

28 Environmental risk analysis

An environmental risk analysis for the M4-M5 Link project (the project) was carried out as part of this environmental impact statement (EIS). This chapter outlines the environmental risk analysis process and identifies the key environmental issues as determined by the analysis.

The Secretary of the NSW Department of Planning and Environment (DP&E) has issued environmental assessment requirements for the project. These are referred to as Secretary's Environmental Assessment Requirements (SEARs). **Table 28-1** sets out these requirements and the associated desired performance outcomes that relate to environmental risk analysis, and identifies where they have been addressed in this EIS.

Table 28-1 SEARs – environmental risk analysis

Desired performance outcome	SEAR	Where addressed in the EIS
<p>2. Environmental Impact Statement</p> <p>The project is described in sufficient detail to enable clear understanding that the project has been developed through an iterative process of impact identification and assessment and project refinement to avoid, minimise or offset impacts so that the project, on balance, has the least adverse environmental, social and economic impact, including its cumulative impacts.</p>	<p>1. The EIS must include, but not necessarily be limited to, the following:</p> <p>(j) the identification and assessment of key issues as provided in the 'Assessment of Key Issues' performance outcome.</p>	<p>The identification of key issues is outlined in section 28.3.</p> <p>A summary of the assessment of key issues is provided in the Executive Summary and Appendix A (Project synthesis).</p>
<p>3. Assessment of Key Issues*</p> <p>Key issue impacts are assessed objectively and thoroughly to provide confidence that the project will be constructed and operated within acceptable levels of impact.</p> <p>* Key issues are nominated by the Proponent in the CSSI project application and by the Department in the SEARs. Key issues need to be reviewed throughout the preparation of the EIS to ensure any new key issues that emerge are captured. The key issues identified in this document are not exhaustive but are key issues common to most CSSI projects.</p>	<p>1. The level of assessment of likely impacts must be proportionate to the significance of, or degree of impact on, the issue, within the context of the proposal location and the surrounding environment. The level of assessment must be commensurate to the degree of impact and sufficient to ensure that the Department and other government agencies are able to understand and assess impacts.</p>	<p>An assessment of the key issues identified for the project is provided in Chapter 8 to Chapter 27 and Appendix H to Appendix X.</p> <p>A summary of the impacts for each key issue is presented in the Executive Summary and Appendix A (Project synthesis).</p>
	<p>2. For each key issue the Proponent must:</p> <p>(c) identify, describe and quantify (if possible) the impacts associated with the issue, including the likelihood and consequence of the impact (comprehensive risk assessment), and the cumulative impacts of: (i) concurrent project construction activities; and (ii) proposed and</p>	<p>Impacts associated with each key issue are described, and where possible quantified, in Chapter 8 to Chapter 27 and Appendix H to Appendix X.</p> <p>A summary of the environmental risk analysis is provided in</p>

Desired performance outcome	SEAR	Where addressed in the EIS
	<p>approved projects (where information is available at the time of writing).</p> <p>(d) demonstrate how potential impacts have been avoided (through design, or construction or operation methodologies);</p> <p>(e) detail how likely impacts that have not been avoided through design will be minimised, and the predicted effectiveness of these measures (against performance criteria where relevant); and</p> <p>(f) detail how any residual impacts will be managed or offset, and the approach and effectiveness of these measures.</p>	<p>section 28.3 including a likelihood and consequence analysis.</p> <p>Further detailed discussion in regards to cumulative impacts is provided in Chapter 26 (Cumulative impacts).</p>

28.1 Environmental risk analysis process

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

- A preliminary environmental assessment, that was carried out as part of the State significant infrastructure (SSI) application report (NSW Roads and Maritime Services (Roads and Maritime) 2016) and subsequent addendums to the SSI application report (Addendum 1 (Roads and Maritime 2016b) and Addendum 2 (Roads and Maritime 2017)) to allow early identification of the key environmental issues and to inform the SSI application
- An assessment of the key issues identified in the SEARs for the project (refer to the SEARs in **Appendix B** (Secretary's Environmental Assessment Requirements checklist))
- An environmental risk review undertaken to confirm the impacts based on the results of the detailed investigations presented in this EIS.

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 28-2**). 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 28-2 Environmental risk categories

Risk category	Description
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 SEARs, this process of key issue identification and analysis continued during the course of preparing the EIS. 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 SEARs, and any other issues
- 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 27** and **Appendix H** to **Appendix X**. As required by the SEARs, a risk analysis, including a likelihood and

consequence analysis, has been undertaken. An assessment of cumulative impacts is presented in **Chapter 26** (Cumulative impacts).

As part of the environmental risk analysis for the project, a residual impact assessment has been undertaken as provided in **Table 28-6**. This assessment provides an analysis of project impacts post-mitigation (ie after management and mitigation measures are applied to manage the impact) based on the risk assessment approach described in **section 28.1.1**.

28.1.1 Likelihood and consequence analysis

To determine the residual impacts for each potential key issue, the following risk assessment approach has been undertaken. The likelihood of an impact occurring following the implementation of management and mitigation measures is assessed using the categories provided in **Table 28-3**.

Table 28-3 Likelihood categories

Likelihood	Description
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.

The consequence of the impact occurring following the implementation of management and mitigation measures is assessed using the categories provided in **Table 28-4**.

