



WestConnex M4-M5 Link

State significant infrastructure application report

January 2016

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Executive summary

Introduction and need

Roads and Maritime Services (Roads and Maritime) propose to construct and operate the M4-M5 Link (the project); which would comprise a new, tolled multi-lane road link between the proposed M4 East at Haberfield and the proposed New M5 at St Peters. The project would also include interchanges at Rozelle and Camperdown.

The project is one component of the WestConnex program of works. WestConnex is a 33 kilometre motorway that is intended to link Sydney's west with the airport and the Port Botany precinct. The WestConnex program of works is proposed to be delivered as a series of projects, each subject to a stand-alone planning assessment and approvals process in accordance with the requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and other relevant legislation.

Key components of the project include:

- Twin motorway tunnels between the M4 East at Haberfield and the New M5 at St Peters. Each tunnel would be around 9.2 kilometres in length and would be built to accommodate three lanes of traffic. Each tunnel would integrate with tunnel stubs constructed underground as part of the proposed M4 East at the Wattle Street interchange and proposed New M5.
- A new road interchange at Rozelle at the disused Rozelle Rail Yard, to provide connections to and from the M4-M5 Link with City West Link, Victoria Road and the Anzac Bridge intersection.
- Tunnel stubs to allow for a potential future connection to the Western Harbour Tunnel and Beaches Link (an additional Sydney Harbour Tunnel road crossing) in the vicinity of the Rozelle interchange.
- A new road interchange at Camperdown to provide north and south-bound on and off ramps connecting to Parramatta Road.
- Connections to the St Peters interchange (constructed as part of the proposed New M5), including the construction of the M4-M5 Link southern portal and integration works within the interchange.
- Ancillary infrastructure and operational facilities for electronic tolling, signage (including electronic signage), ventilation structures and systems, fire and life safety systems, and emergency evacuation and smoke extraction infrastructure.
- A motorway control centre that would include operation and maintenance facilities.
- New service utilities and modifications to existing service utilities.
- Modifications to the surface road network to integrate the new interchanges, including but not limited to the City West Link, Victoria Road, and Parramatta Road.
- Temporary construction ancillary facilities and temporary works to facilitate the construction of the project.

The project would be delivered through a design and construct contract aimed at delivering an innovative, cost effective and environmentally responsive design for the project. The alignment of the project would be located within the project corridor, which forms the basis for the assessment within this document.

Planning and assessment process

Roads and Maritime, as the proponent, has formed the view that the impact of the project is likely to significantly affect the environment. On this basis, the project is declared to be State significant infrastructure under section 115U (2) of the EP&A Act by reason of the operation of clause 14 and clause 1 of Schedule 3 of the *State Environmental Planning Policy (State and Regional Development) 2011*. Accordingly, the project is subject to Part 5.1 of the EP&A Act and requires the preparation of an environmental impact statement and the approval of the Minister for Planning.

Proposed scope of the environmental impact statement

The potential impacts of the project and their associated environmental, social and economic consequences have been identified through a preliminary risk assessment and preliminary investigations. This indicates that the following key environmental issues will require further assessment and may require project specific safeguards and management measures:

- Traffic and transport.
- Air quality and human health
- Noise and vibration
- Property and land use
- Urban Design and visual amenity
- Soil and water quality
- Flooding and drainage
- Groundwater
- Resource management and waste minimisation

These issues will be assessed in a future environmental impact statement for the project, and will detail the existing environment, the potential impacts during construction and/or operation, the identification of the recommended mitigation and management measures to avoid, minimise or manage the potential impacts.

A number of other environmental issues have also been identified. These issues are outlined in this report and are considered to be of lesser consequence, taking into consideration the project scope, the existing environment and the implementation of standard safeguards and management measures.

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Abbreviations and Glossary

AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
Alluvial material	Relatively recent deposits of sedimentary material within river/creek beds, floodplains, lakes or at the base of mountain slopes
Aquifer	Underground layer of water-bearing permeable rock or unconsolidated materials (such as gravel, sand and silt) from which groundwater can be usefully extracted
BoM	Bureau of Meteorology
Carriageway	Section of a roadway used for vehicular traffic. Generally delineated by kerbs, a verge or a median.
CBD	Central business district
CEMP	Construction environmental management plan
Community severance	Reduced access to local amenities and disruption of local social networks caused by the introduction of a physical barrier, such as a major road, or through significant increases in traffic volumes on a road that was not originally regarded as a barrier
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Environmental assessment process	A part of the decision-making process where the environmental impact of a development, proposal or activity is considered in detail, in conjunction with other aspects of the development, proposal or activity
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FM Act	<i>Fisheries Management Act 1994</i>
GDEs	Groundwater dependent ecosystems
Interchange	A grade separated junction or overpass to separate road, rail or other traffic that cross each other, so that crossing movements do not conflict
LGA	Local government area
M4 East	A part of the WestConnex program of works – Homebush Bay Drive, Homebush to Parramatta Road and City West Link (Wattle Street) at Haberfield
New M5	A part of the WestConnex program of works – King Georges Road at Beverly Hills to St Peters
OEH	Office of Environment and Heritage
OLS	Obstacle Limitation Surface

PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation
PAD	Potential Archaeological Deposit
PAN-OPS	Procedure for Air Navigational Services – Aircraft Operations surface
Roads and Maritime	Roads and Maritime Services
SEPP	State environmental planning policy
SMC	Sydney Motorways Corporation, an entity responsible for the delivery of WestConnex motorway.
SMPO	Sydney Motorways Project Office
SWMP	Soil and water management plan
Threatened	As defined under the <i>Threatened Species Conservation Act 1995</i> . A species, population or ecological community that is likely to become extinct or is in immediate danger of extinction
TSC Act	<i>Threatened Species Conservation Act 1995</i>
Tunnel portal	The entry/exit structures at each end of a tunnel
WARR Act	<i>Waste Avoidance and Resource Recovery Act 2001</i>

1 Introduction

1.1 Overview of WestConnex

WestConnex is a NSW Government initiative linking Sydney's west and south-west with Sydney Airport and the Port Botany precinct. The component projects of the WestConnex program of works are:

- M4 Widening – Pitt Street, Parramatta to Homebush Bay Drive, Homebush
- M4 East – Homebush Bay Drive, Homebush to Parramatta Road and City West Link (Wattle Street) at Haberfield
- King Georges Road Interchange Upgrade
- New M5 – King Georges Road at Beverly Hills to St Peters
- M4–M5 Link – Haberfield to St Peters (the subject of this application and hereafter referred to as “the project”)
- Sydney Gateway

The components of WestConnex are shown on Figure 1-1.

Each individual component project is subject to separate planning applications. Each project is being assessed separately, but the impacts of each project are also being considered in the context of the wider WestConnex.

Planning approval for the M4 Widening project (M4 Widening) was granted on 21 December 2014 and work commenced in March 2015. Planning approval for the King Georges Road Interchange Upgrade project was granted on 3 March 2015 and work commenced in July 2015.

The M4 East project is currently being assessed by the Department of Planning and Environment (DP&E) and is subject to planning approval following the public exhibition of the environmental impact statement in late 2015. The EIS for the New M5 is currently on public exhibition until 29 January 2016, and is subject to planning approval.

The Sydney Gateway is the subject of further investigations by the NSW Government and would be subject to separate planning assessment and approval.

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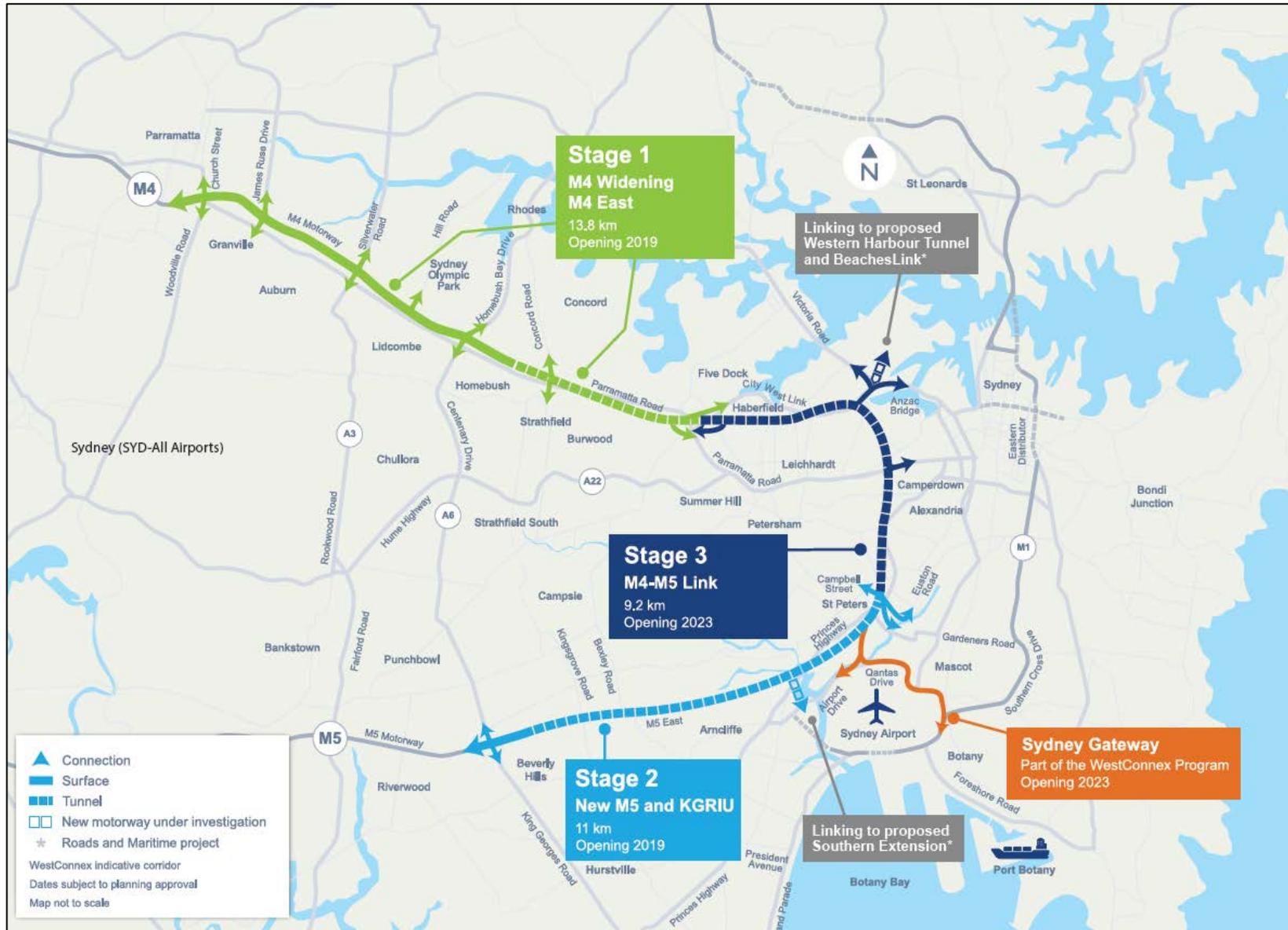


Figure 1-1 Regional context and the WestConnex program of works

1.2 Overview of the project

Roads and Maritime Services (Roads and Maritime) propose to construct and operate the M4-M5 Link (the project); which would comprise a new, tolled multi-lane road link between the M4 East at Haberfield and the New M5 at the St Peters interchange. The project would also include interchanges at Rozelle and Camperdown.

The location and key features are shown in Figure 1-2. The project would span four local government areas including: Ashfield, Leichhardt, Marrickville and Sydney.

Key components of the project include:

- Twin motorway tunnels between the proposed M4 East at Haberfield and the proposed New M5 at St Peters. Each tunnel would be around 9 kilometres in length and would be built to accommodate three lanes of traffic each. Connections to the St Peters interchange (constructed as part of the proposed New M5, including integration works within the interchange at the M4-M5 Link portal)
- A new road interchange at Rozelle within the disused Rozelle Rail Yard, to provide connections to the realigned City West Link, Victoria Road and the Anzac Bridge
- Tunnel stubs to allow for connections to the potential future Western Harbour Tunnel and Beaches Link in the vicinity of the Rozelle interchange
- A new road interchange at Camperdown to provide on and off ramps connecting to Parramatta Road for drivers coming to and from the Sydney CBD
- Ancillary infrastructure and operational facilities for electronic tolling, signage (including electronic signage), ventilation structures and systems, fire and life safety systems, and emergency evacuation and smoke extraction infrastructure
- A motorway control centre that would include operation and maintenance facilities
- New service utilities and modifications to existing service utilities
- Modifications to the surface road network to integrate the new interchanges, including but not limited to, the City West Link, Victoria Road and Parramatta Road and adjustments to pedestrian and cycleway facilities
- Temporary construction ancillary facilities and temporary works to facilitate the construction of the project.

The project would be delivered through a design and construct tender process. The alignment of the project would be located within the project corridor, which forms the basis for the assessment within this document.

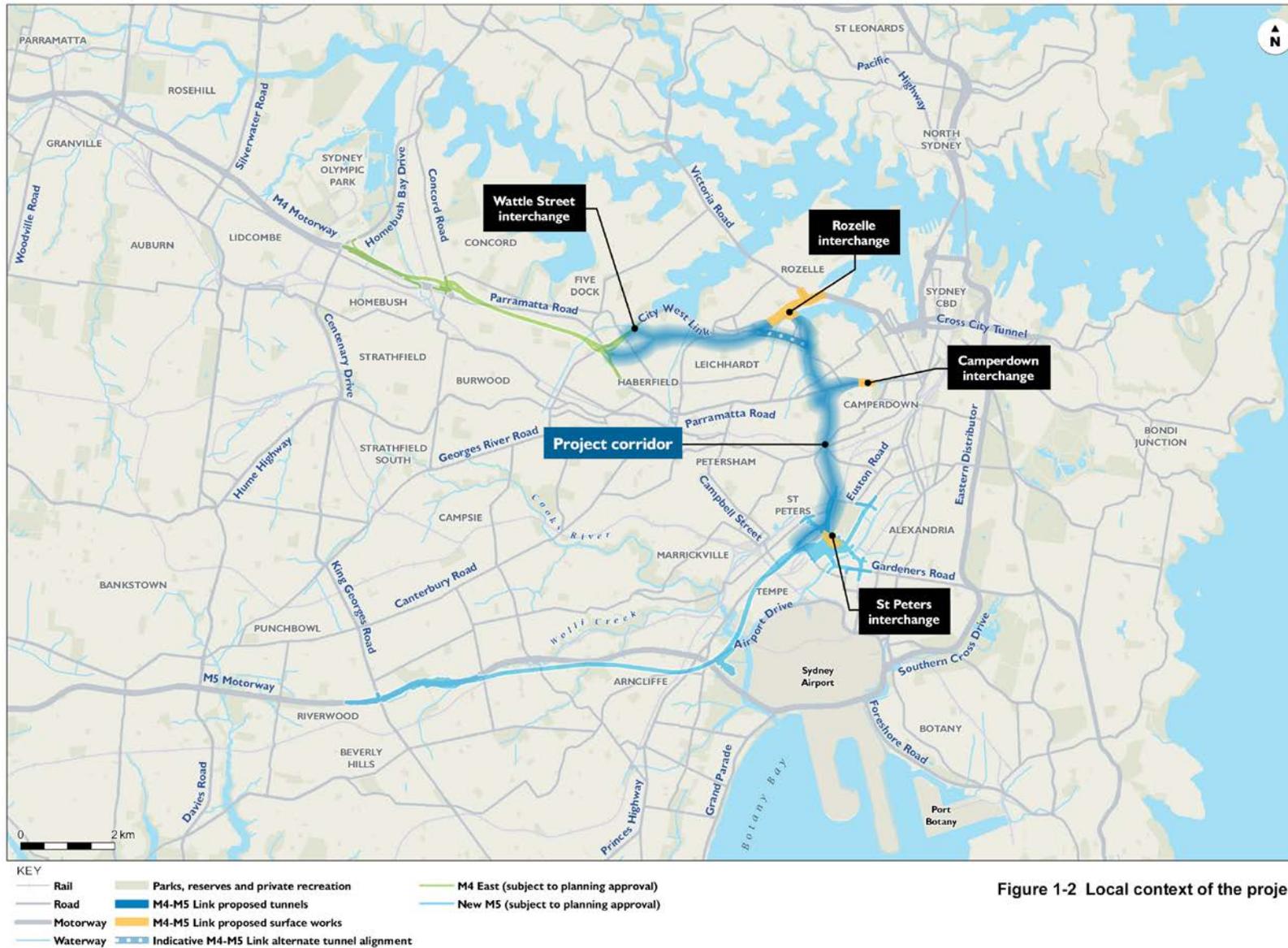


Figure 1-2 Local context of the project

Figure 1-2 Local context of the project

1.3 Statutory process

The project is State significant infrastructure and requires approval under Part 5.1 of the EP&A Act.

Clause 14(1) of the *State Environmental Planning Policy (State and Regional Development) 2011* provides that development is declared, pursuant to 115U (2) of the EP&A Act, to be State significant infrastructure for the purposes of the Act if:

- The development on the land concerned is, by the operation of a State Environmental Planning Policy, permissible without consent under Part 4 of the EP&A Act, and
- The development is specified in Schedule 3.

Clause 94 of the *State Environment Planning Policy (Infrastructure) 2007* (ISEPP) permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent. As the project is for a road and road infrastructure facilities, and is to be carried out by or on behalf of Roads and Maritime, the project is permissible without development consent under Part 4 of the EP&A Act.

Clause 1(1) of Schedule 3 of the *State Environmental Planning Policy (State and Regional Development) 2011* identifies as SSI, general public authority activities for infrastructure or other development (but for Part 5.1 of the Act and within meaning of Part 5 of the Act) would be an activity for which the proponent is also the determining authority and would, in the opinion of the proponent require an environmental impact statement to be obtained under Part 5 of the Act.

Roads and Maritime, as the proponent, has formed the view that the project is likely to significantly affect the environment. On this basis, the project is declared to be State significant infrastructure (SSI) under section 115U (2) of the EP&A Act by reason of the operation of clause 14 and clause 1 of Schedule 3 of the *State Environmental Planning Policy (State and Regional Development) 2011*.

Accordingly, the project is subject to Part 5.1 of the EP&A Act and requires the preparation of an environmental impact statement and the approval of the Minister for Planning.

1.4 Purpose of this report

Roads and Maritime has prepared this application report to support a State significant infrastructure application under section 115X of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

The requirements of clause 192 of the *Environmental Planning and Assessment Regulation 2000* for applications seeking approval of the Minister for Planning to carry out State significant infrastructure are addressed in Attachment A to this report.

The purpose of this application report is to assist the formulation of environmental assessment requirements by the Secretary of the Department of Planning and Environment under section 115Y of the EP&A Act. The application report does the following:

- Describes the project
- Considers the potential environmental issues for the project
- Identifies key environmental issues for the project.

The application report and Secretary environmental assessment requirements would inform the preparation of an environmental impact statement for the project. The form and content of the environmental impact statement would be in accordance with clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*.

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2 Background

2.1 Strategic context and project need

The project is part of the NSW Government's commitment to deliver WestConnex for Sydney in response to the recommendations from Infrastructure NSW, its *State Infrastructure Strategy 2012-2032* (Infrastructure NSW, 2012), the *Long Term Transport Master Plan* (Transport for NSW, 2012a) and the State Priorities announced in September 2015. WestConnex also has the potential to be a catalyst for major urban renewal, as identified in the Draft Metropolitan Strategy.

In addition, *A Plan for Growing Sydney* (NSW Government, 2014) presents a vision for Sydney as a strong global city and the nation's economic and financial powerhouse. It emphasises the need to improve access to major employment hubs and global gateways.

The project would deliver on these strategies and plans and would:

- Complete the final stage of WestConnex by providing a new motorway standard link between the proposed M4 East and New M5 to assist in addressing congested north-south and east-west corridors, including Parramatta Road, the Eastern Distributor, Southern Cross Drive, General Holmes Drive, Princes Highway, King Georges Road, the M5 East Motorway, and the City West Link.
- Facilitate enhanced connectivity with Sydney Airport and Port Botany through the potential future Sydney Gateway, and providing links to Parramatta and Western Sydney
- Reduce travel times and improving reliability
- Provide improvements in road safety
- Facilitate urban renewal in precincts adjoining the corridor, including The Bays Precinct, by improving connectivity and local amenity with less traffic noise and vehicle emissions from congested traffic
- Facilitate connections for the potential future Western Harbour Tunnel and Beaches Link.

The investment in the M4-M5 Link and other WestConnex projects would facilitate a step change in network performance, enabling delivery of major city shaping improvements and delivering economic growth. As part of the broader WestConnex program of works, the project would support NSW's major sources of economic activity and provide a strategic response to the currently inadequate, and highly congested, road network.

Population and jobs

The Sydney transport network currently services a population of 4.2 million people with about 15.5 million trips on a normal weekday. By 2031, Sydney's population is forecast to grow by around 1.6 million people with an additional 689,000 new jobs created (NSW Government, 2014). As identified in the *A Plan for Growing Sydney* (NSW Government, 2014), the majority of the growth will be in western Sydney and will be prioritised in centres such as Parramatta, Penrith and Liverpool to bring jobs closer to home, as well as planned strategic centres such as the South West and Western Sydney Priority Growth Areas. However, the rate of population growth in western Sydney will be faster than that of job growth in the west through to 2031, notwithstanding the planned opening of the Western Sydney Airport and the development of the Western Sydney Employment Area during the mid-2020s.

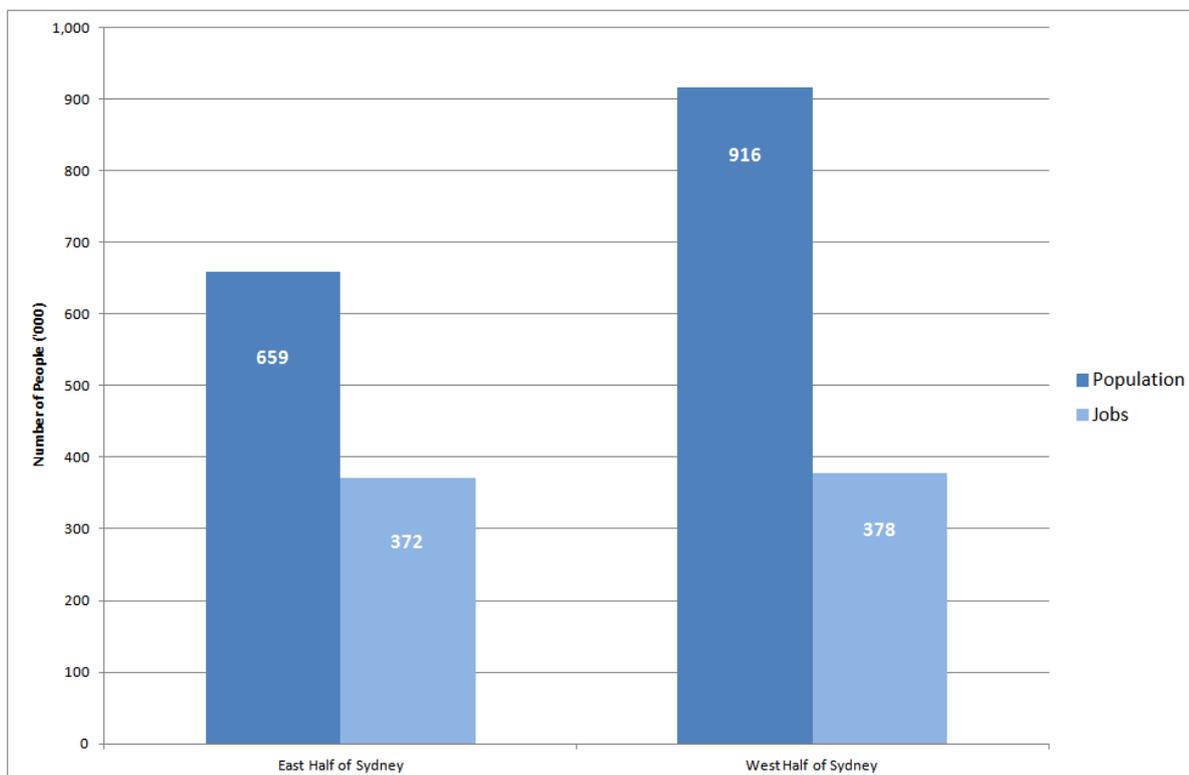


Figure 2-1 Projected population and jobs increases (2011 to 2031) in the eastern and western sections of Sydney

This imbalance between population and jobs growth rates means that there will remain strong demand for workers to travel by car or public transport to eastern Sydney and to centres that form the Global Economic Corridor (Figure 2-2) and non-peak hour business travel between the economic centres of eastern and western Sydney. The NSW Government has also prioritised urban renewal as a means to improve availability of housing, access to employment and public transport choices. This includes the Parramatta Road corridor and The Bays Precinct near Rozelle.

The need for additional capacity on the strategic road network becomes increasingly apparent with the projected growth at Sydney Airport and Port Botany. The Sydney Airport and Port Botany precinct is also the largest employment centre in Sydney after the Sydney Business District (Ernst and Young, 2011). Together, Sydney Airport and Port Botany currently generate around \$10.5 billion of economic activity and handle close to \$100 billion worth of freight each year.

By 2033, passenger growth at Sydney Airport is projected to increase from around 37 million to around 74 million passengers per year (SACL, 2014). Only a small proportion of travel to/from the airport is completed by public transport, with the majority of travel completed via the road network.

Economic impact of road congestion

Sydney's road network serves 93 per cent of passenger journeys and 86 per cent of port freight movements. This includes the approximate 850 bus routes operated in the region. Traffic on key corridors has grown by 50 per cent in the last 20 years, and investment in new roads has struggled to keep up with demand. Travel by road is the dominant transport mode in Sydney, and even with high growth in rail freight and public transport, is predicted to continue to be the most dominant over the next 20 years (Infrastructure NSW, 2012).

By 2031, travel speeds and congestion will significantly worsen on the road network serving western and south western Sydney (the M4 Motorway, Parramatta Road, City West Link, and the M5 Motorway corridor), connections to Sydney Airport and Port Botany (e.g. the M1 corridor) and key north-south links that connect the M4 and M5 Motorway corridors (e.g. the A3 corridor) even with planned future public transport enhancements (Sydney Motorways Corporation, 2015). New road capacity is urgently required to meet the challenge of population growth and substantial increases in freight volumes.

Congestion on the road network has an impact on the NSW economy, which has been estimated at around \$5 billion each year and will increase to \$8.8 billion without improvements to the transport network (Sydney Motorways Corporation, 2015). Around half of these costs are associated with light commercial and heavy vehicles due to losses in productivity due to travel delays and increased vehicle operating costs. Congestion also has societal implications due to longer commuter times and associated environmental impacts.

Freight

Sydney's freight, service and business task is large and significant. Major freight activity precincts across Sydney are strategically located near or along the strategic road network and rail corridors, including Sydney Airport, Port Botany, intermodal facilities at Enfield, Chullora and Macarthur, the future Moorebank intermodal and the Western Sydney Employment Lands.

The Trade and Logistics Report 2011-12 (Sydney Ports Corporation, 2012) indicated that 98 percent of containers imported through Port Botany, and more than 60 percent of exported containers, have their destination or origin in western Sydney. In the absence of any improvements to the network, road freight will continue to be increasingly subject to capacity constraints and peak hour congestion in Sydney, in particular within the M4 Motorway, M5 Motorway, M7 Motorway, M1 and A3 corridors (Sydney Motorways Corporation, 2015).

Sydney Airport serves a growing freight market, with freight projected to increase from around 600,000 tonnes in 2012 to over one million tonnes per year by 2033 (SACL, 2014). Air freight, such as fresh, frozen or chilled perishables, are typically time sensitive and generally unsuitable for rail transport (Sydney Motorways Corporation, 2015).

By 2031, the freight task in NSW is projected to nearly double from 794 million tonnes compared to 2011 (Sydney Motorways Corporation, 2015). The greater demand for imported goods would drive significant growth in port container traffic and result in increased land transport needs, particularly around Port Botany and along major arterial routes. Sydney Ports forecasts container trade through Port Botany to nearly quadruple by 2031, reaching seven million containers per year by 2031 (Infrastructure NSW, 2012).

The development of the proposed Western Sydney Airport has the potential to change the way some freight is moved around Sydney, by providing an alternative entry or exit point for freight. Overall, however, the movement of freight around Sydney is not considered to be significantly altered by the introduction of the new airport. Port Botany and Sydney Airport would remain the key freight entry and exit points for Sydney, with the new airport complementing the existing airport. Further, freight arriving at the new airport would still have destinations across wider Sydney.

Connectivity

Connectivity between major employment centres is critical in supporting the creation of jobs and businesses, particularly the Global Economic Corridor, which spans from Port Botany and Sydney Airport to the Norwest Business Park and Parramatta Central Business District (CBD) via the Sydney and North Sydney CBDs. Sydney's business task requires good access for workers as well as the distribution of goods and services across the Sydney region, which requires diverse and dispersed transport connections to support growth. Improved connections for workers, and to other centres, suppliers, trades and customers through improvements to the transport network, including the strategic road network, is needed to support the growth of these centres and the Global Economic Corridor.

Overall, Sydney's complex transport network will be required to meet increasingly complex travel demands due to the diversification of places of employment, urban infill, higher density residential development within existing areas, as well as the ongoing spatial expansion of Sydney's fringe (Sydney Motorways Project Office, 2013).

WestConnex is one of the NSW Government's major infrastructure priorities. The project is one component of the WestConnex program of works and would form the link between other components of the program - the proposed M4 East and New M5.

