

# CHAPTER 19

## Hazard and risk





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## 19. Hazard and risk

This chapter identifies and describes potential hazards and risks for people and property from the construction and operation of Brisbane Metro, including natural events and the implications of climate change. Consideration is also given to potential risks related to health and safety of the community, workforce and other stakeholders in terms of the environmental factors that can affect human health, public safety and quality of life.

### 19.1 Methodology

In accordance with the *AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines*, a preliminary risk assessment was conducted, including an analysis of the consequences of each identified hazard on a safety basis and safeguards to reduce the likelihood and severity of hazards. Terrorism-related risks associated with Brisbane Metro operations were also considered. The risk assessment methodology applies the principles and guidelines of AS/NZS ISO 31000:2009, and Council's SP500 Risk management policy and SP501 Risk management guidelines.

The hazard and risk assessment involved:

- identification of potential hazards, considering:
  - natural hazards such as flooding, bushfire, storm tide and landslide in accordance with the SPP and planning for safety and resilience to hazards as mapped in City Plan
  - construction hazards such as spills, encountering unknown contaminated land, erosion and sediment control issues, noise and dust
  - operational hazards such as fire and life safety, acts of terrorism (including threat to infrastructure and hostile acts) and inappropriate access and collisions
- identification of possible receptors, including individuals and communities as well as sensitive environments (e.g. natural habitat, catchments, flora and fauna)
- identification of the type and magnitude of exposures relating to these hazards
- quantification of exposure to all potential receptors.

A hazard is something with the potential to cause harm. Risk is the likelihood that the harm will occur from exposure to the hazard. There must be a hazard and a receptor present for a risk to exist.

#### 19.1.1 Risk analysis

The risk analysis identifies the likelihood of a hazard occurring including probability or frequency, and the consequence if the hazard occurs. Risk criteria were developed for Brisbane Metro, enabling the assessment of the potential likelihood and resulting consequence if each hazard were to occur.

Table 19.1 and Table 19.2 detail the methodology used to assign likelihood and consequence ratings to each hazard in accordance with Council's corporate risk management process. The consequence rating is based on a conservative approach, i.e. the worst possible impact. The initial risk analysis is based on the assessment of the consequences of the activity if no mitigation measures are taken to reduce the likelihood and/or severity of the consequence.

Table 19.1: Risk assessment methodology

Risk element	Rating	Definition
Likelihood	Rare	Highly unlikely, would only occur in exceptional circumstances. Almost no historic occurrence within Council or comparable institutions in similar circumstances ( $P \leq 0.001$ )
	Unlikely	Not expected, but there is a slight possibility that it could occur. Very few occurrences within Council or comparable institutions in similar circumstances ( $P = 0.01$ to $0.001$ )

Risk element	Rating	Definition
	Possible	The event might occur. There is a history of occasional occurrence within Council or comparable institutions in similar circumstances (P = 0.25 to 0.01)
	Likely	There is a strong likelihood the event will occur. There is a history of frequent occurrence within Council or comparable institutions in similar circumstances (P = 0.75 to 0.25)
	Almost certain	The event is expected to occur in most circumstances (P ≥ 0.75)

Table 19.2: Risk assessment methodology (consequence)

Risk element	Rating	Definition		
		Workplace health and safety	Natural environment	Social/cultural heritage impact
Consequence	Insignificant	No impact on people	No impact on the environment.	Low social impacts leading to mostly repairable impacts on the local population.
	Minor	Some injuries to people requiring first aid assistance	Environmental incident comprising of 'environmental nuisance' caused by off-site release or harmful onsite release with minor short term and negligible cumulative environmental impacts. Impacts contained without assistance (minor clean-up required). Notification to regulator of possible breach.	Some social impacts leading to short-term decrease in community and individual well-being including one or more of the following: <ul style="list-style-type: none"> <li>some increase in crime, homelessness, poverty and family breakdown</li> <li>some decrease in health and education outcomes</li> <li>minor damage to item of cultural significance.</li> </ul>
	Moderate	Injuries require expert medical treatment, non-hospitalisation	Environment incident comprising of 'material environmental harm'. Damage is managed with site resources and procedures. The event may result in action being taken by a regulator as a breach of standards, regulations or licence conditions. Moderate impact but short recovery time.	Moderate social impacts leading to medium-term decrease in community and individual well-being including one or more of the following: <ul style="list-style-type: none"> <li>serious increase in crime, homelessness, poverty and family breakdown</li> <li>serious decrease in health and education outcomes</li> <li>moderate damage to item of cultural significance.</li> </ul>
	Major	One or more persons with severe injuries requiring hospitalisation and/or resulting in permanent disability	Environment incident comprising 'serious environmental harm'. Environmental damage (major, short term or cumulative) will require outside assistance.	Major social impacts leading to medium-term decrease in community and individual well-being including one or more of the following: <ul style="list-style-type: none"> <li>very serious increase in crime, homelessness, poverty and family breakdown</li> <li>very serious decrease in health and education outcomes</li> </ul>

