

Chapter 22

Hazards and risk

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22 Hazards and risk

22.1 Assessment approach

A desktop assessment has been carried out to identify potential environmental and community hazards and risks that could arise as part of the upgrade of the Great Western Highway between Blackheath to Little Hartley (the project), as well as mitigation measures to address identified hazards and reduce risks. The assessment considered the following legislation, guidelines and resources:

- bushfire prone land mapping and developed by the NSW Rural Fire Service
- Planning for Bush Fire Protection (NSW Rural Fire Service, 2019) and AS3959-2018 Construction of Buildings in Bushfire Prone Areas (Australian Standards, 2018)
- *Work Health and Safety Act 2011* (NSW)
- Storage and Handling of Dangerous Goods Code of Practice (WorkCover NSW, 2005)
- *Dangerous Goods (Road and Rail Transport) Act 2008* (NSW)
- Dangerous Goods (Road and Rail Transport) Regulation (NSW Government, 2014)
- Australian Standard 4825 (Tunnel fire safety)
- Hazardous and Offensive Development Application Guidelines: Applying SEPP 33 (SEPP 33 guidelines) (NSW Government, 2011)
- Australian Dangerous Goods Code (National Transport Commission, 2020).

22.2 Potential impacts – construction

Potential hazards during construction may be associated with:

- bushfires
- storage, use and transportation of dangerous goods and hazardous substances
- damage or disruption of utilities and services
- potential release of coal seam gas from tunnelling activities
- worker health and safety including tunnel hazards, rock falls and the operation of mobile plant and other machinery.

In addition, there is potential for the following technical hazards during construction as discussed in the respective chapters:

- public safety impacts associated with construction traffic management and access (refer to Chapter 5 (Construction) and Chapter 8 (Transport and traffic))
- motorist, pedestrian and cyclist impacts during construction (refer to Chapter 8 (Transport and traffic))
- dust generation during construction (refer to Chapter 9 (Air quality))
- human health impacts associated with noise and air pollution during construction (refer to Chapter 10 (Human health))
- potential impacts associated with excavations, groundwater, geotechnical uncertainty, ground movement and settlement during construction (refer to Chapter 13 (Groundwater and geology))
- potential hazards associated with flooding, including tunnel flooding, during construction activities (refer to Chapter 14 (Surface water and flooding))

- encountering acid sulfate rock, asbestos and contaminated soils during construction activities (refer to Chapter 15 (Soils and contamination))
- climate change impacts (refer to Chapter 23 (Sustainability, climate change and greenhouse gas)).

22.2.1 Bushfires

The project would be located in an area prone to bushfires. The project would be surrounded by highly vegetated landscapes including the Blue Mountains National Park. These vegetated areas are located between Medlow Bath, Blackheath and Mount Victoria and are managed by the National Parks and Wildlife Service. Between Mount Victoria and Little Hartley, the vegetation is also characterised by dense woodland and is managed by the National Parks and Wildlife Service, Blue Mountains City Council and Lithgow City Council. Vegetation around Little Hartley comprises mostly grassland vegetation including pasture grasses.

The bushfire prone land mapping developed by the NSW Rural Fire Service identifies the vegetation between Blackheath and Mount Victoria, excluding the Blackheath and Mount Victoria town centres, as Category 1 vegetation¹ (see Figure 22-1). Other surrounding vegetation is characterised as Category 3 vegetation. The existing Great Western Highway is mostly categorised as a bushfire buffer zone (NSW Rural Fire Service, 2015) and would form a key emergency evacuation route in the Blue Mountains area.

Bushfires during the 2019-2020 summer burnt about 79 per cent, or 855,310 hectares of the Greater Blue Mountains World Heritage Area (Smith, 2021). On 21 December 2019, the Great Western Highway was closed between Katoomba and Hartley due to the risk of bushfire. As such, the risk of bushfire impacting the project is present and ongoing.

Construction of the project could increase the risk of bushfires resulting from:

- conducting hot work activities such as welding, plant operation and operation of an electricity substation adjacent to vegetated areas
- the presence of combustible materials including mulch stockpiling, fuel and chemical storage.

