GOLDFIELDS-ESPERANCE EMERGENCY MANAGEMENT DISTRICT

Risk assessment report

'Highlighting potential disaster impacts'

GOLDFIELDS-ESPERANCE
DISTRICT EMERGENCY MANAGEMENT COMMITTEE

Disclaimer:

The risk assessment results discussed in this report are based explicitly on the credible worst-case hazard scenarios outlined in Section 2 and the views of those who participated in each risk assessment workshop. Risks and impacts other than those discussed here are possible depending on the nature of future hazards.

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The SEMC's State Risk Project is an initiative of the State Government of Western Australia and is joint-funded under the Commonwealth Government's National Partnership Agreement on Natural Disaster Resilience.

SEMC
STATE EMERGENCY MANAGEMENT COMMITTEE

State Risk Project

An Australian Government Initiative

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Executive summary

This document summarises the results of the *State Risk Project* risk assessment workshops in the Goldfields-Esperance Emergency Management (EM) district. It covers six priority hazards, as identified by the Goldfields-Esperance District Emergency Management Committee (DEMC): fire (bushfire), earthquake, human epidemic, marine transport emergency/oil pollution, rail crash and storm. The impacts of these six hazards were assessed across five key impact areas (economy, public administration, people, environment and social setting) as 251 specific risks called risk statements.

Within the larger emergency risk management process, this report sits between the risk analysis and risk evaluation steps as it presents the results of the analysis to stakeholders in order for them to evaluate which risks require treatment (Figure 1).

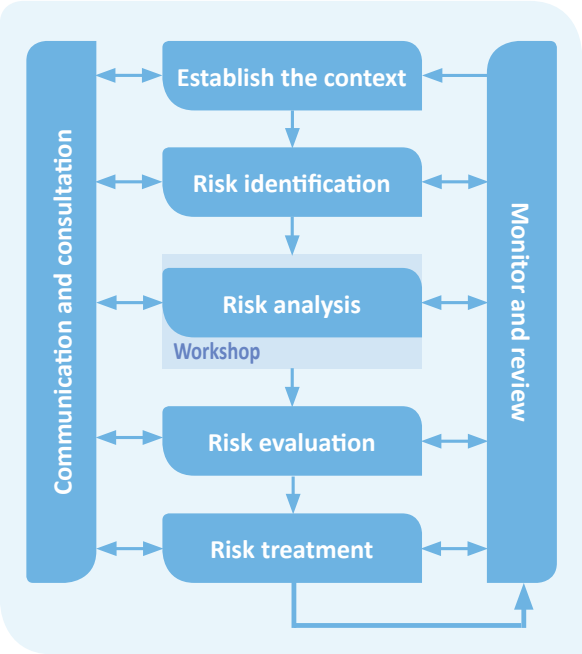


Figure 1: Emergency risk management process[1].

Thirty-two agencies were represented throughout the workshop series which followed the methodology and criteria outlined in the *WA Emergency Risk Management Guide 2015* and the *National Emergency Risk Assessment Guidelines 2015 (NERAG)*[2]. The risk statements were assessed using a tailored *NERAG* consequence table (Appendix C), which is based on the gross area product ($13.6 billion) and the population (61,333) of the EM district.

The results reveal that 2% (5 statements) of the risks assessed were extreme risks and 15% were high risks. A further 28% were medium risks, 34% were low risks and 21% were very low risks. Five percent of the risks could produce catastrophic consequences.

[1]Adapted from AS/NZS ISO 31000 - Reproduced under SAI Global copyright Licence 1411-c083
[2]*National Emergency Risk Assessment Guidelines* (2015) Australian Government Attorney-General's Department

The extreme risks relate solely to the impact on the health of people, resulting in death(s) and/or serious injuries/illnesses. High risk statements appear in all but the environment impact areas, and span all six priority hazards. Lower risks (risk levels of low and very low) dominate the environment and social setting impact areas.

The impacts to people presented the greatest risk to the Goldfields-Esperance EM district, with 74% of them considered extreme or high risk. All hazards pose a risk to human life, with the human epidemic, rail crash, bushfire, earthquake and storm scenarios having the potential to create a catastrophic impact (greater than seven fatalities). In the bushfire, human epidemic, rail crash and storm scenarios, it was suggested that the emergency services and/or health services would be stretched potentially resulting in further deaths directly attributable to the hazard event. This was exacerbated by the remote location of the crash site for the rail crash scenario.

Human epidemic poses a significant risk to the EM district, with 33% of its assessed risk statements considered extreme and high risks and a large number of medium risks (33%). The high and extreme statements primarily consider deaths and injuries, either as a direct result of the epidemic itself or from individuals with existing medical conditions unable to access health care due to the strain placed on the health system by the epidemic. Other high risks stem from the demand on emergency and health services, the day-to-day functionality of facilities for vulnerable people and the impact to community service providers. The latter two were considered to have the potential to reduce the quality of life within the EM district.

The rail crash scenario presents similar high risks to people through death and injury and would pose a significant burden on emergency and health services, particularly on the Royal Flying Doctor Service (RFDS). However, apart from these aspects, the assessed risks for rail crash are relatively low. The largest concern from the rail crash workshop was that there is currently no Hazard Management Agency (HMA) for the track east of Kalgoorlie to the Western Australia-South Australia border. Consequently the designation of responsibilities and cost bearing is uncertain. There are no formal agreements in place for any agency, intrastate or interstate. As Kalgoorlie would be the largest and closest town site to any crash site along this area of track, agencies from this location would be the most likely to respond.

Of the risks assessed for storm, 19% came out as high risks and 33% as medium risk. High risk statements for this hazard relate to the impact on the economy and people. Impacts to transport infrastructure (including disruption) and commercial buildings, contents and services were high risks to the economy, resulting in costs for the district. Likewise, recovery activities across the district were expected to be expensive. The impact to mines was expected to result in a lack of, or delay to, production with knock-on financial implications. In addition, the potential for death and injuries in remote communities and mining sites were a serious concern.

Due to its low likelihood, earthquake risks were mostly assessed as high risks despite the fact that about 28% of the impacts have major (20%) or catastrophic (8%) consequences.

If the likelihood of the earthquake was higher (e.g. 1% chance of occurrence in any given year), these risks would have come out as extreme. Risks with catastrophic consequences related primarily to deaths and injuries, economic losses from damage to private buildings and contents, and the impact to heritage buildings and places of worship, resulting in widespread and permanent loss of cultural significance.

Marine transport emergency posed the least risk to the district with only 9% of statements considered high risk, 30% medium risk, 21% low risk; most (40%) were considered very low risk. It did however have the greatest impact on the environment, primarily as a result of the oil spill and its impact on wildlife and coastal ecosystems (medium risk). High risks related to public administration as an oil spill of that size would likely have national; (perhaps international interest) and would impose heavily on the Department of Transport Marine Safety services, which would need to redirect a large number of resources from other districts to the Esperance coast. The Port of Esperance would be closed for an extended period and be unable to provide services (which would also have financial implications).

The *NERAG* uses a prioritisation system to rank risks for treatment decisions and/or for further investigation. There is only one Priority 1 (highest) statement, 10% are Priority 2, 22% are Priority 3, 27% are Priority 4 and 40% of the statements are Priority 5 (lowest). The following table (Table 1) shows the Priority 1 and 2 risk statements in full along with those risk statements with catastrophic consequences. Catastrophic consequence statements are included because if these impacts do occur they could potentially stretch or outstrip the district's resources and therefore should be considered during the treatment phases.

Table 1: Risk statements for the Goldfields-Esperance EM district with Priority level 1, 2 or catastrophic consequences. Note: MTE = marine transport emergency.

Hazard	Risk statement	Impact area	Consequence	Risk level	Confidence level	Priority level
Bushfire	will impact the health of people and cause death(s).	People	Catastrophic	Extreme	Low	1
Human Epidemic	will impact the health of people and cause death(s)	People	Catastrophic	Extreme	Highest	2
Human Epidemic	will impact the health of people and cause injury and/or serious illness.	People	Catastrophic	Extreme	Highest	2
Human Epidemic	will impact remote health services (e.g. remote nursing posts, small country hospitals, clinics) resulting in deaths, injuries or illness directly attributable to the hazard event.	People	Catastrophic	Extreme	High	2
Human Epidemic	will impact the health of people with other medical conditions due to the demand placed on health services by the epidemic.	People	Catastrophic	Extreme	High	2
Rail Crash	will impact the health of people and cause death(s).	People	Catastrophic	High	High	2
Rail Crash	will impact the health of people and cause injury and/or serious illness.	People	Catastrophic	High	High	2
Rail Crash	will result in a delay of emergency services due to the remote location (and weather conditions), resulting in further deaths.	People	Catastrophic	High	High	2
MTE	will cause an increased demand (surge) on Port Authority services, impacting their ability to maintain core services.	Public Administration	Catastrophic	High	High	2
MTE	will disrupt mining exports from the region (e.g. iron ore), resulting in financial losses.	Economy	Major	High	Low	2

Hazard	Risk statement	Impact area	Consequence	Risk level	Confidence level	Priority level
Rail Crash	will cause an increased demand on emergency services and health services (including ambulance and medical transport services, hospitals, remote nursing posts and clinics), resulting in further deaths directly attributable to the hazard event.	People	Major	High	Moderate	2
Human Epidemic	will impact emergency services (e.g. medical transport services such as RFDS) across the district, resulting in deaths, injuries or illness directly attributable to the hazard event.	People	Major	High	High	2
Bushfire	will impact the health of people and cause injury and/or serious illness.	People	Major	High	Moderate	2
Bushfire	will impact the mental health of people, resulting in medical treatment being required.	People	Major	High	Moderate	2
Bushfire	will cause emergency services (including ambulance and medical transport services such as RFDS) to be overwhelmed, resulting in further deaths directly attributable to the hazard event.	People	Major	High	High	2
Human Epidemic	will impact workforce attendance in the local government services sector, impacting their ability to deliver core services.	Public Administration	Major	High	High	2
Human Epidemic	will impact ambulance services, impacting their ability to maintain core services.	Public Administration	Major	High	High	2
Human Epidemic	will impact private GP services, impacting their ability to deliver core services.	Public Administration	Major	High	High	2
Human Epidemic	will impact RFDS services, impacting their ability to deliver core services.	Public Administration	Major	High	High	2
Human Epidemic	will impact workforce attendance within WA Police, impacting their ability to deliver core services & increasing security issues.	Public Administration	Major	High	High	2

Hazard	Risk statement	Impact area	Consequence	Risk level	Confidence level	Priority level
Human Epidemic	will impact other agencies, not mentioned above (e.g. DFES, DAFWA), impacting their ability to deliver core services.	Public Administration	Major	High	Moderate	2
Bushfire	will cause an increased demand on Child Protection and Family Support services, impacting their ability to maintain core services.	Public Administration	Major	High	High	2
Human Epidemic	will impact the day-to-day functionality of support systems for the vulnerable (e.g. childcare, aged care, disability support).	Social Setting	Major	High	High	2
Human Epidemic	will impact community service providers within the district (such as NGOs, Meals on Wheels, Silver Chain).	Social Setting	Major	High	Moderate	2
Bushfire	will cause health services (e.g. ICU units, hospitals, remote nursing posts, small country hospitals, clinics) to be overwhelmed, resulting in further deaths directly attributable to the hazard event.	People	Major	High	Moderate	2
Bushfire	will impact power infrastructure, impacting the ability to maintain core services.	Public Administration	Moderate	Medium	Low	2
Bushfire	will impact mobile and landline communication infrastructure, impacting on the ability to maintain core services.	Public Administration	Moderate	Medium	Low	2
Earthquake	will impact private buildings and contents, resulting in financial losses.	Economy	Catastrophic	High	Highest	3
Earthquake	will impact the health of people and cause death(s).	People	Catastrophic	High	Highest	3
Earthquake	will impact the health of people and cause injury and/or serious illness.	People	Catastrophic	High	Highest	3
Earthquake	will impact heritage buildings, churches and places of worship, resulting in a loss of cultural significance.	Social Setting	Catastrophic	High	Highest	3

1 Introduction

A series of risk assessment workshops were conducted in the Goldfields-Esperance Emergency Management (EM) district as part of the *State Risk Project*. The project aims to assess the risks posed to the state from all prescribed hazards using a consistent and comprehensive approach. This approach follows the ISO 31000:2009 standard and the methodology outlined in the *National Emergency Risk Assessment Guidelines (NERAG) 2015*. By assessing risks at state, district and local levels, it allows for comparison and the prioritisation of future resource allocations with an emphasis towards prevention and preparedness activities.

Initially, the highest priority hazards for each district are assessed. The six priority hazards for the Goldfields-Esperance EM district, as identified by the District Emergency Management Committee (DEMC) are: fire (for this assessment only bushfire was considered and is hereafter referred to as bushfire), earthquake, human epidemic, marine transport emergency/marine oil pollution (MTE), rail crash and storm. All hazards were assessed within a workshop setting (see Table 2 for schedule) and used a credible worst-case hazard scenario. The credible worst-case scenarios were developed by relevant hazard experts and are chosen with the rationale that planning and risk reduction activities for the largest event will address impacts of smaller events, even if the smaller events are more frequent.

During each workshop, presentations were given by relevant experts to provide the hazard context, outline the anticipated district vulnerabilities and impacts and describe the scenario. Following this, as a group, the participants worked through a series of risk statements to estimate the potential consequences of the scenario event. Each risk statement depicts an impact that is likely to eventuate given the scenario (see Table 1 for examples) and is collectively assigned a likelihood, consequence and confidence level using the *NERAG 2015* criteria. Discussion was encouraged among participants allowing the hazards and impacts to be fully evaluated, with decisions based on group consensus. Risk statements are grouped into five impact areas: economy; people; public administration; social setting; and environment with an average of 50 risk statements assessed per hazard.

Data were captured and analysed following the workshop. The results are presented in this report.

Table 2: Location and date of risk assessment workshops.

Hazard	Location of workshop	Date of workshop
Bushfire	Kalgoorlie	10 August 2016
Earthquake	Kalgoorlie	1 September 2015
Human Epidemic	Kalgoorlie	2 June 2016
MTE	Esperance	10 May 2016
Rail Crash	Kalgoorlie	2 June 2016
Storm	Kalgoorlie	1 September 2015

A range of agencies from across the district were invited to attend the workshops. Agency representation is shown in Table 3.

Table 3: Agencies involved in each risk assessment workshop for the Goldfields-Esperance EM district, listed in alphabetical order. Note: EQ = earthquake; HE = human epidemic; MTE = marine transport emergency; and RC = rail crash.

Agency	Hazard					
	Bushfire	EQ	HE	MTE	RC	Storm
Anglo Gold Ashanti	x					
Australian Rail Track Corporation	x					
City of Kalgoorlie-Boulder	x	x	x		x	x
Co-operative Bulk Handling				x		
Department for Child Protection and Family Support	x					
Department of Agriculture and Food WA	x	x	x	x	x	x
Department of Defence			x		x	
Department of Education		x				x
Department of Fire and Emergency Services	x	x		x	x	x
Department of Health				x		
Department of Human Services			x		x	
Department of Parks and Wildlife	x					
Department of Transport, Marine Safety				x		
Goldfields Indigenous Housing Organisation			x			
Goldfields-Esperance Development Commission	x					
Kalgoorlie Consolidated Gold Mine		x				
Main Roads WA	x		x	x	x	
Office of Bushfire Risk Management	x					
Office of Emergency Management (facilitators)	x	x	x	x	x	x
Office of the National Rail Safety Regulator			x		x	
Port of Esperance				x		
Ri'ziliens				x		

Agency	Hazard					
	Bushfire	EQ	HE	MTE	RC	Storm
Shire of Coolgardie	x					
Shire of Esperance	x		x	x		
Shire of Leonora	x					
Shire of Menzies	x		x		x	
Southern Ports Authority				x		
St John Ambulance	x		x		x	
WA Country Health Service		x	x	x	x	x
WA Police	x	x	x	x	x	x
Water Corporation			x		x	
Western Power		x				x

2 Hazard scenarios

Six hazards were assessed for the Goldfields-Esperance EM district. Hazard scenarios were developed with the assistance of:

- Bureau of Meteorology Western Australia (BOM)
- Department of Fire and Emergency Services (DFES)
- Department of Parks and Wildlife (P&W)
- Department of Transport, Marine Safety
- Geoscience Australia (GA)
- Office of Emergency Management (OEM)
- Southern Ports Authortiy - Port of Esperance
- WA Country Health Services (WACHS)
- WA Police

Bushfire scenario

The bushfire scenario was developed by DFES, P&W and the BOM and has approximately a 4.88% chance of occurrence in any given year.

During the Christmas and New Year holiday period, caravan parks and tourist areas are at maximum capacity. Most local governments are closed and emergency services are operating with low numbers of staff. It is a hot, dry and windy summer's day. A Fire Danger Index (FDI) of 200 occurs on the day, resulting in a catastrophic fire warning.

