

Sydney Gateway

State Significant Infrastructure Scoping Report



Sydney Gateway road project

State Significant Infrastructure Scoping Report

Roads and Maritime Services | November 2018

Prepared by the Gateway to Sydney Joint Venture (WSP Australia Pty Limited and GHD Pty Ltd) and Roads and Maritime Services

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Approval and authorisation

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Signed:	
Dated:	16-11-18

Executive summary

Overview

Sydney Gateway is part of a NSW and Australian Government initiative to improve road and freight rail transport through the important economic gateways of Sydney Airport and Port Botany. Sydney Gateway is comprised of two projects:

- Sydney Gateway road project (the project)
- Port Botany Rail Duplication – to duplicate a three kilometre section of the Port Botany freight rail line.

NSW Roads and Maritime Services (Roads and Maritime) and Sydney Airport Corporation Limited propose to build the Sydney Gateway road project, to provide new direct high capacity road connections linking the Sydney motorway network with Sydney Kingsford Smith Airport (Sydney Airport).

The location of Sydney Gateway, including the project, is shown on Figure 1.1.

Roads and Maritime 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 under Division 5.2 of the NSW *Environmental Planning & Assessment Act 1979* (EP&A Act), and needs approval from the NSW Minister for Planning. The project is also major airport development under the Commonwealth *Airports Act 1996* (Airports Act) and needs approval from the Australian Minister for Infrastructure, Transport and Regional Development. A combined environmental impact statement (EIS) and draft major development plan (MDP) will be prepared to support the application for approval under the EP&A Act and the Airports Act, respectively. The draft MDP will be prepared by Roads and Maritime on behalf of Sydney Airport Corporation Limited.

This report has been prepared to support a State significant infrastructure application to the NSW Department of Planning and Environment seeking the Secretary's environmental assessment requirements (SEARs) for preparation of the EIS.

A separate State significant infrastructure application and scoping report has been prepared for the proposed Port Botany Rail Duplication project, which is being delivered by the Australian Rail Track Corporation.

Project need

Sydney Airport and Port Botany are two of Australia's most important infrastructure assets. Sydney Airport is the largest airport in Australia based on passenger, aircraft and freight movements. Port Botany is one of the largest container ports in Australia and NSW's largest bulk liquid and gas port. The areas around Sydney Airport and Port Botany are also important economic precincts with high concentrations of airport and port related businesses.

Efficient access to Sydney Airport and Port Botany is critical to the economic growth and prosperity of Sydney, NSW and Australia. Over the next 20 years, air travel, air freight, container freight and general traffic in and around Sydney Airport and Port Botany are expected to grow significantly. This will put more pressure on roads, rail and other infrastructure and impact local communities. Without significant infrastructure investment, existing transport constraints and challenges will worsen.

Sydney Gateway, which includes the project, has been proposed to put in place the necessary infrastructure to address these challenges and keep Sydney moving and growing.

While Sydney Airport is serviced by a passenger rail link, air freight vehicle movements will continue to rely on the road network. The numerous businesses located in the vicinity of Sydney Airport and Port Botany that require access to these gateways depend on the existence of a road network that provides fast, efficient access.

The project, together with the WestConnex program of works and other key road infrastructure projects, would expand capacity on NSW roads and support connections to Sydney Airport and Port Botany, which would assist with growth in freight, passenger and employee traffic movements.

The project is needed to improve traffic flow to Sydney Airport and Port Botany, and support domestic and international freight, trade and tourism, underpinning a sustainable NSW economy and Sydney's role as a global city.

Project overview

The project includes new sections of high capacity limited access road linking the Sydney motorway network at St Peters interchange in the north, Terminal 1 and Airport Drive in the south, and Qantas Drive in the east. It includes new bridges over Alexandra Canal, a new access to Terminals 2/3 and active transport connections.

Ancillary works, including drainage, modifications to existing utilities, upgrades to existing transport network interfaces and temporary construction facilities, also form part of the project.

Project objectives

The primary objective of Sydney Gateway is to support sustainable growth in the economy and cater for projected increases in passengers and freight demand. This will be achieved by improving connectivity between the regional growth and freight distribution centres in western Sydney and the Sydney Airport and Port Botany area.

The objectives of the project are to:

- Improve connectivity to Sydney Airport terminals by providing motorway connections that will cater for forecast growth in passenger and air freight volumes
- Support the efficient distribution of freight to and from Port Botany and Sydney Airport to logistic centres in Western Sydney
- Improve the liveability of Mascot town centre by reducing congestion and heavy vehicle movements through the local road network.

Key environmental issues

Potential environmental, social and economic impacts of the project have been identified through a preliminary risk assessment, preliminary investigations and community consultation. The following key issues were identified:

- Traffic, transport and access
- Noise and vibration
- Air quality
- Aviation safety
- Contamination
- Hydrology, flooding and water quality
- Non-Aboriginal heritage
- Aboriginal heritage
- Land use, social and business impacts

- Urban design, landscape character and visual amenity
- Cumulative impacts.

These key issues are outlined in this report and would be subject to further detailed investigation during preparation of the EIS/draft MDP.

Other environmental issues are also identified in the report. Although these issues are considered to be of lesser consequence, taking into account the project scope, the existing environment and the implementation of standard environmental management measures and safeguards, further assessment will also be undertaken as part of the EIS/draft MDP.

Environmental impact statement and major development plan

Following further design development, detailed environmental investigations and engagement with the community and other stakeholders, the EIS/draft MDP will be prepared in accordance with the SEARs, the EP&A Act, the Environmental Planning and Assessment Regulation 2000, the Airports Act and other relevant regulations and guidelines. The EIS/draft MDP will include:

- Further information on the project background, strategic need and the options and alternatives considered
- A detailed description of the project, including its features and how it would be constructed and operated
- An assessment of the potential construction and operational impacts of the project
- A description of the measures to avoid, minimise or manage the potential impacts
- An assessment of other matters specified by section 91 of the Airports Act (which defines the MDP content requirements) including consistency of the project with the master plan and lease for Sydney Airport, and any effects on flight paths and airport noise
- Consideration of issues raised by the community and other stakeholders.

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1. Introduction

1.1 Sydney Gateway

Sydney Kingsford Smith Airport (Sydney Airport) and Port Botany are two of Australia's most important infrastructure assets, providing essential domestic and international connectivity for people and goods. Together they form a strategic centre, which is set to grow significantly over the next 20 years. To support this growth employees, residents, visitors and businesses need reliable access to the airport and port, and efficient connections to Sydney's strategic hubs.

The NSW and Australian governments are making major investments in the transport network to achieve this vision. New road and freight rail options are being investigated to cater for the forecast growth in passengers and freight through Sydney Airport and Port Botany. Part of this solution is Sydney Gateway, which comprises the following road and rail components:

- Sydney Gateway road project
- Port Botany Rail Duplication.

Sydney Gateway (shown on Figure 1.1) will expand and improve the road and freight rail networks to Sydney Airport and Port Botany to keep Sydney moving and growing. Sydney Gateway forms part of the NSW Government's long-term strategy to invest in an integrated transport network and make journeys easier, safer and faster. The Port Botany Rail Duplication forms part of the Australian Government's commitment to invest in transport infrastructure across Australia.

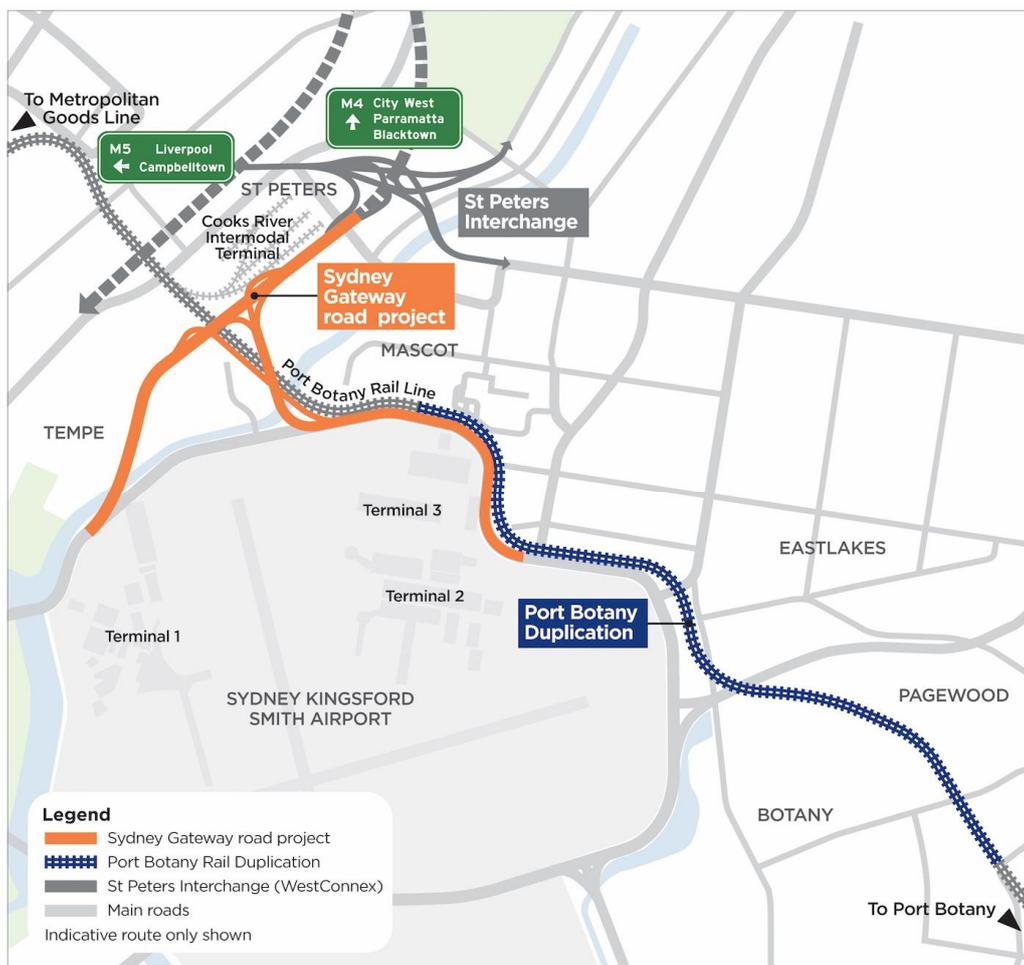


Figure 1.1 Sydney Gateway

1.2 Overview of the project

1.2.1 The project

As part of Sydney Gateway, NSW Roads and Maritime Services (Roads and Maritime) and Sydney Airport Corporation Limited (SACL) propose to build new direct high capacity road connections linking the Sydney motorway network at St Peters interchange with Sydney Airport's domestic and international terminals and beyond.

The Sydney Gateway road project (the project) would comprise new and upgraded sections of road connecting to the airport terminals. It would also include new bridges over Alexandra Canal and other ancillary infrastructure and road connections. The new connections and increased road capacity will help improve traffic flow to Sydney Airport, towards Port Botany and beyond, making the movement of people and goods easier, safer and faster.

The Sydney Gateway road project and the Port Botany Rail Duplication are complementary but separate projects, with separate proponents and approval processes. This scoping report relates to the Sydney Gateway road project. A separate State significant infrastructure application and scoping report has been prepared for the Port Botany Rail Duplication project, which is being proposed and delivered by the Australian Rail Track Corporation.

Further information on the project is provided in section 4.

1.2.2 Location

The general location of the project site (the area that would be directly affected by construction and the location of operational infrastructure) is shown on Figure 1.2. The project site is located in the suburbs of Tempe, St Peters and Mascot, in the Inner West, City of Sydney and Bayside local government areas.

The majority of the project site is located on government-owned land, which mainly consists of Commonwealth-owned land (leased to Sydney Airport Corporation Limited (SACL)) and land owned by the NSW Government (shown on Figure 1.3).

1.3 Statutory process

The project is subject to approval under NSW and Commonwealth legislation. Those parts of the project located on Commonwealth-owned land leased to SACL (shown on Figure 1.3) are subject to Commonwealth planning approval requirements. The remainder of the project is subject to NSW planning approval requirements.

These requirements, and the approach to integrating them, are summarised in sections 1.3.1 to 1.3.3.



Figure 1.2 Location of the project



Figure 1.3 Land ownership

1.3.1 NSW planning approval requirements

Roads and Maritime has formed the view that components of the project not located on Commonwealth-owned land are likely to significantly affect the environment. On this basis the project is declared State significant infrastructure in accordance with Division 5.2 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), and by operation of clause 14(1) and Schedule 3 of State Environmental Planning Policy (State and Regional Development) 2011 and clause 94 of State Environment Planning Policy (Infrastructure) 2007 (described in Appendix A).

State significant infrastructure needs approval from the NSW Minister for Planning. The application for approval will need to be supported by an environmental impact statement (EIS), prepared in accordance with the EP&A Act, the Secretary of the NSW Department of Planning and Environment's environmental assessment requirements (SEARs) and the Environmental Planning and Assessment Regulation 2000 (the Regulation).