There is a possibility that bushfires will occur during the course of construction, given the longer lasting bushfire seasons due to the effects of climate change. During construction, efforts would be made to minimise the interaction of hot work activities and potential ignition sources and intact vegetation in the area surrounding the project.

Construction work involving hot work activities would be avoided where possible particularly during periods subject to higher bushfire risk including during total fire bans. Where unavoidable, such activities would be carried out within buildings, purpose-built workshops, or the tunnel during fit-out to provide increased protection of equipment from bushfires.

Appropriate fire suppression and mitigation measures would be required at all construction sites. Mitigation measures to reduce the risk of construction work starting a bushfire and to manage the impact of bushfire events are provided in Table 22-1.

While long-term road closures are not anticipated during construction, there may be short-term disruption to the local road network due to the movement and delivery of construction equipment and machinery. In the event of a flash bushfire emergency, access along the existing Great Western Highway and local roads would be maintained during construction.

During a bushfire emergency, project surface construction work would likely cease if required, minimising potential delays for surface road traffic due to construction work. The majority of construction work would continue in tunnels underground if possible, minimising impacts to

¹ Category 1 vegetation is the highest risk for bushfire in NSW. This vegetation category has the highest combustibility and likelihood of forming fully developed fires including heavy ember production. Category 3 vegetation is medium bush fire risk vegetation. It is higher in bushfire risk than category 2 (and the excluded areas) but lower than Category 1 (NSW Rural Fire Service, 2019).

operation of the surface road network. Appropriate mitigation measures to minimise and manage impacts in the case of emergencies and incidents are outlined in Table 22-1. Further discussion of road emergency measures is provided in Chapter 8 (Transport and traffic).

