

Chapter 23

Hazards and risks



23 Hazards and risks

This chapter assesses potential hazards arising from incidents during project construction and operation that could pose a risk to public safety, the surrounding community or the environment and summarises the approaches taken to manage these risks. Other potential environmental hazards resulting from construction and operation of the project, and measures to avoid, mitigate and manage these risks are addressed in Chapter 8 (Construction traffic and transport) to Chapter 27 (Cumulative impacts) of this environmental impact statement. The impacts associated with human health risks are detailed in Chapter 13 (Human health).

The Secretary's environmental assessment requirements as they relate to hazard and risk impacts, and where in the environmental impact statement these have been addressed, are detailed in Table 23-1.

The proposed environmental management measures relevant to hazards and risks are included in Section 23.4.

Table 23-1 Secretary's environmental assessment requirements – Hazards and risks

Secretary's requirement	Where addressed in EIS
Transport and traffic	
<p>1. The Proponent must assess construction transport and traffic (vehicle, marine, pedestrian and cyclists) impacts, including, but not necessarily limited to:</p> <ul style="list-style-type: none"> a. a considered approach to route identification and scheduling of marine and land transport movements, particularly outside standard construction hours; j. impacts to water based traffic and shipping channels on Sydney Harbour. 	<p>Chapter 6 (Construction work), Section 6.7 and Section 6.8 show the land and maritime construction traffic/vessel movements for each construction support site, as well as the operating hours of each site.</p> <p>Construction traffic routes are discussed in Chapter 8 (Construction traffic and transport). Section 8.4 discusses the proposed marine and land transport movements. Section 23.2.4 outlines interactions between maritime traffic and tunnel infrastructure during construction.</p>
Health and Safety	
<p>2. The assessment must:</p> <ul style="list-style-type: none"> f. assess the likely risks of the project to public safety, paying particular attention to pedestrian safety, subsidence risks, bushfire risks and the handling and use of dangerous goods; 	<p>An assessment of bushfire risks relating to construction and operation is presented in Section 23.2.6 and Section 23.3.5 respectively.</p> <p>The handling, transport and use of dangerous goods is described in Section 23.2 and Section 23.3.</p> <p>An assessment of potential ground movement associated with the project is provided in Chapter 16 (Geology, soils and groundwater). Ground movement due to construction activities is also discussed in Section 23.2.3.</p> <p>Pedestrian safety is discussed in Chapter 8 (Construction traffic and transport).</p> <p>Section 23.3.3 provides an assessment on the impacts of potential traffic incidents during operation.</p>

Secretary's requirement	Where addressed in EIS
Socio-economic, Land Use and Property	
4. The Proponent must assess potential impacts on utilities (including communications, electricity, gas, fuel and water and sewerage) and the relocation of these utilities.	Chapter 6 (Construction work) details utilities impacted during construction. Chapter 5 (Project description) outlines utilities and services management for the project and Appendix D (Utilities management strategy) provides a detailed description of utilities likely to be impacted and a framework for utility installations, relocations, adjustments and protection.
Hazards	
1. The Proponent must describe the process for assessing the risk of emissions from ventilation facilities on aircraft operations taking into consideration the requirements of the <i>Airports Act 1996 (Commonwealth)</i> and the Airports Regulation 1997.	The process for the assessment of risk of emissions from ventilation facilities on aircraft operation is described in Chapter 2 (Assessment process), and the findings of this assessment are summarised in Section 23.3.6 .

23.1 Assessment methodology

An assessment was carried out to identify environmental hazards and risks that could arise during construction and operation of the project, as well as appropriate risk management measures.

The assessment focused on those hazards with the potential to adversely affect the surrounding environment, and the general public. It took into account the following guidelines:

- *Hazardous and Offensive Development Application Guidelines: Applying SEPP 33* (Department of Planning, 2011)
- *Australian Code for the Transport of Dangerous Goods by Road and Rail (7th edition)* (National Transport Commission, 2007)
- *Storage and Handling of Dangerous Goods Code of Practice* (WorkCover, 2005)
- *Planning for Bushfire Protection* (Rural Fire Service (RFS), 2006)
- *Bush Fire Risk Management Planning Guidelines for Bush Fire Management Committees* (RFS, 2008)
- Bushfire prone land mapping developed and published by the relevant local councils.

23.2 Assessment of potential construction impacts

During construction, potential hazards and risks to public safety, the surrounding community or the environment may be associated with:

- Storage and handling of dangerous goods and hazardous substances (Section 23.2.1)
- Transport of dangerous goods and hazardous substances (Section 23.2.2)
- Ground movement (settlement) or geotechnical uncertainty (Section 23.2.3)
- Interactions between maritime traffic and tunnel infrastructure (Section 23.2.4)
- Damage to or disruption of underground utilities and services (Section 23.2.5)

- Bushfires (Section 23.2.6).

Other potential environmental hazards resulting from the construction of the project are considered and addressed in the relevant chapters of this environmental impact statement.

23.2.1 Storage and handling of dangerous goods and hazardous substances

The anticipated types and quantities of dangerous goods and hazardous substances that would be stored and used within the project construction support sites are listed in Table 23-2. The types and quantities of dangerous goods and hazardous substances would be confirmed during further design development, and if necessary, further screening of potential risks would be carried out at that time. The screening would be used to confirm that the project would not pose a significant off-site risk.