1.3.2 Commonwealth planning approval requirements

Components of the project located on Commonwealth-owned land leased to SACL (Sydney Airport land) are subject to the planning framework prescribed by the Commonwealth *Airports Act 1996* (the Airports Act). In accordance with the Airports Act, the components of the project located on Sydney Airport land are major airport development. A major development plan (MDP), approved by the Australian Minister for Infrastructure, Transport and Regional Development, is required before a major airport development can be undertaken at a leased airport. The required contents of a major development plan, which are defined by section 91 of the Airports Act, are provided in Appendix A. The draft MDP will be prepared by Roads and Maritime on behalf of SACL.

The requirements for approval under the EPBC Act that relate to a significant impact on Commonwealth land, or a significant impact on the environment carried out by a Commonwealth agency, do not apply to actions where an MDP is required (as a result of the operation of sections 26(3)(e), 28(2)(e) and 160(2) of the EPBC Act). However, other approval requirements under the EPBC Act may still apply. At this stage, it is considered unlikely that the components of the project not located on Sydney Airport land will trigger the need for approval under the EPBC Act. The potential to significantly impact matters of national environmental significance or the environment of Commonwealth land, and the need for a referral under the EPBC Act, will be confirmed in consultation with the Australian Department of Infrastructure, Regional Development and Cities, and the Australian Department of the Environment and Energy.

In accordance with section 160 of the EPBC Act, the Australian Minister for Infrastructure, Transport and Regional Development must obtain and consider advice from the Australian Minister for the Environment prior to displaying and approving a draft MDP.

1.3.3 Coordinated assessment and approval process

The different approval processes for the project will be integrated and coordinated to ensure that the approvals meet stakeholder needs and relevant NSW and Commonwealth legislative requirements. To assist this process, Roads and Maritime will hold regular intergovernmental coordination meetings with relevant approval agencies for the project.

The application for approval of the project under the relevant NSW and Commonwealth planning approval process will be supported by an integrated EIS and draft MDP. The approval documentation will be exhibited concurrently, and the receipt and review of submissions will be coordinated between relevant agencies. The project will be assessed as a whole. The relationship between the approval processes is shown on Figure 1.4.

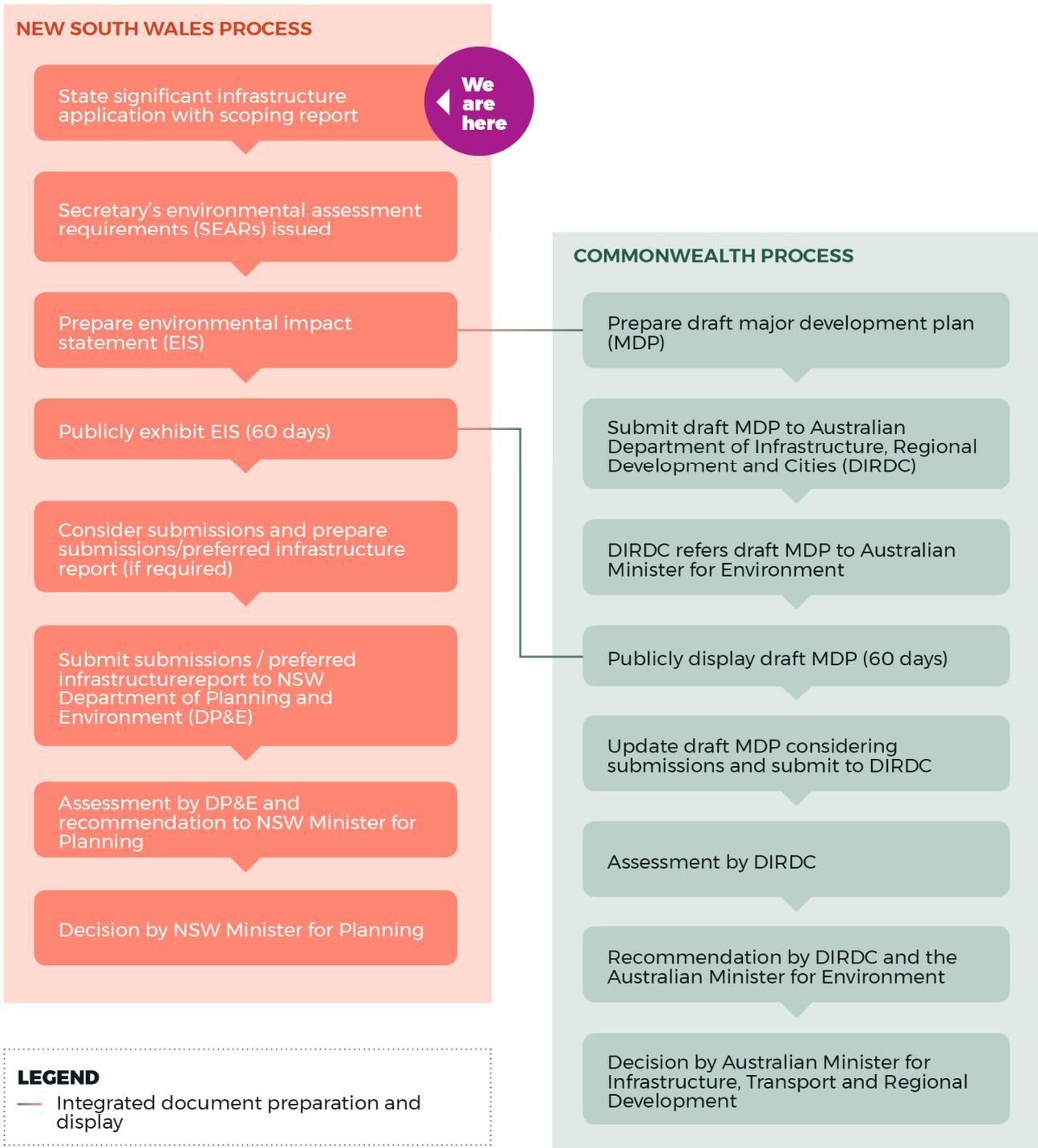


Figure 1.4 Integrated approval process

1.4 Purpose of this report

This report has been prepared to support a State significant infrastructure application for the project, and assist the formulation of the SEARs, in accordance with sections 5.15 and 5.16 of the EP&A Act.

As the environment assessment for the project will be documented in a combined EIS/draft MDP, this report also captures issues to be assessed by the draft MDP.

The report:

- Describes the key features of the project
- Considers the potential environmental issues
- Considers issues potentially of concern to the community and other stakeholders
- Identifies environmental issues for further assessment in the EIS and outlines the scope of assessments that will be undertaken
- Addresses the requirements of clause 192 of the Regulation, which apply to applications seeking approval of the NSW Minister for Planning to carry out State significant infrastructure (refer to Appendix B).

The study area for the purposes of the report is defined as the wider area surrounding the project site, which is the area that has the potential to be directly or indirectly affected by the project (for example, by noise and vibration, visual or traffic impacts). The study area is mainly located in the Inner West, City of Sydney and Bayside local government areas. The key features of the study area are shown on Figure 1.2.

2. Background

2.1 Strategic context and need for the project

2.1.1 Existing situation and key issues

The importance of Sydney Airport and Port Botany

Sydney Airport and Port Botany are among the busiest and most important air and sea freight terminals in Australia. Together, they are known as the State's trade gateways, generating over \$10 billion of economic activity and handling close to \$100 billion of freight per year (Ernst & Young 2011).

Sydney Airport caters for around 40 per cent of Australia's international passenger movements, 46 per cent of domestic/regional passenger movements and 50 per cent of air freight (SACL 2014a and 2018; Department of Infrastructure, Regional Development and Cities 2018). The airport and associated businesses are also a significant employer, with around 31,000 jobs located at the airport itself (SACL 2018).

Port Botany handles 99 per cent of NSW's container demand, moving more than 6,000 containers on average every day. The port also handles 98 per cent of NSW's consumption of liquid petroleum gas (LPG), 90 per cent of bulk chemical products, 30 per cent of refined petroleum fuels and 100 per cent of bitumen products (NSW Ports 2015).

Together, the international gateways of Sydney Airport and Port Botany directly serve the Greater Sydney area, the largest city region economy in Australia, and wider areas of NSW. Efficient access to and from the airport and port is critical to the economy (Ernst & Young 2011).

The area around Sydney Airport and Port Botany also has high concentrations of airport and port related businesses that are also important to the economy. The Sydney Airport and Port Botany area is the largest employment area in Sydney after the Sydney central business district (Ernst & Young 2011).

Access issues

High volumes of traffic access Sydney Airport and Port Botany from all over Sydney. The location of this area around eight kilometres from Australia's most important central business district offers the airport and port significant advantages. However, this location is also a key challenge. A number of arterial roads pass through the area (including the M5 Motorway (M5 East), Southern Cross Drive, General Holmes Drive and Botany Road), increasing traffic volumes and mixing through traffic with traffic servicing the airport, port and surrounding land uses.

The roads around the airport and port are becoming increasingly congested due to increasing numbers of passenger, freight and commuter vehicles. This will continue due to increases in passengers and freight at Sydney Airport and Port Botany, as well as residential and employment growth and urban renewal activities, particularly in Mascot and Botany.

The existing roads surrounding Sydney Airport and Port Botany are already operating near capacity. Strategic modelling undertaken as an input to planning for Sydney Gateway indicates that the lack of spare road capacity will become more of an issue once St Peters interchange is operational.

Infrastructure NSW notes that maintaining the efficiency of infrastructure networks, and access to the gateways of Sydney Airport and Port Botany, will be critical to meeting existing and future needs and supporting the ongoing competitiveness of Sydney and NSW (Infrastructure NSW 2018).

Impacts on the Mascot and Botany town centres

The Mascot town centre is located on Botany Road, about 300 metres to the north of Sydney Airport. The Botany town centre is also located on Botany Road, about 500 metres to the south of the airport and 2.5 kilometres to the north of Port Botany.

Botany Road is one of the main access roads to the Port Botany area and an alternative route between the Sydney central business district and Sydney Airport. The Mascot town centre and surrounding residential areas are substantially affected by traffic accessing the airport and port. Mascot is characterised by high volumes of through and local traffic. This contributes to congestion and access issues, and adversely affects local amenity. Similarly, the Botany town centre is affected by traffic accessing Port Botany via Botany Road.

The Mascot area is experiencing significant urban renewal activity in and around the town centre and Mascot Station. A number of new residential apartment buildings, hotels and commercial developments have recently been constructed and are proposed. The suburb of Botany is also experiencing urban renewal, including various residential developments, particularly near the town centre.

Improvements to access to Sydney Airport and Port Botany are needed to address these issues.

2.1.2 Future demands

Over the next 20 years, container freight, air freight, air travel and general traffic in and around the Sydney Airport and Port Botany area are expected to grow significantly. This will put more pressure on roads and other infrastructure and impact local communities. The key demands driving the need for the project are outlined below.

Sydney Airport passenger movements

By 2039, passenger numbers are forecast to grow by 51 per cent, from 43 million trips in 2017, to 66 million in 2039 (SACL 2018).

The Australian Government has indicated that the Western Sydney Airport at Badgerys Creek will open by 2026. However, Sydney Airport will continue to be the major airport for both passengers and freight. This will place increasing demands on the roads surrounding the airport.

Freight growth

By 2031, the amount of freight moved in NSW is forecast to nearly double to 794 million tonnes (Transport for NSW 2017). The amount of container freight handled by Port Botany is predicted to significantly increase over the next 15 or so years – from about 2.4 million twenty foot equivalent units (TEU) in 2017 to about 4.8 million TEU in 2033 (Transport for NSW 2018).

Air freight handled by Sydney Airport is predicted to increase by about 58 per cent – from 643,000 tonnes in 2017 to around one million tonnes in 2039 (SACL 2018).

Transporting this freight to and from the airport and port will also place additional demands on the road network in the study area.

Population and jobs growth

Greater Sydney is one of the top 10 fastest-growing regions in the world - by 2036, it is projected to be home to another 1.7 million people and 817,000 jobs (Greater Sydney Commission 2018a).

Based on forecast population and job growth, the total number of daily trips made in Sydney by all transport modes will increase to 15 million in 2036 (Transport for NSW 2018b). These statistics indicate a strong growth in demand for road travel on a network that is already constrained. The NSW Government is investing in light rail, rail and public transport solutions to address population and employment growth. However, public transport cannot service all trips to and from Sydney Airport and Port Botany.

As a result of predicted growth in passenger numbers and air freight, the total economic contribution of the airport precinct is projected to increase from \$10.7 billion in 2017 to \$15.5 billion in 2039. The value of economic activity generated or facilitated (by freight or tourism) by the airport is projected to increase from \$38 billion in 2017 to \$52.6 billion in 2039. The number of jobs at the airport are forecast to grow to 36,200 in 2039 (Deloitte Access Economics 2018).

As a result of the above, the number of passenger, staff and associated employment related journeys to the airport and the area around the airport is likely to significantly increase over the next 15 years.