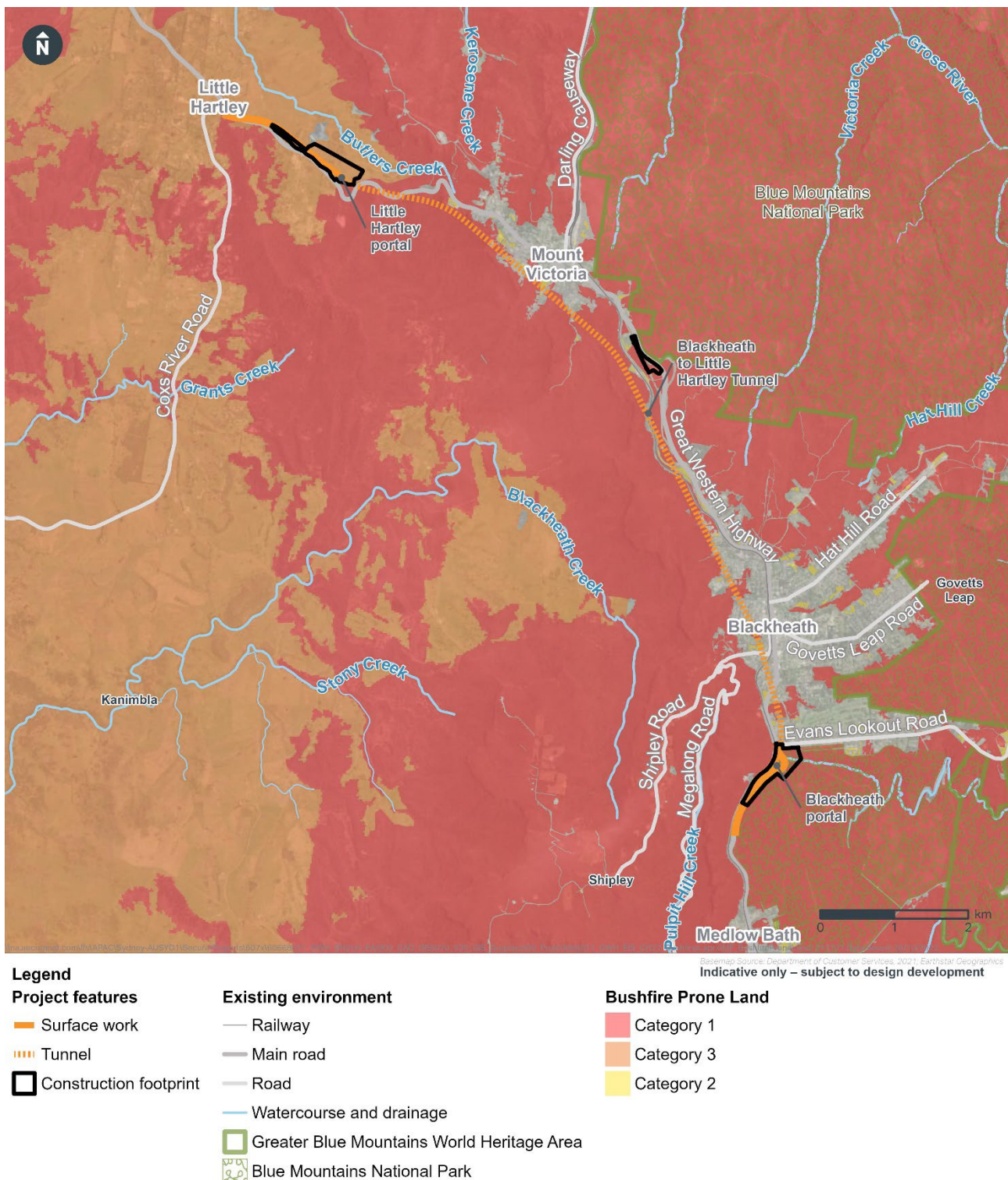


Figure 22-1 Bushfire prone land

22.2.2 Storage, use and transport of dangerous goods and hazardous substances

Dangerous goods and hazardous substances would be temporarily used, stored and transported during construction of the project. This would include petrol, diesel, lubricating and hydraulic oils and greases, industrial grade oxygen, acetylene, cement, premix concrete, concrete curing compounds, concrete retardant, shotcrete accelerator, epoxy glue, coagulants, acids, bases,

disinfectant, antiscalant, membrane preservative, de-bonding agents, contaminated waste and paints.

Potential impacts from dangerous goods and hazardous substances during construction may include:

- spills and leaks from construction vehicles and machinery during refuelling, tunnelling and travelling within and between construction sites
- spills or the emission of other hazardous substances from mechanical or other failures of construction machinery
- spills from construction water treatment plants or emission of other hazardous substances due to human error.

The method of storage would vary depending on the materials but would include drums of various sizes, small and intermediate bulk containers, cylinders in racks, bags/pallets and banded areas where appropriate.

Typically, low volumes of potentially hazardous materials, such as diesel, petrol, lubricants and paints, would be stored on-site, with the exception of the Little Hartley construction site where larger volumes of materials would be required to support tunnel construction. The volume required to be stored on-site would largely depend on the anticipated rates of consumption, with deliveries of dangerous goods coordinated to match consumption rates.

Planning of indicative construction site layouts would ensure hazardous materials are stored appropriately and at an appropriate distance from sensitive receivers, in accordance with the thresholds established under Applying SEPP 33 (NSW Government, 2011). Should the separation distances be unable to be maintained a risk management strategy would be developed on a case-by-case basis.

Environmental hazards and risks associated with the on-site storage, use and transport of chemicals, fuels and materials would be managed through standard mitigation measures to be developed as part of the Construction Environmental Management Plan (CEMP). These measures would include the storage and management of all hazardous substances in accordance with applicable guidelines and standards, so that they do not cause a significant off-site risk.

22.2.3 Damage or disruption of utilities and services

The project would likely require adjustments to existing utility services such as electricity, water, gas and communications. Potential impacts associated with damage, rupture, or failure to shut down or isolate underground utilities during construction include:

- loss of service to local communities if the utility is severed
- electrocution to the construction worker who intercepts the utility
- possible release of untreated sewerage and / or gas from a sewer main, and potential impacts to water mains and drains
- possible release of natural gas from a gas main and possible start of a fire.

