

PILBARA EMERGENCY MANAGEMENT DISTRICT

Risk assessment report

'Highlighting potential disaster impacts'



PILBARA

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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Executive summary

This document summarises the results of the *State Risk Project* risk assessment workshops in the Pilbara Emergency Management (EM) district. It covers five priority hazards as identified by the Pilbara District Emergency Management Committee (DEMC) are: air crash, cyclone, flood, human epidemic and marine transport emergency (MTE). The effects of these hazards were measured against five key impact areas (economy, public administration, people, environment and social setting) using 211 specific risks, called risk statements.

Within the 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).

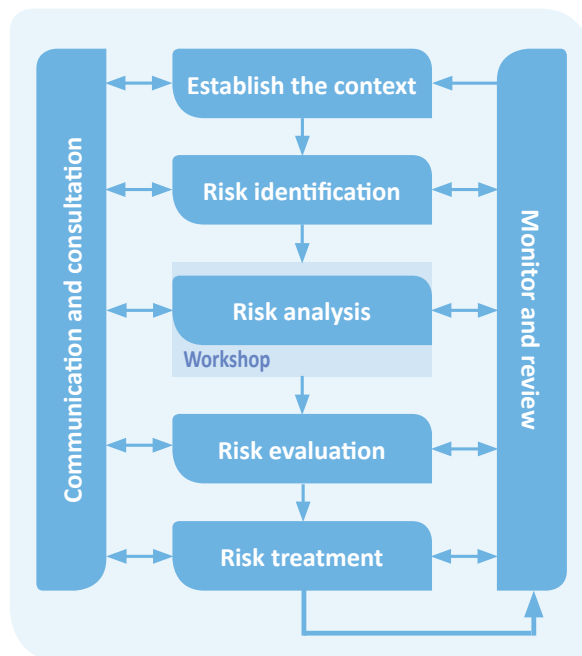


Figure 1: Emergency risk management process.¹

Twenty-three 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 (\$56.831 billion) and the population (68,450) of the EM district.

The results reveal that 1% (2 statements) of the risks assessed are extreme risks, 10% are high, 28% are medium, 32% are low and 29% are very low. Two per cent of the risks could produce catastrophic consequences.

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² *National Emergency Risk Assessment Guidelines* (2015) Australian Government Attorney-General's Department

Extreme and high risk statements are primarily related to public administration, economic and health impacts, whereas low risks relate to the environment and social setting. The two extreme risks concern the impact on the health of people, resulting in death(s) and/or serious injuries and illnesses.

All hazards pose a risk to human life, with human epidemic, cyclone and air crash assessed as having the potential to create a catastrophic impact (greater than seven fatalities). However, it should be noted that the likelihood of this particular risk statement for the cyclone scenario was assessed as only 5%. As a result of the human epidemic and air crash scenarios, the health system would be stretched and emergency services would be overwhelmed, particularly the Royal Flying Doctors Service (RFDS) in transporting burns and critical patients to Perth for treatment.

Overall, cyclone and flood have a greater impact on physical structures such as critical infrastructure and housing; human epidemic and air crash appear to have a greater impact on public administration, particularly health services. In addition, the natural hazards have larger ranging impacts, likely due to their widespread nature, when compared to the hazards that are more location specific (air crash and MTE).

Human epidemic presented the only extreme risks as a result of deaths, injuries and illnesses; however, it also produced the greatest number of low risks (65%). While the health system may be impacted heavily, the nature of the hazard is such that it does not have any impact on physical structures or the environment. In addition, all social setting risk statements were assessed as low risk, implying that the community would be able to return to normal function without requiring external resources if the event occurred. Most of the high risks for the human epidemic scenario can be found in the people and economy impact areas. The most notable economic risk is a reduction in workforce attendance across the district, resulting in productivity and financial losses. It was expected that workforce attendance across the Pilbara would reduce by 20% during the epidemic, which could rise to 50% at its peak. This would have implications on a number of industries, particularly those that require personnel with specialist skills.

The flood scenario produced the greatest number (56%) of high and medium risk statements combined. Further to this, each impact area within the flood scenario produced between 33% and 58% medium risks. This is illustrative of its widespread nature and the range of impacts across all aspects of the district. It is notable that, compared to the other hazards, the flood scenario would have the greatest impact on the social fabric of the district. High risk statements for this hazard relate to the impact on the staff of remote Aboriginal communities corporations, the potential for death, and the impact on the mining industry resulting in financial losses.

Unique to the air crash scenario was the high risk resulting from impacts to mental health. The incident was expected to have an effect on the community as the district is heavily reliant on fly-in, fly-out workers in sectors such as mining. Most likely people would either know someone who was involved in the crash itself: they fly on the aircraft type regularly, or know someone that flies on the aircraft type regularly. Alternatively, the

mental health of medical staff attending the scene may also be impacted. Other high risks resulting from the air crash scenario include injuries and the demand on health and emergency services, particularly medical transport services. While the air crash is confined to a specific location, the potential grounding of the Fokker 100 fleet could have far wider implications. Across the district there are only a handful of airports, which all have their own requirements for aircraft type which may have knock-on effects to services. In addition, the impact on a number of state agencies would initially be high in the days following the incident. Although this is likely to soften as time progresses, the initial spike may require some agencies to seek assistance from outside the Pilbara.

Overall the MTE scenario poses the least risk to the Pilbara EM district. The majority (83%) of all risk statements for this scenario were assessed as a very low risk due to the limited impact it would have on the district as a whole. The location of the incident is confined to the Port of Port Hedland and would impact a limited number of agencies and have minimal impact on the public. Two risk statements were assessed as high risk: the potential for a death of a response or recovery worker (although likelihood of this was assessed as only 25%), and financial losses as result of disruption to mining exports. However, it was noted that this would have a greater impact to the State than the Pilbara EM district itself. It was suggested that had there been an oil spill within the scenario the risks may have been greater. The demand on state agencies and those involved with recovery, as well as impacts to the environment, would likely be higher if this were the case.

There were no high risks to the social setting, suggesting that the district community fabric is strong. The greatest risks related to the displacement or isolation of communities (including Aboriginal communities), residential building damage and the impact on social service providers, most of which stem from the flood scenario.

There were also no high risks to the environment. The most notable risk to the environment is the impact of soil erosion as a result of the flood scenario (medium risk). All other environment risks were assessed as low or very low, with flood having the greater potential impact overall.

The *NERAG* uses a prioritisation system to rank risks for treatment decisions and/or for further investigation. There are three Priority 1 (highest) statements (1 %), 5% of the statements are Priority 2, 13% are Priority 3, 36% are Priority 3 and 45% of the statements are Priority 5 (lowest). The following table (Table 1) shows 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.

Table 1: Risk statements for the Pilbara district with Priority level 1 or 2 or catastrophic consequences. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Hazard	Risk statement	Impact area	Consequence	Risk level	Confidence level	Priority level
H Epidemic	will impact the health of people and cause death(s).	People	Catastrophic	Extreme	Moderate	1
H Epidemic	will impact the health of people and cause injury and/or serious illness.	People	Catastrophic	Extreme	Moderate	1
H 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	Low	1
Air Crash	will impact the health of people and cause death(s) as a direct result of the plane crash.	People	Catastrophic	High	High	2
Air Crash	will impact the health of people and cause injury and/or serious illness.	People	Catastrophic	High	High	2
Flood	will impact the mining industry (e.g. through damage to infrastructure, evacuations of miners etc.) resulting in financial losses.	Economy	Major	High	Moderate	2
Air Crash	will impact mental health, resulting in death.	People	Major	High	Low	2
H Epidemic	will impact port activities, resulting in financial losses.	Economy	Major	High	High	2
H 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	Major	High	Moderate	2
Cyclone	will impact the mining industry (e.g. through damage to infrastructure, evacuations of miners etc.) resulting in financial losses.	Economy	Major	Medium	Low	2

Hazard	Risk statement	Impact area	Consequence	Risk level	Confidence level	Priority level
H Epidemic	will impact workforce attendance leading to productivity loss and consequently financial loss.	Economy	Major	High	Moderate	2
H Epidemic	will impact workforce attendance within the prisons, community corrections and private courts and custody transport providers, impacting their ability to deliver core services.	Public Administration	Major	High	Moderate	2
H Epidemic	will impact educational services, impacting their ability to deliver core services.	Public Administration	Moderate	Medium	Lowest	2
H Epidemic	will impact RFDS services, impacting their ability to deliver core services.	Public Administration	Moderate	Medium	Low	2
Cyclone	will impact the health of people and cause death(s).	People	Catastrophic	High	Moderate	3

1 Introduction

A series of risk assessment workshops were conducted in the Pilbara 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 allocation with an emphasis towards prevention and preparedness activities.

Initially, the highest priority hazards for each district are assessed. The five priority hazards for the Pilbara EM district, as identified by the District Emergency Management Committee (DEMC) include: air crash, cyclone, flood, human epidemic and MTE. 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 in the Pilbara EM district. Note: MTE = marine transport emergency.

Hazard	Location of workshop	Date of workshop
Air Crash	Karratha	21 September 2016
Cyclone	Karratha	17 August 2016
Flood	Karratha	17 August 2016
Human Epidemic	Karratha	21 September 2016
MTE	Karratha	27 July 2016

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 Pilbara EM district, listed in alphabetical order. Note: AC = air crash; HE = human epidemic; MTE = marine transport emergency.

Agency	Hazard				
	AC	Cyclone	Flood	HE	MTE
Burrup Industry Emergency Management Committee				x	
Cape Preston Port Company					x
City of Karratha	x	x	x	x	
Department for Child Protection and Family Support	x	x	x	x	x
Department of Agriculture and Food WA		x	x		
Department of Defence	x	x	x	x	
Department of Fire and Emergency Services	x	x	x		x
Department of Health				x	
Department of Parks and Wildlife		x	x		x
Department of Transport					x
Horizon Power		x	x		
Main Roads WA		x	x		
Office of Emergency Management (Facilitators)	x	x	x	x	x
Pilbara Ports Authority	x	x	x	x	x
Royal Flying Doctor Service		x	x		
Shire of Ashburton	x	x	x	x	
Shire of East Pilbara		x	x		
St John Ambulance	x			x	
Town of Port Hedland	x	x	x	x	
WA Police	x	x	x	x	x
Water Corporation		x	x		
Western Australian Country Health Services	x	x	x	x	
Woodside	x			x	

2 Hazard scenarios

Five hazards were assessed for the Pilbara EM district. Hazard scenarios were developed with the assistance of:

- Australian Transport Safety Bureau (ATSB)
- Bureau of Meteorology Western Australia (BOM)
- City of Karratha
- Department of Fire and Emergency Services (DFES)
- Department of Transport, Marine Safety (DOT)
- Office of Emergency Management (OEM)
- Pilbara Ports Authority (PPA)
- Western Australia Country Health Service (WACHS)
- WA Police

Air crash scenario

The air crash scenario was developed by the ATSB, WA Police and the City of Karratha (Karratha Airport) and has approximately a 0.995% chance of occurrence in any given year.

Background

There are approximately 40 *Fokker 100* aircraft based in WA. The aircraft type is operated by four major airlines and charter operators to provide passenger services to population centres and tourist destinations in regional WA, as well as services to major resource projects (e.g. fly-in fly-out (FIFO) to mine sites). Airports in the Pilbara EM district with suitable runways and navigation aid for the *Fokker 100* aircraft are Karratha, Port Hedland, Barrow Island (restricted operations) and Onslow.

During the cyclone season (Nov-Apr), blue alerts are given to the public to advise them to undertake preparation activities for possible cyclone impacts. Industries such as mining and offshore oil and gas may evacuate their staff, increasing the demand on aviation services. During blue alerts, aircraft may still fly.

Day 1—Tuesday 07/02/20XX

A blue alert for a cyclone expected to impact Karratha is called at 8 am on 07/02/20XX. At 4.45pm, a *Fokker 100*, with 100 people on board, crashes at Karratha Airport. The plane is landing towards the east and crash-lands in the touchdown zone of the runway (Figure 2). The crash is caused by a mechanical failure on landing. The aircraft breaks apart and a fire occurs in one half of the plane.

In addition, there is a significant spillage of aviation turbine fuel during the incident and the fuel continues to leak from a damaged fuel tank (~2,000 litres). A reasonable amount of fuel remains on board the aircraft and a runoff of unburnt fuel occurs.

The following injuries are expected from the air crash:

- ~20 people fatally injured
- ~40 people with serious injuries (~20 people have burns injuries ranging from 40 to 90% of the body and ~5 people who can't walk)
- ~28 people have minor injuries - bruises, scratches, minor stitches
- ~12 people walk away uninjured

Day 2—Wednesday 08/02/XX

The cyclone blue alert is lifted as the cyclone does not reach Karratha. Following the air crash incident, ATSB investigators arrive on site.

The taxiway 'Foxtrot' is opened as a limited-use runway (for turboprop aircraft, potentially smaller jets like *Fokker 100* only). The main runway remains closed until the wreckage is cleared, which will not occur until the ATSB have finished their investigation. Subject to movement restrictions at the western end of the airport, helicopters are still able to take off and land.

Day 5—Saturday 11/02/XX

After four to five days onsite, investigators identify a component failure within the aircraft, which has potential implications for the continuing airworthiness of the aircraft type (*Fokker 100*). The aircraft manufacturer and Civil Aviation Safety Authority (CASA) take immediate action, requiring all *Fokker 100* airplanes to be inspected before further flight. Due to the complexity of the inspection process, it takes 12 hours to complete *each* aircraft. The inspection work requires specially trained personnel and testing equipment. Working in shifts around the clock, three aircraft inspections can be completed each day.