2.1.3 Strategic planning and policy context

The strategic context of Sydney Gateway (including the project) is influenced by strategic plans for transport, land use planning and freight that have been prepared at the national, state and regional/local levels. The project, as part of Sydney Gateway, is consistent with the following strategies:

National

- Australian Infrastructure Plan (Infrastructure Australia 2016)
- Infrastructure Priority List (Infrastructure Australia 2018)

NSW

- Future Transport Strategy 2056 (Transport for NSW 2018a)
- State Infrastructure Strategy 2018-2038 (Infrastructure NSW 2018)
- NSW Draft Freight and Ports Plan (Transport for NSW 2017)

Regional

- A Metropolis of Three Cities – the Greater Sydney Region Plan (Greater Sydney Commission 2018a)
- Eastern City District Plan (Greater Sydney Commission 2018b)
- Greater Sydney Services and Infrastructure Plan (Transport for NSW 2018b)

Local

- Sydney Airport Master Plan 2033 (SACL 2014a) and the Preliminary Draft Sydney Airport Master Plan 2039 (SACL 2018)
- NSW Ports' 30 Year Master Plan (NSW Ports 2015)
- City of Sydney Employment Lands Strategy 2014 – 2019 (City of Sydney 2014).

2.1.4 Project need summary

The project, as part of Sydney Gateway, is needed to address the issues identified in section 2.1.1 and respond to the demands listed in section 2.1.2.

Efficient access to Sydney Airport and towards Port Botany is critical to the economic growth and prosperity of Sydney. Over the next 20 years, air travel, air freight, container freight and general traffic in and around the Sydney Airport and Port Botany area are expected to grow significantly. This will put more pressure on roads and other infrastructure and impact local communities. Without significant infrastructure investment, existing transport constraints and challenges will worsen. Sydney Gateway, which includes the project, has been proposed to put in place the necessary infrastructure to address these challenges and keep Sydney moving and growing.

While Sydney Airport is serviced by a passenger rail link, air freight vehicle movements will continue to rely on the road network. The numerous businesses located in the vicinity of Sydney Airport and Port Botany that require access to these gateways depend on the existence of a road network that provides efficient access.

The project, together with the Port Botany Rail Duplication project, the WestConnex program of works and other key road infrastructure projects, would expand capacity and support connections to Sydney Airport and Port Botany. This would assist with meeting the predicted growth in freight, passenger and employee traffic movements.

Infrastructure NSW recognises that the project will provide a valuable connection between the Sydney motorway network, Sydney Airport and Port Botany. The State Infrastructure Strategy 2018-2038 notes that 'planning for this link has consistently demonstrated that it returns a high benefit relative to its cost, commensurate with the high value of the productive traffic that is expected to use it.' (Infrastructure NSW 2018).

2.2 Project objectives

The primary objective of Sydney Gateway is to support sustainable growth in the economy and cater for projected increases in passenger and freight demand. This will be achieved by improving connectivity between the Sydney Airport and Port Botany area and the regional growth and freight distribution centres of western Sydney.

The objectives of the project are to:

- Improve connectivity to Sydney Airport terminals by providing motorway connections that will cater for forecast growth in passenger and air freight volumes
- Support the efficient distribution of freight to and from Port Botany and Sydney Airport to logistic centres in Western Sydney
- Improve the liveability of Mascot town centre by reducing congestion and heavy vehicle movements through the local road network.

2.3 Project development and selection of the preferred project

2.3.1 Project development

The project has developed in response to the NSW State Infrastructure Strategy, which was released in 2012. The aim of the State Infrastructure Strategy was to focus on the strategic investments and reforms that Infrastructure NSW assessed as being likely to have the most impact on the State over the next 20 years (Infrastructure NSW 2012).

A number of key infrastructure priorities emerged from Infrastructure NSW’s capability assessment of Greater Sydney’s infrastructure deficiencies and forecast population and employment growth. These included high capacity road projects to facilitate improved connections between western Sydney, Sydney Airport and Port Botany, south and south-western Sydney, and other centres along Sydney’s global economic corridor. The projects included a connection to Sydney Airport as part of the WestConnex program of works.

As shown in Figure 2.1, an iterative process of option selection, design development and evaluation has been undertaken to define the project. The options development process has been informed by a range of investigations, including geotechnical, traffic modelling and preliminary environmental investigations.

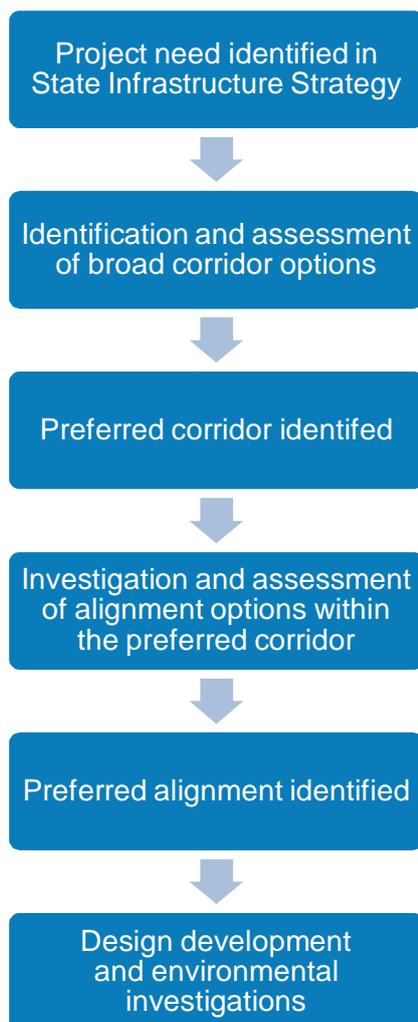


Figure 2.1 Project development process

2.3.2 Project alternatives

Consideration of alternative transport modes

An underground airport rail line was introduced into Sydney’s suburban rail network in 2000 to provide a direct rail link between Sydney Airport (international and domestic terminals), the Sydney CBD and south western Sydney. This line has frequent services and is well patronised. Other public transport services in the area include several local bus routes (described in section 5.2.1) and taxis.

Provision of additional public transport options, such as a new heavy rail link, light rail and/or bus routes, would be expected to deliver supporting benefits, but were not considered as genuine alternatives to the project as a whole. Public transport options would not cater to air and road freight transport requirements, and were considered unlikely to substantially relieve existing road congestion or adequately cater for future traffic demands. Accordingly, it was considered that improvements to public transport alone would be insufficient to address the project need.

Do nothing/do minimum

The 'do nothing/do minimum alternative' would involve operation of the existing road network around Sydney Airport in its existing configuration (including completion of the road upgrading projects described in section 5.2.1). Under this alternative, traffic demand (passenger and freight) on the road network, including through Mascot and onto General Holmes Drive and M5 East, would experience increased congestion and would operate close to, or above, capacity during peak periods. This alternative was not considered to be feasible, as it would not address the issues and demands described in section 2.1, or the objectives listed in section 2.2.

2.3.3 Consideration of corridor options

Consideration of options for a high capacity road connection between the Sydney motorway network at St Peters, Sydney Airport and Port Botany substantially commenced in 2014 as part of the options development process for the WestConnex program of works. This followed the decision to construct the main Sydney motorway network interchange at St Peters.

A range of studies were carried out to identify and assess potential corridor options between St Peters interchange and Sydney Airport. The identified corridors consisted of six surface and tunnel options.

The surface corridor options generally fell into two areas – those where the majority of the road infrastructure would be located mainly to the west of Alexandra Canal (in Tempe and St Peters), and those located to the east of the canal and north of Qantas Drive/Airport Drive (in Mascot). The corridors also differed according to the effects on various land uses and land ownership.

A comparative assessment of each option was undertaken against key assessment criteria, including land use/property impacts, traffic, aviation impacts, program, cost, environmental and engineering constraints.

The preferred corridor identified as an outcome of this assessment consisted of separate links from St Peters interchange to Terminal 1 and Terminals 2/3. The link to Terminal 1 extended southwest from St Peters interchange through the Tyne Container Services site, then south across Alexandra Canal before joining Airport Drive. The Terminals 2/3 link extended south from St Peters interchange, then across Alexandra Canal, joining Qantas Drive to the east of the canal (connecting with Terminals 2/3 via Qantas Drive).

The preferred corridor was considered on balance to best meet the project objectives. It provided the best integration with St Peters interchange, minimised impacts on privately owned land and performed well from a connectivity and traffic perspective.

Tunnel options were not preferred as a result of:

- The short length and comparatively steep gradients required to pass under Alexandra Canal, leading to a sub-optimal road gradient
- The high groundwater level and flood prone areas, which would make it difficult to protect tunnels from flooding

- The surface land requirements associated with tunnelling would be significant and optimal connections to the existing network would be difficult to achieve.

The comparatively high costs and extra risks of tunnelling were considered to outweigh the benefits.

2.3.4 Preferred alignment

Between 2016 and 2017, Roads and Maritime continued to further develop the Sydney Gateway road project. Two main alignment options within the preferred corridor were considered. The key differences between the two alignments related to the land affected, the ongoing use (or bypass) of Airport Drive, the location of new bridges over Alexandra Canal and the potential for impacts to Sydney Airport.

The alignment options were assessed against the key assessment criteria (including land use/property impacts, traffic, aviation impacts, program, cost, environmental and engineering constraints) by means of a multi-criteria assessment. The preferred option was considered to best meet the project objectives on balance and offer the following advantages:

- Improved transport outcomes
- Improved constructability, road geometry and bridge design opportunities
- Fewer impacts on Sydney Airport, including the airport's protected airspace
- Improved architectural design opportunities for the main bridge structures
- Provision for a separate access to the expanding air freight precinct at Sydney Airport.

The disadvantages of the preferred alignment include impacts on public open space (at Tempe Lands) and the former Tempe Tip site.

Following identification of the preferred alignment option, which is broadly shown on Figure 1.1, further design work was undertaken to refine the project features. A description of the proposed project, including the key features, is provided in section 4.

Design development is ongoing, focussed on minimising potential environmental, community and land use impacts, avoiding impacts to Sydney Airport's protected airspace, and optimising project design, constructability, function and cost.

3. Consultation

3.1 Consultation objectives and approach

Community and stakeholder engagement is an important part of the development of the project and plays a critical role in Roads and Maritime's overall consultation processes.

Roads and Maritime has four goals in undertaking community and stakeholder engagement activities:

- Enhance Roads and Maritime's transparency and public accountability
- Ensure that Roads and Maritime's decision-making is inclusive of diverse community ideas and opinions
- Ensure that Roads and Maritime's strategic planning, project development and service delivery meets the balance of community needs and expectations
- Create a more efficient Roads and Maritime based on collaborative decision-making and enhanced public trust.

A Community and Stakeholder Engagement Plan has been prepared to guide communications and engagement activities throughout project development and, if planning approval is received, during construction.

The engagement process will ensure relevant stakeholders and the wider community are proactively engaged and informed about the project and given opportunities to provide feedback. Regular briefings will be held as the project evolves to ensure stakeholders are informed and issues are addressed. Engagement activities will include meetings, regular communication of project information and invitations to project displays.

Issues raised during consultation will be provided to the project design and environmental teams to inform project development, environmental assessment and preparation of the EIS/draft MDP.

3.1.1 Principles of engagement

Roads and Maritime will lead all stakeholder engagement and community consultation for the project, and will follow comprehensive procedures for engaging with stakeholders. These procedures are based around principles of communicating early and often, providing information about construction activities and impacts, explaining how stakeholder and community feedback is used and providing ongoing opportunities for participation and feedback.

Roads and Maritime is identifying opportunities for the community to be part of the decision-making process and help contribute to the project's development.

Roads and Maritime notes that, while all feedback from the community will be considered, the preferred route for the project has been driven by a number of factors that greatly limit options to influence the proposed route alignment. These factors include the location of existing roads and the rail corridor, Sydney Airport safety restrictions, key land uses and sensitive environmental features, and the location of Alexandra Canal.

Roads and Maritime encourages feedback from the community on the project throughout the design and development process. We will continue to ask for community feedback as we move through each stage of planning.

3.1.2 Communication and engagement approach

The Community and Stakeholder Engagement Plan will be reviewed and updated as required following each stage of engagement. Stakeholders have been identified and categorised into four groups within the plan and analysed to identify priorities for engagement. These groups are:

- Landholders and directly impacted stakeholders (such as Inner West Council and SACL)
- Residential community (including residents living in Tempe and Mascot)
- Business community (including businesses operating in and around Sydney Airport and freight logistics businesses)
- Government stakeholders (including Australian and NSW agencies such as the Australian Department of Infrastructure, Regional Development and Cities, NSW Department of Planning and Environment, Civil Aviation and Safety Authority, and NSW Environmental Protection Agency).

These stakeholders and community groups will be engaged as outlined in the Community and Stakeholder Engagement Plan.

3.1.3 Key partners and stakeholders

Roads and Maritime has identified a number of significant stakeholders across the public and private sectors within the study area. Developing strong relationships with these stakeholders during the development and delivery of the project is integral to its success. For directly impacted landowners and leaseholders, a tailored engagement approach has been developed to outline potential impacts, listen to stakeholder concerns and forge long-term working partnerships.