Table 28-4 Consequence categories

Consequence	Description
Minor	Minor effects on biological, social, economic or physical environment, both built and natural. Minor short to medium term damage to small area of limited significance, easily rectified.
Moderate	Moderate effects on biological, social, economic or physical environment, both built and natural. Moderate short to medium term widespread impacts. More difficult to rectify.
Major	Serious effects on biological, social, economic or environment, both built or natural. Relatively widespread medium to long term impacts. Rectification difficult or impossible.

Based on the assessment of the likelihood and consequence of a given impact occurring with the proposed management and mitigation measures in place, a residual risk rating is derived from the risk matrix as presented in **Table 28-5**.

Table 28-5 Risk matrix

Likelihood	Residual risk rating		
	Consequence		
	Minor	Moderate	Major
Certain	Medium	High	High
Likely	Low	Medium	High
Unlikely	Low	Low	Medium

If an identified residual risk is not lowered or remains high, consideration of additional management and mitigation measures will be identified and implemented, or justification provided for the risk.

28.2 Identification of key issues and risks

The environmental risk analysis has been undertaken following the assessment of likely impacts for each of the key issues identified by the SEARs as well as other environmental matters that have been identified as potentially being impacted by the project. The environmental issues are described and assessed in detail in **Chapter 8 to Chapter 27** and **Appendix H to Appendix X**.

28.3 Risk analysis approach

For each of the identified issues, a level of assessment was undertaken commensurate with the potential degree of impact the project may have on that issue. This included an assessment of whether the identified impacts could be avoided or minimised (for example, through design amendments). Where impacts could not be avoided, environmental management measures have been recommended to manage impacts to acceptable levels. These are detailed in full in **Chapter 29** (Summary of environmental management measures).

Environmental management measures will be implemented through the management frameworks put in place by the Construction Environmental Management Plan (CEMP) and Operational Environmental Management Plan (OEMP), and relevant sub-plans. In addition to incorporating management measures, these plans will include details of how the measures will be implemented, monitored and audited for compliance.

The assessment of key issues has been undertaken based on a concept design, as identified in **Chapter 1** (Introduction). The identified management measures will be reassessed during the detailed design for their appropriateness. In relation to managing impacts, the following hierarchy has been implemented during the concept design and will also be implemented during the detailed design. The hierarchy will avoid environmental impacts where possible through design. Where impacts cannot be avoided, feasible and reasonable measures are recommended to minimise these impacts to the greatest extent practicable. As a result, the following assessment does not detail residual risks that are considered low, or the beneficial impacts of the project.

Chapter 8 to Chapter 27 and **Appendix H to Appendix X** of the EIS provide a description of the potential unmitigated impacts of the project. The environmental risk analysis process detailed in **section 28.1** has then been applied to the key project impacts as assessed in **Chapter 8 to Chapter 27** and **Appendix H to Appendix X** to provide a post-mitigation residual risk rating for each identified key risk as outlined in **Table 28-6**.

The numerical codes provided in the management and mitigation measures column refers to the identification (ID) number (eg AQ10) for the relevant environmental management measure, as summarised in **Chapter 29** (Summary of environmental management measures).

Table 28-6 Environmental risk analysis of key issues

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk
Traffic and transport – refer to Chapter 8 (Traffic and transport)					
Construction impacts on road network performance including public transport and active transport.	Construction	<ul style="list-style-type: none"> A Construction Traffic and Access Management Plan (CTAMP) will be prepared and will include the guidelines, general requirements and principles of traffic management to be implemented during construction. It will be prepared in accordance with <i>Austroads Guide to Road Design</i> (with appropriate Roads and Maritime supplements). Alternative public transport and activities transport facilities to be provided where possible (TT01). 	Likely	Moderate	Medium
Traffic-related safety incidents (involving both workers and road users) during construction.	Construction	<ul style="list-style-type: none"> Construction staging and temporary works to be implemented to minimise conflicts with the existing road network and maximise spatial separation between work areas and travel lanes (TT03). 	Unlikely	Major	Medium
Temporary impacts to property access during construction.	Construction	<ul style="list-style-type: none"> Maintain property access where possible. Manage local road closures in consultation with Roads and Maritime, local councils and property owners likely to be impacted (TT14). 	Likely	Minor	Low
Damage or impacts to road infrastructure resulting from construction works.	Construction	<ul style="list-style-type: none"> Road dilapidation reports to be prepared for potentially impacted road infrastructure. Mechanisms to repair damage to the road network caused by the project will be identified (TT18). 	Likely	Minor	Low
Operational road network performance impacts including potential increased traffic on some parts of the network as a result of the project.	Operation	<ul style="list-style-type: none"> A review of operational network performance will be undertaken 12 months and five years from the opening of the project to confirm the network operational impacts of the project (OpTT1) A network integration strategy will be prepared in consultation with local council regarding optimisation measures. This may include measures to improve traffic flow on areas experiencing higher flow as a result of the project (OpTT2 – OpTT3). 	Likely	Moderate	Medium

