

Appendix C

# Environmental risk analysis

# Appendix C – Environmental risk analysis

An environmental risk analysis for the project has been carried out as part of this environmental impact statement. This following outlines the environmental risk analysis process and identifies the key environmental issues as determined by the analysis.

## Assessment methodology

### Identification of environmental risk categories

The environmental risk analysis process carried out for the project included:

- A preliminary environmental assessment (scoping report), that was carried out as part of the *State significant infrastructure application report* (Roads and Maritime, 2017) to allow early identification of the key environmental issues and to inform the State significant infrastructure application
- An assessment of the key issues identified in the Secretary's environmental assessment requirements for the project (refer to the Secretary's environmental assessment requirements checklist in Appendix A of this environmental impact statement)
- An environmental risk review carried out to confirm the impacts based on the results of the detailed investigations presented in this environmental impact statement.

Through the environmental risk analysis process, issues that may be associated with the project were identified and categorised as a 'key issue' or 'other' (see Table 1). This enabled the identification of any matters that might be considered as additional key issues, and provided a basis for an appropriately detailed assessment of these additional key issues in this environmental assessment.

**Table 1 Environmental risk categories**

Consequence level	Definition
Key issue	Potential for high or moderate impacts (actual or perceived) requiring further investigation to identify specific management and mitigation measures.
Other	Potential for low impacts that can be managed effectively with standard and/or best practice management and mitigation measures.

As required by the Secretary's environmental assessment requirements, this process of key issue identification and analysis continued during the course of preparing the environmental impact statement. Emphasis was placed on using the detailed information gathered for the project to identify and review potential environmental issues. More specifically, the analysis:

- Identified environmental issues, including key issues in the Secretary's environmental assessment requirements
- Examined potential impacts and proposed management and mitigation measures in relation to the identified issues
- Identified the impacts likely to remain after management and mitigation measures are applied (ie the residual impacts).

The identified environmental issues are described and assessed in Chapter 8 to Chapter 26. An assessment of cumulative impacts is also presented in Chapter 27 (Cumulative impacts).

## Likelihood and consequence analysis

To determine the residual impacts for each potential key issue, a risk analysis involving a likelihood and consequence analysis was carried out in accordance with the principles of the Australian and New Zealand standard *AS/NZS ISO 31000:2009 Risk Management – Principles and Guidelines*.

This involved:

- Rating the risk of each identified potential impact by identifying the consequences of the impact and the likelihood of each impact occurring
- Considering the probable effectiveness of the proposed management and mitigation measures to determine the likely residual risk of each impact.

The definitions of the likelihood are provided in Table 2 and the definitions of consequences are provided in Table 3. The risk rating was then determined by combining the consequence and likelihood to identify the level of risk as shown in Table 4.

**Table 2 Risk analysis likelihood definitions**

Likelihood	Definition
Certain	Expected to happen routinely during the project life.
Likely	Could easily happen and has occurred on a previous similar project.
Unlikely	Possible, but not anticipated.

**Table 3 Risk analysis consequence definitions**

Consequence level	Definition
Minor	<ul style="list-style-type: none"><li>• Minor effects on biological, social, economic or physical environment, both built and natural.</li><li>• Minor short to medium term damage to small area of limited significance, easily rectified.</li></ul>
Moderate	<ul style="list-style-type: none"><li>• Moderate effects on biological, social, economic or physical environment, both built and natural.</li><li>• Moderate short to medium term widespread impacts. More difficult to rectify.</li></ul>
Major	<ul style="list-style-type: none"><li>• Serious effects on biological, social, economic or environment, both built or natural.</li><li>• Relatively widespread medium to long term impacts. Rectification difficult or impossible.</li></ul>

**Table 4 Risk rating matrix**

Likelihood	Consequence		
	Minor	Moderate	Major
Certain	Medium	High	High
Likely	Low	Medium	High
Unlikely	Low	Low	Medium

## Environmental risk analysis

Using the framework described above, the environmental risk analysis results for the project are presented in Table 5. The risk analysis identifies an initial risk rating for each of the environmental issues and the residual risk rating derived after the application of environmental management measures developed and recommended by this environmental impact statement.