While State Environmental Planning Policy No. 33 – Hazardous and Offensive Development (SEPP 33) would not apply to the project (refer to Chapter 2 (Assessment process)), the principles of SEPP 33 have been followed to consider potential hazards associated with the project. The screening thresholds specified in Hazardous and Offensive Development Application Guidelines: Applying SEPP 33 (Applying SEPP33) (Department of Planning, 2011) have been applied to inventories of dangerous goods to be stored at each construction support site. These screening thresholds represent the level at which dangerous goods may present a credible off-site consequence requiring further, more detailed assessment of risks. Assessment against the screening thresholds is included in Table 23-2.

Table 23-2 demonstrates that the Applying SEPP 33 inventory thresholds would not be exceeded for any material on any site. The storage and use of dangerous goods and hazardous materials on the project construction support sites would therefore not pose an unacceptable risk of harm beyond the construction support site boundary.

Environmental hazards and risks associated with the on-site storage and use of chemicals, fuels and materials would be managed through standard mitigation measures (refer to Section 23.4). Storage of dangerous goods and hazardous substances would be in accordance with the supplier's instructions, and would comply with applicable legislation, guidelines and Australian Standards.

Table 23-2 Indicative dangerous goods and hazardous substances stored at construction support sites

Material	Australian Dangerous Goods Code class	Storage method	Assessment against Applying SEPP 33 inventory thresholds	Construction support site
Explosives	1.1	No on site storage – delivery would be timed to avoid the need for on-site storage	Explosives would not be stored on site and would therefore not be subject to the Applying SEPP 33 thresholds.	N/A
Diesel	C1 ¹ , 3 PG III ²	Self-bunded fuel tank (up to 2.5 kilolitres) and 20 litre jerrycans	Diesel would be less than five tonnes and would not be stored with Class 3 materials. It would therefore not be subject to the Applying SEPP 33 thresholds.	All land based construction support sites.
Petrol	C1 ¹ , 3 PG III ²	Self-bunded fuel tank (up to 2.5 kilolitres) and 20 litre jerrycans	Petrol would be less than five tonnes and would not be stored with Class 3 materials. It would therefore not be subject to the Applying SEPP 33 thresholds.	All land based construction support sites.
Lubricating and hydraulic oils and grease	C2	20 litre drums	Lubricating and hydraulic oils and grease would not be stored with Class 3 materials and would therefore not be subject to the Applying SEPP 33 thresholds.	All construction support sites.

Material	Australian Dangerous Goods Code class	Storage method	Assessment against Applying SEPP 33 inventory thresholds	Construction support site
Industrial grade acetylene	2.1	3.2 m ³ cylinders (13 kilograms)	Individual cylinders containing acetylene would not trigger the Applying SEPP 33 thresholds (100 kilograms). Maximum stored inventories (250 kilograms) would be located more than 25 metres away from the nearest construction support site boundary and would therefore not trigger the Applying SEPP 33 thresholds if considered in aggregate.	All construction support sites.
Industrial grade oxygen	2.2	8.9 m ³ cylinders	Industrial grade oxygen is a class 2.2 dangerous good and is therefore not subject to the Applying SEPP 33 thresholds.	All construction support sites.
Accelerator for shotcrete	3.2	1000 litre intermediate bulk containers (IBC)	Individual IBCs containing accelerator fluid would not trigger the Applying SEPP 33 thresholds (five tonnes). Maximum stored inventories (20,000 litres) would also be located more than eight metres away from the nearest construction support site boundary and would therefore also not trigger the Applying SEPP 33 thresholds if considered in aggregate.	<ul style="list-style-type: none"> • Victoria Road (WHT2) • Yurulbin Point (WHT4) • Berrys Bay (WHT7) • Cammeray Golf Course (WHT10 and WFU8).
Retardants for concrete	3 PGIII	205 litre drums	Retardants would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate.	All land based construction support sites.

Material	Australian Dangerous Goods Code class	Storage method	Assessment against Applying SEPP 33 inventory thresholds	Construction support site
Epoxies	3 PGIII	20 litre drums	Epoxies would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate.	All construction support sites.
Acids	8 PGIII	1000 litre IBC (and smaller containers)	Acids would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate.	All construction support sites.
Bases	8 PGIII	1000 litre IBC	Bases would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate.	All construction support sites.
Disinfectants	8 PGIII	500 litre IBC	Disinfectants would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate.	All land based construction support sites.
General purpose Portland cement	N/A	20 kilogram bags	Cement is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds.	All land based construction support sites.

Material	Australian Dangerous Goods Code class	Storage method	Assessment against Applying SEPP 33 inventory thresholds	Construction support site
Road and joint sealants	N/A	12 litre boxes	Road and joint sealants are not a dangerous good and therefore do not trigger the Applying SEPP 33 thresholds.	All Warringah Freeway Upgrade construction support sites and the following construction support sites associated with the Western Harbour Tunnel component of the project: <ul style="list-style-type: none"> • Rozelle Rail Yards (WHT1) • Victoria Road (WHT2) • Berry Street north (WHT8) • Ridge Street north (WHT9) • Cammeray Golf Course (WHT10).
Concrete curing compounds	N/A	1000 litre IBC	Concrete curing compounds are not a dangerous good and therefore do not trigger the Applying SEPP 33 thresholds.	All land based construction support sites.
Pavement layers curing compound	N/A	1000 litre IBC	Pavement layers and curing compounds are not a dangerous good and therefore do not trigger the Applying SEPP 33 thresholds.	All construction support sites associated with the Warringah Freeway Upgrade component of the project and the following construction support sites associated with the Western Harbour Tunnel component of the project: <ul style="list-style-type: none"> • Rozelle Rail Yards (WHT1) • Victoria Road (WHT2) • Berry Street north (WHT8) • Ridge Street north (WHT9) • Cammeray Golf Course (WHT10).