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk
Air quality - refer to Chapter 9 (Air quality)					
Dust generated by construction.	Construction	<ul style="list-style-type: none"> A Construction Air Quality Management Plan (CAQMP) will be developed that will include measures that will be implemented to manage potential air quality impacts associated with the construction for the project. The plan will be implemented for the duration of construction (AQ1 – AQ25). 	Likely	Minor	Low
Effects of poor in tunnel air quality on human health.	Operation	<ul style="list-style-type: none"> Ventilation systems will be operated to manage emissions level in tunnels and ventilate emissions to atmosphere in a manner that meets relevant NSW Environment Protection Authority (NSW EPA) air quality criteria. 	Unlikely	Minor	Low
Impacts to ambient air quality.	Operation	<ul style="list-style-type: none"> Design and construct ventilation outlets to achieve the regulatory outlet discharge limits and modelled dispersion outcomes for pollutant concentrations at ground level. 	Unlikely	Minor	Low
Increase in modelled pollutant concentrations on Victoria Road to the north of Iron Cove Link, near Anzac Bridge and Canal Road at Mascot, as a result of the general increase in traffic at that location due to the project.	Operation	<ul style="list-style-type: none"> While the project cannot control the general increase in traffic growth over time and related increase in vehicle emissions, the progressive introduction of more stringent vehicle emissions regulations will continue over the life of the project. 	Likely	Moderate	Medium
Noise and vibration - refer to Chapter 10 (Noise and vibration)					
Construction noise and vibration impacts upon sensitive receivers around all construction sites.	Construction	<p>A Construction Noise and Vibration Management Plan (CNVMP) will be prepared for the project. The plan will (NV1):</p> <ul style="list-style-type: none"> Identify relevant performance criteria in relation to noise and vibration Identify noise and vibration sensitive receivers and features in the vicinity of the project Include standard and additional mitigation measures from the CNVG and details about when each will be applied 	Likely	Moderate	Medium

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk
		<ul style="list-style-type: none"> Describe the process(es) that will be adopted for carrying out location and activity specific noise and vibration impact assessments to assist with the selection of appropriate mitigation measures Include protocols that will be adopted to manage works required outside standard construction hours in accordance with relevant guidelines Detail monitoring that will be carried out to confirm project performance in relation to noise and vibration performance criteria. <p>The CNVMP will be implemented for the duration of construction of the project.</p>			
Noise and vibration impacts outside of standard construction hours.	Construction	<p>An Out-of-hours Works Protocol will be developed for the construction of the project. The protocol will include (NV5):</p> <ul style="list-style-type: none"> Details of works required outside standard construction hours, including justification of why the activities are required outside standard construction hours Measures that will be implemented to manage potential impacts associated with works outside standard construction hours Location and activity specific noise and vibration impact assessment process(es) that will be followed to identify potentially affected receivers, clarify potential impacts and select appropriate management measures Details of the approval process (internal and external) for works proposed outside standard construction hours. <p>The protocol will be prepared in consultation with DP&E and the NSW EPA, endorsed by the acoustic advisor for the project and implemented during construction of the project.</p>	Likely	Moderate	Medium
Receivers on Victoria Road near Iron Cove Bridge may receive up to 15 dBA increases in noise from road traffic as a result of the	Operation	<ul style="list-style-type: none"> The use of low noise pavement to further reduce road traffic noise at the source will be investigated during detailed design taking into account whole-life engineering considerations and the overall social, economic and environmental effects. If low noise pavement is found to be appropriate, it will be considered as a management measure when assessing operation noise impacts 	Likely	Moderate	Medium

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk
project.		<p>based on the detailed design (NV10)</p> <ul style="list-style-type: none"> • The area in the vicinity of the western portal of the Iron Cove Link at Rozelle will be assessed further during development of the detailed design to identify appropriate noise mitigation measures to address predicted increases in road traffic noise to the project. The measures that will be considered will include low road noise pavement, noise barriers, at-property treatments and the project design (NV11) • Receivers that qualify for assessment at receiver treatment in relation to operational noise that are also predicted to experience significant exceedances of noise management levels due to construction will be given priority preference for assessment. When at receiver treatments are found to be appropriate, the application of the treatment will be expedited (NV12) • Within 12 months of the commencement of the operation of the project, actual operational noise performance will be compared to predicted operational noise performance. The need for any additional management measures to address any identified operational performance issues and meet relevant operational noise criteria will be assessed and implemented where reasonable and feasible (NV14). 			
Human Health – Refer to Chapter 11 (Human health risk)					
A separate risk assessment was undertaken for human health risks in accordance with a range of international guidance documents as endorsed or accepted by Australian health and environment authorities. Refer to Chapter 11 (Human health risk) for a full list of guidelines.					
Changes in the urban environment associated with the project have the potential to result in a range of impacts on health and wellbeing of the community. The potential for changes to result in impacts on health and wellbeing is complex. Changes that may occur have the potential to result in both positive and negative impacts. Positive impacts include economic benefits, traffic improvements in some areas and increased public open space in the Rozelle Rail Yards site. Negative impacts may occur as a result of traffic disruption during construction, property acquisitions, visual changes, noise impacts and changes in access/cohesion of local areas. These may result in increased levels of stress and anxiety. In many cases the impacts identified are either short term (associated with construction only) and/or management measures have been identified to minimise the impacts on the community. Reference is made to the residual risk assessment for traffic and transport, noise and vibration, air quality. Land use, property, social and economic impacts that relate to potential human health impacts as detailed in Chapter 11 (Human health risk) .					