A dry weather storm, with north-westerly winds crosses the region resulting in multiple ignitions by lightning in varying locations at approximately midday. Up to 16 small fires are ignited in the area north-west and north of Esperance. Three major fires break out, located west of Gibson, south-west of Esperance along the coast and south-east of Dalyup near the South Coast Highway. Throughout the day the wind changes to a strong dry south-westerly, causing the fires to become out of control. The fire west of Gibson passes through the Gibson town site and close to the Esperance Airport. The fire near Esperance moves west of the Esperance town site, and the fire near Dalyup crosses the South Coast Highway.

As a result of the fires, the Gibson town site is impacted, as is the western part of Esperance (Figure 2). Fires have crossed the South Coast Highway, Coolgardie-Esperance Highway and the Gibson-Dalyup Road, and these roads have been closed. The rail line to the east of Gibson has also been impacted.

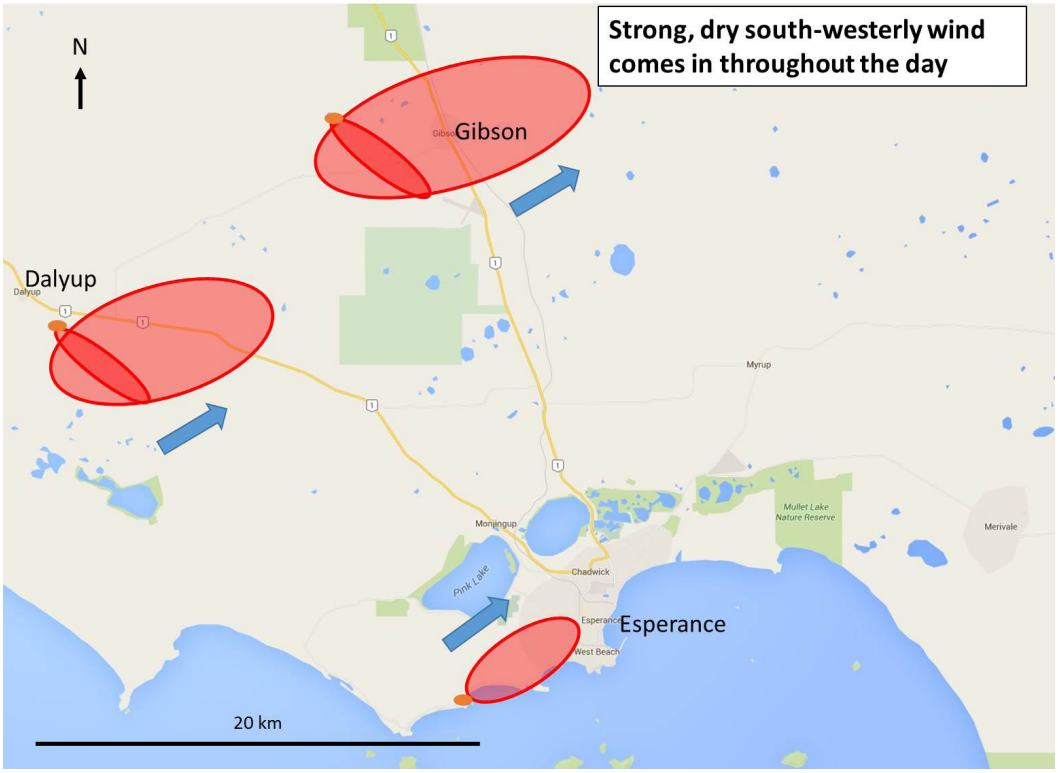


Figure 2: Fire shapes in the Esperance region for the bushfire scenario.

Earthquake scenario

The earthquake scenario was developed by GA and has approximately a 0.04% chance of occurrence in any given year.

It is spring and just prior to school pick-up time. A magnitude 5.6 earthquake, at 7.5 km in depth occurs on a fault line 20 km from Kalgoorlie town centre. Kalgoorlie town centre experiences ground shaking of the magnitude 7-7.5 on the Modified Mercalli scale (Figure 3; Table 4).

The Geoscience Australia report[3] estimates that 35% of buildings in Kalgoorlie are impacted (Figure 4; Table 5) and 19 deaths, 75 major injuries and 557 minor injuries could occur. These figures could be greater as the numbers were based on the earthquake occurring at night time.

[3] Wehner, M.; Ryu, H.; Corby, N.; Robinson, D. and Edwards, M. (2013) *Earthquake Impact Scenarios for Western Australia – Geoscience Australia Professional Opinion.* Geoscience Australia.

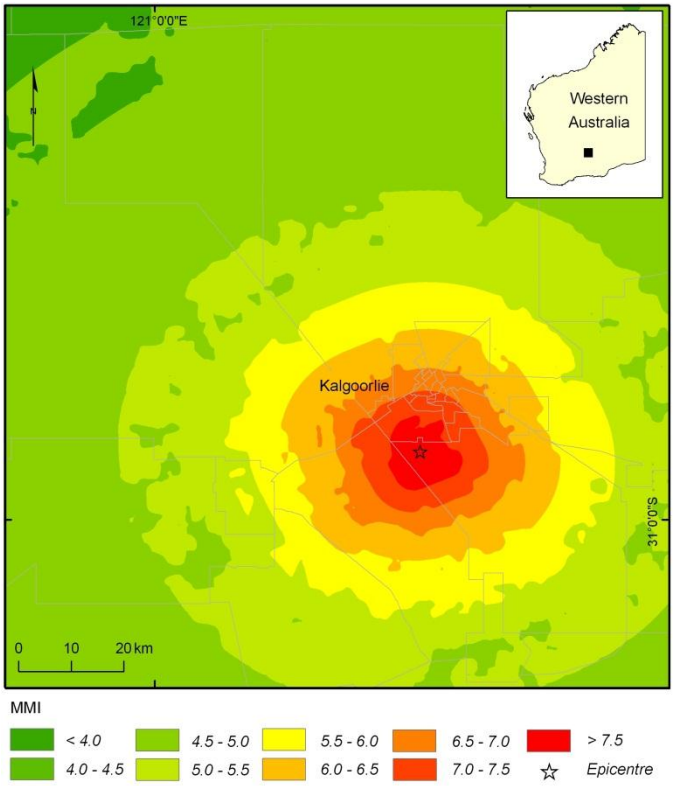


Figure 3: Shaking intensity map for a M5.6 earthquake in Kalgoorlie. Image supplied by GA.

Table 4: Modified Mercalli Intensity (MMI) scale showing expected damage and example earthquake events for shaking intensity V (5) to IX (9).

MMI	Expected impacts	Example event
V	Cracking of vulnerable masonry (e.g. parapets & chimneys) with minor falls. Minor cracking to masonry houses.	Kalgoorlie CBD - 20 Apr 2010
VI	Collapse of vulnerable masonry and severe cracking to other masonry structures.	Boulder CBD - 20 Apr 2010
VII	Severe damage to unreinforced masonry (URM) buildings, some damage to housing, damage to low ductility framed buildings, particularly irregular buildings, with some collapses.	Newcastle - 27 Dec 1989
VIII	Severe to complete damage to URM buildings, severe damage to low ductility buildings.	Christchurch - 22 Feb 2011
IX	Destruction of URM and low ductility framed buildings, damage to all other types.	Meckering - 14 Oct 1968

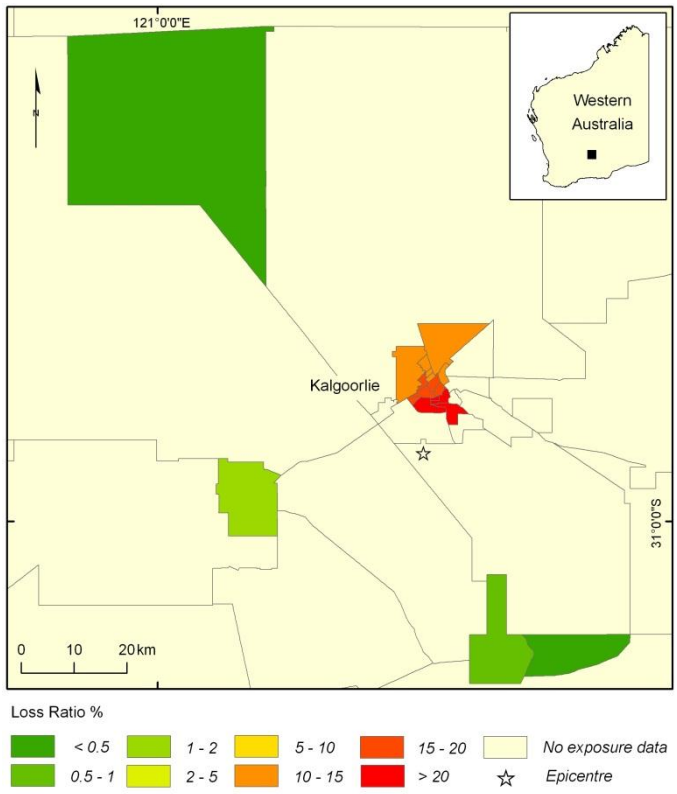


Figure 4: Expected building loss ratio (%) in Kalgoorlie from a M5.6 earthquake. Supplied by GA.

Table 5: Expected building damage from a M5.6 earthquake in Kalgoorlie, Goldfields-Esperance. Supplied by GA.

Mean loss ratio	Number of buildings			
	Slight damage	Moderate damage	Extensive damage	Complete damage
14.7%	1774 (17.2%)	1833 (17.7%)	1334 (12.9%)	1695 (19%)

Human epidemic scenario

The human epidemic scenario was developed by WACHS and has approximately a 3.92% chance of occurrence in any given year.

Note: An epidemic is the occurrence of more cases of illness than would normally be expected in a specific place or group over a given period of time.

Two recent cases of severe respiratory illness are admitted to Laverton Hospital – one is transferred to Kalgoorlie and one to Perth. The patient in Kalgoorlie (Patient A) is a police officer who was on duty at the Laverton NAIDOC week festival, and his condition is deteriorating. The second patient (Patient B) was originally transferred to Kalgoorlie High Dependency Unit (HDU), but required intubation and was later transferred to Royal Perth Hospital (RPH) via the Royal Flying Doctors Service (RFDS). His condition is also deteriorating. A third person who had presented to Laverton, then Warburton clinic, dies after being transferred to Perth. Further cases appear across the district and a number of them result in death. A common factor is their presence at the NAIDOC festival.

Dr Gary Dowse from Communicable Disease Control Directorate (CDCD) calls and emails as a matter of critical urgency about a case of “H5N1R5-alpha influenza virus” (Figure 5) diagnosed in a Chinese National, Mr Xing-Yu Zhoa (Mr XYZ), a recent visitor to the Goldfields. Post-mortem pathology in China confirmed the presence of H5N1R5-alpha, a novel avian influenza virus. More cases in Northern Goldfields and Northern Goldfields Lands are presented. Health worker(s) at hospitals and clinics become sick and cases begin to present in the Midwest-Gascoyne and Perth also. H5N1R5-alpha begins to spread across the Goldfields-Esperance and other districts.

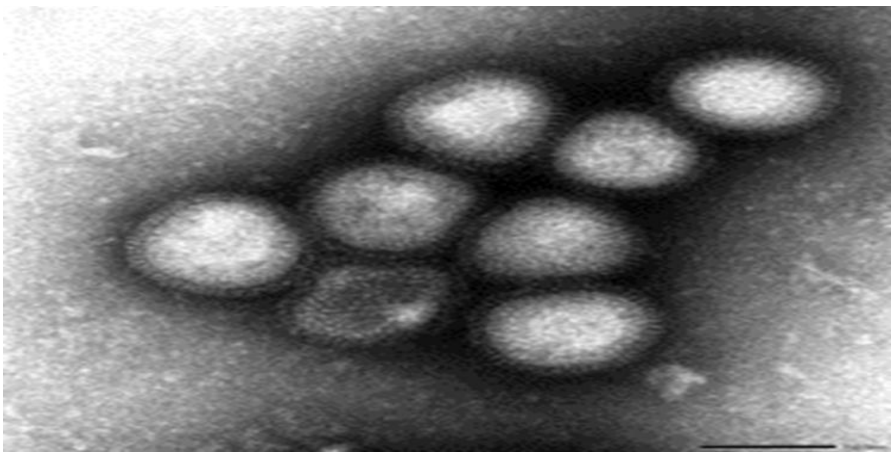


Figure 5: An Avian Influenza virus that has caused disease in humans. Image source: World Health Organisation.

In addition to the natural spread of the virus, there are other factors at play. The Public Health team in the Goldfields-Esperance are not at full capacity and surge capacity staff are limited. Clinical staff in exposed sites (Laverton, Leonora, Kalgoorlie, and Warburton) are also experiencing shortages and staff turnover. There is limited health care worker vaccination uptake in WACHS (<50% of frontline staff) and limited Clinical Health and Hospital staff in Laverton. Only Emergency Department bays are available with limited isolation facilities in Warburton Clinic. Triage points/Fever clinics are required to be setup across the district. Stocks of the influenza vaccination ‘Tamiflu’ are low and there is a limited amount of Personal Protection Equipment (PPE) available. There is capacity for

high dependency care in the Goldfields and social distancing measures (e.g. cancelling community events) are initiated.

In 2014, the Department of Health developed crude modelling of a novel pandemic virus and estimated the following factors in the event of an epidemic:

- Clinical attack rate: 7-35%
- Case fatality rate: 1-2.5%
- Age-specific impact, 3 peaks: <5 years; 20-35 years; >65 years
- Pregnant women and chronically ill will be vulnerable
- Timing/seasonality: usually winter
- Duration: 7–10 months
- Absenteeism: up to 20% at peak of pandemic
- Vaccine development and manufacture will take six months

For the purpose of this scenario, this modelling was applied to the Goldfields-Esperance district. Based on an estimated population of 60,000, for Avian Influenza AH5/N1, the attack rate would be 10% of the population, with a case fatality rate of 2%. This would result in ~6000 cases and 120 deaths.

Marine transport emergency scenario

The marine transport emergency/marine oil pollution scenario was developed by the Southern Ports Authority – Port of Esperance and the Department of Transport, Marine Safety. It has approximately a 0.995% chance of occurrence in any given year.

During a winter storm, an iron ore vessel in berth three at the Port of Esperance breaks its moorings and blocks the inside channel. The vessel becomes grounded and breaks up into parts, releasing approximately 1500 tonnes of oil into the harbour (Figure 6). The port is closed for up to six months, having major impacts on the import/export economy, in particular iron ore and grain.

Figure 6: Movement of ship towards the north once the lines holding the ship break, blocking the inner channel for the MTE scenario. Image supplied by Southern Ports Authority – Port of Esperance.

Rail crash scenario

The rail crash scenario was developed by the DFES and WA Police and has approximately a 0.725% chance of occurrence in any given year.

Following a heavy rain event, the India Pacific passenger train (carrying approximately 300 people, including staff) derails at 6 am on a Monday morning in winter. The train derails 450 km east of Kalgoorlie (Figure 7), with the locomotives and at least two carriages rolled and significantly damaged. A number of other carriages have also come off the tracks. Fuel from the locomotives spills into the surrounding environment and the railway line is damaged and unusable. There are multiple deaths and injuries among passengers and staff on board. A significant rainfall event prior to the derailment has turned dirt access tracks into mud and some airstrips nearby are unusable.

Figure 7: Location of the rail crash between Kalgoorlie and the SA border for the rail crash scenario.

Storm scenario

The storm scenario was developed by the BOM and has approximately a 0.95% chance of occurrence in any given year.

During the April school holidays an extra-tropical cyclone, moving at approximately 50-80 km an hour, with an associated band of severe thunderstorms (Figure 8), tracks east from Mount Magnet, travelling over the Goldfields-Esperance district for 12 hours. A weekly rainfall total of 250-300 mm falls across the district with daily totals during the scenario event of 100-150 mm (Figure 9). The cyclone track is similar to that of Tropical Cyclone Vance in 1999.

The storm is widespread across the Goldfields-Esperance district, with Kalgoorlie and Esperance (the main population centres) impacted. Inland flash flooding and wind speeds of 90-100 km/hr result from the storm.

Major transport links are impacted. The main east-west rail line is inundated, as are the main highways: Great Eastern Highway, the Goldfields Highway, Eyre Highway and the Great Central Road. In addition, a number of water bores across the district are inundated.

As a result of it being school holidays, a number of people are camping or staying in tourist areas within the district.