Material	Australian Dangerous Goods Code class	Storage method	Assessment against Applying SEPP 33 inventory thresholds	Construction support site
Paint for tunnel roof	N/A	1000 litre IBC	Paint is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds.	<ul style="list-style-type: none"> • Rozelle Rail Yards (WHT1) • Victoria Road (WHT2) • White Bay (WHT3) • Cammeray Golf Course (WHT10).
Paints	N/A	50 litre drums	Paints are not a dangerous good and therefore do not trigger the Applying SEPP 33 thresholds.	<ul style="list-style-type: none"> • Rozelle Rail Yards (WHT1) • Victoria Road (WHT2) • White Bay (WHT3) • Cammeray Golf Course (WHT10 and WFU8) • Blue Street (WFU1).
Coagulants	N/A	1000 litre IBC	Coagulants are not a dangerous good and therefore do not trigger the Applying SEPP 33 thresholds.	<ul style="list-style-type: none"> • Victoria Road (WHT2) • White Bay (WHT3) • Yurulbin Point (WHT4) • Berrys Bay (WHT7) • Cammeray Golf Course (WHT10).
Anti-scalent	N/A	100 litre drums	Anti-scalent is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds.	<ul style="list-style-type: none"> • Victoria Road (WHT2) • White Bay (WHT3) • Yurulbin Point (WHT4) • Berrys Bay (WHT7) • Cammeray Golf Course (WHT10).

Note 1: Classified as C1 if not stored with other Class 3 flammable liquids

Note 2: Classified as 3 PG III if stored with other Class 3 flammable liquids

23.2.2 Transport of dangerous goods and hazardous substances

Dangerous goods and hazardous materials that would be transported to each construction support site are outlined in Table 23-3. Potential transportation hazards and risks have been considered through comparison of the type, quantity and frequency of dangerous goods and hazardous materials transportation with the thresholds presented in the Applying SEPP 33 Guideline. In all cases, the transportation of dangerous goods and hazardous materials to project construction support sites would be below the Applying SEPP 33 thresholds. This indicates that risks associated with transport of dangerous goods and hazardous materials would not be significant.

The proposed haulage routes outlined in Chapter 6 (Construction work) have been identified to avoid local roads where possible and would therefore minimise the risks associated with the transport of dangerous goods and hazardous materials.

Table 23-3 Indicative dangerous goods and hazardous substances transported to construction support sites

Material	Australian Dangerous Goods Code class	Transport frequency	Transport quantity	Assessment against Applying SEPP 33 transport thresholds	Construction support site destination
Explosives	1.1	As required, if blasting is carried out	As required	Not subject to the Applying SEPP 33 thresholds if not transported with Class 3 dangerous goods.	<ul style="list-style-type: none"> • Rozelle Rail Yards (WHT1) • Victoria Road (WHT2) • Berrys Bay (WHT7) • Cammeray Golf Course (WHT10).
Diesel ¹	C1 ² , 3 PG III ³	Daily	1500 litres	Not subject to the Applying SEPP 33 thresholds if not transported with Class 3 dangerous goods. Refuelling at cofferdam sites would be carried out by fit-for-purpose refuelling barge.	All construction support sites.
Petrol ¹	C1 ² , 3 PG III ³	Weekly	50 litres	Not subject to the Applying SEPP 33 thresholds if not transported with Class 3 dangerous goods. Refuelling at cofferdam sites would be carried out by fit-for-purpose refuelling barge.	All construction support sites.
Lubricating and hydraulic oils and grease	C2	Weekly	40 litres	Not subject to the Applying SEPP 33 thresholds if not transported with Class 3 dangerous goods.	All construction support sites.
Industrial grade acetylene	2.1	Monthly	410 litres ⁴	Transport quantities would not trigger the Applying SEPP 33 thresholds.	All construction support sites.
Industrial grade oxygen	2.2	Monthly	410 litres ⁴	Not subject to Applying SEPP 33 transport thresholds.	All construction support sites.

Material	Australian Dangerous Goods Code class	Transport frequency	Transport quantity	Assessment against Applying SEPP 33 transport thresholds	Construction support site destination
Accelerator for shotcrete	3PGII	Weekly	100 litres ⁴	Transport quantities would not trigger the Applying SEPP 33 thresholds.	<ul style="list-style-type: none"> • Victoria Road (WHT2) • Yurulbin Point (WHT4) • Berrys Bay (WHT7) • Cammeray Golf Course (WHT10 and WFU8).
Retardants for concrete	3PGIII	Monthly	205 litre drum	Transport quantities would not trigger the Applying SEPP 33 thresholds.	<p>All land based construction support sites associated with the Western Harbour Tunnel component of the project and the following construction support sites associated with the Warringah Freeway Upgrade component of the project:</p> <ul style="list-style-type: none"> • Blue Street (WFU1) • High Street south (WFU2) • Cammeray Golf Course (WFU8).
Epoxies	3PGIII	Monthly	20 litres ⁴	Transport quantities would not trigger the Applying SEPP 33 thresholds.	All construction support sites.
Acids, bases and detergents	8PGII	Monthly	20 litres ⁴	Not subject to Applying SEPP 33 transport thresholds.	All construction support sites.
General purpose Portland cement	N/A	Monthly	72 bags	This is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds.	All land based construction support sites.
Road and joint sealants	N/A	Monthly	4 x 12 litre boxes	This is not a dangerous good and therefore does not trigger the Applying	All construction support sites associated with the Warringah