Day 6 to Day 19—Sunday 12/02/XX to Saturday 25/02/XX

It takes approximately 13 days for the all *Fokker 100* in WA to be inspected. The loss of the *Fokker 100* for inspection is partially offset by other aircraft types. However, these only meet 60-70% of the normal capacity across regional WA in the early stages.

Day 9—Wednesday 15/02/XX

The main runway fully opens to flights.



Figure 2: Air crash location at Karratha Airport.

Cyclone scenario

The cyclone scenario was developed by the BOM and has approximately a 0.1% chance of occurrence in any given year³.

On 13 December 20XX, a tropical low that has been developing off the North Pilbara coast begins to track south (Figure 3). At this time, the BOM issues a cyclone watch. The system strengthens into a Category 5 cyclone late on 14 December. The cyclone makes landfall as a Category 5 approximately 20 km west of Karratha before weakening as it moves inland. The cyclone is travelling at a speed of 15 km/h. Late on 15 December the system passes Pannawonica as a Category 3 before reaching Newman on the morning of 16 December as a Category 1 cyclone.

³ Note: A Category 5 cyclone crossing the Pilbara coast has an approximate chance of occurrence of 1% in any given year. A Category 5 cyclone crossing the coast just west of Karratha around the highest astronomical tide, resulting in a 12 m storm surge, has a chance of occurrence of 0.1% in any given year.

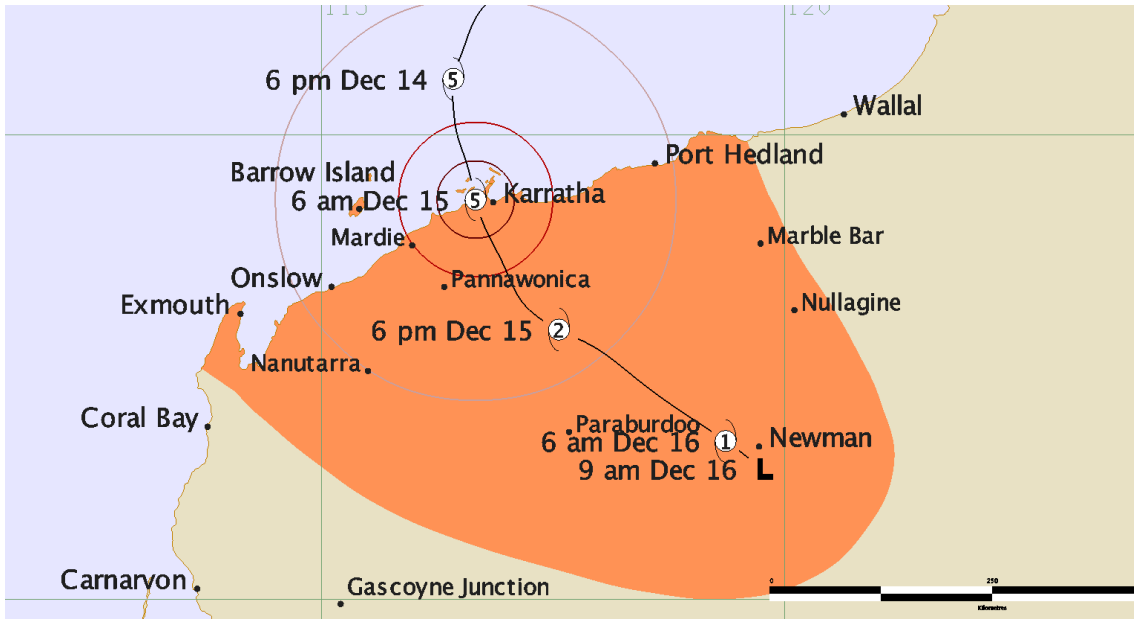


Figure 3: Map of the cyclone track between 14 and 16 December. Image supplied by BOM.

The cyclone produces significant rainfall and winds in excess of 200 km/h, gusting to 275 km/h as it crosses the coast. The cyclone also produces a significant storm surge, peaking in Karratha at 12 m above Australian Height Datum (AHD) (Figure 4).

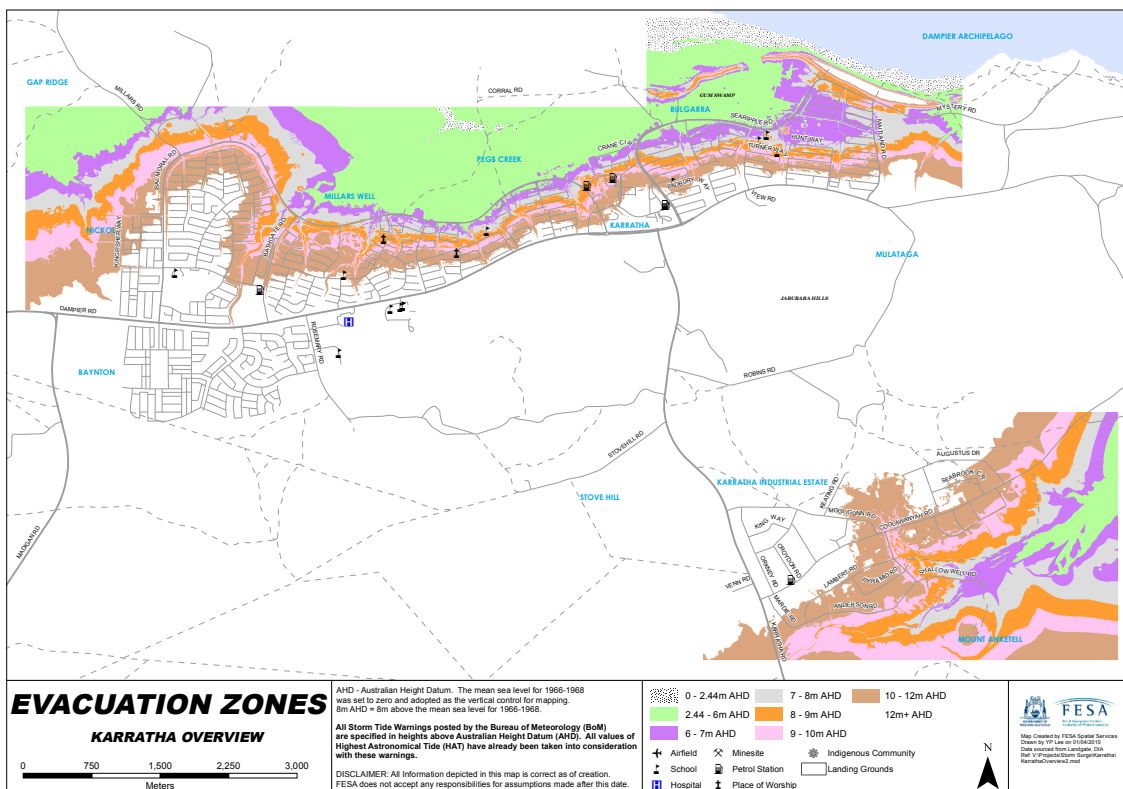


Figure 4: Storm surge mapping for Karratha. Note, for this scenario, all coloured areas would be inundated. Image supplied by DFES.

Flood scenario

The flood scenario was developed by the BOM and has approximately a 0.499% chance of occurrence in any given year.

In the year preceding the flood scenario the Pilbara receives above average rainfall. Further rain at the beginning of December causes saturation of many catchments.

In mid-December, a slow-moving Category 5 tropical cyclone makes landfall just west of Karratha. The system contains a significant rainband resulting in heavy rainfall in the Pilbara district over the next few days. The effects of the cyclone last between 3-6 hours at any given location. Rainfall during the event is in excess of 600 mm over five days, with a peak daily total of 350 mm.

Major flooding is expected in a number of locations across the Pilbara including the following catchments (Table 4):

- De Grey
- Pilbara coastal rivers
- Fortescue River
- North Interior
- Onslow Coast
- Ashburton River (lower)
- Lyndon-Minilya (North)

Catchments in the Pilbara are large; therefore impacts will be most noticeable a few days after the cyclone has passed.

Table 4: Estimated flood severity over the course of the rainfall event for six catchments in the Pilbara. Flood severity was not modelled for the North Interior catchment. Table supplied by BOM.

Flood severity	Below minor	Minor	Moderate	Major					
Catchments	12/12	13/12	14/12	15/12	16/12	17/12	18/12	19/12	20/12
De Grey	Below minor	Minor	Moderate	Moderate	Major	Moderate	Minor	Below minor	Below minor
Pilbara Coastal Rivers	Below minor	Minor	Moderate	Major	Major	Moderate	Minor	Below minor	Below minor
Fortescue River	Below minor	Below minor	Minor	Moderate	Major	Major	Moderate	Minor	Below minor
Onslow Coast	Below minor	Below minor	Minor	Moderate	Major	Moderate	Minor	Below minor	Below minor
Ashburton River	Below minor	Below minor	Below minor	Minor	Moderate	Major	Major	Moderate	Minor
Lyndin-Minilya Rivers	Below minor	Below minor	Minor	Moderate	Major	Moderate	Minor	Below minor	Below minor

Human epidemic scenario

The human epidemic scenario was developed by the WACHS and has approximately a 4.88% chance of occurrence in any given year.

9am, 13 July, 20XX

Emergency Department Doctor from Hedland Health Campus (HHC) contacts the Public Health Team at Pilbara Health Campus to inform about the overnight admission of two people from a FIFO mine site 200 km out of Port Hedland.

The Public Health Team notes the following from the medical officer:

Mr AB, a 44-year-old man, is a machine operator at a mine site. He flies in from his residence in Bali to Port Hedland Airport on a commercial flight. He is then transferred by bus to the mine site with nine other people who reside in different parts of WA, and two from Queensland. Mr AB develops 'flu-like' illness on 7 July, 24 hours before flying in from Bali; he presents for work on the 9 July and continues to work for two days before presenting to the onsite medical officer on 11 July.

On 11 July, **Mr CD**, a 54-year-old driver of the bus that transported Mr AB, presented to the mine onsite medical officer with severe respiratory signs and symptoms. Before transporting Mr CD to hospital the medical officer reviewed Mr AB and found he too was suffering severe respiratory symptoms. Both Mr AB and CD were transported by the site ambulance to Hedland Health Campus. Mr AB was admitted and placed in a single room and Mr CD was admitted to the high dependency unit. Tests were taken from both patients, but missed the plane for transport to Pathwest in Perth. They are sent the next day (14 July).

6pm, 13 July 20XX

A three-year-old **boy EF** from Newman, who returned from Bali on the Port Hedland flight is transferred from Newman Hospital direct to Perth by RFDS with a severe respiratory illness and requires intubation en-route. He is accompanied by his mother who is 23 weeks pregnant.

2pm, 15 July, 20XX

Boy EF from Newman tests positive for the "H5N1R5-alpha influenza virus", a novel avian influenza virus considered by the World Health Organisation (WHO) as a new strain causing an emerging global pandemic among humans. The boy represents the first confirmed case to occur in Australia. He has sepsis and is not expected to survive the next 12 hours. His mother also has a flu-like illness and is being treated.

In addition, Mr AB is informed by his partner that his housekeeper in Bali has been admitted to hospital and that two other people from the area where they live have passed away with flu-like illness. No further details are known.

3pm, 15 July 20XX

A ship arrives in Port Lambert from China with a mostly Filipino crew. The Department of Agriculture and Water Resources report that someone on board, **Mr JK**, is seriously ill with a fever and cough. He is taken from the ship by ambulance to Nickol Bay Hospital (NBH). He is tested for bacterial and viral infections.

4pm, 15 July 20XX

Pathwest confirms Mr AB has H5N1R5-alpha influenza virus. Mr AB is starting to improve but Mr CD is worsening. Boy EF dies and his mother is now sick.

10am, 16 July 20XX

Pathwest confirms the results of Mr JK from the ship. He has H5N1R5-alpha influenza virus also and is gradually worsening. Doctors at NBH are querying evacuating him to Perth. A plane is organised to evacuate Mr CD from Hedland and Mr JK from Karratha together. A doctor accompanies them both.

Further background for scenario:

At the time of these events the H5N1 Subtype, Re-5 Strain is a known subtype of Avian influenza previously found in chickens, ducks and geese, but with infrequent transmission to humans and no person-to-person transmission documented. There is a vaccine available for H5N1R5 strain for use in poultry. There is no vaccine for use in humans.

On 7 July, 20XX, the Government of the People's Republic of China issued a statement to WHO that a H5N1 Subtype Re-5-like Strain has been transmitted from a goose farmer and linked to 25 people in Qingdao City, Shandong Province. None of these 25 people had worked with or had more than casual contact with birds. When 130 new cases developed as the virus was transmitted from these 25 people, a State of Emergency was declared in China. The WHO was informed, as person-to-person transmission of a new strain (H5N1R5-alpha) seemed likely. On 13 July, WA Health officials were discussing implementation of border control measures with the Commonwealth. The Pandemic phase for Australia had not yet been escalated. By 14 July, the WHO reported 500 cases worldwide, mostly in China, but some in travellers in Korea, Thailand, Indonesia, South Africa and India.

Marine transport emergency scenario

The MTE scenario was developed by PPA and the DOT, Marine Safety and has approximately a 0.995% chance of occurrence in any given year.

A fully laden iron ore ship leaving the Port of Port Hedland suffers steering gear failure and runs aground in the channel (Figures 5 and 6). Parts of the ship break during the grounding; however, the ship does not completely break apart. The ship blocks the channel for at least two weeks before it is salvaged.

For this scenario, it was assumed that no oil leaks from the ship. A discussion of the possible impacts if there was an oil spill in this scenario is included in Appendix A.



Figure 5: Channel map for the Port of Port Hedland. The black box shows the extent of Figure 6, where the grounding occurs. Image supplied by DOT.