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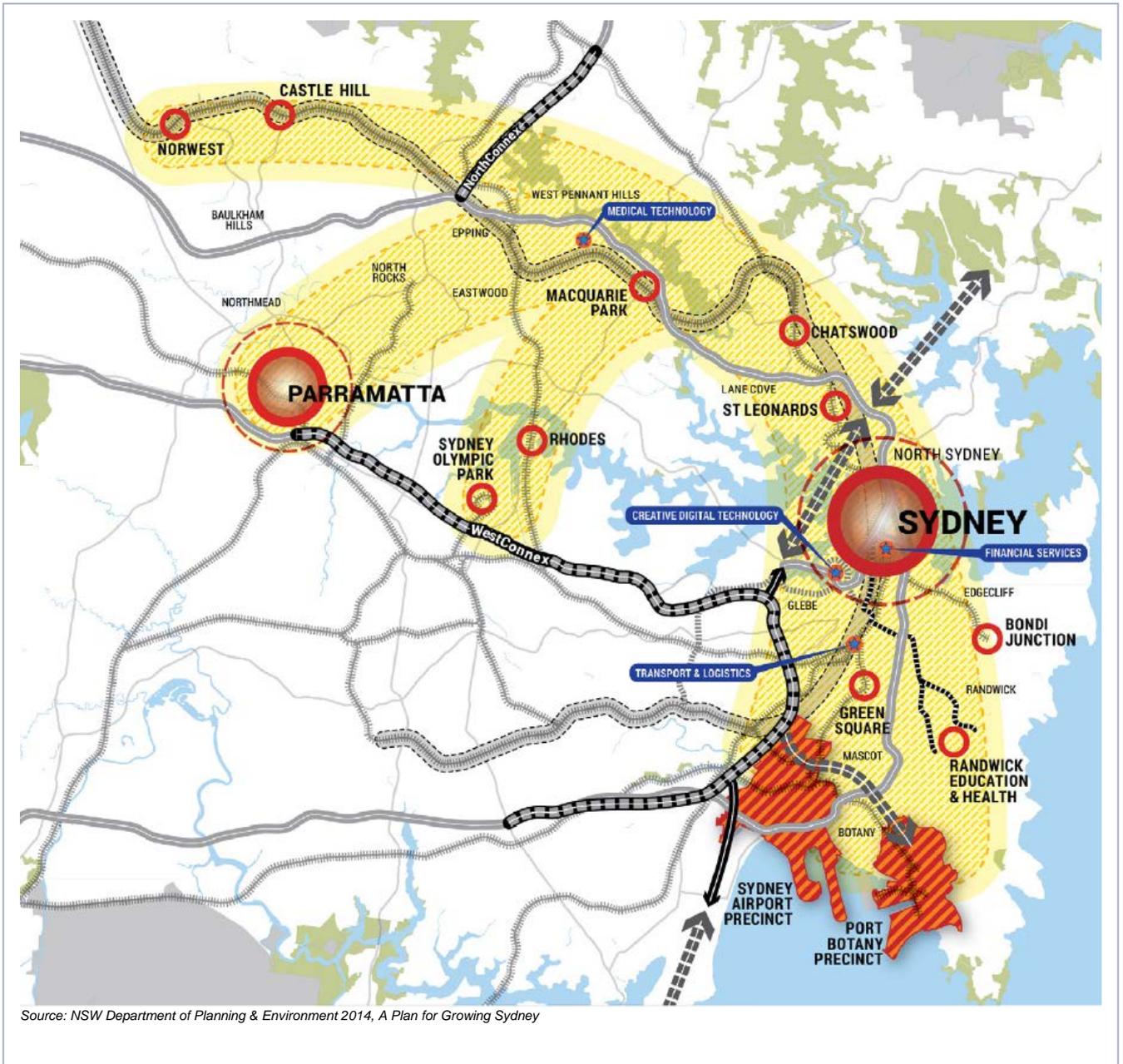


Figure 2-2 The Global Economic Corridor

2.2 Strategic planning and policy context

2.2.1 State priorities

In 2015, the NSW Premier announced a new set of State Priorities. These included a number of priorities relevant to WestConnex:

- 150,000 new jobs by 2019 - creating jobs and apprenticeships for the construction sector through infrastructure investment. WestConnex is set to be a major employer in NSW.
- Building infrastructure – key infrastructure across the state will be delivered on time and on budget to support our growing population. WestConnex is a major infrastructure investment in NSW.
- Encouraging business investment – infrastructure delivered by the government will significantly improve the ease of doing business in NSW by reducing congestion, increasing reliability and productivity and

driving business confidence. WestConnex will link key employment centres and provide improved conditions for freight, making it easier for businesses.

- Protecting our credit rating – NSW is one of only two states to retain its AAA credit rating. Strong financial management will ensure this strong fiscal position is retained. WestConnex is delivering innovative financial solutions to fund delivery of the motorway.
- Boosting apprenticeships – the NSW Government is committed to training apprentices and providing the state with a lasting legacy of a highly skilled workforce with on-the-job training. WestConnex is committed to delivering apprenticeships as part of the Sydney Motorway Corporation Sustainability Strategy (2015).
- Improving road travel reliability – new transport infrastructure will help ensure consistency of journey times on key roads continues to improve, enabling better use of existing roads, building extra road capacity and contributing to improved journey reliability and road safety. WestConnex will deliver travel time savings for motorists across Sydney.
- Reducing road fatalities – improved motorways and roads will generate a significant reduction in traffic incidents.

2.2.2 NSW 2021 – A Plan to Make NSW Number One

NSW 2021: A plan to make NSW number one (NSW 2021) (NSW Department of Premier and Cabinet, 2011) set the priorities for action and guided resource allocation to deliver economic growth and critical infrastructure throughout NSW. The NSW 2021 Performance Report (NSW Department of Premier and Cabinet, 2014) provides information on how the NSW Government intends to measure and deliver on the goals, targets and measures outlined in NSW 2021.

NSW 2021 emphasises the investment and delivery of an efficient and effective transport system, including road infrastructure that will relieve congestion, improve travel times, improve road safety and enhance and expand capacity on key road corridors. These outcomes will contribute to both the national and state economies as well as reducing the costs of doing business for many large and small businesses and services.

The project would involve the delivery of key road infrastructure identified by the NSW Government that would enhance and expand capacity on the motorway network, which would help to achieve priority actions outlined in NSW 2021, including goal 1 (improve the performance of the NSW economy), goal 2 (rebuild the State's finances), goal 4 (increase the competitiveness of doing business in NSW), goal 7 (reduce travel times), goal 8 (grow public transport patronage), goal 10 (improve road safety), goal 19 (invest in critical infrastructure) and goal 20 (build liveable cities).

2.2.3 NSW State Infrastructure Strategy

The *NSW State Infrastructure Strategy 2012-2032* (Infrastructure NSW, 2012) (2012 State Infrastructure Strategy) is a 20 year strategy developed by Infrastructure NSW. It identifies and prioritises the delivery of critical public infrastructure to enhance productivity and economic growth. Infrastructure NSW's assessment of the State's existing infrastructure has highlighted critical deficiencies in urban road capacity and provides strategic options for delivery, required to meet the challenges of population growth and substantial increases in freight volumes.

The 2012 State Infrastructure Strategy identified that the most pressing investment needs to occur on the M4 and M5 corridors, due to their importance to freight and business transport, as well as their connections to 'global Sydney', its cultural precincts, the 'global economic corridor', and the international gateways of Sydney Airport and Port Botany.

The State Infrastructure Strategy Update (Infrastructure NSW 2014) identified the possible expansion of WestConnex to include connections to Victoria Road and the Anzac Bridge to the north (the Northern Extension) and a connection to President Avenue at Monterey to the south (the Southern Extension). These extensions, together with a completed WestConnex, would provide a western bypass of the Sydney CBD, alleviating pressure on existing north-south corridors (e.g. Eastern Distributor), on the Sydney orbital network and reducing journey times to Sydney's southern suburbs. The project provides for connection to Victoria Road, Anzac Bridge and the potential future Western Harbour Tunnel to the north and would provide stub tunnels for connection to the potential future Southern Extension) NSW Long Term Transport Master Plan

The *NSW Long Term Transport Master Plan* (Transport for NSW, 2012a) (the Transport Master Plan) provides a framework for the delivery of an integrated, modern transport system by identifying NSW's transport actions and investment priorities over the next 20 years. WestConnex is identified in the Transport Master Plan as an immediate priority for the NSW Government.

The Transport Master Plan recognises that WestConnex will support Sydney's long term economic growth through improved motorway access and connections linking Sydney's international gateways including Sydney Airport, Port Botany, Western Sydney and employment areas across Sydney. It also notes that WestConnex would relieve road congestion, and thereby improve the speed, reliability and safety of travel, including in the M4 and M5 corridors. The project would enable the connections to Sydney Airport and Port Botany via the Sydney Gateway.

2.2.4 Transport mode-specific strategies

Six modal strategies were developed to support the Transport Master Plan and would be considered during the development to ensure integration and connectivity with these transport modes as appropriate. These modal strategies are;

- Sydney's Rail Future
- Sydney's Light Rail Future
- Sydney's Bus Future
- Sydney's Cycling Future
- Sydney's Walking Future.

2.2.5 NSW Freight and Ports Strategy

The Freight Strategy is a core component of NSW's overall strategic planning framework and supports the goals identified in NSW 2021. One objective of the Freight and Ports Strategy is the delivery of an efficient freight network that supports the projected growth of the NSW economy.

One of the actions identified in the Freight Strategy is to connect and complete Sydney's motorway network, including priority freight movements. It recognises that WestConnex is a key component in expanding capacity on NSW roads, which would provide benefits for freight movement, including around major freight activity centres including Port Botany and Sydney Airport. The project would remove a large number of heavy freight vehicles from surface roads, such as Parramatta Road and key north-south corridors that connect the M4 and M5 motorway corridors (for instance, Route A3), which would result in a range in amenity related benefits for local communities located along routes. The construction of an alternative route would present savings in travel time.

2.2.6 Other strategic planning policies

Parramatta Road Urban Transformation Program

The *New Parramatta Rd: Draft Parramatta Road Urban Renewal Strategy* (UrbanGrowth NSW, 2015a) (Parramatta Road Strategy) identifies areas along the corridor where there will be a focus on encouraging growth and changes in the long term (about 20 years). The aim of the strategy is to create an environment with good design, land use mix, housing choice and infrastructure, as well as improved access to community facilities and services and access to public and active transport. It is envisaged that up to 40,000 new dwellings and 50,000 new jobs would be generated in the urban renewal precincts (UrbanGrowth NSW, 2015a).

A key element of this program is improved public transport services along Parramatta Road. The proposed M4 East project, subject to planning approval, and this project would enable traffic reductions on Parramatta Road from Burwood to the CBD, which would in turn free up road space and create greater public transport options for existing and new residents along the Parramatta Road corridor. This road program includes planning for the construction and delivery of walking and cycling infrastructure in key locations along the corridor.

The Bays Precinct

The Transformation Plan: The Bays Precinct (Urban Growth NSW, 2015b) establishes the strategy for how The Bays Precinct would be developed over 20 years for residential, employment, entertainment and open space uses. The Bays Precinct, located around two kilometres from the CBD, encompasses around areas

surrounding Blackwattle Bay, Rozelle Bay and White Bay. The Bays Precinct comprises eight precincts, including the former Rozelle Rail Yard.

The NSW Government's ambition for The Bays Precinct is to drive an internationally competitive economy, through the creation of attractive destinations on Sydney Harbour that will transform Sydney, NSW and Australia (Urban Growth NSW, 2015b). The Bays Precinct is intended to be staged and coordinated with the planning and delivery of WestConnex, the CBD and South East Light Rail projects and the long term considerations of The Bays Precinct's port uses. However, redevelopment of the Bays Precinct is not part of this project.

The project would be located within the former Rozelle Rail Yard, and the project would have the potential to reconnect areas to the north and south of the rail yard and to improve connections between Lilyfield, the harbour and The Bays Precinct.

2.2.7 WestConnex Business Case

In November 2015, the *WestConnex Updated Strategic Business Case* (Sydney Motorway Corporation, 2015) (the Updated Business Case) was released which updated the business case endorsed by the NSW Government in 2013.

The Updated Business Case outlines the need for WestConnex and identifies the process for delivering this major infrastructure initiative, with a Benefit Cost Ratio of 1.71 for the WestConnex program of works, without the wider economic benefits and 1.88 with the broader economic benefits. The estimated capital investment cost for the M4-M5 Link project is \$7,247 M.

The Business Case articulates the overall objectives of WestConnex, which are discussed in **Section 2.3**.

2.3 Project objectives

The WestConnex program of works is a key recommendation of the State Infrastructure Strategy and was the subject of an Updated Business Case approved by the NSW Government in December 2015. WestConnex is also identified as a key element of Sydney's road future in the Long Term Transport Master Plan.

The core objectives of WestConnex are to:

- Support Sydney's long-term economic growth through improved motorway access and connections linking Sydney's international gateways and Western Sydney and places of business across the city
- Relieve road congestion so as to improve the speed, reliability and safety of travel on the M4, M5 and CBD/airport/port corridors, including parallel arterial roads
- Cater for the diverse travel demands along these corridors that are best met by road infrastructure
- Create opportunities for urban renewal, improved liveability, and public and active transport improvements along and around Parramatta Road
- Enhance the productivity of commercial and freight generating land uses strategically located near and along transport infrastructure
- Fit within the financial capacity of the State and Federal Governments, in partnership with the private sector
- Optimise user pays contributions to support funding in a way that is affordable, equitable and fair
- Integrate with the preceding and proposed future stages of WestConnex projects without creating significant impacts on the surrounding environment or duplicating any potential issues across the construction periods.

Two additional specific objectives for the project were identified since the development of the 2013 Business Case for WestConnex, being:

- Provide the ability for an additional Sydney Harbour tunnel road crossing, the Western Harbour Tunnel and Beaches Link, to connect to WestConnex
- Support improved connectivity between Sydney, the Sutherland Shire, and the Illawarra; with the ability for the proposed 'Southern Extension' project to connect to WestConnex.

Additionally, the project, consistent with the WestConnex program of works, includes an objective to protect natural and cultural resources and enhance the environment through the following key approaches:

- Manage in-tunnel air quality so as to meet community visibility expectations and Environmental Protection Authority (EPA) standards
- Manage tunnel ventilation emissions to ensure local air quality meets Environmental Protection Authority (EPA) standards
- Maintain regional air quality
- Minimise adverse impacts at a local level on air/noise quality
- Minimise construction and operational energy use
- Manage noise in accordance with the NSW Road Noise Policy and realise opportunities to reduce or mitigate noise impacts
- Provide for improvement of social and visual amenity
- Minimise impacts on natural systems including biodiversity
- Minimise impact on Aboriginal and non-Aboriginal cultural heritage
- Minimise impacts on surface and groundwater sources and water quality including management of contaminated areas
- Reduce susceptibility to, and minimise impacts of flooding
- Integrate sustainability considerations throughout the design, construction and operation of the project, including consideration of the Infrastructure Sustainability Council of Australia (ISCA) Sustainability Rating tool scorecard.

2.4 Consultation

2.4.1 Issues raised during consultation

WestConnex program consultation and communication has been underway since 2012 and is ongoing. The consultation process is being guided by the WestConnex stakeholder engagement and communications strategy developed to:

- Raise awareness and understanding of the full economic and travel benefits of WestConnex
- Ensure clear and transparent communications
- Foster stakeholder engagement and community support
- Manage project and government reputation risk.

In addition to the broader WestConnex consultation program, engagement and communication strategies have been developed for each stage of WestConnex.

Broadly, the consultation process to date has included:

- Targeted stakeholder discussions and briefings with State Government agencies, local councils, advocacy groups, elected representatives and peak bodies
- Roundtable discussions with stakeholders such as councils, the freight industry and business groups
- Information sessions with community members and stakeholders in key communities
- Discussions with individual stakeholders, landholders and community members
- Customer research groups involving residents, professional road users and business operators.

Stakeholder consultation has been supported by a variety of communication activities, including:

- Direct mail to key stakeholders, including a letter introducing the WestConnex concepts and encouraging stakeholders to view the animation and participate in the forum in late 2012
- A website at www.westconnex.com.au with background information, maps, videos, customer surveys and details for how to provide feedback

- A centralised feedback and information telephone line 1300 660 248

2.4.2 Stakeholder and community issues

Any issues identified during the stakeholder and community consultation are closely analysed to develop design solutions to mitigate impacts on local communities. Issues identified during community consultation associated with the WestConnex program of works include:

- Air quality issues associated with ventilation facilities and tunnel portals
- Access and traffic impacts on local areas, particularly in the vicinity of tunnel portal locations
- Safe accessibility to homes, schools and services
- Construction impacts, including noise and vibration, dust, surface water, heritage and groundwater
- Impacts on properties and perceived impacts on property values in the vicinity of tunnel portals and ventilation facilities
- The need to consider alternative modes of transport, particularly public transport and cyclists.

2.4.3 Animations and website

A website has been set up at www.westconnex.com.au. Animations explaining the key concepts of the WestConnex program of works are included on the website and have been translated into eight community languages. The Strategic Environmental Review which provides an overview of the environmental impacts of the whole WestConnex program of works is also included on the website.

2.4.4 Stakeholder engagement and communication strategy

Consultation for the M4–M5 Link will focus on identifying key issues of potential concern to stakeholders, as well as provide clear opportunities for feedback on the project design and its potential benefits and impacts.

An M4–M5 Link stage-specific stakeholder engagement and communication strategy will guide consultation with stakeholders and the community during the project's milestones and construction activities. This strategy will detail how affected communities will be engaged regarding the project and the proposed future stakeholder consultation.

2.5 Selection of the preferred project

Strategic alternatives to the project have been considered against the WestConnex objectives, including:

- Base case ('do nothing')
- Construction and operation of public transport options
- Construction and operation of freight transport options
- Improvements to the existing arterial road network
- Demand management
- Construction and operation of the new motorway.

The base case or the 'do nothing' option would involve the continued operation of the Sydney strategic road network in its current configuration. Traffic demand (passenger and freight) on the existing M4 and M5 Motorway corridors, and other key arterial road connections such as Parramatta Road, the City West Link and the M1 corridor (Eastern Distributor/Southern Cross Drive/General Holmes Drive) would experience increased congestion and are predicted to operate near or above their capacities by 2031 during peak periods. The 'do-nothing' option would mean that the strategic road network would continue to have safety, efficiency and capacity problems that would have negative flow on effects to the economy, users of the network and amenity along the strategic road network as well as adverse environmental outcomes. As such, the do nothing option was not considered further as it would not meet the WestConnex objectives.

Public transport options such as heavy rail, light rail or buses as an alternative to WestConnex would contribute to relieving congestion along the M4 and M5 Motorway corridors by potentially reducing the number of passenger vehicles using these corridors. However; the transport demands along the M4 and M5 Motorway corridors cater for a diverse range of needs, including trade and freight movements, which would not be improved nor catered for should this option be implemented.

The transfer of traffic from surface roads to tunnels would provide more road space to be used for bus transit and enable faster journey times.

Although opportunities exist to shift more freight from the road network onto the freight heavy rail network, the need to transport freight by road will continue. The Freight Strategy notes that dedicated freight rail corridors are being planned to ensure passenger and freight rail demand can be accommodated. However, rail freight transport is more effective for long distance transport of goods to regional centres while Sydney's freight, service and business task relies upon a dispersed point-to-point transport connection to customers within the metropolitan area. Assuming that the NSW Government's target of doubling the share of container freight moved by rail is achieved by 2020 (Transport for NSW, 2013), more than 70 per cent of Port Botany's trade would still be moved by road, requiring investment in an efficient road network to support the Port Botany and Sydney Airport precincts (Transport for NSW, 2013). The Freight Strategy notes that road corridors, including WestConnex would be designed to reflect heavy vehicle access requirements as a key component.

Improvements to the arterial road network that provide north-south connections such as the A1 and A3 corridors, would only provide incremental change in the efficiency of the road network, and would not support the additional capacity required for regional traffic growth. Continued urban development along these corridors has resulted in limited capacity for widening and/or upgrades to these roads. Limited road reservations would mean that any future improvements to the road network would not be able to proceed without considerable constructability, and unacceptable social and environmental impacts. As such, improvements to key north-south corridors are not a feasible or long-term alternative to WestConnex.

Demand management measures, aimed to reduce individual trip lengths and make various transport mode options more viable, would help to spread demand during the peak travel to less congested time periods. This would contribute to relieving congestion and would create opportunities for improved public transport initiatives. However, the implementation of these measures alone would not satisfy the WestConnex objectives as it would not cater for the diverse travel demands and requires flexibility of working arrangements to take advantage of the 'time of day' tolling or transport pricing benefits. As such, demand management initiatives are seen to present a complementary initiative to WestConnex, rather than a feasible alternative.

The option to construct and operate a new motorway would respond to the diverse travel demands within the arterial road network, and would relieve congestion on the M4 and M5 Motorway corridors by providing additional road capacity and re-distributing traffic from surface roads onto a new motorway link between the M4 and M5 Motorway corridors.

Further investigations were undertaken to provide connections between WestConnex and additional strategic network proposals identified by the NSW Government. This includes an option to provide a northern extension of WestConnex to connect to the potential future Western Harbour Tunnel and Beaches Link at Rozelle and a connection to the south of the Sydney CBD via Parramatta Road. Two options were carried forward for further consideration:

- The 2013 option of a tunnel generally under Parramatta Road, with a northern extension extending from Camperdown to Rozelle to connect to the proposed Harbour Link
- An alignment that duplicates the City West Link to Rozelle before turning south to Camperdown and connecting to the St Peters interchange.

These options were costed and the analysis showed that amended design, duplicating the City West Link to Rozelle would be;

- More cost effective, and has a stronger economic case, than delivering a northern extension as a separate project
- Would be able to accommodate the Western Harbour Tunnel and Beaches Link without additional infrastructure investment
- Would provide similar reductions in surface traffic on Parramatta Road to the 2013 option.

It was concluded that an alignment that duplicates the City West Link would be adopted as the preferred option (Sydney Motorway Corporation, 2015) as it would best meet the WestConnex objectives but would also:

- Provide similar reductions in surface traffic to the 2013 preferred option, that would enable urban renewal and improved public transport along Parramatta Road

- Accommodate connections to the potential future Western Harbour Tunnel and Beaches Link without future additional infrastructure investment and is more cost effective than delivering an extension to the M4-M5 Link at a later stage.

Design development is ongoing and is aimed at optimising the function and cost of the project, and minimising potential environmental impacts. This includes:

- Optimising the design of the Rozelle interchange in response to the integration with The Bays Precinct strategic planning initiatives as well as constructability and staging of the surface road network changes. This includes an alternative tunnel alignment to reduce the complexity of the surface works as shown in Figure 1-2.
- Optimising the design of the Camperdown interchange to minimise impacts on property (including the Royal Princes Alfred Hospital and the University of Sydney) and nearby heritage items
- Selecting appropriate sites for ventilation facilities based on achieving optimal dispersion of emissions, minimising air quality impacts and meeting with the requirements of the Civil Aviation Safety Authority with respect to Sydney Airport operations. The western ventilation will be constructed as part of the proposed M4 East project, subject to planning approval and is located at the corner of Parramatta Road and Wattle Street, Haberfield. This location is clear of any potential obstruction to Sydney Airport operations.

3 Project description

3.1 Overview

Roads and Maritime Services propose to construct and operate the project which would comprise a new, tolled multi-lane road link between the proposed M4 East at Haberfield and the proposed New M5 at the St Peters interchange. The project would also include interchanges at Rozelle and Camperdown.

Key components of the project would include:

- Twin motorway tunnels between the proposed M4 East at Haberfield and the proposed New M5 at St Peters. Each tunnel would be around 9 kilometres in length and would be built to accommodate up to three lanes of traffic each. Each tunnel would integrate with tunnel stubs constructed underground as part of the proposed M4 East at the Wattle Street interchange and future New M5 at the St Peters interchange (subject to planning approvals)
- Connections to the St Peters interchange (constructed as part of the proposed New M5), including the construction of the M4-M5 Link southern portal and integration works within the interchange
- A new road interchange at Rozelle at the disused Rozelle Rail Yard, to provide connections to and from the M4-M5 Link with City West Link, Victoria Road and the Anzac Bridge intersection.
- Tunnel stubs to allow for a potential future connection to the Western Harbour Tunnel and Beaches Link in the vicinity of the Rozelle interchange.
- A new road interchange at Camperdown to provide on and off ramps connecting to Parramatta Road for drivers coming to and from the Sydney CBD.
- Ancillary infrastructure and operational facilities for electronic tolling, signage (including electronic signage), ventilation structures and systems, fire and life safety systems, and emergency evacuation and smoke extraction infrastructure.
- A motorway control centre that would include operation and maintenance facilities.
- New service utilities and modifications to existing service utilities.
- Modifications to the surface road network to integrate the new interchanges, including but not limited to the City West Link, Victoria Road, and Parramatta Road.
- Temporary construction ancillary facilities and temporary works to facilitate the construction of the project.

The project corridor is shown on Figure 3-1.

The final configuration of the twin main alignment tunnels, interchanges, surface road connections and ancillary surface facilities would be determined as part of the design development process.

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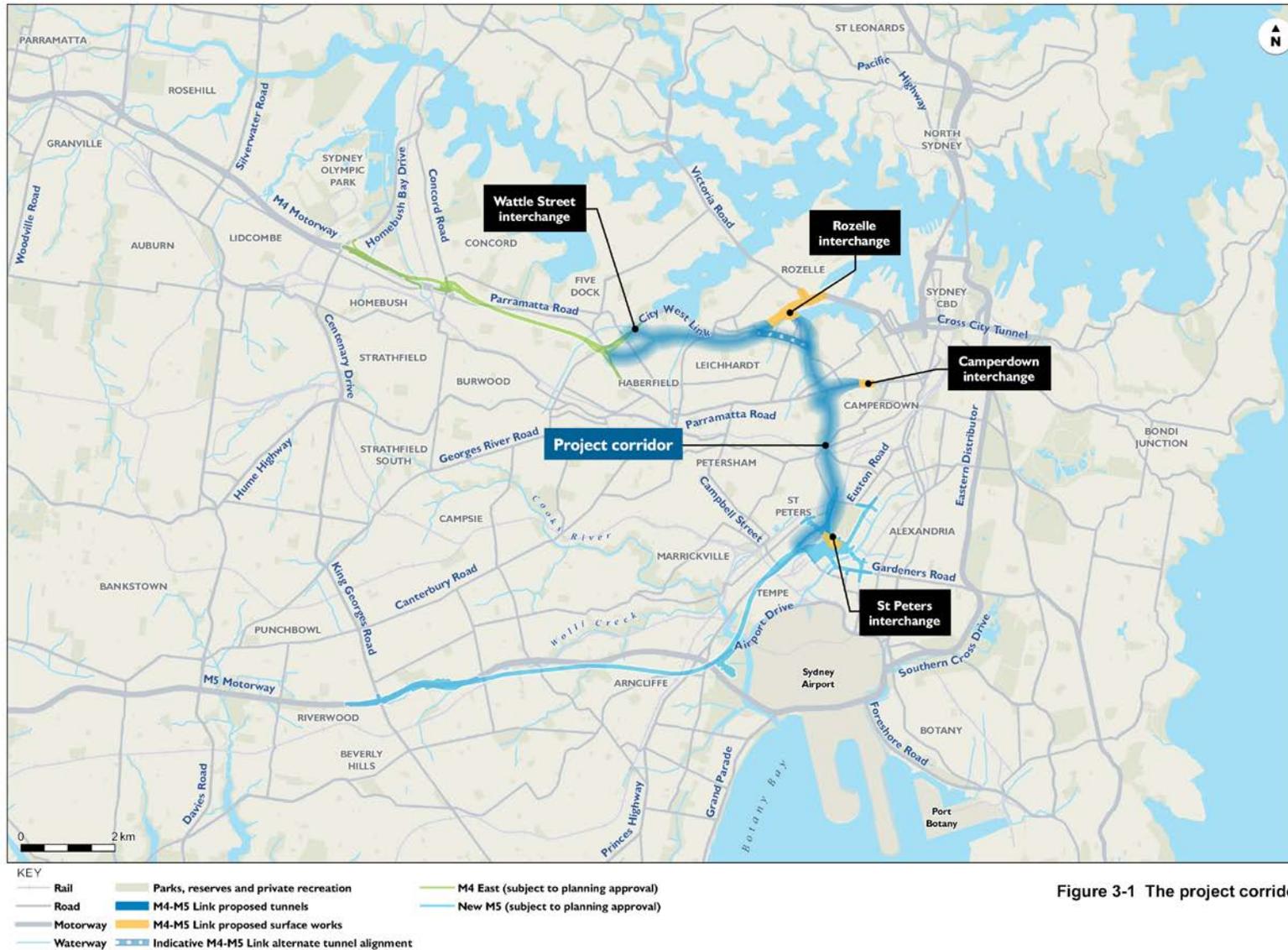


Figure 3-1 The project corridor

Figure 3-1 The project corridor

3.2 Connection to the Wattle Street interchange

The M4-M5 Link would connect to on- and off- ramps that are to be constructed as part of the future M4 East project, subject to planning approval, which would provide connections for westbound and east bound traffic.

The on- and off-ramps constructed as part of the future M4 East, subject to planning approval, would be located between the realigned Wattle Street carriageways between Parramatta Road and Ramsey Street, and would connect to Wattle Street, near Allum Street, and extend to Martin Street, Haberfield in cut and cover tunnels.

As part of this project, the connections from the on- and off-ramps at Martin Street would be extended underground to connect to the M4-M5 Link main alignment tunnels. The fitout of the on- and off-ramps constructed as part of the future M4 East project, subject to planning approval, such as lighting, pavement and line marking, would be completed as part of this project.

3.3 The motorway tunnel

The twin motorway tunnels between the proposed M4 East and New M5 projects (between Haberfield and St Peters) would be around 9 kilometres in length and would be built to be three lanes wide in the mainline tunnels. The ramps which form the connections to and from the surface roads would be built two lanes wide and operated either as single to two lanes to the merge point in the tunnel, depending on location and demand.

The tunnels would have a posted speed limit of 80 kilometres per hour.

On- and off-ramps at each end of the project and at the interchanges would include sections of tunnel to provide direct connections from the mainline tunnels to the proposed M4 East, the proposed New M5 and surface roads at Wattle Street, Camperdown and the St Peters interchange. The depth of the tunnel would vary depending on geological constraints and operational design requirements (such as road grade). The shallowest sections of the project are likely to be near the interchanges at Haberfield, Rozelle, Camperdown and St Peters.

Tunnel stubs would be provided for connections to the possible future Western Harbour Tunnel and Beaches Link in the vicinity of the future Rozelle interchange.

The final tunnel alignment would be determined as part of the design development process.

3.4 Rozelle interchange

The Rozelle interchange would be located within the existing Rozelle Rail Yard, and would provide a link between the Sydney Central Business District (CBD) and the mainline tunnels via connections to the City West Link, Victoria Road and Anzac Bridge.

The interchange would be constructed to maintain existing connectivity along the surface road network between the City West Link, The Crescent, Victoria Road and the Anzac Bridge. However, the City West Link and The Crescent would be modified to accommodate the interchange with associated modifications to intersections along these roads and approaching surface roads. This would involve improvements to the City West, Link, Victoria Road and Anzac Bridge intersection. The interchange would also be constructed to allow for a connection with the possible future Western Harbour Tunnel and Beaches Link.

An alternative route for the mainline tunnel in the vicinity of the interchange would also be investigated further. The final interchange design would be determined as part of the design development process. This includes potential improved connections to the Bays Precinct which would be determined in consultation with Urban Growth NSW.

3.5 Camperdown interchange

The Camperdown interchange would provide connections to Parramatta Road, in the general vicinity of Ross Street Glebe, for traffic travelling to or from the east of the interchange. No access to the M4-M5 Link for traffic travelling to or from the west of the interchange would be provided.

The interchange would be constructed underground in tunnel with ramps rising in cut and cover tunnels to the portals at the surface to provide direct connections to Parramatta Road from the mainline tunnels. Bus lanes on Parramatta Road would be maintained. The interchange would be designed to allow for future public transport improvements, including the ability for Transport for NSW to implement bus improvements or light rail along that section of Parramatta Road in the future.

The final interchange design and alignment of the M4-M5 Link tunnels would be determined as part of the design development process, and would take into consideration the potential impacts on surrounding heritage items, the Royal Prince Alfred Hospital and the University of Sydney.

3.6 St Peters interchange

The M4-M5 Link would connect to the St Peters interchange to enable traffic to travel to and from the western and inner western suburbs of Sydney, the airport precinct and Port Botany. The interchange would provide connections between the project and:

- The future Sydney Gateway
- Gardeners Road, Mascot
- Euston Road at the intersection of Campbell Road, St Peters.

Connections between the project and the New M5 would be provided as direct tunnel connections.

The majority of the interchange would be constructed as part of the New M5 project (subject to planning approval), which includes embankments and bridge structures for the above connections, as well as a cut and cover structure beneath Campbell Street and Albert Street to facilitate the construction of the M4-M5 Link southern portal (subject to planning approval).

