPAC	Department of Premier and Cabinet (Tasmania)
DRR	Disaster risk reduction
State Growth	Department of State Growth (Tasmania)
ECC	Emergency Coordination Centre
EM	Emergency management
EPA	Environmental Protection Authority (NRE TASNRE Tas)
FMAC	Fire Management Area Committee
FMD	Foot and mouth disease
GA	Geoscience Australia
HEPA filter	High-efficiency particulate air filter
HMA	Hazard Management Authority (refer to the Tasmanian Emergency Management Arrangements)
Hydro	Hydro Electric Commission Tasmania
IT/ ICT	Information (Communications) Technology
JATWC	Joint Australian Tsunami Warning Centre

MAST	Marine and Safety Tasmania
Medfly	Mediterranean fruit fly
MRT	Mineral Resources Tasmania (State Growth)
MWH	Mean wave height
NBN	National Broadband Network
NDRRF	National Disaster Risk Reduction Framework
NERAG	National Emergency Risk Assessment Guidelines
NRE TASNRE Tas	Department of Natural Resources and Environment Tasmania (Previously Department of Primary Industry, Parks, Water and the Environment (DPIPWE)
OSEM	Office of Security and Emergency Management (DPAC)
PESRAC	Premier's Economic and Social Recovery Advisory Committee
PM	Particulate matter
PPE	Personal protective equipment
PPRR	Prevention, Preparedness, Response, Recovery (EM Spectrum)
PWS	Parks and Wildlife Service (part of NRE TASNRE Tas)
RDS	Radio Dispatch Service
REMC	Regional Emergency Management Committee
SEMC	State Emergency Management Committee
SES	State Emergency Service
SoT	Spirit of Tasmania
SRCT	Special Response and Counter Terrorism (TasPol)
SSEMP	State Special Emergency Management Plan
TASDRA	Tasmanian Disaster Risk Assessment (2022) (This assessment)
TasGRN	Tasmanian Government Radio Network (currently being implemented)
TasPol	Tasmania Police
TEMA	Tasmanian Emergency Management Arrangements
TFS	Tasmania Fire Service
THS	Tasmanian Health Service (Department of Health)
TSNDRA	Tasmanian State Natural Disaster Risk Assessment (2016)
TWWHA	Tasmanian Wilderness World Heritage Area
USAR	Urban Search and Rescue
VPN	Virtual private network
WebEOC	Web-based emergency operating centre (information system)

GLOSSARY

Accepted risk	Refer to Tolerated risk
Alpine areas	Areas more than 900 m above sea level
Business continuity planning	Proactive measures to ensure an organisation's activities can continue during/after an event. A contingency plan takes into account potential risks and disruptions.
Capacity	The combination of all the strengths, attributes and resources available within an organisation, community or society to manage and reduce disaster risks and strengthen resilience. (UNDRR)
Cascading/ compounding hazards/ consequences/ concurrent hazards	Cascading disasters are those which cause emergency events to occur, for example, flooding causing a dam failure, causing in turn further flash flooding. Compounding disasters refers to interlinked hazards that occur at the same time, for example, heatwave, bushfire and smoke exposure. Concurrent disasters are those that happen at the same time, but are not directedly caused by each other, for example, a major cyber outage during a pandemic [198].
Catastrophic (disaster)	A disaster with extreme consequences in line with categories defined in NERAG (refer to Appendix 2)
Consequence	The outcome of an event that affects objectives. Note: • 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. (NERAG/ISO Guide 73:2009 Risk management)
Contingency	A management process that analyses disaster risks and establishes arrangements in advance to enable timely, effective and appropriate responses. (UNDRR)
Community and culture	Equivalent to NERAG 'social setting' consequence category. Refer to Appendix 2 for classifications
Core functions	The essential or critical infrastructure and services on which Tasmanians rely every day. (NERAG consequence category 'public administration' – refer to Appendix 2)
Critical infrastructure and services (CI&S CISC)	As defined by the Australian Government's Critical Infrastructure Resilience Strategy (noting this definition is currently being reviewed). Includes: energy – power and fuel supply water and sanitation telecommunications transport infrastructure and services, including ports, airports and public information systems as well as road/rail infrastructure food supply chains health facilities and services banking and finance. Increasingly, jurisdictions include other vital functions, such as data centres, police and emergency services/infrastructure.
Cyber security incident/outage	"a single or series of unwanted or unexpected cyber security events that have a significant probability of compromising an organisation's business operations. Cyber security incidents can impact the confidentiality, integrity or availability of a system and the data that it stores, processes or communicates"[199]. This assessment uses the term cyber outage as the focus is not on the reason for a cyber outage but on business continuity during/after such an event.
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. (UNDRR)