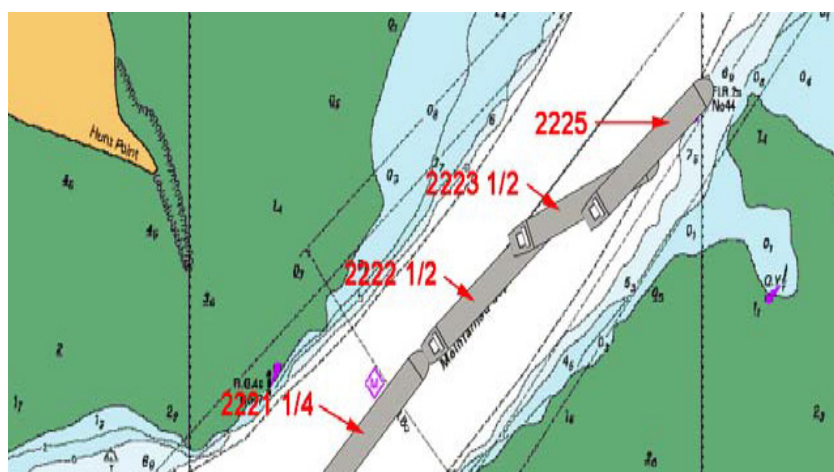


Figure 6: Movement of the bulk iron ore carrier prior to grounding in the channel at the Port of Port Hedland. The ship labelled '2225' is the location of the grounded ship for this scenario.

3 Assessed risk statements

A total of 211 risk statements were assessed across the five assessed hazards: air crash (36); cyclone (53); flood (52); human epidemic (40); and MTE (30).

Table 5 shows the number of risk statements for each hazard, separated into the five impact areas (economy, public administration, people, environment and social setting).

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

The risk statements were assessed using the tailored *NERAG* consequence table for the Pilbara EM district found in Appendix C. The consequence levels are based on the gross area product (\$56.831 billion) and the population (68,450) of the Pilbara EM district.

Table 5: Number of risk statements assessed for each hazard in the Pilbara EM district. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Hazard	Impact area				
	Economy	Public administration	People	Environment	Social setting
Air crash	10	13	5	3	5
Cyclone	14	21	4	3	11
Flood	15	19	4	3	11
H Epidemic	8	13	5	-	14
MTE	9	5	5	4	7

4 Pilbara EM district risk profile

The risk profile for the Pilbara EM district for the five assessed hazards is shown in Figure 8 (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 7) combines the data and categorises it by hazard and risk level.

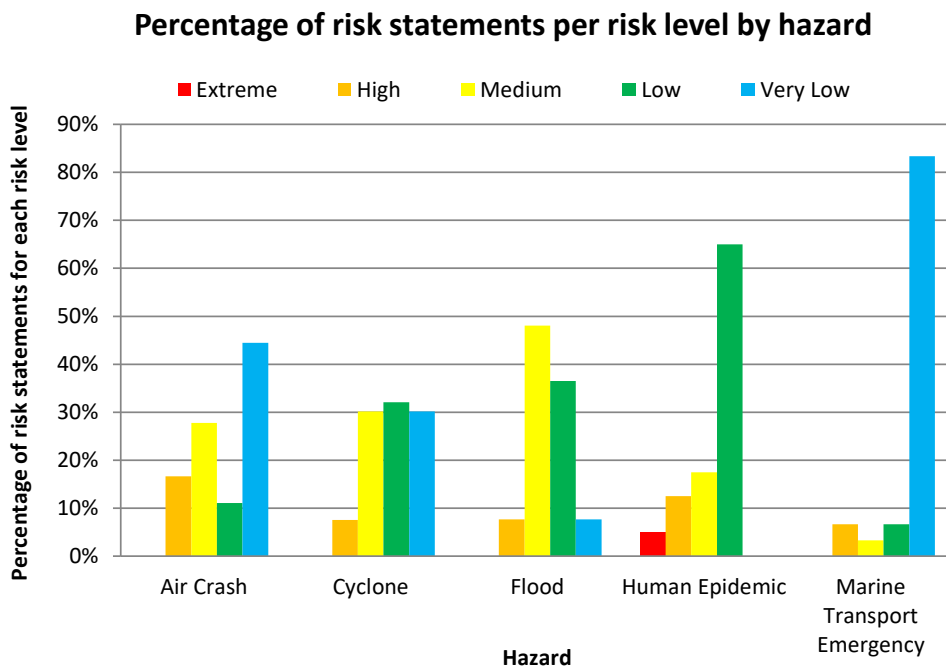


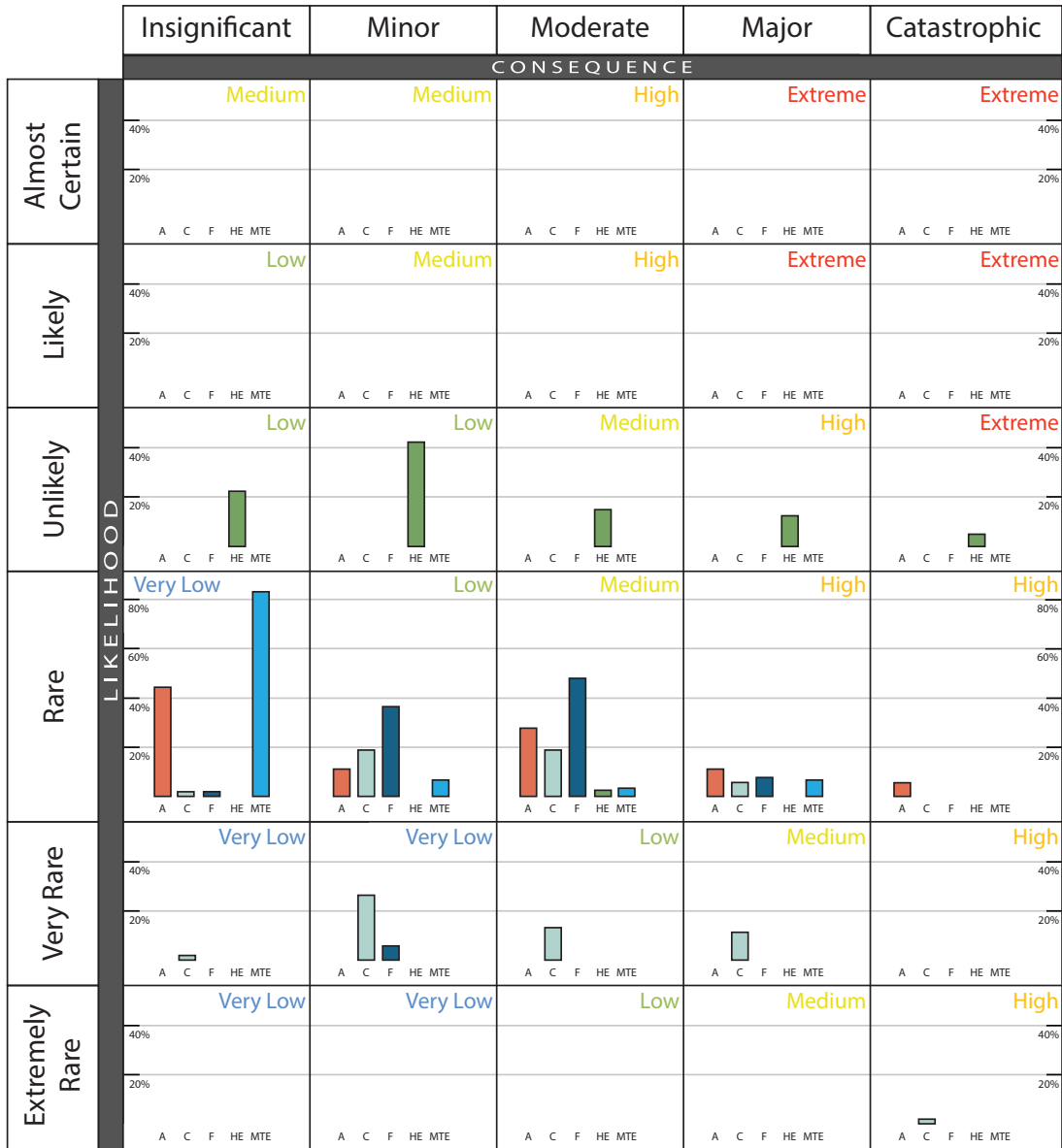
Figure 7: Percentage of risk statements at each risk level for each hazard. Note each hazard sums to 100%.

Of the 211 statements assessed for all five hazards, 1% are extreme risks, 10% are high risks, 28% are medium risks, 32% are low risks and 29% are very low risks. Individual hazard risk assessment summaries can be found in Appendix A.

The human epidemic scenario is the only hazard assessed as having extreme risks. This is a result of the catastrophic consequence of at least seven deaths expected and the demand placed on health services. The cyclone and air crash scenarios are also expected to result in at least seven deaths, however the lower likelihood of these events results in a medium risk level.

Following this, air crash has the highest percentage (17%) of high risks and flood (48%) the highest proportion of medium risks. A dominant feature of Figure 7 is the very low risks assessed for MTE and air crash. The proportion of very low risks for these two hazards may be because either existing control measures are effective and/or the events are localised. MTE has the highest percentage (83%) of very low risk statements of all the hazards. It is possible that these risk levels could change if the scenario did include an oil spill.

Pilbara EM District Risk Profile



Legend

- Air Crash (A)
- Cyclone (C)
- Flood (F)
- Human Epidemic (HE)
- Marine Transport Emergency (MTE)

Key

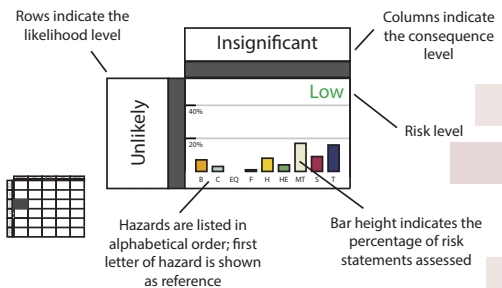


Figure 8: Percentage of risk statements for each hazard assessed in the Pilbara EM district, categorised by their likelihood, consequence and risk level.

Catastrophic consequences would be produced by the air crash, cyclone and human epidemic scenarios and are classified as either a high or extreme risk (2%). 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 11% of the risk statements.

Figure 9 illustrates the spread of risks to the Pilbara 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 economy and public administration impact areas which have an equal number of high risks. The environment and social setting impact areas have the highest proportion of low and very low risks.

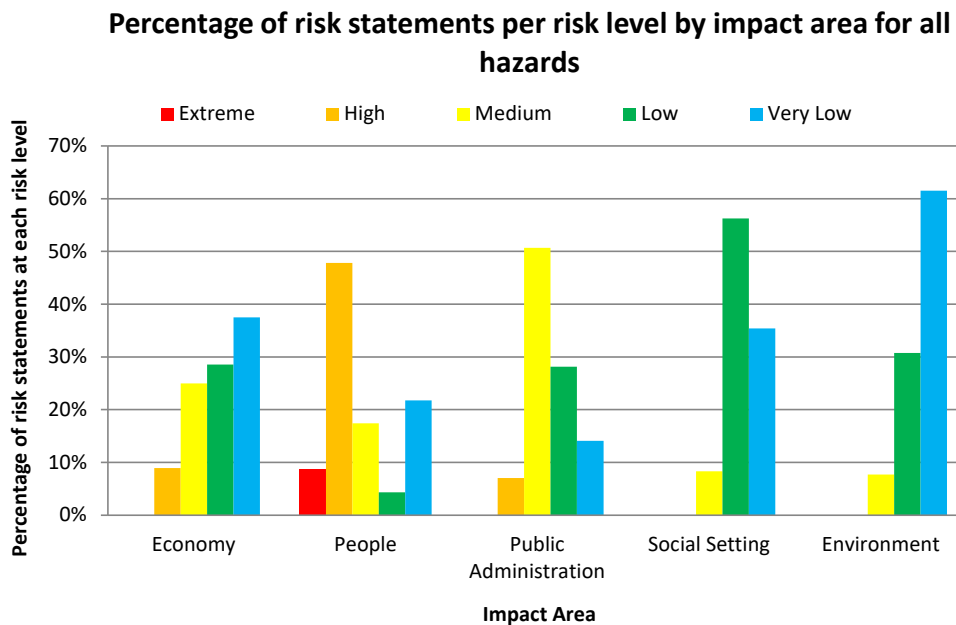







Figure 9: Percentage of risk statements per risk level, by impact area for all hazards. Note: each impact area sums to 100%.

Common themes from extreme and high risk statements

<p>ECONOMY</p>		<ul style="list-style-type: none"> • Disruption to the mining infrastructure and industry (including exports from the region), resulting in financial losses. • Impact to marine infrastructure and industry, resulting in recovery costs and financial losses. • Impact to workforce attendance resulting in productivity loss and consequently financial loss (<i>human epidemic only</i>).
<p>PEOPLE</p>		<ul style="list-style-type: none"> • Emergency events result in death(s) (<i>extreme risk level for human epidemic; catastrophic consequences for air crash, cyclone and human epidemic</i>). • Emergency event result in injuries/illnesses (<i>catastrophic consequences for air crash and human epidemic; extreme risk level for human epidemic</i>). • Emergency events will cause emergency and health services to be overwhelmed, resulting in further death(s) directly attributable to the hazard event. • Emergency events will endanger the health of response and recovery personnel, resulting in injuries, illness and/or death (<i>MTE only</i>).
<p>PUBLIC ADMINISTRATION</p>		<ul style="list-style-type: none"> • Increased demand on state agencies (<i>DFES for cyclone, and RFDS for air crash</i>), impacting their delivery of core services. • Impact to workforce attendance within the prisons, community corrections and private courts and custody transport providers, impacting their ability to deliver services (<i>human epidemic only</i>). • Increased demand on public facilities, impacting the ability to provide welfare services (<i>cyclone only</i>). • Disruption to staff of remote Aboriginal communities' corporations, impacting their ability to provide support to their communities (<i>flood only</i>).
<p>SOCIAL SETTING</p>		<ul style="list-style-type: none"> • <i>No social setting risk statements were ranked as extreme or high risks.</i>
<p>ENVIRONMENT</p>		<ul style="list-style-type: none"> • <i>No environment risk statements were ranked as extreme or high risks.</i>

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

Fifty-six economy risk statements were assessed across the five hazards (Table 6). The statements address impacts to a significant industry or the decline in economic activity across the EM district (see Appendix C for criteria).