Engagement activities include regular one-on-one meetings and communication to ensure key issues for these stakeholders are considered.

Australian Rail Track Corporation (ARTC), who is developing and delivering the Port Botany Rail Duplication project as part of Sydney Gateway, is a key partner.

SACL is a key stakeholder and partner. There will be extensive engagement with both parties about the project design to minimise potential impacts to Sydney Airport and ARTC's current and future operations.

It is recognised that several stakeholders will be interested in staying informed about both Sydney Gateway projects. In these instances, Roads and Maritime and ARTC are working closely together to co-ordinate engagement activities and briefings.

3.2 Engagement activity

Community engagement began when Sydney Gateway was publically announced by the NSW Government on 12 September 2018. Activities undertaken during this period are summarised in Table 3.1.

Table 3.1 Engagement activities undertaken to date

Activity	Timing	Detail
Initial briefings	September 2018	Stakeholder briefings to provide information on Sydney Gateway and set up meetings for more detailed discussions.
Contact with affected landowners	September 2018	Briefings to provide information on potential land impacts and set up meetings for more detailed discussions.
Sydney Gateway webpage	Ongoing	A dedicated webpage (https://www.rms.nsw.gov.au/projects/sydney-south/sydney-gateway/index.html) has been set up to provide information on Sydney Gateway, including updates and announcements.
1800 number and email	Ongoing	Contact mechanisms have been set up to enable community members to contact the project team: Email: sydneygateway@rms.nsw.gov.au Phone: 1800 654 446
Community update	September 2018	A community update has been prepared and is available via the webpage. Copies of the update have been delivered to 27,000 residents and businesses in close proximity to Sydney Gateway.
Sydney Gateway animation	Ongoing	An animation is available via the Sydney Gateway webpage.
Online community engagement map	Ongoing	An online community consultation feedback mapping tool is available via the Sydney Gateway webpage. This tool provides the opportunity for people to provide feedback and comments directly on the online map.
Community pop-up information displays	September and October 2018	Project displays at key locations to provide information on Sydney Gateway.
Door knocking local residents and businesses	September and October 2018	Door knocking with local residents and businesses to provide information on Sydney Gateway and seek feedback. Included a survey of businesses in relation to project impacts.

3.2.1 Community engagement

The project’s key communities are Mascot, St Peters and Tempe. Other important communities that are indirectly impacted by the project include Botany. Our community engagement activities to date have focused on these areas.

Roads and Maritime has held pop-up information sessions, doorknocked residents and surveyed small and large businesses in the Sydney Gateway study area. Table 3.2 provides a summary of the communications activity undertaken and levels of engagement with the community.

Table 3.2 Community engagement activities undertaken to date

Method	Figures
Distribution of community update	27,000
Properties door knocked	139 properties (24 businesses + 115 residents)
Emails (out)	12

Method	Figures
Emails (received)	12
Social media	Two facebook posts
Comments on collaborative map	130
Sydney Gateway information static display	One week at Terminal 1 and two weeks at Terminals 2/3.
Webpage visits	3,897 webpage visits – average time two minutes and seven seconds
Postcards	200 distributed during pop-up sessions

3.2.2 Property owner engagement

Roads and Maritime has engaged with property and landowners, licensees and tenants of lands across the project area.

While the project would not directly impact land occupied by residential properties, there would be some impacts to land occupied by established commercial, industrial and freight service properties.

The acquisitions process is being led by Roads and Maritime’s property team, in accordance with the property acquisition reforms introduced by the NSW Government in October 2016 in response to the review of the *Land Acquisition (Just Terms Compensation) Act 1991* undertaken by David Russell SC (the Russell Review).

3.3 Community feedback received

Issues raised by the community to date include those relating to traffic and road safety, active transport, project scope and the environment. Local businesses have enquired about business impacts during construction and congestion issues associated with traffic to Port Botany. The main issue themes to date are shown on Figure 3.1. Feedback received from the community and stakeholders during the initial phase of engagement is outlined in Table 3.3.

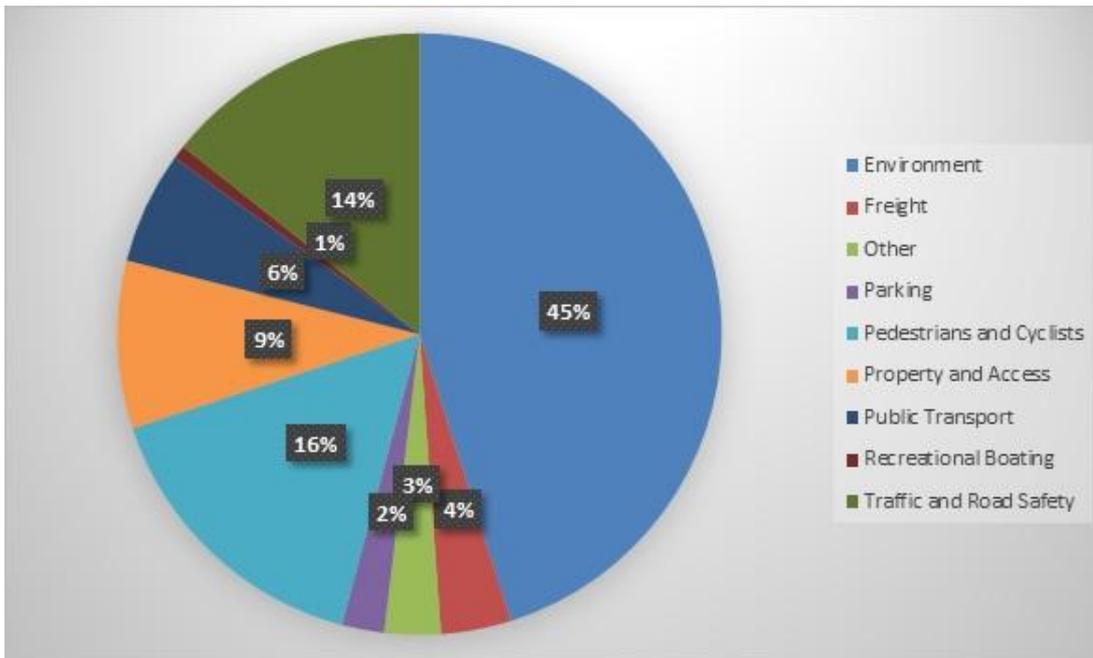


Figure 3.1 Themes arising during engagement

Table 3.3 Summary of feedback raised to date

Category	Issues raised
Pedestrians and cyclists (active transport)	<ul style="list-style-type: none"> Concerns about the impact of the existing cycle ways on Airport Drive to Coward Street, including suggestions to extend the cycle route into Mascot and beyond Lack of footpaths in east Tempe and the need for better active transport access
Environment	<ul style="list-style-type: none"> Concern about potential impacts to Tempe Recreation Reserve and Tempe Wetlands Concerns about potential impacts to the off-leash dog exercise area in Tempe Concerns about potential impacts to local flora and fauna, especially in green spaces in Tempe Proximity of the road to green space and potential operational impacts Concerns about building the road over the former Tempe tip site
Freight	<ul style="list-style-type: none"> Suggestion for on-off ramps to the project at Canal Road Requested access from the project into the Cooks River Intermodal Terminal Suggestion for a road link between St Peters interchange and Port Botany
Parking	<ul style="list-style-type: none"> Suggestion to encourage more people to park at Sydney Airport rather than on local residential streets in Tempe by reducing airport parking fees
Property and access	<ul style="list-style-type: none"> Concerns from Tempe residents about increases in noise and air pollution from being close to a new major road Questions about changes to traffic conditions on Qantas Drive Questions about vehicle access into the international terminal from the project

Category	Issues raised
Public transport	<ul style="list-style-type: none"> • Request to increase bus services to the airport • Request to remove the station access fee for train journeys to the airport stations • Concerns about insufficient public transport routes to the airport
Traffic and road safety	<ul style="list-style-type: none"> • Concerns about increasing numbers of cars using Canal Road from potential on-off ramps from the project • Concerns about additional traffic onto Campbell Street • Suggestion for additional flyovers from Joyce Drive to Wentworth Avenue • Suggestion for a dedicated truck road • Suggestion for a direct tunnel to Foreshore Road • Suggestion to reconfigure the M1 interchange into Botany Road • Suggestion to connect the project to local roads to reduce congestion • Suggestion to extend the flyover to General Holmes Drive

3.4 Engagement during the EIS/draft MDP process

A range of consultation and engagement activities will occur while the EIS/draft MDP is prepared and exhibited. These activities will provide information to, and collect feedback from, the community and other stakeholders. Engagement activities will help inform the project design and management of environmental issues. Key elements of this engagement are outlined below.

3.4.1 Community engagement

Consistent points of information and contact, including the Sydney Gateway webpage, email and 1800 telephone number, will be maintained throughout planning, design and delivery.

Project updates and key milestones will be published on the webpage and engagement with the community and other stakeholders will occur while the EIS/draft MDP is prepared. Information will be provided about potential impacts of the project (during construction and operation) and feedback sought on how impacts could be avoided, mitigated or managed.

Community Engagement Managers will act as the direct point of contact for the community, businesses and other stakeholders on behalf of the project. They will provide a vital link in maintaining close contact with local communities and stakeholders and will bring feedback on local issues to the project design, technical and delivery team.

3.4.2 Consultation with approval agencies

As described in section 1.3.3, the different approval processes for the project will be integrated and coordinated to ensure that the approvals meet stakeholder needs and relevant NSW and Commonwealth legislative requirements. To assist this process, Roads and Maritime will hold regular intergovernmental coordination meetings with relevant approval agencies for the project:

- NSW Department of Planning and Environment
- Australian Department of Infrastructure, Regional Development and Cities.
- Australian Department of the Environment and Energy.

3.5 Engagement during public exhibition of the EIS/draft MDP

In accordance with the Regulation, an EIS must be placed on public exhibition for at least 28 days. However for this project, and specifically in relation to the MDP, a longer exhibition period is proposed to be consistent with the requirements of the Airports Act (which requires a 60 business day exhibition period).

Advertisements will be placed in local newspapers to advise of the exhibition, provide details of where the EIS/draft MDP can be viewed and provide information on other consultation activities during the exhibition period.

During the exhibition period any person may make a submission regarding the project and these submissions will be considered in the assessment of the EIS/draft MDP.

Consultation activities to support exhibition will include:

- Media releases
- Information sessions
- Community event displays
- Doorknocks with the community
- Letterbox drop of Sydney Gateway community updates
- Sydney Gateway website
- Newspaper advertising
- Static displays
- Stakeholder briefings
- Government agency engagement
- Digital engagement tools.

3.6 Engagement after exhibition of the EIS/draft MDP

If the project receives planning approval, Roads and Maritime would continue to engage with the stakeholders and the community during construction. Roads and Maritime would lead a construction stage engagement program, which would include:

- A construction engagement plan
- Notifications regarding work outside standard working hours and work that might impact existing transport (eg road closures or changes to existing pedestrian routes or bus stops)
- A community complaints and response management system
- A 24-hour free community project information line
- Updates to the project website
- Newsletters, information brochures and fact sheets
- Construction updates
- Meetings with key stakeholders
- Media releases and project development advertisements in local and metropolitan papers
- Ongoing role of Community Engagement Managers to act as a single point of contact for the community
- Translator interpreter services.