**Table 5 Environmental risk analysis**

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
<b>Traffic and transport</b>							
<b>Construction</b>							
<ul style="list-style-type: none"> <li>Construction traffic impacts on road network performance</li> <li>Local road and parking impacts.</li> </ul>	Major	Likely	High	Refer to environmental management measures in Chapter 8 (Construction traffic and transport) and incorporated into construction method (refer to Chapter 6 (Construction work)).	Moderate	Likely	Medium
<ul style="list-style-type: none"> <li>Temporary disruption to bus services</li> <li>Construction impacts on cyclists and pedestrian routes.</li> </ul>	Major	Likely	High		Moderate	Likely	Medium
<ul style="list-style-type: none"> <li>Temporary maritime traffic impacts to ferries, recreational users, community groups and clubs, commercial and government operations.</li> </ul>	Major	Likely	High		Moderate	Likely	Medium

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
<b>Operation</b>							
<ul style="list-style-type: none"> <li>Improved travel times and accessibility to and from the Lower North Shore, particularly between North Sydney and Rozelle</li> <li>Road network performance improvements</li> <li>Improved road safety</li> <li>Provision of new and improved public and active transport links</li> <li>Improved connectivity</li> <li>Urban amenity improvements.</li> </ul>	Positive impact						
<ul style="list-style-type: none"> <li>Increased traffic on some parts of the arterial and local road network and changes to some access arrangements.</li> </ul>	Moderate	Likely	Medium	Incorporated into project design (refer to Chapter 5 (Project description) and Chapter 9 (Operational traffic and transport)).	Moderate	Likely	Low

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
<b>Noise and vibration</b>							
<b>Construction</b>							
<ul style="list-style-type: none"> <li>Ground-borne noise impacts during tunneling.</li> </ul>	Major	Likely	High	Refer to environmental management measures in Chapter 10 (Construction noise and vibration) and incorporated into construction method (refer to Chapter 6 (Construction work)).	Moderate	Likely	Medium
<ul style="list-style-type: none"> <li>Airborne noise impacts from surface works during standard construction hours</li> <li>Construction vibration impacts during standard construction hours.</li> </ul>	Major	Likely	High		Moderate	Likely	Medium
<ul style="list-style-type: none"> <li>Noise and vibration impacts outside of standard construction hours surface works.</li> </ul>	Major	Certain	High		Major	Likely	Medium
<ul style="list-style-type: none"> <li>Construction road traffic noise impacts.</li> </ul>	Moderate	Likely	Medium		Minor	Likely	Low

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
<b>Operation</b>							
<ul style="list-style-type: none"> <li>Reduced road traffic noise as a result of traffic moving off surface roads into the tunnels.</li> </ul>	Positive impact						
<ul style="list-style-type: none"> <li>Road traffic noise impacts.</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 11 (Operational noise and vibration) and incorporated in project design (refer to Chapter 5 (Project description)).	Minor	Likely	Low
<ul style="list-style-type: none"> <li>Noise impacts from motorway facilities (eg ventilation fans, attenuators, substations, fire water tanks, water treatment plants etc).</li> </ul>	Moderate	Unlikely	Low		Minor	Unlikely	Low



Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
<b>Air quality</b>							
<b>Construction</b>							
<ul style="list-style-type: none"> <li>Local air quality impacts due to dust generation.</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 12 (Air quality) and incorporated into construction method (refer to Chapter 6 (Construction work)).	Minor	Likely	Low
<ul style="list-style-type: none"> <li>Emissions from construction plant and equipment</li> <li>Emissions during blasting (if required)</li> <li>Odour impacts from treatment and stockpiling of dredged material (eg at White Bay).</li> </ul>	Moderate	Likely	Medium		Minor	Likely	Low

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
<b>Operation</b>							
<ul style="list-style-type: none"> <li>In tunnel air quality impacts to human health</li> <li>Impacts to ambient air quality due to increased traffic and emissions from tunnel ventilation facilities</li> <li>Odour impacts from vehicle emissions.</li> </ul>	Moderate	Likely	Medium	Incorporated in project design (refer to Chapter 5 (Project description) and Chapter 12 (Air quality)).	Minor	Unlikely	Low
<b>Human health</b>							
<b>Construction</b>							
<ul style="list-style-type: none"> <li>Human health impacts associated with air quality.</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 13 (Human health).	Moderate	Unlikely	Low
<ul style="list-style-type: none"> <li>Human health impacts associated</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures	Moderate	Unlikely	Low