Table 6: 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
<i>Disruption to transport routes</i>			Flood	Cyclone	
<i>Health services</i>				H Epidemic	Air Crash
<i>Impacts to agricultural and pastoral activities</i>			Flood	Flood	Cyclone
<i>Impacts to aviation</i>			Air Crash		Air Crash (3) Cyclone Flood
<i>Impact to bridges or their approaches</i>				Cyclone Flood	
<i>Impacts to commercial activities</i>				H Epidemic (3)	MTE (2)

Category	Risk level				
	Extreme	High	Medium	Low	Very Low
<i>Impacts to commercial buildings, contents and services</i>			Cyclone Flood		
<i>Impacts to communication infrastructure</i>			Flood		Cyclone
<i>Impacts to marine infrastructure and industry</i>		Cyclone H Epidemic	Flood		MTE (2)
<i>Impacts to mining infrastructure and industry</i>		Flood MTE			
<i>Impacts to power supply infrastructure</i>			Cyclone	Flood	
<i>Impact to private buildings and contents</i>			Cyclone Flood		
<i>Impacts to sewerage systems</i>				Flood	Cyclone
<i>Impacts to tourism</i>				Cyclone Flood H Epidemic	Air Crash MTE (2)
<i>Impacts to transport infrastructure</i>			Flood	Cyclone	
<i>Impacts to water supply infrastructure</i>				Flood	Cyclone
<i>Response and recovery activities</i>					Air Crash MTE (2)
<i>Workforce productivity losses</i>		H Epidemic	Air Crash (2) Cyclone	H Epidemic	Air Crash

Overall, the majority (66%) of the impacts to the economy were assessed as low or very low risks. There are, however, a number of high and medium risks that should be considered during the risk treatment phase.

The high risks to the Pilbara EM district economy are financial losses resulting from disruption to the mining and marine industries and a reduction in workforce attendance, leading to productivity losses. The human epidemic scenario would have the greatest impact on workforce productivity losses. It was expected that on average, workforces across the district would decrease by 20%, with this peaking to 50% at the height of the epidemic. In addition, the epidemic was anticipated to continue for up to 10 months, resulting in a reduced workforce over a long period of time. This would be extremely problematic in sectors such as mining where some jobs require specialist skills that cannot be easily replaced. As a result of the reduction in workforce, the Pilbara Ports Authority expected they would cut down to skeleton crews across the district. With a large volume of traffic through these ports, estimated at a movement of \$100 million a day, this could result in major consequences of financial losses greater than \$2.27 billion over an extended period. It is important to note, however, that most port revenue does not go to the Pilbara district itself, but rather to the state.

The cyclone scenario also poses a high economic risk to the marine industry. Severe winds from a Category 5 cyclone would require boat ramps and ports to be closed at least 12 hours prior to their onset. Impacts to mining infrastructure at the port are most likely to occur as a result of the storm surge; however it was expected that financial losses would primarily be from disruption to the sector rather than damage to infrastructure itself. Because the ports would be closed, mining companies would operate at minimum extraction rates to avoid excess stockpiles. The flood scenario was also anticipated to impact mining activities, posing a high risk. Damage to infrastructure, particularly rail, would hinder activities. In addition, flood waters on mine sites may become contaminated and may need to be disposed of appropriately and at cost.

The majority of high and medium risks (68%) stem from the natural hazard scenarios (cyclone and flood). Impacts to physical structures, such as private and commercial buildings and contents, sewerage systems, transport, communications, water and power infrastructure are greater for these hazards, likely due to their widespread nature, compared to the hazard scenarios that are more location specific (air crash, MTE). Human epidemic is unlikely to have any effect on physical structures due to the nature of the hazard.

The lowest risks to the district stem from impacts to tourism. Tourism does not play a large role in the Pilbara's economy and therefore suffers no significant losses, albeit they will be greater from the wider spread events (cyclone, flood or human epidemic) than the localised incidents (air crash or MTE).

Risks to people

Twenty-three risk statements assessed the impact to people across the five workshops. 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 7.

Table 7: 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
<i>Deaths</i>	H Epidemic	Air Crash Cyclone Flood MTE			MTE
<i>Disease Outbreak</i>			Flood		Cyclone
<i>Emergency services (e.g. medical transport)</i>		Air Crash Flood H Epidemic	Cyclone		MTE
<i>Health services</i>		Air Crash H Epidemic			MTE
<i>Impacts to general health</i>				H Epidemic	
<i>Injuries and illnesses</i>	H epidemic	Air Crash	Cyclone Flood		MTE
<i>Mental health</i>		Air Crash			

The only two extreme risks for the Pilbara district are in the people impact area, and come from the human epidemic scenario.

All hazards pose an extreme to medium risk to the Pilbara district in regards to deaths. Air crash, cyclone and human epidemic were expected to result in catastrophic consequences, which for the Pilbara district means at least seven deaths. The risk is extreme for human epidemic as it has a greater chance of occurrence in any given year

(4.87%) compared to the other hazards (0.1%-<1%), where the risk is high. In addition, the likelihood of seven deaths occurring in the cyclone scenario was estimated as only a 5% chance of occurring, if the cyclone occurred.

The flood and MTE scenarios were anticipated to result in major consequences (at least one death). For the MTE scenario, this was specifically a death of response and recovery personnel, not the general public. It was anticipated that while there is potential for a death during ship retrieval, the likelihood of this happening was low. The risk to the general public was assessed as very low. The likelihood of a death in a flood was higher; it was suggested this would likely be due to people not adhering to safety advice (e.g. driving through flood waters).

Injuries and illnesses are an extreme risk for the human epidemic scenario, specifically due to the nature of the hazard as it is suspected that a large number of people within the district would become ill with avian influenza, resulting in a catastrophic consequence. The air crash scenario is also expected to produce catastrophic consequences for injuries and illness. It is anticipated that approximately 68 passengers would suffer injuries ranging from spinal damage to burns and there is potential for persons on the ground to also be injured. In addition, there is potential for a further death in both the air crash and human epidemic scenarios due to the limited capacity of the health system. For air crash, hospitals would be unable to accept a high volume of burns patients (capacity would be exceeded at ~20 patients) and they would likely send patients to Perth. Similarly, for human epidemic there would not be enough capacity to hold a high volume of patients and comorbidity (i.e. other health problems) may exacerbate this issue.

Emergency services (including medical transport services) were expected to be delayed or overwhelmed, resulting in a further death for the flood, air crash and human epidemic scenarios (high risk). In smaller areas that are heavily reliant on roads that may be washed out in a flood, ambulances may struggle to respond. In addition, the demand on RFDS for the air crash and human epidemic scenarios would be significant due to long travel times back to Perth.

Air crash was the only scenario where mental health was specifically discussed. It is expected to have an effect on the community as the district is heavily reliant on fly-in, fly-out workers. Most likely people would either know someone who was involved in the crash itself; fly on the aircraft type regularly; or know someone that flies on the aircraft type regularly. Medical staff attending the scene may also be impacted. It was thought that this could potentially lead to a suicide.

Risks to public administration

Seventy-one statements were assessed across the five hazards that addressed public administration impacts (Table 8). These statements 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 delivery (see Appendix C for criteria).

Table 8: 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
<i>Administration of aboriginal communities</i>		Flood		Cyclone	
<i>Demand on Port Authority services</i>				MTE	
<i>Demand on public facilities</i>		Cyclone	Flood		
<i>Disruption of educational services</i>			H Epidemic		
<i>Disruption to aviation</i>			Air Crash Cyclone	Flood	
<i>Emergency services</i>		Air Crash Cyclone	Air Crash (2) Cyclone (2) Flood (2) H Epidemic MTE	Air Crash Cyclone (2) Flood H Epidemic (2)	Flood
<i>Government services</i>		H Epidemic	Air Crash (3) Cyclone Flood H Epidemic	H Epidemic (2) MTE	Air Crash (2)
<i>Health services</i>			Air Crash Cyclone Flood H Epidemic (4)		
<i>Home care services</i>				Cyclone Flood	
<i>Impacts to communication service delivery</i>			Flood		Cyclone

Category	Risk level				
	Extreme	High	Medium	Low	Very Low
<i>Impacts to port and marina services</i>				Cyclone	
<i>Impacts to power supply service delivery</i>			Cyclone	Flood	
<i>Impacts to sewerage service delivery</i>			Flood	Cyclone	
<i>Impacts to water supply service delivery</i>			Cyclone Flood		
<i>Public information</i>				H Epidemic	
<i>Public unrest</i>					Air Crash
<i>Response & recovery activities</i>			Cyclone (3) Flood (3)	Cyclone Flood	Air Crash Cyclone Flood MTE (2)

Eight of the public administration risk statements were expected to result in major consequences, suggesting that the organisations would encounter a severe reduction in core services and/or may require external assistance to deliver them. These statements were predominantly a result of the cyclone scenario, but also the air crash, human epidemic and flood hazards. Five of the eight statements presented a high risk and the remainder a medium risk, due to differences in scenario likelihoods.

In the event of the cyclone, the potable water supply, power supply, the aviation industry and public facilities would be impacted (medium risk). While it would be a priority to restore essential services, particularly to hospitals, the cyclone is likely to cause a compounding impact of loss of power, water as well as limiting access to sites to undertake repairs. It is anticipated that the Defence Force may be asked to bring in water; however the water outage period is not expected to exceed 72 hours. The associated storm surge could leave 5000 people requiring temporary evacuation, placing high demand on public facilities within the district (predominantly in Karratha). DFES would also be impacted by the storm surge as their main office, the SES building and the fire station would all be inundated. Although their services can be mobile, and they would likely continue to operate from Port Hedland, external resources would be required to assist, resulting in a high risk.

Referencing the 2009 Ashmore Reef Disaster as a relevant historical scenario and given the number of RFDS planes available, the demand placed on RFDS in the air crash scenario would impact their ability to provide services. They would require assistance to continue services (high risk).

The human epidemic scenario is expected to impact workforce attendance in prisons, community corrections and private courts and custody transport providers, impacting their ability to deliver core services (high risk). It was commented that industrial action to withdraw the workforce may be sought if there were a real or perceived threat. Inter-prison movements across district boundaries occur daily and are a dynamic core service that if compromised could accelerate the spread of the epidemic across borders and boundaries as transport is via coach, bus and plane. Corrections also utilise RFDS for emergency movements of ill prisoners; however as mentioned in the previous section, this resource is likely to be overwhelmed.

The administration of Aboriginal communities is likely to be impacted by the flood scenario and is considered high risk. A number of communities could become isolated with limited supplies. Coupled with a loss of power and communications, access issues for food, fuel and medical supplies could affect many Aboriginal communities within the Pilbara. The Department of Aboriginal Affairs anticipated that they would require a significant amount of resources to assist both in the delivery of their core functions (high risk) and to return the communities to normal function (medium risk).

A number of statements across all hazards were assessed as medium risk; particularly, the impact on emergency, government and health services. Notably, a large number of these stem from the cyclone and flood scenarios. This is most likely due to their impact on the built environment across a large geographic extent.

The MTE scenario does not feature heavily in the impacts to the public administration sector because the scenario is fairly limited in both its location, and the agencies it may affect. While it would place a higher demand than normal on the Pilbara Ports Authority and the Department of Transport, Marine Safety (both low risks), it would likely not affect many other agencies. The exception to this being Water Police services, whose main focus would be on the incident for at least a week. This could impact their ability to respond to other incidents were these to occur.

Risks to social setting

Forty-eight risk statements assessed the impact to the EM district social setting across the six hazards (Table 9). The social setting focuses on impacts to community wellbeing, community services and culturally important activities and objects (see Appendix C for criteria).

Table 9: 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
<i>Availability of essential supplies</i>				Cyclone Flood (2) H Epidemic (2)	
<i>Breakdown of social networks</i>				H Epidemic (2)	
<i>Community services and events</i>				H Epidemic (2)	Cyclone
<i>Culturally significant facilities and customs</i>				H Epidemic	MTE (2)
<i>Displacement or isolation of Aboriginal communities</i>			Flood		Cyclone
<i>Displacement or isolation of communities</i>			Flood	Cyclone (2) Flood H Epidemic	
<i>Education facilities</i>				H Epidemic	Cyclone Flood
<i>Facilities for vulnerable people</i>				Flood H Epidemic	Cyclone
<i>Flora and Fauna</i>					MTE
<i>Impacts to people's health affecting wellbeing</i>				Air Crash Flood H Epidemic (2)	Cyclone MTE
<i>Impacts to tourism</i>					MTE
<i>Loss of income</i>				Flood H Epidemic	Air Crash Cyclone MTE
<i>Psychological and emotional stress</i>				Air Crash (2)	Air Crash MTE
<i>Residential building damage</i>			Flood	Cyclone	
<i>Social services providers</i>			Flood	H Epidemic	Cyclone

All social setting statements were assessed as medium risks or lower, with all four medium risks stemming from the flood scenario.

It is anticipated that both cyclone and flood would lead to short (<14 days) and long term (>14 days) displacement or isolation of communities, with long-term displacement considered to have a greater impact on the community. For flood, the loss of roads and airstrips may impact the functionality of more remote towns, particularly inland, requiring some assistance to return to normal function.