4. The project

4.1 Overview

4.1.1 Key features

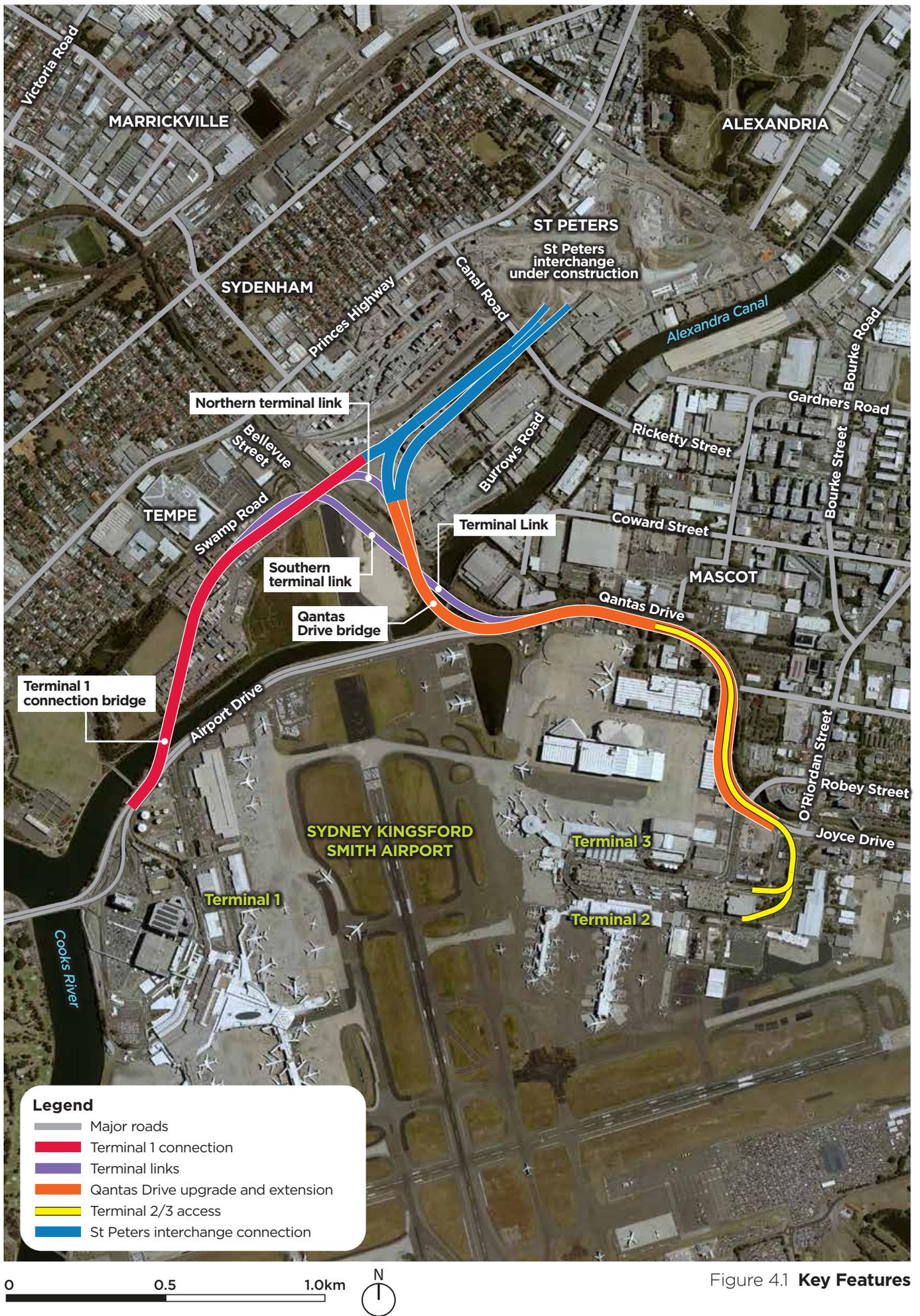
Roads and Maritime and SACL propose to build new direct high capacity road connections linking the Sydney motorway network at St Peters interchange with Terminal 1 and Airport Drive in the south and Qantas Drive and Terminals 2/3 in the east. Key features of the project, as shown on Figure 4.1, include:

- Terminal 1 connection – a new grade-separated section of road connecting Terminal 1 and the Sydney motorway network via St Peters interchange, including a new bridge over Alexandra Canal
- Qantas Drive upgrade and extension – widening and upgrading Qantas Drive and providing a new grade-separated section of road connecting the Sydney motorway network and Terminals 2/3 via a new high-level bridge over Alexandra Canal
- St Peters interchange connection – a new grade-separated section of road connecting Qantas Drive and the Terminal 1 connection with St Peters interchange
- Terminal links – two new grade separated sections of road linking Terminal 1 and Terminals 2/3, including a new bridge over Alexandra Canal
- Terminals 2/3 access – a new grade-separated road connection to Terminals 2/3 from the upgraded Qantas Drive
- Active transport facilities – realigning the existing shared path and providing connections to other shared paths around Alexandra Canal, Tempe and Mascot
- Ancillary works – including new sections of road to provide access to airport land, new drainage infrastructure, signage and lighting, protecting/relocating utilities and relocating/adjusting advertising billboards (if required).

These features of the project are described in more detail in section 4.2. The design alignment of the project is within the general project location shown on Figure 1.2.

As described in section 4.2, the project includes new bridges across Alexandra Canal. The need for piers within or close to the canal as part of these bridges is currently being determined as part of the design process.

The project would also require temporary facilities during construction, including compounds, laydown areas and site access.



4.1.2 Location and land ownership

The project is located about eight kilometres south of Sydney's central business district (as shown on Figure 1.2). The northern extent of the project is located at St Peters interchange, which is currently being constructed to the north of Canal Road in St Peters. The western extent of the project is located near the entrance to Terminal 1 on Airport Drive, to the north of the Giovanni Brunetti Bridge and southwest of Link Road. The eastern extent of the project is located near the intersection of Joyce Drive, Qantas Drive, O'Riordan Street and Sir Reginald Ansett Drive.

The project is located to the north of Sydney Airport on both sides of Alexandra Canal. The project site is located within or close to a range of different land uses and infrastructure, including airport land and associated facilities, the former Tempe Tip site, Tempe Lands, the Cooks River Intermodal Terminal, Port Botany Rail Line, residences, hotels and businesses. Key features of the study area are shown on Figure 1.2. Further information on land uses within and in the vicinity of the project site is provided in section 5.10.1.

The project is located mainly on Commonwealth and NSW Government owned land. Other landowners include local government and private entities (including SACL). Broad patterns of land ownership within and in the vicinity of the project site are shown on Figure 1.3.

4.1.3 Work outside the scope of the project

The project would not include some preliminary works including surveys, utilities protection, preventative maintenance and adjustments, test drilling, test excavations, geotechnical investigations or other tests, sampling or investigation for the purposes of the design or assessment of the project.

4.2 Key design features

Key features of the preliminary design are outlined below. These features are subject to further refinement, including completion of ongoing geotechnical and other environmental and design investigations. A detailed description of the project will be provided in the EIS/draft MDP.

4.2.1 Terminal 1 connection

The Terminal 1 connection would connect the Sydney motorway network and Terminal 1 via the St Peters interchange connection (described in section 4.2.3). It would also provide access to Terminal 1 via Qantas Drive and the northern terminal link (described in section 4.2.4). Features of the Terminal 1 connection include:

- A dual four-lane road link extending between the St Peters interchange connection and Terminal 1
- A tie-in to the existing section of Airport Drive near the entrance to Terminal 1
- Tie-ins to the terminal links to provide access between Terminal 1 and Terminals 2/3
- A section of shared path along the side of the new road, connecting to the existing shared path along Alexandra Canal (described in section 4.2.6)
- A bridge over Alexandra Canal at the south-eastern end (the Terminal 1 connection bridge)
- A bridge over the Port Botany Rail Line and Bellevue Street in Tempe at the northern end.

The existing section of Airport Drive adjacent to Alexandra Canal (between the Terminal 1 connection and Qantas Drive) would be closed to public traffic and limited to airport use.

4.2.2 Qantas Drive upgrade and extension

Qantas Drive would be upgraded and extended across Alexandra Canal via a new grade separated section of road and bridge. This new section of road would connect the Sydney motorway network (via the St Peters interchange connection described in section 4.2.3) and Terminals 2/3 (via the access described in section 4.2.5). It would also connect to Joyce Drive to and from provide access to General Holmes Drive and Port Botany via Foreshore Road. Features of the Qantas Drive upgrade include:

- Widening and upgrading Qantas Drive to dual three-lanes between about 300 metres east of Alexandra Canal and O’Riordan Street
- New dual three-lane sections of elevated road between Qantas Drive and the St Peters interchange connection, including a new high level bridge (the Qantas Drive bridge) passing over Alexandra Canal, the southern terminal link (described in section 4.2.4) and the Port Botany Rail Line
- A tie-in to Joyce Drive near the entrance to Terminals 2/3
- A tie-in to the southern terminal link (described in section 4.2.4) about 300 metres east of Alexandra Canal
- A tie-in to the northern terminal link (described in section 4.2.4) at the north-western end.

4.2.3 St Peters interchange connection

The St Peters interchange connection, located at the north-western end of the project site, would connect the new section of Qantas Drive and the Terminal 1 connection with St Peters interchange, providing access to and from the Sydney motorway network. Features of the St Peters interchange connection include:

- An elevated, multi-lane, fully grade-separated section of road crossing over Canal Road
- A tie-in to the Terminal 1 connection at the south-western end
- A tie-in to the new section of Qantas Drive at the south-eastern end.

4.2.4 Terminal links

The two terminal links would provide access between Terminal 1 and Terminals 2/3. Features of the two links include:

- The northern terminal link – providing access to Terminal 1 from Terminals 2/3. The northern terminal link would consist of a one-way, two-lane section of road leaving the new section of Qantas Drive via slip lanes at its north-western end on the western side of Alexandra Canal, connecting to the north-eastern end of the Terminal 1 connection.
- The southern terminal link – providing access to Terminal 2/3 from Terminal 1. The southern terminal link would consist of a one-way, two-lane section of road leaving the Terminal 1 connection via slip lanes on the western side, before passing under the Terminal 1 connection and the new section of Qantas Drive. It would then cross Alexandra Canal via a new low level bridge (the terminal link bridge) before joining the upgraded section of Qantas Drive on the eastern side of the canal.

4.2.5 Terminals 2/3 access

A new elevated road structure is proposed to provide direct access from the upgraded Qantas Drive to Terminals 2/3. It would separate eastbound traffic travelling to Terminals 2/3 from through traffic, including east–west traffic travelling along Joyce and Qantas drives, and north–south traffic travelling to/from

Terminals 2/3 between Robey and O’Riordan streets and Sir Reginald Ansett Drive. Features of the Terminals 2/3 access include:

- A new elevated section of road from Qantas Drive near Ewan Street, passing over the intersections of Robey and O’Riordan streets, towards Terminals 2/3
- New connecting lanes into Terminals 2/3.

4.2.6 Active transport facilities

A new three metre shared cycle and pedestrian path would be provided in two main corridors. The first corridor, from Terminal 1 to St Peters interchange, would facilitate travel from identified key generators and attractors, including:

- Tempe Reserve
- Connection to Wollli Creek and Southern suburbs
- The local area network.

The second corridor would start at Terminal 1, and tie into existing infrastructure along Alexandra Canal near where the Port Botany Rail Line crosses Alexandra Canal. It would provide access to:

- Mascot Station and Mascot town centre
- Green Square
- Port Botany.

Further development of the active transport facilities would be undertaken in consultation with relevant stakeholders.

4.2.7 Ancillary and other works

Ancillary and other works include:

- A new intersection on the Terminal 1 connection to provide access to the freight area located north of Terminal 1 (on the eastern side of Alexandra Canal) via a new roundabout and a new bridge across the canal
- Provision for a new access (ie provision of a stub road for later development by SACL) to the Sydney Airport northern lands staff car park (located in Tempe on the western side of Alexandra Canal) from the new roundabout proposed as part of the new intersection on the Terminal 1 connection (described above)
- A ramp and new access to Sydney Airport land on the north-western side of Alexandra Canal near Burrows Road, located just to the south of the northern terminal link, including a bridge over the Port Botany Rail Line
- Closure of Swamp Road in Tempe
- New and adjusted drainage infrastructure
- Adjustments to utilities (described in section 4.3.5)
- Adjustments to the locations of existing advertising billboards (if required)
- Modifications to Sydney Airport’s high intensity approach lights
- Signage and lighting.

4.3 Construction

4.3.1 Indicative construction methodology

Indicative construction activities and methodologies include:

- Site set up and preparation
- Realigning, protecting, modifying or replacing utilities
- Removing existing structures where required
- Clearing vegetation where required
- Earthworks
- Building of structures, including bridges, abutments, reinforced earth walls, pavements, intersections, signage gantries, noise walls and other necessary infrastructure.
- Landscaping
- Finishing work, including installing safety barriers, fencing, pavement marking, signage and lighting
- Demobilisation activities, including removing construction equipment, compounds and site tidy up.

4.3.2 Ancillary construction facilities

Ancillary facilities, which do not usually form a permanent part of the project, are required to construct the project. Examples include site compounds, sedimentation basins, casting yards, temporary lay down areas and stockpile sites.

Spoil and materials handling activities, worker facilities and vehicle parking facilities are also commonly classed as ancillary facilities.

The potential impacts of construction compounds would be minimised, where reasonable and feasible, by:

- Selecting locations as close as possible to work areas
- Avoiding sensitive environmental and community locations
- Maximising opportunities for direct access to arterial roads for construction traffic and avoiding the need to use local residential streets
- Minimising property disturbance and acquisition requirements, particularly in residential areas.

The location and size of ancillary facilities will be confirmed as the design and construction planning progresses. Nominated facilities will be described and assessed by the EIS/draft MDP.

4.3.3 Timing

It is estimated that the project would take up to around three and a half years to construct.

During construction, some out-of-hours work (work undertaken during weekends, evenings and at night) is likely to be required to minimise disruption to road and rail operations and access to Sydney Airport, and avoid potential aviation safety issues.

4.3.4 Temporary diversions

Temporary diversions for road traffic, pedestrians and cyclists may be required at the interfaces between construction work areas and public roads. In some locations, property accesses may be temporarily affected.

4.3.5 Utility interactions

Utilities such as water, drainage (stormwater), wastewater, electrical, gas and telecommunications infrastructure located within or crossing the project site may need to be protected or adjusted depending on the design and in accordance with the requirements of the relevant asset owner. Utilities that may be affected by construction include:

- High pressure gas mains (Jemena)
- Ethylene pipeline (Qenos)
- High voltage power (AusGrid)
- Potable and wastewater pipelines (Sydney Water)
- Telecommunication services
- Sydney Airport utilities and services.