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
with noise and vibration from tunneling activities.				in Chapter 13 (Human health).			
<ul style="list-style-type: none"> <li>Human health impacts associated with noise and vibration from surface works.</li> </ul>	Major	Likely	High	Refer to environmental management measures in Chapter 13 (Human health).	Moderate	Likely	Medium
<ul style="list-style-type: none"> <li>Human health impacts associated with social impacts.</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 13 (Human health).	Minor	Unlikely	Low
<ul style="list-style-type: none"> <li>Underwater noise impacts (from piling and dredging activities) to human health.</li> </ul>	Major	Unlikely	Medium	Refer to environmental management measures in Chapter 13 (Human health).	Moderate	Unlikely	Low
<b>Operation</b>							
<ul style="list-style-type: none"> <li>Human health benefits associated with improved surface road air and noise environments, and social aspects across the broader network.</li> </ul>	Positive impact						

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
<ul style="list-style-type: none"> <li>Human health impacts associated with ambient air quality.</li> </ul>	Moderate	Unlikely	Low	Incorporated in project design (refer to Chapter 5 (Project description)).	Minor	Unlikely	Low
<ul style="list-style-type: none"> <li>Human health impacts associated with noise and vibration.</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 11 (Operational noise and vibration) and incorporated in project design (refer to Chapter 5 (Project description)).	Minor	Unlikely	Low
<ul style="list-style-type: none"> <li>Human health impacts associated with and social impacts during operation.</li> </ul>	Moderate	Unlikely	Low	Refer to environmental management measures in Chapter 21 (Socio-economics).	Minor	Unlikely	Low
<b>Non-Aboriginal heritage</b>							
<b>Construction</b>							
<ul style="list-style-type: none"> <li>Direct impacts to terrestrial heritage items, archaeology or heritage conservation areas</li> <li>Direct impacts to</li> </ul>	Major	Certain	High	Refer to environmental management measures in Chapter 14 (Non-Aboriginal heritage).	Moderate	Likely	Medium

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
marine heritage items.							
<ul style="list-style-type: none"> <li>Potential direct impacts to terrestrial heritage items due to the proximity of construction vehicles and equipment.</li> </ul>	Major	Unlikely	Medium	Refer to environmental management measures in Chapter 14 (Non-Aboriginal heritage).	Moderate	Unlikely	Low
<ul style="list-style-type: none"> <li>Indirect impacts to terrestrial heritage items due to temporary visual, aesthetic and social impacts, or permanent settlement and vibration impacts</li> <li>Indirect vibration, visual and settlement impacts to marine heritage items.</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 14 (Non-Aboriginal heritage).	Minor	Likely	Low
<b>Aboriginal heritage</b>							
<b>Construction</b>							
<ul style="list-style-type: none"> <li>Direct impacts to terrestrial Aboriginal</li> </ul>	Major	Unlikely	Medium	Refer to environmental management measures	Moderate	Unlikely	Low

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
heritage sites.				in Chapter 15 (Aboriginal cultural heritage).			
<ul style="list-style-type: none"> <li>Indirect impacts to terrestrial Aboriginal heritage sites due to vibration and settlement.</li> </ul>	Moderate	Unlikely	Low	Refer to environmental management measures in Chapter 15 (Aboriginal cultural heritage).	Minor	Unlikely	Low
<ul style="list-style-type: none"> <li>Direct and indirect impacts to potential submerged Aboriginal sites.</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 15 (Aboriginal cultural heritage).	Minor	Unlikely	Low
<b>Geology, soils and groundwater</b>							
<b>Construction</b>							
<ul style="list-style-type: none"> <li>Soil erosion and offsite sedimentation during construction</li> <li>Exposure of acid sulfate soils or soil salinity during construction.</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 16 (Geology, soils and groundwater).	Minor	Unlikely	Low
<ul style="list-style-type: none"> <li>Disturbance of contaminated land or groundwater contamination</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 16 (Geology, soils and groundwater)	Moderate	Likely	Medium