Risk element	Rating	Definition		
		Workplace health and safety	Natural environment	Social/cultural heritage impact
	Catastrophic	Fatality or multiple fatalities	Environmental incident comprising 'serious environmental harm' of an extensive area where the core environmental values or attributes of the city are threatened. Long-term damage, requiring long-term recovery (years).	<ul style="list-style-type: none"> <li>major damage to item of cultural significance.</li> </ul> <p>Major social impacts leading to long-term decrease in community and individual well-being including one or more of the following:</p> <ul style="list-style-type: none"> <li>very serious increase in crime, homelessness, poverty and family breakdown</li> <li>very serious decrease in health and education outcomes</li> <li>major damage to structures of cultural significance.</li> </ul>

**19.1.2 Risk evaluation**

Combining the consequence and likelihood ratings allows development of an overall risk rating for the hazard. Table 19.3 details the corresponding risk rating depending on the likelihood and consequence previously determined. The risk rating determines the level of treatment required to manage the risk.

Table 19.3: Risk matrix

Likelihood (frequency)	Consequence (impact)				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	Low+	Medium +	High	Very high	Extreme
Likely	Low -	Medium -	Medium +	High	Very high
Possible	Negligible	Low +	Medium -	Medium +	High
Unlikely	Negligible	Low -	Low +	Medium -	Medium +
Rare	Negligible	Negligible	Negligible	Low -	Low +

**19.1.3 Risk treatment**

The risk rating identified through risk evaluation determines the treatment or management level applied to the risk. The risk ratings include extreme; very high; high; medium (+/-); low (+/-); and negligible. The general management principles for each risk rating are:

- extreme/very high – excessive risk to people and property, significant and urgent actions required to reduce the risk
- high and medium – implement mitigation measures to reduce the risk to as low as practicable
- low and negligible – monitor and manage the risk to the extent necessary.

The risk evaluation is repeated following the preliminary assessment to take into account the risk mitigation measures applied. This residual risk is developed on the assumption that all identified mitigation measures are effectively implemented.

### 19.1.4 Risk management requirements

Risk management is relevant to all stages in the life of an activity, function, project, product or asset for the rigorous and consistent management for both potential benefits and potential threats<sup>1</sup>.

AS/NZS ISO 31000:2009 provides a framework to identify and document hazards and risks associated with Brisbane Metro, in a rigorous and consistent manner enabling the ongoing identification of hazards for risk assessment throughout each stage of Brisbane Metro. The hazard and risk register will allow for the hazards and their mitigation measures to be identified, implemented (as appropriate), monitored and audited as part of performance monitoring and value management assessment in future stages of Brisbane Metro.

The standards and legislation relating to transport, handling and use of hazardous materials that apply to Brisbane Metro include the following documents:

- *AS 1216 Classification, Hazard identification and Information Systems for Dangerous Goods*
- *AS 1678 Emergency Procedure Guides – Transport*
- *AS 1940 Storage and Handling of Flammable and Combustible Liquids*
- *AS 3780 The Storage and Handling of Corrosive Substances*
- *AS 2809 Road Tank Vehicles for Dangerous Goods*
- *AS 2931 Selection of Use of Emergency Procedure Guides for Transport of Dangerous Goods*
- *AS 2187 Explosives – Storage, Transport and Use*
- *Workplace Health and Safety Act 2011 (Cwth)*
- *Work Health and Safety Act 2011 (Qld)*
- *Explosives Act 1999 (Qld)*
- EP Act.

Additional legislation and policy relevant to hazards and risk include:

- SPP 2017 – planning for safety and resilience to hazards
- *Transport Security (Counter-Terrorism) Act 2008 (Qld)*.

## 19.2 Hazard receptor identification

### 19.2.1 Hazardous activities or events

The following provides a preliminary review of potentially hazardous areas, activities or events that may occur during construction and operation of Brisbane Metro, presenting a risk to people and property. These risks will be reviewed, assessed and quantified progressively through the further development of Brisbane Metro.