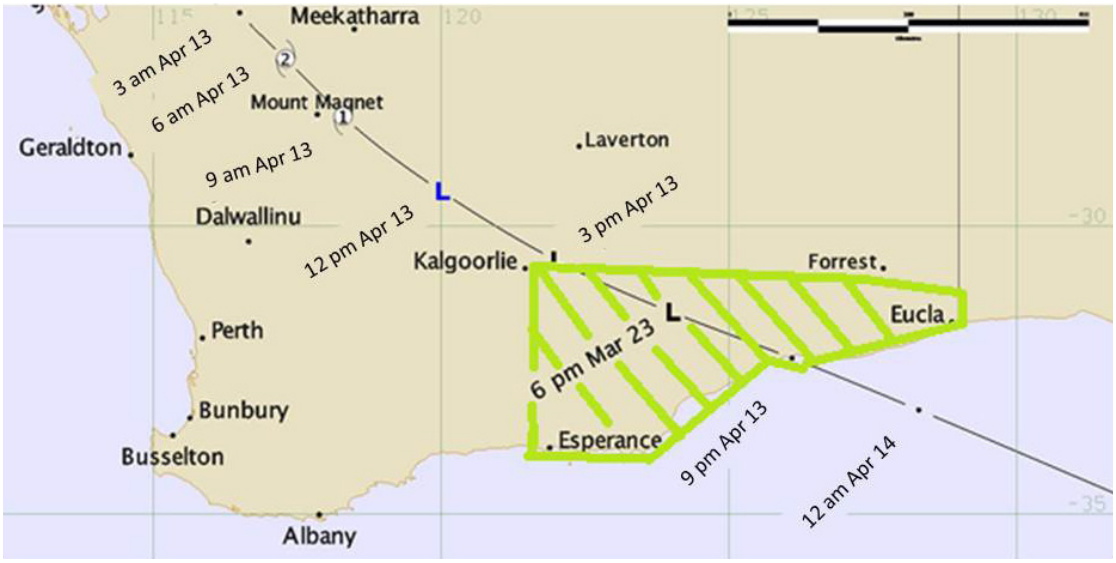


Figure 8: Extra-tropical cyclone track and associated thunderstorm area for the storm scenario. Image supplied by the BOM.

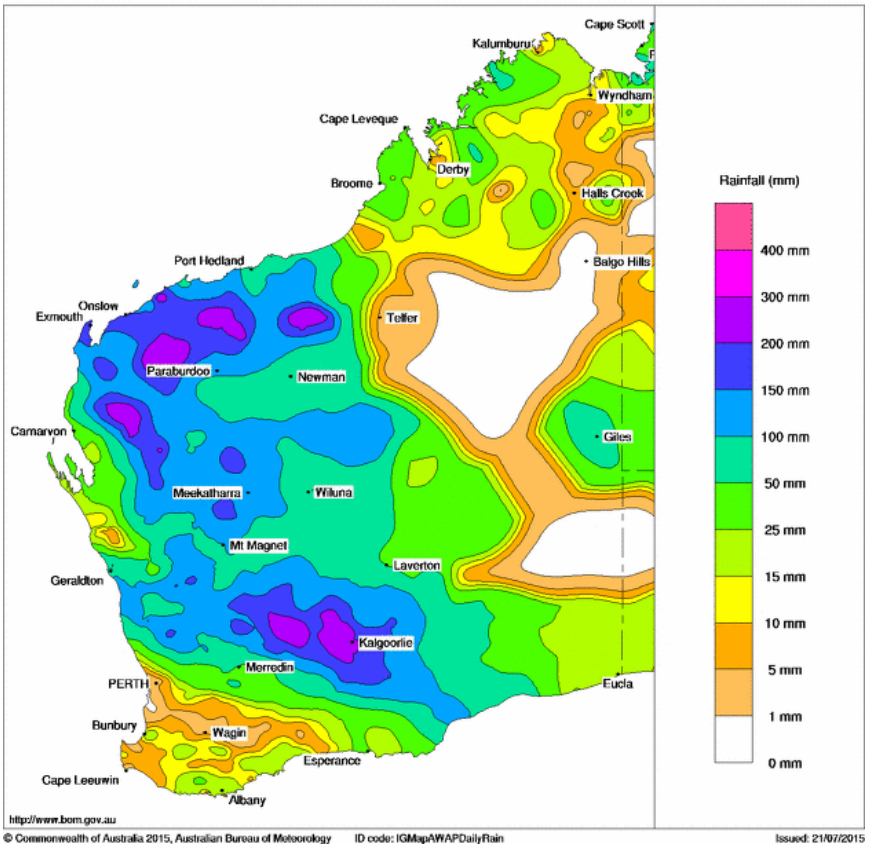


Figure 9: Forecast rainfall following the extra-tropical cyclone and associated thunderstorms. Image supplied by the BOM.

3 Assessed risk statements

A total of 251 risk statements were assessed across the six priority hazards: bushfire (48); earthquake (49); human epidemic (40); MTE (33); rail crash (27); and storm (54).

Table 6 shows the number of risk statements for each hazard separated into the five impact areas (economy, people, public administration, social setting and environment).

The statements were generated to cover all foreseen impacts of the scenario events across the five impact areas. No environment statements were assessed for earthquake or human epidemic as risks to ecosystems and/or species were not foreseen at the time of the workshops.

The risk statements were assessed using the tailored *NERAG* consequence table for the Goldfields-Esperance EM district found in Appendix C. The consequence levels are based on the gross area product ($13.6 billion) and the population (61,333) of the EM district.

Table 6: Number of risk statements assessed for each hazard in the Goldfields-Esperance EM district. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Hazard	Impact area				
	Economy	People	Public administration	Social setting	Environment
Bushfire	14	5	14	11	4
Earthquake	14	3	17	15	-
H Epidemic	9	5	12	14	-
MTE	11	5	6	7	4
Rail Crash	7	5	8	4	3
Storm	15	4	14	13	8

4 Goldfields-Esperance EM district risk profile

The risk profile for the Goldfields-Esperance EM district for the six assessed hazards is shown in Figure 11 (following page). This diagram shows the percentage of risk statements for each hazard as they sit on the *NERAG 2015* risk matrix. The matrix is used to categorise risk statements by their likelihood, consequence and risk level. The bar graph below (Figure 10) combines the data and categorises it by hazard and risk level.

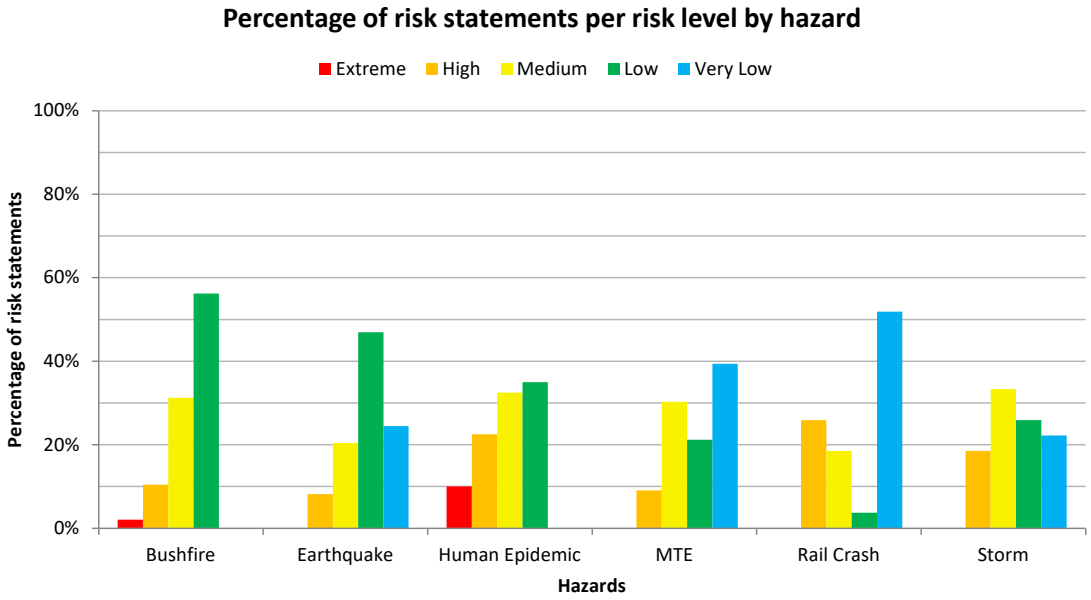


Figure 10: Percentage of risk statements per risk level by hazard. Note: each hazard sums to 100%.

Of the 251 statements assessed for all six hazards, 2% are extreme risks, 15% are high, 28% are medium, 34% are low risks and 21% are very low risks. Individual hazard risk assessment summaries can be found in Appendix A.

The human epidemic scenario was assessed as having the greatest number of extreme and high risks (33%). This is mainly due to the large number of deaths expected from a hazard of this nature and the consequent demand on health services. Following this, rail crash has the highest percentage (26%) of high risks.

As illustrated in Figure 10, bushfire has the highest percentage (56%) of low risk statements of all the hazards; though it also has one extreme risk. Rail crash has the highest percentage (52%) of very low risks, followed by MTE (39%).

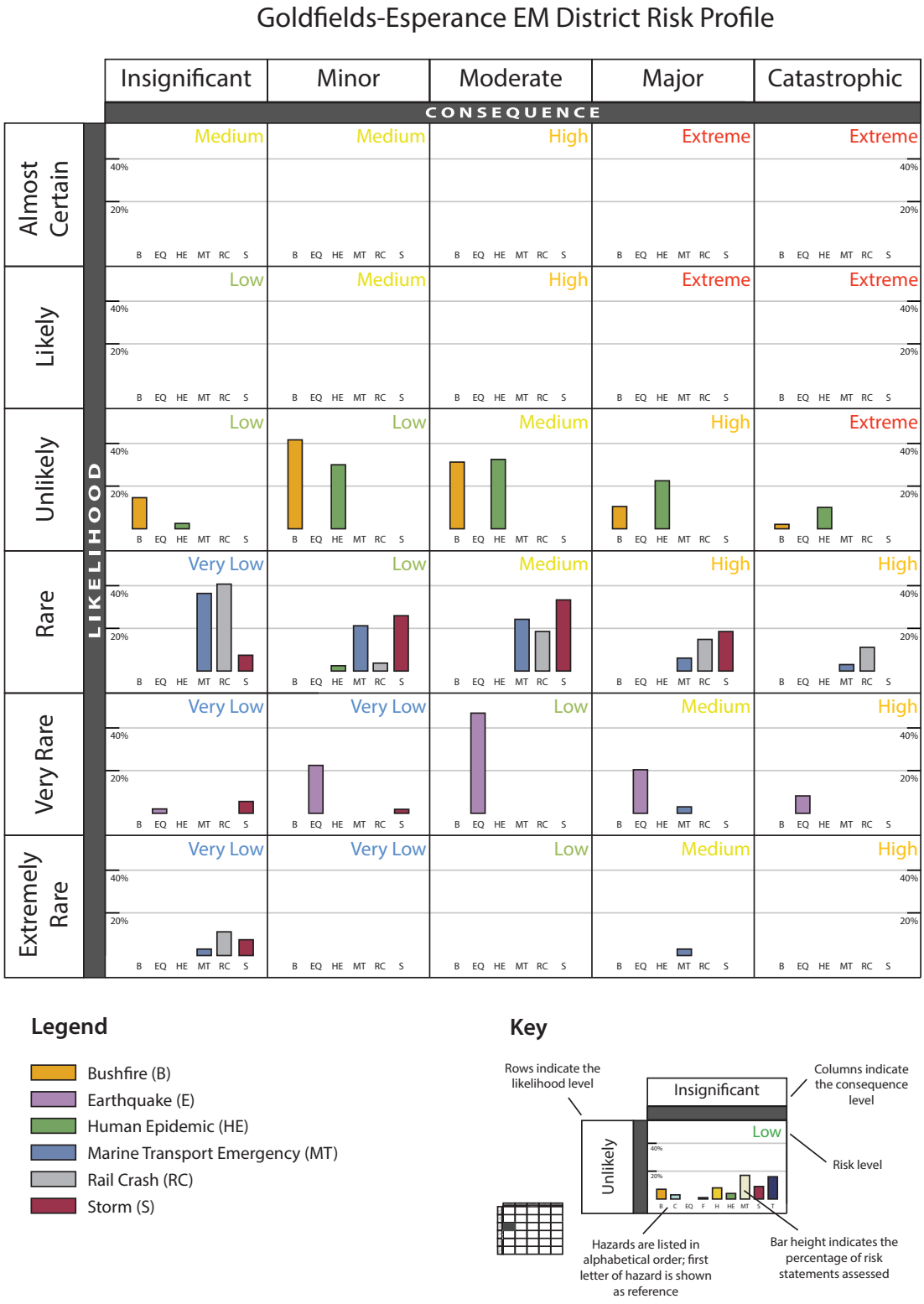


Figure 11: Percentage of risk statements for each hazard assessed in the Goldfields-Esperance EM district, categorised by their likelihood, consequence and risk level.

The extreme risks are related to the bushfire and human epidemic scenarios (Figure 10 and Figure 11) and directly relate to deaths and/or injuries as a result of these events. Catastrophic consequences would be produced by all hazard scenarios except storm, and are classified as either a high or extreme risk. Regardless of the likelihood, catastrophic consequences can strain and outstrip the district's resources and should be considered during the treatment phase. Major consequences were assessed to result from 17% of the risk statements.

Figure 12 illustrates the spread of risks to the Goldfields-Esperance EM district across the five impact areas. The greatest proportion of risk statements assessed as extreme and high risk sit within the people impact area. This is followed by the public administration and economy impact areas respectively. The environment and social setting impact areas have the highest proportion of low and very low risks.

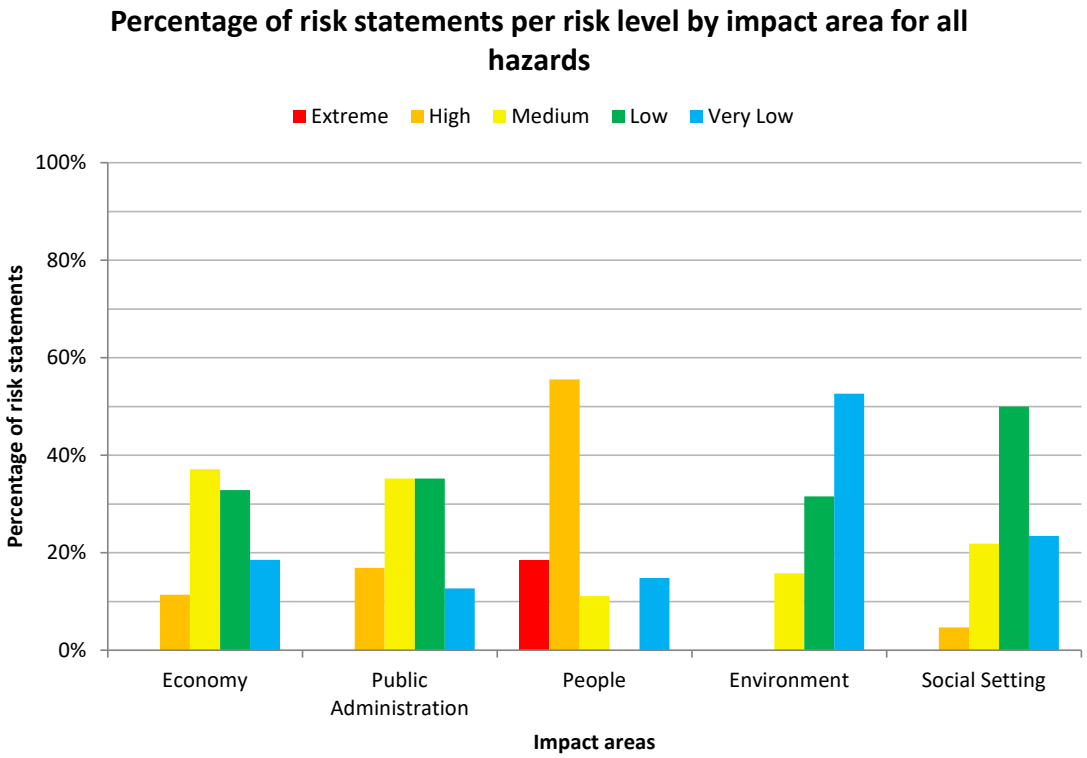


Figure 12: Percentage of risk statements per risk level, by impact area for all hazards. Note: each impact area sums to 100%.