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
<ul style="list-style-type: none"> <li>during construction works</li> <li>Marine contamination during dredging activities.</li> </ul>				and incorporated into construction method (refer to Chapter 6 (Construction work)).			
<ul style="list-style-type: none"> <li>Disturbance of contaminated sediments during marine construction activities.</li> </ul>	Major	Likely	High	Refer to environmental management measures in Chapter 16 (Geology, soils and groundwater) and incorporated into construction method (refer to Chapter 6 (Construction work)).	Minor	Likely	Low
<ul style="list-style-type: none"> <li>Groundwater drawdown impacts and tunnel inflows during construction</li> <li>Impacts to groundwater quality due to saltwater intrusion, mobilisation of contaminants, acidification during construction.</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 16 (Geology, soils and groundwater) and incorporated into construction method (refer to Chapter 6 (Construction work)).	Minor	Unlikely	Low

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
<b>Operation</b>							
<ul style="list-style-type: none"> <li>Ground movement (ie settlement) impacts to nearby buildings and structures.</li> </ul>	Moderate	Unlikely	Low	Refer to environmental management measures in Chapter 16 (Geology, soils and groundwater).	Minor	Unlikely	Low
<ul style="list-style-type: none"> <li>Groundwater impacts due to tunnel inflows and drawdown</li> <li>Impacts to groundwater quality due to saltwater intrusion, mobilisation of contaminants, acidification construction and operation.</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 16 (Geology, soils and groundwater) and incorporated in project design (refer to Chapter 5 (Project description)).	Minor	Unlikely	Low
<b>Hydrodynamics and water quality</b>							
<b>Construction</b>							
<ul style="list-style-type: none"> <li>Marine water quality impacts from increased turbidity and sedimentation from dredging.</li> </ul>	Major	Likely	High	Incorporated in construction method (refer to Chapter 6 (Construction work)).	Moderate	Unlikely	Low



Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
<ul style="list-style-type: none"><li>• Surface water quality impacts due to soil disturbance, runoff and discharge of tunnel water.</li></ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 17 (Hydrodynamics and water quality).	Moderate	Unlikely	Low
<ul style="list-style-type: none"><li>• Impacts on geomorphology, water availability and flows.</li></ul>	Moderate	Unlikely	Low		Minor	Unlikely	Low
Operation							
<ul style="list-style-type: none"><li>• Operational hydrodynamic impacts within Sydney Harbour due to tunnel.</li></ul>	Minor	Unlikely	Low	Incorporated in project design as described in Chapter 5 (Project description).	Minor	Unlikely	Low
<ul style="list-style-type: none"><li>• Surface water quality impacts due to runoff and discharge of tunnel water.</li></ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 17 (Hydrodynamics and water quality).	Moderate	Unlikely	Low
<ul style="list-style-type: none"><li>• Impacts on geomorphology, water availability and flows.</li></ul>	Minor	Likely	Low		Minor	Unlikely	Low

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
Flooding							
Construction							
• Impacts on construction activities due to flooding.	Moderate	Likely	Medium	Incorporated into construction planning. Also refer to environmental management measures in Chapter 18 (Flooding) and incorporated into construction method (refer to Chapter 6 (Construction work)).	Moderate	Unlikely	Low
• Impacts on flood-prone areas and properties.	Moderate	Likely	Medium		Moderate	Unlikely	Low
Operation							
• Flooding of the tunnels.	Moderate	Likely	Medium	Incorporated into project design (refer to Chapter 5 (Project description)). Also refer to environmental management measures in Chapter 18 (Flooding).	Moderate	Unlikely	Low
• Impacts on flood-prone areas and properties.	Moderate	Likely	Medium		Moderate	Unlikely	Low