Utilities with the potential to be affected by the project, and the approach to managing them, will be confirmed during the design process in consultation with the relevant utility authority or owner. The approach to managing utilities will be described in the EIS/draft MDP.

5. Key environmental issues

5.1 Overview

Key issues are defined as issues where there is the potential for a high or moderate impact (actual or perceived) and where assessment is required to determine the level of the potential impact and the measures required to mitigate and/or manage the impact. The outcomes of preliminary environmental investigations and feedback received from the community and other stakeholders indicate that the following are the key environmental issues for the project:

- Traffic, transport and access
- Noise and vibration
- Air quality
- Aviation safety
- Contamination
- Hydrology, flooding and water quality
- Non-Aboriginal heritage
- Aboriginal heritage
- Property and land use
- Socio-economic and business impacts
- Urban design, landscape character and visual amenity
- Cumulative impacts.

Further information on these issues is provided in sections 5.2 to 5.12.

A number of other environmental issues have also been identified. These issues, which are outlined in section 6, are considered to be of lesser consequence based on the project scope, the existing environment and the implementation of standard management measures. It is expected that these other issues are not likely to be key issues for the project, however the potential impact of these issues would be assessed in the EIS/draft MDP.

Sensitive receivers in the vicinity of the project site are described in section 5.3.1.

5.2 Traffic, transport and access

5.2.1 Overview

The main features of the transport network in the study area are shown on Figure 5.1 and described below.

Road network

Key roads in the study area are described in Table 5.1. These roads are main roads classified under the NSW *Roads Act 1993*, except for Qantas and Airport drives, which are located on Sydney Airport land.



Figure 5.1 Transport Features

Most of the roads listed in Table 5.1 are used by traffic accessing Sydney Airport. Terminal 1 is accessed from the south and west via Marsh Street from the M5 Motorway and from the east via Airport Drive. Airport Drive becomes Qantas Drive and then Joyce Drive further to the east. Terminals 2/3 are accessed via Qantas Drive from the west, Joyce Drive from the east and O’Riordan Street from the north.

To improve traffic flow into and out of the terminals a one-way road system has been constructed around the access to Terminals 2/3 and at O’Riordan and Robey streets near Qantas Drive. Traffic enters Terminals 2/3 via Sir Reginald Ansett Drive and exits via Seventh Street and Robey Street.

In addition to providing access to Sydney Airport, the roads around the airport also play a role in providing an east–west arterial function within the regional road network.

Table 5.1 Description of key roads

Road corridor	Description	Annual average daily traffic ¹
M5 Motorway	<p>The M5 Motorway is a 30 km long motorway that forms part of the Sydney Orbital Network. It connects Sydney Airport and the Sydney central business district (via the M1) with the south-western suburbs.</p> <p>The M5 Motorway consists of two parts – the tolled M5 South West Motorway, located between Preston and Beverly Hills, and the M5 East, located mainly in tunnel between Beverly Hills and General Holmes Drive/the M1.</p> <p>The M5 East tunnel rises to the surface at Marsh Street and connects to the M1 to the east of Cooks River.</p>	<p>Northbound: 55,551 Southbound: 53,316</p>
General Holmes Drive (M1)	<p>In the vicinity of Sydney Airport, General Holmes Drive is a major divided road that forms part of the Sydney Orbital Network and Highway 1. Sections of Highway 1 are designated the M1.</p> <p>General Holmes Drive extends from Joyce Drive/Southern Cross Drive to Ramsgate in Sydney’s south. The road passes under the southern end of Sydney Airport via a tunnel under the north–south runway and taxiways to the third runway. General Holmes Drive provides access to the M5 to the west, Southern Cross Drive to the east, Foreshore Road and Port Botany to the south and Joyce Drive to the north.</p>	<p>Northbound: 24,660 Southbound: 27,053</p>
Southern Cross Drive (M1)	<p>Southern Cross Drive is a major divided road that forms part of the Sydney Orbital Network and Highway 1. It provides access between Sydney Airport and the Sydney central business district via the Eastern Distributor to the east and General Holmes Drive to the west.</p>	<p>Northbound: 65,418 Southbound: 54,302</p>
Mill Pond Road	<p>Mill Pond Road is a short section of divided road providing access between General Holmes Drive and Botany Road, and General Holmes Drive and Southern Cross Drive.</p>	<p>Eastbound: 22,773</p>
Marsh Street	<p>Marsh Street extends from West Botany Street in Arncliffe (west of Cooks River) to Airport Drive near Terminal 1. It provides access to Airport Drive and Terminal 1 from the M5. Marsh Street crosses Cooks River via the Giovanni Brunetti Bridge.</p>	<p>Eastbound: 29,366 Westbound: 27,668</p>

Road corridor	Description	Annual average daily traffic ¹
Airport Drive Qantas Drive Joyce Drive	<p>These roads are located along the northern boundary of Sydney Airport, between Marsh Street in the west and General Holmes Drive in the east. These all form part of the same roadway, with the road name changing from west to east (from Airport Drive to Qantas Drive to Joyce Drive).</p> <p>Airport Drive provides access to Terminal 1. Qantas and Joyce drives provide access to Terminals 2/3, intersecting with Robey and O’Riordan streets and Sir Reginald Ansett Drive.</p> <p>Parts of the project site are located on Qantas and Airport drives.</p>	No data
Botany Road	<p>Botany Road extends roughly north–south from Redfern through Mascot and Botany to Port Botany (a distance of about 10 km). The road provides an alternative access between the Sydney central business district, Sydney Airport and Port Botany.</p> <p>Near the airport, Botany Road intersects with General Holmes, Mill Pond and Southern Cross drives.</p>	Northbound: 16,282 Southbound: 15,284
O’Riordan Street	<p>O’Riordan Street extends roughly north–south for a distance of about 3.5 km between Alexandria and Sydney Airport. The northern end of O’Riordan Street is located at the intersection of Botany Road and Bourke Street. The southern end intersects with Qantas, Joyce and Sir Reginald Ansett drives adjacent to the project site.</p> <p>O’Riordan Street provides an alternative access between the Sydney central business district and Sydney Airport. It is also a key access route for businesses and commuters travelling between Alexandria, Mascot and Sydney Airport.</p>	Northbound: 29,944 Southbound: 22,231
Wentworth Avenue	<p>Wentworth Avenue extends roughly east–west for a distance of about 3.5 km between Mascot and Eastgardens. Wentworth Avenue is currently being extended to the east to intersect with General Holmes Drive as part of Roads and Maritime’s Airport East Precinct Upgrade project. This project also includes provision of a new rail overbridge over Wentworth Avenue to replace the General Holmes Drive level crossing.</p>	Eastbound: 27,070 Westbound: 23,847
Princes Highway	<p>Princes Highway forms part of Highway 1 and the A36. It provides access between the Sydney central business (via King Street in Newtown, City Road and Broadway) and areas to the south of Sydney.</p> <p>The highway travels through Tempe and St Peters about 300 m to the west of the project site.</p>	Northbound: 35,409 Southbound: 24,311
Foreshore Road	<p>Foreshore Road is one of the main access roads to and within Port Botany. It intersects with General Holmes Drive in the north and Botany Road in the south.</p>	Northbound: 11,376 Southbound: 13,437

Note 1: Roads and Maritime Traffic Volume Viewer, 2018

Road performance issues

Preliminary traffic investigations have identified the following issues with the existing and future performance of the road network in the study area:

- Significant traffic congestion in peak periods as a result of high traffic volumes and road capacity constraints at several locations
- Many intersections are operating above capacity in peak periods
- At closely spaced intersections traffic queues adversely affect the operation of adjacent intersections
- The capacity of lanes for turning vehicles is often exceeded, causing queuing in through lanes.

As described in section 2.1, the amount of freight handled by Sydney Airport and Port Botany, and the number of passengers and employees accessing Sydney Airport and the Mascot area, are predicted to increase significantly. The existing road network has limited ability to cater for this predicted growth. Alexandra Canal provides a physical barrier, limiting east–west traffic flow. This leads to traffic funnelling onto the existing limited east–west routes. There is also limited capacity in the Mascot local area to accommodate the predicted traffic from the Sydney motorway network, which will connect via St Peters interchange to Gardeners Road.

Recent and future road projects

Roads and Maritime is undertaking a number of road upgrades to improve traffic flow in and around Sydney Airport. These include:

- Airport East Precinct Upgrade, which involves upgrading roads east of Sydney Airport and replacing the rail level crossing at General Holmes Drive with a new rail bridge. The upgrade includes:
 - extending Wentworth Avenue to the west of Botany Road under the Port Botany Rail Line and a new rail bridge at the Wentworth Avenue extension
 - closing General Holmes Drive between Joyce Drive and Botany Road, including removing the existing level crossing for the Port Botany Rail Line
 - improving the Mill Pond Road intersections with General Holmes Drive and Botany Road
 - widening Joyce Drive and General Holmes Drive between O’Riordan Street and Mill Pond Road to three lanes in each direction.
- Airport North Precinct Upgrade, which involves reconfiguring Robey Street and the southern end of O’Riordan Street to accommodate upgrades to the internal road network at Terminals 2/3 and improve network efficiency
- Airport West Precinct Upgrade, which involves widening Marsh Street in Arncliffe to three lanes westbound.

Also under construction is the WestConnex New M5, which includes a section of motorway in tunnels passing under Princes Highway, Cooks River and Marsh Street to the west and south of the project site. The New M5 also includes construction of St Peters interchange near the intersection of Princes Highway and Canal Road at the northern end of the project site. The WestConnex M4-M5 Link would also connect to St Peters interchange from the north.

Other key transport infrastructure

Sydney Airport

Sydney Airport is one of Australia’s most important pieces of transport infrastructure. As well as serving passengers travelling to and from Sydney it is Australia’s largest transport and logistics hub. Some 34 international, six domestic and six regional airlines operate from the airport to 97 destinations, including 11 international and eight regional destinations not served by any other Australian airport (SACL 2014a). The airport also generates significant traffic volumes associated with employee traffic movements.

There is a network of roads on Sydney Airport land that intersect with Airport, Qantas and Joyce drives.

Port Botany Rail Line

The Port Botany Rail Line forms part of the Sydney Freight Network, which is a dedicated freight only network operated by ARTC. The line extends from Port Botany in the southeast to Marrickville in the west, where it connects to the Southern Sydney Freight Line,

The Port Botany Rail Line is located adjacent to, or in the vicinity of, much of the project site (with some parts located in the project site). Between O’Riordan Street and Alexandra Canal the rail corridor adjoins Qantas Drive on the northern side of the road. The rail line crosses O’Riordan and Robey streets and Alexandra Canal via bridges. It then extends to the northwest, passing under Princes Highway.

Freight facilities

Sydney Airport and Port Botany are highly significant in terms of the movement of freight. Sydney Airport handles in excess of 643,000 tonnes of air freight per year, of which over 527,000 tonnes is international air freight (SACL 2017). Port Botany is the second largest container port in Australia and NSW’s only container port, moving more than 6,000 containers on average per day (NSW Ports 2015).

The other major freight facility in the study area is the Cooks River Intermodal Terminal located in St Peters to the west of Alexandra Canal (shown on Figure 5.1). The Cooks River Intermodal Terminal is owned by NSW Ports and operated by Maritime Container Services (a subsidiary of Qube Logistics) as an inland extension to Port Botany. It is connected to the port by the Port Botany Rail Line, with eight rail sidings located in the terminal. The terminal provides facilities for container storage, repair, washing and upgrading, as well as other ancillary container related services. It is the largest container storage facility in NSW. The project site is located adjacent to the terminal, and also affects an area within the terminal.

The Port Botany Rail Line is also an important freight facility in the study area, moving containers between Port Botany, Cooks River Intermodal Terminal and other intermodal terminals in western Sydney. The roads described in section 5.2.1 also play a role in the movement of freight to and from the airport and port.

Another facility in the immediate vicinity of the project site related to the freight industry is Tyne Container Services. Tyne provides container related services, including repair and storage.

Public transport

Rail

The Sydney Trains T8 Airport and South Line passes through the study area via a tunnel, with stations at Mascot (Mascot Station), Terminal 1 (International Airport Station) and Terminals 2/3 (Domestic Airport Station). The T8 line crosses under Joyce Drive and the Port Botany Rail Line and follows the alignment of O’Riordan Street to the north. The T8 line is operated by Sydney Trains. Stations in the study area are privately owned.

Bus

The bus routes listed in Table 5.2 operate along many of the key roads in the study area. In the immediate vicinity of the project site, route 400 operates along Qantas and Airport drives, with stops at Terminal 1 and Terminals 2/3.