Common themes from extreme and high risks

ECONOMY		• Impact to private and commercial buildings and contents, resulting in financial costs and asset losses *(catastrophic for earthquake)*. • Impact to transport infrastructure, incurring financial costs *(storm only)*. • Disruption of major road and rail freight routes *(storm only)*. • Impacts to the mining industry. • Response and recovery activities resulting in costs for the district *(storm only)*.
PEOPLE		• Emergency events result in death(s) (*catastrophic consequences for earthquake, rail crash, bushfire and human epidemic; extreme risk level for human epidemic and bushfire*). • Emergency events result in injuries/illnesses *(catastrophic consequences for earthquake, rail crash and human epidemic; extreme risk level for human epidemic)*. • Emergency events will cause emergency and health services to be overwhelmed, resulting in further deaths directly attributable to the hazard event. • A delay in emergency services due to remote location (and weather conditions), resulting in further deaths (*rail crash only*).
PUBLIC ADMINISTRATION		• Impact to medical services (ambulance, RFDS WA, General Practitioner (GP) services), impacting their ability to maintain core services. • Increased demand and/or reduced workforce attendance for state agencies (DFES, WA Police, Port Authorities, Dept. of Transport Marine Safety, CPFS, and DAFWA etc.) and local government, impacting their delivery of core services. • Reduced potable water supply/services as a result of contamination or damage to critical infrastructure *(storm only)*.

SOCIAL SETTING		• Impact to community service providers within the district *(human epidemic only)*. • Impact to day-to-day functionality of support systems for the vulnerable people (e.g. childcare, aged care, disability support) *(human epidemic only)*. • Impact to heritage buildings, churches and places of worship, resulting in a loss of cultural significance *(catastrophic consequences for earthquake)*.
ENVIRONMENT		• *No environment risk statements were assessed as extreme or high risks.*

5 Analysis of risk profile

In order to understand any potential relationships, the assessed risks have been grouped into categories to determine common themes or if certain areas and sectors are at higher risk.

In the following tables, risk statements are represented by showing the hazard name under the assigned risk level. Where a number follows the hazard name, more than one statement from that hazard fits into that category and risk level. There may also be more than one statement for a hazard in a category. For example, statements addressing horticulture, crops and agriculture infrastructure would all appear in the impacts to agriculture and pastoral activities category. Risk statements were written for each hazard to address anticipated impacts; therefore there are categories where not all hazards appear.

Risks to economy

Seventy economy risk statements were assessed (Table 7). The statements address impacts to a significant industry or the decline in economic activity across the district (see Appendix C for criteria).

Table 7: Impacts to economy by hazard and risk level. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Category	Risk level				
	Extreme	High	Medium	Low	Very Low
Disruption to transport routes		Storm (2)	Bushfire	Earthquake	Rail Crash (2)
Health services			H Epidemic		
Impacts to agricultural and pastoral activities			Bushfire (2) MTE	Bushfire H Epidemic Storm	
Impacts to aviation				Bushfire	
Impacts to bridges or their approaches			Storm	Earthquake	
Impacts to commercial activities			H Epidemic MTE	H Epidemic (2) MTE	MTE Rail Crash

Category	Risk level				
	Extreme	High	Medium	Low	Very Low
Impacts to commercial buildings, contents and services		Storm	Bushfire Earthquake		
Impacts to communication infrastructure			Storm	Bushfire	Earthquake
Impacts to marine infrastructure and industry			MTE (2)	H Epidemic	
Impacts to mining infrastructure and industry		MTE Storm	Earthquake H Epidemic Rail Crash		
Impacts to natural gas distribution					Earthquake Storm
Impacts to power supply infrastructure			Bushfire Storm		Earthquake
Impacts to private buildings and contents		Earthquake	Bushfire Storm		
Impacts to rail infrastructure					Rail Crash
Impacts to sewerage systems				Bushfire Earthquake Storm	
Impacts to tourism			H Epidemic MTE	Bushfire Earthquake (2) MTE Storm	MTE Rail Crash
Impacts to transportation infrastructure		Storm		Bushfire Earthquake	
Impacts to water supply infrastructure			Storm	Bushfire Earthquake	
Response and recovery activities		Storm	Bushfire Rail Crash		Earthquake MTE
Workforce productivity losses			H Epidemic		

Overall, most risks to the economy were assessed as medium or low risks. There are, however, a number of high risks that should be considered during the risk treatment phase.

The greatest risk to the Goldfields-Esperance economy is posed by the storm scenario, particularly from transport route disruption (road and rail), impacts to commercial buildings and impacts to mining infrastructure and industry. MTE also poses a high risk to the mining industry as a result of the disruption to imports/exports and the costs associated with finding alternative transportation routes.

Damage to private buildings and contents was seen to be the greatest economic risk in the event of an earthquake; whereas damage to commercial buildings and contents was at greater risk from storm. The human epidemic, MTE and rail crash scenarios would have no impact on buildings.

Most (37%) of risks to the economy were assessed as medium. Impacts to agricultural and pastoral activities are greatest from bushfire and MTE but for differing reasons. A direct impact would be experienced from the bushfire scenario as crops would likely be burned, including those in storage facilities; however, the degree of impact would depend on the time of year with the greatest effect during harvest season. In this scenario, it was anticipated that the harvest would be over; however, stored crops may be impacted, particularly if it were a bumper season. Fencing and buildings would also be exposed to fire, as would stored machinery. In addition, farms surrounding Gibson would be most impacted as there are a large number of livestock operations in proximity to the town site. Conversely, the MTE scenario would have indirect impacts on agricultural and pastoral activities. With the Port of Esperance closed for a period of time, grain would need to be diverted out of Esperance via road, most likely to nearby ports for exporting. This would incur associated costs due to the need for additional transporting resources, and financial losses from delays.

Medium economic risks to the mining industry came out of the human epidemic, earthquake and rail crash scenarios. There was concern that a reduced workforce as a result of a human epidemic would result in productivity losses. Mining camps and their close quarters may increase the spread of the epidemic, and staff unable to work at a mine site would not be easily replaced due to the need for specific specialist skills. Following the earthquake scenario, mine sites would need to be surveyed and declared safe before production could continue. The rail crash scenario would likely delay mining resources transported by rail on the east-west line and alternative routes may be required.

The MTE scenario poses a medium economic risk to different aspects of the marine industry. The port infrastructure itself would likely be affected resulting in costs of approximately $10 million to repair. The diversion of vessels, due to the clean-up operation, would impact their normal operations resulting in anticipated knock-on financial losses of >$5.4 million. In addition, the seafood and fisheries retail industry (e.g. shops, supermarkets and fishmongers) could be impacted by reputational damage as a result of the oil spill. It was suggested that people may perceive fish products,

particularly abalone, to be contaminated if it comes from the same location (or even the same coastline) as the location of the oil spill.

Economic losses to tourism were assessed as low or very low risk for all hazards except MTE and human epidemic, which were considered medium risks. It was expected that the MTE scenario would prevent commercial businesses from functioning as a number rely on the port itself. In addition, Esperance draws most tourists and a direct impact to Esperance may impact the EM district's tourist earnings. The human epidemic scenario is anticipated to impact the tourism, hospitality and entertainment industries, resulting in financial losses of >$5.4 million. People are unlikely to travel unnecessarily during an epidemic event; therefore tourist expenditure in hotels, motels, camp grounds and tourist attractions is likely to reduce. It was expected that the stigma of the epidemic could last up to a year, depending on the severity of the epidemic itself.

The impact to utilities was assessed as medium risk for the storm and bushfire scenarios. The storm scenario would impact communications, power and water supply infrastructure, incurring repair costs and financial losses through disruption to business services. The bushfire scenario could damage power lines, expecting to cost >$5.4 million in repairs. In comparison, in the 2015 Esperance fire event, costs to repair power infrastructure were approximately $7.6 million.

Risks to people

Twenty-seven risk statements assessed the impact to people. These statements addressed deaths, injuries or illnesses, further deaths or illnesses/injuries as a result of the event's impact on emergency services (primarily medical transport) and on health services. The risk posed to each of these elements by the assessed hazards is shown in Table 8.

Table 8: Impacts to people by hazard and risk level. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Category	Risk level				
	Extreme	**High**	**Medium**	**Low**	**Very Low**
Deaths	Bushfire H Epidemic	Earthquake Rail Crash Storm	MTE		
Disease outbreak					Storm

Category	Risk level				
	Extreme	High	Medium	Low	Very Low
Emergency services		Bushfire H Epidemic Rail Crash (2)			MTE
Health services	H Epidemic	Bushfire Rail Crash Storm	Earthquake		MTE
Impacts to general health	H Epidemic				
Injuries or illnesses	H Epidemic	Bushfire Earthquake Rail Crash Storm	MTE		MTE
Mental health		Bushfire			

All statements assessed as extreme risk are in the people impact area. The consequence table for the Goldfields-Esperance district states that 'at least one death' is a major consequence; therefore, if a death is likely to occur in a hazard scenario, a major consequence was selected. As a result, the majority of the risks for people fall into the extreme and high risk category. Deaths in the human epidemic, bushfire, rail crash and earthquake scenarios were expected to produce a catastrophic consequence exceeding seven deaths.

The potential for health services to be stretched by the human epidemic, bushfire, storm and rail crash scenarios is high. This is due to the limited capacity of hospitals in the district. If there were a high number of injuries/illnesses external assistance would be required from other districts. The potential for emergency services to be stretched, resulting in further death/injury is also a high risk for bushfire, human epidemic and particularly rail crash. The demand placed on RFDS for medical transport to Perth plays a significant role here, as does the remote locations of the scenario events.

Risks to public administration

Seventy-one risk statements were assessed across the six hazards that addressed public administration impacts (Table 9). These pertain to the continuity of an agency's core services. For example, at medium risk or higher, either a significant reduction in services would occur or external assistance from outside the EM district would be required to maintain service levels (see Appendix C for criteria).

Table 9: Impacts to public administration by hazard and risk level. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Category	Risk level				
	Extreme	High	Medium	Low	Very Low
Administration of Aboriginal communities			Storm		
Availability of essential supplies					Earthquake
Demand on Port Authority services		MTE			
Demand on public facilities				Earthquake	Rail Crash
Disruption of educational services			H Epidemic		
Disruption to aviation				Bushfire Storm	
Disruption to supply of natural gas				Earthquake	Storm
Emergency services		H Epidemic (2) Rail Crash (2)	Bushfire (2) Rail Crash Storm (2)	Earthquake (3) Storm	
Government services		Bushfire H Epidemic (3) MTE	Bushfire Earthquake H Epidemic	Earthquake (3)	Rail Crash
Health services		H Epidemic	Earthquake H Epidemic (2) Rail Crash Storm	Bushfire H Epidemic	
Home-care services			Storm	Bushfire	
Impacts to communication service delivery				Bushfire Storm	Earthquake
Impacts to power supply service delivery			Bushfire Storm		Earthquake

Category	Risk level				
	Extreme	High	Medium	Low	Very Low
Impacts to sewerage service delivery				Earthquake Storm	
Impacts to water supply service delivery		Storm	Earthquake	Bushfire	
Public information				H Epidemic	
Response and recovery activities			Bushfire (2) MTE Rail Crash Storm (2)	Bushfire (2) Earthquake (2) MTE	MTE (2) Rail Crash

The greatest risk to public administration in the Goldfields-Esperance EM district stems from the human epidemic scenario. Primarily, this is due to reduced workforce attendance by 20% for a prolonged period, impacting a number of state agencies and emergency responders. In addition, the extra demand placed on medical transport services, such as ambulance and RFDS, would see a severe reduction in their delivery of core services.

The rail crash scenario would significantly reduce the ability of state agencies to deliver core services, particularly the WA Police, DFES and St John Ambulance (SJA). This is due to the remote location of the crash and the high number of passengers that would require treatment and/or assistance. The bushfire scenario would stretch CPFS services, requiring assistance external to the district as large evacuations would be facilitated for major town sites such as (the West side of) Esperance and Gibson.

The MTE scenario would see the Port of Esperance unable to deliver core services. In this event, due to the blocked channel, the port would be closed for a number of months and unable to facilitate trade for this length of time. In addition, the Department of Transport, Marine Safety would experience a significant reduction in the delivery of their core services as all their resources would be focused on the event – including assistance from other ports such as Fremantle and Albany. This may be exacerbated by the fact that an oil spill of that size would likely have national and perhaps international interest.

All of the above were assessed as high risks for the Goldfields-Esperance district.

Most (35%) of public administration statements were assessed as medium risk for the Goldfields-Esperance EM district. These risks centre on response and recovery activities, emergency services (including health services) and utilities. In particular, the earthquake scenario would disrupt the lives of many staff in these roles, and their families, which would greatly affect their ability to maintain normal work practices and deliver core services.

The impact to emergency services, including DFES, WA Police and SJA, for the bushfire, rail crash and storm scenarios would result in a significant reduction in their core service provision, with assistance required from other districts. The inability to access remote areas (e.g. due to flash flooding, damaged road surfaces, distance and lack of earth moving machinery) would further exacerbate this impact in the instance of a storm or rail crash event.

The impact on health services, including WACHS, hospitals, clinics, nursing posts and pathological and diagnostic imaging services was considered a medium risk in the case of the human epidemic, rail crash, and storm and earthquake scenarios. It was noted that health services currently operate at maximum capacity across the district and an increased demand would stretch their resources.

Impacts to essential service provision present as low to very low risk for MTE and rail crash; however they pose a medium risk in the case of the natural hazard scenarios. Damage to power infrastructure was expected in the fire and storm scenarios, yet supply disruption would likely be minimal in most areas due to contingency plans including back-up generators. External assistance would be required to mobilise generators and restore damaged infrastructure. Impacts to potable water supply were considered a high risk for the storm scenario and medium for the earthquake scenario as a result of contamination or damage to infrastructure. However, it was assessed as low risk for bushfire. Although there may be issues with access to the fire ground following the event, generators would be placed once access is granted to avoid disruption to services. If there were to be a disruption, it would likely only impact the supply in the Esperance area of the district as it has its own power generation facilities and is near the fires.

Risks to social setting

Sixty-four risk statements assessed the impact to the EM district social setting across the six hazards (Table 10). The social setting focuses on community wellbeing, community services and culturally important activities and objects (see Appendix C for criteria).

Overall, only three statements were assessed as high risk, with the majority of impacts not expected to break the social fabric of the community.

Table 10: Impacts to social setting by hazard and risk level. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Category	Risk level				
	Extreme	High	Medium	Low	Very Low
Availability of essential supplies			Storm	Bushfire Earthquake H Epidemic (2) Storm	Earthquake Rail Crash
Breakdown of social networks			H Epidemic (2)	Bushfire Earthquake	Storm
Community services and events				H Epidemic (2)	Earthquake
Culturally significant facilities and customs		Earthquake		H Epidemic MTE (2)	MTE Storm
Death/injury of animals				Bushfire Storm	Earthquake
Displacement or isolation of Aboriginal communities				Storm	
Displacement or isolation of communities			Bushfire Earthquake Storm (2)	H Epidemic	Earthquake
Education facilities			Earthquake H Epidemic	Bushfire Storm	
Facilities for vulnerable people		H Epidemic	Storm	Bushfire Earthquake	
Flora and fauna					MTE
Impacts to people's health				Bushfire Earthquake (2) H Epidemic (2) MTE Storm	
Impacts to tourism				Bushfire	MTE Rail Crash
Loss of income			Earthquake H Epidemic	Bushfire	Rail Crash Storm

Category	Risk level				
	Extreme	High	Medium	Low	Very Low
Psychological and emotional stress				Rail Crash	MTE
Residential building damage			Bushfire Earthquake	Storm	
Social services providers		H Epidemic		Bushfire	Earthquake

The three high risks stemmed from the human epidemic and earthquake scenarios. The earthquake was considered to have catastrophic consequences, implying widespread and permanent loss of objects of identified cultural significance. It was suggested that there would be a lack of funding to rebuild such sites, particularly those that are privately owned.

For the human epidemic scenario, the impact to the day-to-day functionality of support systems for the vulnerable (childcare, aged care, disability support) and community service providers (such as NGOs and Meals on Wheels), may result in a reduced quality of life for those who require these services. The greatest concern was for the elderly, due to their vulnerability, and to health workers, due to fear of contracting the illness through the nature of their work. Comparatively, support systems for vulnerable people were considered medium risk for the storm scenario.

Medium risks centred around short and long term displacement of persons, including remote, in the event of a natural hazard; the breakdown of social and family support networks in the event of a human epidemic; the impact to the day-to-day functionality of educational facilities in an earthquake and a human epidemic; and the impact to residential contents and dwellings in a fire or earthquake.

The majority (73%) of social setting statements were assessed as low or very low risk. This suggests that the social structure of the district is resilient and would return to normal function following an event. Low risks primarily addressed the impact on commercial buildings and contents (including availability of essential services); the displacement, death or injury of animals (livestock and domestic), and the impact to community activities.

It was noted that while many of these risks are low, they are highly dependent on how an event is managed as to how the community may respond. For example, in the case of the MTE scenario, the management of the oil spill would affect how the community would be impacted. This would depend on the extent of damage to the aesthetics and reputation of the area and how the media portrays the event.

It is important to note that awareness of an incident would also affect how the community is impacted. Limited media coverege of two previous rail crashes on the line east of

Kalgoorlie had no impact on the district community. It was suggested that had those crashes been larger or had greater media coverage, the community may have responded differently.