Disaster resilience	Disaster resilience is the ability of all sectors of society and individuals to survive, adapt and thrive in the face of turbulent change or acute stresses. If a community is resilient then everybody is responsible, accountable and works together using evidence to: reduce disaster risk better withstand, recover from and adapt if disasters do occur. (TDRS Background and supporting information p 9)
Economic loss	Total economic impact that consists of direct economic loss and indirect economic loss. Direct economic loss is the monetary value of total or partial destruction of physical assets existing in the affected area. Direct economic loss is nearly equivalent to physical damage. Indirect economic loss is a decline in economic value added as a consequence of direct economic loss and/or human and environmental impacts. Refer to Appendix 2 for categorisations.
Emergency services management sector (EM sector)	Tasmania's EM sector includes specialist individuals and organisations with accountabilities and/or formally defined roles relating to: response and/or relief and recovery support enabling and supporting prevention and preparedness actions. The sector includes management authorities and support agencies in line with TEMA. (TDRS Background and supporting information p 10)
Evacuation	Moving people and assets temporarily to safer places before, during or after the occurrence of a hazardous event in order to protect them. (UNDRR)
(Disaster) event	Occurrence or change of a particular set of circumstances. (NERAG)
Expediency (of measures)	The ability of the measure/control to be used or deployed readily, and the level of acceptability to the stakeholders and community. (NERAG)
Exposure	The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas; one of the three elements of risk (UNDRR 2017).
Functions	Core processes, activities or services carried out by an organisation.
Hazard	A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation. Hazards may be natural, anthropogenic or socio-natural in origin; one of the three elements of risk (UNDRR 2017).
Land use planning	An integrated system of laws, policies and procedures to ensure decisions about the use and development of land and natural resources in Tasmania help achieve sustainable use and development of natural and physical resources. (TDRS Background and supporting information p 39)
Legacy (decisions, investments, buildings)	The impact of previous decisions on creating, increasing or limiting risk.
Likely/likelihood	The probability of an event or specific consequence occurring. Categorised in line with NERAG (refer to Appendix 2).
People at increased risk in an emergency	Sometimes referred to as vulnerable people or priority populations, refer to 'People at risk in an emergency: a guide for government and non-government service-providers'.
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. (NERAG)
Prevention	Regulatory and physical measures to ensure that emergencies are prevented or their effects mitigated. (NERAG)
Recovery	The restoring or improving of livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and "build back better", to avoid or reduce future disaster risk. (UNDRR)
Residual risk	Risk remaining after risk treatment. Note:

	• residual risk can contain unidentified risk • residual risk can also be known as 'retained risk'. (NERAG)
Response	Actions taken directly before, during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected. (UNDRR)
Risk	The effect of uncertainty on objectives (NERAG). The intersection of hazard, exposure and vulnerability (Profiling Australia's Vulnerability). The combination of the severity and frequency of a hazard, the numbers of people and assets exposed to the hazard, and their vulnerability to damage (UNDRR 2017).
Risk assessment	Overall process of risk identification, risk analysis and risk evaluation (NERAG).
Risk reduction measures	Actions, structures and or investments to reduce disaster risk. Incorporates treatments and controls to reduce risks.
Risk tolerance	Organisation's (or jurisdiction's) or stakeholder's readiness to bear the risk after risk treatment to achieve its objectives (NERAG).
Risk transfer	The process of formally or informally shifting the financial consequences of particular risks from one party to another, whereby a household, community, enterprise or state authority will obtain resources from the other party after a disaster occurs, in exchange for ongoing or compensatory social or financial benefits provided to that other party.
Strength (of control/ measure)	The ability of the measure/control (or group of measures/controls), when operating as intended and when required, to achieve its objective (NERAG).
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 components. Systemic risks are interconnected with non-linear cause-effect relationships (NERAG).
Underlying disaster risk drivers	Processes or conditions, often development-related, that influence the level of disaster risk by increasing levels of exposure and vulnerability or reducing capacity (UNDRR).
Vulnerability	The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, community, assets or systems to the impacts of hazards'[200](UNDRR 2017).
Zoonotic	Disease transmissible between animals and humans.

Appendix 2: NERAG consequence matrix

Category additions since 2016 assessment in italics.