As part of this project, the southern portal, on- and off-ramps to the main alignment tunnels, and a short section of surface roads at the interchange would be constructed.

3.7 Motorway operational facilities

The project would require motorway operation facilities during operation, including but not limited to: motorway control centres, maintenance facilities, ventilation structures and systems, fire and life safety systems, emergency evacuation and smoke extraction infrastructure, and groundwater treatment systems.

In determining the size and location of the motorway operation facilities, operational and technical need, existing land use activities, potential environmental impacts and amenity impacts on the surrounding community would be taken into account. The location and size of the motorway operation facilities would be developed as part of determining the preferred project design and would be assessed in the environmental impact statement for the project.

The exception to this is the western ventilation facility, which would be constructed as part of the proposed M4 East at the corner of Parramatta Road and Wattle Street and would provide ventilation for the proposed M4 East and the project.

3.8 Construction

Construction of the project would occur over a period of around four years and would include (but not be limited to) the following:

- Enabling and temporary works, including utilities relocation, construction power, construction water supply, site establishment, demolition works, property and public transport modifications (if required)
- Construction of the road tunnels, interchanges, intersections and roadside infrastructure
- Haulage of spoil generated during tunnelling and excavation activities
- Fit-out of the road tunnels and support infrastructure, including ventilation and emergency response systems

- Construction and fit-out of the tunnel control centre
- Realignment, modification or replacement of surface roads, bridges, intersections and/or underpasses and service utilities
- Environmental management and pollution control facilities for the project.

Temporary works may be required during construction, such as temporary diversions for road traffic or pedestrians and cyclists near work areas, or alternative arrangements where property accesses may be temporarily disrupted.

Road headers and/or tunnel boring machines may be used for the deeper parts of the alignment, while cut and cover construction methods may be required at shallower sections, such as near the tunnel portals. Other excavation activities likely to be undertaken include the creation of cross passages and caverns or shafts for other support infrastructure, as well as stub tunnels for a connection to a future possible Western Harbour Tunnel and Beaches Link.

The project would require ancillary facilities during construction, including but not limited to: construction compounds, sedimentation basins, concrete batching plant, pre-cast yards and stockpiles. In determining the size and location of the construction ancillary facilities, existing land use activities, potential environmental impacts and amenity impacts on the surrounding community would be taken into account. At a minimum, construction ancillary facilities would be required close to the portals to provide tunnelling support. The location and size of the ancillary construction facilities would be developed as part of determining the preferred project design and would be assessed in the environmental impact statement for the project.

The project would not include some preliminary works for the purpose of the design or assessment of the project which are intended to be conducted prior to approval of the project, including:

- Surveys
- Test drilling and excavations
- Test excavations
- Geotechnical, contamination and environmental investigations
- Utility relocations and connections
- Site access ways and associated traffic management measures
- Other tests, surveys, sampling or investigations.

There may be additional early works that may be required, which would be further refined during the EIS process.

4 Key environmental issues

4.1 Overview

Key issues are those that may have high or moderate impacts (actual or perceived) and assessment is necessary to determine the level of potential impact and to develop appropriate measures to mitigate and manage the impacts.

The outcomes of the preliminary environmental investigations indicate the following key environmental issues will require further detailed assessment and may require project specific impact mitigation measures.

- Traffic and transport
- Air quality and human health
- Noise and vibration
- Property and land use
- Urban design and visual amenity
- Soil and water quality
- Flooding and drainage
- Groundwater
- Resource management and waste minimisation

A number of other environmental issues have also been identified. These issues are outlined in Chapter 5 and are considered to be of lesser consequence taking into consideration the project scope, the existing environment and the implementation of standard management and safeguard measures. It is expected that these other environment issues would not likely be key issues; however the potential impact of these other environmental issues would be assessed further in any future environmental impact statement for the project.

4.2 Traffic and transport

4.2.1 Overview

The M4 Motorway and M5 Motorway corridors provide important and strategic access between Sydney's east and west and south west. The M5 East Motorway in conjunction with the Eastern Distributor also provides improved access between the CBD, the lower North Shore and south-west of Sydney.

Key supplementary arterial routes near the project corridor, which also provide important north-south connectivity between the strategic road network, consist of the following:

- Route A1 (Pacific Highway) which provides connections between the M1 Motorway at Wahroonga to the Cahill Expressway
- Route A3 (King Georges Road, Roberts Road, Centenary Drive and Homebush Bay Drive)
- Route A6 (extends from Pennant Hills Road/M2 Motorway in the north to Princes Highway/Heathcote Road in the south and includes Silverwater Road, St Hilliers Road, Rawson Street, Olympic Drive, Joseph Street, Rookwood Road and Fairford Road)
- Route A36 (Princes Highway), which provides connections to the southern section of Route A1, the Sutherland Shire and the NSW south coast.

The surrounding road network is shown on **Figure 4-1**. There are a number of challenges that road users and the community encounter on a daily basis in this current road network:

- The missing link in the Sydney motorway network's east-west spine created by the M4 Motorway terminating at North Strathfield – constraining movements between Sydney's west, its international gateways and key places of business
- Congestion, low travel speeds and unreliable travel times on the M4 Motorway, M5 East, Parramatta Road and in the Sydney Airport/Port Botany precinct that delay freight, public transport and add cost to business
- Poor urban amenity along Parramatta Road due to heavy traffic volumes and congestion throughout weekdays and on weekends.

The demand on the network is forecast to grow significantly as a result of population and employment growth in Sydney. This includes growth at Sydney Airport, Port Botany, the Sydney Global Economic Corridor, the Western Sydney Employment Area and the South-West Growth Centre.

In the absence of the improvements to the strategic road network, roads that are already congested are likely to experience worsening congestion by 2031. This includes the M4 Motorway corridor, City West link, Anzac Bridge, Victoria Road and the M1 corridor (in particular, the Harbour Bridge/Tunnel, Eastern Distributor/Southern Cross Drive). In the case of Parramatta Road, east of North Street, the road is forecast to experience an increase of 24 per cent in average weekday vehicles between 2012 and 2031 in the absence of WestConnex (Sydney Motorway Corporation, 2015).

Much of the M4 and M5 Motorway corridors, Parramatta Road, City West Link/Anzac Bridge corridor, Victoria Road and the M1 corridor are expected to operate near or above their capacities over all peak periods by 2031 (Sydney Motorway Corporation, 2015). By 2031, congestion would significantly reduce average peak hour speeds on most strategic roads by up to 70 per cent (Sydney Motorway Corporation, 2015).

The construction of the proposed M4 East and New M5 projects would assist in addressing future network constraints. However, in the absence of a connection between these corridors, north-south corridors would continue to decline in network performance.

Public transport network

Bus routes

The project corridor does not run directly parallel to existing roads, and as such there are no existing bus routes which run from Haberfield to St Peters following the project corridor. However there are a number of bus routes which provide east-west and north-south connectivity. Routes predominately follow distributor and arterial roads within the area. This includes Parramatta Road, the Crescent, Victoria Road and Anzac Bridge, King Street, Sydney Park Road, Euston Road, and Mitchell Street, Alexandria.

Cycling and pedestrian facilities

There are no continuous cycle paths which follow the project corridor. However the general area has a number of cycle paths managed by the councils, that provide east-west and north-south connectivity for cyclists. A continuous cycle way along Parramatta Road provides a key east-west cycle link, south of the Haberfield to Rozelle section of the project corridor. Other sections of strategic cycle corridors in proximity to the project corridor include Anzac Bridge, Lilyfield Road, Victoria Road, foreshore areas along Rozelle and Blackwattle Bays, and the Bourke Road cycle route. Sections of on and off road cycle paths also occur along local roads within proximity to the project corridor.

Pedestrian footpaths are provided on most roads within the project corridor. Pedestrian crossings along major roads are, in the majority, restricted to signalised pedestrian crossings.

In the case of St Peters, the New M5 proposes a number of key improvements to cycle and pedestrian paths in the vicinity of the local road network upgrades, including dedicated cycle paths and a new bridge connection to Mascot.

Light rail

The L1 light rail line runs parallel to part of the project alignment between the stations at Hawthorne (Leichardt) and Glebe and runs along the former Rozelle freight rail corridor.

Train lines

There are no train lines parallel to the project corridor, however the corridor crosses the T1 (North Shore, Northern and Western Lines) and the T2 (Airport, Inner West and Southern Line) in the vicinity of Camperdown.

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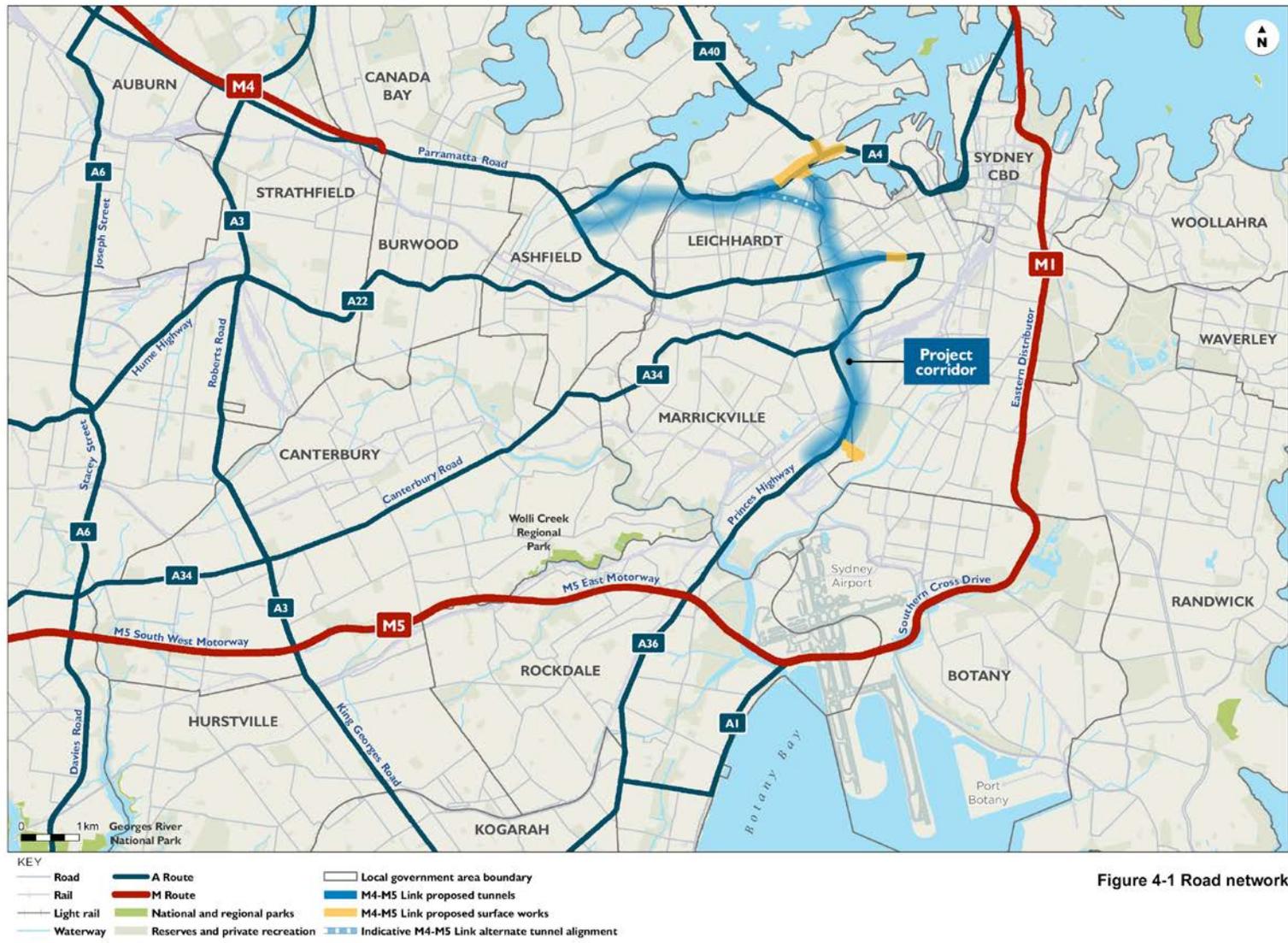


Figure 4-1 Road network

Figure 4-1 Road network

4.2.2 Summary of issues

Construction

Construction of the project would require the use of heavy vehicles to deliver construction plant, equipment and materials as well as for the removal of waste, including general construction waste, office waste and spoil from tunnelling activities. Additional discussion on construction waste is provided in Section 4.10 (Resource management and waste minimisation). Heavy vehicle movements during the tunnelling stage are expected to occur on a 24 hour basis.

It is anticipated that there would be an increase in the number of light vehicles on the surrounding road network during the construction of the project, associated with the construction workforce.

Surface construction works, including ancillary infrastructure, portal works and tie-ins to the surrounding road network, as well as the establishment of construction sites and associated entry / exit points may result in changes or modifications to:

- Existing property access
- Existing pedestrian and cyclist access and movements
- Speed limits on the motorway and surrounding roads.

Additional heavy and light vehicle movements and surface construction works associated with the project have the potential to generate the following traffic and transport related impacts during construction:

- Deterioration in intersection and traffic performance along the local road network due to heavy vehicle movements associated with construction and spoil removal, narrowing of lanes, speed restrictions and temporary road closures
- Changes in local traffic conditions as a result of traffic shifting from the motorway onto alternative routes while construction work is underway
- Potential safety risks for road users, including buses, pedestrians and cyclists during construction due to temporary road arrangements or the close proximity of construction activities to normal traffic
- Temporary disruptions and delays to traffic and public transport services, including buses as a result of speed restrictions and / or potential temporary road closures
- Temporary impacts on pedestrian and cyclist access on adjacent roads where modifications are required to accommodate access to construction areas
- Impacts to local parking as a result of construction workforce
- Temporary impacts to property access.

Operation

The implementation of the full WestConnex project would improve network efficiency in the inner south western areas of the city and provide better, more reliable access to commercial centres across the city, including to Sydney Airport and Port Botany from the west, thereby adding to Sydney's transport productivity.

As a key component of WestConnex, this project provides a north-south motorway link between the M4 and M5 Motorway corridors and would act as an inner western bypass of the CBD. The key related strategic traffic objectives of the project can be defined as:

- Provide an efficient motorway link between M4 and M5 and improve traffic flow on the motorway network
- Enable long term motorway network development, including facilitating new cross harbour capacity
- Improve accessibility and reliability of commercial vehicle movement in the M4 and M5 Motorway corridors to economic centres, including to Sydney Airport and Port Botany economic zone
- Improve traffic conditions and ease future congestion on the inner western and south western network, including Parramatta Road, supporting urban regeneration and growth
- Improve overall network productivity.

Traffic patterns on the existing road network within the project corridor would change as a result of the project. These changes are due to the additional infrastructure provided, tolling and surface network changes. This includes lower traffic volumes and reduced peak congestion on key congested north-south roads, including Eastern Distributor, General Holmes Drive (around 15,000 vehicles per day in 2031), Southern Cross Drive (24,000 vehicles per day in 2031), Princes Highway and King Georges Road (Sydney Motorway Corporation, 2015). The project would also significantly relieve traffic on existing key east-west roads including M5 East (around 60,000 vehicles per average weekday in 2031), , around 19 per cent reduction in traffic volumes on Parramatta Road and reduced volumes on City West Link and Marion Street in Leichardt in 2031. Predicted traffic volumes on this section of the project are around 105,000 per average weekday in 2031.

The exception to this is sections of Parramatta Road, east of Glebe Point Road, which would experience an increase in traffic (Sydney Motorway Corporation, 2015). The potential impacts of this increase are subject to further investigations.

The project may also, subject to further investigations, lead to the deterioration or improvement of individual intersection performance at existing intersections due to the introduction of new movements in the vicinity of interchanges. Changes to bus, pedestrian and cycle networks may also occur, depending on the final design of the interchanges, which would also require further investigation.

Overall, the project will:

- Improve journey times and travel reliability on the 2031 motorway network
- Improve traffic efficiency and level of service for freight and public transport on the road network through the relief of road congestion to improve the speed, reliability and safety of the travel along the project corridor and parallel arterial roads. In the case of freight and heavy vehicles, the project (as part of the full WestConnex) results in significant improvements to heavy vehicle access and travel times to the port and airport by as much as 20 minutes once the full WestConnex program of works is complete (Sydney Motorway Corporation, 2015)
- Enhance productivity of commercial and freight generating land uses, including employment areas in the Sydney Airport and Port Botany area.

4.2.3 Proposed further assessments

The environmental impact statement would include a construction and operational traffic and transport assessment to identify and assess potential impacts and management measures.

The construction traffic study would include identification and assessment of:

- Potential traffic and transport impacts on the road network, including consideration of public transport impacts, as well as pedestrian and cyclist access throughout construction of the project
- Potential cumulative impacts with other stages of the WestConnex project and other major projects in the vicinity of the project
- An assessment of construction traffic impacts including spoil haulage, route identification, number, frequency and size of construction related vehicles, the nature of existing traffic, and the need to close, divert or otherwise reconfigure elements of the road network associated with construction of the project
- Recommendations for construction traffic and transport mitigation measures, including preparation of construction environmental management plans incorporating traffic management plans.

The operational traffic study would identify and assess traffic impacts associated with the project, including an assessment of existing local and regional traffic volumes and traffic patterns against forecast volumes and potential changes to traffic patterns associated with the project. Traffic modelling to be undertaken as part of the operational traffic assessment would be undertaken for the opening year, being the year of completion of the project, and 10 years from the opening date, which would include the completion of the WestConnex program of works.

A detailed operational traffic assessment would also include(as a minimum):

- An assessment of the “Do Nothing” scenario, i.e. the future impacts of traffic if the project were not built
- A description of existing and future intersection functionality as a result of the project

- Quantification of:
 - Anticipated benefits of improved intersection performance
 - Travel times
- Direct and indirect operational traffic implications on the local and regional road network, including freight movements
- Identification and assessment of potential operational traffic impacts around interchanges and required modifications to the existing local road network
- Identification and analysis of the performance of key intersections and interchanges during AM and PM peak periods
- Traffic time analysis
- An assessment of the impact of tolling on motorways and the surrounding road network based on the tolling strategy for the program of works
- An assessment of impact of the project on road users, including motorists, public transport, pedestrians and cyclists
- Road safety analysis
- Recommendations for operational traffic and transport mitigation measures.

4.3 Air quality and human health

4.3.1 Overview

The NSW State of the Environment 2012 (EPA, 2012) provides a report on the status and condition of the major environmental resources in New South Wales (including the atmosphere) and examines the associated environmental trends. The report identifies that air quality within the Sydney metropolitan area consistently meets national air quality standards for four of the six major air pollutants (lead, CO, sulphur dioxide and nitrogen dioxide).

With regard to emissions from vehicles, the key air pollutants are:

- Carbon monoxide (CO)
- Oxides of nitrogen (NO_x), including nitrogen dioxide (NO₂)
- Particulate matter, including fine and ultra-fine particles (PM₁₀ and PM_{2.5})
- Air toxics, including benzene, toluene, xylenes, formaldehyde and polycyclic aromatic hydrocarbons (PAHs) which are predominately adsorbed to particulates.

These pollutants are potentially harmful to human health.

The NSW State of the Environment 2012 report states that transport emissions are the most important human-related source of air pollution in Sydney. In 2008, motor vehicles were the largest source of emissions of oxides of nitrogen (63 per cent of total emissions) and the second largest source of volatile organic compounds emissions (24 per cent of total emissions) in the Sydney Report.

Although there is relatively little information on air quality near major roads, the underlying air quality at urban background locations is generally good (EPA, 2012). The State of the Environment Report identifies that ambient concentrations of CO, NO₂ and air toxics within the Sydney metropolitan area are all consistently below the respective national standards, and emission of these pollutants have decreased by 20 to 40 per cent since the early 1990s (EPA, 2012). Exceedances of the standards for particulate matter (PM₁₀) (and ozone) occurred between 1994 and 2011. However, recorded exceedances of particulate matter standards in Sydney are attributed to natural events such as bushfires and dust storms. In NSW, measured PM_{2.5} concentrations have generally been at or below the 24-hour average National Environmental Protection Measure (NEPM) for Ambient Air Quality 24-hour average advisory reporting standard but above the annual average advisory reporting standard (EPA, 2012). Measured PM_{2.5} concentrations in the years 2000 to 2003 were above the reporting standard and in subsequent years were close to the standard, except for 2009 which had the highest peaks ever recorded due to dust storms (EPA, 2012).

The closest OEH air quality monitoring stations to the project are at Earlwood and Rozelle. The OEH Air Quality Statement for 2014 noted that most parts of NSW experienced good air quality during 2014 (OEH, 2014a). The Air Quality Index (AQI), which standardises measurements of ozone, CO, sulfur dioxide (SO₂), NO₂, particulate matter and visibility into one metric, was in the very good, good or fair category for at least 93 per cent of the time in Sydney. There were 11 distinct days when AQI levels in Sydney were in the hazardous category (an AQI greater than 200). The majority of these days were associated with smoke from bushfires and hazard-reduction burns.

Roads and Maritime has established several air quality monitoring stations near the M5 East Motorway ventilation facility in Turrella. These stations measure compliance with the air quality goals specified in the planning approval for the tunnel. Exceedances of the PM₁₀ ambient goal, and one exceedance of the NO₂ ambient air quality goal, have been detected as a result of the monitoring. These exceedances were not attributable to emissions from the ventilation facility; rather they were associated with extreme weather events, bushfires, nearby construction activity or equipment failure.

Air quality monitoring stations have also been established to support the proposed M4 East and New M5 projects, and these will also provide information that is relevant to the M4-M5 Link project. Additional project-specific monitoring stations will be established for the project itself.

4.3.2 Summary of issues

Construction

The construction of the project has the potential for the following air quality related impacts:

- Temporary increases in emissions associated with the use of the ancillary concrete batching plant vehicles, plant and machinery. This includes temporary ventilation systems within the tunnel during construction
- Temporary increases in dust which may occur as a result of:
 - Earthworks
 - Vegetation clearance
 - Use of the ancillary concrete batching plant
 - Construction activities
 - Stockpiling of construction materials
 - Increase in heavy vehicle movement
 - Temporary ventilation systems within the tunnel during construction.

The potential impacts of increased dust and emissions would be dependent on the scale of the activity, quantities of the material handled, and the proximity of sensitive receivers at any one construction location.

Operation

During the operation of the project, the potential emissions to air are associated with vehicular fuel combustion. As discussed in Section 4.3.1, the primary air pollutants of concern are CO, NO₂ and PM₁₀ and PM_{2.5}.

In-tunnel air quality

As vehicles are the primary source of air quality emissions, the level of emissions from the project would be affected by the length of the tunnel(s), its grade and the mix of vehicles travelling through the tunnel. Maintaining a free flow of traffic in the tunnel(s) would also be a significant factor in minimising the emissions generated by vehicles using the project.

The design parameter for ventilation systems and the management of in-tunnel air quality for tunnels within NSW has been historically based on a CO limit. CO has also been used as a proxy for monitoring and management of all traffic related pollutants. In NSW, a 15-minute average CO in-tunnel limit is used, which since the 1990s has been based on the World Health Organisation (WHO) limit of 87 parts per million (ppm). Visibility limits are also adopted in many tunnels for the purposes of road safety.

The NSW Government has appointed an Advisory Committee on Tunnel Air Quality (the Advisory Committee) to review current international best practice and experience from Australian motorway tunnels. The committee will:

- Review and set performance standards for road tunnel emissions
- Recommend appropriate monitoring, compliance and reporting mechanisms to support public confidence in the operation of road tunnels
- Provide ongoing advice to the NSW Government on air quality issues.

Roads and Maritime will consult with the Advisory Committee and other relevant agencies concerning appropriate in-tunnel air quality criteria and to confirm the air quality assessment methodology.

Local air quality – surface roads

At a local level, air quality effects would be influenced by the emissions associated with vehicles on surface roads and in tunnels. The reduction in traffic congestion along surface roads has the potential to deliver air quality improvements to areas along key arterial roads. These local effects would be the subject of further investigation.

Local air quality – ventilation facilities

The project would require ventilation facilities for the tunnel. Well-designed ventilation facilities are very effective at dispersing tunnel emissions and are expected to be an important component of the final ventilation design solution.

The tunnel ventilation system would be designed and operated to meet in-tunnel air quality criteria, as well as to meet local and regional air quality criteria. The tunnel ventilation system would take account of in-tunnel ambient air quality, traffic conditions and external meteorological conditions. The tunnel ventilation design would be optimised to avoid unnecessary capacity and minimise operational energy use and consider aviation safety constraints (refer to **Section 5.5 and 5.8**) while ensuring air quality outcomes are met.

The locations of ventilation facilities, including outlets, would be subject to further design development, except for the western portals, which would utilise the ventilation facility that would be constructed as part of the proposed M4 East project at Haberfield.

Other ventilation facilities would most likely be located close to the tunnel portals at Rozelle, Camperdown and St Peters. The location of ventilation facilities near the tunnel exit portals would be the most cost effective and energy efficient location, given the reduced requirement for pushing tunnel air in the opposite direction to traffic flow to avoid emitting tunnel air through the portals. Management of in-tunnel air quality may require construction of ventilation facilities at intermediate locations along the main tunnel alignment. This would be confirmed during design development for the project.

Air discharged from tunnel ventilation outlets would be subject to detailed investigations as part of the air quality assessment. The assessment would be based on the location and design characteristics of the facilities, emissions to air (based on in-tunnel emissions inventories), buildings and land use, prevailing meteorological and topographical effects to determine any changes in air pollutant concentrations at sensitive receptors. It is worth noting, that detailed modelling for the proposed M4 East and New M5 projects showed that the ventilation outlets made only a very small contribution to pollutant concentrations at ground-level receptor locations (WestConnex Delivery Authority, 2015; Roads and Maritime Services, 2015a).

Treatment of emissions

Air pollution control technology has been used in a limited number of tunnels in a few countries including Norway, Austria, Germany and Japan as well as the M5 East Motorway tunnel trial in Sydney. This technology includes the use of electrostatic precipitators to remove particles as well as catalytic and biological processes and adsorption technologies to remove nitrogen oxides. Evidence to date suggests that the benefits of such measures when applied to road tunnels are limited to specific situations (Advisory Committee on Tunnel Air Quality, 2014).

A range of solutions to manage in-tunnel air quality would be considered during the design of the project including, but not limited to, ventilation (including number, size and position of outlets) and air treatment technologies.

Summary

The operation of the project has the potential for the following air quality impacts, and associated human health implications:

- Potential increase and decrease in near roadside air pollutant concentrations due to changes in traffic volumes on surface roads, or the introduction of new roads
- Potential increase in air pollutant levels near the ventilation facilities
- Potential exposure to air pollutants for motorists using long tunnels

4.3.3 Proposed further assessments

A detailed air quality and human health risk assessment would be prepared to provide (as a minimum) assessment of the impacts of both construction and operation of the project in comparison with the “Do Nothing” scenario.

Construction

For construction, an assessment would be undertaken which would consider mitigation and management measures to reduce and minimise the emission of dust and other pollutants during construction. Emissions from concrete batching plants are predominantly particulate matter, although relatively small quantities of combustion pollutants (CO, NO_x, SO₂ and VOCs) can also be emitted. Should a concrete batching plant be required, a quantitative assessment of particulate matter emissions would be undertaken.

Operation

For the assessment of air quality impacts during operation, an assessment of in-tunnel air quality would be undertaken to predict the levels of CO, NO₂ and particulates based on the proposed ventilation design, and to predict the potential exposure to motorists. Roads and Maritime will continue to consult with the Advisory Committee on Tunnel Air Quality and other relevant agencies concerning appropriate in-tunnel air quality criteria to inform this assessment.

The operational air quality assessment would be undertaken in accordance with *Approved Methods for the Modelling and Assessment of Air Pollution in NSW* (DEC, 2005) to assess the potential impacts on surrounding sensitive receivers. The operational air quality assessment would apply modelling techniques endorsed in that guideline and relevant air quality criteria. The methodology applied to the assessment would be determined in consultation with the Advisory Committee on Tunnel Air Quality, DP&E and the EPA. Local dispersion conditions, existing background levels of pollutants, future changes in the vehicle fleet, and changes in vehicle emissions on surface roads will all be taken into account. Background monitoring data from existing air quality monitoring stations would be used in the assessment, in addition to data collected from project-specific air quality monitoring stations. As far as possible, the model predictions will be validated using measurements from the project-specific air quality monitoring stations.

The assessment would consider both expected traffic conditions and a very conservative ‘regulatory worst case’ in which emissions from the ventilation outlets would be fixed at the limit value.

The assessment will focus on ground-level concentrations of air pollutants, although concentrations at elevated locations will also be determined to allow for a range of building/receptor heights. However, the work undertaken for the proposed M4 East and New M5 projects showed that concentrations at elevated receptor locations (10 metres and 30 metres above the ground) would not change significantly as a result of the projects, and there would probably be few restrictions on future developments (Roads and Maritime, 2015a; 2015c).

The management of operational emissions and air quality will also form part of the assessment.

For example, WestConnex is designed to facilitate the unrestricted movement of heavy freight vehicles. To do this, WestConnex is being designed around the principles of ‘flatter, higher and wider’ tunnels. WestConnex infrastructure has been designed to accommodate 25/26-metre B-double trucks. Flatter tunnels with lower gradients reduce excessive braking and engine strain for heavy vehicles, higher vertical clearance minimises the risk of large vehicles impacting the tunnel roof, while wider lanes provide greater separation of vehicles (Roads and Maritime Services, 2015c).

A human health risk assessment would also be undertaken to assess the potential human health implications of in-tunnel air quality as well as the implications of changes in air quality external to the project as a result of the project. This would be based on the results of the air quality modelling for the project. A cumulative assessment would also be undertaken to consider a worst case scenario for motorists travelling the length of tunnels proposed as part of the wider WestConnex Scheme. The methodology for the assessment would be determined in consultation with NSW Health.

4.4 Noise and vibration

4.4.1 Overview

Due to the urban nature of the project corridor, the predominant noise source contributing to the existing noise environment is road traffic. In the north-western section of the corridor between Haberfield and Rozelle, key noise sources are Parramatta Road and City West Link. In the south-eastern section of the corridor, key noise sources are Parramatta Road, Princes Highway, Sydney Airport, and the T2 (Airport, Inner West and South), T3 (Bankstown) and T4 (Eastern suburbs and Illawarra) railway lines.

A wide range of sensitive receivers are located within the project corridor, which include:

- Residential properties
- Parks and recreational areas, such as Easton Park at Rozelle, Buruwan Park at Annandale, Federal Park at Glebe, Bicentennial Park at Glebe, and Sydney Park at St Peters
- Education facilities, including indoor and outdoor areas, such as the University of Sydney
- Hospitals, including the Royal Prince Alfred at Camperdown
- Places of worship, such as the St Joseph's Catholic Church at Camperdown
- Aged care facilities.

There are also a number of commercial and industrial receivers within the project corridor, including accommodation providers.

During construction, the project would result in localised noise and vibration impacts, particularly where surface works would occur for interchanges, tunnel portals and ancillary surface infrastructure. Tunnelling could also generate vibration and ground borne noise impacts on sensitive receivers located above the project alignment and in the vicinity of construction compounds.