Risks to environment

Nineteen risk statements were assessed across four hazards for the environment (Table 11). These statements address impacts to ecosystems, species and landscapes (see Appendix C). No environment statements were assessed for earthquake or human epidemic as risks to the ecosystem or species were not foreseen at the time of the workshop. With the exception of increased sedimentation in water bodies, environmental impacts from an earthquake are likely to be limited to specific sites where chemical or asbestos contamination may occur.

Table 11: Impacts to environment by hazard and risk level. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Category	Risk level				
	Extreme	High	Medium	Low	Very Low
Contamination from toxic substances				Bushfire	Rail Crash
Debris or pollutants entering the riverine or marine environment			MTE		Storm
Flora and fauna			MTE Storm	Bushfire (2) MTE	MTE Rail Crash (2) Storm (3)
Invasive non-native flora and fauna				Storm	
Soil erosion					Storm
Spread of diseases				Bushfire	Storm

Most environmental risks were considered either low (32%) or very low (53%). There were no extreme or high risks. Two of the three medium risks to the environment came from the MTE scenario. An oil spill of 1,500 tonnes could affect the environment for up to one year, potentially longer depending on how the dispersal of oil is managed during the incident. Debris and pollutants would enter the marine environment, impacting marine ecology. There are a number of species, such as the Golden Seal that are only found in Esperance in WA which may be impacted; however, they are not currently an endangered species. There was a level of uncertainty regarding whether a full recovery

would be possible, but existing resources would be sufficient to manage an adequate recovery/repopulation of impacted ecosystems.

The medium risk for the storm scenario was due to the impact to creek lines that feed into the Lake Warden catchment near Esperance, which contains several biodiversity assets of varying conservation significance. A large storm event would affect sedimentation, riparian vegetation, water bird habitats, the water balance and biochemical processes in the lake catchment. P&W suggested they would need to increase water monitoring to assess biochemical effects and assess damage to the catchment to assist recovery.

Low risks to the environment primarily stemmed from the fire scenario and minor impacts to species recognised at the local and district level, such that no permanent loss was likely and recovery would be unassisted. There was also concern for the spread of vegetative diseases, such as dieback from machinery. It was noted that the fires in the scenario would not directly impact any national parks or wetlands; however, if they did the impacts may be greater. The risk to flora and fauna as a result of the rail crash scenario was assessed as very low. Although some impact to ecosystems may be experienced, it would be very localised and would likely recover unassisted. However, a recovery program of this scale would incur significant financial costs.

Risks by theme

Risk statements were assessed across the five impact areas (economy, public administration, people, social setting and environment) following the *NERAG* consequence criteria. However, some risks crosscut multiple impact areas. By combining them into themes, common risks are highlighted for different sectors and actors.

The eleven themes identified for the Goldfields-Esperance EM district are: Aboriginal communities and cultural activities; buildings; community; education; environment; government; health; industry/commercial; tourism; transport; and utilities.

The colour coding in these tables follows the impact areas: pink – economy; orange – public administration; blue – people; purple – social setting; green – environment.

Aboriginal communities and cultural activities

Storm poses the highest risk to Aboriginal communities and cultural activities (Table 12). It was assessed that the storm event could cause disruption to remote Aboriginal communities organisations, impacting on their ability to provide services. The storm scenario was also expected to result in remote towns, including indigenous communities, becoming isolated with limited services and supplies, impacting their ability to function, however this was considered to be a lower risk.

Table 12: Risks related to Aboriginal communities and cultural activities. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Aboriginal communities and cultural activities					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Administration of Aboriginal communities			Storm		
Displacement or isolation of Aboriginal communities				Storm	

Buildings

Storm and earthquake present the highest risks to the built environment, and damage costs from private and commercial buildings, contents and services (Table 13). This is closely followed by bushfire. Underinsurance was considered a potential risk factor following an earthquake event. The effect on community wellbeing as a result of losing private buildings is a lower risk but would likely depend on the recovery effort, funding and timeframes. It was expected that some people may permanently move from the district if homes were damaged by earthquake or bushfire. Impacts to emergency service response buildings were considered a low risk in the event of an earthquake or storm. Similarly, rail crash presented a minimal risk to buildings, in that operational response would require infrastructure resources for an operators centre, but this could be accommodated. The impact to buildings was not evaluated for the human epidemic and MTE scenarios.

Table 13: Risks related to buildings. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Buildings					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Demand on public facilities				Earthquake	Rail Crash
Emergency services				Earthquake Storm	
Impacts to commercial buildings, contents and services		Storm	Bushfire Earthquake		
Impacts to private buildings and contents		Earthquake	Bushfire Storm		
Residential building damage			Bushfire Earthquake	Storm	

Community

The high risks to the community are from the impact to social service providers, facilities for vulnerable people and culturally significant facilities and customs (Table 14). This mainly relates to a potential reduction in the quality of life to those dependent on care (such as the elderly and children), as a result of a human epidemic incident. The permanent loss of culturally important buildings was also a high risk as it was anticipated that there would be a lack of funding available to restore damaged historical buildings, particularly those that are privately owned.

The medium risks relate to the availability of essential supplies, the breakdown of social networks, displacement or isolation of communities, disruption to home-care services and loss of income. All hazards except rail crash represented a medium risk in one or more of these categories. Those in remote communities were expected to be impacted the most, with the potential for them to disperse permanently from the district, particularly as a result of a bushfire, earthquake or storm.

Table 14: Risks to the community. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Community					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Availability of essential supplies			Storm	Bushfire H Epidemic (2) Earthquake Storm	Earthquake Rail Crash
Availability of essential supplies					Earthquake
Breakdown of social networks			H Epidemic (2)	Bushfire Earthquake	Storm
Community services and events				H Epidemic (2)	Earthquake
Culturally significant facilities and customs		Earthquake		H Epidemic MTE (2)	MTE Storm
Death/injury of animals				Bushfire Storm	Earthquake
Displacement or isolation of communities			Bushfire Earthquake Storm (2)	H Epidemic	Earthquake

Community					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Facilities for vulnerable people		H Epidemic	Storm	Bushfire	Earthquake
Home Care Services			Storm	Bushfire	
Loss of income			Earthquake	Bushfire	Rail Crash Storm
Psychological and emotional stress				Rail Crash	MTE
Social service providers		H Epidemic		Bushfire	Earthquake

Education

Only human epidemic and the three natural hazards caused impacts to education facilities (Table 15) as the MTE and rail crash scenarios are unlikely to impact these facilities. The risk is considered greater for human epidemic and earthquake than for bushfire and storm. In the event of a human epidemic, schools would be advised to either close or isolate students with symptoms. As the epidemic would be expected to progress over 7 to 10 months, there would be ongoing reductions to educational services and some assistance external to the district may be required to help return them to normal function (e.g. to fill in positions of ill teachers).

Bushfire and storm presented a low risk to education. The bushfire scenario takes place in school holidays; if it were term time it may have a greater impact. It was suggested that for these hazards, the students would likely be mobile and could be 'shuffled' around the district to accommodate where necessary.

Table 15: Risks related to education. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Education					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Disruption of educational services			H Epidemic		
Education facilities			Earthquake H Epidemic	Bushfire Storm	

Environment

Environment was not assessed for human epidemic and earthquake as there were no foreseen impacts at the time of the workshop. The environmental risks for the remaining four hazards were assessed as medium to very low (Table 16).

The greatest risks to the environment are from debris or pollutants entering the riverine/ marine environment and impacts to flora and fauna predominantly from the MTE scenario. Within the scenario, 1500 tonnes of oil is released into the ocean. Although the spread is likely to be mitigated, it is expected there would still be oiled wildlife and coastlines. It was suggested that a large number of sea birds would be impacted, along with the Golden Seal, which is only found in the Esperance area within WA. There are no endangered species within the area of impact. The impact to the community wellbeing due to the potential wildlife and coastline impact was considered very low.

Table 16: Risks to the environment. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Environment					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Contamination from toxic substance				Bushfire	Rail Crash
Debris or pollutants entering the riverine or marine environment			MTE		Storm
Flora and fauna			MTE Storm	Bushfire (2) MTE	MTE Rail Crash (2) Storm (3)
Flora and fauna					MTE
Invasive non-native flora and fauna				Storm	
Soil erosion					Storm
Spread of diseases				Bushfire	Storm

Government

There is a wide spread of risk levels for all government categories from high to very low risk (Table 17). The highest risks for the government sector are to emergency services, government services, economic costs associated with recovery activities and the demand placed on port authorities (from the MTE scenario).

As a result of the MTE scenario, the Port of Esperance would be shut down for a period of time and would not be able to deliver the majority of its core services until the channel was reopened. It would also place a large demand on the Department of Transport to provide assistance for the oil spill response.

The rail crash scenario would likely result in a surge in demand for emergency services to attend the scene, which being in a remote area, may require more resources than other incidents. In this case, the limited regional DFES and SJA resources are likely to be exhausted, particularly for the first 12 hours of response. A large demand for emergency services, particularly those related to health (e.g. SJA, RFDS), would also be required for the human epidemic scenario. In addition, it was suggested that in the event of the human epidemic, workforce attendance across the district would be likely to decrease by 20% impacting most government services. The bushfire scenario would place the most demand on CPFS and DFES, who could be involved in the evacuation of large numbers of people.

The above mentioned risks and other high and medium risks were assessed to require assistance external to the district.

Table 17: Risks related to government activities. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Government					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Demand on Port Authority services		MTE			
Emergency services		Rail Crash	Bushfire (2) Rail Crash Storm (2)	Earthquake	
Government services		Bushfire H Epidemic (3) MTE	Bushfire Earthquake H Epidemic	Earthquake (3)	Rail Crash
Public information				H Epidemic	

Government					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Response and recovery activities			Bushfire (2) MTE Rail Crash Storm (2)	Bushfire (2) Earthquake (2) MTE	MTE (2) Rail Crash
Response and recovery activities		Storm	Bushfire Rail Crash		Earthquake MTE

Health

The highest health related risks to the Goldfields-Esperance EM district are from deaths or injuries/illnesses (Table 18). This is either as a direct result of the hazard event itself or as a result of the demand the event places on emergency services such that they become overwhelmed, leading to a further death/injury. It is expected that the human epidemic scenario would place the most demand on health services, with four of the five extreme health risks resulting from this scenario. Remote services would be overwhelmed by the demand, and unable to cope. As a consequence, those with other medical conditions would be impacted to the point that catastrophic consequences (greater than seven deaths) would be expected.

In the event of the rail crash scenario, assistance would be required from other districts (and potentially interstate) due to the remote location and number of people involved. Deaths or injuries from the storm event may be a result of disease burden, such as mosquito borne viruses. Bushfire was considered to have the greatest impact on mental health as a result of the forecast number of deaths and number of responders required to assist in the fire event. The MTE scenario would have minimal impact on health services.

Table 18: Risks related to health. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Health					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Deaths	Bushfire H Epidemic	Earthquake Rail Crash Storm	MTE		
Disease outbreak					Storm
Emergency services		Bushfire H Epidemic Rail Crash (2)			MTE

Health					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Emergency services		H Epidemic (2) Rail Crash			
Health services	H Epidemic	Bushfire Rail Crash Storm	Earthquake		MTE
Health services			H Epidemic		
Health services		H Epidemic	Earthquake H Epidemic (2) Rail Crash Storm	Bushfire H Epidemic	
Impact to general health	H Epidemic				
Impacts to people's health				Bushfire Earthquake (2) H Epidemic (2) MTE Storm	
Injuries and illnesses	H Epidemic	Bushfire Earthquake Rail Crash Storm	MTE		MTE
Loss of income			H Epidemic		
Mental Health		Bushfire			
Workforce productivity loss			H Epidemic		

Industry/commercial

The greatest industry impacts would be to the mining industry as a result of the MTE and storm scenarios (Table 19). As a result of the MTE incident, the Port of Esperance would be unable to import or export goods for an extended period of time, resulting in large costs associated with arranging alternate transport modes. The storm impacts to roads and mine sites (through subsequent flooding) may result in significant and costly delays within the sector. The rail crash would also disrupt goods transportation; though the risk was rated lower (medium risk). In addition, it is possible that the MTE scenario may impact the abalone industry, both directly (through oil contamination) and indirectly (through reputational damage). Potentially, reputational damage may occur through proximity, even if the abalone is not impacted.

Decreased workforces, as a result of the human epidemic scenario, are expected to cause productivity losses for commercial and mining activities. Agricultural activities could be less impacted by the loss of port facilities, meaning other grain transport options would need to be sought and bushfires could also impact crops and fencing infrastructure.

Table 19: Risks related to industrial/commercial activities. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Industry/commercial					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Impacts to agricultural and pastoral activities			Bushfire (2) MTE	Bushfire H Epidemic Storm	
Impacts to commercial activities			H Epidemic MTE	H Epidemic (2) MTE	MTE Rail Crash
Impacts to marine infrastructure and industry			MTE (2)	H Epidemic	
Impacts to mining infrastructure and industry		MTE Storm	Earthquake H Epidemic Rail Crash		

Tourism

Impacts to tourism were assessed as medium to very low risks. The financial impacts of the human epidemic and MTE scenarios are the most notable risks. The nature of an epidemic is such that people would not want to travel unnecessarily to areas where they may become ill. The oil spill from the MTE scenario could affect the coastal areas, or be perceived to affect them. These areas are the main tourist draw cards in the EM district.

Table 20: Risks to tourism. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Tourism					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Impacts to tourism			H Epidemic MTE	Bushfire Earthquake (2) MTE Storm	MTE Rail Crash
Impacts to tourism				Bushfire	MTE Rail Crash

Transport

Storm poses the highest risk to transportation networks, resulting in financial losses incurred through delays and disruptions or the physical damage of infrastructure (Table 21). The rail crash scenario would disrupt the main east-west railway line, however it was suggested this would be for a very short period of time as the track could be repaired or a diversion created within a week or two. Similarly, the bushfire scenario would result in short-term road closures with the reopening of roads following post-fire inspections.

Although no specific risk statements assessed the impact to transport from the MTE scenario, it was anticipated that the redirection of goods due to closure of the Port of Esperance would likely increase the burden of goods transportation through alternative modes. The increase in road (and potentially rail) traffic would likely have an associated economic impact.

Table 21: Risks related to transport. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Transport					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Disruption to aviation				Bushfire Storm	
Disruption to transport routes		Storm (2)	Bushfire	Earthquake	Rail Crash (2)
Emergency services				Earthquake	
Impacts to aviation				Bushfire	
Impacts to bridges or their approaches			Storm	Earthquake	
Impacts to rail infrastructure					Rail Crash
Impacts to transport infrastructure		Storm		Bushfire Earthquake	

Utilities

All risks to utilities are a result of the natural hazard events, with the greatest risk posed by the storm scenario, followed by the bushfire and earthquake scenarios (Table 22). The economic impacts to the critical infrastructure from each hazard are either an equal or greater risk than the impact to service delivery, except in the case of water. The greatest

utilities economic impacts are expected to result from storm impacts to communication and water infrastructure and bushfire impacts to power infrastructure. The cost of the impact to water supply infrastructure (pink row – Table 22) was assessed to result in a moderate economic consequence (>$5.44 million) for both the storm and earthquake scenarios. However, the storm impact is a medium risk and the earthquake a low risk, due to earthquake having a lower likelihood of occurrence overall. Similarly, the impacts to water supply delivery (orange row – Table 22) were assessed as a major consequence (a severe reduction in the delivery of core services) for both the storm and earthquake scenarios, but the risk level is high for storm and medium for earthquake.

Table 22: Risks related to utilities. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Utilities					
Category	**Extreme**	**High**	**Medium**	**Low**	**Very Low**
Impact to natural gas distribution					Earthquake Storm
Disruption to supply of natural gas				Earthquake	Storm
Impacts to communication infrastructure			Storm	Bushfire	Earthquake
Impacts to communication service delivery				Bushfire Storm	Earthquake
Impacts to power supply infrastructure			Bushfire Storm		Earthquake
Impacts to power supply service delivery			Bushfire Storm		Earthquake
Impacts to sewerage systems				Bushfire Earthquake Storm	
Impacts to sewerage service delivery				Earthquake Storm	
Impacts to water supply infrastructure			Storm	Bushfire Earthquake	
Impacts to water supply delivery		Storm	Earthquake	Bushfire	

6 Risk evaluation

The next step in the risk management process is to evaluate the risks, determining whether the identified risks are acceptable or requires treatment (Figure 13).