Table 5.2 Bus routes in the study area

Route no	Route
303	Sans Souci to city Circular Quay via Mascot
305	Stamford Hotel to Central
309	Port Botany Depot to Central
310	Eastgardens to Central via Botany Road
400	Burwood to Bondi Junction via Eastgardens (stops at Sydney Airport)
410	Bondi Junction to Rockdale
418	Bondi Junction to Burwood
M20	Botany to Gore Hill
X03	Sans Souci to Circular Quay (express morning peak only)

Active transport

Several designated cycleways and shared paths are located within the study area. The main cycleway in the study area is a dedicated off-road shared path that extends from Wolli Creek Station, through Cahill Park, along the southern bank of the Cooks River, to Marsh Street and along the eastern bank of Alexandra Canal adjacent to Airport Drive. The path continues to and along the southern side of Coward Street. It connects to the shared paths on Bourke Street, Bourke Road and Gardeners Road, travelling to the Sydney central business district.

A shared pedestrian/cycle bridge (Airport Bridge) crosses Alexandra Canal in the vicinity of Link Road. It connects the shared path network around Tempe Recreation Reserve and Tempe Park to the path along the eastern bank of Alexandra Canal.

An on-road cycleway extends along South and Smith streets in Tempe, between the Tempe Recreation Reserve and Princes Highway. A shared path also extends along the eastern side of the highway between Smith and Bellevue streets.

5.2.2 Summary of potential issues

Construction

There would be temporary traffic and transport issues during construction as temporary lane closures, narrowing of lanes and disruptions to some roads would be required. This would have the potential to impact vehicular traffic and public and active transport using these roads.

Construction would directly impact a number of roads and intersections, including Airport and Qantas drives, and the intersections of Robey and O’Riordan streets with Qantas and Joyce drives. These roads are critical in terms of access to Sydney Airport. Careful management of works would be required to minimise the potential impacts on access to the airport, surrounding land uses and the road network.

During construction, heavy vehicles would deliver construction plant, equipment and materials, and would remove waste. There would be an increase in heavy vehicle volumes on roads used as haul routes and an increase in light vehicle movements associated with smaller deliveries and construction worker transport.

Construction and the movement of construction vehicles would have the potential to result in:

- Changes to intersection and traffic performance due to heavy vehicle movements, narrowing of lanes, speed restrictions and temporary lane closures
- Disruptions and delays to traffic and public transport
- Disruptions to pedestrian and cyclist access where modifications are required to accommodate access to construction areas
- Loss of local parking in some areas
- Changes/disruption to property accesses in the immediate vicinity of some work areas
- Impacts to the shared paths in Tempe and along Alexandra Canal
- Cumulative traffic and transport impacts taking into account other projects in the study area (described in section 5.12).

Operation

Operation would change the movement of traffic and transport in the study area as a result of the new road links and associated infrastructure, including bridges, new access roads, intersections and shared paths. Traffic flows would change, with increases in volumes along new and upgraded roads and a change in traffic volumes on adjacent local roads. The impacts of these changes would vary according to land use and location. The impacts would also be influenced by potential future changes in land use and the road and rail networks.

Once the project is operational there would be a redistribution of traffic within the local and regional road network. This would have the potential for impacts and benefits to be experienced by communities along these routes.

Potential traffic, transport and access issues associated with the proposed new road infrastructure and changes to traffic movements include:

- Closure of Swamp Road in Tempe
- Potential increase in heavy vehicles travelling on Burrows Road (to access SACL land in this location).

The project would provide a high capacity road connection between the Sydney motorway network, Sydney Airport and Port Botany. Potential traffic, transport and access benefits of the project include:

- Improved connections and travel times to Sydney Airport and Port Botany, particularly from the west
- Better separation of north–south and east–west traffic movements
- Reduced congestion on local roads in Mascot and Botany
- Provision for future growth in freight, passenger and employee traffic movements
- Better access for heavy vehicles transporting freight to/from Port Botany and western Sydney (via St Peters interchange and the Sydney motorway network).

5.2.3 Proposed further assessment

A detailed traffic, transport and access assessment will be undertaken to assess the potential impacts and benefits of construction and operation. The construction assessment will include:

- Confirming the existing traffic and transport environment
- Identifying and assessing potential traffic impacts, including haulage route identification, construction traffic volumes, the nature of existing traffic and the need to close, divert or otherwise reconfigure elements of the road network

- Identifying and assessing other potential transport impacts, including impacts on public and active transport
- Identifying and assessing potential access impacts
- Considering the potential for cumulative construction impacts
- Identifying mitigation measures.

The operational assessment will include:

- Assessing existing local and regional traffic volumes and patterns against forecast volumes and potential changes to traffic patterns
- Modelling traffic once the project is operational, including for the opening year and 10 years from opening
- Identifying and assessing potential operational traffic, transport and access impacts on the local and regional road network and land uses, including impacts on freight movements, public and active transport
- Carrying out a road safety analysis
- Considering the potential for cumulative operation impacts and benefits
- Identifying mitigation measures.

5.3 Noise and vibration

5.3.1 Overview

The project site is located in a highly developed urban area with a mix of transport, commercial, residential, industrial and recreational land uses. The noise environment is highly influenced by aircraft noise associated with the operation of Sydney Airport. The study area is located within the 25 Australian Noise Exposure Forecast (ANEF) contour for aircraft noise, which forms part of the Sydney Airport Master Plan. In terms of existing aircraft noise, the study area is located in an area that experiences more than 100 noise events above 70 decibels per day (Airservices Australia 2017).

Sydney Airport also generates noise from ground-based activities, including road traffic, operation of plant and equipment, aircraft movements on the ground and on-site construction and development activities.

Other influences on the noise environment include the movement of freight trains along the Port Botany Rail Line and traffic using the roads described in section 5.2.1, particularly the movement of heavy vehicles and container trucks travelling to and from Port Botany along these roads.

Sensitive receivers in the vicinity of the project site include:

- Residential land uses near the project site in Tempe and Mascot (shown on Figure 5.6) with the closest residences including those located:
 - In Tempe, east of the Princes Highway on and around South and Smith streets (about 100 metres west of the project site)
 - In Mascot, east of O’Riordan Street on Robey Street and Baxter Road (about 200 metres northeast of the project site)
- Hotels in Mascot (shown on Figure 5.6), particularly those located near the intersection of Qantas and Joyce drives and O’Riordan Street (including the Stamford Plaza and Mantra hotels) and those located at the western end of King Street
- Community and recreation facilities in Tempe and Mascot (shown on Figure 5.6)

- Heritage listed structures (shown on Figure 5.4)
- The Qantas Flight Training Facility, located at the Qantas Jet Base on Qantas Drive (shown on Figure 5.6).

5.3.2 Summary of potential issues

Construction

Noise and vibration would be generated during construction. Potential noise and vibration sources include:

- Operation of mobile and stationary construction plant and equipment
- Fixed sources, construction compounds and other ancillary facilities
- Construction vehicle movements.

The level of impact would depend on the relative exposure of sensitive receivers and the type, duration, location and timing of construction activities.

Potential noise and vibration issues include:

- Elevated noise and vibration levels around construction sites, compounds, site accesses and haul routes
- Noise associated with out-of-hours work (described in section 4.3.3)
- Impacts on amenity, particularly for residents, employees, hotel guests and users of recreation areas and other community facilities
- Vibration impacts (structural or cosmetic) on buildings and other structures, including heritage listed items
- Vibration impacts on the operation of any sensitive equipment located near the project site
- Cumulative noise impacts taking into account other projects in the study area (described in section 5.12) and the operation of Sydney Airport.

Operation

As noted in section 5.2.2, operation would result in a redistribution of traffic within the local and regional road network. This would have the potential for noise impacts and benefits to be experienced by the community and other stakeholders along these routes.

Potential issues during operation include:

- Noise associated with the operation of new road infrastructure and increased traffic volumes
- Removal of potential noise shielding provided by buildings at the Qantas Jet Base on Qantas Drive
- Noise associated with elevated infrastructure (such as bridges).

The potential for cumulative noise impacts also needs to be considered. This would include noise generated by operation of the project combined with noise from other nearby projects (including the Port Botany Rail Duplication) and land uses (particularly Sydney Airport).

The project is not anticipated to be an ongoing source of vibration during operation.

5.3.3 Proposed further assessment

A detailed noise and vibration assessment will be undertaken to assess the potential impacts of construction and operation. It will include:

- Identifying noise and vibration sensitive receivers
- Baseline monitoring to characterise the local noise environment
- Establishing project-specific construction noise management levels and vibration criteria
- Identifying and assessing potential airborne and ground-borne noise and vibration impacts on sensitive receivers during construction, including the impact of out-of-hours work
- Assessing potential road traffic noise impacts during construction
- Establishing operational noise criteria
- Identifying and assessing potential noise impacts during operation, at the year of opening and 10 years after opening, for the 'build' and 'no build/do nothing' scenarios
- Considering cumulative noise and vibration impacts
- Identifying mitigation measures.

The assessment will be undertaken in accordance with the following guidelines:

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

5.4 Air quality

5.4.1 Overview

Key influences on air quality in the study area include:

- Aircraft movements and other operational activities at Sydney Airport
- Vehicle emissions from the surrounding road network, with the main potential air pollutants being:
 - Carbon monoxide
 - Oxides of nitrogen, including nitrogen dioxide
 - Particulate matter
 - Air toxics, including benzene, toluene, xylenes, formaldehyde and polycyclic aromatic hydrocarbons, which are predominately adsorbed to particulate matter
- Emissions associated with the movement of freight trains along the Port Botany Rail Line, with diesel locomotives and train movements emitting oxides of nitrogen and particulate matter
- Emissions associated with industrial, commercial and freight operations (including dust and other pollutants) in St Peters, Tempe, Mascot and Botany.

Other contributors to air quality include domestic solid fuel burning, lawn mowing and domestic/commercial solvent and aerosol use.

A review of the National Pollution Inventory (2016/2017 reporting year) identified the following air pollution sources within three kilometres of the project site:

- Sydney (Kingsford Smith) Airport, Mascot
- Viva Energy, Mascot
- Qantas Sydney, Mascot
- Sydney Trains Sydenham Maintenance Centre, Sydenham
- Alexandra Asphalt Plant, Alexandria
- Monroe Springs, Alexandria
- Australian Refined Alloys, Alexandria
- Spotless Facility Services, Rosebery
- Kellogg's Botany Plant, Botany.

The impact of these emission sources on local air quality will vary depending on their location and prevailing climatic conditions.

5.4.2 Summary of potential issues

Construction

Construction has the potential to affect air quality in the vicinity of the project site and construction vehicle haul routes. Potential sources of air quality impacts include:

- Temporary increases in dust as a result of:
 - Earthworks and ground disturbance
 - Vegetation removal
 - Decommissioning and demolition activities
 - Stockpiling of construction materials
 - Wind erosion from exposed soils or stockpiles
 - Heavy vehicle movements
- Temporary increases in emissions associated with the use of construction plant and equipment and the movement of vehicles
- Temporary increases in local odorous and non-odorous emissions, such as volatile organic compounds and methane, caused by the disturbance of materials at the former Tempe Tip site or disturbance of gas venting infrastructure located at Sydney Airport's northern lands staff carpark
- Cumulative air quality impacts taking into account other projects in the study area (described in section 5.12).

The potential impact of increased dust and emissions depend on the scale of the activity, the quantities of material handled, the distance to sensitive receivers and wind conditions. Any impacts would be temporary.

Operation

During operation, the main potential source of air quality impacts would be vehicle exhaust emissions, with the main emissions for consideration being carbon monoxide, oxides of nitrogen and particulate matter. The main air quality issues would arise from the movement of traffic along the new road infrastructure, which would have the potential to increase the amount of traffic moving through the study area and change air quality in the vicinity of traffic routes.

The project would also result in a redistribution of traffic within the local and regional road network, with associated changes in air quality. The redistribution of traffic may benefit local amenity in some areas. The project would also improve the movement of traffic, reducing congestion and stop-start vehicle movements, with the potential for improvements to air quality.

The potential for cumulative air quality impacts also needs to be considered. This would include impacts generated by operation of the project combined with other nearby projects (including the Port Botany Rail Duplication) and land uses (particularly Sydney Airport).

5.4.3 Proposed further assessment

A detailed air quality assessment will be undertaken to assess the potential impacts of construction and operation. It will include:

- Identifying sensitive receivers
- Characterising the local air quality environment
- Establishing project-specific criteria
- Identifying and assessing potential impacts on sensitive receivers using modelling in accordance with the Approved Methods for the Modelling and Assessment of Air Pollution in NSW (DEC 2005)
- Predicting direct pollutant emission levels and indirect emissions from changes in traffic
- Assessing the potential impacts of emissions and odour on surrounding sensitive receivers
- Considering cumulative air quality impacts
- Identifying mitigation measures.

5.5 Aviation safety

5.5.1 Overview

Obstructions and lighting in the vicinity of an airport have the potential to create air safety hazards and limit the scope of aviation operations into and out of an airport. The most critical areas of concern are the immediate approach and take-off areas.

The airspace around Sydney Airport is subject to a number of controls and regulations to ensure the safe and efficient operation of aircraft. The controls aim to ensure:

- The airspace aircraft fly in is obstacle-free
- Radar and other air navigation equipment can operate free from interference
- Airport safety lights are not obscured.