With the majority of the project being in tunnel, potential operational noise impacts on sensitive receivers would be limited to where project infrastructure is located at the surface or where traffic volumes on surface roads would change. This would include potential reductions in traffic noise at sensitive receivers due to the shift of traffic from surface roads into the project tunnels.

4.4.2 Summary of issues

Construction

The construction of the project would likely result in the following noise and vibration issues:

- Airborne noise from surface works including at the interchanges at Rozelle, Camperdown and St Peters
- Airborne noise from construction ventilation systems, ancillary construction facilities and any open cut sections of the project
- Ground-borne noise from tunnelling and piling
- Potential vibration impacts on buildings near to surface works, or buildings near to, or above, the tunnel alignment. This includes impacts to sensitive equipment located at the Royal Prince Alfred Hospital
- Construction traffic noise from the use of heavy vehicles and construction equipment
- Potential vibration impacts on buildings generated by blasting activities, which may be required depending on the geological conditions encountered

- Cumulative noise impacts where works with other WestConnex projects or other major projects may overlap. This includes Wattle Street interchange, St Peters interchange, and Sydney Metro. This is discussed further in **Section 5.9**.

Construction works during the evening and night time periods would be required, with the potential for tunnelling and associated above-ground support activities (including spoil haulage) to occur 24 hours a day, seven days a week. This is likely to result in impacts to sensitive receivers. There is also likely to be a requirement for some surface works at the interchanges to be conducted during the evening and night time periods for safety and operational reasons.

Operation

The project would result in the re-distribution of traffic within the road network surrounding the project, which would change the operational noise environment of existing surface roads. The project is likely to result in localised increases in road traffic noise at the following locations:

- Areas adjacent to the proposed interchanges at Rozelle and Camperdown including the tunnel portals and open cut sections of the project
- The St Peters Interchange and associated local road connections

Other sources of operational noise emissions may include ventilation infrastructure the motorway control centre and other surface ancillary infrastructure.

4.4.3 Proposed further assessments

A detailed noise and vibration assessment would be prepared to provide (as a minimum):

- Identification of potentially affected noise and vibration sensitive receivers
- Establishment of project specific construction noise management levels
- Establishment of construction vibration goals
- Identification of out of hours work required during construction
- An assessment of noise (airborne and ground-borne) and vibration impacts from the construction of the project on identified residential and other sensitive receivers (including the Royal Prince Alfred at Camperdown). This includes the potential use of blasting as part of the tunnelling methodology (if required)
- An assessment of road traffic noise from the use of heavy vehicles and equipment during the construction of the project
- An assessment of noise from the operation of the project on identified residential and other sensitive receivers at the year of opening and 10 years after opening for the 'build' and 'no build/Do Nothing' scenarios
- If required, recommendations for feasible and reasonable noise and vibration mitigation measures to be implemented during construction and operation.

The assessment of noise and vibration impacts for the construction and operation of the project would be undertaken in accordance with the following guidelines as relevant:

- NSW Road Noise Policy (DECCW, 2011)
- Noise Criteria Guideline (Roads and Maritime, 2015a)
- Noise Mitigation Guideline (Roads and Maritime, 2015b)
- Environmental Noise Management Manual (Roads and Traffic Authority, 2001).
- Interim Construction Noise Guideline (DECC, 2009)
- Assessing Vibration: a Technical Guideline (DEC, 2006)

4.5 Property and land use

4.5.1 Overview

The project would span four local government areas including: Ashfield, Leichhardt, Marrickville and Sydney. Land use and existing development within and around the project corridor is predominately urban in nature, containing a mix of residential, commercial, open space and recreational uses. There is little industrial use land within the corridor, with the exception of areas within and adjoining the Rozelle Rail Yards. There are several major transport corridors and infrastructure located in or adjacent to the project corridor, including Parramatta Road, the City West Link, the Inner West Light Rail and the Sydney Trains suburban rail network. A more detailed description of the land uses within the project corridor is provided below.

- **Residential land:** Predominantly low density residential and general residential, with medium and high density residential land uses located in areas close to public transport and along major roads
- **Open space:** Nature reserves, active recreational uses (such as sports grounds) and passive recreational uses are located throughout the project corridor. Key open spaces within the project corridor include Federal Park, Bicentennial Park, Hogan Park Camperdown Memorial Rest Park and Sydney Park.).
- **Commercial land:** Concentrated in the suburbs of Rozelle, Newtown, Camperdown and St Peters, with smaller local centres distributed throughout the project corridor. Commercial uses are typically concentrated along major roads (such as the King Street) and at train stations, alongside medium and high density residential uses. Community facilities, churches, schools, medical and veterinary centres are located along the length of the project corridor.

Land zoning within the project corridor is set by the following environmental planning instruments:

- *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005*, a deemed State Environmental Planning Policy (SEPP)
- *Sydney Regional Environmental Plan No.26 – City West*
- *Ashfield Local Environmental Plan 2013* (Ashfield LEP)
- *Leichhardt Local Environmental Plan 2013* (Leichhardt LEP)
- *Marrickville Local Environmental Plan 2011* (Marrickville LEP)
- *Sydney Local Environmental Plan 2012* (Sydney LEP).

Other environmental planning instruments that apply to the project corridor, or apply to land immediately adjoining the corridor include:

- *State Environmental Planning Policy (Major Development) 2005*, which identifies the Sydney Harbour Port and Related Employment Lands at Rozelle and Pyrmont as a State Significant site, which identifies the Minister for Planning as the consent authority for certain developments
- *State Environmental Planning Policy (Infrastructure) 2008*, which identifies certain road infrastructure projects as being permissible without consent
- *Sydney LEP 2012 (Harold Park) 2011*, which zones the former Harold Park Paceway.

The regional zoning context of the project and the land use zoning within the project corridor are shown on **Figure 4-2** and **Figure 4-3** respectively. The zoning generally reflects actual land uses within project corridor. Refer to **Figure 4-4** for a map illustrating all open spaces within the project corridor.

A number of strategic urban transformation initiatives are underway in Sydney as part of the NSW Government's 20 year growth strategy – *A Plan for Growing Sydney* (NSW Government, 2014). The portfolio of projects supporting this strategy is being delivered by UrbanGrowth NSW. Urban transformation projects which would interact with the project include Parramatta Road Urban Transformation Program and The Transformation Plan: The Bays Precinct.

The *Parramatta Road Urban Transformation Program* (UrbanGrowth NSW, 2015a) aims to make the Parramatta Road corridor a better place for people to work and live, by investing in more housing, jobs, open spaces and public amenity improvements across eight precincts (Granville, Auburn, Homebush, Burwood, Kings Bay, Taverners Hill, Leichhardt, and Camperdown). Redevelopment within the Camperdown precinct is likely to directly interact with the project.

The *Transformation Plan: The Bays Precinct* (UrbanGrowth NSW, 2015b) seeks to create attractive waterfront destinations and revitalise public spaces, promenades and workplaces. The Bays Precinct consists of 95 hectares of government owned land, 94 hectares of harbour waterways, and comprises Rozelle Bay and its foreshores which are partially located within the project corridor. The *Transformation Plan: The Bays Precinct* (UrbanGrowth NSW, 2015b) has identified that the redevelopment of the Rail Yards has the potential to reconnect areas to the north and south of the Rail Yards and to improve connections from Lilyfield to the water. Residential and employment areas and public spaces have been identified as potential future uses of the area. The transformation of Rozelle Rail Yards has been identified as a longer-term priority, to be commenced around 2022 and beyond.

Parts of Rozelle Rail Yards, located east of the Catherine Street overbridge at Lilyfield, would also be used as part of the approved CBD and South East Light Rail as a maintenance depot.

In addition to these major planning initiatives, *A Plan for Growing Sydney* identifies the Camperdown Education and Health Precinct, located in areas surrounding the Royal Prince Alfred Hospital and University of Sydney at Camperdown, as a priority strategic centre to support educational and health related land uses and infrastructure.

Sydney Metro is another project which is located within or near the project corridor.

Two alignment options for the Sydney Metro City & Southwest were previously identified in the vicinity of the project, a University of Sydney alignment and a Waterloo alignment. The Waterloo alignment was selected at the end of 2015. This alignment passes through the project corridor in the vicinity of St Peters.

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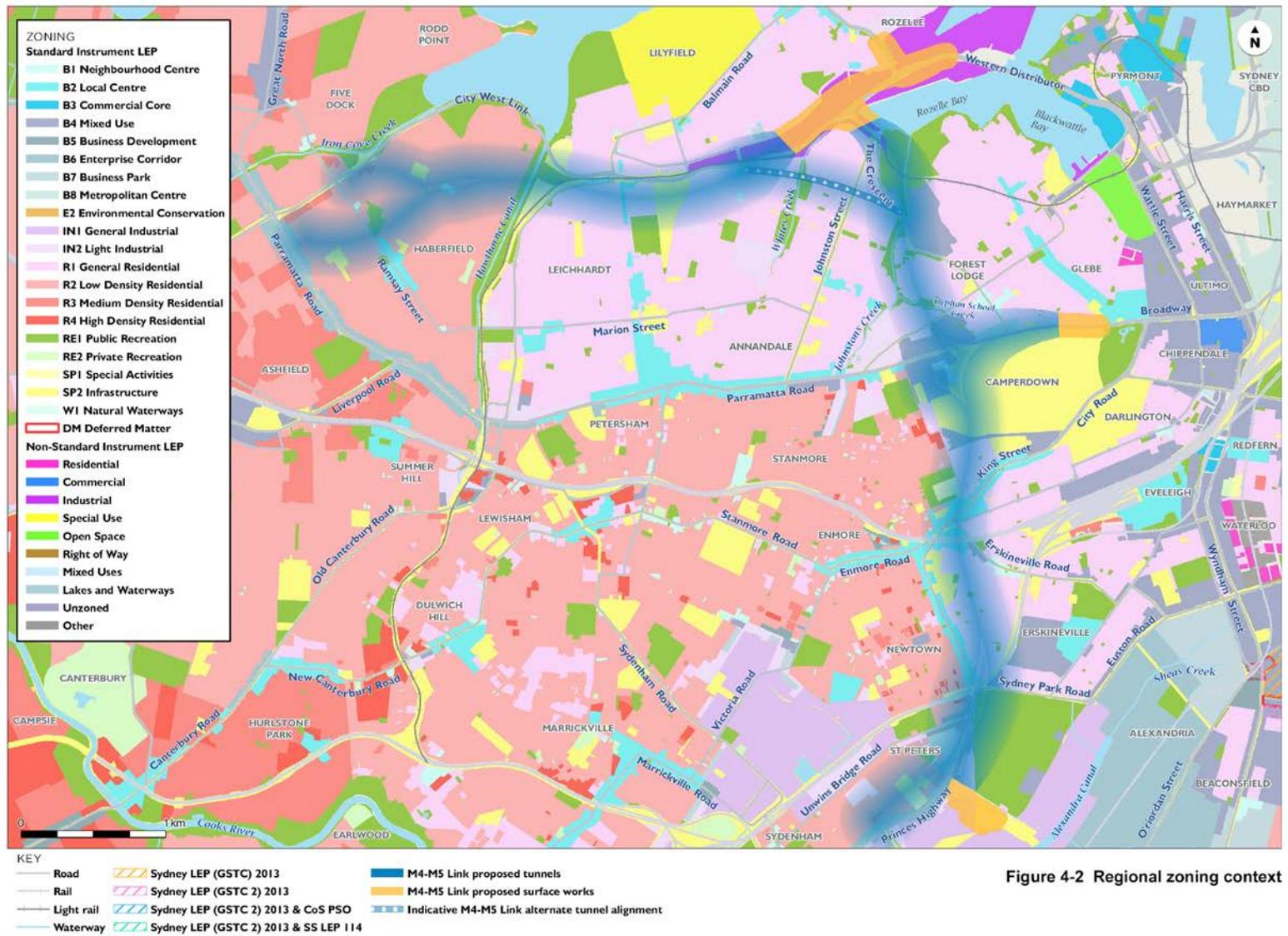


Figure 4-2 Regional zoning context

Figure 4-2 Regional zoning context

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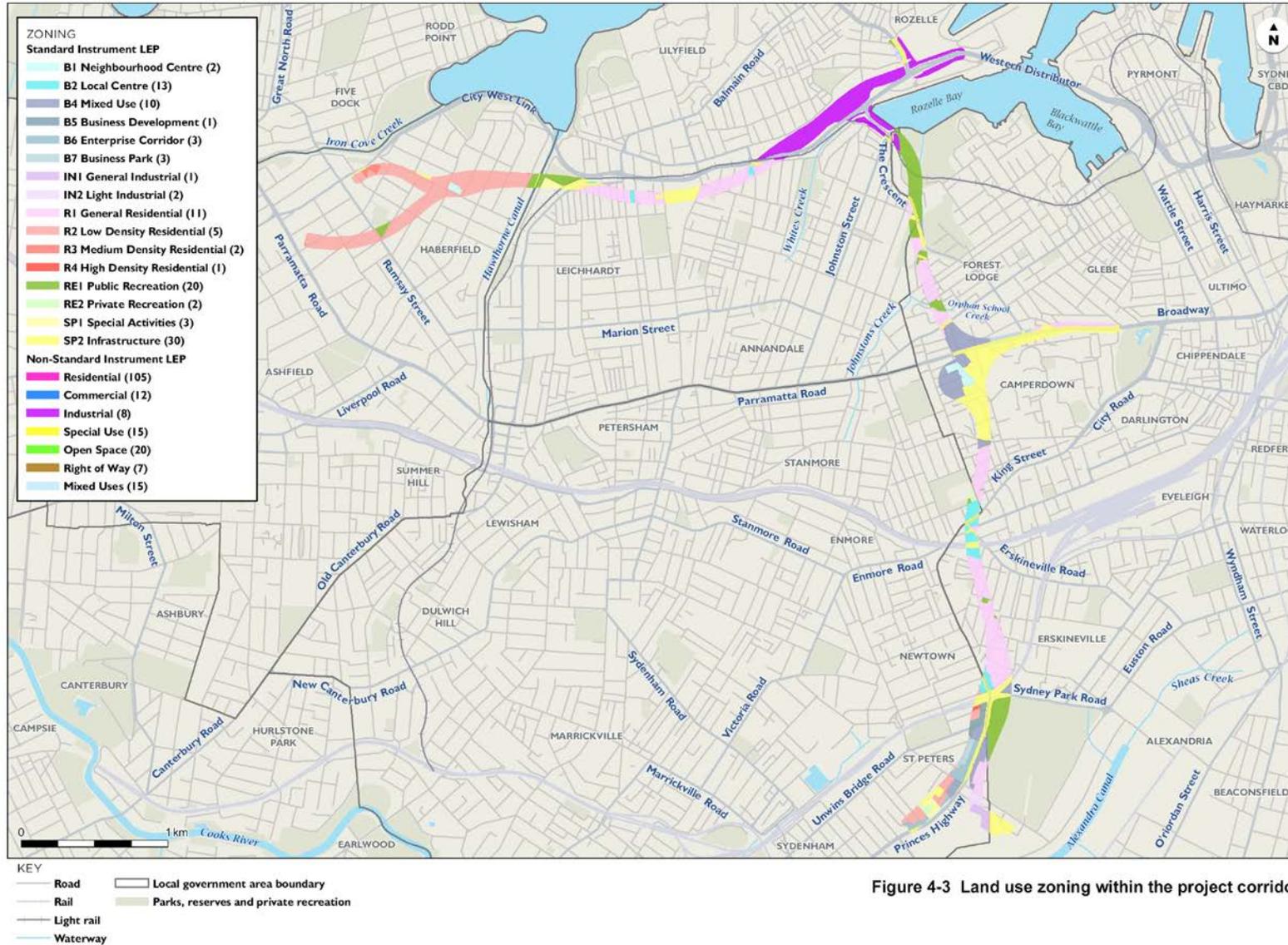


Figure 4-3 Land use zoning within the project corridor

Figure 4-3 Land use zoning within the project corridor

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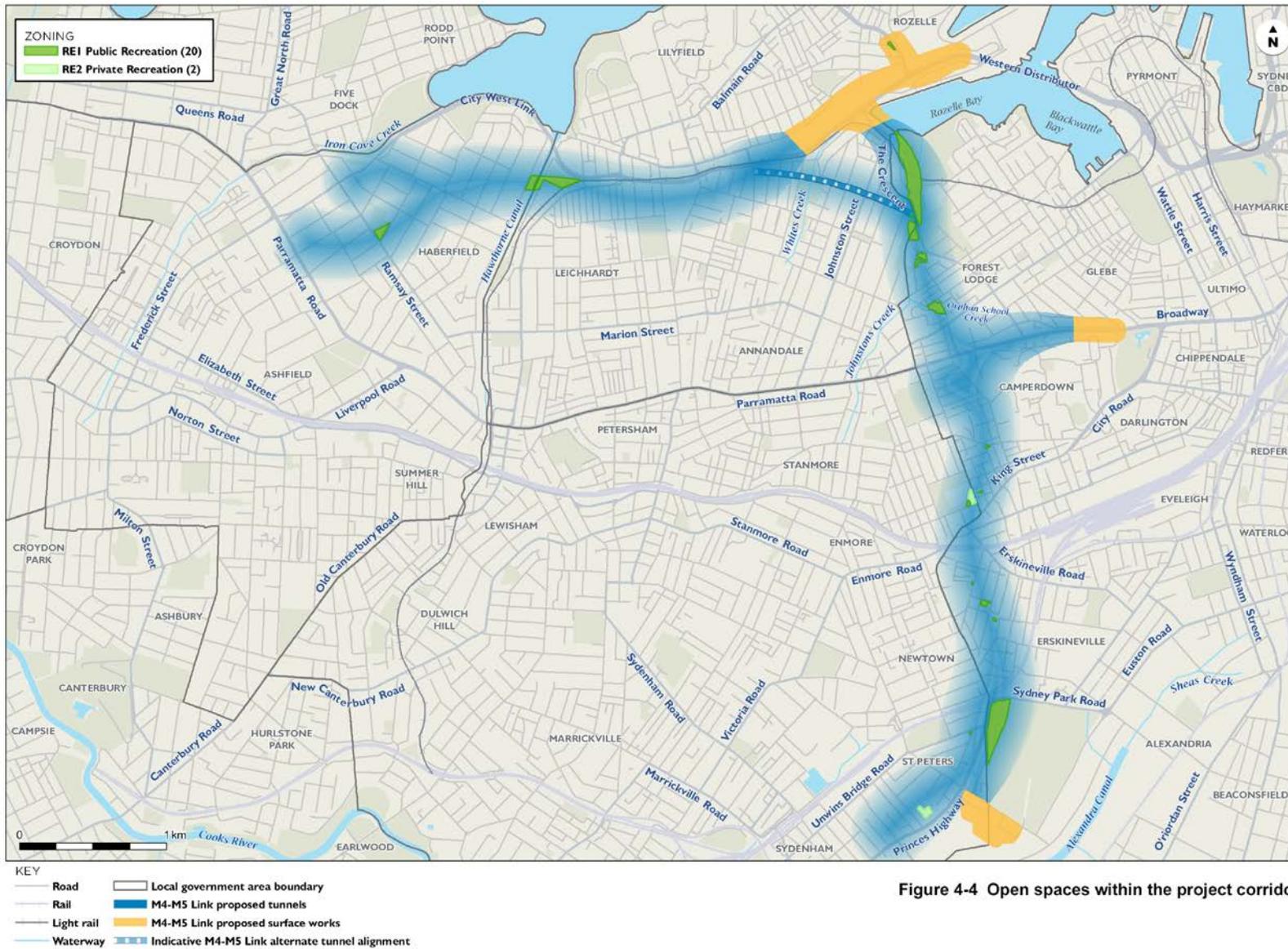


Figure 4-4 Open spaces within the project corridor

Figure 4-4 Open spaces within the project corridor

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4.5.2 Summary of issues

Construction

During construction, potential impacts to land use and property issues could occur as a result of;

- Ancillary construction facilities and infrastructure, such as site compounds or construction sediment basins, if located outside of existing road reserves. This would potentially require full or partial land acquisition and a temporary change in land use
- Temporary diversions for road construction, cyclists and pedestrians. Temporary diversions or disruptions of roads, pedestrian or cycle routes, if required, would be identified in the environmental impact statement, and would be managed in consultation with the relevant local councils and Roads and Maritime. This would include the realignment of the City West Link and works at intersections along this section of road at the Rozelle interchange, which would be staged to minimise disruption to the road network
- Alteration and / or temporary disruption to property access. Alternative arrangements would be negotiated with the affected parties in order to enable continued access and to minimise disruption as much as reasonably possible.

The location and size of construction ancillary facilities would be developed during the design development process for the preferred project design and described and addressed in the environmental impact statement.

Existing land uses, site accessibility and potential opportunities to co-locate permanent operation facilities would be considered when determining the size and location of construction facilities. In the event that land is required that is not owned by the NSW Government, discussions would be held with the affected property owner concerning the purchase or lease of the land required during construction.

Operation

Impacts on land use and property could occur as a result of:

- Full or partial property acquisition to accommodate surface infrastructure and activities, such as construction compounds, at-surface roads, interchanges and ancillary infrastructure. The need for acquisition would be minimised, where possible, and the location of surface infrastructure would consider potential impacts on land uses
- Severance and sterilisation of land. Options for incorporating sterilised or fragmented land into the future road corridor would also be investigated, or alternatively, suitability for the land to be consolidated and resold following the completion of construction would be explored
- Changes in property access. In some cases, accesses would require permanent relocation to cater for new or widened road reserves. The extent of such changes, including the number of properties affected and whether access would be lost or relocated, would be assessed and identified in the environmental impact statement
- Changes to development potential of properties
- Impacts on land uses along key surface roads within the project corridor due to the associated improvements to amenity and local network efficiencies. Improvements to travel times would also deliver benefits to businesses that would support the continued growth of key employment areas in the immediate vicinity of the project corridor
- Full or partial property acquisition for the location of permanent operational ancillary facilities.

With the majority of the project being in tunnel, substantial direct land use impacts would generally be avoided for the majority of the project length in terms of acquisition, severance or sterilisation. As such, direct land use and property impacts are anticipated to be limited to areas where surface components are proposed that extend outside existing road corridors. This is anticipated to occur primarily in areas close to the southern and northern extents of the project and at other surface infrastructure locations.

It is not anticipated that additional acquisition would be required at the Wattle Street interchange and the St Peters interchange, as the proposed M4 East and New M5 operational footprints, respectively, have been designed to cater for the project in order to minimise cumulative impacts to the surrounding community.

Residual land at the St Peters interchange would be incorporated into the final urban design strategy for the interchange, which is currently nominated for open space purposes. Roads and Maritime will consult with City of Sydney and Marrickville Councils concerning potential recreational uses within this area.

The potential impacts on any relevant future strategic planning initiatives or precincts being progressed by the NSW Government would be dependent on the preferred project design. Consultation with UrbanGrowth NSW concerning The Bays Precinct and Parramatta Road is ongoing. The integration of the project or impacts of the project on these initiatives would be identified and assessed as part of the environmental impact statement. **Section 5.9** further considers the potential for cumulative impacts with other developments.

The design of the mainline tunnels for the project would consider the final alignment design for the Sydney Metro City & Southwest project, as well as any interfaces of the Rozelle interchange with the maintenance depot for the CBD and South East Light Rail. Roads and Maritime will continue to consult with Transport for NSW concerning the coordination of these projects with the M4-M5 Link.

4.5.3 Proposed further assessments

A detailed assessment of the property and land use issues would be prepared to provide (as a minimum):

- The identification of the local land uses, existing access arrangements and potential property acquisition for both public and private land adjacent to the project
- Assessment of the potential impacts of the project on property, land use (including approved developments and strategic planning initiatives) and access arrangements during construction and operation of the project
- Interaction with other major projects within the project corridor, including other WestConnex projects
- Identification of appropriate management and safeguard measures to minimise these impacts.

4.6 Urban design and visual amenity

4.6.1 Overview

The project corridor covers a varied urban environment, comprising several distinct landscape character zones and visual catchments.

Haberfield

The suburb of Haberfield has a unique visual character which is due to its historic significance as Australia's first planned garden suburb. The visual importance of the suburb is related to the housing pattern, architecture, and tree-lined streetscapes.

Leichhardt / Lilyfield / Rozelle

Much of the locality is subject to urban renewal with planning proposals to rezone small isolated industrial sites for higher density residential and mixed uses. Currently, the area is characterised by low to medium density housing with primarily late Victorian and Federation architecture, and scattered examples of interwar period dwellings and intact weatherboard cottages.

Within the project corridor is the open space corridor along Hawthorne Canal incorporating Richard Murden Reserve and Blackmore Park. This open space corridor extends southwards as well as to the Sydney Harbour foreshore area to the north. The open space corridor offers pedestrian and cycle connections to the Iron Cove Bay foreshore areas, Sydney Harbour foreshore attractions, and the Sydney CBD.

Rozelle Rail Yards and Rozelle Bay Maritime Precinct

The Rozelle Rail Yards and the Rozelle Bay maritime precinct are a prominent feature within the project corridor. As the topography is elevated in the area towards Victoria Road, these sites are visible to motorists, pedestrians and cyclists utilising the transport network, though much of the Rozelle Rail Yard is screened by trees and vegetation.

Both sites have been identified as new destinations within the Bays Precinct Transformation Plan. The Rozelle rail yards are identified for affordable housing and public spaces and the Rozelle Bay area is identified for commercial, residential, open space uses, together with working harbour industries and on-water recreation facilities.

Glebe / Camperdown

The area of Glebe is characterised by Victorian homes, Federation houses, terraces, and cottages, of which a number are heritage listed. This residential development is intermixed with community facilities, open space and transport infrastructure. Key recreational and community features within the project corridor include Bicentennial and Federal Parks, Jubilee Oval, and the Johnstons Creek corridor. The former Harold Park Raceway is also located within the project corridor and is currently being developed for medium density development. The site will provide around 1,250 new residences once complete.

The suburbs of Forest Lodge and Camperdown have strong association with the University of Sydney and the Royal Prince Alfred Hospital. The area is dominated by these large sites and their associated uses and infrastructure which dominate the visual character and culture of the area, including university colleges, sporting and recreational spaces, civic buildings, and medical facilities. A number of inner city houses, terraces and apartment complexes are also prominent. There is a large stone retaining wall adjacent to Parramatta Road in Camperdown and the landscaped frontage of the University of Sydney in the vicinity of the proposed surface works for the project.

Newtown

Newtown supports a dense population and much of the character is defined by the suburbs history and creative culture. The iconic King Street in Newtown has maintained much of its original character and the street, along with many buildings along it, are locally listed heritage items.

Sydney Park

Sydney Park, located on a former industrial area and landfill at the northern extent of the project corridor, represents a large area of public open space. The area adjacent to the park is a mix of light industrial and residential development.

This area will undergo change as part of the New M5 project (if approved), with the closure of the former Alexandria Landfill and acquisition of industrial land along Campbell Road, and the widening of Campbell Road and Euston Road as part of the local road upgrades. Areas of open space and new pedestrian/cycle infrastructure would be provided as part of the St Peters interchange (if approved) which will enhance connectivity to Sydney Park and surrounding suburbs.

4.6.2 Summary of issues

Construction

Construction of the project has the potential for the following urban design and visual amenity impacts:

- Visual impacts from active construction areas and the introduction of associated construction ancillary facilities and storage areas. This includes lighting
- Vegetation clearing within the project corridor
- Construction traffic management measures such as road barriers and associated construction lighting
- Construction management measures such as fencing and noise hoarding
- Temporary impacts on views to and from heritage items.

At the Rozelle interchange, views of construction activities would be apparent from Victoria Road, City West Link and The Crescent and other elevated areas, including motorists on immediately surrounding roads, and surrounding industrial and residential areas (where not screened by existing vegetation or buildings).

Where surface works would occur along Parramatta Road at Camperdown, the project has the potential to impact on key visual and heritage features including the University of Sydney.

Operation

Operation of the project has the potential for the following urban design and visual amenity impacts:

- Visual impact of new infrastructure on existing views from residences and surrounding development including:

- The interchanges and tunnel portals
 - Surface infrastructure such as ventilation facilities
 - Gantries and signs
 - Noise mitigation measures, such as noise barriers and noise mounds, if required. The height and location of any new or modified noise walls (or mounds) would be informed by the future noise impact assessment and would be subject to consideration of the reasonableness and feasibility of such a noise mitigation approach. This would include the consideration of visual impacts and overshadowing
- Impact to the motorist experience due to visual quality of new motorway infrastructure, structures and elements, and changes to the existing landscape, views and visual characteristics of existing roads
 - Impact on the landscape characteristics of existing open spaces adjacent to the project, and views from these spaces
 - The removal of mature trees and vegetation, if unavoidable through design
 - Overshadowing caused by operational surface infrastructure
 - Impacts to existing pedestrian and cycle pathways adjacent to, along and across the corridor in particular around the Rozelle interchange where an important cycleway into the city is located
 - Landscape character and visual impact associated with future development of The Bays Precinct and other urban renewal projects
 - Integration with the urban design of the proposed M4 East and New M5.

The visual impacts of the project would be dependent on the design features of the interchanges and other surface infrastructure, landscape treatments and the exploration of opportunities to integrate the surface infrastructure elements with the surrounding features of the area. Design of the portals, the interchange and surface infrastructure would take into consideration their visibility and presence within their context to ensure an appropriate design response. The design of the project would also be guided by the *WestConnex Urban Design Framework* (Roads and Maritime, 2013a) that has been developed for the broader WestConnex program of works. This framework will ensure a consistent high quality design approach and outcome across all three stages.

In addition, the integration of the project at the St Peters interchange would consider the broader urban design for the interchange as well as future uses of the residual space following the completion of construction. This area, located adjacent to Campbell Road, has been nominated for open space and the types of recreational uses would be decided in consultation with Marrickville and City of Sydney Councils.

4.6.3 Proposed further assessments

Further assessment of the potential for visual impacts and landscape character impacts along the project corridor would be conducted as part of the environmental impact statement, which would include as a minimum:

- Identification of the visual qualities present, including the existing landscape character of the region, sensitive locations and receivers, catchments and key viewpoints
- An assessment of visual impacts from the construction and operational stages of the project on existing views and landscapes. This includes a review of relevant heritage items
- An assessment of the urban design elements of the project
- Identification of urban design mitigation measures, where required.

The design of the project would be in keeping with urban design principles for the project, the *WestConnex Urban Design Corridor Framework* and the Roads and Maritime guideline *Beyond the Pavement: Urban Design Policy Procedures and Design Principles* (Roads and Maritime, 2014), which identifies the following urban design principles regarding road infrastructure:

- Contributing to urban structure and revitalisation
- Fitting with the built fabric
- Connecting modes and communities

- Fitting with the landform
- Responding to the natural pattern
- Incorporating heritage and cultural contexts
- Designing roads as an experience in movement
- Creating self-explaining road environments
- Achieving integrated and minimal maintenance design.

Additional guidelines would be considered, where applicable, during the design development process and the preparation of the environmental impact statement:

- The Environmental Impact Statement Practice Note: Guidelines Character and Visual Impact Assessment (Roads and Maritime, 2013b)
- Bridge Aesthetics: Design guidelines to improve the appearance of bridges in NSW (Roads and Maritime, 2012)
- Noise wall design guideline: Design guidelines to improve the appearance of noise walls in NSW (Roads and Traffic Authority, 2006)
- Landscape guideline: Landscape design and maintenance guidelines to improve the quality, safety and cost effectiveness of road corridor planting and seed (Roads and Traffic Authority, 2008a)
- Shotcrete Design Guidelines: Design guidelines to avoid, minimise and improve the appearance of shotcrete (Roads and Traffic Authority, 2005)
- Designing to Minimise Vandalism (Final Draft) (Roads and Traffic Authority, 2008b).