For cyclone, approximately 1500 homes in Karratha could be affected by the storm surge, requiring a significant welfare effort. Although both scenarios are expected to result in moderate consequences, flood has produced a medium risk and cyclone a low risk as the chance of occurrence in any given year is lower for the cyclone scenario.

Similarly, it is expected that flood would have the greatest impact on Aboriginal communities, resulting in displacement or isolation. Flood is also expected to have the greatest impact on social service providers as it may be hard to travel around the district.

Residential building damage is expected to result in moderate consequences for both the cyclone and flood scenarios. It is anticipated that people may move away from the district following the hazard event and that external resources may be required to help return the community to normal function. Again, although the impacts are expected to be similar, this is a medium risk for flood and a low risk for cyclone because of the different scenario likelihoods.

The majority of social setting risk statements were assessed as low (56%) or very low (35%) risk. This suggests that the social structure of the district is resilient for the most part, and could return to normal function with minimal disruption. Low risks of note addressed the availability of essential supplies, impacts to people's health and the potential for loss of income. It was noted through the workshops that the population of the Pilbara EM district is transient in its nature, thus people moving out of the area is not uncommon and would not play a significant role in the disruption of the social fabric.

Risks to environment

Thirteen risk statements were assessed across four of the hazards for the environment. These statements address impacts to ecosystems, species and landscapes (see Appendix C for criteria). No environment statements were assessed for human epidemic as risks to the ecosystem or species were not foreseen at the time of the workshop.

Table 10: 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
<i>Contamination from toxic substances</i>					Air Crash (3)
<i>Debris or pollutants entering the riverine or marine environment</i>				Flood	Cyclone MTE
<i>Flora and fauna</i>				Cyclone Flood	MTE (3)
<i>Soil erosion</i>			Flood	Cyclone	

The most notable risk to the environment is the impact of soil erosion as a result of the flood scenario (medium risk). Flooding can often cause erosion in river catchments. Similar damage to that experienced on the Fortescue River from a 2015 flood event is expected, which could be long term and require assisted recovery.

All other environment risks were assessed as low or very low, with flood having the greatest potential impact overall.

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 Pilbara EM district are: Aboriginal communities and cultural activities; buildings; community; education; environment; government; health; industry/commercial; tourism; transport; and utilities. The environment category is not shown here as the data are the same as that represented in Table 10.

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

Both the natural hazard events are expected to impact Aboriginal communities and cultural activities, with flood being a greater risk than cyclone (Table 11).

The impact to the administration of Aboriginal communities is expected to have major consequences for the flood scenario, resulting in a high risk. The Department of Aboriginal Affairs anticipated that a significant amount of resources would be required to assist both in the delivery of their core functions (high risk) and to return the communities to normal function (medium risk). It is likely that a number of communities could become isolated with limited supplies. Coupled with a loss of power and communications, access issues for food, fuel and medical supplies could affect many Aboriginal communities within the Pilbara, particularly where good governance and resources may not be present.

For the cyclone scenario, the impact to the administration of Aboriginal communities is expected to have moderate consequences, resulting in a low risk. Similar to flood, access to food, fuel and medical supplies, as well as power supply and communications, would likely be impacted. Relocation and evacuations may also be required. It was anticipated that some resources would need to be diverted to deliver core services, and external assistance would be sought. The social implications of this are a lower risk than the administration itself.

Table 11: 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		Flood		Cyclone	
Displacement or isolation of Aboriginal Communities			Flood		Cyclone

Buildings

Only the natural hazards were assessed for impacts to the built environment, as it was not foreseen that air crash, human epidemic or MTE would have any impact on buildings. The only high risk to buildings stems from the cyclone scenario (Table 12). With a large number of persons (~5000) expected to be displaced by the storm surge inundation, primarily in Karratha, there would be an increased demand on public facilities for welfare centres. More sustainable housing options could be temporary mining camps in and near the town but these are progressively being dismantled. Impacts to private and commercial buildings and contents are expected to result in moderate economic consequences (>\$22.7 million) for both the flood and cyclone scenarios. The social implications of this were expected to have moderate consequences, whereby some people may move away from the district because of the event. This results in a medium risk for flood and a low risk for cyclone because of the scenario's lower likelihood.

Table 12: Risks related to buildings. Note: H Epidemic = human epidemic; MTE = marine transport emergency.

Buildings					
Category	Extreme	High	Medium	Low	Very Low
<i>Demand on public facilities</i>		Cyclone	Flood		
<i>Emergency services</i>			Cyclone		Flood
<i>Commercial buildings, contents and services</i>			Cyclone Flood		
<i>Private buildings and contents</i>			Cyclone Flood		
<i>Residential building damage</i>			Flood	Cyclone	

Community

The majority of risks under the community theme are the same as those represented in the social setting section (see Table 9, page 33), with the exception of the impact to home-care services and public unrest (Table 13). The impact to home-care service provision poses a low risk for both flood and cyclone. The risk of public unrest from the air crash scenario was considered to be very low. It was suggested that the community would in fact rally together following the incident; however, there may be some residual animosity towards the commercial airline itself.

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

Community					
Category	Extreme	High	Medium	Low	Very Low
<i>Availability of essential supplies</i>				Cyclone Flood (2) H Epidemic (2)	
<i>Breakdown of social networks</i>				H Epidemic (2)	
<i>Community services and events</i>				H Epidemic (2)	Cyclone
<i>Culturally significant facilities and customs</i>				H Epidemic	MTE (2)
<i>Displacement or isolation of communities</i>			Flood	Cyclone (2) Flood H Epidemic	
<i>Facilities for vulnerable people</i>				Flood H Epidemic	Cyclone
<i>Home-care services</i>				Cyclone Flood	
<i>Loss of income</i>				Flood	Air Crash Cyclone MTE
<i>Psychological and emotional stress</i>				Air Crash (2)	Air Crash MTE
<i>Public unrest</i>					Air Crash
<i>Social service providers</i>			Flood	H epidemic	Cyclone

Education

Risks related to educational facilities were only assessed for human epidemic, cyclone and flood (Table 14) as MTE and air crash would be unlikely to impact these facilities due to their localised nature. The greatest impact would be disruption to educational services as a result of the human epidemic scenario. It was anticipated that students would be less likely to attend schools than teachers. As long as there is a sufficient teacher-to-pupil ratio, services would still continue through the amalgamation of classes and the use of support teachers. The education of students may be impacted in the short term, but their safety would not be. Cyclone and flood pose a very low risk to education. The timing of these scenarios means that students would be on school holidays; therefore the provision of education would be re-organised by the time the new school year began. If these events were to occur during school term, the risks may be higher. However, in general, classes can be quite mobile and when there is an event of such nature, they can be moved as needed.

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

Education					
Category	Extreme	High	Medium	Low	Very Low
<i>Disruption of educational services</i>			H Epidemic		
<i>Educational facilities</i>				H Epidemic	Cyclone Flood

Government

The majority of risks under the government theme are the same as those represented in the public administration section (see Table 8, page 30), with the exception of the economic impact from response and recovery activities (Table 15). Overall financial losses from response and recovery activities were expected to be insignificant (<\$2.2 million) for both the air crash and MTE scenarios; this was not assessed for cyclone, flood and human epidemic. For the air crash scenario, costs are likely to be high and additional resources would be required; however, these costs would be borne by the state not the Pilbara EM district, thus residual costs are insignificant. Similarly, with the MTE scenario, costs would likely be borne by the owner of the vessel that grounds in the channel; consequently district costs are minimal.

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

Government					
Category	Extreme	High	Medium	Low	Very Low
<i>Demand on Port Authority services</i>				MTE	
<i>Emergency services</i>		Cyclone	Air Crash (2) Flood MTE	Cyclone Flood H Epidemic	
<i>Government services</i>		H Epidemic	Air Crash (3) Cyclone Flood H Epidemic	H Epidemic (2) MTE	Air Crash (2)
<i>Public information</i>				H Epidemic	
<i>Response and recovery activities</i>					Air Crash MTE(2)
<i>Response and recovery activities</i>			Cyclone (3) Flood (3)	Cyclone Flood	Air Crash Cyclone Flood MTE (2)

Health

The highest health-related risks to the Pilbara EM district are deaths, injuries and illnesses from the human epidemic scenario (Table 16). The hazard scenario has a significant number of persons with a novel strain of avian influenza and a number of deaths as a result. While the consequences of death for this scenario are considered the same as those from cyclone and air crash, the likelihood of the human epidemic scenario occurring is greater and thus is an extreme risk. It was noted that although at least 7 deaths may occur as a result, the likelihood of this was assessed as 40%.

It is expected that the health system would be overwhelmed and require significant external assistance for all scenarios except the MTE scenario. However, this was only anticipated to lead to a further potential death in the scenarios with a high volume of injuries and/or fatalities (air crash and human epidemic). Human epidemic is expected to place the most demand on health services, with the only two extreme risks resulting from this scenario.

The air crash scenario features heavily in the high risks and is expected to have the greatest impact on emergency services, particularly RFDS. The demand placed on RFDS to transport patients, specifically burns patients, to Perth for treatment would significantly impact their service provision and they would likely require external assistance in this event.

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

Health					
Category	Extreme	High	Medium	Low	Very Low
<i>Deaths</i>	H Epidemic	Air Crash Cyclone Flood MTE			MTE
<i>Disease outbreak</i>			Flood		Cyclone
<i>Emergency services</i>		Air Crash Flood H Epidemic	Cyclone		MTE
<i>Emergency services</i>		Air Crash	H Epidemic	Air Crash Cyclone H Epidemic	
<i>Health services</i>				H Epidemic	Air Crash
<i>Health services</i>		Air Crash H Epidemic			MTE
<i>Health services</i>			Air Crash Cyclone Flood H Epidemic (4)		
<i>Impacts to general health</i>				H Epidemic	
<i>Impacts to people's health</i>				Air Crash Flood H Epidemic (2)	Cyclone MTE
<i>Injuries and illnesses</i>	H Epidemic	Air Crash	Cyclone Flood		MTE
<i>Loss of income</i>				H Epidemic	
<i>Mental health</i>		Air Crash			

Industry/commercial

The greatest industry impacts in the Pilbara EM district are financial losses resulting from disruption to the marine and mining industries, and a reduction in workforce attendance leading to productivity losses. These come as a result of the cyclone, flood, human epidemic and MTE scenarios (Table 17).

Workforce productivity losses would be greatest from the human epidemic scenario. It was anticipated that on average, workforces across the district would decrease by 20%, with this peaking to 50% at the height of the epidemic. Due to the prolonged period over which the epidemic is expected to take place, this could be extremely problematic when trying to replace employees in sectors that require specialist skills. As a result of a reduced workforce, the Pilbara Ports Authority expected they would cut down to skeleton crews across the district. With a large volume of traffic through these ports, this could result in major economic consequences over an extended period. It is important to note, however, that most port revenue does not go to the Pilbara district itself, but rather to the state.

The marine industry is also impacted by the cyclone scenario, which poses a high risk. Severe winds from a Category 5 cyclone would require boat ramps and ports to be closed prior to their onset. Mining companies reliant on ports would continue production but at minimum output. Impacts to infrastructure are most likely to occur as a result of the storm surge; however it was expected that financial losses would primarily be from disruption to the sector rather than damage to infrastructure itself.

Agricultural and pastoral activities are expected to be most impacted by flooding. The impact on livestock, through death or injury, resulting in financial losses was assessed as medium risk, as a large amount of water standing in fields for an extended period may result in drowning and feed issues. The flood scenario was also expected to impact on cropping in the district, with a potential knock-on effect through the season. This was assessed to have a minor consequence as it was anticipated to result in less than one year profit reductions (low risk).

For air crash, if the *Fokker 100* fleet were to be grounded due to mechanical issues, the impact on the mobility of mining/offshore workers who use aircraft to travel to their place of employment would result in a number of companies incurring additional costs in order to keep production going. As the Pilbara is dominated by the mining, oil and gas industries, the impact on mobility of workers other than those in the mining/offshore industry was considered lower risk.

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

Industry/commercial					
Category	Extreme	High	Medium	Low	Very Low
<i>Impacts to agricultural and pastoral activities</i>			Flood	Flood	Cyclone
<i>Impacts to commercial activities</i>				H Epidemic (3)	MTE (2)
<i>Impacts to marine infrastructure and industry</i>		Cyclone H Epidemic	Flood		MTE (2)
<i>Impacts to mining infrastructure and industry</i>		Flood MTE			
<i>Impacts to port and marina services</i>				Cyclone	
<i>Workforce productivity losses</i>		H Epidemic	Air Crash Cyclone	H Epidemic	

Tourism

All hazards pose a low to very low risk to tourism in the district (Table 18). The natural hazards are expected to create greater financial losses in the sector due to their more widespread nature. Tourism does not play a major economic role in the Pilbara, thus the social consequences of any impacts to tourism are also very low.

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

Tourism					
Category	Extreme	High	Medium	Low	Very Low
<i>Impacts to tourism</i>				Cyclone Flood H Epidemic	Air Crash MTE (2)
<i>Impacts to tourism</i>					MTE

Transport

Flood poses the highest risk to road networks in the Pilbara, resulting in financial losses incurred through either delays or the physical damage of infrastructure (Table 19). Inland gravel roads would be the most susceptible. In addition, the North West Coastal Highway may be vulnerable, due to its age. The cyclone scenario would impact the road network, but only via the subsequent flooding. Impacts to transport infrastructure were assessed to cause disruptions to emergency service activities and are a medium risk for both cyclone and flood. It is anticipated that there would be issues with mobilising staff around the district and RFDS in particular may be restricted in its ability to transport patients.

Air crash and cyclone would have the greatest impact on the aviation industry through disruption to air services. For cyclone, the impact would primarily be to Karratha Airport which is likely to reopen in a matter of days following the cyclone. However, it was suggested that considerable resources (those external to the district) may be required to help return to normal function.