Hazards from interference with underground utilities and services would include potential impacts from intercepting existing utilities, as well as utilities required to enable the construction of the project.

The project runs parallel to an overhead 132 kV electricity cable (Line 940/941) located about one kilometre from the Great Western Highway. To avoid disruption or damage to this powerline, or other existing services located in the vicinity of the project, these services would be protected, relocated or removed before construction via the methods outlined in Chapter 5 (Construction).

A preliminary dial-before-you-dig search has identified existing utilities near the Blackheath portal and Little Hartley portal which include telecommunications and electricity conduits, gas, sewer and

water mains. Prior to construction, a new dial-before-you-dig search would be conducted followed by pothole surveys, to confirm existing and new underground utilities.

Consultation with utility providers has been carried out and would continue during design development and construction to mitigate the risk of unplanned and unexpected disturbance of utilities. In rare circumstances, the relocation of utilities may result in short term outages of some utilities to surrounding areas.

Mitigation measures to minimise the risk of disruption to project utilities and services are provided in Table 22-1.

22.2.4 Intercepting coal seam gas

The project would involve tunnelling through geology near Little Hartley, which is mapped as Illawarra coal measures, which typically contain coal seams of varying thicknesses. The indicative depth of the Illawarra coal measures geological stratum is shown in Figure 13-1 in Chapter 13 (Groundwater and geology). Coal seam gas is a natural gas found in coal deposits, typically 300-600 metres underground (Department of Climate Change, Energy, the Environment and Water, 2021). Large quantities of gas are stored on the internal surfaces of coal, and contained under pressure.

Given coal seam gas is composed primarily of methane, a potent greenhouse gas, appropriate drainage and venting would be established during construction of the tunnels to limit anthropogenic climate change, potential contamination of groundwater, aquifers and soils, or spontaneous combustion due to the interaction with methane and oxygen or heat from construction equipment.

Tunnelling through the Illawarra coal measures may present a hazard if coal seam or methane gas in the coal measures or surrounding soils are intercepted. The presence of methane and carbon monoxide gases have the potential to create an explosive atmosphere during excavation. To manage this potential impact, detailed site investigations would be carried out to characterise, quantify and map the extent of potential for coal seam gas. If required based on these investigations, gas drainage and venting would be implemented prior to construction in areas where potential coal seam gas is likely to be intercepted.

Impacts associated with interception of coal seam gas are further discussed further in Chapter 5 (Construction) and Chapter 13 (Groundwater and geology).

22.2.5 Public safety

The potential hazards to public safety during construction include:

- fires or explosions
- rock falls at cuttings
- operation of mobile plant and other machinery.

These hazards are discussed below. Other hazards to public safety during construction are discussed in the respective chapters:

- ground movement (refer to Chapter 13 (Groundwater and geology))
- exposure to airborne pollutants (refer to Chapter 9 (Air quality) and Chapter 10 (Human health))
- acid sulfate rock and sources of contamination (refer to Chapter 15 (Soils and contamination))
- flooding (refer to Chapter 14 (Surface water and flooding))
- traffic and pedestrian safety (refer to Chapter 8 (Transport and traffic)).

Fires or explosions

The project would include work near naturally combustible materials within soil. Encountering flammable materials including coal seam gases located underground is discussed in Section 22.2.4. In addition, construction machinery used during construction would contain flammable and combustible materials such as diesel and petrol, and potential ignition sources would include hot work procedures and electrical equipment. The use and storage of combustible materials on-site and at construction sites would generally be located at surface level.

Works, especially those near naturally combustible materials, would increase the risk of fires or explosions. Measures developed during detailed construction planning to manage worker safety in the event of a fire or explosion would also adequately manage potential public safety risks during construction.

Rock falls at cuttings and earthquakes

During excavation of tunnels, rock falls can occur if portal breakthrough areas are not secured properly before excavation. Rock falls have the potential to injure construction workers and community members and may cause damage to construction machinery and private property or vehicles.

In the event of an earthquake during construction, there is potential for ground displacement and shaking which also has the potential to injure construction workers.