4.7 Soil and water quality

4.7.1 Overview

Topography

The project corridor is low lying, with gentle undulating hills with elevations of up to around 35 metres Australian height datum (AHD). The undulation is most prominent in the section of the project corridor which runs from Haberfield to Rozelle, traversing across small valleys with associated creeks and canals which drain into Sydney Harbour. These waterways include Iron Cove Creek, Hawthorne Canal, Whites Creek, Johnstons Creek and Orphan School Creek (see **Section 4.8.1**).

The Johnstons Creek and White Creek water courses draining into Sydney Harbour are likely to have deeply incised valleys into underlying Hawkesbury Sandstone, which over geological time have been backfilled with softer sediments. These sediment backfilled valleys are often referred to as paleochannels, and the base of the valleys will be many metres below existing ground level.

The area of highest elevation within the project corridor is within Camperdown, particularly along City Road where elevation reaches up to around 50 meters AHD. This area forms a slight ridge separating the Sydney Harbour catchment from the Cooks River catchment (see **Section 4.8**).

Soils

Soils within the project corridor are identified from the Soil Landscapes of the Sydney 1:100,000 Sheet (Chapman, G.A and Murphy, C.L., 1989). The section of the project corridor between Haberfield and Rozelle, and south to Camperdown, comprises an interchanging mix of Blacktown, soil landscapes. These soil landscapes are Blacktown, Gynea and Disturbed Terrain. The project corridor between Camperdown and connections to St Peters Interchange is predominantly comprised of the Blacktown soil landscape.

Relevant characteristics of these landscapes are provided in **Table 4-1**.

Table 4-1 Soil landscapes within the project corridor

Soil Landscape	Limitations
Blacktown (Bt)	<ul style="list-style-type: none"> Gently undulating rises on Wianamatta Group shales and Hawkesbury shale. Moderately reactive highly plastic subsoil. Low soil fertility. Poor soil drainage.
GyMEA (Gy)	<ul style="list-style-type: none"> Undulating to rolling rises and low hills on Hawkesbury Sandstone. Localised steep slopes. High soil erosion hazard. Rock outcrops. Shallow, highly permeable soil. Very low soil fertility.
Disturbed (xx)	<ul style="list-style-type: none"> Level plain to hummocky terrain, extensively disturbed by human activity, including complete disturbance, removal or burial of soil. Dependent on nature of fill material. Mass movement hazard. Unconsolidated low wet-strength materials. Impermeable soil. Poor drainage. Localised very low fertility. Toxic materials.

Residual, colluvial and alluvial surface soils are expected to overlie the rock along the alignment. Localised areas of soil disturbance and filling associated with suburban development are anticipated, and the extents of such filling will vary depending on local ground conditions and the purpose of the fill.

Former brickworks quarries occupied sites in and around the area now covered by Sydney Park in St Peters. The brickworks on the Sydney Park site operated between 1893 and 1970, using clay excavated from pits at the site. It is understood the pits have been filled with municipal waste, capped and profiled to form the current Sydney Park.

Geology

The Hawkesbury Sandstone extends beneath the Greater Sydney region, forming the basement rock along the proposed M4-M5 Link alignment. The Hawkesbury Sandstone is overlain by the Ashfield Shale between St Peters and Camperdown, and again along the higher topographies in Annandale and Leichhardt. A relatively thin band of Mittagong Formation may be present between the Hawkesbury Sandstone and Ashfield Shale.

The Geology of the Sydney 1:100,000 Sheet 9130 (Herbert, C., 1983) has indicated the following geological units present within the project corridor (**Table 4-2**).

Table 4-2 Geological units within the project corridor

Unit	Era	Period	Epoch	Environment / Palaeo-environment
Mf/Qha	Cainozoic	Quaternary	Holocene	Man-made fill
Rwa	Mesozoic	Triassic	Middle Triassic	Potentially lacustrine (related to a lake).
Rh	Mesozoic	Triassic	Middle Triassic	Braided alluvial channel fill.

Source: Geology of the Sydney 1:100,000 Sheet 9130 (Herbert, C. 1983)

Contamination

There are a number of current and former land uses within the project corridor which may have resulted in contamination. These include industry, rail (including maintenance) and service stations. As the development of the design progresses the likelihood that these areas would be affected would be known and approaches to mitigate impacts would be developed.

There are eight known contaminated sites within 500 meters of the project corridor listed on the Environment Protection Authority's Contaminated Land record (EPA, 2014):

- White Bay Power Station, Robert Street, Rozelle

- Former Unilever Sulphonation Plant Reynolds Street, Rozelle
- O’Dea Reserve, Salisbury Lane, Camperdown
- Former Tidyburn Facility, 53 Barwon Park Road, St Peters
- Alexandra Canal (sediments)
- Macdonaldtown Triangle, Burren Street, Eveleigh
- Former Service Station, 81 Wilson Street, Newtown
- Land adjacent to Former Service Station, 79 Wilson Street, Newtown.

The risk posed to the project corridor, and future construction activity, would be assessed as part of future investigations.

In addition to the above mentioned contaminated sites, the project corridor would be located within or adjacent to parts of the former Alexandria Landfill, which would be closed as part of the New M5 (subject to planning approval). The New M5 proposes to close this landfill and cap areas of contamination. A groundwater cut off wall would also be installed to manage the generation of leachate from landfill cells. Landfill gas collection systems would also be present as part of the closed landfill.

The project corridor also traverses a number of rail corridors which have the potential to be contaminated by residual contamination or adjacent industrial uses. This includes the Rozelle Rail Yards. Typical contamination sources associated with rail corridors include:

- Use of fill material of unknown origin in the railway corridor
- Presence of asbestos associated with historical structures, brake shoes etc
- Fuel and chemical spills associated with train and railway infrastructure maintenance.

Acid sulfate soils

Acid sulfate soils and potential acid sulfate soils are naturally occurring soils containing iron sulfides which, on exposure to air, oxidise and create sulfuric acid. This increase in acidity can result in the mobilisation of aluminium, iron and manganese from the soils. Acid sulfate soil planning maps have been developed by the NSW Government to better manage works that could disturb acid sulfate soils. The maps establish five classes of land based on the probability of acid sulfate soils occurrence and the type of works that might disturb them. These classes are defined in **Table 4-3** below.

Table 4-3 Acid sulfate soils plan classes

Acid sulfate soils class	Work which would potentially expose acid sulfate soils
Class 1	Any work
Class 2	Work beyond the natural ground surface and work by which the water table is likely to be lowered.
Class 3	Work beyond one metre below the natural ground surface and work by which the water table is likely to be lowered beyond one metre below the natural ground surface.
Class 4	Work beyond two metres below the natural ground surface and work by which the water table is likely to be lowered beyond two metres below the natural ground surface.
Class 5	Work within 500 metres of adjacent Class 1, 2, 3, or 4 land which are likely to lower the water table below 1 metre AHD on adjacent Class 1, 2, 3 or 4 land.

A search of the Australian Soils Resource Information System indicated the project corridor is located on land classified with an acid sulfate soil class 1, 2, 3, and 5. The majority of the project corridor comprises class 5 soils and is at a low risk of impacts associated with acid sulfate soils. Areas in proximity to waterways, namely Iron Cove Creek, Hawthorne Canal, Whites Creek, Johnstons Creek, Orphan School Creek and Alexandra Canal are identified as being areas of acid sulfate soils class 1, 2 and 3. The highest risk of acid sulfate soils occurrence is in areas close to Hawthorne Canal and Rozelle interchange.

Water quality

The catchments located within the project are identified in **Section 4.8** (Flooding and drainage) and include the Sydney Harbour and the Cooks River catchments.

A 2014 study of 38 NSW estuaries within 300 kilometres of the Sydney CBD categorise both Sydney Harbour and Cooks River as two of four 'severely modified' estuaries (NSW Parliamentary Research Service, 2015).

Sydney Harbour and its tributaries are polluted due to substantial modification with around 80 per cent of its catchment urbanised and industrialised.

The Cooks River catchment is regarded as one of the most polluted urban river catchments in Australia and forms the catchment area for the southern end of the project corridor. Water quality of the catchment has been affected historically by stormwater pollution, industrial and domestic wastewater discharge, rubbish dumping and modifications of the waterway. Present levels of pollutants, including nutrients, sediments, toxicants and faecal coliforms make the Cooks River unsafe for swimming, unsuitable for many aquatic species and a health risk for commercial fishing.

Sewage overflows, rubbish dumping and stormwater pollution continue to affect the water quality of these catchments. Detrimental impacts are further compounded by continued urbanisation within the catchment area, hindering opportunities to improve the management, environmental and recreational qualities of the waterways.

4.7.2 Summary of issues

Construction

Construction of the project has the potential for the following soil, water and contamination related impacts:

- Impacts to water and soils due to spills or leaks of fuels and / or oils from construction plant and equipment and / or from vehicle / truck incidents
- Impacts to water and soils due to spills or leaks of other hazardous substances and dangerous goods from construction work and / or from vehicle / truck incidents
- Exposure of soils during construction resulting in direct erosion impacts. This may lead to dirty water runoff and sedimentation in local watercourses including Iron Cove Creek, Hawthorne Canal, Whites Creek, Johnstons Creek, Orphan School Creek and Alexandra Canal, as well as downstream waterbodies including Iron Cove, Rozelle Bay and Botany Bay. Sedimentation may also occur on adjacent land
- Generation of a net surplus of spoil as tunnelling would comprise of a large component of the project. Construction of a tunnel within the project corridor would likely occur within the Ashfield Shale and Hawkesbury Sandstone geological units
- Interaction with quaternary aged sediments present within the project corridor may include soft clays and organic soils, loose silts and sands. These can pose a constraint to construction for reasons such as instability, low bearing capacity and settlement. These constraints are commonly encountered and established treatment options are available for structures, earthworks and pavements
- Disturbance of contaminated soils, especially if surface work is undertaken within land known to be contaminated, or on land which has been identified as potentially contaminated based on current and historic activities. Disturbance of contaminated soils has the potential to result in offsite pollution
- Exposure of soil containing acid sulfides to oxygen, resulting in the production of sulfuric acid, which may become bioavailable in the environment and affect local aquatic ecosystems, water quality and visual amenity
- Interaction with the former Alexandria Landfill, which would be closed as part of the New M5 project (subject to planning approval). Construction areas for the project would be subject to land forming as part of the New M5, and considerations of any potential interactions with capping, leachate collection or gas collection systems would need to be considered during construction.

Operation

Potential impacts during operation would include:

- Impact to water quality of receiving watercourses due to the discharge of treated groundwater and other waste waters (such as tunnel wash or deluge system water). The discharge would likely be into a local watercourse, such as Iron Cove Creek, Hawthorne Canal, Whites Creek, Johnstons Creek, Orphan

School Creek, or Alexandra Canal. This could have an impact on the water quality of the receiving waterway, depending on the discharge volumes, treatment and the point of discharge

- Impact to water quality of receiving watercourses due to increased runoff from roads. This would typically contain oils and greases, petrochemicals and heavy metals as a result of vehicle leaks, operational wear, road wear and atmospheric deposition. Increased flows could also lead to increased potential for scouring of soils and watercourses
- Spills or leaks of fuels and / or oils from vehicle accidents, or from operational plant and equipment.

4.7.3 Proposed further assessments

Geotechnical investigations would inform the design of the tunnel and therefore the expected quantities of spoil from tunnelling activities (refer to **Section 4.10** for additional information related to resource management and waste). The quantity of spoil would also depend on the tunnelling technique adopted for the project. Spoil management is discussed further in **Section 4.10**.

The environmental impact statement for the project would also include:

- Identification of waterways and groundwater systems that may be impacted by the construction and operation of the project
- Assessment of the potential impacts to soil and water, including field investigations
- Assessment of the risk of erosion and sedimentation in accordance with Roads and Maritime's Erosion and Sedimentation Management Procedure (Roads and Maritime, 2008)
- Likely groundwater discharge volumes into local watercourses during construction and operation, and the associated impacts on water quality. Associated impacts on biodiversity values are considered in Section 5.4.
- Assessment of potential settlement along the tunnel alignment and the potential impacts to structures and infrastructure
- Identification of areas of known contamination or with potential contamination (soil and groundwater) that could be impacted by the project, and the potential impacts associated with the disturbance of these areas. This would be supported by further investigations to identify, quantify and assess the contamination.

4.8 Flooding and drainage

4.8.1 Overview

The project corridor is located within the Sydney Harbour catchment (specifically, the Parramatta River and Port Jackson sub-catchments) and the Cooks River catchment. However, the majority of surface works would be located in the Sydney Harbour catchment, with only limited works proposed within the Cooks River catchment at the St Peters interchange.

Key waterways located within and adjacent to the project corridor are shown on **Figure 4-5**. Tributaries of Sydney Harbour located within the project corridor include:

- Iron Cove Creek (also known as Dobroyd Canal); runs along part of the northern project corridor boundary at the western end of the project corridor (tunnel section). Iron Cove Creek drains into Iron Cove
- Hawthorne Canal; traverses the project corridor (tunnel section) in the vicinity of Blackmore Park, Leichhardt. Hawthorne Canal Creek drains into Iron Cove
- Whites Creek; traverses the project corridor (at Rozelle interchange) in the vicinity of Rozelle Bay. Whites Creek drains into Rozelle Bay
- Johnstons Creek; traverses the project corridor (tunnel section) in the vicinity of Harold Park, Annandale. Johnstons Creek drains into Rozelle Bay
- Orphan School Creek; traverses the project corridor just north of Camperdown interchange. Orphan School Creek drains into Johnstons Creek.

Whites Creek is a stormwater channel with a total length of around 3.92 kilometres extending from Parramatta Road to Rozelle Bay in a north-south direction (Sydney Water, 2014). The channel is predominately brick and concrete in fabric (Sydney Water, 2014). Whites Creek discharges into Rozelle Bay at the Bay's most western extent.

Johnstons Creek runs in a north-south direction from Petersham under Parramatta Road to Rozelle Bay around 400 metres east of the Whites Creek. Johnstons Creek was originally a natural watercourse, and was converted into a brick and concrete channel in the 1890s. Orphan School Creek is a stormwater drain and a minor tributary of Johnstons Creek which branches to the east past Wignall Road, forming part of the border of Camperdown and Forest Lodge.

Sections of the project corridor in proximity to Iron Cove Creek, Hawthorne Canal, Whites Creek and Johnstons Creek are located within land which could potentially be affected by a one in 100 year Average Recurrence Interval flood event. Those sections located close to Iron Cove Creek and Hawthorne Canal are in tunnel and are therefore unlikely to be impacted during a flood event. However, sections located close to Whites Creek and Johnstons Creek have the potential to be impacted by a one in 100 year Average Recurrence Interval flood event, dependant on the final design of tunnel portals and interchanges.

The Cooks River catchment covers an area of about 10,200 hectares and flows for about 23 kilometres from Graf Park in Bankstown into Botany Bay at Kyeemagh (Cooks River Alliance 2013). One of the eight tributaries of the Cooks River, Sheas Creek / Alexandra Canal, is located to the south of the project corridor, where the project would link into the St Peters interchange. St Peters interchange would be constructed as part of the New M5 project (subject to planning approval) and would drain to the canal. Alexandra Canal is an artificial waterway (formerly known as Sheas Creek), which extends for about four kilometres from Huntley Street, Alexandria in the north-west to its confluence with the Cooks River at Tempe. Alexandra Canal was built during the 1890s to provide access for water transport for the delivery of cargo (Heritage Branch 2014).

The area of St Peters interchange, located adjacent to Alexandra Canal, is presently prone to flooding and the surface roads which link into St Peters interchange could potentially be affected during a flood event. The St Peters interchange once constructed, (subject to approval) would not be inundated during the 100 year ARI.

Localised flooding could occur at any section of the project and connecting roads if the capacity of the drainage system is not sufficient to accommodate surface flows.

Impacts relating to water quality and geomorphology of the above tributaries are discussed in **Section 4.7** (Soil and water quality).

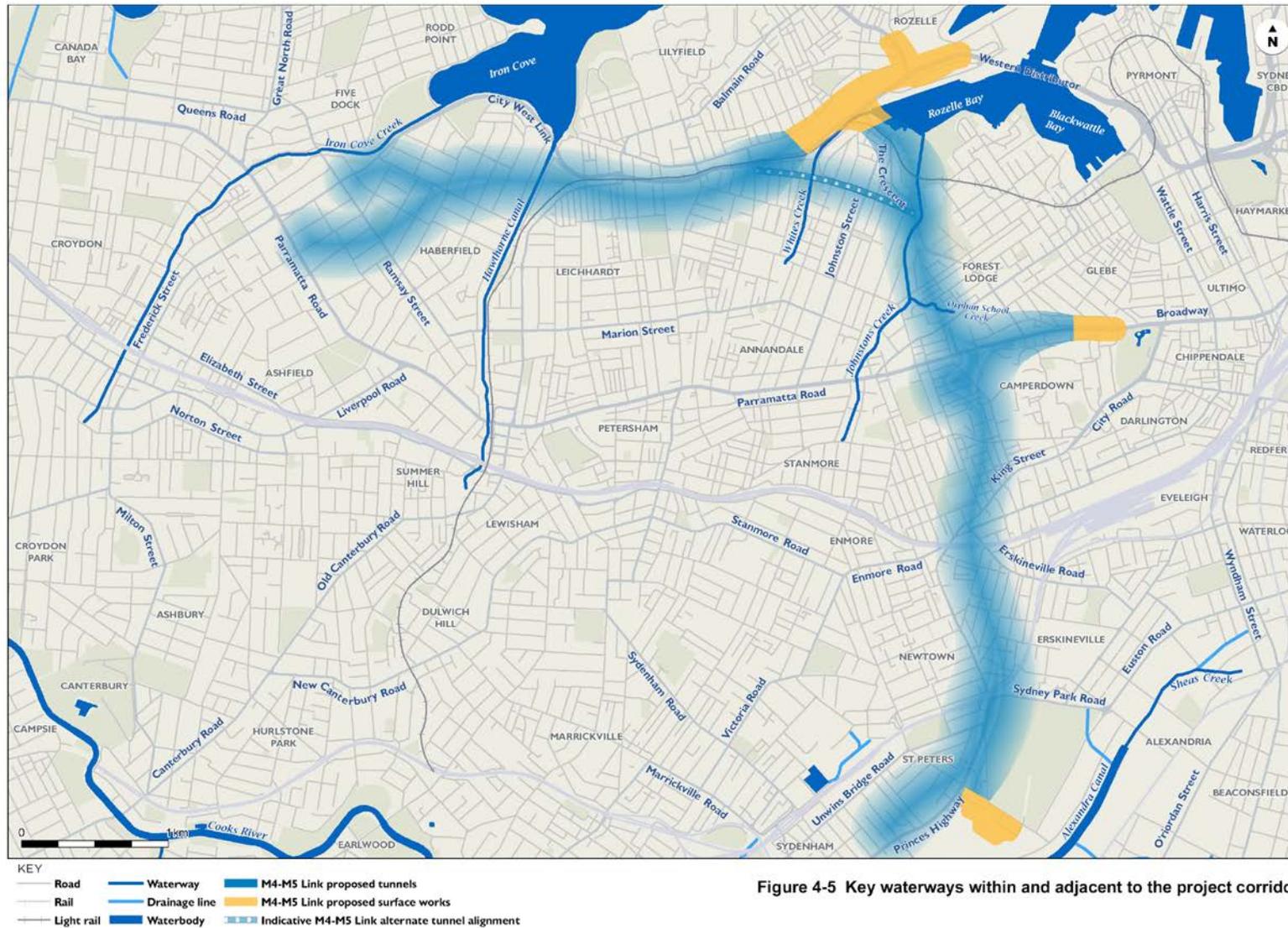


Figure 4-5 Key waterways within and adjacent to the project corridor

Figure 4-5 Key waterways within and adjacent to the project corridor

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4.8.2 Summary of issues

Construction

Construction of the project has the potential to result in the flooding impacts:

- Changes to local overland flows and existing minor drainage paths through the disruption of existing flow mechanisms, both of constructed drainage systems or those of overland flow paths
- Changes to flooding regimes from construction work and/or from the position of temporary construction infrastructure and compounds.

Operation

Operation of the project has the potential to result in the flooding impacts:

- Increased impervious surfaces and/or changes to the total catchment area of existing drainage infrastructure due to surface work at tunnel portals and tie-ins to existing roads. If the capacity of the drainage system is not adequate this could lead to localised flooding. Considerable increases to runoff at these locations could potentially require upgrades to existing drainage infrastructure, and may require additional mitigation measures (such as stormwater drainage basins and the like)
- Potential obstruction to flood flows as a result of new infrastructure or a reduction in flood plain area, which could have an impact downstream flooding behaviour or on nearby existing developments.

4.8.3 Proposed further assessments

The environmental impact statement for the project would include an assessment of the flooding and drainage impacts associated with the project.

- Potential flooding impacts during construction
- Potential flooding impacts during the operation of the project. The assessment would consider the 100 year ARI event and the Probable Maximum Flood (PMF)
- Operational drainage infrastructure required to convey stormwater flows
- Required alterations to existing road drainage infrastructure in the vicinity of surface work at tunnel portals and tie-ins to existing roads
- Required connections to third party stormwater systems for operational surface ancillary facilities
- Appropriate mitigation and management measures to safeguard the environment during construction and operation of the project.

4.9 Groundwater

4.9.1 Overview

Groundwater along the project corridor is present within the Ashfield Shale and underlying Hawkesbury Sandstone, although the Ashfield Shale is not always present along the project corridor.

Groundwater levels within the two main geological units are variable but typically the shape of the regional water table is a subdued reflection of the topography with the water table being deepest beneath hills and shallowest beneath creeks or gullies.

The quality of groundwater within the Ashfield Shale is generally saline and corrosive. Groundwater quality within the Hawkesbury Sandstone is generally of good quality and often of potable quality. Elevated concentrations of dissolved iron and manganese naturally occur within the Hawkesbury Sandstone which can cause iron staining when discharged. Groundwater quality in the upper part of the Hawkesbury Sandstone is sometimes poor due to leakage from the overlying Ashfield Shale.

Perched groundwater is also present within weathered sections of the Ashfield Shale. The perched groundwater typically forms isolated pockets of groundwater above the regional water table. Perched groundwater is not continuous and does not form an aquifer.

The project corridor is located within land under regulation by the *Greater Metropolitan Region Groundwater Sources Water Sharing Plan*. The majority of the project corridor is within the Sydney Basin – Central groundwater management area, a porous rock groundwater source. Part of the project corridor is also within the Botany Sandbeds near St Peters, an alluvial and coastal sand bed aquifer.

Thirty three existing registered bores have been identified in close proximity to the project corridor from a search of the Bureau of Meteorology Australian Groundwater Explorer database. These boreholes include thirty two monitoring bores and one unknown bore. The majority of these bores are relatively shallow (less than 10 metres in depth) however a number of bores exceed 20 metres in depth, with one bore depth recorded at nearly 50 metres.

There are two main groundwater systems operating within the Botany Sand Beds; the deeper, confined fractured / porous Triassic Hawkesbury Sandstone and upper Quaternary Botany Sand Beds (Ivkovic, K M, Marshall, S K et. al 2013). The upper Quaternary Botany Sands aquifer has a shallow water table and is unconfined to semi-confined. The sediments within the sand beds are highly permeable, resulting in the semi-confined layers of the sand beds being highly vulnerable to contamination. For this reason, parts of the aquifer are under embargo for certain uses due to contamination.

The area around Botany and its surrounding suburbs (including St Peters) have been heavily used by industry and historically before any environmental protection controls were in place. As a result, heavy metals including chromium, nickel, lead and arsenic may have contaminated the aquifer.

Some of these industrial uses have led to contamination of the groundwater within the aquifer. Because of known or potential contamination, the NSW Government has taken a precautionary approach to ensure public health is not put at risk from exposure to potentially contaminated groundwater. Under the precautionary approach, the Botany Sand Beds aquifer is divided into four management zones; the known contaminated Orica exclusion area, and three other management zones. The project corridor is partly within Zone 2. Within Zone 2, the use of groundwater is banned from domestic uses in order to minimise the risk to bore users and prevent the spread of contamination through pumping. Industrial bore users within all management zones are required to test their bore water annually and report the results of testing to the NSW Office of Water and the Office of Environment and Heritage. However, there are no industrial bore users within the project corridor. There has been an embargo in place since August 2003 on the acceptance of new licence applications to extract groundwater.

The proposed New M5 (if approved) would include the installation of a groundwater cut off wall along the south-eastern edges of the former Alexandria Landfill, which would be closed to facilitate the construction of the St Peters interchange. This would minimise the ingress of groundwater into the former landfill from the Botany Sands aquifer.

While former industrial uses have increased the groundwater contamination potential in the vicinity of St Peters within the project corridor, the potential for groundwater contamination also exists in the vicinity of Rozelle Bay. The edges of Rozelle Bay have been subjected to uncontrolled historical filling of generally gravelly sand but could also contain hazardous materials. The fill material is typically a wedge that increases towards the Harbour. The fill is recharged by direct rainfall and runoff and groundwater from the adjacent Hawkesbury Sandstone. Based on the proximity to Sydney Harbour, groundwater levels around Rozelle Bay would be expected to be around one or two metres below ground level. Groundwater in this area would therefore discharge directly into Sydney Harbour. There is potential that the fill, if hazardous, may have resulted in the contamination of the groundwater in the vicinity of Rozelle.

4.9.2 Summary of issues

Construction

Groundwater is likely to be encountered during construction as tunnelling activities move through the underlying shales and into the Hawkesbury Sandstone. As such, discharge of treated groundwater from tunnel construction work will be required. The rates and magnitude of groundwater inflow are anticipated to be similar to other recent tunnelling projects undertaken in the Sydney Basin, including the Eastern Distributor, Cross City Tunnel, and M5 East Motorway tunnels.

The risk of increased inflow is greater where a tunnel excavation encounters open defects with direct connectivity to significant storages of water, either groundwater or surface water. Areas of higher risk are typically those in the vicinity of surface water courses and paleochannels, which may follow structural weaknesses in the basement rock, and particularly where the cover of rock between the water course and tunnel is low. Therefore, some areas along the project corridor such as Hawthorne Canal at Leichhardt are likely to have greater groundwater ingress and will require management during construction. The area around Rozelle also has the potential for high water tables due to its proximity to the harbour and will also require consideration of management of increased water ingress.

There is potential for groundwater to be contaminated due to anthropological fill in the areas of St Peters and Rozelle. Groundwater inflow will therefore require treatment prior to discharge. It is likely that groundwater encountered by tunnelling activities would be discharged to a local watercourse as surface water. Alternatively, groundwater may be discharged to sewer under a trade waste agreement.

Operation

Depending on the final design, the tunnel component of the project may either be drained or undrained. An un-drained tunnel precludes the inflow of groundwater into the tunnel. A drained tunnel allows ongoing groundwater inflow requiring groundwater collection, treatment and discharge during the operational phase.

If the final design of the tunnel component of the project is a drained tunnel (i.e. a tunnel allowing ongoing groundwater inflow), local groundwater in the vicinity of the tunnel may be drawn down to the tunnel invert level. This may impact the functionality of existing groundwater bores listed above and could have an impact on groundwater dependent ecosystems. The design would also have to accommodate higher inflow rates predicted for areas of higher risk, such as around the Hawthorne Canal and Rozelle, and the potential for contaminated groundwater to be encountered near St Peters and Rozelle Bay.

Should the final design include a drained tunnel, there is the potential for contaminated groundwater to be intercepted as part of ongoing groundwater inflow. The extent of potential impact, if any, on existing bores, would be considered in the environmental impact statement for the project.

4.9.3 Proposed further assessments

Geotechnical, groundwater, and preliminary contamination investigations would be conducted to inform the design process and the environmental impact statement. These investigations would identify the ground conditions for tunnelling across the project corridor, including further understanding of the hydrogeological conditions (such as water level and quality) and other areas across the project corridor likely to experience increased rates of ingress (such as at interchange locations).

The results of these investigations would be used to undertake a groundwater impact assessment, which would consider local and regional hydrology impacts along the length of the project, and would include:

- A review of historical data held for local groundwater levels and quality, with consideration of any supplementary data collected specifically for the project, or other components of the WestConnex program of works
- Estimates of groundwater inflow and the extent of drawdown that would occur, including cumulative impacts of the proposed M4 East and New M5
- Consideration of the Greater Metropolitan Region Groundwater Sources Water Sharing Plan and the NSW Aquifer Interference Policy (Office of Water, 2012b)
- Characterisation of the water quality of groundwater inflows along the tunnel to inform treatment requirements for potential discharge to surface water
- Characterisation of potential mobilisation of saline groundwater, contaminated groundwater and exposure of acid sulfate spoils, and the associated impacts
- Impacts to existing groundwater users, surface water features and groundwater dependent ecosystems

Identification of management measures during construction and operation.

4.10 Resource management and waste minimisation

4.10.1 Overview

Resource management and waste minimisation would be considered throughout various stages of the project from design and construction through to operation. Large quantities of materials would be required for the construction of the project such as concrete, asphalt, steel, gravel, sand, aggregate and road base. This would need to be sourced from quarries, manufactures and suppliers, which would generally be from areas outside the project corridor. Waste associated with the project would be generated from a number of streams including:

- Excavation waste
- Demolition waste
- Wastewater
- Hazardous waste
- Vegetation waste
- Liquid waste
- Construction waste
- General waste.

All wastes would be managed using the waste hierarchy approach of waste avoidance, waste re-use before consideration of waste disposal. All wastes would be managed in accordance with the waste provisions contained within the *Protection of the Environment Operations Act 1997* and, where reused off site, would comply with relevant NSW Environment Protection Authority resource recovery exemptions. The most significant waste stream associated with the project is likely to be spoil generated from the excavation of the road tunnels that is in excess of project requirements. Spoil that is in excess of project requirements would be preferentially beneficially re-used in other road projects and any non-road development sites that may require engineered fill, or other land rehabilitation projects. This would be managed in accordance with a spoil management strategy for the project.

The works at the St Peters interchange are not anticipated to require removal of previously disposed wastes at the Alexandria Landfill by virtue that the landfill would be closed and the land prepared as part of the New M5 (subject to planning approval). Historic landfilling at Rozelle/Glebe would need to be investigated to determine potential contamination, should this be disturbed by the project. This is discussed in **Section 4.7**.

Water resources would be required during construction, particularly during tunnelling. In addition, water resources will be required in the performance of other activities such as compaction of pavement materials, dust suppression and concrete batching. Water resources could be sourced from within or outside the project corridor. Higher quality water for some construction activities may be sourced from potable water supplies. Water from groundwater sources may also be used. The final volume, source and quality requirements for water supplied to the project would be determined through the design development process for the preferred project design and reflected in the environmental impact statement.