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk																				
Land use and property - refer to Chapter 12 (Land use and property)																									
Ground settlement resulting in damage to buildings, structures or utility infrastructure.	Construction/ Operation	<ul style="list-style-type: none"> Ground settlement will be managed to comply with the following criteria where possible (PL6): <table border="1"> <thead> <tr> <th>Beneath structure/facility</th> <th>Maximum settlement</th> <th>Maximum angular distortion</th> <th>Limiting tensile strain (per cent)</th> </tr> </thead> <tbody> <tr> <td>Buildings – Low or non-sensitive properties (ie less than or equal to two levels and carparks).</td> <td>30 mm</td> <td>1 in 350</td> <td>0.1</td> </tr> <tr> <td>Buildings – High or sensitive properties (ie greater than or equal to 3 levels and carparks).</td> <td>20 mm</td> <td>1 in 500</td> <td>0.1</td> </tr> <tr> <td>Roads and parking areas.</td> <td>40 mm</td> <td>1 in 250</td> <td>N/A</td> </tr> <tr> <td>Parks.</td> <td>50 mm</td> <td>1 in 250</td> <td>N/A</td> </tr> </tbody> </table> <ul style="list-style-type: none"> A Settlement Monitoring Plan will be prepared and implemented. The plan will include provisions for the development of management measures that will be implemented depending on the outcomes of the settlement monitoring results (PL8). 	Beneath structure/facility	Maximum settlement	Maximum angular distortion	Limiting tensile strain (per cent)	Buildings – Low or non-sensitive properties (ie less than or equal to two levels and carparks).	30 mm	1 in 350	0.1	Buildings – High or sensitive properties (ie greater than or equal to 3 levels and carparks).	20 mm	1 in 500	0.1	Roads and parking areas.	40 mm	1 in 250	N/A	Parks.	50 mm	1 in 250	N/A	Likely	Moderate	Medium
			Beneath structure/facility	Maximum settlement	Maximum angular distortion	Limiting tensile strain (per cent)																			
			Buildings – Low or non-sensitive properties (ie less than or equal to two levels and carparks).	30 mm	1 in 350	0.1																			
			Buildings – High or sensitive properties (ie greater than or equal to 3 levels and carparks).	20 mm	1 in 500	0.1																			
			Roads and parking areas.	40 mm	1 in 250	N/A																			
Parks.	50 mm	1 in 250	N/A																						
Urban design and visual amenity - refer to Chapter 13 (Urban design and visual amenity)																									
Impacts to visual amenity from construction ancillary facilities.	Construction	<ul style="list-style-type: none"> Ancillary facilities, including the locations of visible structures and plant and perimeter fencing and treatments, will be developed to minimise visual impacts for adjacent receivers where feasible and reasonable (LV1) Regular maintenance of site hoarding and perimeter site areas should be undertaken, including the prompt removal of graffiti (LV3) 	Likely	Moderate	Medium																				

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk
		<ul style="list-style-type: none"> Hoarding and temporary noise walls will be erected as early as possible within the site establishment phase to provide visual screening (LV5) The detailed design will explore opportunities to design acoustic sheds to be visually recessive, such as the use of mid-toned colours and materials to minimise the intrusiveness and potential glare of the sheds, or the use of transparent materials where feasible to minimise potential overshadowing impacts (LV6). 			
Antisocial behaviour around construction ancillary facilities and operational infrastructure.	Construction and operation	<ul style="list-style-type: none"> Specific design measures at construction ancillary facilities will be identified to prevent crime, based on principles of Crime Prevention Through Environmental Design (LV10). 	Likely	Minor	Low
Impacts to visual amenity and landscape character at and around the Rozelle Rail Yards.	Operation	<ul style="list-style-type: none"> Integrate the new open space at Rozelle with the Lilyfield Road streetscape through considered street tree planting and associated landscape works (LV13) Implement urban design and landscaping measures that allow permeable views between the City West Link carriageway and the new open space to provide a sense of openness and connection with the open space for motorists and the community (LV14) Investigate measures to minimise view impacts of the project to sensitive residential receptors in the vicinity of the Rozelle Rail Yards as described in this assessment and include in the UDLP where reasonable and feasible (LV15) Develop a design that aims to incorporate the ventilation outlets at the Rozelle Rail Yards as an integral component of the larger open space composition, with reference and consideration to the Ventilation Facility Design Review (Annexure 2 of Appendix L (Technical working paper: Urban design)) (LV16) Consult with UrbanGrowth NSW regarding the interface between the project footprint and the White Bay Power Station precinct. Design the interface to ensure compatibility between the two areas from a landscaping, visual, heritage and active transport 	Likely	Moderate	Medium

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk
		<p>connectivity perspective (LV17).</p> <ul style="list-style-type: none"> Investigate measures to retain the mature trees of high retention value adjacent to the light rail corridor at the corner of The Crescent and City West Link, or provide screen planting alongside the retaining wall edge of the light rail corridor, to minimise landscape and visual impacts (LV18). 			
Impacts to visual amenity and landscape character at and around the Iron Cove Link.	Operation	<ul style="list-style-type: none"> Investigate vegetative and other screening measures along Victoria Road to improve the visual amenity of the streetscape and reduce impacts associated with the ventilation outlet and increased glare from the portals to residential dwellings to the north of Victoria Road (LV19). Provide a well-articulated, integrated car parking and landscape design for the bioretention facility in Manning Street that is place sensitive, and enhances the interface between the project and both King George Park and adjacent residences (LV20). 	Likely	Minor	Low
Social and economic - refer to Chapter 14 (Social and economic)					
Impacts to businesses as a result of changes in traffic, access, parking and amenity.	Construction	<ul style="list-style-type: none"> Prepare and implement Business Management Plans to reduce the overall effects on potentially impacted businesses and commercial operations (SE1). 	Likely	Moderate	Medium
Impacts to the community access and connectivity.	Construction	<ul style="list-style-type: none"> Implement the CTAMP, which will include measures aimed at minimising disruptions as a result construction changes to traffic flow, parking and local amenity (TT01 – TT12) Implement the Community Communication Strategy (SE2), which will include measures: <ul style="list-style-type: none"> Procedures and mechanisms that will be implemented by the in response to the key social impacts identified for the project Property acquisition support services that will be provided Procedures and mechanisms to communicate to project stakeholders (including affected communities), the access and connectivity enhancements and new community and social facilities that will be delivered as part of the project through the Social Infrastructure Plan and to update stakeholders on delivery progress 	Likely	Moderate	Medium