The air crash scenario would result in a significant reduction in aviation services at Karratha Airport until the crash wreckage had been cleared and investigations completed. The flow-on effect of cancelling all flights in and out of Karratha would impact schedules and demand elsewhere. The effect of the grounding of the entire *Fokker 100* fleet is expected to impact all airports that operate that aircraft type. Some airports in the Pilbara, such as Paraburdoo Airport, are limited in the aircraft they can accommodate. Economic costs associated with the grounding, such as using alternative aircraft, disrupting scheduled maintenance and associated knock-on costs were assessed as a medium risk.

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

Transport					
Category	Extreme	High	Medium	Low	Very Low
<i>Disruption to aviation</i>			Air Crash Cyclone	Flood	
<i>Disruption to transport routes</i>			Flood	Cyclone	
<i>Emergency services</i>			Cyclone Flood		
<i>Impacts to aviation</i>			Air Crash		Air Crash (3) Cyclone Flood
<i>Impacts to bridges or their approaches</i>				Cyclone Flood	

Transport					
Category	Extreme	High	Medium	Low	Very Low
<i>Impacts to transport infrastructure</i>			Flood	Cyclone	
<i>Workforce productivity losses</i>			Air Crash		Air Crash

Utilities

Only cyclone and flood were assessed for their impact on utilities as the other hazards were not foreseen to cause impacts.

The costs incurred from these natural events correlate to impacts in service provision: financial loss (pink rows – Table 20) from damage to infrastructure is the same risk as the corresponding loss in service provision (orange rows). The exception to this being water supply and sewerage systems. In general, these systems are well designed and less exposed comparatively such that damage and repairs would be lower. However, disruptions to services are a higher risk level because these systems rely on the power supply to operate, which itself is deemed a high risk for cyclone and a medium risk for flood.

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

Utilities					
Category	Extreme	High	Medium	Low	Very Low
<i>Impacts to communication infrastructure</i>			Flood		Cyclone
<i>Impact to communication service delivery</i>			Flood		Cyclone
<i>Impacts to power supply infrastructure</i>			Cyclone	Flood	
<i>Impacts to power supply service delivery</i>			Cyclone	Flood	

Utilities

Category	Extreme	High	Medium	Low	Very Low
<i>Impacts to sewerage systems</i>				Flood	Cyclone
<i>Impacts to sewerage service delivery</i>			Flood	Cyclone	
<i>Impacts to water supply infrastructure</i>				Flood	Cyclone
<i>Impacts to water supply service delivery</i>			Cyclone Flood		

6 Risk evaluation

The next step in the risk management process is to evaluate the risks, determining whether the risk is acceptable or requires treatment (Figure 10).

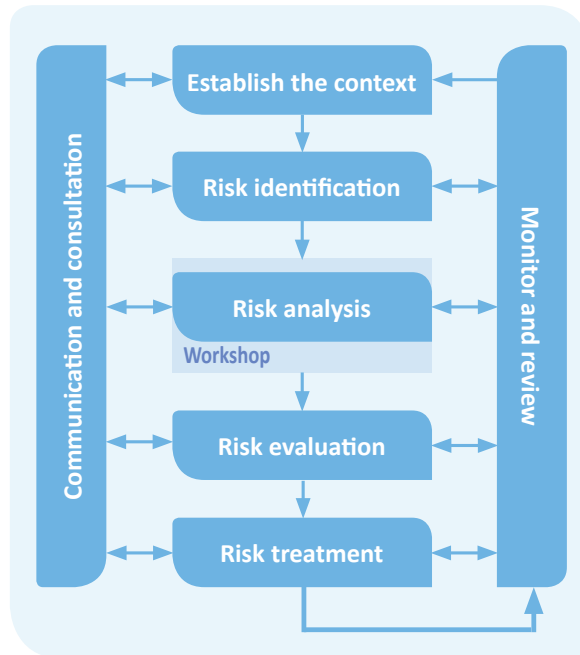


Figure 10: Emergency risk management process.⁴

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 11 illustrates that the majority of the Pilbara EM district risk statements are classified as Priority 5 (45%), meaning that these are broadly acceptable risks which require no further action, other than monitoring and review during the next risk assessment phase. Eleven risk statements (5%) have been classified as Priority level 2, indicating that these risks have a high priority for further investigation and/or treatment.

Three risk statements were classified as Priority 1 (1%), all of which relate to human epidemic. Two of these statements have been classified as a Priority 1 because they have an extreme risk level and moderate confidence level; the other has a high risk level but its confidence level is low. These three statements should be investigated further to improve confidence in the assigned consequence and risk levels.

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

Table 21 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.

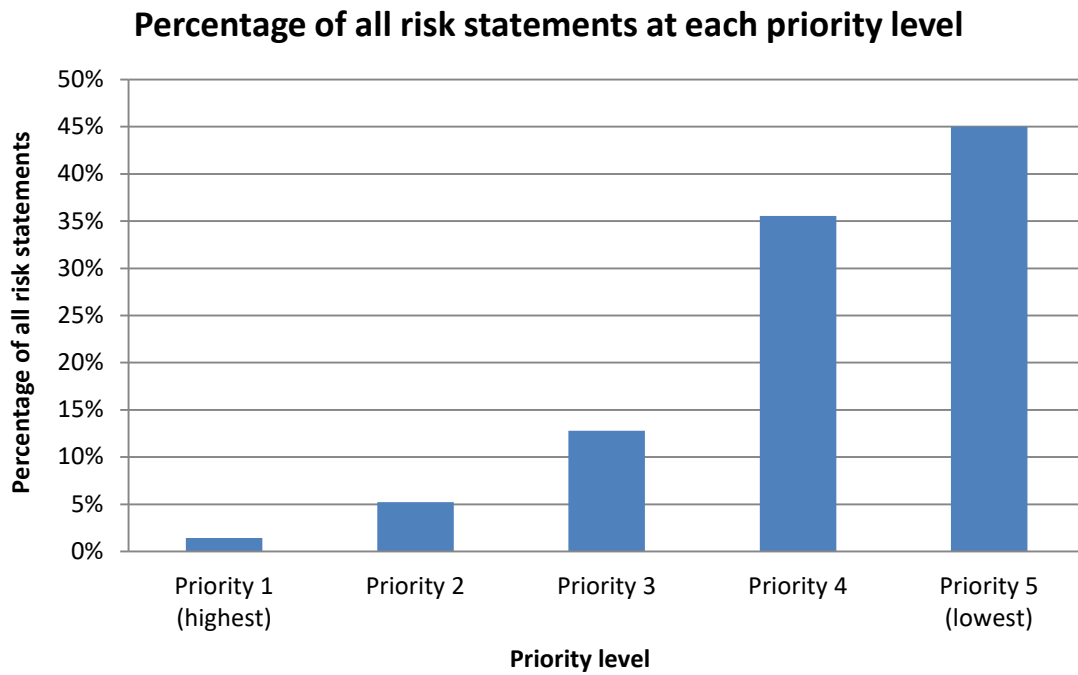


Figure 11: Percentage of all risk statements at each priority level. Priority 1 – highest; Priority 2 – high; Priority 3 – medium; Priority 4 – low; Priority 5 – lowest.

Table 21: Risk statements for the Pilbara district with Priority level 1 or 2 or catastrophic consequences. Note: H Epidemic = human epidemic.

Hazard	Risk statement	Impact area	Consequence	Risk level	Confidence level	Priority level
H Epidemic	will impact the health of people and cause death(s).	People	Catastrophic	Extreme	Moderate	1
H Epidemic	will impact the health of people and cause injury and/or serious illness.	People	Catastrophic	Extreme	Moderate	1
H 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	Low	1
Air Crash	will impact the health of people and cause death(s) as a direct result of the plane crash.	People	Catastrophic	High	High	2
Air Crash	will impact the health of people and cause injury and/or serious illness.	People	Catastrophic	High	High	2
Flood	will impact the mining industry (e.g. through damage to infrastructure, evacuations of miners etc.) resulting in financial losses.	Economy	Major	High	Moderate	2
Air Crash	will impact mental health, resulting in death.	People	Major	High	Low	2
H Epidemic	will impact port activities, resulting in financial losses.	Economy	Major	High	High	2
H 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	Major	High	Moderate	2
Cyclone	will impact the mining industry (e.g. through damage to infrastructure, evacuations of miners etc.) resulting in financial losses.	Economy	Major	Medium	Low	2
H Epidemic	will impact workforce attendance leading to productivity loss and consequently financial loss.	Economy	Major	High	Moderate	2

Hazard	Risk statement	Impact area	Consequence	Risk level	Confidence level	Priority level
H Epidemic	will impact workforce attendance within the prisons, community corrections and private courts and custody transport providers, impacting their ability to deliver core services.	Public Administration	Major	High	Moderate	2
H Epidemic	will impact educational services, impacting their ability to deliver core services.	Public Administration	Moderate	Medium	Lowest	2
H Epidemic	will impact RFDS services, impacting their ability to deliver core services.	Public Administration	Moderate	Medium	Low	2
Cyclone	will impact the health of people and cause death(s).	People	Catastrophic	High	Moderate	3



7 Future actions

A preliminary 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.

Air crash

This section summarises the risk to the Pilbara EM district from the air crash scenario. The percentage of risk statements at each risk level for the scenario is shown in Figure 12.

Percentage of risk statements at each risk level for air crash

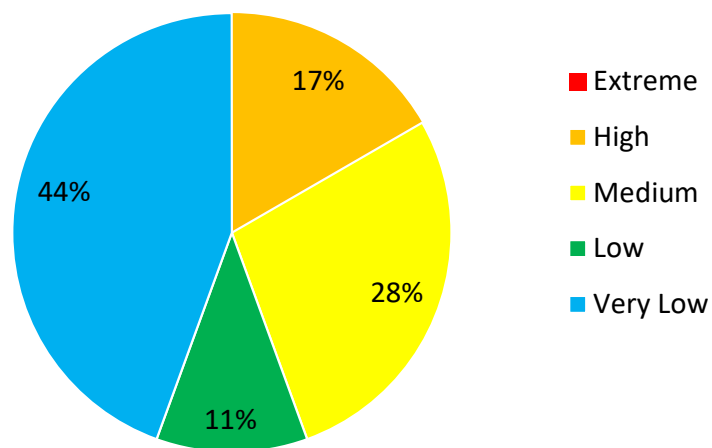


Figure 12: Percentage of risk statements at each risk level for air crash

Air crash risk assessment

ECONOMY



Extreme and High risks

Nil.

Medium risks

Financial losses associated with the grounding of the *Fokker 100* aircraft. Stakeholders commented that there could be significant costs across the district as a whole, particularly as some airports can only accept a limited selection of planes, such as Paraburdoo Airport. Financial losses from impacts to the mobility of mining/offshore industry employees and a lack of workforce on site. Many companies would have contingencies for this, such as extending or delaying the time for workers on site, but there would be additional costs.

Low risks

Nil.

Very Low risks

Stakeholders noted that they would require additional resources to manage the event but costs associated with response and recovery activities, including environmental clean-up, would be likely be borne by the state not the Pilbara EM district. Other very low risks were: response and recovery activities; impacts to airfreight services; mobility of non-mining/offshore workers; infrastructure damage to Karratha Airport; tourism; confidence in the aviation industry.

PEOPLE



Extreme risks

Nil.

High risks

Approximately 20 deaths and 40 serious injuries were anticipated. Additional deaths due to health and emergency services, including medical transport, being overwhelmed (primarily based on the burns unit being overwhelmed and the limited capacity of RFDS in this situation). An additional death may occur due to the time required to transport people to Perth. Impacts to mental health leading to death were also a high risk.

Medium, Low and Very low risks

Nil.

Air crash risk assessment

PUBLIC ADMINISTRATION



Extreme risks

Nil.

High risks

Increased demand (surge) on RFDS, affecting their service provision. Given the limited number of planes available, RFDS would likely seek assistance outside the EM district to deliver their services.

Medium risks

Impacts to service delivery of DFES, WA Police (including disaster victim identification unit), WA Health and other state agencies and the aviation industry. Each organisation would encounter a surge in response, which would taper off during recovery. During this time, all agencies would either encounter a significant reduction in their core service delivery and/or would require resources from external to the district to assist.

Low risks

St John Ambulance would experience a limited reduction in their core service provision.

Very Low risks

Impact to the services of ATSB, local governments, Department of Defence. Risk of social unrest.

SOCIAL SETTING



Extreme, High and Medium risks

Nil.

Low risks

The impact to the community due to the deaths and/or serious injuries and the impacts to survivors, affecting community wellbeing. Stakeholders commented that the air crash scenario would damage but not break the community's social fabric. There are likely to be family members in the district who have relatives that die in the air crash. Impacts to response workers.

Very Low risks

Losses of income or employment. Impacts to the social morale of people that use or work on similar aircraft.

ENVIRONMENT



Extreme, High, Medium and Low risks

Nil.

Very Low risks

Contamination of the environment from the release of aviation fuel and toxic substances on the plane were determined to be insignificant to the EM district as there would be no damage to ecosystems. At the local level, the impacts could be significant. Contamination to the environment from the use of firefighting foam was evaluated as insignificant. Karratha Aviation Rescue Fire Fighting noted that while the old foam had environmental impacts, the new foam that they are now using does not have any known environmental impacts.

Cyclone

This section summarises the risk to the Pilbara EM district from the cyclone scenario. The percentage of risk statements at each risk level for the scenario is shown in Figure 13.