Material	Australian Dangerous Goods Code class	Transport frequency	Transport quantity	Assessment against Applying SEPP 33 transport thresholds	Construction support site destination
				SEPP 33 thresholds.	<p>Freeway Upgrade component of the project and the following construction support sites associated with the Western Harbour Tunnel component of the project:</p> <ul style="list-style-type: none"> • Rozelle Rail Yards (WHT1) • Victoria Road (WHT2) • Berry Street north (WHT8) • Ridge Street north (WHT9) • Cammeray Golf Course (WHT10).
Concrete curing compounds	N/A	Monthly	50 litres	This is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds.	All Western Harbour Tunnel and Warringah Freeway Upgrade land based construction support sites.
Pavement layers curing compound	N/A	Monthly	100 litres	This is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds.	<p>All construction support sites associated with the Warringah Freeway Upgrade component of the project and the following construction support sites associated with the Western Harbour Tunnel component of the project:</p> <ul style="list-style-type: none"> • Rozelle Rail Yards (WHT1) • Victoria Road (WHT2) • Berry Street north (WHT8) • Ridge Street north (WHT9) • Cammeray Golf Course (WHT10).

Material	Australian Dangerous Goods Code class	Transport frequency	Transport quantity	Assessment against Applying SEPP 33 transport thresholds	Construction support site destination
Paint for tunnel roof	N/A	5 to 6 deliveries	50 litre drums	This is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds.	<ul style="list-style-type: none"> • Rozelle Rail Yards (WHT1) • Victoria Road (WHT2) • White Bay (WHT3) • Cammeray Golf Course (WHT10).
Paints	N/A	Monthly (during second half of construction program)	250 litres	This is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds.	<ul style="list-style-type: none"> • Rozelle Rail Yards (WHT1) • Victoria Road (WHT2) • White Bay (WHT3) • Cammeray Golf Course (WHT10 and WFU 8) • Blue Street (WFU1).
Coagulants	N/A	Monthly	150 kilograms	This is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds.	<ul style="list-style-type: none"> • Victoria Road (WHT2) • White Bay (WHT3) • Yurulbin Point (WHT4) • Berrys Bay (WHT7) • Cammeray Golf Course (WHT10).
Anti-scalent	N/A	Monthly	1000 litres	This is not a dangerous good and therefore does not trigger the Applying SEPP 33 thresholds.	<ul style="list-style-type: none"> • Victoria Road (WHT2) • White Bay (WHT3) • Yurulbin Point (WHT4) • Berrys Bay (WHT7) • Cammeray Golf Course (WHT10).

Note 1: For some construction support sites, the quantity of diesel and unleaded petrol delivered to site would be greater than the quantity stored within the facility at any time, because the delivery volume takes into the account fuel that is brought to the facility by mini-tanker and used to directly refuel plant. As this fuel is 'in use' in the plant it is not classified as 'stored'.

Note 2: Classified as C1 if not stored with other Class 3 flammable liquids.

Note 3: Classified as 3 PG III if stored with other Class 3 flammable liquids

Note 4: Per construction support site.

23.2.3 Ground movement and geological uncertainty

Ground movement (or settlement) refers to a localised lowering of the ground level due to construction activities involving excavation or disturbance below ground. If unmanaged, ground movement can present a risk to the stability of nearby buildings and other structures, including building basements and ground support structures.

An assessment of potential ground movement associated with the project is provided in Chapter 16 (Geology, soils and groundwater). Preliminary ground movement investigations indicate that there may be potential settlement of greater than 40 millimetres around the Warringah Freeway portal, while the Rozelle portal could potentially experience maximum total settlement of 30 to 35 millimetres. This would be assessed as 'slight' severity under relevant guidelines.

No buildings were found to be in the 'slight' to 'very severe' damage categories. Buildings categorised with 'very slight' damage would be mainly located at shallow cover tunnels near portals and/or larger span cavern locations as those found at Cammeray.

'Very slight' damage (fine cracks) would be easily treated during normal decoration. Damage would generally be restricted to internal wall finishes, with small cracks visible on external brickwork or masonry.

Building/structure condition surveys would be carried out as applicable prior to commencement of construction. Any impacts from settlement caused by the project would be rectified to the condition prior to construction works. For further information regarding potential ground movement associated with the project, please see Chapter 16 (Geology, soils and groundwater).

Geotechnical investigations have been carried out to understand the ground conditions where construction would occur. These investigations have confirmed that high quality Hawkesbury sandstone would be encountered for the majority of the proposed tunnel alignment. Furthermore, the alignment of the proposed tunnels means that they would be very deep for the majority of their length, with a significant layer of stone between the tunnels and surface.

This data has been used to inform the project design and tunnel construction methods to reduce the construction risks associated with uncertain ground conditions (additional geotechnical investigations would be carried out during further design development to confirm ground conditions, where required). Primary support for the project tunnels would be installed as the excavation progresses, as recommended by an appropriately qualified geotechnical or tunnel engineer, to ensure tunnel stability during construction.

23.2.4 Interactions between maritime traffic and tunnel infrastructure

The project would require marine vessel movements during construction of the immersed tube tunnels in Sydney Harbour, including:

- Barges for delivering material, removing cofferdam spoil, removing dredged material, or for other construction activities
- Barges with piling equipment and cranes
- Tugboats for manoeuvring barges
- Transport vessels for workers.

During immersion of the tube tunnel units, there is a risk that maritime traffic could collide with these units if they pass over the tunnels before they are in the final position on the bed of the

harbour. The timeframe for immersion would be very short (less than two days per unit), and measures would be put in place to manage this risk, such as restrictions to marine vessel movements passing over the crossing location during immersion of the tube tunnels. As outlined in Chapter 8 (Construction traffic and transport), simulation work carried out has demonstrated that the installation of immersed tube tunnels can be carried out safely.