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk
		<ul style="list-style-type: none"> - Procedures and mechanisms that will be used to engage with affected business owners to identify potential access, parking, business visibility and other impacts to develop measures to address potential impacts on a case by case basis. 			
Acquisition of property required for the project.	Construction	<ul style="list-style-type: none"> • Land acquisition for the project will be undertaken in accordance with the <i>Land Acquisition (Just Terms Compensation) Act 1991</i> (NSW) and the <i>Roads and Maritime Services land acquisition information guide</i> (Roads and Maritime 2014b) and the land acquisition reforms announced by the NSW Government in 2016. A property acquisition factsheet that outlines the process and provides further information for concerned residents will continue to be made available online and in hard copy at project information centres (SE3) • Affected households will continue to have access to a counselling service that assists people through the property acquisition process (SE4) • An independent service will continue to be provided to vulnerable households (eg elderly, those suffering an illness) to assist with relocation. Assistance could include finding a suitable house for relocation, arranging removalists, disconnecting services and attending appointments with solicitors or other representatives (SE5) • A community relations support toll-free telephone line will be operated to respond to any community concerns or requests for translation services (SE6). 	Certain	Minor	Medium
Soil and water quality – refer to Chapter 15 (Soil and water quality)					
Impacts on water quality in project catchments due to the water discharge, including discharge of treated surface and groundwater.	Construction	<ul style="list-style-type: none"> • Construction water treatment facilities will be designed and managed so that treated water will be of suitable quality for discharge to the receiving environment. The level of treatment provided will consider the characteristics of the waterbody, any operational constraints or practicalities and associated environmental impacts and be developed in accordance with ANZECC (2000) and with consideration to the relevant NSW 	Unlikely	Moderate	Low

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk
		WQOs and <i>Protection of the Environment Operations Act 1997</i> (NSW). The discharge criteria for the treatment facilities will be finalised and included in the Construction Soil and Water Management Plan (CSWMP). An ANZECC (2000) species protection level of 90 per cent is considered appropriate for adoption as discharge criteria for toxicants where practical and feasible. The discharge criteria for the treatment facilities will be included in the CSWMP (SW10).			
Impacts on local soil and water quality due to disturbance of actual or potential acid sulfate soils and/or acid drainage discharge.	Construction	<ul style="list-style-type: none"> Appropriate stockpiling and management of contaminated materials will be implemented (CM05) Washing water and waste will be appropriately contained, treated and disposed of (CM10) The CSWMP prepared for the project will include measures for the management of acid sulfate soils if encountered (CM07) Procedures, prepared in accordance with the requirements of the <i>Acid Sulfate Soil Manual</i> (Acid Sulfate Soil Management Advisory Committee 1998), will be included in the CSWMP and implemented in the event that acid sulfate soils, rocks or monosulfidic black oozes are encountered during construction of the project (SW11). 	Likely	Minor	Low
Contamination – refer to Chapter 16 (Contamination)					
Impacts to site workers and local community through direct contact, inhalation and/or ingestion of dust from contaminated soil or hazardous building materials exposed through demolition and ground disturbance.	Construction	<ul style="list-style-type: none"> Further investigation of contamination areas will be undertaken and a Remediation Action Plan will be prepared where necessary (CM01) A site specific asbestos management plan will be prepared and include details of specific management measures to be implemented for asbestos or asbestos containing materials (CM02) A hazardous materials assessment will be carried out prior to and during demolition of buildings. Subsequent demolition works will be undertaken in accordance with the relevant Australian Standards and relevant NSW WorkCover Codes of Practice, including the Work Health and Safety Regulation 2011 (NSW) (CM03). 	Unlikely	Moderate	Low

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk
Increased contamination in areas through cross contamination associated with the incorrect handling or disposal of spoil/unexpected finds and/or potential leaks and spills from construction equipment and plant.	Construction	<ul style="list-style-type: none"> Stockpile management procedures will be implemented to control dust, odour and cross contamination (CM05) An unexpected find and hazardous materials procedure will be implemented and plant, equipment and supplies will be managed to prevent spills and leaks (CM06 and HR3) Suitable areas will be identified to allow for contingency management of unexpected waste materials, including contaminated materials. Suitable areas will be required to be hardstand or lined areas that are appropriately stabilised and bunded, with sufficient area for stockpile storage (RW9) Safety Data Sheets for dangerous goods and hazardous substances will be stored on site prior to their arrival (HR4) Transport of dangerous goods and hazardous substances will be conducted in accordance with relevant legislation and codes, including the Dangerous Goods (Road and Rail Transport) Regulation 2014 (NSW) and the Australian Code for the Transport of Dangerous Goods by Road and Rail (National Transport Commission 2008) (HR5). 	Likely	Minor	Low
Flooding and drainage - refer to Chapter 17 (Flooding and Drainage)					
Impacts on surrounding properties due to the potential alterations of flood levels and behaviour due to construction ancillary facilities and due to new operational facilities.	Construction and operation	<ul style="list-style-type: none"> A Flood Mitigation Strategy identifying potential flood risks to and from the project and measures to minimise risks will be prepared and implemented (FD01, FD02 and FD03) Further hydrological and hydraulic modelling of detailed design to assess potential flood impact, design out where possible or otherwise mitigate potential flooding impacts (FD06) Floor level surveys will be carried for buildings where peak in the 100 year ARI design flood are predicted to increased due to the project, and further design refinements will be made to minimise impacts (FD08). 	Unlikely	Moderate	Low
Impacts on flood levels and behaviour due to sea level rise and potential increase in rainfall intensity due	Operation	<ul style="list-style-type: none"> The detailed assessment of potential climate change related flood risks to the project will be revised for the detailed design and design changes or management measures implemented to limit climate induced risks to flooding and drainage (FD07). 	Unlikely	Major	Medium