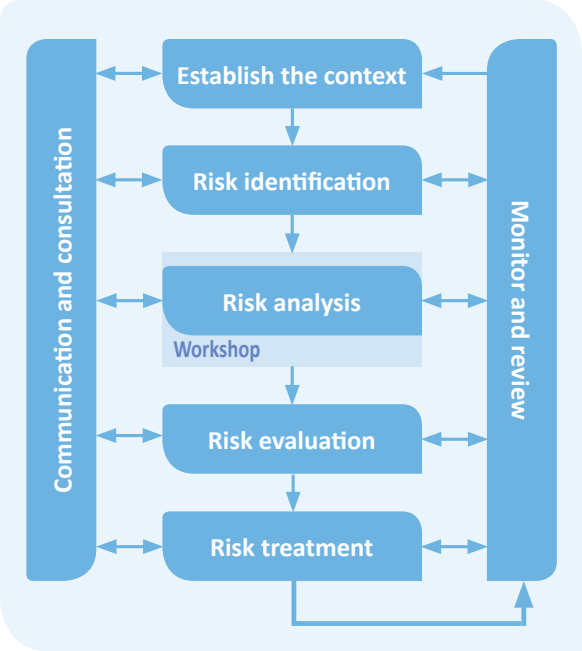


Figure 13: Emergency risk management process[4].

The *NERAG* uses a prioritisation system to rank risks for treatment decisions and/or for further investigation. *NERAG* priority is based on the risk level and confidence associated with each assessed risk. Priority ranges from 1 (highest priority) to 5 (lowest priority). The following prioritisation of risks is a helpful tool to focus attention on the more significant risks. However, the determination of whether a risk is acceptable or should be treated has governance, financial and societal implications and is best administered by the appropriate level(s) of government.

Figure 14 shows that most (40%) of the Goldfields-Esperance risk statements are classified as Priority 5, meaning that these are broadly acceptable risks which require no further action other than monitoring and review during the next risk assessment phase. Conversely, twenty-five risk statements (10%) have been classified as Priority 2 indicating that these risks have a high priority for further investigation and/or treatment. These statements span the bushfire, earthquake, MTE and rail crash scenarios and are present in all impact areas with the exception of the environment. Over half of the Priority 2 statements stem from the human epidemic scenario, and most have high or highest confidence. Therefore this priority level is a result of major and catastrophic consequences, high to extreme risk levels and/or a higher likelihood of occurrence in any given year than the other hazards.

[4] Adapted from AS/NZS ISO 31000 - Reproduced under SAI Global copyright Licence 1411-c083

One risk statement for the Goldfields-Esperance district was assessed to be a Priority level 1 and concerns deaths as a result of the bushfire scenario. This is due to the combination of a catastrophic consequence (at least seven deaths), an extreme risk level and a low level of confidence. Due to the low confidence level, this statement may benefit from further investigation.

Table 23 contains the Priority 1 and 2 risk statements in full and those risk statements with catastrophic consequences. Catastrophic consequence statements are included because if these impacts do occur they could potentially stretch or outstrip the district's resources and therefore should be considered during the treatment phases.

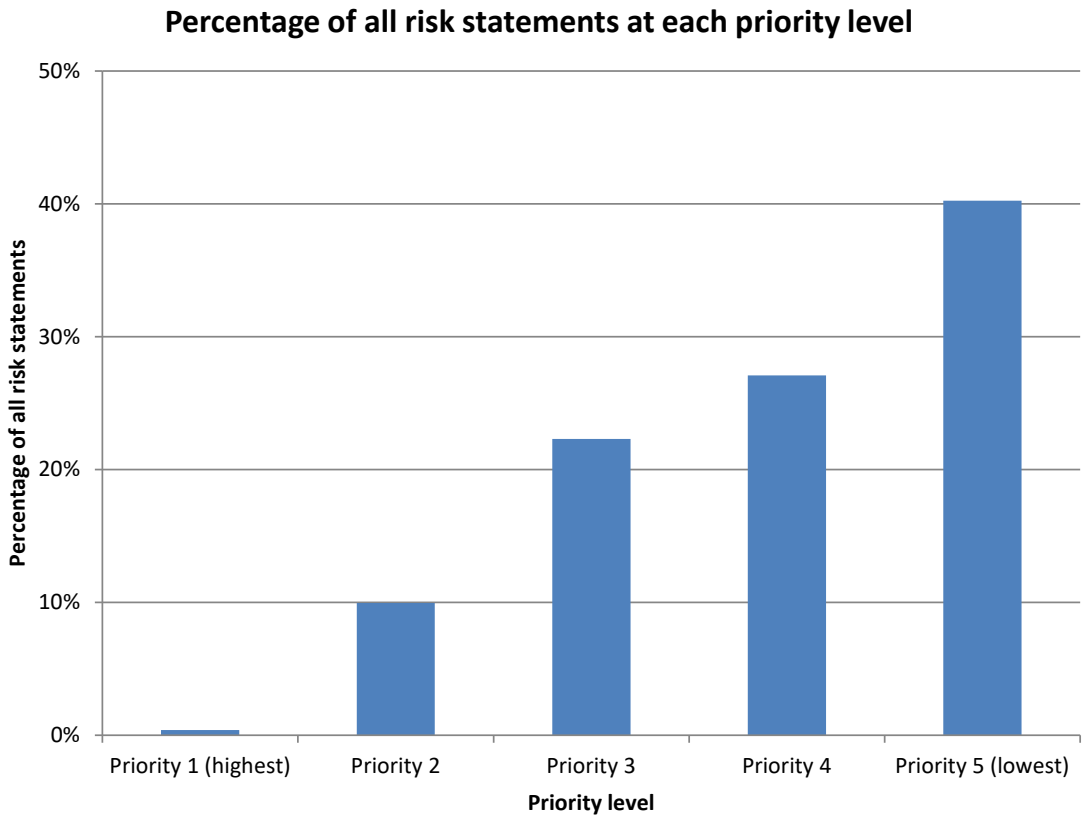


Figure 14: Percentage of all risk statements at each priority level. Priority 1 – highest; Priority 2 – high; Priority 3 – medium; Priority 4 – low; Priority 5 – lowest.

Table 23: Risk statements for the Goldfields-Esperance EM district with Priority level 1, 2 or catastrophic consequences. Note: MTE = marine transport emergency.

Hazard	Risk statement	Impact area	Consequence	Risk level	Confidence level	Priority level
Bushfire	will impact the health of people and cause death(s).	People	Catastrophic	Extreme	Low	1
Human Epidemic	will impact the health of people and cause death(s)	People	Catastrophic	Extreme	Highest	2
Human Epidemic	will impact the health of people and cause injury and/or serious illness.	People	Catastrophic	Extreme	Highest	2
Human Epidemic	will impact remote health services (e.g. remote nursing posts, small country hospitals, clinics) resulting in deaths, injuries or illness directly attributable to the hazard event.	People	Catastrophic	Extreme	High	2
Human Epidemic	will impact the health of people with other medical conditions due to the demand placed on health services by the epidemic.	People	Catastrophic	Extreme	High	2
Rail Crash	will impact the health of people and cause death(s).	People	Catastrophic	High	High	2
Rail Crash	will impact the health of people and cause injury and/or serious illness.	People	Catastrophic	High	High	2
Rail Crash	will result in a delay of emergency services due to the remote location (and weather conditions), resulting in further deaths.	People	Catastrophic	High	High	2
MTE	will cause an increased demand (surge) on Port Authority services, impacting their ability to maintain core services.	Public Administration	Catastrophic	High	High	2
MTE	will disrupt mining exports from the region (e.g. iron ore), resulting in financial losses.	Economy	Major	High	Low	2

Hazard	Risk statement	Impact area	Consequence	Risk level	Confidence level	Priority level
Rail Crash	will cause an increased demand on emergency services and health services (including ambulance and medical transport services, hospitals, remote nursing posts and clinics), resulting in further deaths directly attributable to the hazard event.	People	Major	High	Moderate	2
Human Epidemic	will impact emergency services (e.g. medical transport services such as RFDS) across the district, resulting in deaths, injuries or illness directly attributable to the hazard event.	People	Major	High	High	2
Bushfire	will impact the health of people and cause injury and/or serious illness.	People	Major	High	Moderate	2
Bushfire	will impact the mental health of people, resulting in medical treatment being required.	People	Major	High	Moderate	2
Bushfire	will cause emergency services (including ambulance and medical transport services such as RFDS) to be overwhelmed, resulting in further deaths directly attributable to the hazard event.	People	Major	High	High	2
Human Epidemic	will impact workforce attendance in the local government services sector, impacting their ability to deliver core services.	Public Administration	Major	High	High	2
Human Epidemic	will impact ambulance services, impacting their ability to maintain core services.	Public Administration	Major	High	High	2
Human Epidemic	will impact private GP services, impacting their ability to deliver core services.	Public Administration	Major	High	High	2
Human Epidemic	will impact RFDS services, impacting their ability to deliver core services.	Public Administration	Major	High	High	2
Human Epidemic	will impact workforce attendance within WA Police, impacting their ability to deliver core services & increasing security issues.	Public Administration	Major	High	High	2

Hazard	Risk statement	Impact area	Consequence	Risk level	Confidence level	Priority level
Human Epidemic	will impact other agencies, not mentioned above (e.g. DFES, DAFWA), impacting their ability to deliver core services.	Public Administration	Major	High	Moderate	2
Bushfire	will cause an increased demand on Child Protection and Family Support services, impacting their ability to maintain core services.	Public Administration	Major	High	High	2
Human Epidemic	will impact the day-to-day functionality of support systems for the vulnerable (e.g. childcare, aged care, disability support).	Social Setting	Major	High	High	2
Human Epidemic	will impact community service providers within the district (such as NGOs, Meals on Wheels, Silver Chain).	Social Setting	Major	High	Moderate	2
Bushfire	will cause health services (e.g. ICU units, hospitals, remote nursing posts, small country hospitals, clinics) to be overwhelmed, resulting in further deaths directly attributable to the hazard event.	People	Major	High	Moderate	2
Bushfire	will impact power infrastructure, impacting the ability to maintain core services.	Public Administration	Moderate	Medium	Low	2
Bushfire	will impact mobile and landline communication infrastructure, impacting on the ability to maintain core services.	Public Administration	Moderate	Medium	Low	2
Earthquake	will impact private buildings and contents, resulting in financial losses.	Economy	Catastrophic	High	Highest	3
Earthquake	will impact the health of people and cause death(s).	People	Catastrophic	High	Highest	3
Earthquake	will impact the health of people and cause injury and/or serious illness.	People	Catastrophic	High	Highest	3
Earthquake	will impact heritage buildings, churches and places of worship, resulting in a loss of cultural significance.	Social Setting	Catastrophic	High	Highest	3

7 Future actions

A preliminary risk treatment discussion will be held with relevant agencies to review the risk assessment results and begin the conversation concerning risk tolerability and potential treatment strategies.

Appendix A: Individual hazard risk assessment summaries

This appendix contains a summary of the assessed risks for each of the hazards separated into the five impact areas.

Bushfire

This section summarises the risk to the Goldfields-Esperance EM district from the bushfire scenario. The percentage of risk statements at each risk level for the scenario is shown in Figure 15.

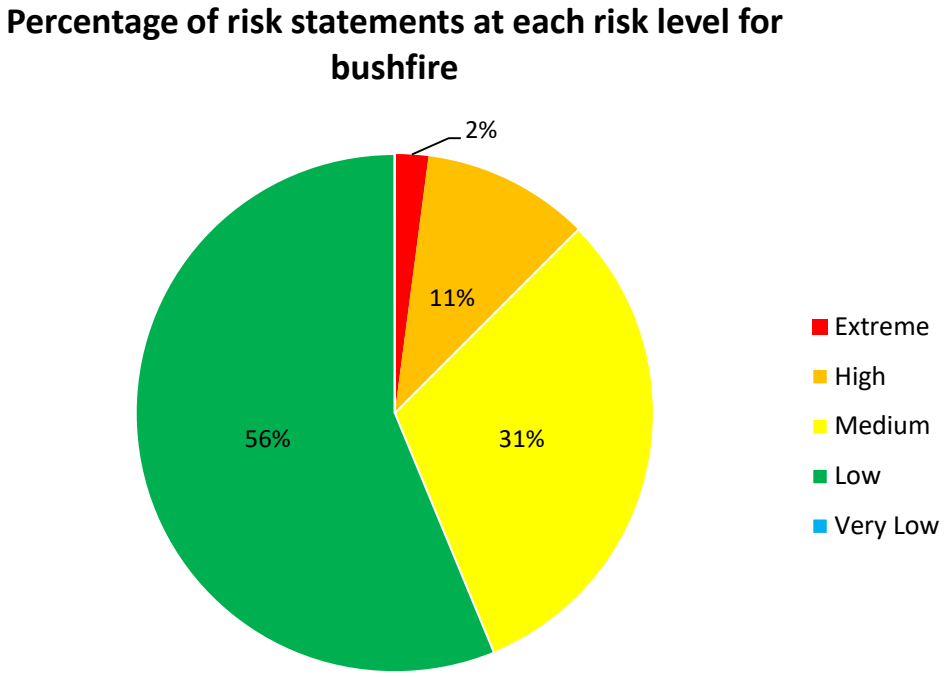
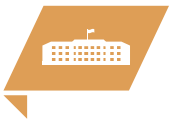


Figure 15: Percentage of risk statements at each risk level for bushfire.

Bushfire risk assessment		
ECONOMY		**Extreme and High risks** Nil. **Medium risks** Financial losses resulting from damage to residential and commercial buildings. In addition to homes being destroyed, a number of community facilities would also be impacted. Recovery activities costing the district, with the largest cost likely to come from clean-up and disposal of asbestos from burnt buildings. Financial losses in the agricultural sector, costs incurred through damage to power infrastructure and disruption of major road and rail routes. **Low risks** Financial loss to industries that support tourism and impacts to telecommunications. **Very Low risks** Nil.
PEOPLE		**Extreme risks** In this scenario there is a potential for more than seven deaths. This equates to a catastrophic consequence and an extreme risk. This assessment was justified by the approximately 80 houses likely to be impacted by the three fires, depending on the rate of spread and the amount of warning time. **High risks** Risk statements related to injuries and illness (including mental health issues) and emergency and health services becoming overwhelmed resulting in a further death were assessed as high risk. **Medium, Low and Very Low risks** Nil.
PUBLIC ADMINISTRATION		**Extreme risks** Nil. **High risks** Due to the evacuations required, there would be an increased demand on CPFS, resulting in a reduction in their core service provision and requiring assistance from outside of the district. **Medium risks** The increased demand on DFES and P&W would require additional resources from outside of the district. Police and ambulance have the same risk, and would be significantly stretched, but have resources within the district to help manage and respond to the fires. The Department of Education would be able to maintain their core function but would likely bring in assistance from other districts also. Impact to both power and telecommunications services as infrastructure is likely to be damaged. **Low risks** Impacts to local governments, health services, Main Roads WA and the aviation sector **Very Low risks** Nil.

Bushfire risk assessment		
SOCIAL SETTING		**Extreme and High risks** Nil. **Medium risks** Impacts to the district community wellbeing from the loss of people's homes and the evacuation of people away from the area. Approximately 90-100 people would likely be displaced. Some may move out of the area temporarily until houses are rebuilt; however, some may move out of the EM district permanently. **Low risks** Impacts to the community's wellbeing as a result of the death of animals, the breakdown of social networks, losses of employment, impact of the day-to-day functioning of educational facilities and disruption of social service providers. Most of these statements were assessed to have insignificant or minor consequences such that the community social fabric is damaged but not broken and some external resources are required to return the community to normal function. This was based on the experiences from the 2015 Esperance bushfires. **Very Low risks** Nil.
ENVIRONMENT		**Extreme, High, Medium and Low risks** Nil. **Very Low risks** All four environment risk statements were assessed as low risk. These cover the impact to flora and fauna, contamination from toxic substances and the spread of vegetative diseases. The fires would impact on species recognised at the local and district level but would not cause significant or long-term damage to indigenous species, national parks or wetlands. There is a potential for the spread of vegetative diseases from machines or vehicles especially if they have travelled through areas of dieback and then into areas without dieback. However, this was considered a low risk.

Earthquake

This section summarises the risk to the Goldfields-Esperance EM district from the earthquake scenario for the five impact areas. The percentage of risk statements at each risk level for the scenario is shown in Figure 16.