Percentage of risk statements at each risk level for cyclone

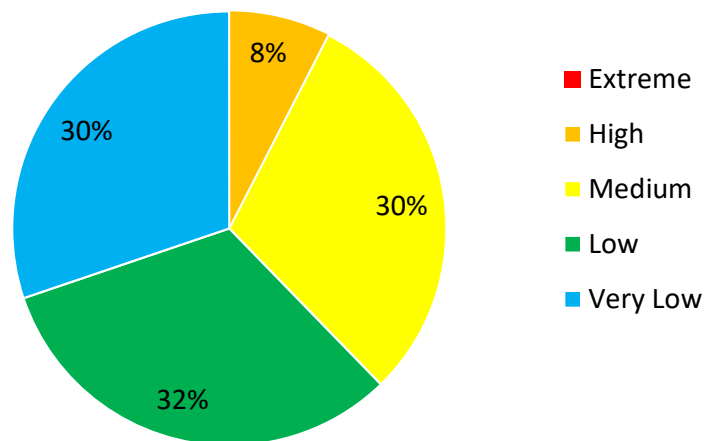


Figure 13: Percentage of risk statements at each risk level for cyclone.

Cyclone risk assessment

Extreme risks

Nil.

High risks

Financial losses resulting from the impacts to vessels, marinas, marine infrastructure, boat ramps and/or major ports. Losses would primarily be from disruption, not damage. Ports would be closed prior to the onset of strong winds. Offshore oil and gas industries would de-man vessels and would continue production but at minimum output.

Medium risks

Impacts to power infrastructure and private and commercial buildings and contents. Specifically, the possibility of widespread inundation of private and commercial buildings in the Karratha area. Disruption to the mining industry. The potential economic losses to the mining industry have a major consequence, while the others have moderate consequences.

Low risks

Financial losses due to impacts to roads, bridges and infrastructure, disruption to major freight routes and reputational damage to the tourism sector.

Very Low risks

Economic losses due to impacts to communications, sewerage, potable water, aviation and the livestock sector.

ECONOMY



Cyclone risk assessment

PEOPLE



Extreme risks

Nil.

High risks

Deaths were assessed as high risk with the potential for catastrophic consequences. This indicates the potential for at least seven deaths; however the chance of this level of consequence was low, assessed as 5%.

Medium risks

Injuries and illnesses directly attributable to the cyclone were assessed as a medium risk and a major consequence, indicating at least 1 critical and/or 7 serious injuries; however the chance of this level of consequence occurring was assessed as 35%. Further deaths as a result of access restrictions for ambulance and medical transport services was assessed as a major consequence (at least 1 death) and was rated as having a 70% chance of occurring.

Low risks

Nil.

Very Low risks

Impacts to people's health due to stagnant water and waterborne diseases.

PUBLIC ADMINISTRATION



Extreme risks

Nil.

High risks

DFES would encounter a severe reduction in their core services as a result of the possible inundation of their facilities within Karratha. It would require them to run their operations out of Port Hedland and seek assistance from outside the district. With a large number of persons (~5000) expected to be displaced by the storm surge inundation, there would be an increased demand on public facilities to act as welfare centres.

Medium risks

Impacts to services provided by local government, CPFS, WA Health, DAFWA, Main Roads, emergency response buildings, aviation, water and power supplies. CPFS noted that the level of impact would be reduced by teams brought in from Perth prior to the cyclone.

Low risks

Impacts to the services provided by the Department of Education, WA Police, St. John Ambulance, remote Aboriginal community corporations, Parks & Wildlife, NGOs, ports and wastewater providers.

Very Low risks

Nil.

Cyclone risk assessment

SOCIAL SETTING



Extreme, High and Medium risks

Nil.

Low risks

Short (<14 days) and long-term (>14 days) displacement of the community. A significant number of houses in Karratha would be inundated, resulting in a number of people displaced in the district. Assistance external to the district would be required to return the community to normal function. Impacts to private and commercial retail outlets and services.

Very Low risks

Impacts to the community as a result of deaths and injuries, a reduction in NGO services, cancellation of cultural events, impacts to facilities for the vulnerable, remote Aboriginal communities, educational facilities and losses of income.

ENVIRONMENT



Extreme, High and Medium risks

Nil.

Low

Soil erosion in river catchment areas; impacts on flora and fauna.

Very Low risks

Impacts from debris and pollutants entering marine/estuarine/riverine environments.

Flood

This section summarises the risk to the Pilbara EM district from the flood scenario. The percentage of risk statements at each risk level for the scenario is shown in Figure 14.

Percentage of risk statements at each risk level for flood

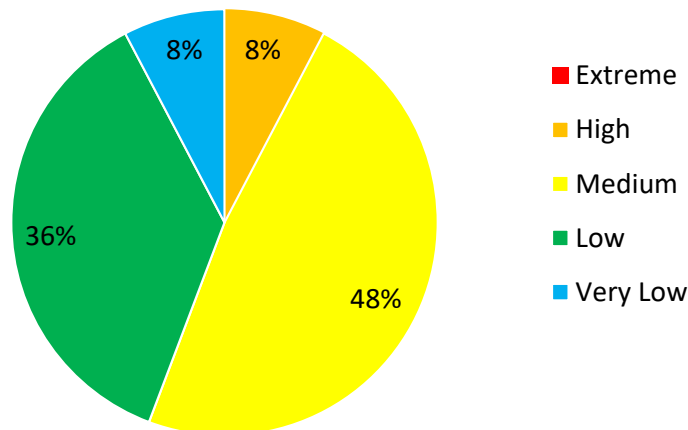


Figure 14: Percentage of risk statements at each risk level for flood.

Flood risk assessment

ECONOMY



Extreme risks

Nil.

High risks

Impacts to the mining industry. The evacuation of mine staff and damage to infrastructure was assessed to have a major consequence, indicating the potential for at least \$227.3 million in financial losses.

Medium risks

Impacts to communications infrastructure causing some exchanges to stop working. Staff would be required from outside of the EM district to assist in restoring communications; however, any damage costs would be borne by Telstra, rather than the EM district. Impact to vessels, marinas, marine infrastructure and major ports was expected to result in moderate consequences. There is potential for the Port of Port Hedland to be impacted by the filling of berth pockets with silt which may require dredging. Impacts to private buildings and contents, with the greatest impact expected in inland towns. Impacts to major freight routes and livestock through death/injury of animals or feed issues.

Low risks

Impacts to bridges, power supplies, sewerage, water supply, cropping and tourism.

Very Low risks

Impacts to aviation.

PEOPLE



Extreme risks

Nil.

High risks

Deaths, either directly caused by the flood or as a result of disruption to emergency services (particularly medical transport services), were assessed as high risk. In more rural areas, emergency services are heavily reliant on roads e.g. between Tom Price and Paraburdoo. If these roads are impacted, the services would likely be impacted. Both statements were assessed to have major consequences indicating the potential for at least one death.

Medium risks

Injury, illness and an outbreak of a waterborne disease were assessed as medium risks.

Low and Very Low risks

Nil.

Flood risk assessment

PUBLIC ADMINISTRATION



Extreme risks

Nil.

High risks

Impact of the flood event on remote Aboriginal community corporations was assessed as a high risk due to the difficulty of supporting communities without significant external resources.

Medium risks

Access to some parts of the district is likely to be limited following the flood event. This, coupled with limited resources and the need to bring staff in from outside of the district to assist in the event results in a medium risk level for services provided by DFES, CPFS, WA Health, DAFWA, Parks & Wildlife and Main Roads. Impacts to essential services such as potable water, sewerage, communications and transport infrastructure were assessed as medium risks. This was primarily due to the potential for physical damage to critical infrastructure and the time associated with fully restoring services.

Low risks

Impacts to power supply and the delivery of core services by WA Police, ambulance, local government, NGOs and the aviation industry.

Very Low risks

Impacts to emergency response buildings and educational facilities.

SOCIAL SETTING



Extreme and High risks

Nil.

Medium risks

Isolation of remote Aboriginal communities in low-lying areas or near rivers and floodways was assessed as a medium risk. The flood event could lead to access issues for food, fuel, money and medical resources. Impacts to residential dwellings and contents, long term (>14 days) displacement of communities, impacts to the services of NGOs.

Low risks

Deaths/injuries affecting the community, short term (<14 days) displacement, impacts to educational facilities, losses of income and limited goods and services as a result of either the closure of businesses or from transport disruption.

Very Low risks

Impacts to educational facilities.

Flood risk assessment

ENVIRONMENT



Extreme and High risks

Nil.

Medium risks

The risk of soil erosion in river catchments was assessed a medium risk. Participants drew on historical experience of the Fortescue River which suffered long term damage from previous flood events.

Low risks

Impacts to flora and fauna, as well as impacts caused by debris and pollutants, were assessed as a low risk with a minor consequence indicating either minor or localised impacts not requiring assistance for recovery.

Very Low risks

Nil.

Human Epidemic

This section summarises the risk to the Pilbara EM district from the human epidemic scenario. The percentage of risk statements at each risk level for the scenario is shown in Figure 15.

Percentage of risk statements at each risk level for human epidemic

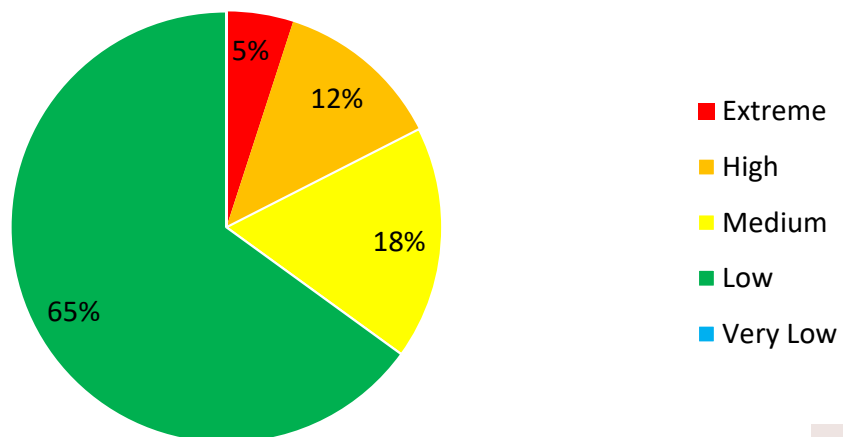


Figure 15: Percentage of risk statements at each risk level for human epidemic.

Human epidemic risk assessment

ECONOMY



Extreme risks

Nil.

High risks

Financial losses associated with reduced workforce attendance.

Stakeholders estimated that workforce attendance would be reduced by ~20% across the district, with this peaking to 50% in some situations.

This would be significant in a job where particular skills are required and difficult to replace. Impacts to port activities, resulting in financial losses were estimated to be \$100 million a day; however, revenue from the port goes to the state, not directly to the EM district.

Medium and Low risks

Nil.

Very Low risks

Financial losses resulting from impacts to commercial spending in the retail sector; tourism, hospitality and entertainment industries. Other very low risks were: demand for medical resources; transport providers (e.g. bus or airport); the mining industry; and major events.

PEOPLE



Extreme risks

The human epidemic scenario is expected to result in at least seven deaths and numerous people with serious illness.

High risks

Further deaths due to emergency services, including medical transport services, being overwhelmed resulting in at least one death. Stakeholders commented there was a low likelihood of this occurring. Impacts to remote health services resulting in deaths, or illness directly attributable to the epidemic was evaluated as high risk.

Medium risks

Nil.

Low risks

Impacts to the health of people with other medical conditions, due to the demand placed on health services by the epidemic.

Very Low risks

Nil.

Human epidemic risk assessment



Extreme risks

Nil.

High risks

Impacts to workforce attendance within the prisons, community corrections and private courts and custody transport providers, impacting core services. Industrial action to withdraw workforce may be taken if there is a perceived or real threat. Inter-prison movements occur every day and could accelerate the spread of the disease.

Medium risks

Impact to WA Police core service provision. While the consequences may be moderate for WA Police at the peak of the event, generally the consequences will be minor. RFDS evaluated their impacts to service delivery as medium risk and determined staff would likely be affected as they are in a small plane with closed doors, which can encourage the spread of the virus. In order to maintain health and private GP services, staff would need to be transferred from outside of the EM district to assist. Pathological and diagnostic imaging services are minimal across the Pilbara district; therefore impacts to these services were assessed as medium risk. Stakeholders commented that there are no regional stockpiles of medical supplies (e.g. linen, meals and face masks) and that suppliers would stock Perth before the Pilbara. Education services could be affected and classes might be amalgamated and run by support teachers if necessary.

Low risks

Impacts to the service delivery of: the local government sector, due to low workforce attendance; agencies delivering public information; ambulance services; and other State agencies (e.g. DFES, CPFS).

An additional comment raised by the Port Authority was the need for good communication between port staff and health staff. Problems could potentially arise, for example, if a ship closure is declared and there is no crew on a vessel during cyclone season. There could potentially be other problems like hospitals not being able to accommodate all the crew from a vessel.

Very Low risks

Nil.

Human epidemic risk assessment

Extreme, High and Medium risks

Nil.

Low risks

The breakdown of community social networks and reluctance to visit churches and places of worship were assessed to disrupt the community social fabric. Conversely, social media can help maintain communication. People may be reluctant to visit public facilities due to illness and/or a concern for getting sick. Alternatively, there may also be difficulty in getting people to self-isolate. Low risks also include: impacts to community activities; persons remaining isolated or quarantined in their homes for extended periods of time; impacts to community service providers; availability of basic needs, due to absenteeism or low workforce attendance; day-to-day functionality of support systems for the vulnerable (e.g. childcare, aged care, disability support); reluctance to attend workplaces; impacts to the day-to-day functionality of educational institutions; and the breakdown of existing family and support networks.

Very Low risks

Nil.

SOCIAL SETTING



ENVIRONMENT



The environment impact area was not assessed for human epidemic.

Marine Transport Emergency

This section summarises the risk to the Pilbara EM district from the MTE scenario. The percentage of risk statements at each risk level for the scenario is shown in Figure 16.