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk
to future climate change.					
Biodiversity - refer to Chapter 18 (Biodiversity)					
Loss of foraging habitat for the Grey-headed Flying-fox and loss of habitat for microbats.	Construction and operation	<ul style="list-style-type: none"> • A Construction Flora and Fauna Management Plan (CFFMP) will be developed and implemented during construction. Management measures and environmental controls to be implemented before and during construction including (B1): <ul style="list-style-type: none"> - An unexpected threatened species finds procedure - Section 3.3.2 Standard precautions and mitigation measures of the <i>Policy and Guidelines for Fish Habitat Conservation and Management Update 2013</i> (DPI-Fisheries NSW 2013) - Tree assessment and management protocols consistent with <i>AS 4970-2009 Protection of trees on development sites</i> - Weed management protocols • Foraging tree species for the Grey-headed Flying-fox to be considered in the Urban Design and Landscape Plan to provide compensatory planting (OB9) • Prior to the commencement of any works associated with the modification of the Victoria Road bridge, an inspection will be carried out by a suitably qualified and experienced ecologist to confirm the presence of roosting microbats. If roosting microbats are identified, measures to manage potential impacts will be developed in consultation with an appropriate microbat expert and included in the CFFMP prior to the commencement of any work with the potential to disturb the roosting locations (as confirmed by the microbat expert). The plan will include management measures outlined in the Biodiversity Assessment Report and from any additional assessments carried out during detailed design and project delivery as relevant (B2). 	Likely	Minor	Low
Impacts to aquatic habitat in Whites Creek and Rozelle Bay.	Construction	<ul style="list-style-type: none"> • The proposed road bridge at Whites Creek will be designed with consideration of <i>Policy and Guidelines for Fish Habitat Conservation Update 2013</i> (DPI, 2013) and <i>Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings</i> (NSW Fisheries 2003) (B3) 	Unlikely	Minor	Low

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk
		<ul style="list-style-type: none"> Site-specific Erosion and Sediment Control Plans (ESCPs) will be prepared for each work location associated with or in the vicinity of waterways and culverts that will be modified as part of the project. The ESCPs would contain measures to stabilise all surfaces disturbed as a result of the project as soon as possible following the disturbance to prevent erosion and to minimise sedimentation in adjacent aquatic environments (B4). 			
Groundwater - refer to Chapter 19 (Groundwater)					
High groundwater inflows (in excess of the one litre per second per kilometre design criterion) which could result in increased groundwater drawdown.	Construction	<ul style="list-style-type: none"> Groundwater inflows within the tunnels will be minimised by designing the final tunnel alignment to minimise intersections with known palaeochannels and alluvium present in the project footprint (GW1) Appropriate waterproofing measures will be identified and included in the detailed design to permanently reduce the inflow into the tunnels to below one litre per second per kilometre for any kilometre length of the tunnel (GW2) Appropriate measures will be investigated and implemented at dive structures and shafts and for cut-and-cover sections of the tunnel to minimise groundwater inflow (GW3) A detailed groundwater model will be developed by the construction contractor. The model will be used to predict groundwater inflow rates and volumes within the tunnels and groundwater levels (including drawdown) in adjacent areas during construction and operation of the project (GW7) Groundwater inflow within and groundwater levels in the vicinity of the tunnels will be monitored during construction and compared to model predictions and groundwater performance criteria applied to the project. The groundwater model will be updated based on the results of the monitoring as required and proposed management measures to minimise potential groundwater impacts adjusted accordingly to ensure that groundwater inflow performance criteria are met (GW8). 	Unlikely	Moderate	Low

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk
Non-Aboriginal heritage - refer to Chapter 20 (Non-Aboriginal heritage)					
Full or partial loss, or damage to historical heritage items due to demolition.	Construction	<ul style="list-style-type: none"> Construction Heritage Management Plan (CHMP) will be prepared and implemented as part of the Construction Environmental Management Plan. The CHMP will include (NAH01): <ul style="list-style-type: none"> Measures that will be implemented to manage potential impacts to items of heritage significance Inclusion of heritage awareness and management training for relevant personnel involved in site works Details regarding the conservation and curation of any historical artefacts recovered during works A Heritage Salvage Strategy will be prepared to identify the salvage potential of the fabric and features from heritage items and potential heritage items that will be demolished to facilitate the project. This could include timber joinery, fireplaces, stained glass, stairs, decorative tiles, bricks, steel truss structures, windows etc. The strategy will also identify options and a process for dissemination of salvaged items to owners, community groups and interested parties (NAH09). 	Certain	Minor	Medium
Potential impact on features of heritage significance associated with the White Bay Power Station.	Construction	<ul style="list-style-type: none"> The railway cutting on the eastern side of Victoria Road, associated with the White Bay Power Station, will be considered during the development of the detailed design for the realigned Victoria Road and associated bridge. The final design will seek to avoid impact to the railway cutting and maintain the visual relationship between the cutting and the White Bay Power Station site. Landscaping sympathetic to the relationship, developed in consultation with a heritage specialist, will be included in the Urban Design and Landscape Plan for the project (NA11) A condition assessment of the southern penstock (and its associated water channels) will be carried out by a heritage specialist and a structural engineer prior to any works in the vicinity with the potential impact upon the item. If required any conservation works required to limit potential impacts on 	Unlikely	Moderate	Low