Exposures / consequences	Insignificant	Minor	Moderate	Major	Catastrophic
1. People's health, safety and wellbeing # deaths, injuries or illnesses *# People missing, Indirect/long term health/wellbeing consequences*	0 deaths, 0 major or minor illnesses/ injuries expected	0 deaths or major illnesses/ injuries expected	1-5 deaths or major illnesses/ injuries expected	5-54 deaths or major illnesses/ injuries expected	>54 deaths or major illnesses/ injuries expected
2. Core functions[201] Decreased capacity of governing bodies and utilities to deliver core functions	Unaffected or within normal parameters	Limited reduction in core function delivery	Significant reduction to core function delivery, or some resources diverted or external help to deliver some functions needed	Severe reduction to core function delivery, or significant resources diverted or external help needed to deliver most functions	Unable to deliver core functions
3. Economy Economic activity and/or asset monetary value loss//economic impact on important industries *Indirect economic consequences, eg due to reputational damage, loss of intellectual assets (state gross product of $32 billion[202])*	Inconsequential losses/decline in economic activity	< $12.8 million losses/decline in economic activity	>=$12.8 million - $128 million losses/decline in economic activity	>= $128 million - $1.28 billion losses/ decline in economic activity	>=$1.28 billion losses or decline in economic activity
4. Environment Loss of ecosystems or species, loss of environmental values of interest *Indirect consequences, eg soil erosion due to vegetation loss*	Minor damage to values recognised at state or local level.	State/local-level significant damage or National-level minor damage	National-level significant damage or State-level severe destruction	National-level severe damage or State-level permanent destruction	National-level values permanent destruction
5. Community and culture[203] Community displacement or isolation Loss of connectedness Loss of culturally significant objects, or the interruption of cultural events as a direct consequence of the hazard. *Increased stresses in everyday life, Disruption of education/other activities*	Temporary disruption, no permanent dispersal or loss of connectedness, minor damage to cultural assets/delays to culturally important events	Connectedness damaged, some recovery resources needed, some damage of cultural assets, delay or reduced scope of culturally important events	Connectedness broken, significant recovery resources needed, damage of cultural assets, delayed culturally important events	Connectedness significantly broken, extraordinary recovery resources needed, widespread damage/loss of cultural assets, postponed events	Community ceases to function effectively/ widespread and permanent loss of cultural assets, culturally important activity cancelled

Cross-hazard likelihood and consequence matrix (NERAG)

Likelihood	**Consequence**				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain every year	Medium	Medium	High	Extreme	Extreme
Very high 1-<9 years	Low	Medium	High	Extreme	Extreme
High 10-< 99years	Low	Low	Medium	High	Extreme
Moderate 100-<999 years	Very low	Low	Medium	High	High
Low 1K-<10K years	Very low	Very low	Low	Medium	High
Very low >=10K years	Very low	Very low	Low	Medium	High

Appendix 3: Participating organisations

Organisations	Organisations	Organisations
Aged and Community Services Australia	George Town Council	Sorell Council
Agility Logistics	Hobart City Council	State Emergency Service
Ambulance Tasmania, Department of Health	Huon Aquaculture	State Growth, Trade, Business and Trade
Australia Pacific Airport	Huon Valley Council	State Growth Office of Energy Planning
Australian Antarctic Division	Hydro Tasmania	State Growth Mineral Resources Tasmania
Australian Defence Force	Kentish Council	State Growth Resource Policy Forest Industry engagement and support
Basslink	King Island Council	State Growth Transport
Biosecurity Advisory Committee	Kingborough Council	Sustainable Timber Tasmania
Biosecurity Tasmania, NRE Tas	Latrobe Council	Tas Gas Pipelines
Brand Tasmania, State Growth	Launceston City Council	TasCOSS
Break O'Day Council	Libraries Tasmania	Tasman Council
Brighton Council	Livestock Transport Association of Tas	Tasmanet
Bureau of Meteorology	Local Government Association of Tasmania	Tasmania Fire Service
Burnie City Council	Meander Valley Council	Tasmania Livestock Exchange
Central Coast Council	MNF group	Tasmania Police
City of Launceston	Multicultural Council of Tasmania	Tasmanian Aboriginal Centre
Clarence City Council	NBNco	Tasmanian Council of Churches
Department of Communities	Neighbourhood Houses (St Helens)	Tasmanian Farmers and Graziers Association
Department of Education	Northern Midlands Council	Tasmanian Salmonoid Growers Association
Department of Health	NRM South	TasNetworks
Department of Justice	Origin Energy	TasPorts
Department of Natural Resources and Environment Tasmania Environmental Protection Authority	Page Transport	TasRail
Department of Police, Fire and Emergency Management	Pharmacy Guild	TasTAFE
Department of Premier and Cabinet	Public Health Services	TasWater
Department of State Growth	Red Cross	

Organisations	Organisations	Organisations
George Town Council	Sacred Heart Primary School, Geeveston	Telstra
Glamorgan Spring Bay Council	Salvation Army	University of Tasmania
Glenorchy City Council	Scottsdale Pork	Volunteering Tasmania
Health Department	SeaLink Bruny Island Ferry	West Tamar Council
Fruit Growers Tasmania	Sacred Heart Primary School, Geeveston	

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