Percentage of risk statements at each risk level for MTE

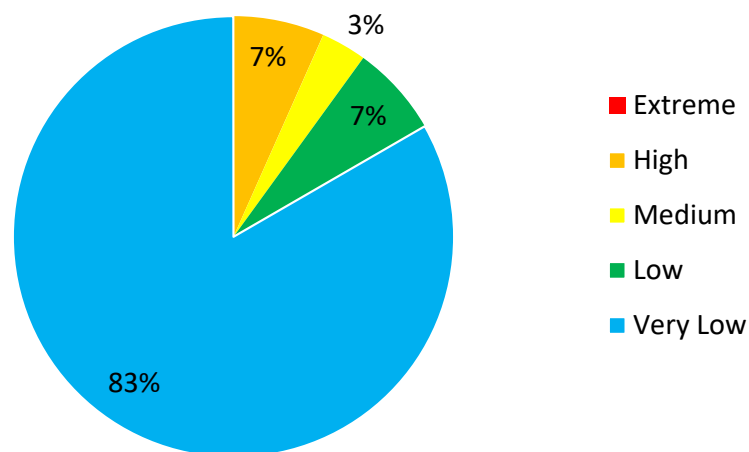


Figure 16: Percentage of risk statements at each risk level for marine transport emergency.

Discussion regarding possible impacts from an oil spill

The scenario used for this risk assessment assumed that no oil would spill from the ship when it grounded. After the risk assessment was completed a discussion was held with the workshop participants to consider the risk if oil was to spill. For this discussion, it was assumed that 150-200 tonnes (the contents of one fuel tank) of oil would spill. Impacts from an oil spill scenario are discussed below, in blue, for each impact area.

Marine transport emergency risk assessment

Extreme risks

Nil.

High risks

The only economy risk statement which was assessed as a high risk was related to the disruption of mining exports from the port due to the blocked channel. The channel could be blocked for at least one to two weeks before the grounded ship is re-floated. It was anticipated that the loss from shipping could be approximately \$100 million per day and would be at least \$1 billion (a major consequence) over the ten days the channel and port would be closed. Since the port is normally operating at maximum capacity, any disruption to exports would not be able to be accommodated at a later time.

Medium and Low risks

Nil.

Very Low risks

As this scenario caused no damage to port infrastructure there would be no cost associated with this. If there are costs from delays, these are likely to be for companies located outside of the district. Response and recovery activities were also assessed as very low risk. As part of the National Plan for Maritime Environmental Emergencies, the cost of the recovery and clean-up is covered by the polluter (the 'polluter pays' principle) who is the ship's owner or the ship's insurance cover. In this case the financial cost to the district is minimal as the district does not bear the cost. In addition, the Port of Port Hedland has insurance to cover any losses related to their operations. There may be some financial losses for tug and pilot services; however most of these are fixed contract services.

ECONOMY



Oil spill assessment

- *Oil was anticipated to wash onto beaches and shore clean-up would be required. This clean-up would likely take four weeks, prolonging the impact.*
- *It is expected that beaches in the area would be closed if oil washed up on them, affecting tourism.*
- *Some smaller businesses may be impacted because they may lose business due to the port shutdown.*
- *Various parts of the port might have to be closed at different times to allow for oil clean-up, especially around pylons and jetties.*
- *Fisheries and aquaculture may experience economic losses but most of these are located out of the Port Hedland area.*

Marine transport emergency risk assessment

PEOPLE



Extreme risks

Nil.

High risks

The potential for deaths, as a direct result of the grounding, is unlikely given that it is not a major incident. However, it was thought that there is a higher potential for response workers to be injured or killed. All tug boat operators and salvage personnel are trained, though, there is always the potential for injuries, accidents and/or deaths. As such, the statement regarding the health of response workers was assessed as a high risk because there is a possibility that at least one person could die.

Medium and Low risks

Nil.

Very Low risks

Further deaths resulting from emergency and health services being overwhelmed and the potential for minor injuries.

Oil spill assessment

- *There is still a potential for people's health to be affected through slips and respiratory problems, especially if appropriate personal protective equipment is not used.*

Extreme and High risks

Nil.

Medium risks

Increased demand on Water Police services, impacting core services. For this type of event, the Water Police would be in attendance for at least a week, providing any support and security as required.

Low risks

Increased demand on Pilbara Ports Authority (PPA) and Department of Transport (DOT) services, impacting core services. The core function of the PPA is to facilitate shipping and while this would be disrupted, other work (core and non-core) would be undertaken. For the DOT, an incident management team would be set up at the Port of Port Hedland.

Very Low risks

Response from state agencies would be minimal and they would only be required in an operational area support role. CPFS would only be involved if there was a large number of passengers who needed assistance. The DoT would be significantly affected if there was an oil spill, as would P&W.

Not applicable

There were four public administration risk statements that were assessed as not applicable for this scenario. The first related to an increased demand on DFES HAZMAT services/response; since there is no oil spill, these services would not be required. Because the incident occurs in the port there would be no local government involvement for recovery; this would be facilitated by the PPA. As the ship involved in the incident is a bulk carrier and not a cruise ship, there would be no increased demand on accommodation or public buildings for accommodating evacuated passengers.

PUBLIC ADMINISTRATION



Marine transport emergency risk assessment

Oil spill assessment

- *PPA – would assist with escorting volunteers on to the site to help with response if required. PPA has approximately 140 people based at Port Hedland; most are trained in the deployment of oil spill response equipment. PPA would have several key personnel engaged in the incident management team and clean-up operations which would affect the delivery of some of their core services, although day-to-day operations would continue.*
- *DoT – would call people in from outside the district and the response would be conducted at a state level. DOT has business continuity plans in place to conduct their services and have different plans for trained and untrained volunteers. DOT would find accommodation for trained volunteers and would go through a labour hire company for all volunteers.*
- *WA Police – would have staff members engaged in incident management teams and on recovery committees, so their resources would be required for a longer time. Resources may also be required for security to keep people off beaches and manage protests. These activities would put a strain on WA Police resources.*
- *P & W – would act as first responders in the oil clean-up operation as they have several people who are trained for oiled wildlife response. These activities would have an impact on the delivery of their core services and they would pause day-to-day services and call in external (to the Pilbara district) staff to assist.*
- *CPFS – as before, would only become involved if there was a large number of people/passengers involved (e.g. a cruise ship).*

Extreme, High, Medium and Low risks

Nil.

Very Low risks

Impacts to the community would be localised and would not affect the whole Pilbara EM district. Impact to the district's reputation, loss of aesthetics and psychological effects of any deaths would largely be restricted to the ship's crew, the port and the immediate community around the port. Community impacts from pollution, environmental damage and loss of tourism were considered insignificant and unlikely to occur.

Oil spill assessment

- *People in the Pilbara are generally more accustomed to industrial activities than other districts. However, a large number have boats and enjoy coastal activities including fishing so there may be public activism if the beaches are closed and people cannot access sites.*
- *CPFS may need to pull in additional resources from outside the district to provide support services.*
- *People would be asking questions about how this type of incident occurs and can it be prevented in the future.*
- *Impacts to the social setting would largely depend on how the incident was managed and how the media was managed by companies and agencies involved.*

SOCIAL SETTING



Marine transport emergency risk assessment

Extreme, High, Medium and Low risks

Nil.

Very Low risks

Impacts to marine wildlife (including endangered species), debris, pollutants and the channel environment were all assessed as very low risk because there was no oil spill in the scenario.

Oil spill assessment

- *In the immediate area where the ship grounds there are wetlands, mangroves, beaches and turtles (vulnerable species) which could be impacted. Pre-positioned booms and skimmers could be rapidly deployed to minimise these impacts. There are a large number of boom resources in the port due to the number of ship movements.*
- *If oil did get past the boom, it may have a minor impact; however, if it spread to the beaches it would require a removal program.*
- *Turtles are susceptible to hydrocarbons. Yet, if impacted, the whole population is unlikely to be wiped out. It would have a locally significant impact but not a district-wide impact.*
- *The Pilbara EM district is home to migrating shore birds from the northern hemisphere during certain seasons, which could lead to a greater impact if the incident were to occur during these times.*
- *The Port of Port Hedland has a sea dumping permit to dispose of channel material out in the ocean and the channel is dredged every year. Thus it is a disturbed environment regardless, so there would be no additional impact to the channel environment.*

ENVIRONMENT



Appendix B: District profile

The Pilbara EM district (Figure 17) spans an area of 507,896 km² and is considered to be an economic powerhouse in Western Australia. It has an approximate population of 68,450 which is generally concentrated in the western coastal areas, with the inland areas being more sparsely populated. Rich Aboriginal culture is present throughout the Pilbara, as well as some of the most ancient petroglyphs (rock art) and rock formations in the world. The Pilbara has an arid to sub-tropical climate characterised by the inland desert areas in the east and more sub-tropical coastal areas towards the west.

The City of Karratha, Town of Port Hedland, Shires of Ashburton, Exmouth and East Pilbara are the five local governments that operate within the district.

The main economic base is the mining and energy sector, followed by tourism, fishing and the pastoral sector. The gross regional product is approximately \$56.831 billion per annum.

Natural and man-made hazard events occur throughout the region. Priority hazards (as identified by the Pilbara DEMC) are: air crash, cyclone, flood, human epidemic and marine transport emergency.

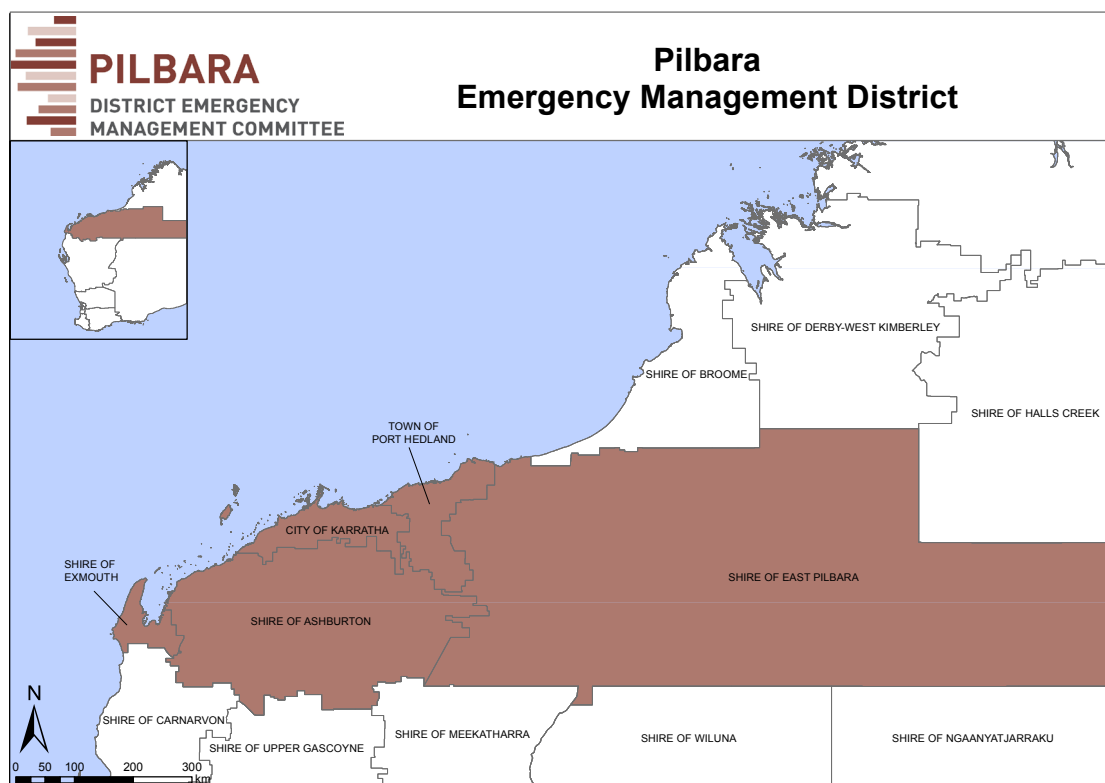


Figure 17: Pilbara EM District.

Appendix C: Pilbara EM district consequence table

(based on population: 68,450; gross area product: \$56.831 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 69 serious injuries.
Economy					
Loss in economic activity and/or asset value	Decline of economic activity and/or loss of asset value less than \$2,273,240.	Decline of economic activity and/or loss of asset value between \$2,273,240 and \$22,732,400	Decline of economic activity and/or loss of asset value between \$22,732,400 and \$227,324,000	Decline of economic activity and/or loss of asset value between \$227,324,000 and \$2,273,240,000.	Decline of economic activity and/or loss of asset value greater than \$2,273,240,000.
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 state, local or regional level and/or	Minor damage to ecosystems and species recognised at the national level. and/or	Permanent destruction of an ecosystem or species recognised at the local/regional level. and/or	Permanent destruction of an ecosystem or species recognised at the national or state level. and/or
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. and/or	Governing bodies encounter severe reduction in the delivery of core functions. and/or	Governing bodies are unable to deliver their core functions.
Social Setting					
Community wellbeing	<ul style="list-style-type: none"> Community social fabric is disrupted Existing resources sufficient to return the community to normal function No permanent dispersal. 	<ul style="list-style-type: none"> Community social fabric is damaged Some external resources required to return the community to normal function No permanent dispersal. 	<ul style="list-style-type: none"> Community social fabric is broken Significant external resources required to return the community to normal function Some permanent dispersal. 	<ul style="list-style-type: none"> Community social fabric is significantly broken Extraordinary external resources are required to return the community to functioning effectively Significant permanent dispersal. 	<ul style="list-style-type: none"> 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 matrix⁵ 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

State Emergency Management
Committee

20 Stockton Bend

Cockburn Central WA 6164

E. info@semc.wa.gov.au

W. www.semc.wa.gov.au



An Australian Government Initiative