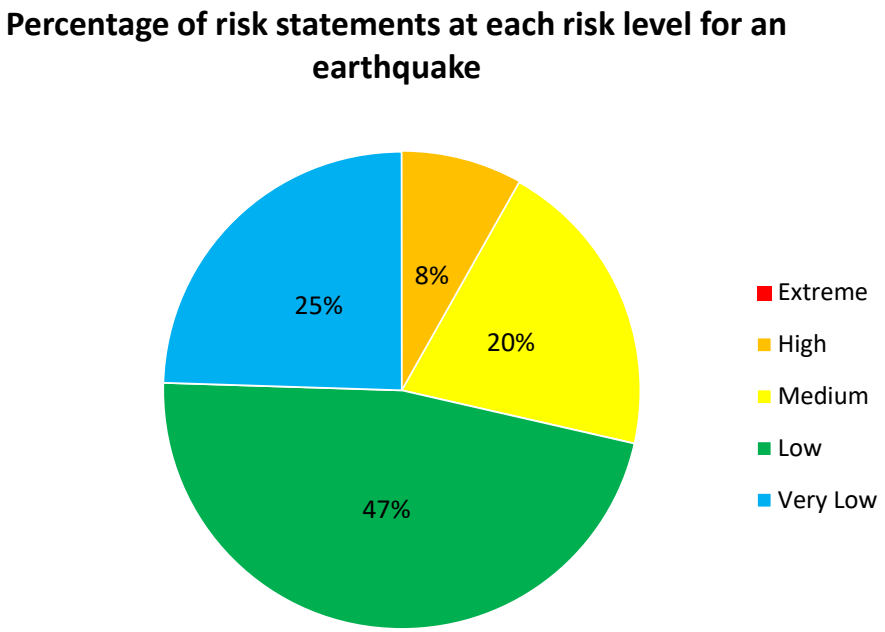
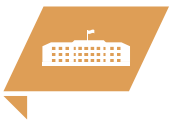


Figure 16: Percentage of risk statements at each risk level for earthquake.

Earthquake risk assessment	
ECONOMY	**Extreme risks** Nil. **High risks** Damage to private buildings and contents incurring costs presented the only high risk from earthquake for the economy category. **Medium risks** Impacts to mining (underground and open-pit) infrastructure, commercial buildings and contents resulting in financial costs, presented a medium risk to the district. **Low risks** Impacts to sewerage systems, water supply infrastructure, transportation infrastructure, including bridges and approaches to bridges, and resultant disruption of transport routes. **Very Low risks** Recovery activities, impacts to natural gas distribution and communication and power supply infrastructure. It was anticipated that the earthquake would activate the Western Australia Natural Disaster Relief and Recovery Arrangements, and costs would mostly be borne by the state rather than the district. Cashflow could be an issue between repair and reimbursement.

Earthquake risk assessment		
PEOPLE		**Extreme risks** Nil. **High risks** Risk statements discussing the potential for deaths and serious injury/ illness were ranked as a high risk. **Medium risks** A medium risk to the people category was the increased demand on emergency services and health services, such that it results in further deaths directly attributable to the hazard event. **Low and Very Low risks** Nil.
PUBLIC ADMINISTRATION		**Extreme and High risks** Nil. **Medium risks** Risk statements address the demand on health services and the disruption to the lives of public administration staff and their families, hindering their ability to maintain core services. **Low risks** Response and recovery activities by state agencies and local government. Impact on emergency services, government services, demand on public facilities and disruption to sewerage systems and natural gas supply. **Very Low risks** Impacts to power supply and communications service delivery, and the availability of essential supplies.
SOCIAL SETTING		**Extreme risks** Nil. **High risks** The impact to heritage buildings, churches and places of worship, resulting in the permanent loss of cultural significance. Kalgoorlie is a historical town of significance with a number of older and heritage buildings; the historical character of the town is its main identity. Thus, the permanent losses are likely to impact the EM district community wellbeing. **Medium risks** Medium risks concern the impact to residential dwellings and contents, displacement from homes, impacts to the day-to-day functionality of educational facilities and losses of employment. **Low risks** Impacts on health, particularly the mental health of residents and recovery workers, impacts to the day-to-day functionality of facilities for vulnerable people (aged care, childcare, disability support), the availability of essential supplies and a breakdown in family and social networks. **Very Low risks** Death/injury of animals, impacts to social service providers, community services and events, the availability of essential supplies, and displacement/ isolation of communities.

Earthquake risk assessment

ENVIRONMENT

Environment was not assessed for earthquake.

Human epidemic

This section summarises the risk to the Goldfields-Esperance EM district from the human epidemic scenario for the five impact areas. The percentage of risk statements at each risk level for the scenario is shown in Figure 17.

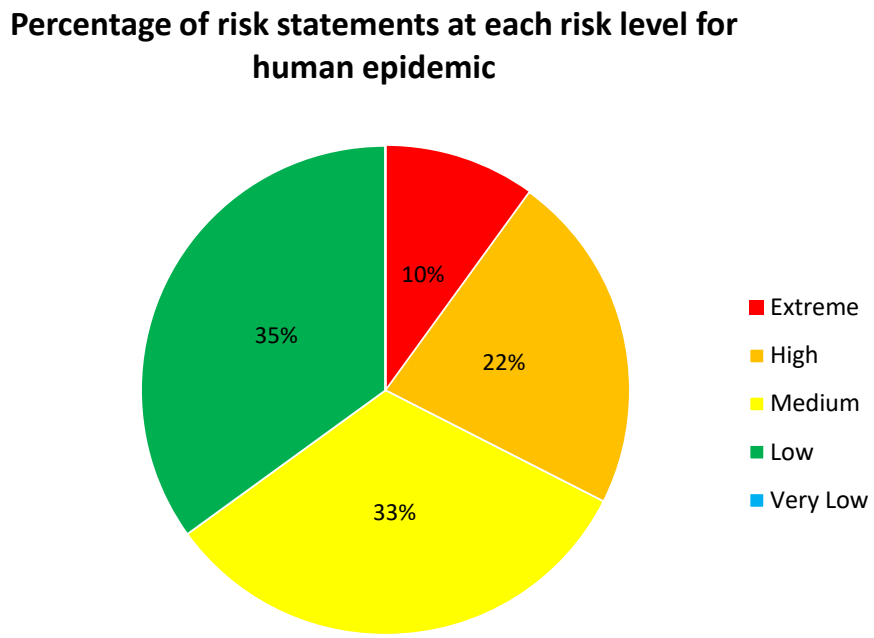


Figure 17: Percentage of risk statements at each risk level for human epidemic.

Human epidemic risk assessment		
ECONOMY		**Extreme and High risks** Nil. **Medium risks** A 20% decrease in workforce attendance across the district for up to 10 months is anticipated. Consequently, financial losses are expected due to loss of productivity across several sectors, and a decrease in visitation numbers impacting tourism, hospitality and entertainment industries. The high demand for medical resources could be costly. Financial impacts to the mining industry; in particular, if workers were to become ill, it would be difficult to replace them as they may not have persons with the specific skills required. **Low risks** Impact to transport providers, agriculture, the Port of Esperance and commercial spending in the retail sector. **Very Low risks** Nil.
PEOPLE		**Extreme risks** Impact to health resulting in at least seven deaths was assessed as an extreme risk. Similarly, catastrophic consequences are expected for illness and/or injuries (>7 critical illnesses/injuries or >62 serious illnesses/injuries). It was suggested that this number would be reached relatively quickly and the overall number of deaths would likely be much greater. Remote health services would be overwhelmed, particularly as some clinics have very limited equipment. Impact to persons with existing medical conditions may result in further deaths due to the demand placed on health services by the epidemic. RFDS would be overwhelmed and may not be able to respond to other patients in distress. **High risks** Emergency services, including fire, ambulance, police, medical transport services and RFDS would be impacted by the human epidemic event, which may result in a further death or further injuries/illnesses. **Medium, Low and Very Low risks** Nil.

Human epidemic risk assessment

PUBLIC ADMINISTRATION

Extreme risks

Nil.

High risks

Impact to local government, ambulance services, GP services, RFDS, WA Police and other state agencies such as DFES and DAFWA were assessed as high risk, primarily due to a decrease in workforce attendance and limited staffing in a number of agencies. All agencies would encounter a severe reduction in the delivery of their core functions and would require external assistance to support them.

Medium risks

Impact to health services resulting in a significant reduction in core service delivery. All core services in public health would focus on the epidemic and the hospital would cancel elective services and seek assistance external to the district. Greater demand on the Department of Education would require external assistance. Impact to the workforce within prisons - the Eastern Goldfields Regional Prison has established procedures to manage incidents related to human epidemic outbreaks. However, if a staff member were to become ill they would likely require assistance external to the district.

Low risks

The performance of agencies issuing public information and the impact to suppliers of health service goods (e.g. linens, meals, masks etc.).

Very Low risks

Nil.

Human epidemic risk assessment		
SOCIAL SETTING		**Extreme risks** Nil. **High** Impacts to the day-to-day functionality of support systems for the vulnerable (aged care, childcare, disability support) and to community service providers (Meals on Wheels, Silver Chain etc.) would result in a reduced quality of life within the district. Aged care may suffer the most and it may be difficult to staff as they would require specific skills. There would be a high risk to all health and community workers and a potential fear of sickness. **Medium risks** Schools would be advised to isolate students with symptoms and parents may need to stay home from work if schools are closed. The breakdown of community social networks and existing family and support networks was expected to result in the social fabric being broken. It was suggested that this would be a consequence of the high number of deaths, lack of services in some areas, closure of schools, and families having to stay home to look after children. Some families may permanently disperse outside of the district as a result. **Low risks** As a consequence of deaths, and the symptoms associated with the epidemic, people may leave town for a short period of time but are likely to remain within the district. Impact to the availability of goods and services. Persons remaining isolated in their homes or quarantined areas for extended periods of time (>14 days). **Very Low risks** Nil.
ENVIRONMENT		*Environment was not assessed for human epidemic.*

Marine transport emergency

This section summarises the risk to the Goldfields-Esperance EM district from the MTE scenario for the five impact areas. The percentage of risk statements at each risk level for the scenario is shown in Figure 18.

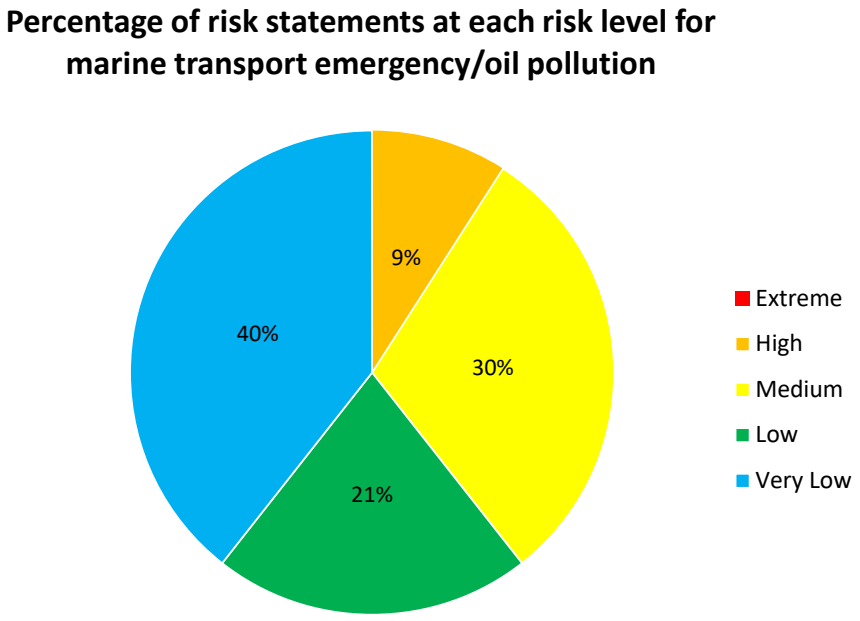
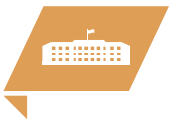


Figure 18: Percentage of risk statements at each risk level for marine transport emergency.

	Marine transport emergency risk assessment
ECONOMY	**Extreme risks** Nil. **High risks** As a high mineral exporter, the disruption of mining exports through the Port of Esperance would result in financial loss. It would take significant logistics to export these products from another port. **Medium risks** Financial losses from the impacts to grain harvest and to exports from the Port of Esperance were assessed as medium risks. Due to the ship wreckage and oil spill, there may be reputational damage to the retail abalone and fisheries industries, resulting in financial losses. **Low risks** Impacts to the aesthetics affecting tourism, disruption of the coastal environment affecting major marine events and response and recovery activities. **Very Low risks** Response and recovery activities were assessed as very low risk because for this scenario the polluter (the ship's owner or insurance company) will pay these costs.

		Marine transport emergency risk assessment
PEOPLE		**Extreme and High risks** Nil. **Medium risks** There is potential for a death by the snapping and recoiling of a mooring line, although this is unlikely. It was assessed, with low likelihood, that one person might be critically injured or more than seven people could sustain serious injuries. To reduce the health impacts, response personnel are trained and are generally not volunteers. **Low risks** Nil. **Very Low risks** Health impacts of response and recovery workers and impacts to health and medical transport services.
PUBLIC ADMINISTRATION		**Extreme risks** Nil. **High risks** The Port of Esperance's core business is to facilitate trade but in this scenario they would not be able to do this while the channel was blocked, potentially for 2-4 months. Based on this, the port authority would be unable to deliver its core service (a catastrophic consequence). This event would require a level 3 response and all of the staff from the Department of Transport, Marine Safety would be in Esperance to respond to the event. **Medium risks** Increased demand in accommodation services for response and recovery workers. **Low risks** Increased demand on response and recovery vessels. **Very Low risks** Response from state agencies such as Police and SJA. Recovery works undertaken by local government would be manageable.
SOCIAL SETTING		**Extreme, High and Medium risks** Nil. **Low risks** Impacts to the brand image of the district and the impact on recreational use of the foreshore. The brand image and foreshore activities may be impacted in the short term but would recover. **Very Low risks** Damage to the aesthetics of the area, impacts to the health of marine wildlife, longer term disruption to tourism and long-term clean-up activities.

Marine transport emergency risk assessment	
ENVIRONMENT	**Extreme and High risks** Nil. **Medium risks** Impacts to the health of marine wildlife and effects on the environment could last for up to one year, including impact to some species that are only found in the Esperance area, such as the Golden Seal and some seabirds. **Low risks** Nil. **Very Low risks** No species in the area are critically endangered and therefore the risk to them was assessed as very low.

Rail crash

This section summarises the risk to the Goldfields-Esperance EM district from the rail crash scenario for the five impact areas. The percentage of risk statements at each risk level for the scenario is shown in Figure 19.

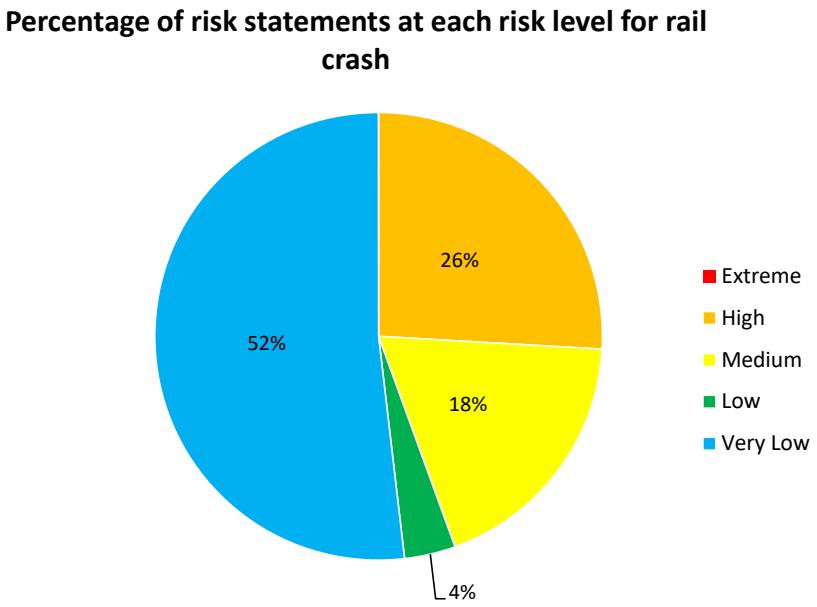


Figure 19: Percentage of risk statements at each risk level for rail crash.

Rail crash risk assessment		
ECONOMY		**Extreme and High risks** Nil. **Medium risks** The resultant costs to the district from response and recovery activities required following the derailment. Repair costs for damaged trans access roads may initially be the responsibility of local government but may then be covered by the ARTC. As there is currently no HMA for the train line itself, it was uncertain as to who may be responsible for recovery costs. **Low risks** Costs and financial losses resulting from a disruption to major freight and passenger routes, impacts to the tourism industry and disruptions to major events **Very Low risks** Disruption of mining activities that use rail freight routes.
PEOPLE		**Extreme risks** Nil. **High risks** At least 7 deaths and more than 62 serious injuries and seven critical injuries would result from the derailment scenario. The remote location of the crash site, combined with the lack of access routes due to the prior rain event, would result in a delay in emergency services. It would take emergency services 5-7 hours to get to the site, potentially resulting in a further death and further injuries. The large resource demand on WA health services, ambulance services and RFDS services, would severely reduce their ability to deliver core services elsewhere. **Medium, Low and Very Low risks** Nil.
PUBLIC ADMINISTRATION		**Extreme risks** Nil. **High risks** Increased demand on emergency services (fire and ambulance) and increased demand on RFDS, who advised that they would require external assistance from across the state and also potentially from South Australia. **Medium risks** Increased demand on WA Police, WA Health services and other state agencies such as CPFS. The impact to WA Police would be greatest in the initial 12-24 hours as they are likely to be the first to respond given their current contingency plan. CPFS would likely be overwhelmed due to the high volume of persons involved, both in the derailment incident and the response. **Low risks** Nil. **Very Low risks** Impact to local government's ability to deliver core services, the increased demand on public facilities and the impact to government offices, depots and facilities would be very low risks.