Mitigation measures would be applied to reduce the risk of rock falls and earthquakes, including the use of appropriate personal protective equipment, frequent tunnel inspections, scaling, progressive installation of properly secured ground support, safety fencing and overhead protection.

Operation of mobile plant and other machinery

Other construction activities that could result in potential impacts to the safety of workers and the local community if not properly managed include:

- the operation of mobile plant and construction equipment on-site
- construction failures or incidents resulting in fire, flooding, inundation, or excavation collapse.

The potential safety hazards associated with the operation of mobile plant include the plant overturning, objects falling on the plant or plant operator, the operator falling from the plant, or collisions between the plant and other persons or machinery.

The following construction activities can result in construction failures:

- unsafe storage of gas, chemicals or fuels resulting in leaks and possible fire ignition or electrocution
- smoking on-site as a source of fire ignition
- interception of power, gas, sewer or water services causing fires, flooding, or inundation and possible electrocution
- storing excavated materials too close to the trench, stress loading the soil or heavy machinery vibration causing excavation collapse.

Safety hazards during construction would be managed through the implementation of standard workplace health and safety requirements. A Work Health and Safety Management Plan and safe work method statements would be developed in accordance with regulatory requirements.

A range of additional mitigation measures are proposed to manage safety during construction. These are outlined in Chapter 8 (Transport and traffic) to Chapter 24 (Cumulative impacts). A consolidated list of mitigation measures is provided in Appendix R (Compilation of environmental mitigation measures).

22.3 Potential impacts – operation

This section discusses the potential hazards during operation of the project:

- bushfires and other natural disasters
- storage, use and transportation of dangerous goods and hazardous substances
- public safety hazards including the operation of mobile plant and other machinery.

In addition, the following hazards during operation have been identified and are discussed in the respective chapters:

- motorist, pedestrian and cyclist hazards during operation (refer to Chapter 8 (Transport and traffic))
- potential hazards associated with operational in-tunnel and ambient air quality (refer to Chapter 9 (Air quality))
- human health impacts associated with noise and air pollution during operation (refer to Chapter 10 (Human health))
- flooding, including in tunnel flooding, during operation of the project (refer to Chapter 14 (Surface water and flooding))
- geotechnical uncertainty and ground movement during operation (refer to Chapter 13 (Groundwater and geology) and Chapter 20 (Business, land use and property) for ground movement impacts to properties)
- operational hazards associated with climate change impacts, including changes in temperature, rainfall and storm intensity (refer to Chapter 23 (Sustainability, climate change and greenhouse gas)).

22.3.1 Bushfires

Once operational, the project would improve the resilience of the Great Western Highway corridor between Blackheath and Little Hartley to bushfire risk and other natural disasters as the new tunnel would provide an additional route of travel across this section of the Blue Mountains. In the case that other roads across the Blue Mountains such as Bells Line of Road are closed due to bushfire risk, increased capacity would be available along the Great Western Highway with the project.

During more localised bushfire events that may impact the Great Western Highway between Blackheath and Little Hartley, there is potential for the tunnel to be affected by smoke, which could impact the visibility of motorists in the tunnel and the in-tunnel air quality.

The ventilation system described in Chapter 4 (Project description) is designed to operate in emergencies as well as normal conditions for both the ventilation outlet option and the portal emissions option. The system relies on drawing in ambient air into the tunnel. In the event the ambient air outside the tunnel is polluted with bushfire smoke, acceptable air quality may not be able to be maintained in the tunnel. If in-tunnel air quality deteriorates to below acceptable standards due to bushfire smoke, the tunnel would be closed to motorists to minimise impacts to human health. If in-tunnel air quality meets the acceptable standards, the tunnel would remain open and could provide a safe evacuation route.

Most of the project's operational ancillary facilities would be designed in consideration of bushfire risk, such as road surface materials, retaining walls, road barriers. Operational ancillary facilities would be located and designed taking into account Planning for Bush Fire Protection (NSW Rural Fire Service, 2019) and AS3959-2018 guidelines which prescribe minimum setback distances for infrastructure near bushfire prone land.