4.10.2 Summary of issues

Construction

Impacts associated with resource use and waste generation are likely to be predominantly associated with the construction of the project. These include:

- Potential impact on resource availability as a result of resource use requirements for the project.
- Generation of waste during construction of the project, including:
 - Demolition wastes from existing structures that require removal
 - Excavated wastes, such as soil and rock, primarily from tunnelling and cutting
 - Depending on the final locations of excavation activities, these wastes are expected to be largely characterised as Virgin Excavated Natural Material although contaminated spoil may be generated

- Vegetation waste from the removal of trees, shrubs and ground covers that are unable to mulched and reused within the project
- Packaging materials such as crates, pallets, cartons, plastics and wrapping materials
- Surplus construction material and general site reinstatement such as fencing, sediment, concrete, steel, formwork and sand bags
- Site compound waste such as liquid wastes from cleaning, repairing and maintenance, waste from spillages, fuel or oil waste, effluent from site amenities and general office wastes.

Operation

The operation of the project has the following resource use and waste management related impacts:

- Generation of wastes from operational maintenance and repair activities required over the life of the project. The type and volume of wastes generated would be dependent on the nature of the activity, but would predominantly consist of green waste, oil, road materials, as well as contaminated waste resulting from potential fuel spills and leaks
- Supply of water for the deluge system, which would form part of the fire and life safety system
- Water used as part of the deluge system or for tunnel washing would be captured, and treated using the groundwater inflow water treatment plant, prior to being discharged into the environment. This is discussed in **Section 4.7**(Soil and water quality)
- Litter generated by road users.

With the implementation of standard work practices during routine maintenance and repair activities, the overall impact of operational waste streams and volumes would be minimal.

4.10.3 Proposed further assessments

The environmental impact statement would provide further details on waste and resource management for the project, including:

- Estimates of the quantity of spoil that would be generated
- Identification of a management hierarchy to reduce the volume of excess spoil generated by the project, such as through design, through use within the project, or use in other projects
- Identification of the approximate resource requirements for the project, including estimation of the material and water requirements
- Identification of available materials in the region including from quarries, potential material suppliers, and reuse of materials
- Identification of available water supplies in the region and the locality (including recycled water)
- Identification of specific waste impacts of the project and the waste management approach
- Identification of management and mitigation measures for resource use and waste across the project including potential spoil re-use and disposal sites and transport impacts. This includes strategies to minimising the export of excavated materials off-site, maximising re-use opportunities and minimising the volume of excavated material disposal to landfill
- Identification of opportunities to use recycled materials provided they are fit for purpose and meet engineering requirements.

The impacts associated with the handling, storage and transport for spoil has been discussed in **Section 4.2** (Traffic and transport), **Section 4.3** (Air quality and human health), **Section 4.4** (Noise and vibration) and **Section 4.7** (Soil and water quality).

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5 Other environmental issues

5.1 Overview

Other environmental issues listed below are considered to be of lesser consequence taking into account the scope of the project, the existing environment and the implementation of standard and best practice management and mitigation measures. It is considered unlikely that these would be key issues for the project; however, further assessment would be undertaken as part of any future environmental impact assessment for the project. Any environmental management and safeguard measures required to minimise and mitigate impacts would be documented as part of the environmental impact statement.

5.2 Social and economic

5.2.1 Overview

The majority of the project is in tunnel with localised surface works proposed, with surface works located primarily on publically owned land or land reserved for the project. As such, social interactions with the project are anticipated to be largely confined to areas in the vicinity of surface works and are not categorised to be a key issue for the project. The project would span Ashfield, Leichhardt, Marrickville and Sydney Local Government Areas. Key statistics of these combined LGAs are summarised in **Table 5-1** below.

Table 5-1 Key population statistics (Australian Bureau of Statistics, 2011)

Statistic	Description
Population *	471,801
Median age	32 to 37 years
Main occupations	Professionals. Clerical and administrative workers. Managers.
Average motor vehicles per dwelling	1
Total in labour force	207,219
Main mode of travel to work	Ashfield LGA: Car (as driver or passenger) (42.8%), Train (31.3%) Leichhardt LGA: Car (as driver or passenger) (50%), Bus (21%) Marrickville LGA: Car (as driver or passenger) (41.2%), train (26.2%) Sydney LGA: Walked (25.3%), Car (as driver or passenger) (25.2%), train (15.8%)

* Estimated residential population as at June 2014

Land use of high social value

Land uses of high social value within the project corridor comprise a mixture of facilities, including areas of for passive and active recreation, such as parks, nature reserves and sporting facilities, as well as churches, community halls, child care facilities, the University of Sydney, schools and medical centres, including a hospital. A list of land uses of high social value are provided in **Appendix C**. Open spaces and recreational areas within the project corridor are shown on **Figure 4-4**.

Economic context

Sydney is recognised as the economic capital of Australia and its economic output is expected to almost double by 2031. *A Plan for Growing Sydney* (the Plan), released in December 2014, is the NSW Government's plan for the future of the Sydney Metropolitan Area over the next 20 years. The Plan provides key directions and actions to guide Sydney's productivity, environmental management, and liveability, including the delivery of housing, employment, infrastructure and open space. One the goals of the Plan is for Sydney to have a competitive economy with world-class services and transport. The Plan seeks to achieve this goal through the delivery of a number of strategies, which WestConnex would support:

- Enhance capacity at Sydney's gateways and freight networks, by supporting the operation of Sydney Airport and Port Botany

- Expand the Global Economic Corridor, by improving infrastructure and removing bottlenecks to grow economic activity
- Enhance linkages to regional NSW, by improving access to services through improved transport links to regional NSW
- Deliver infrastructure, by preserving future road corridors to support future growth.

Areas of commercial and industrial land use

There is little industrial land within the project corridor with the exception of areas at Rozelle and Balmain, which support light industrial, port and maritime land uses. However, this area is planned to undergo land use change to support housing, entertainment and open space uses in addition to employment land uses as part of The Bays Precinct.

Commercial land is limited to local centres and mixed use areas, and is concentrated in the suburbs of Rozelle, Annandale, Glebe, Camperdown, Newtown and St Peters. Commercial uses are typically concentrated along major roads (such as the Victoria Road, Darling Street, Glebe Point Road, Parramatta Road and King Street) and at train stations, alongside medium and high density residential uses.

Health and educational facilities and supporting businesses (including accommodation providers) are also concentrated in Camperdown in the vicinity of the Royal Prince Alfred Hospital and University of Sydney (the Broadway and Camperdown Education and Health Precinct).

In proximity to the project corridor, Sydney Airport and Port Botany precincts will remain the focus for industrial and employment land uses, and will remain the international gateway for Sydney.

5.2.2 Potential impacts

Potential impacts of the project are not considered to be a key issue given that the project is primarily in-tunnel and surface works are largely on publically owned land or land already reserved for the project. Nonetheless, potential impacts and benefits of the project are described.

Construction

Construction of the project has the potential for the following social and economic related impacts:

- Impacts associated with property acquisition, including uncertainty for residents and business owners about the property acquisition process and potential need to relocate
- Disruption to access to private properties, businesses and community facilities
- Some increased trade during construction due to customers from the construction workforce
- Impacts associated with acquisition (temporary and / or permanent) of areas of high social value
- Temporary changes to access and potential for traffic delays and disruptions near to construction work, including for motorists, public transport users, pedestrians and cyclists, commercial and freight transport operators, and emergency services
- Impacts on amenity for local residents, businesses and users of community facilities (including schools) located close to the construction compounds and proposed construction work, as a result of increased dust, noise and traffic from construction activities, including the haulage of spoil material and parking for construction workers
- Temporary disruption to pedestrian and cycle access near construction work, including potential changes along the City West Link, The Crescent, Victoria Road and Parramatta Road
- Potential impacts on road safety for motorists, cyclists and pedestrians near to construction work and construction compounds, particularly at interchange locations
- Direct or indirect impacts on the use of sections of open space, pedestrian and cyclist facilities where surface works would be required. This includes areas near the Rozelle interchange and St Peters interchange, noting that impacts to Sydney Park would be indirect only (e.g. amenity related impacts such as potential construction noise).

Operation

There is the potential for operation of the project to have the following economic and amenity-related benefits:

- Improved access, connectivity and reliability for local and regional businesses, freight and communities
- Improved amenity for residents, pedestrians and other users along major roads related to a reduction in road traffic noise and improved air quality
- Opportunities for urban renewal along Parramatta Road and The Bays Precinct
- Increased road capacity to service growth in employment lands and residential developments
- Improved travel times along local surface roads as a result of a reduction in congestion
- Improved freight travel times for vehicles using the project
- Improved access to Sydney Airport and Port Botany
- Improved accessibility for businesses
- Community perceptions about increased severance, cohesion and access
- Bypassing of suburbs, which would impact on businesses that rely on trade from passing vehicles
- Amenity impacts to properties close to the project, due to changes in traffic noise, visual impacts of surface infrastructure and potential changes in air quality
- Changes to local access and connectivity near surface roads.

A reduction of heavy vehicle traffic on major arterials would allow traffic to flow more freely, increasing local accessibility and reducing travel times for motorists, pedestrians and cyclists. The project would also provide a continuous motorway-standard service for vehicles travelling to and from greater Sydney and the Sydney Orbital Network, facilitating more efficient movement of freight between centres of important economic activity. This would likely generate productivity benefits for the State economy, as well as other less tangible benefits related to potential increases in regional development.

The potential for increased severance, cohesion and access is anticipated to be minor, as the majority of the project would be in tunnel. However, surface components may fragment land and alter accessibility for residents and other users of these areas. Such changes are not expected to result in a significant loss of community cohesion within the area.

In removing a portion of traffic from surface roads, the project may have an impact on some businesses that rely on trade from passing vehicles (for example, service stations and fast food outlets). Alterations to traffic flow throughout the local road network may have similar implications for businesses in other suburbs.

5.2.3 Proposed further assessment

A social and economic impact assessment would be undertaken which would consider the potential impacts of the project (beneficial and adverse, as well as direct and indirect), including:

- A description of the social and economic profile for the communities and businesses surrounding the project
- An assessment of the potential positive and negative impacts of the project on the social and economic values of the area during construction and operation
- Identification of appropriate management and safeguard measures.

The assessment would consider the *Environmental Planning and Impact Assessment Practice Note – Socio-Economic Impact Assessment* (Roads and Maritime, 2013c).

5.2.4 Management and safeguard measures

Property acquisition

All acquisitions would be under the terms of the *Land Acquisition (Just Terms Compensation) Act 1991* (NSW) and in accordance with the *Land Acquisition Information Guide* (Roads and Maritime 2014).

Home owners would be supported to obtain alternate independent property valuations in accordance with the Land Acquisition Information Guide.

Advertising of the WestConnex Assist counselling program would continue as well as providing first language support for households with English as a second language.

Access and connectivity

- A community involvement plan would be implemented to provide timely, regular and transparent information about changes to access and traffic conditions, details of future work programs and general construction progress throughout the construction phase of the project. Information would be provided in a variety of ways including letter box drops, media releases, internet site, signage and 24 hour project information line. Local residents, business owners and bus passengers would be notified of traffic management procedures. Ongoing consultation with communities would provide information on planned construction activities, changes to property access, and changes to any bus stop arrangements
- Bus stop, pedestrian and cycle way changes would be advertised locally, including to local social infrastructure providers
- Appropriate signage would be applied to ensure motorists understand how to access local businesses adjacent to construction works.

Amenity - Noise and vibration

Implement noise treatments at properties in advance of construction (during early works). The potential for at property noise treatments would be investigated and implemented during the pre-construction phase for all properties likely to be significantly impacted by construction noise to reduce the impacts as much as possible.

Amenity – Visual

The design of the project would be in keeping with urban design principles for the project, the *WestConnex Urban Design Corridor Framework* and the Roads and Maritime guideline *Beyond the Pavement: Urban Design Policy Procedures and Design Principles* (Roads and Maritime, 2014). A landscape plan would be prepared and implemented in consultation with the community to ensure the management approach contributes to sustaining community cohesion and identity throughout the construction period.

Business impacts

Businesses impacted by the project would be consulted with to ensure key issues are addressed such as access arrangements, traffic conditions, parking and local supplier opportunities.

A 24 hour project information line and website would be maintained to enable business owners and/or operators to receive prompt responses to their concerns, access information and view assistance measures in place during construction related work.

Social infrastructure

Consultation would continue with all key social infrastructure providers to assist them and their clients in planning for and adapting to the changes expected during the construction period.

Notification of any traffic and access changes during construction periods would be provided to emergency services well in advance of the changes occurring.

5.3 Non-Aboriginal heritage

5.3.1 Overview

The project corridor spans several areas of heritage conservation significance and contains a number of locally and state listed heritage items. Many of these areas and items date back to Sydney's early settlement and industrial and suburban development.

A preliminary non-Aboriginal heritage desktop assessment was performed in December 2015, which included a search of relevant statutory and non-statutory heritage databases and a review of the heritage listings within local environmental plans. These included:

- NSW State Heritage Register and Inventory
- Section 170 Heritage and Conservation Registers administered by Sydney Water, RailCorp, Roads and Maritime, Ausgrid and NSW Ports
- Ashfield LEP 2013
- Leichhardt LEP 2013
- Marrickville LEP 2011
- Sydney LEP 2012
- *Sydney Regional Environmental Plan No 26 – City West*
- *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005*
- Register of National Estate
- National Trust of Australia
- Australian Heritage Places Inventory
- Commonwealth and National Heritage Lists.

A number of heritage items were identified within 100 metres the project corridor (refer to **Figure 4-6**). Of these, thirteen items were identified as being of State significance and are listed on the State Heritage Register (refer **Table 5-2**).

Table 5-2 State heritage listed sites located in proximity to the project corridor

SHR #	Name	Location
0829	Royal Prince Alfred Hospital – Victoria & Albert Pavilions	Missenden Road, Camperdown
0830	Royal Prince Alfred Hospital – Admission Block	Missenden Road, Camperdown
0128	University Hall & Cottages	281– 285 Broadway, Glebe
0462	St Stephen's Anglican Church and Cemetery	187 – 189 Church Street, Newtown
0032	St Peter's Anglican Church	187-209 Princes Highway, St. Peters
0747	Uniting Church and Pipe Organ	280a King Street, Newtown
1325	Johnston's Creek Sewer Aqueduct	Annandale
1034	Glebe Railway Viaduct	Federal Park, Glebe
1250	St Peters Railway Station group	Princes Highway, St Peters
1213	Newtown Railway Station group and Former Newtown Tramway Depot	King Street, Newtown
1379	Yasmar	185 Parramatta Road, Haberfield
1015	White Bay Power Station	Victoria Road, Rozelle
1630	Pressure Tunnel and Shafts	-

The remaining items are of local significance (145 items listed as locally significant on LEPs) and/or listed on Section 170 Heritage and Conservation registers, such as the Hawthorne Canal Stormwater Channel No. 62, Johnstons Creek Stormwater Channel No 55 (Sydney Water) and Glebe Viaducts (RailCorp).

The majority of heritage items identified within the project corridor are:

- Houses and structures (school, churches, cottages, brickwork). This includes the State and locally listed Royal Prince Alfred Hospital at Camperdown, and the locally listed stone retaining wall, fence and steps adjacent to Arundel Street at Forest Lodge
- Recreational areas, waterways and wetlands (for example, Federal Park, Johnstons Creek, and Orphan Creek Public Reserve)
- Utility infrastructure, including sewer pumping stations and vents, the Southern and Western Suburbs Ocean Outfall Sewer (SWSOOS) aqueduct and the City Tunnel (water supply)
- Railway station groups, including the Newtown and St Peters railway station groups.

Nineteen heritage conservation areas are also located within the project corridor, summarised by local government area in **Table 5-3**.

There are no World Heritage, National Heritage or Commonwealth Heritage Places recorded within the project corridor.

Table 5-3 Heritage Conservation Areas located within the project corridor

Local government area	Conservation Area
Ashfield	<ul style="list-style-type: none"> • Haberfield Conservation Area
Leichhardt	<ul style="list-style-type: none"> • Hornsey Street Heritage Conservation Area • Annandale Heritage Conservation Area
Sydney	<ul style="list-style-type: none"> • Toxteth Heritage Conservation Area • Hereford and Forest Lodge Heritage Conservation Area • Sydney University Heritage Conservation Area • Bligh & Camperdown Terrace Heritage Conservation Area • O'Connell Town Estate Heritage Conservation Area • Bucknell Street Heritage Conservation Area • King Street Heritage Conservation Area • Gowrie Street Heritage Conservation Area • Newman and Gibbes Streets Heritage Conservation Area • Toogood & White's Estate Heritage Conservation Area • Pleasant Avenue Heritage Conservation Area • Former Macdonaldtown Estate Heritage Conservation Area • Union Street West Heritage Conservation Area
Marrickville	<ul style="list-style-type: none"> • North Kingston Estate Heritage Conservation Area • King Street / Enmore Road Heritage Conservation Area • Goodsell Estate Heritage Conservation Area

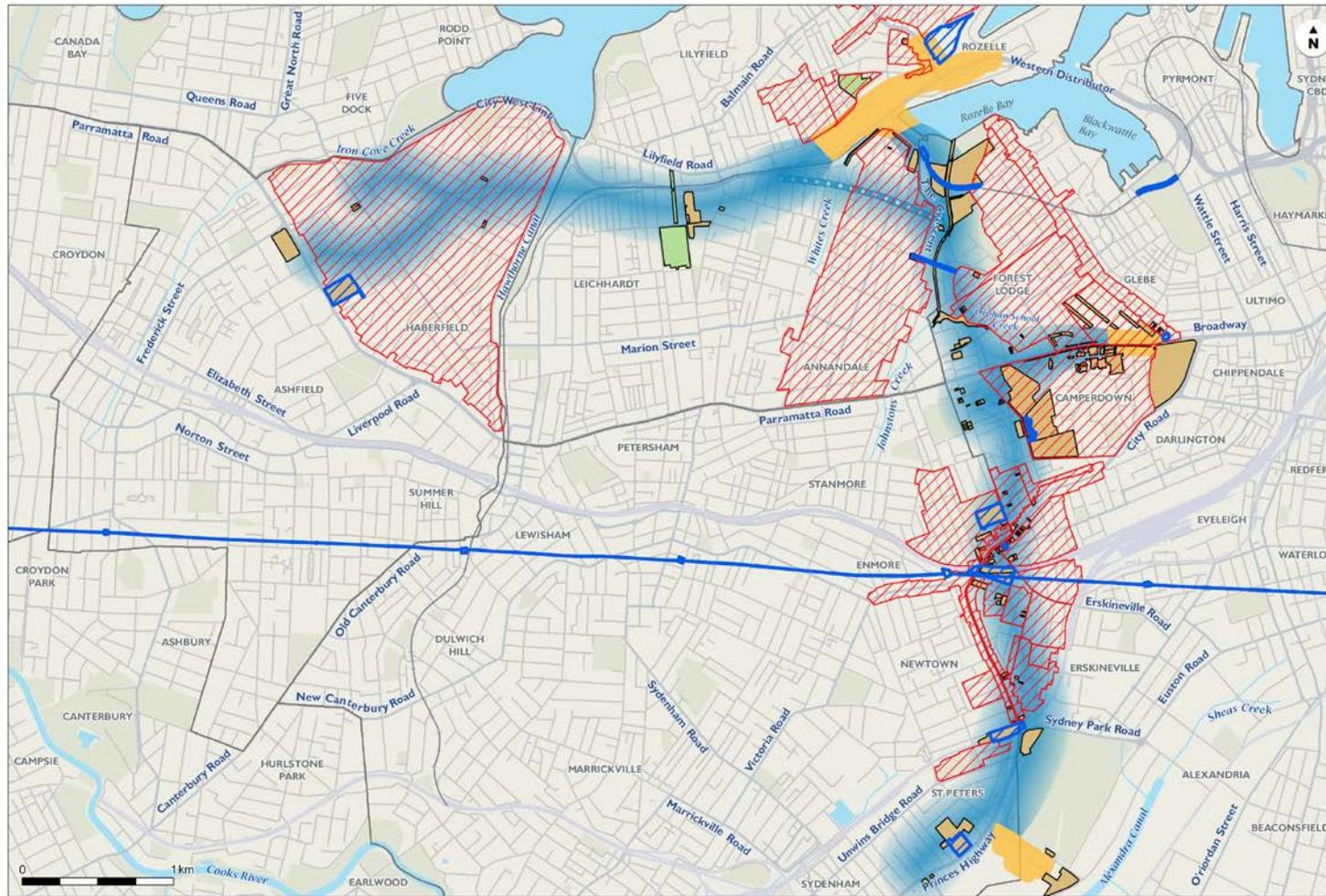


Figure 5-1 Heritage listed items within and adjacent to the project corridor

Figure 5-1 Heritage listed items within and adjacent to the project corridor

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5.3.2 Potential impacts

Construction

There is the potential for direct and indirect impacts to non-Aboriginal heritage items and conservation areas to occur during the construction of the project. Potential construction impacts include:

- Physical impact on the item or within the curtilage of the item. This could include permanent impacts such as the partial or complete demolition of the item to facilitate future operational surface infrastructure and ancillary facilities, or could include temporary impacts to the curtilage of a heritage listed item due to temporary use of the site for compound areas and other temporary facilities
- Structural damage to a heritage item due to vibration and settlement associated with tunnelling or surface works
- Temporary impacts on views to or from heritage items and within heritage conservation areas.

The project corridor is sufficiently broad to avoid direct impacts on heritage items during the design development process. None of the State heritage listed items would be directly impacted by surface works and ground borne vibration would be managed by strict adherence to limits set to prevent impacts to heritage structures.

There is also the potential for additional non-Aboriginal heritage items to be identified during the construction process. These are likely to be archaeological remains of earlier habitation and industrial activities within sections of the project corridor.

Operation

It is anticipated potential impacts to heritage items are largely contained to the construction stage of the project as a result of direct physical impacts. However, there is the potential for residual direct and indirect impacts to non-Aboriginal heritage items and conservation areas to occur during operation of the project. Potential impacts during operation would include:

- Physical impact on the item or within the curtilage of the item as a result of architectural treatment to buildings for operational noise attenuation
- Structural damage due to settlement associated with tunnelling works
- Permanent changes to views to or from heritage items due to permanent motorway operation facilities
- Permanent alteration to curtilage of a heritage listed item.

Depending on the final location and design of surface infrastructure, there would be opportunity to avoid and / or minimise the potential for permanent operational impacts.

5.3.3 Proposed further assessment

The project would be designed and constructed to avoid and/or minimise any impacts to areas of heritage value wherever feasible, and to avoid direct impacts to items listed on the State Heritage Register. Further investigation of the potential impacts on non-Aboriginal heritage items would be undertaken and presented in the environmental impact statement. This would include:

- Updated searches of non-Aboriginal heritage databases and a review of literature relating to heritage within the project corridor
- An assessment of significance for known State and local heritage items within the project corridor in accordance with the Burra Charter (ICOMOS, 2013) and the *Assessing Heritage Significance, NSW Heritage Manual 2, 2001* (NSW Heritage Office, 2001) and *Statements of Heritage Impact, 1996* (NSW Heritage Office, 1996)
- Pedestrian survey of areas around the surface elements, to identify additional buildings or items that may be of heritage significance and may not have been included in LEP listings
- Assessment of potential impacts to items of local and state heritage significance, including consideration of construction vibration impacts and predictions of settlement associated with tunnelling works and permanent impacts such as altered historical arrangements and access, landscapes and vistas, and architectural noise treatments

- An archaeological assessment, where required, to determine the presence of potential non-Aboriginal archaeological items and the potential impacts as a result of the project. The need for an archaeological assessment would be determined based on the outcomes of the literature review, the investigations detailed above and the nature of the potential impact. It may include archaeological test excavations
- Consultation with the relevant stakeholders such as the Office of Environment and Heritage and local councils
- Management measures to minimise impacts to identified non-Aboriginal heritage values.

5.3.4 Management and safeguard measures

Avoidance of direct impacts on heritage items would be sought during the project corridor design development process. Ground borne vibration would be managed by strict adherence to limits set to prevent impacts to heritage structures.

Standard management and safeguard measures would be considered through the design development process for the preferred project design and preparation of the Environmental Impact Statement including the implementation of stop works and referral procedures in the event of unexpected finds of non-Aboriginal heritage items.

5.4 Biodiversity

5.4.1 Overview

Flora

Threatened flora

Database searches of the NSW BioNet Atlas of Wildlife and the EPBC Protected Matters Search Tool, undertaken on 17 December 2015 identified previous records of 22 listed threatened flora species listed under the EPBC Act and / or the TSC Act, or their habitat, as occurring within 10 kilometres of the project corridor (refer to **Table B-1** in **Appendix B**).

Vegetation communities

SEPP 14 Wetlands

State Environmental Planning Policy No 14 – Coastal Wetlands (SEPP 14 wetlands) is in place to protect coastal wetlands that are significant in the environmental and economic interest of the State, from future development. There are no SEPP 14 wetlands within or in proximity to the project corridor.

Towra Point Wetlands

Towra Point Wetlands is a RAMSAR listed site and is an estuarine complex comprising a mixture of spits, bars, mudflats, dunes and beaches. It is the largest wetland of its type in the Sydney Basin bioregion and represents vegetation types that are now rare in the area. The wetland system comprises 60 per cent of the remaining saltmarsh communities and 40 per cent of the remaining mangrove communities in Sydney and is an important area for migratory and native bird species, with records in the area of more than 200 species. The Towra Point Wetlands is located about 9.7 kilometres south of the project corridor on the southern side of Botany Bay.

Threatened ecological communities

Searches of the Protected Matters Search Tool, BioNet Atlas of NSW Wildlife identified 23 listed threatened ecological communities with the potential to occur within project corridor, as summarised in **Table 4-1**.

The search of the BioNet Atlas of NSW Wildlife was undertaken within the 10 kilometre minimum allowable search area centred on the project corridor, the search of the Protected Matters Search Tool database was also undertaken with a 10 kilometre buffer around the project corridor and the DPI estuarine habitat maps were examined within the project corridor only.

The Native Vegetation of the Sydney Metropolitan Area dataset (NSW Office of Environment and Heritage, 2014) was also examined to identify any vegetation communities previously mapped within the project corridor. Of the 23 listed threatened ecological communities with the potential to occur within the project corridor, only one was mapped as occurring within the project corridor, as summarised in **Table 4-1**. This community is *Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions* and a small area of this community is mapped as occurring in one location between Chapman Road and Johnstons Creek near Jubilee Oval and Federal Park as shown in **Figure 5-2**. This community was also verified as part of the City of Sydney Urban Ecology Strategic Plan (CoS, 2014) and is listed as Vulnerable under the *Environment Protection and Biodiversity Act 1999* (EPBC Act). The project is in tunnel at this location and would not directly impact the saltmarsh.

Examination of the Department of Primary Industries (DPI) Fishing and Aquaculture estuarine habitat maps for Port Jackson showed that Rozelle Bay has potential for mangrove and seagrass (*Zostera/Halophila* sp.) communities to be present. Mangrove Forest (protected under the FM Act) was also identified along Bicentennial Park at Glebe (CoS, 2014).

Other vegetation communities

The project corridor has been predominantly mapped as urban native and exotic cover, as part of the Native Vegetation of the Sydney Metropolitan Area dataset (NSW Office of Environment and Heritage, 2014).

Table 4-1 Threatened ecological communities within 10 kilometres of the project corridor

Ecological community	Commonwealth listing (EPBC Act)		NSW listing (TSC Act/FM Act)		Mapped within project corridor
	Yes / No	Status	Yes / No	Status	
Blue Gum High Forest in the Sydney Basin Bioregion.	Yes	Critically Endangered	Yes	Critically Endangered	✘
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion.	Yes	Endangered	Yes	Vulnerable	✘
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions (also listed as Subtropical and Temperate Coastal Saltmarsh)	Yes	Vulnerable	Yes	Endangered	✓
Coastal Upland Swamp in the Sydney Basin Bioregion.	Yes	Endangered	Yes	Endangered	✘
Cooks River / Castlereagh Ironbark Forest in the Sydney Basin Bioregion.	Yes	Critically Endangered	Yes	Endangered	✘
Cumberland Plain Shale Woodland in the Sydney Basin Bioregion	Yes	Critically Endangered	Yes	Critically Endangered	✘
Duffys Forest Ecological Community in the Sydney Basin Bioregion.	No	-	Yes	Endangered	✘
Eastern Suburbs Banksia Scrub in the Sydney Basin Bioregion.	Yes	Endangered	Yes	Endangered	✘
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.	No	-	Yes	Endangered	✘
Hydrocybeae Community of Lane Cove Bushland Park in the Sydney Basin Bioregion	No	-	Yes	Critically Endangered	✘
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.	Yes	Critically Endangered	Yes	Endangered	✘
Moist Shale Woodland in the Sydney Basin Bioregion.	Yes	Critically Endangered	Yes	Endangered	✘
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.	No	-	Yes	Endangered	✘

Ecological community	Commonwealth listing (EPBC Act)		NSW listing (TSC Act/FM Act)		Mapped within project corridor
	Yes / No	Status	Yes / No	Status	
Shale gravel Transition Forest in the Sydney Basin Bioregion.	Yes	Critically Endangered	Yes	Endangered	✘
Shale Sandstone Transition Forest in the Sydney Basin Bioregion	Yes	Critically Endangered	Yes	Critically Endangered	✘
Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion.	No	-	Yes	Endangered	✘
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.	No	-	Yes	Endangered	✘
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.	No	-	Yes	Endangered	✘
Sydney Freshwater Wetlands in the Sydney Basin Bioregion.	No	-	Yes	Endangered	✘
Sydney – Turpentine Ironbark Forest.	Yes	Critically Endangered	Yes	Endangered	✘
Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions.	No	-	Yes	Endangered	✘
Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion	Yes	Endangered	No	-	✘
Western Sydney Dry Rainforest in the Sydney Basin Bioregion.	Yes	Critically Endangered	Yes	Endangered	✘

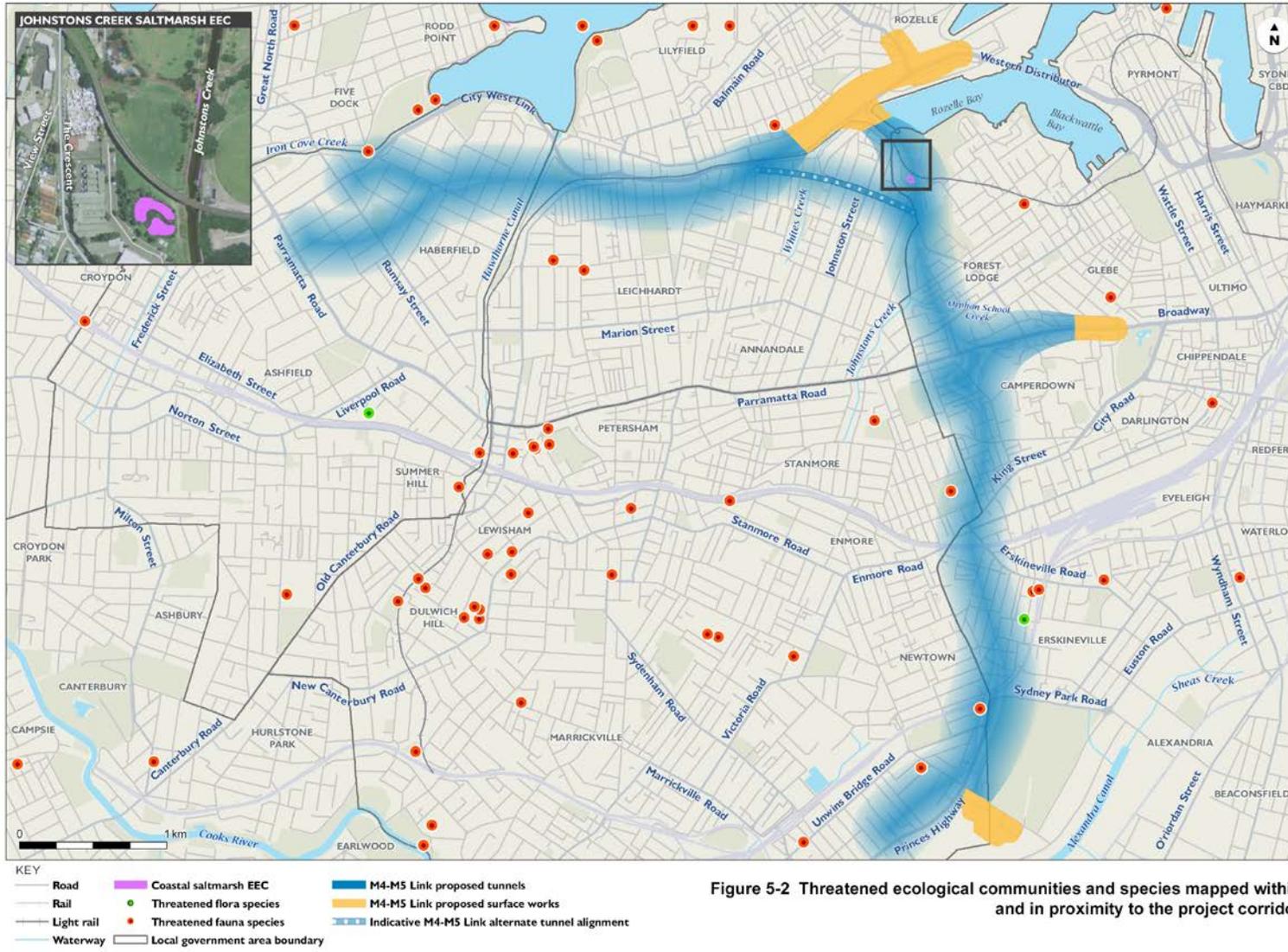


Figure 5-2 Threatened ecological communities and species mapped within and in proximity to the project corridor

Noxious weeds

The *Noxious Weeds Act 1993* establishes control mechanisms to reduce the negative impacts of weeds on the economy, community and environment. Noxious and environmental weeds are known to be present across the project corridor. Under Section 13 of the *Noxious Weeds Act 1993*, Roads and Maritime, as a public authority, is obliged to control noxious weeds on land that it owns and to prevent noxious weeds from spreading to adjoining properties.