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
<b>Biodiversity (construction stage only)</b>							
<b>Flora</b>							
<ul style="list-style-type: none"> <li>Impact on native vegetation and threatened ecological communities.</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 19 (Biodiversity).	Minor	Unlikely	Low
<b>Fauna</b>							
<ul style="list-style-type: none"> <li>Impacts to fauna habitat, including aquatic and marine habitats</li> <li>Impacts on threatened fauna species and endangered populations.</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 19 (Biodiversity).	Minor	Likely	Low
<ul style="list-style-type: none"> <li>Underwater noise impacts (from piling and dredging activities) to marine ecology.</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 19 (Biodiversity).	Minor	Likely	Low

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
Land use and property							
Construction							
<ul style="list-style-type: none"><li>Property acquisition</li><li>Creation of residual and surplus lands.</li></ul>	Moderate	Certain	High	Refer to environmental management measures in Chapter 20 (Land use and property).	Minor	Certain	Medium
<ul style="list-style-type: none"><li>Temporary land use changes.</li></ul>	Moderate	Certain	High		Minor	Likely	Low
Operation							
<ul style="list-style-type: none"><li>Creation of subsurface stratum</li><li>Potential restrictions on future development due to subsurface tunnels and elevated receivers near operational ventilation facilities.</li></ul>	Minor	Unlikely	Low	Refer to environmental management measures in Chapter 20 (Land use and property).	Minor	Minor	Low
Socio-economics							
Construction							
<ul style="list-style-type: none"><li>Temporary impacts on social infrastructure and community values</li></ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 21 (Socio-economics).	Moderate	Likely	Medium

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
<ul style="list-style-type: none"> <li>during construction</li> <li>Impacts to businesses during construction (passing trade, access, parking etc)</li> <li>Access and connectivity impacts during construction.</li> </ul>							
<b>Operation</b>							
<ul style="list-style-type: none"> <li>Improved access and transport and connections</li> <li>Reduced congestion and travel times.</li> </ul>	Positive impact						
<ul style="list-style-type: none"> <li>Impacts to businesses during operation (passing trade, etc).</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 21 (Socio-economics).	Minor	Likely	Low

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
<b>Urban design and visual amenity</b>							
<b>Construction</b>							
<ul style="list-style-type: none"> <li>Landscape character and visual impacts from construction activities and construction support sites.</li> </ul>	Major	Likely	High	Refer to environmental management measures in Chapter 22 (Urban design and visual amenity).	Moderate	Likely	Medium
<b>Operation</b>							
<ul style="list-style-type: none"> <li>Landscape character and visual impacts from surface infrastructure (tunnel portals, motorway facilities and ventilation outlets).</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 22 (Urban design and visual amenity).	Minor	Likely	Low
<b>Hazard and risk</b>							
<b>Construction</b>							
<ul style="list-style-type: none"> <li>Transport and storage of hazardous substances and dangerous goods</li> </ul>	Major	Unlikely	Medium	Refer to environmental management measures in Chapter 23 (Hazard and risk).	Moderate	Unlikely	Low

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
during construction.							
• Interactions between maritime traffic and tunnel infrastructure.	Major	Unlikely	Medium		Moderate	Unlikely	Low
• Potential rupture of, or interference with, underground utilities.	Major	Unlikely	Medium		Moderate	Unlikely	Low
• Risk of bushfires.	Major	Unlikely	Medium		Moderate	Unlikely	Low
Operation							
• Transport and storage of hazardous substances and dangerous goods during operation.	Major	Unlikely	Medium	Refer to environmental management measures in Chapter 23 (Hazard and risk).	Moderate	Unlikely	Low
• Traffic incidents, including incidents within the immersed tube tunnels.	Major	Unlikely	Medium		Moderate	Unlikely	Low
• Interference with aviation.	Major	Unlikely	Medium		Moderate	Unlikely	Low

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
Resource use and waste management							
Construction							
<ul style="list-style-type: none"><li>Increased demand on electricity and water supply</li><li>Increased demand on local and regional resources including sand and aggregate</li><li>Increased diesel use during construction.</li></ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 24 (Resource use and waste management).	Minor	Unlikely	Low
<ul style="list-style-type: none"><li>Impacts associated with poor waste management during construction</li><li>Impacts associated with unexpected waste volume or types.</li></ul>	Moderate	Likely	Medium		Minor	Unlikely	Low
Operation							
<ul style="list-style-type: none"><li>Increased electricity and water use during operation.</li></ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 24 (Resource use and waste management).	Minor	Unlikely	Low



Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
<b>Sustainability</b>							
<p>An assessment of the sustainability of the project was carried out in Chapter 25 (Sustainability), which describes how sustainability principles have been applied to the design, construction and operation of the project including:</p> <ul style="list-style-type: none"> <li>• Application of the principles of ecologically sustainable development to the project</li> <li>• Legislation and policies relevant to the project</li> <li>• The sustainability framework that has been developed for the project, including the application of the Infrastructure Council of Australia's Infrastructure Sustainability rating scheme to the project.</li> </ul> <p>A Sustainability Management Plan for the project will be developed and implemented during detailed design, to give effect to the sustainability framework for the project. The management plan will detail measures to meet the sustainability objectives and targets and Infrastructure Sustainability rating scheme credit requirements.</p> <p>With the proposed Sustainability Management Plan in place there is a low residual risk of the principles of ecologically sustainable development, relevant legislation and policies or the sustainability framework not being implemented across all elements of the project.</p>							
<b>Climate change risk and adaptation (Operation stage only)</b>							
<ul style="list-style-type: none"> <li>• Impact of climate change on road operations and infrastructure</li> <li>• Impact of climate change on customer and staff comfort.</li> </ul>	Major	Unlikely	Medium	Refer to environmental management measures in Chapter 26 (Climate change risk and greenhouse gas).	Minor	Unlikely	Low
<b>Greenhouse gases</b>							
<b>Construction</b>							
<ul style="list-style-type: none"> <li>• Emissions of greenhouse gases from embodied</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 26 (Climate	Minor	Likely	Low

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
energy in construction materials and electricity consumption.				change risk and greenhouse gas).			
<b>Operation</b>							
<ul style="list-style-type: none"> <li>Emissions of greenhouse gases from operational energy use and vehicle emissions.</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 26 (Climate change risk and greenhouse gas).	Minor	Likely	Low

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
<b>Cumulative impacts</b>							
<b>Construction</b>							
<ul style="list-style-type: none"> <li>Construction noise and traffic associated with developments in proximity to construction sites including the Beaches Link and Gore Hill Freeway Connection project (if approved), the Chatswood to Sydenham component of Sydney Metro City &amp; Southwest, the M4-M5 Link project and other developments.</li> </ul>	Moderate	Likely	Medium	Refer to environmental management measures in Chapter 27 (Cumulative impacts).	Moderate	Likely	Medium
<ul style="list-style-type: none"> <li>Road based spoil haulage management (traffic and noise impacts).</li> </ul>	Moderate	Likely	Medium		Minor	Likely	Low

Potential impact	Unmitigated consequence	Unmitigated likelihood	Unmitigated risk	Proposed environmental management measures	Residual consequence	Residual likelihood	Residual risk
<b>Operation</b>							
When completed, the Western Harbour Tunnel and Beaches Link program of works is expected to deliver beneficial cumulative impacts including significant increases in travel speeds through sections of the surface road network, increased reliability, increased connectivity, and a reduction in average travel times.	Positive impact						

## Risk analysis outcomes

No potential impacts with a residual risk rating of 'high' were identified for the project.

A number of 'medium' level residual risks were identified. Through the detailed design of the project further review of the 'medium' residual risk level items would be carried out, and where necessary implement additional measures to ensure these risks are suitably managed. During further design development there would be further opportunity to:

- Resolve residual impacts through detailed design refinement
- Develop effective construction methodologies and planning with the construction contractor to ensure that management and mitigation measures are effectively implemented
- Implement a process of review, correction and audit for the Construction Environmental Management Plan and Operation Environmental Management Plan as detailed in the environmental management measures identified in Chapter 28 (Synthesis of the environmental impacts). This is a process of continuous improvement that will form part of the Construction Environmental Management Plan and Operational Environmental Management Plan and allow for management measures to be updated or improved during construction and operational phases where practical.

Other issues which have been identified as having a low residual risk would be adequately managed through further design development and construction, and by the implementation of environmental management measures proposed in this environmental impact statement.