#### Natural hazards

- The metro depot at Rochedale is mapped in City Plan as a medium bushfire buffer area. An area of landslide susceptibility is located adjacent to the site and will be traversed for site access.
- Eight Mile Plains station is mapped in City Plan as having a high chance of inundation from overland flow flooding.
- Griffith University station, including the new bus turnaround and layover facility, is mapped in City Plan as a high and medium bushfire hazard and buffer area.
- The existing busway south of Greenslopes station runs through an area mapped in City Plan as medium bushfire hazard and buffer and also has a high likelihood of inundation from overland flow.

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<sup>1</sup> Standards Australia (2005) *HB 436:2004 (Incorporating Amendment No. 1)*, Risk Management Guidelines Companion to AS/NZS 4360:2004

- The proposed construction laydown area at Hanlon Park has a high likelihood (five per cent annual chance) of creek flooding inundation and a low chance of storm surge inundation as mapped in City Plan.
- UQ Lakes station is mapped within City Plan as having a high likelihood (five per cent annual chance) of inundation from Brisbane River flooding.
- There is a high risk of flooding at the existing busway adjoining the BCEC from significant Brisbane River flooding events.
- Victoria Bridge and North Quay are mapped as areas of medium and high storm tide inundation risk and an erosion prone area for coastal erosion.
- There is a risk of flooding from overland flows of the existing busway west of the Roma Street station.
- Normanby and Herston stations are at high risk (five per cent annual chance) from overland flow flooding.
- Ernie's Roundabout at Herston is mapped as a medium storm tide inundation risk, an erosion-prone area for coastal erosion and high likelihood of creek flooding with a duration of inundation of up to six hours.

### Construction hazards

- Operation of vehicles and construction equipment onsite including in a confined space.
- Storage of dangerous goods, including oils and fuels, in relatively compact construction worksites.
- Use of oils, fuels and other dangerous goods, and their transport to construction areas.
- Transportation of excavated spoil to placement areas offsite.
- Excavation and transportation off-site of contaminated soil.
- Working with electricity and in proximity to electricity in the operational rail corridors and electrical infrastructure along roads.
- Working within operating rail and busway environments.
- Working in noisy construction environments.
- Construction failures or incidents, which could result in tunnel or underground collapse or subsidence, flooding or inundation.
- Construction failures or incidents resulting in collapse of structures.
- Changes to surface road and services networks.
- Risk of contamination of groundwater from drawdown.
- Accidental disturbance of utilities.
- Separation of pedestrians and general traffic from construction activities and equipment.
- Flooding and inundation from both surface and groundwater sources including contaminated groundwater.

### Operational hazards

- Brisbane Metro incidents both on surface and below ground.
- Maintenance works in the busway and and/or ancillary infrastructure.
- Acts of terrorism or vandalism, such as acts leading to fires and/or explosions.
- Inappropriate access to the busway.
- Collapse, subsidence or failure of structural components.
- Flooding and inundation from both surface and groundwater sources.

### 19.2.2 Existing environment and receptors

The study area comprises the southern and inner northern suburbs of Brisbane and the CBD. It includes areas of residential, retail, commercial, business, industry, health facilities, educational facilities, open space, natural features and infrastructure including busways, rail corridors, state and local roads, footpaths, bikeways and service utilities.

The majority of Brisbane Metro will use existing busway infrastructure, for which most infrastructure will not be modified. The construction of Brisbane Metro will require above- and below-ground construction, connections to the existing busways, construction traffic and access works including temporary and permanent changes to the surface road and public transport networks.

Receptors within the study corridor that will potentially be subject to hazardous events associated with Brisbane Metro include:

- residential communities and other sensitive heritage, health and educational land uses adjacent to the Brisbane Metro alignment, Brisbane Metro stations, construction worksites, ancillary surface works locations, transport routes and soil placement areas
- commuters who use busways, rail and associated commuter facilities associated with Brisbane Metro
- motorists, pedestrians and cyclists who use the road network and footpaths near Brisbane Metro
- the workforce constructing and operating Brisbane Metro
- groundwater and surface water catchments including the Brisbane River, Breakfast Creek, Norman Creek and Bulimba Creek
- ecological communities of the Brisbane River as well as vegetated areas and parks such as Tooley Forest Park.

### 19.3 Risk assessment

An assessment of hazards and risks associated with Brisbane Metro was undertaken in accordance with the method described in section 19.1.

#### 19.3.1 Natural hazard risks

Areas susceptible to natural hazards have been identified along the alignment. As much of the alignment is existing busway, this assessment focuses on the sections of new or altered infrastructure. The key natural hazards relate to:

- creek flooding relating to access to the proposed depot
- overland flow and riverine flooding at the new underground Cultural Centre station and transition structure
- creek flooding at Ernie's Roundabout.

The assessment included the effects of climate change on flooding.