Fauna

Threatened fauna and threatened fauna populations

Sixty-four threatened fauna species and three threatened fauna populations listed under the EPBC Act and / or the TSC Act (and / or the *Fisheries Management Act 1994* (FM Act)) or their potential habitat have been previously recorded within 10 kilometres of the project corridor (refer to **Table B-2** in **Appendix B**). Fauna species included:

- Thirty-eight bird species
- Two fish species
- Four frog species
- Eleven mammal species
- Six reptile species
- Two shark species
- One gastropod species.

The three threatened fauna populations listed under the EPBC Act or TSC Act which have been previously recorded within 10 kilometres of the project corridor include:

- Grey Nurse Shark (east coast population) (*Carcharias taurus*), a critically endangered population under the FM Act and EPBC Act
- Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (SE mainland population) (*Dasyurus maculatus maculatus*), a vulnerable population under the TSC Act and endangered population under the EPBC Act
- Koala – combined populations of QLD, NSW and ACT (*Phascolarctos cinerus*), a vulnerable population under the TSC Act and EPBC Act.
- None of these populations are known to occur within the project corridor.

Migratory species

Fourteen listed threatened marine migratory bird species listed under the TSC Act and / or EPBC Act have been previously recorded within the project corridor (refer to **Table B-2** in **Appendix B**). An additional six migratory marine species listed under the EPBC Act may occur or may have potential for foraging, feeding or related behaviour within the project corridor.

The project corridor is in close proximity to large waterbodies such as Canada Bay and Rozelle Bay, which provide connection to open water. As such, nineteen listed migratory marine species have been identified as potentially occurring within the project corridor.

Aquatic habitat

The project corridor encompasses part of Rozelle Bay (and Johnsons Creek) and Hawthorne Canal (Canada Bay). All waterways within the project corridor are declared as key fish habitat by the NSW DPI (Water); being those aquatic habitats that are important to the sustainability of the recreational and commercial fishing industries, the maintenance of fish populations generally and the survival and recovery of threatened aquatic species.

Wildlife corridors

Wildlife corridors are connections across the landscape that link up areas of habitat, while supporting multiple land uses. Wildlife corridors generally comprise native vegetation and connect two or more areas of similar wildlife habitat. Corridors are critical for the maintenance of ecological processes, including allowing for the movement of animals and the continuation of viable life processes such as breeding and the maintenance of genetic diversity. Landscape connections between larger areas of habitat through wildlife corridors enable migration, colonisation and breeding of flora and fauna.

Corridors can comprise either discontinuous areas of habitat, such as wetlands and roadside vegetation, continuous lineal strips of vegetation and habitat, such as riparian strips and ridge lines, or parts of a larger habitat area selected for its known or likely importance to local fauna.

Based on their ecological value, the following areas are considered to have potential functionality as wildlife corridors or part of wildlife corridors:

- Vegetation along Johnstons Creek and its connection with Rozelle Bay
- Vegetation along Hawthorne Canal and its connection with Canada Bay.

The Johnstons Creek corridor has been identified as a potential habitat linkage. The identified potential habitat linkage extends along the Rozelle and Blackwattle Bay foreshore to the University of Sydney, Sydney Park and other priority sites and habitat areas in adjoining local government areas (CoS, 2014).

Priority sites

As part of City of Sydney's Plan Urban Ecology Strategic Plan, a number of priority sites were identified based on an assessment of their biodiversity values including vegetation structure, indigenous species diversity, and natural features. Those relevant to the project corridor include *Sydney Park* and *Glebe Foreshore Walk East – Orphan School Creek, Glebe-Forest Lodge*.

Sydney Park is recognised for its habitat connectivity potential, diverse fauna habitat features, and high indigenous flora species diversity. Glebe Foreshore is recognised for its existing and potential endangered ecological community presence (coastal saltmarsh and potential for Sydney Turpentine Ironbark Forest), presence of Mangrove Forest, diverse fauna habitat features, and high indigenous flora species diversity, and the potential for naturalisation of the Johnstons Creek Canal.

Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are communities of plants, animals and other organisms whose extent and life processes are dependent on groundwater, such as wetlands and vegetation on coastal sand dunes. The project corridor is located within land that forms part of the Sydney Basin – Central and the Botany Sands Groundwater Source, subject to the provisions of the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011*. A review of priority groundwater dependent ecosystem listed on Schedule 4 of the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011* and a search of the National Atlas of Groundwater Dependent Ecosystems (Australian Bureau of Meteorology) did not identify any groundwater dependent ecosystems within or in close proximity to the project corridor.

5.4.2 Potential impacts

Construction and operation

The project has the potential to impact on biodiversity, including threatened and protected species, populations and communities. Impacts on biodiversity (direct and indirect) would be mostly associated with areas of surface disturbance. However, potential impacts could potentially occur as a result of surface water discharges, and groundwater drawdown could have impacts on GDEs (if further investigation identifies any present within the corridor). The mechanisms by which these impacts could occur include:

- Vegetation clearance at the locations of interchanges, surface infrastructure, ancillary facilities and motorway control centre resulting in habitat loss and edge effects
- Potential loss of connectivity between habitat areas (wildlife corridors), resulting in habitat fragmentation
- Noise impacts resulting in disturbance to protected bird and bat species
- Mortality of individuals during both the construction and operation of the project
- Introduction and / or spread of noxious weeds and other invasive species
- Impacts to groundwater levels due to groundwater inflows during construction and operation
- Mobilisation of sediments into waterways and potential pollution from materials used in the process of construction and operation, resulting in downstream impacts to aquatic species and communities

5.4.3 Proposed further assessment

Throughout the environmental assessment process, opportunities to avoid, minimise and / or offset impacts to areas of ecological value would be investigated, where reasonable.

A biodiversity assessment would be prepared as part of the environmental impact statement for the project following the *Framework for Biodiversity Assessment* (OEH, 2014), the *Fisheries NSW policy and guideline for fish habitat conservation and management (Update 2013)* (DPI, 2013), the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (NSW Office of Water, 2012) and if required, the *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014).

5.4.4 Management and safeguard measures

As well as implementing standard management and safeguard measures, project specific measures recommended within the biodiversity assessment prepared for the project would be implemented. These would include measures to minimise the impacts of the project on flora and fauna, in particular, threatened species, populations and communities, and critical habitat.

5.5 Greenhouse gas

5.5.1 Overview

The transport sector contributes around 17 per cent of Australia's total greenhouse gas emissions (Department of the Environment, 2015). Around 90 per cent of these emissions are considered to be attributed to the combustion of fuel for road transport (Climate Change Authority, 2014; Maddocks et al., 2010). Reducing the contribution of emissions from road transport would therefore have a significant impact on emissions reduction for the transport sector, and for Australia's overall emissions profile.

In NSW there are a number of policies which aim to reduce GHG emissions, including the NSW Energy Efficiency Action Plan (OEH, 2013b) and NSW Government Resource Efficiency Policy (OEH, 2014e). In addition, the NSW Long Term transport Master Plan (Transport for NSW, 2012a) includes an objective to 'Improve sustainability – by maintaining and optimizing the use of the transport network, easing congestion, growing the proportion of travel by sustainable modes such as public transport, walking and cycling, and becoming more energy efficient.'

Emissions of greenhouse gas emissions sources can be categorised into three different scopes (1, 2 or 3) in accordance with the World Business Council for Sustainable Development and World Resources Institute Greenhouse Gas Protocol (2005), and the Australian Government greenhouse gas accounting and reporting systems. Specifically:

- Scope 1 emissions, also referred to as direct emissions are emissions generated by sources owned or controlled by the project, such as the use of diesel fuel in project-owned construction plant, equipment or vehicles and the clearing of vegetation
- Scope 2 emissions, also referred to as indirect emissions are emissions generated from the consumption of purchased electricity in project-owned or controlled equipment or operations. These emissions are generated outside the project's boundaries, for example, the electricity used to power tunnel ventilation systems and lights
- Scope 3 emissions, also referred to as indirect upstream/downstream emissions, includes emissions generated in the wider economy due to third party supply chains and road users as a consequence of activity within the boundary of the project, for example GHG emissions associated with the mining, production and transport of materials used in construction.

5.5.2 Potential impacts

Construction

The construction of the project would contribute to greenhouse gas emissions, either directly or indirectly, as a result of:

- Fuel consumption for transporting materials to site and the operation of construction plant and site vehicles
- Spoil and waste removal
- Vegetation clearance
- Electricity used to power construction plant and site offices
- Indirect GHG emissions such as through embodied energy of construction materials
- Decomposition of waste.

Operation

The key sources of greenhouse gas emissions during the operation of the project would include:

- Fuel consumed by vehicles travelling along the project route (operational road use)
- Road maintenance activities (fuel and materials)
- Electricity used to power tunnel systems (such as tunnel ventilation, computer systems and lighting).

Key contributors to operational emissions are likely to be operational road use and mechanical tunnel ventilation systems. Energy consumption by tunnel ventilation systems can be reduced by good road design and efficient ventilation design. The air quality approach for the project, and the selected ventilation infrastructure, would be a key component of determining the energy consumption for the project.

There is likely to be some offset of total emissions due to increase vehicle fuel efficiency within the road network.

5.5.3 Proposed further assessment

A greenhouse gas assessment would be conducted for the construction and operation of the project in accordance with the following:

- *Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard* (World Council for Sustainable Business Development and World Resources Institute, 2005)
- *National Greenhouse and Energy Reporting Act 2007* (Clth)
- *AS/ISO 14064.1:2006 Greenhouse Gas Part 1: Specification with guidance at the organisational level for quantification and reporting of greenhouse gas emissions and removals*
- The current Australian National Greenhouse Accounts: National Greenhouse Accounts Factors (NGA Factors) (Department of the Environment, 2015)
- Greenhouse Gas Assessment Workbook for Road Projects (the TAGG Workbook) (Transport Authorities Greenhouse Group (TAGG), 2013).

It is anticipated that the greenhouse gas assessment would:

- Identify the assessment boundary and sources of greenhouse gas emissions associated with the construction, operation and maintenance of the project
- Determine the quantity of each emissions source (such as fuel consumed, electricity, and construction materials) in line with the TAGG workbook
- Quantify the greenhouse gas emissions associated with each greenhouse gas source using equations specified in the NGA Factors and the TAGG Workbook
- Present the greenhouse gas emissions associated with the construction, operation and maintenance of the project
- Identify opportunities (mitigation measures) which may be implemented to reduce greenhouse gas emissions associated with the project.

The design of the project would be prepared with consideration of the WestConnex sustainability strategy that has been developed for the overall program of works. This Strategy identifies targets and initiatives for reducing greenhouse gas emissions among other sustainability initiatives (see **Section 5.10**).

5.5.4 Management and safeguard measures

Greenhouse gas and climate change issues are commonly encountered on road projects and can be managed and mitigated through the implementation of standard approaches. Standard management and safeguard measures have been identified below, which would be considered through the design development process for the preferred project design and identified as appropriate in the Environmental Impact Statement for the project. These may include:

- Consideration of the preferential selection of materials, vehicles and construction equipment with characteristics such as lower embodied energy and greater fuel efficiency, where feasible
- Construction plant and equipment would be maintained to reduce energy efficiency losses associated with damaged or unmaintained equipment
- Construction transport requirements would be reduced wherever reasonably possible, for example through use of local staff, resources, suppliers, and landfills
- Vegetation clearance would be minimised wherever reasonably possible
- Reductions in operational emissions would be achieved by developing an optimal design, including the vertical and horizontal alignments and reduction of stop start driving. These reductions would be cumulative over the design life of the project. Energy efficient ventilation and lighting system designs would also be key areas of consideration for achieving optimal energy efficiency outcomes during the operational phase.

5.6 Aboriginal heritage

5.6.1 Overview

The project corridor is located within the traditional country of the Darug (also spelt Dharuk, Dharruk, Dharug and Daruk) language group. Darug territory extended from the Hawkesbury River in the north, to Appin in the south, and west into the Blue Mountains, an area which incorporates some of the oldest archaeological sites in the Sydney region (Attenbrow 2010: 18-19).

As to the names and distribution of clans across the Sydney region, very little information on this subject exists. Nonetheless, available ethnohistoric data suggest the presence of numerous clans across Sydney, each of which distinguished itself from its neighbours by way of unique weapon/tool and body designs/decorations and, in some instances, hair styles as well (Attenbrow 2002: 2, 2010: 22-29). Named clans for the portion of the Port Jackson catchment east of the junction of the Parramatta and Lane Cove Rivers include the Gadigal, Gamaragal, Borogegal and Gayamaygal.

The Aboriginal archaeological record of Port Jackson's coastal zone – defined here as all land east of Parramatta, south of Broken Bay and north of Botany Bay – is well-researched, with formal investigations of this record having been undertaken since the late 19th century (e.g. David and Etheridge 1889a, 1989b, Etheridge and Whitelegge 1907). Recent decades, in particular, have witnessed a dramatic increase in the number of Aboriginal archaeological investigations undertaken in this zone, both in developer-funded and academic research contexts (Attenbrow 2010). Middens and rock shelter sites are particularly well represented in this zone, with the latter incorporating a variety of evidence of past Aboriginal activities including food preparation and consumption, organic and non-organic tool manufacture and maintenance, the production of rock art and the burial of the dead (Attenbrow 2010; Donlan 1995; McDonald 2008). However, a variety of other site types (e.g. grinding groove and rock engraving sites, open artefact sites) are also known.

Since early European settlement, the project corridor has been subject to significant disturbance from agricultural uses, residential, industrial and various infrastructure uses (such as utility infrastructure, roads and port development).

A search of the Aboriginal Heritage Information Management System (AHIMS) database was undertaken in December 2015 to identify previously recorded sites within and surrounding the project corridor (refer to **Figure 5-3**). A total of eight sites were identified within 500 metres of the project corridor comprising three open artefact sites (isolated artefacts and artefact scatters), two areas of Potential Archaeological Deposit (PAD), one midden, one art site and one resource and gathering site. Of these, none are recorded as being located directly within the project corridor with the closest being Aboriginal midden site #45-6-2278 located 70 metres from the corridor. The sites are identified in **Table 5-4**.

Data provided by the Office of Environment and Heritage (OEH) consists of a centroid coordinate for each registered site. The coordinate data held in the AHIMS register is known to contain coordinate errors, meaning that this data should be considered as a guide only until confirmed by field inspection.

Table 5-4 AHIMS sites located within 500 metres of the project corridor

AHIMS ID	Description	Approximate distance from project corridor
45-6-2278	Midden	70 metres
45-6-2676	Art	210 metres
45-6-2745	PAD	170 metres
45-6-2767	Resource and gathering site	250 metres
45-6-0751	Open artefact site	330 metres
45-6-2680	PAD	490 metres
45-6-2629	Open artefact site	430 metres
45-6-2822	Open artefact site	380 metres

5.6.2 Potential impacts

Construction

Direct or indirect impacts on previously recorded AHIMS sites are not anticipated given the review undertaken did not identify any registered sites within the project corridor. However, there is potential for previously unrecorded Aboriginal sites to be identified and impacted by the project as a result of excavation at surface work locations, particularly in areas of archaeological sensitivity such as tidal estuarine foreshore zones and former tributaries of Port Jackson.

The risk of impacts to Aboriginal sites is likely to be low given that most of the project would be located greater than 20 metres below ground. This risk is further mitigated by the disturbed and highly urbanised environment along most of the project corridor.

Operation

The project would be designed and constructed to minimise the potential for direct and indirect impacts on the known Aboriginal heritage sites, therefore potential direct or indirect impacts on Aboriginal sites are not anticipated during operation. The potential impact on Aboriginal heritage and identification of management measures would be determined during the preparation of the environmental impact statement.

5.6.3 Proposed further assessment

An Aboriginal cultural heritage assessment report would be prepared for the project, including completion of at least stage 2 of the Roads and Maritime *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI) (Roads and Maritime, 2011). The Aboriginal cultural heritage assessment report would include but not be limited to:

- An archaeological survey of the project area to identify known and potential Aboriginal objects, places and cultural values
- A review of relevant plans or diagrams showing the location of the project in relation to known and potential Aboriginal objects, places or cultural values
- An assessment of significance of known and potential Aboriginal objects, places and cultural values
- An assessment of known and potential impacts to Aboriginal objects, places and cultural values resulting from the construction and implementation of the project
- If advancing to Stage 3 of the PACHCI, consultation with the Aboriginal community in accordance with that guideline. If advancing to Stage 3, consultation with the Aboriginal community would occur in accordance with the Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010a)
- Identification of mitigation measures required to minimise impacts of the project on Aboriginal cultural heritage.

The Aboriginal cultural heritage assessment report would be prepared in accordance with the following policy documents and heritage guidelines:

- The PACHCI
- *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW, 2010a)
- *Code of practice for archaeological investigation of Aboriginal Objects in NSW* (DECCW, 2010b).

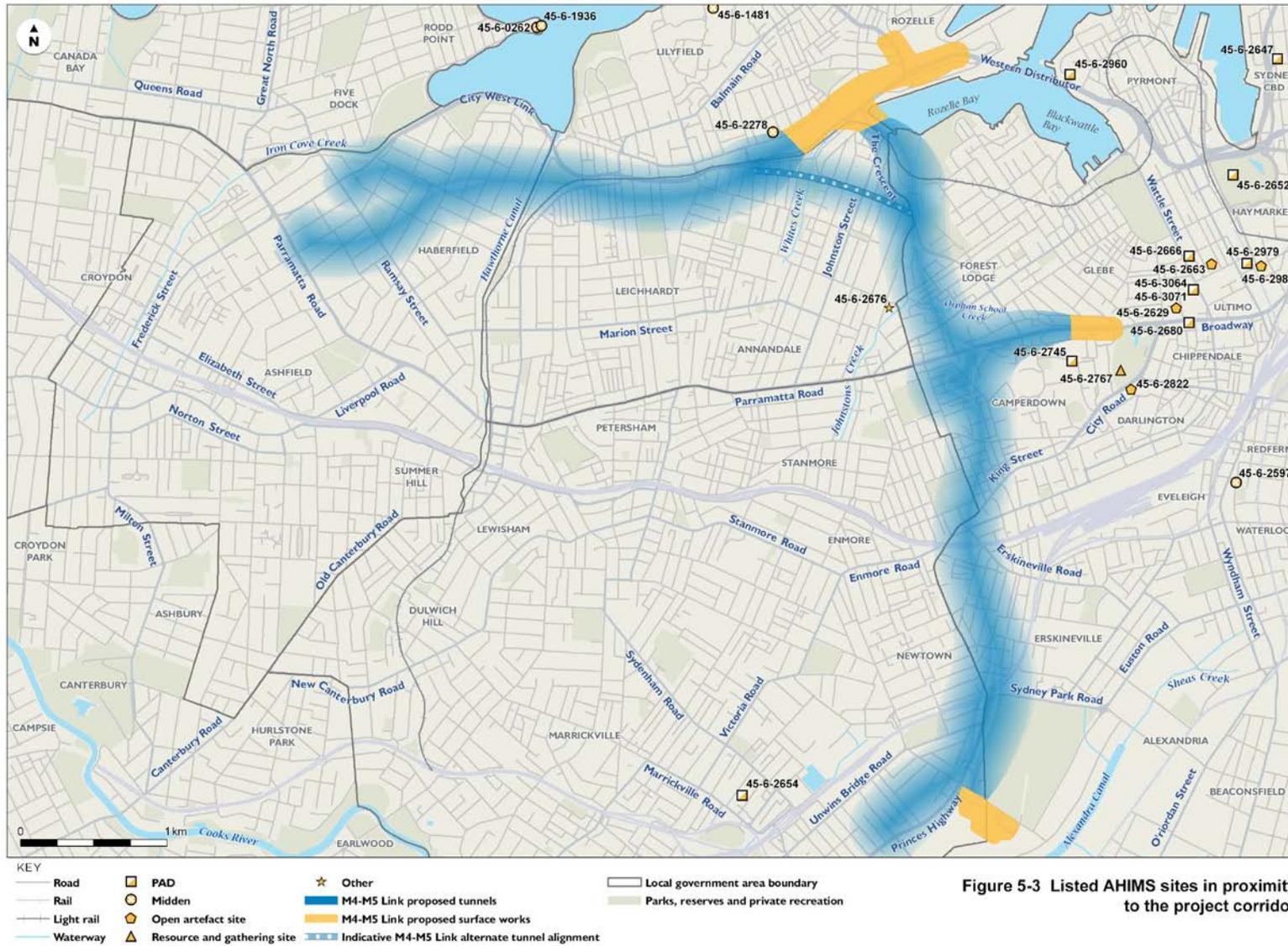


Figure 5-3 Listed AHIMS sites in proximity to the project corridor

Figure 5-3 Listed AHIMS sites in proximity to the project corridor

5.6.4 Management and safeguard measures

Standard management and safeguard measures would be considered through the design development process for the preferred project design and preparation of the Environmental Impact Statement including the implementation of stop works and referral procedures in the event of unexpected finds of Aboriginal heritage items.

5.7 Climate change risk and adaptation

An increase in the global concentration of greenhouse gases has led to an increase in the Earth's average surface temperature, contributing to the phenomenon of climate change. In 2015, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Australian Bureau of Meteorology (BoM) released an assessment of observed climate change and projected future changes in Australia over the 21st century (CSIRO and BoM, 2015a). This recent assessment confirms the long term warming trend, showing that in Australia, the average surface air temperature has increased by 0.9°C since records began in 1910, with most of the warming occurring since 1950. Australia's warmest year since 1910 was in 2013 (CSIRO and BoM, 2015a).

The *Fifth Assessment Report (AR5)* produced by the Intergovernmental Panel on Climate Change (IPCC) states with high confidence that Australia is already experiencing impacts from recent climate change. Observed trends include changes in the frequency of air temperature extremes, changes in mean and extreme rainfall, changes in the frequency and intensity of storm events, ocean warming, ocean acidification and sea level rise.

Certain current and predicted climate events and trends pose a risk to road infrastructure, by way of physical damage, accelerated deterioration of assets and reduced network capacity and road safety (Maddocks et al, 2010). As a result it is important to understand the most likely and 'worst case' implications of climate change on high-value infrastructure, such as the project.

The physical implications of climate change on major road infrastructure projects, such as roads and highways, are typically considered during the design and environmental assessment process for such projects.

In 2015 CSIRO and BoM published updated climate projections for Australia, adopting new global greenhouse gas emissions scenarios developed by the IPCC for the AR5. The ensemble of projections are spatially broken down into eight natural resource management 'clusters', which largely correspond to broad-scale climate and biophysical regions of Australia. The project falls within the East Coast Cluster which forms the central part of the eastern seaboard of Australia. Key projections for the East Coast Cluster for 2090 under a high emissions scenario include (BoM and CSIRO (2015b)):

- Higher average surface temperatures. The magnitude of projected increases ranges from 1.5–2.5 degrees Celsius by 2090
- Increase in the frequency and intensity of extreme heat events. The number of days per year over 35 degrees Celsius and 40 degrees Celsius is projected to increase by six days and 0.9 days respectively by 2090
- Decline in mean annual rainfall by at least 15 per cent by 2090
- Increase in the frequency and intensity of extreme rainfall events by between 10 per cent and 30 per cent by 2090
- Continued sea level rise. The sea level is projected to increase by 0.44 metres and 0.88 metres by 2090.

5.7.1 Potential impacts

Construction

The potential impacts of climate change would be negligible during the construction phase due to its relatively short timeframe.

Operation

Road networks and infrastructure assets are exposed and vulnerable to climate change because of their long design life, during which many impacts of climate change are likely to become more significant.

The key climate change risks to road projects are associated with changes in the intensity and frequency of extreme rainfall events which may typically result in the following:

- Increased potential for localised flooding impacting on road infrastructure and potential increases in road maintenance activities and costs
- Increased risk of road closures
- Drainage and stormwater impacts
- Erosion impacts, resulting in sediment loss from the site
- Watercourse impacts, including changes to channel structure and other characteristics resulting from changes in hydrological conditions
- Landslips.

In coastal regions road projects are also vulnerable to sea level rise which will worsen damage from coastal erosion, storm surge and coastal flooding and may even eventually lead to long-term inundation and loss of land.

Risks to infrastructure associated with climate change may also generate knock-on effects or additional risks such as (Maddocks et al, 2010):

- Risks to road user health and safety
- Interruption or delays to commuter travel
- Interruption or delays to commercial activities that depend on road transport
- Increased maintenance and replacement costs
- Increased liability resulting from damage to road infrastructure
- Higher insurance costs for road authorities.

5.7.2 Proposed further assessment

A climate change risk assessment for the project would be undertaken in accordance with the Roads and Maritime Technical Guide for Climate Change Adaptation for the State Road Network (Roads and Maritime Unpublished, 2015c). The assessment would include:

- Identification of key climate variables such as temperature, rainfall and extreme events
- Identification of potential climate change scenarios, based on the latest and relevant climate projections that broadly identify how each climate variable may change over the design life of the project
- Identification of climate-based risks that may impact on the project as a result of climate change
- An assessment of potential impacts of priority climate change risks based on the consequence and likelihood of each risk
- Recommendation of adaptation options to mitigate climate risks.

5.7.3 Management and safeguard measures

Construction of the project would aim to minimise greenhouse gas emissions, largely through:

- Regularly maintaining construction plant and equipment to reduce energy efficiency losses associated with damaged or unmaintained equipment.
- Reduce construction transport requirements wherever reasonably possible, for example through use of local staff, resources, suppliers, and landfills.

The management of risks associated with the impacts of climate change on the operation and maintenance of the project would be through undertaking a climate change risk assessment as described in **Section 5.7.2** and discussion with project design project engineers to adequately design and plan for predicted changes in climatic conditions.

Safeguards and management measures to minimise the emission of greenhouse gases associated with the operation and maintenance of the project would include:

- Consideration of the preferential selection of materials, vehicles and construction equipment with characteristics such as lower embodied energy and greater fuel efficiency, where feasible.
- The minimisation of vegetation clearance where reasonably possible.
- Development of an optimal design, including the vertical and horizontal alignments and reduction of stop start driving. These reductions would be cumulative over the design life of the project.

5.8 Hazards and risk

5.8.1 Overview

Hazard and risk impacts associated with the project have the potential to affect the surrounding environment and human health.

Potential impacts are likely to arise during the construction and operation of the project. Impacts are likely to evolve predominantly from the use of the tunnelling system. These potential impacts may involve leakage, spillage and accidental release from the incorrect handling or storage of hazardous materials.

Potential impacts arising from the operation phase would involve tunnel air quality and vehicle and personal safety.

Sydney Airport is located to the south-west of the project corridor. The *Airports (Protection of Airspace) Regulations 1996* (Commonwealth) (Airspace Regulations), was established to protect airspace at and around regulated airports in Australia, including Sydney Airport. The Airspace Regulations define the 'prescribed airspace' for Sydney Airport as the airspace above any part of either the obstacle limitation surface (OLS) or procedures for air navigation services – aircraft operations surfaces for the airport (PAN-OPS). OLS is an invisible level that defines the limits to which objects may project into the airspace around an aerodrome so that aircraft operations may be conducted safely. PAN-OPS protection surfaces are imaginary 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) so that aircraft operations may be conducted safely.

Under the *Airports Act 1996* (Commonwealth), 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 Commonwealth Department of Infrastructure and Regional Development or is otherwise exempt under the Airspace Regulations. Controlled activities include (depending on the precise event or occurrence):

- The construction of buildings and structures that intrude into prescribed airspace
- Artificial light sources that exceed specified intensity levels
- Activities that result in air turbulence that exceed specified levels
- Activities that involve the emission of smoke, dust, other particulate matter, steam or other gas that exceed specified levels.

With respect to emissions, the Civil Aviation Safety Authority prohibits discharge of emissions at a velocity of 4.3 metres per second at the PAN-OPS protection surfaces.

5.8.2 Potential impacts

Construction

Potential impacts associated with the construction of the project may include:

- Environment and human health risks associated with the accidental release of hazardous materials due to improper handling or storage, or in the event of a traffic accident resulting in the release of hazardous material. All hazardous substances that may be required for construction would be stored and managed in accordance with the *Work Health and Safety Act 2011* and the *Storage and Handling of Dangerous Goods Code of Practice* (WorkCover NSW, 2005)
- There would also be the potential for the rupture or interference with underground services during construction
- Occupational health and safety hazards, such as dangers to construction workers, road users and the general public may also occur during construction. This could include tunnel collapse or flooding and inundation during construction. Such risks would be managed through the implementation of an occupational health and safety plan and other management plans (such as construction traffic and an incident response plan)
- Aviation hazards, associated with construction activities (e.g. cranes) that intrude into the OLS or construction lighting that exceeds specified levels. Such risks would be managed so that structures do not intrude the OLS, and that construction lighting would adhere to the established guidelines on the location and permitted intensities of ground lights within a six kilometre radius of Sydney Airport.