23.2.5 Damage or disruption to underground utilities

The project has been designed, where possible, to avoid utilities, taking into account the results of utility investigations and consultation with utility providers carried out during the design process (refer to Chapter 7 (Stakeholder and community engagement)). Where the project is unable to avoid utilities, if possible, they would be relocated and/or protected prior to the commencement of construction to avoid impacts. Otherwise relocation and protection would occur during construction.

Consultation with utility infrastructure providers would continue during the design and construction phases of the project 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. Utilities which would be directly impacted and require protection and/or relocation have been considered in Appendix D (Utilities management strategy).

23.2.6 Bushfires

A bushfire risk assessment was carried out to assess potential bushfire implications of the project. In accordance with *Planning for Bushfire Protection* (RFS, 2006) the predominant vegetation class (bushfire prone land) has been assessed to a distance of 140 metres from the project in all directions. Table 23-4 provides the assessed bushfire risk level for construction support sites located on, or in proximity to, bushfire prone land. The level of bushfire risk is determined using a combination of likelihood and consequence, with the likelihood of bushfire risk for all assets being defined as the chance of a bushfire igniting and spreading and the consequence being the outcome or impact of a bushfire event (RFS, 2008).

Table 23-4 Bushfire risk level for construction support sites

Construction support site(s)	Bushfire risk level	Proximity to bushfire prone land
Rozelle Rail Yards (WHT1) Victoria Road (WHT2) White Bay (WHT3) Yurulbin Point (WHT4) Berry Street north (WHT8) Ridge Street north (WHT9) Cammeray Golf Course (WHT10) Waltham Street (WHT11) All Warringah Freeway Upgrade construction support sites (WFU1 to WFU 9)	Low	No bushfire prone land within 140 metres.

Construction support site(s)	Bushfire risk level	Proximity to bushfire prone land
Sydney Harbour south cofferdam (WHT5) and Sydney Harbour north cofferdam (WHT6)	Low	Not applicable as the construction support sites are located within Sydney Harbour.
Berrys Bay (WHT7)	Low	The south-western portion of the site is located in an area classified as bushfire prone land (dry Sclerophyll forest).

The bushfire risk assessment concluded that all areas of the project are considered to have a bushfire risk level of 'low'. It should be noted however that the Berrys Bay construction support site (WHT7) is situated within 140 metres of Balls Head Reserve, which is bushfire prone land given the presence of dry Sclerophyll forests. As such, Balls Head Reserve is considered a potential bushfire hazard with a 'possible' likelihood of occurrence.

Balls Head Reserve is managed by North Sydney Council, including fuel management, as identified in the *Mosman North Sydney Willoughby Bushfire Risk Management Plan 2017-2022* (Mosman North Sydney Willoughby Bush Fire Coordinating Committee, 2008). Council management of Balls Head Reserve would contribute to the bushfire protection measures for the construction support site at Berrys Bay.

Strategies to reduce risk from bushfire, such as site layout, setbacks from bushfire prone vegetation, access and emergency procedures at Berrys Bay construction support site (WHT7) would be developed and implemented during construction (refer to Section 23.4).

23.3 Assessment of potential operational impacts

During operation, the following potential hazards and risks may be associated with the project:

- Storage and use of dangerous goods and hazardous substances (Section 23.3.1)
- Transport of dangerous goods and hazardous substances (Section 23.3.2)
- Traffic incidents on surface roads and within tunnels (Section 23.3.3)
- Interactions between maritime traffic and tunnel infrastructure (Section 23.3.4)
- Bushfires (Section 23.3.5)
- Atmospheric turbulence caused by discharges from the ventilation outlets and motorway facilities at the Rozelle Interchange and at the Warringah Freeway and the interface with aviation (Section 23.3.6).

Other potential environmental hazards resulting from the operation of the project are considered and addressed in the relevant chapters of this environmental impact statement.

23.3.1 Storage and handling of dangerous goods and hazardous substances

Dangerous goods and hazardous materials would be stored at the operational facilities to be provided as part of the project and used during operation of the project. The types and quantities of dangerous goods and hazardous materials to be stored on-site during operation are summarised in Table 23-5. Additional small quantities of other materials may be required on-site from time to time to support occasional maintenance activities. Managed in accordance with the measures in Section 23.4, these materials would not pose a substantial risk to the general public during operation of the project.

Comparison of the types and quantities of dangerous goods and hazardous materials to be stored on-site with the thresholds in Applying SEPP 33 demonstrates that operational inventories would not pose a significant risk of harm beyond the boundary of the operational facilities.

Table 23-5 Indicative dangerous goods and hazardous substances stored on-site during operation

Material and Australian Dangerous Goods Code class	Storage method (amount stored at any one time)	Inventory thresholds in the SEPP 33 Guidelines	Assessment against Applying SEPP 33 inventory thresholds
Diesel C1 ¹ , 3 PG III ²	Bunded tanks on site	N/A	Diesel would be less than five tonnes and would not be stored with Class 3 materials. It would therefore not be subject to the Applying SEPP 33 thresholds.
Grease C2	400-gram cartridge, 20 litre containers stored undercover on site	N/A	Grease would not be stored with Class 3 materials and would therefore not be subject to the Applying SEPP 33 thresholds.
Adhesives C2, PGIII	375-gram cartridge, 20 litre containers stored on site	5 tonnes	Adhesives would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate.
Acetylene C2.1	Size G cylinders on site	100 kilograms	Individual cylinders containing acetylene would not trigger Applying SEPP 33 thresholds. Maximum stored inventories would not trigger the Applying SEPP 33 thresholds if considered in aggregate.
Line-marking aerosol C2.1	375 millimetre aerosol container stored undercover on site	100 kilograms	Line-marking aerosol would not trigger the Applying SEPP 33 thresholds.
Oxygen C2.2	Size G cylinders on site	N/A	Industrial grade oxygen is a Class 2.2 dangerous good and is not subject to the Applying SEPP 33 thresholds.
Kerosene C3, PGIII	20 litre container stored in an undercover bunded area on site	5 tonnes	Kerosene would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate.