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk
		<p>deteriorated fabric (loose bricks, corroded steel) will be identified and implemented prior to construction (NA12)</p> <ul style="list-style-type: none"> The southern penstock and its associated water channels (location and extent unknown) will be protected during works associated with the reconstruction of the Victoria Road Bridge (NA13). 			
Aboriginal heritage - refer to Chapter 21 (Aboriginal heritage)					
Potential impact on previously unidentified Aboriginal heritage items (unexpected finds).	Construction	<ul style="list-style-type: none"> Any items of potential Aboriginal archaeological or cultural heritage conservation significance or human remains discovered during construction will be managed in accordance with the Unexpected Heritage Finds and Humans Remains Procedure developed for the project (AH1). 	Unlikely	Moderate	Low
Impacts to Aboriginal Heritage Information Management System (AHIMS) site #45-6-2278.	Construction	<ul style="list-style-type: none"> Verification of the presence and condition of by a AHIMS site #45-6-2278 by a suitably qualified archaeologist, subject to access (AH2) If the AHIMS site #45-6-2278 is verified, an assessment will be completed by a suitably qualified and experienced person prior to the commencement of any vibration intensive construction activities in the vicinity. The assessment will consider all vibration intensive activities that will occur in the vicinity, the likely vibration levels and relevant vibration criteria and identify the management measures, including monitoring, that will be implemented to prevent and reduce potential impacts. A final condition assessment will be carried out at the completion of construction detailing recommendations for remediation measures if required (AH2 – AH3). 	Unlikely	Moderate	Low
Greenhouse gas - refer to Chapter 22 (Greenhouse gas)					
Emissions of greenhouse gases during construction.	Construction	<ul style="list-style-type: none"> An Energy Efficiency and Greenhouse Gas Emissions Strategy and Management Plan will be prepared for the project. The strategy will identify initiatives to be implemented during construction and operation of the project to improve energy efficiency, reduce Green House Gas (GHG) emissions, energy use and embodied life cycle impacts (GHG1). 	Certain	Minor	Low
Greenhouse gas	Operation	<ul style="list-style-type: none"> An Energy Efficiency and Greenhouse Gas Emissions Strategy 	Certain	Minor	Low

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk
emissions generated during operation.		and Management Plan will be prepared for the project. The strategy will identify initiatives to be implemented during construction and operation of the project to improve energy efficiency, reduce GHG emissions, energy use and embodied life cycle impacts (GHG1).			
Greenhouse gas emissions from operational road use.	Operation	<ul style="list-style-type: none"> The tunnel will be designed with appropriate vertical alignments and grades to allow vehicles to maintain constant speeds and minimise fuel use to reduce potential greenhouse gas emissions (OGHG7). 	Certain	Minor	Low
Resource use and waste minimisation - refer to Chapter 23 (Resource use and waste minimisation)					
Excessive consumption of resources during construction.	Construction	<ul style="list-style-type: none"> Construction material will be sourced in accordance with the relevant aims of the <i>WestConnex Sustainability Strategy</i> (Sydney Motorway Corporation 2015) and a Sustainability Strategy (that will be developed during detailed design), including to optimise resource efficiency and waste management, and the selection of locally sourced materials and prefabricated assets where possible, to reduce greenhouse gas emissions. Unnecessary resource consumption will be avoided through the detailed design of the project and by making realistic predictions about the required quantities of resources, such as construction materials (RW1). 	Unlikely	Minor	Low
Impacts associated with poor waste management during construction.	Construction	<ul style="list-style-type: none"> Wastes will be managed and disposed of in accordance with relevant NSW legislation and government policies (RW2) A Construction Waste Management Plan will be prepared as part of the CEMP and regularly updated during detailed design and construction, detailing appropriate procedures for waste management. The plan will include the waste management measures described in this EIS (RW3) Waste management measures will be based on the waste hierarchy principles (RW4). 	Unlikely	Minor	Low
Impacts associated with unexpected waste volume or types during construction.	Construction	<ul style="list-style-type: none"> Suitable areas will be identified to allow for contingency management of unexpected waste materials, including contaminated materials. Suitable areas will be required to be hardstand or lined areas that are appropriately stabilised and 	Unlikely	Minor	Low