Operation

Potential impacts associated with the operation of the project may include:

- Environment and human health risks associated with the accidental release of hazardous materials in the event of a traffic accident resulting in the release of hazardous material
- Spills or leaks from minor vehicle accidents
- Large fires or explosions from major vehicle accidents
- Tunnel collapse or subsidence
- Flooding and inundation during operation
- Potential aviation hazards.

Contaminants associated with either a spill, fire suppression (including deluge system) or clean up would be contained and treated by the tunnel drainage system. At interchanges, contaminants have the potential to enter the environment from paved or unpaved surfaces. Water quality treatment measures would reduce the risk of contaminants discharging to the receiving environment.

The project would involve the construction and operation of ventilation facilities at Rozelle, Camperdown and St Peters. Emissions from these ventilation facilities may have the potential to penetrate the obstacle limitation surface and the PAN-OPS, and as such, the design of these facilities would need to consider these constraints so that emissions do not intrude into the PAN-OPS at a velocity of 4.3 metres per second at a minimum. Physical structures would be designed to not protrude into the OLS.

5.8.3 Proposed further assessment

Hazards and risks would be considered in the environmental impact statement. As part of this, a screening of dangerous goods and hazardous materials against the *Applying SEPP 33: Hazardous and Offensive Development Application Guidelines* (Department of Planning, 2011) thresholds would be undertaken. Design features of the project to manage risk and hazards during the operational stage of the project would also be outlined within the environmental impact statement, which would include an assessment of the potential hazards associated with chemicals associated with clean-up activities or deluge systems.

The requirements of the *Airports Act 1996* (Commonwealth) and the Airport Regulations will be considered during design development. This would be supported by a plume rise assessment for the ventilation structures. The Civil Aviation Safety Authority would be consulted on the outcomes of this assessment to determine whether or not the project would be deemed a controlled activity under the *Airports Act 1996* (Commonwealth). Any approval under that Act, if required, would be sought separate to the approvals required under State legislation.

5.8.4 Management and safeguard measures

To ensure the continued management of hazards and risks during the operation of the project, standard mitigation strategies would be implemented such as:

- Prohibition of dangerous goods within the project.
- Tunnel monitoring equipment to observe traffic conditions within the tunnel.
- Fire protection systems, which would include a fire suppression and firefighting system and would allow egress for pedestrians and access for emergency services.
- The ventilation system would be designed to ensure conditions are provided for the safe egress of passengers and to vent smoke in the event of a fire.
- Visual and audible communications systems would be used to also communicate incidents to motorists within and outside the tunnel.
- An Incident Response Plan to respond to accidents or spills.
- Appropriate design criteria for portal flood immunity and drainage infrastructure capacities.

5.9 Cumulative impacts

5.9.1 Overview

A cumulative impact refers to the result of the impact of an action coinciding or interacting with other impacts during the same time period and in the same area. Cumulative impacts are likely to have an effect on the following areas:

- Traffic and transport
- Air quality and human health
- Noise and vibration
- Property and land use
- Visual amenity
- Social and economic
- Flooding and drainage
- Soils and water quality
- Groundwater
- Non-Aboriginal heritage
- Biodiversity
- Greenhouse gas
- Aboriginal heritage
- Resource use.

A desktop assessment has identified developments which have the potential to interact with the project. It is likely the majority of cumulative impacts would take place during the construction of the project which is expected to take place between 2019 and 2023.

5.9.2 Potential impacts

Key developments that are expected to interact with the project include:

- WestConnex Stage 1 M4 (Parramatta to Haberfield). This includes the M4 Widening between Pitt Street and Homebush Bay Drive, and M4 East between Homebush Bay Drive to Parramatta Road and Haberfield. The construction of M4 Widening commenced in March 2015 and is expected to be operational in 2016.

If the proposed M4 East is approved, major works to construct the M4 East are planned to start in mid-2016. The proposed M4 East is intended to connect to this project in tunnel at Haberfield and some infrastructure for the project would be built as part of the proposed M4 East, including tunnel stubs, on- and off-ramps at Wattle street, and a ventilation facility. There may be cumulative impacts associated with traffic and/or noise during construction and operation at the surface. However, the construction of elements as part of the proposed M4 East is intended to minimise cumulative impacts on the community at this location. Further, the project would be commencing construction near the completion of the proposed M4 East construction period.

- WestConnex New M5 (Beverley Hills to St Peters). Stage 2 will run from the existing M5 corridor at Beverley Hills via tunnel to an interchange at St Peters. The southern end of project would connect to the proposed New M5 at the St Peters interchange (if approved). There is the potential for cumulative traffic and noise impacts on the community at the St Peters interchange. However, the construction of elements as part of the proposed New M5 is intended to minimise cumulative impacts on the community at this location. Further, the project would be commencing construction near the completion of the proposed New M5 construction period (if approved).
- Sydney Gateway and other associated ground transport improvements identified by Sydney Airport Corporation within its *Sydney Airport Master Plan 2033* (SACL, 2014). Depending on the approval and scheduling of these works, this could result in cumulative construction traffic and construction noise impacts on the surrounding community. In the long term, these projects are expected to assist in improving traffic flows to/from WestConnex and the connections to employment areas in the Sydney Airport and Port Botany area. Sydney Gateway would link to the project as well as proposed M4 East through the St Peters interchange.
- WestConnex enabling works around the Sydney Airport. This project involves upgrades to roads around Sydney Airport, including widening Marsh Street to three lanes in each direction, widening Joyce Drive to six lanes, minor works and line marking to provide for six lanes along General Holmes Drive, a new underpass beneath Wentworth Avenue and associated works, minor upgrades to Mill Pond Road, and upgrades to bus, bicycle and pedestrian infrastructure. Upgrade works to O'Riordan Street are also proposed. Works in the Airport East Precinct commenced construction in late 2015, while upgrades in the Airport West and North Precincts are still in planning and approval phases.
- Other Sydney Airport projects. The *Sydney Airport Master Plan 2033* (SACL, 2014) identifies a number of construction activities associated with its aprons, airfield and terminals over the next 19 years, including works within the first five years and 10 year periods. Depending on the scheduling of these works, this could result in cumulative construction traffic and construction noise impacts on the surrounding community. In the long term, WestConnex would deliver capacity to cater for increased traffic demand associated with growth at Sydney Airport.
- 'Southern Extension'. The planning and assessment process is in its early stages, there is the potential that there may be some concurrent construction of the project and Southern Extension, should this project proceed.
- The Western Harbour Tunnel and Beaches Link. The planning and assessment process is in its early stages, there is the potential that there may be some concurrent construction of the project and Western Harbour Tunnel and Beaches Link, should this project proceed.
- The Sydney Metro project, being delivered by Transport for NSW, this project involves 65 kilometres of a new stand-alone railway network from Rouse Hill to Bankstown. The proposed alignment for Stage 2 of the Sydney Metro includes a section of tunnel which is located within the project corridor. The design of the M4-M5 tunnels would need to take into consideration the design of the Sydney Metro tunnels to avoid tunnel corridor and structural conflicts. Further, the proposed Sydney Metro construction sites include a dive site to launch the tunnel boring machines at Marrickville, north of Sydenham Station and south of Bedwin Road. This dive site is less than 500 metres from the project corridor which could result in conflicts or cumulative impacts.

- The Bays Precinct Transformation Proposed redevelopment at Rozelle Bay includes the transformation of Rozelle Rail Yards which are located within the project corridor at the site of Rozelle interchange. Residential and employment areas and public spaces have been identified as potential future uses of Rail Yards, with works planned to commence around 2022 and beyond.
- CBD and South East Light Rail. This project involves a new light rail line extending from Circular Quay along George Street to Central Station, through Surry Hills to Moore Park, then to Kensington and Kingsford via Anzac Parade and Randwick via Alison Road and High Street. The project includes a maintenance depot in the Rozelle Rail Yards which is located in the project corridor. The project received planning approval in June 2014.

There are also local large scale projects, such as Green Square, which may also have cumulative localised impacts.

Operation of the WestConnex program of works in conjunction with other transport infrastructure projects such as the wider WestConnex program of works and the potential future Southern Access Motorway would produce a number of operational benefits, namely:

- Improved travel efficiency and reliability
- Enhanced economic productivity
- Improved road safety and road surface conditions, leading to improved liveability through public and active transport
- Improvements to air quality by removing traffic from surface roads into a suitably designed ventilated tunnel
- Improvements to local amenity, particularly through improved traffic conditions, air quality and noise and vibration.

Construction

Concurrent or consecutive construction of the project with one or a number of the abovementioned projects has the potential to result in some adverse cumulative construction impacts for sensitive receivers. Cumulative impacts would be largely related to air quality, noise and vibration and traffic and transport. The majority of cumulative construction impacts, should they occur, would be concentrated to areas where the projects have an overlapping impact on sensitive receivers, for example at the future tie in point of the project with the proposed M4 East and New M5 (if approved).

Operation

Operation of the project simultaneously with other large road infrastructure projects and residential developments has the potential to generate cumulative impacts. Such cumulative impacts would be localised and would be largely related to amenity impacts on local residents, the local community and users of recreational areas within and in the vicinity of the project corridor. This may potentially include impacts to local traffic conditions, noise and vibration, air quality and human health, social and economic impacts as well as impacts to visual amenity. Cumulative groundwater impacts may also occur and would need to be investigated further as part of the environmental impact statement.

5.9.3 Proposed further assessment

Project-specific assessments that would be completed for the project would consider the potential for cumulative impacts, including the potential cumulative impacts associated with the completed WestConnex program of works. The environmental impact statement would consider the interrelationships between the project, the wider WestConnex program of works and other major developments, understand the potential cumulative impacts associated with these interactions and establish mitigation strategies.

5.9.4 Management and safeguard measures

The mitigation and management of cumulative impacts associated with the WestConnex program of works would be overseen and managed by the Sydney Motorway Corporation and Roads and Maritime. The cumulative impact resulting from other major developments would be dependent on the scheduling of those developments in the context of this project. Mitigation and management measures would be detailed in the Construction Environmental Management Plan, and through coordination between the relevant construction contractors (if required).

5.10 Sustainability

5.10.1 Overview

The World Commission on Environment and Development report *Our Common Future* (Brundtland, 1987) identifies sustainable development as being ‘development which meets the needs of the present, without compromising the ability of future generations to meet their own needs’. Although this early definition of sustainable development is succinct, the concept of sustainable development is actually dynamic; changing in response to the limitations imposed on environmental resources at any time as a result of technology, social organisation and by the ability of the biosphere to absorb the effects of human activities.

The provision of properly functioning infrastructure is essential for sustained economic growth, international competitiveness, public health and overall quality of life (Mirza, 2006). The Infrastructure Sustainability Council of Australia (ISCA) defines sustainable infrastructure as that which is designed, constructed and operated to optimise environmental, social and economic outcomes over the long term (ISCA, 2012).

The WestConnex Sustainability Strategy (the Sustainability Strategy) (WestConnex Delivery Authority, 2015) describes how sustainability initiatives will be integrated into the design, construction and operation of projects across the WestConnex program of works. The Sustainability Strategy outlines a sustainability vision, commitments, guiding principles, objectives and overarching targets across a range of sustainability themes, and was prepared to align with the Transport for NSW Sustainability Framework as well as other relevant Government sustainability instruments such as the NSW Government Resource Efficiency Policy (OEH, 2014d) and the NSW Waste Avoidance and Resource Recovery Strategy 2014-21 (EPA, 2014).

Due to the large scale of the WestConnex program of works, and by virtue of the fact that it will be delivered in discrete stages over several years, the Sustainability Strategy aims to ensure that sustainability is consistently applied across all projects and teams.

The Sustainability Strategy provides a framework to implement sustainability objectives and targets through the project’s contract requirements, competitive tender evaluation process and project specific Sustainability Management Plans during the design and construction stage. The Sustainability Strategy also shows the relationship between the sustainability vision, commitments, guiding principles and broader NSW Government sustainability instruments.

The project would achieve an Infrastructure Sustainability rating of ‘Excellent’ for the design and construction phases of the project. The Sustainability Strategy has been prepared to guide the implementation of sustainability across the WestConnex program of works and to facilitate the ISCA rating process. The IS rating scheme was developed and is administered by ISCA. The IS rating scheme is a comprehensive rating system for evaluating sustainability across the design, construction and operation of infrastructure.

5.10.2 Potential impacts

Construction

During the construction phase, key issues to address in terms of sustainability would include;

- Resource consumption of fuel, water and materials for construction
- Scope 1, 2 and 3 greenhouse gas emissions generated during construction (see **Section 5.5.1**)
- Generation of waste (including that produced by the project and by construction workers)
- Waste arising from potential contaminated lands
- Sustainable procurement – whole of life environmental, social and economic considerations.

Strategies for addressing the above are included within the Sustainability Strategy and include the use of recycled products to reduce the demand on resources, in instances where the use of such materials is cost and performance competitive. This may include the use of fly ash and slag within concrete mixes. Wherever possible, resource recovery principles would also be applied to the construction of the project, including recovery of resources for reuse, recycling and reprocessing.

Operation

Issues to address in terms of sustainability during the operation phase would include;

- Resource consumption of fuel, water and materials for maintenance activities

- Scope 1, 2 and 3 greenhouse gas emissions generated during operation, particularly as a result of energy use to power operational systems such as ventilation, lighting etc
- Sustainable procurement – whole of life environmental, social and economic considerations
- Climate change mitigation and adaptation
- Strategies for addressing the above are included within the Sustainability Strategy and would be addressed through the design of the project.

5.10.3 Proposed further assessment

During detailed design, a project-specific Sustainability Management Plan would be prepared to guide the implementation of sustainability throughout the design and construction phases, and to facilitate the achievement of the ISCA rating.

5.10.4 Management and safeguard measures

Management measures developed to mitigate environmental impacts would consider and be consistent with the Sustainability Strategy.

6 Conclusion

Roads and Maritime is seeking approval to construct and operate the M4-M5 Link (the project); which would comprise a new, tolled multi-lane road link between the proposed M4 East at Haberfield and New M5 at the St Peters interchange. The project would also include interchanges at Rozelle and Camperdown.

The project would span four local government areas including: Ashfield, Leichhardt, Marrickville and Sydney.

The project is one component of the WestConnex program of works. WestConnex is a 33 kilometre motorway that is intended to link Sydney's west with the airport and the Port Botany precinct. The WestConnex program of works is proposed to be delivered as a series of projects, each of which would be subject to a stand-alone planning assessment and approvals process in accordance with the requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and other relevant legislation.

Roads and Maritime has formed the opinion that the project is likely to significantly affect the environment. Roads and Maritime is the proponent and a determining authority for the project. Accordingly, the project is State significant infrastructure under Part 5.1 of the EP&A Act. Approval from the Minister for Planning is required for the project.

The potential impacts of the project and their associated environmental, social and economic consequences have been identified through a preliminary risk assessment and preliminary investigations. This indicates there are key environmental issues that will require further assessment and may require project specific safeguards and management measures.

The key environmental issues identified for the project include:

- Traffic and transport
- Air quality and human health
- Noise and vibration
- Property and land use
- Urban design and visual amenity
- Soil and water quality
- Flooding and drainage
- Groundwater
- Resource management and waste minimisation

The environmental impact statement will include the following:

- A detailed description of the project including its components, construction activities and potential staging
- A comprehensive assessment of the potential impacts on the key issues including a description of the existing environment, assessment of potential direct and indirect and construction, operation and staging impacts
- Description of measures to be implemented to avoid, minimise, managed, mitigate, offset and/or monitor the potential impacts
- Identify and address issues raised by stakeholders.

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Appendix A Requirements of the Environmental Planning and Assessment Regulation

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Clause 192 of the *Environmental Planning and Assessment Regulation 2000* requires that an application for approval of the Minister to carry out State Significant Infrastructure must include:

- a) Details of any approvals that would, but for section 115ZG of the *Environmental Planning and Assessment Act 1979* (EP&A Act), be required for carrying out of the State Significant Infrastructure, and
- b) Details of any authorisations that must be given under section 115ZH of the EP&A is the application is approved, and
- c) A statement as to the basis on which the proposed infrastructure is State Significant Infrastructure including, if relevant, the capital investment value of the proposed infrastructure.

Approvals that would otherwise apply

Approvals that may be required to carry out the project, if not for section 115ZG of the EP&A Act include:

- A permit under section 201, 205 or 219 of the *Fisheries Management Act 1994*.
- An approval under Part 4, or an excavation permit under section 139, of the *Heritage Act 1977*.
- An Aboriginal heritage impact permit under section 90 of the *National Parks and Wildlife Act 1974*.

A water use approval under section 89, a water management work approval under section 90 or an activity approval under section 91 of the *Water Management Act 2000*. Section 115ZG does not remove the need to obtain an aquifer interference approval under the *Water Management Act 2000*, if that were to be otherwise required.

Authorisations if the application is approved

Authorisations that may be required for the project under section 115ZH of the EP&A Act include:

- An environment protection licence under Chapter 3 of the *Protection of the Environment Operations Act 1997*.
- Consent under section 138 of the *Roads Act 1993* (if required).

State significant infrastructure application

Clause 14(1) of the *State Environmental Planning Policy (State and Regional Development) 2011* provides that development is declared, pursuant to 115U (2) of the EP&A Act, to be State significant infrastructure for the purposes of the Act if:

- The development on the land concerned is, by the operation of a State Environmental Planning Policy, permissible without consent under Part 4 of the EP&A Act, and
- The development is specified in Schedule 3.

Clause 94 of the *State Environment Planning Policy (Infrastructure) 2007* (ISEPP) permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent. As the project is for a road and road infrastructure facilities, and is to be carried out by or on behalf of Roads and Maritime, the project is permissible without development consent under Part 4 of the EP&A Act.

Clause 1(1) of Schedule 3 of the *State Environmental Planning Policy (State and Regional Development) 2011* identifies as SSI, general public authority activities for infrastructure or other development (but for Part 5.1 of the Act and within meaning of Part 5 of the Act) would be an activity for which the proponent is also the determining authority and would, in the opinion of the proponent require an environmental impact statement to be obtained under Part 5 of the Act.

Roads and Maritime, as the proponent, has formed the view that the impact of the project is likely to significantly affect the environment. On this basis, the project is declared to be State significant infrastructure (SSI) under section 115U (2) of the EP&A Act by reason of the operation of clause 14 and clause 1 of Schedule 3 of the *State Environmental Planning Policy (State and Regional Development) 2011*. Accordingly, the project is subject to Part 5.1 of the EP&A Act and required the approval of the Minister for Planning.

Capital Investment Value

The capital investment value of the project is \$7,247 M.

Appendix B Threatened flora and fauna species lists

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Table B-1 Listed threatened flora species with the potential to occur or previously recorded within the Project corridor

Scientific name	Common name	Commonwealth listing (EPBC Act)		NSW listing (TSC Act)	
		Yes/No	Status	Yes/No	Status
Flora (species)					
<i>Acacia bynoeana</i>	Bynoe's Wattle	Yes	Vulnerable	Yes	Endangered
<i>Acacia pubescens</i>	Downy Wattle	Yes	Vulnerable	Yes	Vulnerable
<i>Acacia terminalis</i> subsp. <i>terminalis</i>	Sunshine Wattle	No	-	Yes	Endangered
<i>Allocasuarina glareicola</i>	Sunshine Wattle	Yes	Endangered	No	-
<i>Allocasuarina portuensis</i>	Nielsen Park She-oak	Yes	Endangered	Yes	Endangered
<i>Asterolasia elegans</i>	-	Yes	Endangered	Yes	Endangered
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	Yes	Vulnerable	Yes	Endangered
<i>Cryptostylis hunteriana</i>	Leafless Tongue-orchid	Yes	Vulnerable	No	-
<i>Darwinia biflora</i>	-	Yes	Vulnerable	Yes	Vulnerable
<i>Deyeuxia appressa</i>	-	Yes	Endangered	No	-
<i>Eucalyptus camfieldii</i>	Camfield's Stringybark	Yes	Vulnerable	Yes	Vulnerable
<i>Eucalyptus nicholii</i>	Narrow-leaved Black Peppermint	No	-	Yes	Vulnerable
<i>Genoplesium baueri</i>	Yellow Gnat-orchid	Yes	Endangered	No	-
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	Yes	Vulnerable	No	-
<i>Melaleuca deanei</i>	Deane's Paperbark	Yes	Vulnerable	Yes	Vulnerable
<i>Microtis angusii</i>	Angus's Onion Orchid	Yes	Endangered	Yes	Endangered
<i>Pelargonium</i> sp. <i>Striatellum</i>	Omeo Stork's-bill	Yes	Endangered	Yes	Endangered
<i>Pimelea curviflora</i> var. <i>curviflora</i>	-	Yes	Vulnerable	Yes	Vulnerable
<i>Pimelea spicata</i>	Spiked Rice-flower	Yes	Endangered	No	-
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	Yes	Endangered	No	-
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	Yes	Vulnerable	Yes	Endangered
<i>Thesium australe</i>	Austral toadflax	Yes	Vulnerable	No	-

Table B-2 Listed threatened fauna species and populations with the potential to occur or previously recorded within the project corridor

Scientific name	Common name	Commonwealth listing (EPBC Act)		NSW listing (TSC Act)	
		Yes/No	Status	Yes/No	Status
Fauna (species)					
Aves (Birds)					
<i>Anthochaera Phrygia</i>	Regent Honeyeater	Yes	Critically Endangered	Yes	Critically Endangered
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Yes	Endangered	Yes	Endangered
<i>Burhinus grallarius</i>	Bush Stone-curlew	Yes	Endangered	Yes	Endangered
<i>Calidris ferruginea</i>	Curlew Sandpiper	Yes	Endangered	Yes	Endangered
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	Yes	Endangered	Yes	Endangered
<i>Diomedea epomophora epomophora</i>	Southern Royal Albatross	Yes	Vulnerable*	No	-
<i>Diomedea epomophora sanfordi</i>	Northern Royal Albatross	Yes	Endangered*	No	-
<i>Diomedea exulans antipodensis</i>	Antipodean Albatross	Yes	Vulnerable*	No	-
<i>Diomedea exulans exulans</i>	Tristan Albatross	Yes	Endangered*	No	-
<i>Diomedea exulans gibsoni</i>	Gibson's Albatross	Yes	Vulnerable*	Yes	Vulnerable
<i>Fregetta grallaria grallaria</i>	White-bellied Storm Petrel	Yes	Vulnerable	No	-
<i>Grantiella picta</i>	Painted Honeyeater	Yes	Vulnerable	Yes	Vulnerable
<i>Haematopus longirostris</i>	Pied Oystercatcher	No	-	Yes	Endangered
<i>Hieraetus morphnoides</i>	Little Eagle	No	-	Yes	Vulnerable
<i>Lathamus discolor</i>	Swift Parrot	Yes	Endangered*	Yes	Endangered
<i>Macronectes giganteus</i>	Southern Giant-Petrel	Yes	Endangered*	Yes	Endangered
<i>Macronectes halli</i>	Northern Giant-Petrel	Yes	Vulnerable*	Yes	Vulnerable
<i>Neophema chrysogaster</i>	Orange-bellied Parrot	Yes	Critically Endangered	Yes	Critically Endangered
<i>Neophema pulchella</i>	Turquoise Parrot	No	-	Yes	Vulnerable
<i>Ninox strenua</i>	Powerful Owl	No	-	Yes	Vulnerable
<i>Numenius madagascariensis</i>	Eastern Curlew	Yes	Critically Endangered	No	-
<i>Pachyptila turtur subantarctica</i>	Fairy Prion (southern)	Yes	Vulnerable	No	-

Scientific name	Common name	Commonwealth listing (EPBC Act)		NSW listing (TSC Act)	
		Yes/No	Status	Yes/No	Status
<i>Phoebastria fusca</i>	Sooty Albatross	Yes	Vulnerable	Yes	Vulnerable
<i>Pterodroma leucoptera leucoptera</i>	Gould's Petrel	Yes	Endangered	Yes	Vulnerable
<i>Pterodroma neglecta neglecta</i>	Kermadec Petrel (western)	Yes	Vulnerable	Yes	Vulnerable
<i>Ptilinopus superbus</i>	Superb Fruit-Dove	No	-	Yes	Vulnerable
<i>Rostratula australis</i>	Australian Painted Snipe	Yes	Endangered	No	-
<i>Sternula albifrons</i>	Little Tern	No	.*	Yes	Endangered *
<i>Sternula nereis nereis</i>	Australian Fairy Tern	Yes	Vulnerable	No	-
<i>Thalassarche bulleri</i>	Buller's Albatross, Pacific Albatross	Yes	Vulnerable*	No	-
<i>Thalassarche cauta cauta</i>	Shy Albatross	Yes	Vulnerable*	No	-
<i>Thalassarche cauta salvini</i>	Salvin's Albatross	Yes	Vulnerable*	No	-
<i>Thalassarche cauta steadi</i>	White-capped Albatross	Yes	Vulnerable*	No	-
<i>Thalassarche eremita</i>	Chatham Albatross	Yes	Endangered*	No	-
<i>Thalassarche melanophris</i>	Black-browed Albatross	Yes	Vulnerable*	No	-
<i>Thalassarche melanophris impavida</i>	Campbell Albatross	Yes	Vulnerable*	No	-
<i>Tyto novaehollandiae</i>	Masked Owl	No	-	Yes	Vulnerable
<i>Xenus cinereus</i>	Terek Sandpiper	No	-	Yes	Vulnerable
Fish					
<i>Epinephelus daemeli</i>	Black Rockcod, Black Cod, Saddled Rockcod	Yes	Vulnerable	Yes	Vulnerable **
<i>Prototroctes maraena</i>	Australian Grayling	Yes	Vulnerable	Yes	Endangered **
Amphibia (Frogs)					
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	Yes	Vulnerable	No	-
<i>Litoria aurea</i>	Green and Golden Bell Frog	Yes	Vulnerable	Yes	Endangered
<i>Litoria raniformis</i>	Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog	Yes	Vulnerable	No	-
<i>Mixophes balbus</i>	Stuttering Frog	Yes	Vulnerable	Yes	Endangered
Mammals					
<i>Arctocephalus pusillus doriferus</i>	Australian Fur-seal	No	-	Yes	Vulnerable
<i>Balaenoptera musculus</i>	Blue Whale	Yes	Endangered	Yes	Endangered*

Scientific name	Common name	Commonwealth listing (EPBC Act)		NSW listing (TSC Act)	
		Yes/No	Status	Yes/No	Status
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat, Large Pied Bat	Yes	Vulnerable	No	-
<i>Eubalaena australis</i>	Southern Right Whale	Yes	Endangered	Yes	Endangered*
<i>Isodon obesulus obesulus</i>	Southern Brown Bandicoot (Eastern)	Yes	Endangered	No	-
<i>Megaptera novaeangliae</i>	Humpback Whale	Yes	Vulnerable	Yes	Vulnerable*
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	No	-	Yes	Vulnerable
<i>Myotis macropus</i>	Southern Myotis	No	-	Yes	Vulnerable
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	Yes	Vulnerable	No	-
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	Yes	Vulnerable	No	-
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	Yes	Vulnerable	Yes	Vulnerable
Reptiles					
<i>Caretta caretta</i>	Loggerhead Turtle	Yes	Endangered*	No	-
<i>Chelonia mydas</i>	Green Turtle	Yes	Vulnerable*	No	-
<i>Dermochelys coriacea</i>	Leatherback Turtle	Yes	Endangered*	No	-
<i>Eretmochelys imbricata</i>	Hawksbill Turtle	Yes	Vulnerable*	No	-
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	Yes	Vulnerable*	No	-
<i>Natator depressus</i>	Flatback Turtle	Yes	Vulnerable*	No	-
Sharks					
<i>Carcharodon carcharias</i>	Great White Shark	Yes	Vulnerable	Yes	Vulnerable*
<i>Rhincodon typus</i>	Whale Shark	Yes	Vulnerable	No	-
Other					
<i>Pommerhelix duralensis</i>	Dural Land Snail	Yes	Endangered	No	-
Fauna (populations)					
<i>Carcharias taurus</i>	Grey Nurse Shark (east coast population)	Yes	Critically Endangered	Yes	Critically Endangered **
<i>Dasyurus maculatus maculatus</i>	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (SE mainland population)	Yes	Endangered	Yes	Vulnerable
<i>Phascolarctos cinereus</i>	Koala – combined populations of QLD, NSW and ACT	Yes	Vulnerable	Yes	Vulnerable

*notes that the species is also recorded as being migratory and marine under the EPBC Act

** notes that species is listed under the NSW Fisheries Management Act 1994

Appendix C Sensitive land uses

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Table C-1 Sensitive land uses in the project corridor

Sensitive land use name
Private recreation
Unidentified private recreation area on Silver Lane, St Peters
Unidentified private recreational area in the southeast corner of Camperdown Memorial Park, Lennox Street, Newtown
Public recreation / open space
Algie Park, Ramsay Street, Haberfield,
Timbrell Park, Henley Marine Drive, Five Dock
Blackmore Park, Canal Road, Leichhardt
Pioneer Memorial Park, Norton Street, Leichhardt
Whites Creek Valley Park, White Street, Lilyfield
Easton Park, Denison Street, Rozelle
Annandale Park, Chapman Road, Annandale
Federal Park, Chapman Road, Annandale
Bicentennial Park, Eglinton Road, Glebe
Harold Park, The Crescent, Annandale
Hogan Park, The Crescent, Annandale
Victoria Park, City Road, Camperdown
Camperdown Park, Australia Street, Camperdown
Camperdown Memorial Rest Park, Lennox Street, Newtown
Amy Street Park, Amy Street, Erskineville
Flora Street Park, Flora Street Erskineville
Sydney Park, Sydney Park Road, Alexandria
Camdenville Park, May Street, ST Peters
May Street Reserve, May Street, St Peters
Simson Park, Campbell Road, St Peters
Rowswell Playground, Roberts Street, St Peters
Places of worship
St Peters Church of England, Church Street, St Peters
Community facilities
Tom Foster Community Centre, Darling Street Newtown
Child Care
Rosebud Cottage Child Care, Quirk Street, Rozelle
Education
University of Sydney, Great Western Highway, Camperdown
Sax and Woodwind Musee Studio, Great Western Highway
The Taxi School, King Street, Newtown
The School of Silversmiths, May Street, St Peters
St Peters Public School, St Peters Street, St Peters
Health care centre
Ramsay Street Medical Centre Street, Haberfield
Dr W G D Patrick, Missenden Road, Camperdown
Macquarie Anaesthetic Group, Missenden Road, Camperdown
Dr Arthur Vasilaras and Dr K Lee, Briggs Street Camperdown
Dr P Sawrikar GP, Ross Street, Forest Lodge
Balmain Veterinary Hospital Pty Ltd, Victoria Road, Rozelle
The University Veterinary Teaching Hospital, Great Western Highway, Camperdown
Dr J H Lee, Dr Frumar, Dr W S Selby, Dr C Retsas, Dr M Khadra and Dr Ian Hill, Carillon Ave, Camperdown
Dr David V Pohl, Dr J Petchell, Dr Michael J Quinn Whitfeld and Dr Brian Harrisberg, Missenden Road, Newtown
Dr D Ryan, Susan street, Newtown
Newtown Dental Care, Kings Street, Newtown
Newtown Beauty Therapy Glazer Technology
Orthopaedic Surgeon, King Street, Newtown
Hospital
Royal Prince Alfred Hospital, Missenden Road, Camperdown

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