Material and Australian Dangerous Goods Code class	Storage method (amount stored at any one time)	Inventory thresholds in the SEPP 33 Guidelines	Assessment against Applying SEPP 33 inventory thresholds
Oxygen (subsidiary risk) C5.1	Size G cylinders on site	5 tonnes	Oxygen has a subsidiary risk Class of 5.1. It would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate.
Sodium hydroxide C8, PGII	10,000 litre feed tank in an undercover bunded area on site	25 tonnes	Sodium hydroxide would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate.
Bitumen C9	12,000 litre tanker (brought onto site as required)	N/A	Bitumen is a Class 9 dangerous good and is not subject to the Applying SEPP 33 thresholds.
Coagulant N/A	12,000 litre feed tank in an undercover bunded area on site	N/A	Coagulant is not classified as a dangerous good and does not trigger the Applying SEPP 33 thresholds.
Polymers N/A	20 kilogram bags stored in a container undercover on site	N/A	Polymers are not classified as a dangerous good and would not trigger the Applying SEPP 33 thresholds.
Non-shrink grout N/A	20 kilogram bags stored undercover on site	N/A	Non-shrink grout is not classified as a dangerous good and does not trigger the Applying SEPP 33 thresholds.
Release agent (lanolin-based) N/A	20 litre drums stored undercover on site	N/A	Release agent (lanolin-based) is not classified as a dangerous good and does not trigger the Applying SEPP 33 thresholds.

Note 1: Classified as C1 if not stored with other Class 3 flammable liquids.
Note 2: Classified as 3 PG III if stored with other Class 3 flammable liquids.

23.3.2 Transport of dangerous goods and hazardous substances

Dangerous goods and hazardous materials that would be transported to the project during operation are outlined in Table 23-6. The risks associated with transport of dangerous goods and hazardous materials would not be significant.

The mainline tunnels would be listed as prohibited areas under Road Rules 2014 – Rule 300-2: NSW rule: carriage of dangerous goods in prohibited areas (Regulation 300-2) prior to opening to traffic. The transport of dangerous goods in prohibited areas, including the mainline tunnels, would be prohibited. Signage would be provided near tunnel entry portals advising of applicable restrictions to ensure compliance with Regulation 300-2.

Table 23-6 Dangerous goods and hazardous substances transported during operation

Material and Australian Dangerous Goods Code class	Transport frequency	Transport quantity (indicative only)	Transport thresholds in the SEPP 33 Guidelines	Assessment against Applying SEPP 33 transport thresholds
Diesel C1 ¹ , 3 PG III ²	As required	As required	N/A	Diesel would not be transported with Class 3 materials and would therefore not be subject to the Applying SEPP 33 thresholds.
Grease C2	Weekly	50 cartridges (20 kilograms)	N/A	Grease would not be transported with Class 3 materials and would therefore not be subject to the Applying SEPP 33 thresholds.
Adhesives C2, PGIII	Weekly	50 cartridges (19 kilograms)	Minimum transport load or transport frequency of 10 tonnes, more than 60 times per week.	Adhesives would not trigger the Applying SEPP 33 thresholds.
Acetylene C2.1	Weekly	50 cylinders	Minimum transport load or transport frequency of two tonnes, more than 30 times per week.	Industrial grade acetylene would not trigger the Applying SEPP 33 thresholds for minimum transport load or transport frequency of two tonnes, more than 30 times per week.
Line-marking aerosol C2.1	Quarterly	50 cans	Minimum transport load or transport frequency of two tonnes, more than 30 times per week.	Line-marking aerosol would not trigger the Applying SEPP 33 thresholds.
Oxygen C2.2	Weekly	50 cylinders	N/A	Industrial grade oxygen is a Class 2.2 dangerous good and is not subject to the Applying SEPP 33 thresholds.
Kerosene C3, PGIII	Monthly	80 litres	Minimum transport load or transport frequency of 10 tonnes, more than 60 times per week.	Kerosene would not trigger the Applying SEPP 33 thresholds.

Material and Australian Dangerous Goods Code class	Transport frequency	Transport quantity (indicative only)	Transport thresholds in the SEPP 33 Guidelines	Assessment against Applying SEPP 33 transport thresholds
Oxygen (subsidiary risk) C5.1	Weekly	50 cylinders	Minimum transport load or transport frequency of two tonnes, more than 30 times per week.	Oxygen has a subsidiary risk Class of 5.1. It would not trigger the Applying SEPP 33 thresholds.
Sodium hydroxide C8, PGII	Six monthly	10,000 litres	Minimum transport load of 25 tonnes.	Sodium hydroxide would not trigger the Applying SEPP 33 thresholds if considered as individual containers or in aggregate.
Bitumen C9	Quarterly	12,000 litres	Minimum transport frequency of more than 60 times per week.	Bitumen would not trigger the Applying SEPP 33 thresholds.
Coagulant N/A	Quarterly	10,000 litres	N/A	Coagulant is not classified as a dangerous good and does not trigger the Applying SEPP 33 thresholds.
Polymers N/A	Quarterly	1000 kilograms	N/A	Polymers are not classified as a dangerous good and would not trigger the Applying SEPP 33 thresholds.
Non-shrink grout N/A	Monthly	1900 kilograms	N/A	Non-shrink grout is not classified as a dangerous good and does not trigger the Applying SEPP 33 thresholds.
Release agent (lanolin-based) N/A	Twice monthly	180 litres	N/A	Release agent (lanolin-based) is not classified as a dangerous good and does not trigger the Applying SEPP 33 thresholds.