Rail crash risk assessment		
SOCIAL SETTING		**Extreme, High and Medium risks** Nil. **Low risks** Some impact to the mental health of response workers involved in the incident response. WA Police and DFES advised that they would bring in health and welfare staff to assist. **Very Low risks** It was pointed out that a derailment has happened twice in the last few months in the Goldfields-Esperance district (2016) and there has been no noticeable impact to tourism, the availability of basic commercial products and services, losses of income/employment, indicating that the result of this scenario would be similar.
ENVIRONMENT		**Extreme, High, Medium and Low risks** Nil. **Very Low risks** Disposal of fuel and contaminated soil may be an issue following the incident. It would require a clean-up operation but there would be no expected damage to ecosystems and species in the area. There may be food waste and litter at the crash site that may impact a localised area of the environment but not the ecosystem as a whole. There is likely to be no impact to flora and fauna in the Goldfields-Esperance district.

General comments

The largest concern from the rail crash workshop was that there is currently no HMA for the track east of Kalgoorlie to the WA/SA border. Consequently, the designation of responsibilities and cost bearing is uncertain. There are no formal agreements in place for any agency, intrastate or interstate. As Kalgoorlie would be the largest and closest town site to any crash site along this area of track, agencies from this location would be the most likely to respond.

Storm

This section summarises the risk to the Goldfields-Esperance EM district from the storm scenario for the five impact areas. The percentage of risk statements at each risk level for the scenario is shown in Figure 20.

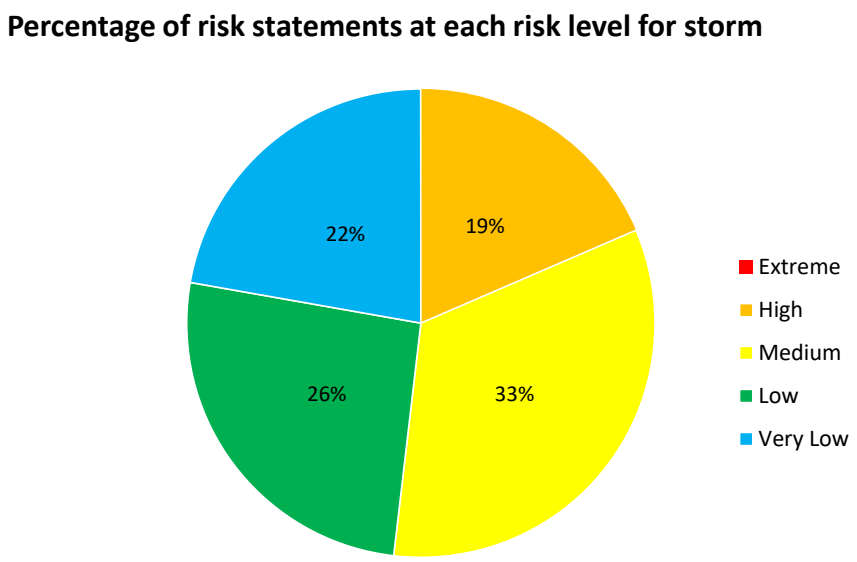
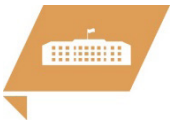


Figure 20: Percentage of risk statements at each risk level for storm.

Storm risk assessment	
ECONOMY	**Extreme risks** Nil. **High risks** Damage to transport infrastructure, resulting in repair costs and consequent disruption to major freight routes (road and rail) was assessed as high risk, as was the impact to commercial building, contents and services including in the retail, transport, mine services, construction and food retail sectors. Recovery costs and the economic impact to mines (underground and open-pit) due to a lack of production and damage to infrastructure were also assessed as high risk. **Medium risks** Financial losses as a result of impacts to private buildings and contents as well as the costs associated with impacts to power and communication infrastructure and bridges were considered medium risks. **Low risks** Impacts to sewerage systems, agricultural and pastoral activities and tourism were considered a low economic risk. **Very Low risks** Impacts to natural gas distribution were assessed as a very low economic risk.

Storm risk assessment		
PEOPLE		**Extreme risks** Nil. **High risks** Risk statements discussing the potential for deaths and serious injury/ illness were ranked as a high risk. The increased demand on emergency services and health services, such that it results in further deaths directly attributable to the hazard event, was also considered a high risk. **Medium and Low risks** Nil. **Very Low risks** An increase in certain communicable diseases in the short and long term.
PUBLIC ADMINISTRATION		**Extreme and High risks** Nil. **Medium risks** Risks centre on the demand on emergency services and health services, business disruptions to health care and home-care based services, the impact on power and communications services, the response required by state agencies at a district level impacting their ability to maintain their core services, the inability to access remote areas and disruption to indigenous community corporations and their staff. **Low and very low risks** The impact on emergency service response buildings and facilities, sewerage systems, aviation infrastructure and natural gas supply.
SOCIAL SETTING		**Extreme and High risks** Nil. **Medium risks** Long (>14 days) and short (<14 days) term displacement away from homes potentially resulting in community dispersal, the impact to the day-to-day functionality of facilities for vulnerable people (aged, disabled, and childcare) and the isolation of remote towns resulting in an inability for the community to function, are medium risks. **Low risks** The effects of impacts to the health of persons resulting in death or injury, domestic animals and livestock, and damage to personal and commercial buildings and contents on the district community's wellbeing are considered low risk. Likewise, the day-to-day functionality of educational facilities and the evacuation of Aboriginal communities to areas with families not aligned to their culture. **Very Low risks** The impact to culturally significant facilities and customs, the breakdown of social networks and loss of income.

Storm risk assessment	
ENVIRONMENT 	**Extreme and High risks** Nil. **Medium risks** One medium risk was identified which concerned the impact to creek lines that feed into lake systems surrounding Esperance, scarring river banks and increasing sediment, resulting in an impact to vegetation and species in riverine environments. **Low risks** Low risks to the environment were a potential surge in non-native flora impacting negatively on native flora and the contamination of marine or estuarine/riverine environments as a result of pollutant runoff or debris. It was noted that there may be an impact to nationally accredited wetlands in the area if the current controls were to cease. As long as the existing controls continue at the same standard or greater, the wetlands would not be impacted. **Very Low risks** Impact to flora and fauna in the region, as well as soil erosion, were considered very low risk.

Appendix B: District profile

The Goldfields-Esperance Emergency Management District is one of the largest and more remote districts in Western Australia. Encompassing over 953,000 km^2, it covers nine local governments and includes over 20 remote Aboriginal communities. The district stretches from the town of Esperance 720 km south east of Perth to the Shire of Wiluna in the north and east to the South Australian border (Figure 21).

Mining is a major industry in the district, with the famous 'super pit' situated outside of the City of Kalgoorlie-Boulder, as well as many other large mining projects across the area. The pastoral and agricultural industries also play a significant role in the economy. The region's beautiful landscapes, pristine natural bushland, rugged coastal areas and famous beaches mean that tourism is another important industry.

The district has a population of approximately 61,333 and a gross area product of approximately $13.6 billion per annum.

Natural and man-made hazard events occur throughout the region. Priority hazards (as identified by the Goldfields-Esperance DEMC) are: bushfire, earthquake, human epidemic, marine transport emergency, rail crash and storm.

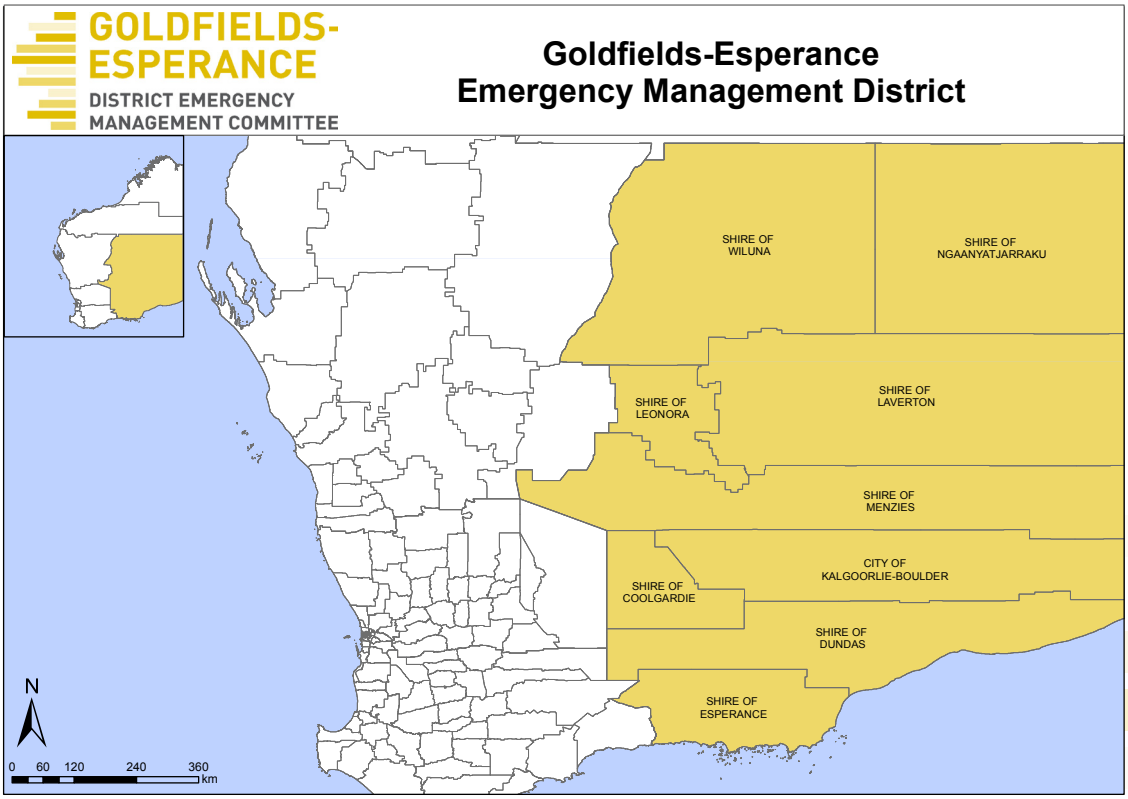


Figure 21: Goldfields-Esperance EM district.

Appendix C: Goldfields-Esperance EM district consequence table

(based on population: 61,333; gross area product: $13.6 billion)

	Insignificant	Minor	Moderate	Major	Catastrophic
People*					
Mortality	Not Applicable	At least 1 death	At least 1 death	At least 1 death	At least 7 deaths
Injuries / Illness	1 serious injury or any minor injuries.	1 person critically injured with long-term or permanent incapacitation or 1 person seriously injured.	1 person critically injured with long-term or permanent incapacitation or 1 person seriously injured.	1 person critically injured with long-term or permanent incapacitation or more than 7 serious injuries	More than 7 critical injuries with long-term or permanent incapacitation or more than 62 serious injuries
Economy					
Loss in economic activity and/or asset value	Decline of economic activity and/or loss of asset value < $544,000	Decline of economic activity and/or loss of asset value > $544,000	Decline of economic activity and/or loss of asset value > $5,440,000	Decline of economic activity and/or loss of asset value > $54,400,000	Decline of economic activity and/or loss of asset value > $544,000,000
Impact on important industry	Inconsequential business sector disruption	Significant industry or business sector is impacted by the emergency event, resulting in short-term (i.e. less than one year) profit reductions	Significant industry or business sector is significantly impacted by the emergency event, resulting in medium-term (i.e. more than one year) profit reductions	Significant structural adjustment required by identified industry to respond and recover from emergency event	Failure of a significant industry or sector
Environment					
Loss of species and/or landscapes	No damage to ecosystems at any level	Minor damage to ecosystems and species recognised at the local or regional level	• Minor damage to ecosystems and species recognised at the state level • Significant loss or impairment of an ecosystem or species recognised at the local or regional level	• Minor damage to ecosystems or species recognised at the national level • Significant loss or impairment of an ecosystem or species recognised at the state level • Severe damage to or loss of an ecosystem or species recognised at the local or regional level	• Permanent destruction of an ecosystem or species recognised at the local, regional, state or national level • Severe damage to or loss of an ecosystem or species recognised at the national or state level • Significant loss or impairment of an ecosystem or species recognised at the national level
Loss of environmental value	Inconsequential damage to environmental values of interest	Minor damage to environmental values of interest	Significant damage to environmental values of interest	Severe damage to environmental values of interest	Permanent destruction of environmental values of interest
Public Administration					
Governance Functions	Governing bodies' delivery of core functions is unaffected or within normal parameters	Governing bodies encounter limited reduction in delivery of core functions	• Governing bodies encounter significant reduction in the delivery of core functions • Governing bodies are required to divert some available resources to deliver core functions or seek external assistance to deliver some of their core functions	• Governing bodies encounter severe reduction in the delivery of core functions • Governing bodies are required to divert a significant amount of available resources to deliver core functions or seek external assistance to deliver the majority of their core functions	Governing bodies are unable to deliver their core functions
Social Setting					
Community wellbeing	• Community social fabric is disrupted • Existing resources sufficient to return the community to normal function • No permanent dispersal	• Community social fabric is damaged • Some external resources required to return the community to normal function • No permanent dispersal	• Community social fabric is broken • Significant external resources required to return the community to normal function • Some permanent dispersal	• Community social fabric is significantly broken • Extraordinary external resources are required to return the community to functioning effectively • Significant permanent dispersal	• Community social fabric is irreparably broken • Community ceases to function effectively, breaks down • Community disperses in its entirety
Community Services	Inconsequential / short term impacts	Isolated / temporary reductions	Ongoing reductions	Reduced quality of life	Community unable to support itself
Culturally important objects	Minor damage to objects of cultural significance	Damage to objects of identified cultural significance	Damage or localised widespread damage to objects of identified cultural significance	Widespread damage or localised permanent loss of objects of identified cultural significance	Widespread and permanent loss of objects of identified cultural significance
Culturally important activities	Minor delay to a culturally important community event	Delay to or reduced scope of a culturally important community event	Delay to a major culturally important community event	Temporary cancellation or significant delay to a major culturally important community event	Permanent cancellation of a major culturally important community activity

*Criteria for people have been rounded up to the nearest whole person.

Appendix D: Glossary and risk matrix

Annual Exceedance Probability (AEP)	The probability of an emergency event of a given size or larger occurring in any given year, expressed as a percentage.
AS/NZS ISO 31000:2009	International standard for risk management which forms the basis of the Emergency Risk Management process.
Consequence	Impact(s) of an event on the five key areas: environment, economy, people, social setting and public administration.
Emergency	The occurrence or imminent occurrence of a hazard which is of such a nature or magnitude that it requires a significant and coordinated response.
Emergency Risk Management (ERM)	A systematic process which contributes to the wellbeing of communities and the environment. The process considers the likely effects of hazardous events and the controls by which they can be minimised.
Hazard	Source of potential harm or a situation with a potential to cause loss.
Impact	To have a noticeable or marked effect on.
Level of risk (risk level)	Magnitude of a risk or a combination of risks, expressed in terms of the combination of consequences and their likelihood.
Likelihood	Chance of something happening. It is used as a general descriptor of probability and may be expressed qualitatively or quantitatively.
Recovery	The support of emergency affected communities in the reconstruction and restoration of physical infrastructure, the environment and community, psychological and economic wellbeing.
Response	The combatting of the effects of an emergency, provision of emergency assistance for casualties, reduction of further damage, and help to speed recovery.
Risk	The combination of the probability of an event and its negative consequences.

The matrix[5] below calculates risk levels based on the consequence and likelihood levels assigned to a risk statement. Please note the likelihood of a statement in this report is determined by multiplying the scenario probability (AEP) by the probability of the risk statement occurring (as determined in workshops).

	Consequence level				
Likelihood	**Insignificant**	**Minor**	**Moderate**	**Major**	**Catastrophic**
Almost Certain (63% per year or more)	Medium	Medium	High	Extreme	Extreme
Likely (10% to <63% per year)	Low	Medium	High	Extreme	Extreme
Unlikely (1% to <10% per year)	Low	Low	Medium	High	Extreme
Rare (0.1% to <1% per year)	Very low	Low	Medium	High	High
Very Rare (0.01% to <0.1% per year)	Very low	Very low	Low	Medium	High
Extremely rare (<0.01% per year)	Very low	Very low	Low	Medium	High

[5] from the *National Emergency Risk Assessment Guidelines* (2015) Australian Government Attorney-General's Department

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SEMC
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State Risk Project

An Australian Government Initiative