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk
		bunded, with sufficient area for stockpile storage (RW9).			
Climate change and risk adaption - refer to Chapter 24 (Climate change risk and adaptation)					
<p>A separate risk assessment was undertaken for climate change risks in accordance with the Roads and Maritime Draft <i>Technical Guide for Climate Change Adaptation for the State Road Network</i>, with risks assessed using the likelihood and consequence criteria and risk assessment approach outlined in the Technical Guide. Refer to Chapter 24 (Climate change risk and adaptation) for a summary of the risk assessment approach and Appendix X (Detailed climate change risk assessment) for the full risk assessment.</p> <p>The detailed risk assessment (Appendix X) identified a total of 33 direct and indirect risks to the project. Of these risks, the detailed risk assessment identified one extreme, four high and 12 medium risks. Remaining risks were rated low or negligible. A detailed climate change risk assessment will be undertaken during detailed design in accordance with AS 5334-2013 Climate change adaptation for settlements and infrastructure - A risk based approach.</p> <p>The assessment will identify and implement adaptation measures to address high and extreme risks. It is considered likely that, upon implementation of adaptation measures listed in Chapter 24 (Climate change risk and adaptation), extreme and high risks will be reduced to a residual risk rating of at least medium. The decision to implement adaptation measures to reduce medium risks will also be considered during detailed design.</p>					
Hazards and risk - refer to Chapter 25 (Hazard and risk)					
Impacts associated with the incorrect storage of dangerous goods.	Construction and operation	<ul style="list-style-type: none"> Storage of dangerous goods and hazardous materials will occur in accordance with suppliers' instructions and relevant Australian Standards and legislation including the (HR1): <ul style="list-style-type: none"> - <i>Work Health and Safety Act 2011</i> (NSW) - Storage and Handling of Dangerous Goods Code of Practice (WorkCover NSW 2005) - Environment Protection Manual for Authorised Officers: Bunding and Spill Management, technical bulletin (NSW EPA 1997) Storage methods may include bulk storage tanks, chemical storage cabinets/containers or impervious bunds (OpHR6). 	Unlikely	Moderate	Low
Impacts associated with the incorrect transportation of dangerous goods.	Construction and operation	<ul style="list-style-type: none"> Transport of dangerous goods and hazardous substances will be conducted in accordance with relevant legislation and codes, including the Dangerous Goods (Road and Rail Transport) Regulation 2014 and the Australian Code for the Transport of Dangerous Goods by Road and Rail (National Transport Commission 2008) (HR5) The transport of dangerous goods and hazardous substances will 	Unlikely	Moderate	Low

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk
		be prohibited through the mainline tunnels and entry and exit ramps (OpHR6).			
Impacts associated with fires or other incidents in project tunnels.	Operation	<ul style="list-style-type: none"> 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), Permanent International Association of Road Congresses (PIARC) (European), AS4825 (Australian) and Roads and Maritime standards (OpHR1) An Incident Response Plan will be developed as part of the Emergency Response Plan for the project and implemented in the event of an accident or incident. The plan will include management and response measures to be implemented in the event of an incident (OpHR4) The response to incidents within the motorway will be managed in accordance with the memorandum of understanding between Roads and Maritime and the NSW Police Service, NSW Rural Fire Service, NSW Fire and Rescue and other emergency services (OpHR5). 	Unlikely	Moderate	Medium
Impacts associated with asbestos.	Construction	<ul style="list-style-type: none"> An asbestos survey will be undertaken of buildings to be demolished as part of the project in accordance with an Asbestos Management Plan as part of the Work Health and Safety Plan. The survey will be conducted by a suitably qualified person (RW13) Asbestos handling and management will be undertaken in accordance with an Asbestos Management Plan as part of the Work Health and Safety Plan and relevant NSW legislation, government policies and Australian Standards. The plan will include prior notification to adjacent communities about potential hazards (RW14). 	Likely	Minor	Low
Sustainability - refer to Chapter 27 (Sustainability)					
<p>An assessment of the sustainability of the project was undertaken in Chapter 27 (Sustainability). The sustainability of the project was assessed against four principles of ecologically sustainable development:</p> <ul style="list-style-type: none"> The precautionary principle Inter-generational equity Conservation of biological diversity and ecological integrity 					

Summary of key impacts	Construction/ Operation	Management and mitigation measures	Likelihood	Consequence	Residual risk
<ul style="list-style-type: none"> <li data-bbox="181 284 929 311">· Improved valuation and pricing and incentive mechanisms. <p data-bbox="181 347 2011 507">The assessment reviewed the sustainability of the project and concluded that the project is consistent with the principles of ecologically sustainable development, In order to ensure the principles of ecologically sustainable development are incorporated into the project, a Sustainability Management Plan will be prepared and include measures such as governance structures, processes and systems that ensure integration of all sustainability considerations (vision, commitments, principles, objectives and targets), initiatives, monitoring and reporting during the detailed design and construction phases of the project.</p> <p data-bbox="181 539 1995 603">With the proposed Sustainability Management Plan in place there is a low residual risk of the principles of ecologically sustainable development not being implemented across all elements of the project.</p>					

28.4 Risk analysis outcomes

28.4.1 Medium residual risk

A number of medium level residual risks have been identified in this residual risk assessment. Through the detailed design of the project there is further opportunity to:

- Resolve 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 CEMP and OEMP as detailed in **Chapter 29** (Summary of environmental management measures). This is a process of continuous improvement that will form part of the CEMP and OEMP and allow for management measures to be updated or improved during construction and operational phases where practical.

Following the implementation of the above, medium residual risk level items would be further reviewed during the detailed design development and where necessary additional measures implemented to ensure these risks are suitably mitigated.

28.4.2 Low residual risk

Other impacts identified as having a low residual risk are considered to have already been managed to a reasonable and feasible level. Regardless of the low risk rating, the same level of review, correction and continual improvement would be applied to the measures identified to address these impacts as will be detailed in the CEMP and OEMP.

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