Note 1: Classified as C1 if not stored with other Class 3 flammable liquids.
Note 2: Classified as 3 PG III if stored with other Class 3 flammable liquids.

23.3.3 Traffic incidents

The project has been designed to provide efficient, free flowing traffic conditions with capacity to safely accommodate forecast traffic volumes. The project design incorporates all feasible and reasonable traffic safety measures including those related to geometry, pavement, lighting, signage and shared user facilities consistent with current Australian Standards, road design guidelines and industry best practice. In doing so, the design of the project inherently minimises the likelihood of incidents and accidents.

Each project tunnel would be one directional, reducing the risk of crashes through head on collisions and simplifying smoke management and egress requirements. The transport of dangerous goods and hazardous substances would be prohibited through the mainline tunnels and entry and exit ramps, reducing the risk of very large fires or the release of toxic materials in the tunnels.

Notwithstanding, human factors in particular cannot be entirely removed during operation of the project and there would remain a residual risk of incidents and accidents. In the event of incidents and accidents, the project has been designed to meet appropriate fire and life safety requirements. The key fire and life safety aspects of the project are described in Chapter 5 (Project description), and would include maintenance and emergency breakdown bays, fire and incident detection equipment, communication systems, fire suppression systems, emergency lighting, smoke management and power systems, cross passages or longitudinal egress passages, and tunnel closure systems. The fire and life safety systems would be installed in accordance with Australian Standard *AS 4825:2011 Tunnel Fire Safety*, applicable Austroads and Transport for NSW guidelines, and the outcomes of consultation with emergency services.

In the event of an incident, approaching traffic would be prevented from entering the mainline tunnels. Vehicle occupants upstream of the fire or incident would be instructed to stop their vehicles, and exit in the opposite direction through the section of carriageway that would be protected by the smoke management system, or through an exit door to a pressurised and fire rated cross-passage leading to the other non-incident mainline tunnel.

Occupants downstream of the fire or incident would be encouraged to continue driving out of the tunnel. If this is not possible and they are forced to evacuate on foot, egress would be provided via exit doors to pressurised and fire rated cross-passages leading to the non-incident mainline tunnel. Emergency services would be able to reach the fire or incident via the non-incident tunnel, or from the upstream direction in the affected tunnel. Emergency vehicle cross passages have also been included in the design at key locations.

During emergency conditions the ventilation system would extract smoke from the affected tunnels. Depending on the location of the incident, smoke would be emitted from one or more of the ventilation outlets and from the tunnel portals at the mainline tunnel surface connections.

23.3.4 Interactions between maritime traffic and tunnel infrastructure

The crossing of Sydney Harbour would comprise two immersed tube tunnels between Birchgrove and Waverton. The immersed tube tunnels would be placed in a dredged trench on the bed of Sydney Harbour and then backfilled with a combination of locking fill and rock armour to secure the tunnel on the bed of the harbour and protect the tunnel from impact loading. Existing depth in the main channel would be maintained to provide sufficient clearance for all harbour traffic in Sydney Harbour.

With respect to maritime traffic, the immersed tube tunnel units would be designed to protect against:

- Falling and dragging anchors
- Sinking vessels
- High currents
- Propeller wash and vessel wake.

As such, it is not expected that there would be any risk to the tunnels during operation of the project as a result of maritime traffic.

23.3.5 Bushfires

Most of the project's operational facilities would not be vulnerable to bushfire risk due to its incombustible nature (road surface materials, retaining walls, road barriers), fire safety ratings and/or location underground.

No operational facilities would be located within 140 metres of bushfire prone vegetation.

23.3.6 Aviation risks

The operational design of the project has considered airspace protection and associated risks and hazards. As discussed in Chapter 2 (Assessment process), under the *Airports Act 1996*, a 'controlled activity' in relation to a prescribed airspace must not be carried out or caused to be carried out without the approval of the Secretary of the Department of Infrastructure and Regional Development or otherwise exempt under the Airspace Regulations 2007.

Regulations define the 'prescribed airspace' for Sydney Airport as the airspace above any part of either an obstacle limitation surface (OLS) or procedures for air navigation systems operations (PANS-OPS) surface for Sydney Airport.

The OLS is an invisible level that defined the limits to which objects may project into the airspace around an aerodrome so that aircraft operations may be conducted safely. The OLS defines the airspace to be protected for aircraft operating during the initial and final stages of flight or manoeuvring near Sydney Airport. This has been established in accordance with International Civil Aviation Organisation specifications, as adopted by the Civil Aviation Safety Authority.

PANS-OPS surfaces are conceptual surfaces in space that establish the airspace that is to remain free of any potential disturbance (including physical objects and other disturbances such as emissions from ventilation outlets) so that aircraft operations may be conducted safely. Where structures may (under certain circumstances) be permitted to penetrate the OLS, they would not normally be permitted to penetrate any PANS-OPS surface.

Operational buildings and structures that form part of the project, including the ventilation outlets and motorway facilities at the Rozelle Interchange and at the Warringah Freeway, are designed to be below the prescribed airspace heights.

The Civil Aviation Safety Authority stipulates requirements for the construction and operation of new infrastructure that has the potential to influence aviation safety. The Civil Aviation Safety Authority may determine that exhaust from a ventilation outlet is a hazardous object if the vertical velocity of the emissions exceeds 4.3 metres per second within the OLS and/or PANS-OPS surfaces.