Mitigation measures proposed to limit bushfire hazards and risks during operation are provided in Table 22-1. This includes the development of a Bushfire Management Plan to be implemented during operation which would detail the conditions under which the tunnel would be closed and outline access arrangements in the event of a bushfire.

22.3.2 Storage, use and transport of dangerous goods and hazardous substances

Dangerous goods and hazardous substances stored, used and transported for the project during operation would be limited and may include coagulants, polymers, acid and bases. Additional small quantities of other hazardous materials may occasionally be required on-site for the water treatment plant at Little Hartley and to support maintenance activities.

The regulations and safe practices described for the construction phase of the project would also apply to the operational stage (refer to Section 22.2.2).

A decision on whether dangerous goods would be permitted to be transported through the tunnel would be made during ongoing design development in consultation with the relevant stakeholders.

22.3.3 Public safety

There are various potential public safety hazards during the project's operation. The section below discusses the hazards related to the operation of mobile plant and other machinery.

Other hazards to public safety during operation are discussed in the respective chapters:

- in-tunnel and ambient air quality impacts for motorists (refer to Chapter 9 (Air quality), Chapter 10 (Human health))
- traffic incidents in the tunnels or adjoining roads (refer to Chapter 8 (Transport and traffic))
- ground movement (refer to Chapter 13 (Groundwater and geology))
- impacts associated with an operational power supply connection to the project substation at Little Hartley.

Operation of mobile plant and other machinery

Project maintenance activities would include ventilation system testing and maintenance, fire system testing and maintenance, cleaning, road repaving, and repair works as required. These activities could result in potential impacts to the local community if not properly managed. Such hazards could arise from:

- the operation and movement of operational maintenance plant and vehicles on-site
- maintenance incidents resulting in fire, flooding, inundation, or damage to project infrastructure.

Safety hazards during operational activities would be managed through Transport's existing environmental management system, and specifically through a Bushfire Management Plan and an Incident Response Management Plan, as detailed further in Table 22-1.

Earthquakes

The structural design for the tunnel has considered the potential impacts of earthquakes on both the bored tunnel segment and the permanent tunnel lining. This would manage potential ground movement impacts to the tunnel during an earthquake.

22.4 Environmental mitigation measures

Mitigation measures to avoid, minimise or manage project hazards and reduce their risk are detailed in Table 22-1. A full list of performance outcomes and environmental mitigation measures for the project is provided in Appendix R (Compilation of environmental mitigation measures).

Table 22-1 Environmental mitigation measures – hazards and risk

ID	Mitigation measure	Timing
HR1	<p>A Bushfire Management Plan (BMP) will be prepared and implemented during construction and operation of the project, in consultation with the NSW Rural Fire Service and Fire and Rescue NSW. The BMP will be prepared in accordance with Planning for Bush Fire Protection 2019 (NSW Rural Fire Service, 2019) and AS 3959-2018 – Construction of Buildings in Bushfire-prone Area, and will include:</p> <ul style="list-style-type: none"> • regular review of bushfire prone land mapping developed by the NSW Rural Fire Service near the project • monitoring of weather and local bushfire ratings • ensuring appropriate access arrangements are available in the event of a bushfire • operational requirements for community notifications in the event of a bushfire • ensuring plant and equipment are fitted with appropriate spark arrestors, where practicable • ensuring appropriate evacuation procedures for workers and the public in case of a bushfire • ensuring site workers are informed of the site rules including designated smoking areas and putting rubbish in designated bins • obtaining hot work permits and implementing total fire bans as required • implementing adequate storage and handling requirements for potentially flammable substances in accordance with relevant guidelines. 	Design and construction
HR2	<p>Dangerous goods required during construction and operation of the project will be stored and handled in accordance with the relevant guidelines including:</p> <ul style="list-style-type: none"> • applicable Australian Standards • for liquids, a minimum bund volume requirement of 110% of the volume of the largest single stored volume, within the bund. 	Construction and operation
HR3	Closed circuit television cameras will be installed to monitor traffic flows to enable early detection of incidents and queues in the tunnel.	Operation