The nature and severity of these risks have been considered in the design of Brisbane Metro's infrastructure and operational strategy (refer to Chapter 5 and Chapter 8). Further consideration of flooding will be undertaken through the detailed design phase.

#### 19.3.2 Construction risks

Construction risks associated with Brisbane Metro relate to the construction environment and activities. They include:

- operation of vehicles and construction equipment in the confined underground and station areas; leading to the potential for spillages, fire, poor air quality and collisions

- storage of hazardous substances in relatively compact construction worksites
- construction failures and accidents including structural and station collapse or subsidence, flooding and worker injuries and death
- the use of oils, fuels and other hazardous chemicals, and their transport to construction areas
- possible underground inflow of pollutants such as hydrocarbons and toxic chemicals (South Brisbane)
- the transport of excavated materials to disposal areas.

Hazardous chemical risks require management to avoid the potential for adverse impacts. Section 19.1.4 identifies the legislation, standards and policies that apply for the transport, storage, use and disposal of hazardous chemicals. Approvals required for hazardous chemicals are identified in Chapter 22.

Risks associated with contaminated groundwater and soil are addressed in Chapters 7 and 9 and relevant approvals are identified in Chapter 22.

Construction risks can generally be mitigated through the implementation of appropriate construction methodologies, practices and procedures. Where there is the possibility of a fatality, the consequence cannot be reduced. However, the likelihood of the consequence occurring can be reduced as far as practicable. General construction management measures are addressed in Chapter 23.

### 19.3.3 Operational risks

The main hazards anticipated to have an unmitigated risk rating of 'extreme' result from external influences including acts of terrorism or vandalism, abnormal weather events and unauthorised access to Brisbane Metro infrastructure. Identification of the risks during the ongoing design of Brisbane Metro can allow for these risks to be addressed through design enhancements. For example, to manage unauthorised access, the platforms of underground stations are proposed to be separated from the bus lanes using platform screen doors to remove access unless a metro vehicle or bus is boarding/unboarding.

## 19.4 Risk management plan

Risk management is a continual process which requires monitoring and review. Brisbane Metro has committed to an ongoing process of risk management, which includes the development of a risk management plan identifying the roles and responsibilities of specific bodies and personnel during both construction and operation. This plan will be developed in conjunction with the Queensland Government and building upon existing risk management plans.

The plan will also identify a schedule for review of the risks in line with the Brisbane Metro objectives.

If the Chief Executive of TMR designates Brisbane Metro as a 'security-identified surface transport operation', a whole-of-project risk management plan will be required under the *Transport Security (Counter-Terrorism) Act*.

## 19.5 Health and safety

The assessments for the draft Design Report have considered environmental factors that have the potential to affect human health, public safety and quality of life, such as air pollutants, odour, worksite lighting, impacts to amenity, dust, noise, vibration and water quality during the construction and operational phases of Brisbane Metro (refer to relevant chapters). These issues have been raised by community and stakeholder groups through the consultation for the Brisbane Metro.

Mitigation and management measures are identified in the relevant chapters to avoid or minimise the risk of impacts. As the busway is currently in operation, policies and procedures are in place to manage risks to people operating and using the busway as well as living nearby. Council will work with the Queensland Government to further develop these policies and procedures to incorporate changes relevant to Brisbane Metro.

### 19.6 Emergency management plan

The Queensland Government has existing emergency management procedures for evacuation of the busway during an incident due to external influences, natural disaster or operations failure. These procedures will be further developed by Council and the Queensland Government to include the changes to the busway infrastructure and operations related to Brisbane Metro.

The procedures will include strategies to address such things as:

- evacuation routes from underground stations, tunnel and aboveground stations including disabled access
- procedures in the event of a fire, spillage or flooding event
- procedures in the event of a collision within the tunnel
- acts of terrorism
- roles and responsibilities
- effective communication systems/channels in the event of an emergency
- traffic management/control systems.

### 19.7 Summary

This preliminary risk assessment has identified a list of potential hazards to people and property relevant to Brisbane Metro's planning, construction and operation. The application of mitigation measures or safeguards can generally reduce the risk rating of the hazard and lower the residual risk. The most significant risks identified in this assessment are associated with the need to evacuate underground stations and tunnels in the event of an emergency.

The risk assessment process is intended to be continuous, carried forward throughout the different phases of Brisbane Metro. This preliminary risk assessment has provided a framework for further more detailed hazard identification and risk analysis, evaluation and treatment.

The health and safety values of the community, stakeholders and workforce have been identified and are addressed by the relevant chapters within the draft Design Report. Future detailed assessment of human and public health is required in later stages of Brisbane Metro delivery.