A plume rise assessment was carried out in accordance with the *Civil Aviation Safety Authority Advisory Circular Plume Rise Assessments AC 139-5(1) November 2012* to determine whether

plume rise resulting from the operation of the ventilation outlets and motorway facilities at the Rozelle Interchange and Warringah Freeway would be a controlled activity as defined in section 183 of the *Airports Act 1996*. The modelling considered the expected case scenario, based on predicted weekday traffic flows within the project tunnels and the capacity case, based on the maximum theoretical airflow that can be discharged from each ventilation outlet, for the project only. The capacity case scenario is a conservative upper bound of potential plume rise extents from the ventilation outlets, and the ventilation outlets are not expected to operate at design capacity on a regular basis. In addition, the cumulative case was modelled, which considered co-located ventilation outlets at the Warringah Freeway for Western Harbour Tunnel and Beaches Link program of works.

A plume rise assessment found that the ventilation outlet and motorway facilities at the Warringah Freeway would not exceed 4.3 metres per second at the OLS and PANS-OPS surfaces under the expected case scenario. During the capacity case, the plume velocities would exceed the OLS during the project only and cumulative scenarios. However, the plume velocities would not exceed 4.3 metres per second at the PANS-OPS surface in the project only and cumulative scenarios.

A plume rise assessment for the ventilation outlet and motorway facilities at the Rozelle Interchange found that:

- Under the expected case, plume velocities from the ventilation outlet and motorway facilities would not exceed 4.3 metres per second at the PANS-OPS and OLS surfaces
- Under the capacity case, the plume velocity from the ventilation outlet and motorway facilities would exceed 4.3 metres per second at the PANS-OPS surface only (noting that the PANS-OPS surface at the Rozelle Interchange is lower than the OLS surface). However, the assessment found that although an exceedance for the PANS-OPS surface was predicted, this is estimated to occur very infrequently (0.02 per cent of the time).

The design of the ventilation outlets and motorway facilities would be finalised during further design development and would be designed to satisfy requirements set by the Department of Infrastructure, Regional Development and Cities in relation to erected structures (such as ventilation outlets), equipment manoeuvring and lighting. A plume rise application would be prepared for the approval under the *Airports Act 1996* to cover both the ventilation outlet and motorway facilities at the Rozelle Interchange and at the Warringah Freeway where they may constitute a controlled activity.

23.4 Environmental management measures

The implementation of environmental management measures for the project would avoid, to the greatest extent possible, risks to public safety and achieve the desired performance outcomes in relation to the hazards identified in this chapter. Environmental management measures relating to hazards and risk identified in this chapter are outlined in Table 23-7. Management measures relating to other potential environmental hazards resulting from the construction or operation of the project are outlined in Chapter 8 (Construction traffic and transport) to Chapter 27 (Cumulative impacts) of this environmental impact statement.

Table 23-7 Environmental management measures – hazards and risks

Ref	Phase	Impact	Environmental management measure	Location
HR1	Construction	Storage of dangerous goods and hazardous	Dangerous goods and hazardous materials will be stored in accordance with supplier's instructions and relevant legislation, Australian Standards, and	WHT/WFU

Ref	Phase	Impact	Environmental management measure	Location
		substances	applicable guidelines and may include bulk storage tanks, chemical storage cabinets/containers or impervious bunds.	
HR2	Construction	Transportation of dangerous goods and hazardous substances	Dangerous goods and hazardous substances will be transported in accordance with relevant legislation and codes, including the <i>Dangerous Goods (Road and Rail Transport) Act 2008</i> , Road and Rail Transport (Dangerous Goods) (Road) Regulation 1998 and the <i>Australian Code for the Transport of Dangerous Goods by Road and Rail</i> (National Transport Commission, 2007).	WHT/WFU
HR3	Construction	Bushfire	Adequate access and egress for fire fighting vehicles and construction vehicles and staff will be provided at the Berrys Bay construction support site (WHT7). Access roads will have a minimum width of four metres to allow passage of fire fighting vehicles.	WHT (Berrys Bay construction support site (WHT7))
HR4	Construction		Adequate setbacks from bushfire prone vegetation will be provided for the Berrys Bay construction support site (WHT7).	WHT (Berrys Bay construction support site (WHT7))
HR5	Construction		First response capabilities, including fire extinguishers, water carts and hoses, will be provided at the Berrys Bay construction support site (WHT7).	WHT (Berrys Bay construction support site (WHT7))
HR6	Operation	Fire and life safety	The fire and safety systems and measures adopted for the project will be equivalent to or exceed the fire safety measures recommended by NFPA502 (American), PIARC (European), AS4825 and AS3959-2009 (Australian) and relevant Transport for NSW standards.	WHT/WFU
HR7	Operation	Transportation of dangerous goods and hazardous substances	The transport of dangerous goods and hazardous substances will be prohibited through the mainline tunnels and on and off-ramp tunnels.	WHT/WFU

Ref	Phase	Impact	Environmental management measure	Location
HR8	Operation	Incident response	The response to incidents within the motorway will be managed in accordance with the memorandum of understanding between Transport for NSW and the NSW Police Service, NSW Rural Fire Service, NSW Fire Brigade and other emergency services.	WHT/WFU
HR9	Operation	Aviation risks	The ventilation outlet and motorway facilities at Rozelle Interchange and Warringah Freeway will be operated in accordance with any conditions of approval from the Secretary of Department of Infrastructure and Regional Development to manage penetration of the OLS and PANS-OPS surfaces.	Ventilation outlet and motorway facilities at the Rozelle Interchange and at the Warringah Freeway

Western Harbour Tunnel = WHT, Warringah Freeway Upgrade = WFU