Airspace protection

The Airports Act and the Commonwealth *Airports (Protection of Airspace) Regulations 1996* (the Airspace Regulations) establish a framework for protecting airspace at and around airports.

The Airspace Regulations define the 'prescribed airspace' around Sydney Airport. The Airports Act defines any activity that intrudes into an airport's prescribed airspace to be a 'controlled activity', which requires approval. Controlled activities include:

- Construction of buildings and structures and other activities that intrude into a prescribed airspace

- Artificial light sources that exceed specified intensity levels
- Activities resulting in air turbulence that exceed specified levels
- Activities involving the emission of smoke, dust, other particulate matter, steam, or other gas that exceed specified levels.

The Civil Aviation Safety Authority (CASA) is responsible for airspace regulation. Airservices Australia (Airservices) manages the airspace and provides air traffic control services and equipment to ensure the safe and efficient flow of air traffic.

In accordance with the Commonwealth *Civil Aviation Regulations 1998*, CASA also regulates ground lighting where it has the potential to impact airport operations.

Airspace protection is also covered by the National Airports Safeguarding Framework, which is a nationally agreed set of guidelines on issues such as:

- Building generated windshear and turbulence
- Wildlife airport buffers and landscaping controls to reduce the incidence of bird strike
- Lighting restrictions to prevent pilot distraction
- Mitigation of other risks.

Obstacle limitation and Procedures for Air Navigation Services – Aircraft Operations surfaces

The airspace around Sydney Airport is protected by a series of invisible ‘surfaces’ at varying altitudes, which include the obstacle limitation surface (OLS) and the Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS) surface. These surfaces form part of the airport’s prescribed airspace.

The OLS provides a protected space that is free of obstructions for aircraft flying into and out of the airport. It defines the lower limits of an airport’s airspace, which should be kept free of obstacles during the initial and final stages of flight or manoeuvring. Intrusions into the OLS require approval under the Airports Act.

The PANS-OPS protects aircraft flying into and out of the airport when the flight is guided solely by instruments in conditions of poor visibility. The PANS-OPS surface is generally situated above the OLS. Intrusions into the PANS-OPS surface are prohibited.

Navigation aids

There are currently no legislative requirements for protection of navigational aids. However, the CASA Manual of Standards sets out rules for protecting navigational aids. These standards aim to ensure that there is no interference with signals from ground-based navigation equipment, or obstruction of the airport high intensity approach lights. Sydney Airport has developed protection surfaces for navigational aids for reference.

5.5.2 Summary of potential issues

Construction

Potential aviation safety issues associated with construction include:

- Use of large plant and machinery, such as cranes and piling rigs, which may intrude into the prescribed airspace
- Temporary lighting or light spill, which may result in an aviation hazard
- Interference with navigational aids such as radar and airport lighting

- Accidental disruptions to utilities and services, which might affect airport lighting or power to navigational aids.

Operation

The project includes elevated structures (including the bridges over Alexandra Canal) with the potential to intrude into the prescribed airspace. The elevated structures are being designed so they do not intrude into the OLS and PANS-OPS surfaces. Other operational issues include:

- Potential for interference with navigational aids
- Potential for obstruction of the high intensity approach lights
- Impacts of lighting
- The introduction of new infrastructure or landforms that may create or influence wind shear and turbulence.

5.5.3 Proposed further assessment

The potential impacts of construction and operation on the prescribed airspace of Sydney Airport and the safety of airport operations will be assessed. The scope of the assessment would be determined in collaboration with SACL, and will include consultation with CASA, Airservices and the Australian Department of Industry, Regional Development and Cities (as required).

5.6 Contamination

5.6.1 Overview

Listed contaminated sites (EPA)

A search of the NSW Environment Protection Authority’s contaminated land record indicated that there are three sites within 200 metres of the project site for which written notices under the NSW *Contaminated Land Management Act 1997* (CLM Act) have been issued. A review of the list of contaminated sites notified to the Environment Protection Authority (EPA) indicated that there is one notified site within 200 metres of the project site. These sites are listed in Table 5.3 and shown on Figure 5.2.

Table 5.3 Listed contaminated sites

Site name	Location	Contamination status	Location in relation to the project site
Former Tempe Tip	South Street, Tempe	Regulated under the CLM Act	Within and adjacent to the project site
Alexandra Canal Sediments	Off Huntley Street, Alexandria	Regulated under the NSW CLM Act	Within and adjacent to the project site
Former Mascot Galvanising	336-348 King Street, Mascot	Regulated under the CLM Act	About 150 m east of the project site
Cooks River Rail Terminal	20 Canal Road, St Peters	Notified site, regulation under the CLM Act not required	Within and adjacent to the project site

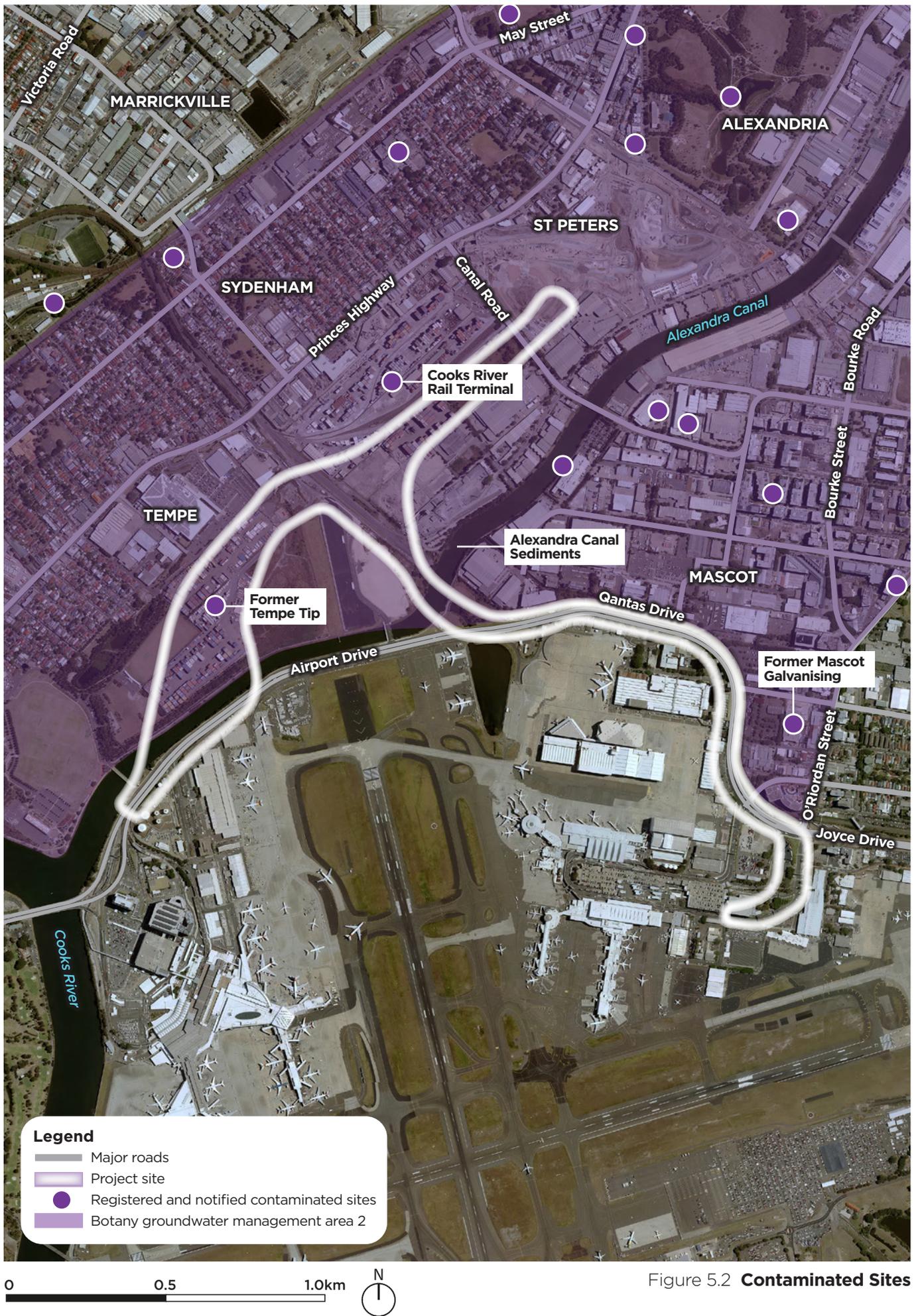


Figure 5.2 Contaminated Sites

Information on contamination issues at the listed contaminated sites located within and adjacent to the project site (as noted in Table 5.3) is provided below. Information on other actual and potential contamination issues in the study area follows.

Former Tempe Tip

The former Tempe Tip site was used for municipal waste landfill between about 1910 and 1986. Reported contaminants of concern include landfill gases, heavy metals, nutrients, petroleum hydrocarbons, polycyclic aromatic hydrocarbons, phenols, pesticides, phthalates (plasticizer compounds), chlorinated hydrocarbons, volatile organic compounds, dioxins, ammonia, polychlorinated biphenyls and asbestos.

Remediation works undertaken to date include installation of a soil-bentonite cut-off wall along the boundary with Alexandra Canal, capping, and a landfill gas and leachate collection systems.

Parts of the former Tempe Tip site are now occupied by the Tempe Lands (described in section 5.10.1, Ikea and Tyne Container Services).

Alexandra Canal

Alexandra Canal has been subject to historical contamination as a result of direct discharge and runoff from the numerous industries and other land uses located along the canal from the late 1800s. As a result, the beds of the canal are highly contaminated. The remediation order notes that the canal bed sediments are contaminated with chlorinated hydrocarbons, including organochlorine pesticides (chlordane, total DDT and dieldrin), polychlorinated biphenyls and metals. The order notes that the contamination presents a significant risk of harm to human health and the environment.

Further information on the canal is provided in section 5.7.1.

Cooks River Rail Terminal

The project site is located along the eastern boundary of this site, which is also known as the Cooks River Intermodal Terminal. Although the site is not subject to an EPA clean-up order it has a known and documented history of industrial use since at least 1947. A site audit undertaken in 2006 indicated that the site is suitable for its approved use (as an intermodal terminal).

Other identified areas of contamination

Sydney Airport northern lands staff carpark

A number of contamination investigations of this site, located to the west of Alexandra Canal, have been undertaken by SACL. Bonded asbestos containing material and asbestos fines/fibrous asbestos within fill materials were identified across the site. A remediation action plan was prepared and implemented by SACL.

The site is impacted by gases originating from the adjoining former Tempe Tip site. Ground gas monitoring is on-going. The site is managed by SACL in accordance with a long term environmental management plan that documents the protocols to be followed during any future sub-surface works at the site.

Sydney Airport

Joint User Hydrant Installation (JUHI) (a SACL tenant) operates a bulk fuel storage terminal adjacent to Airport Drive on Sydney Airport land. The JUHI site is impacted by hydrocarbons that are being managed under a remedial action plan. Remedial actions have included removing liquid hydrocarbons where possible and regular groundwater monitoring of the hydrocarbon plume.

There are a number of known contaminated groundwater plumes within Qantas's lease areas, including the Qantas Jet Base (located on Airport Drive). Site investigations identified a number of contaminants in the soil and/or groundwater, including hydrocarbons, PAH, per- and poly-fluoroalkyl substances (PFAS) and heavy metals.

The Joint Oil Storage Facility (JOSH) site located near Airport Drive has also been identified as an area of soil and groundwater contamination. A remediation system is operating in this area to remove light non-aqueous phase liquid on the groundwater table.

SACL northern lease areas, Boral site and Cooks River Intermodal Terminal

These sites, located to the west of Alexandra Canal and north of the Port Botany Rail Line, have been extensively used for a variety of industrial land uses over many years and includes areas of uncontrolled fill.

At the Boral site, a large LPG fuel tank explosion occurred at the former Boral gas plant in 1990. Buildings on the site, originally built as wool stores with significant asbestos containing materials, were damaged by the explosion.

Previous investigations undertaken by HLA-Envirosciences within the Boral site reported elevated concentrations of polycyclic aromatic hydrocarbons and heavy fraction petroleum hydrocarbon. Potential free tar and fragments of asbestos containing materials were also observed.

Groundwater contamination

Historical industrial uses in Mascot, St Peters, Tempe, Botany and surrounding suburbs have included chemical manufacturing, fuel storage, tanneries, metal electroplaters, service stations and depots, landfills, dry cleaners and wool scorers. These industries have resulted in the potential and known occurrence of a wide range of pollutants in groundwater in the study area, including:

- Heavy metals
- Nutrients
- Perfluorinated compounds
- Pesticides
- Petroleum hydrocarbons, including volatile organic compounds and polycyclic aromatic hydrocarbons
- Phthalates and polychlorinated biphenyls
- Chlorinated hydrocarbons, dioxins and phenols
- light non-aqueous phase liquid
- PFAS.

Due to the extent of known contamination and to ensure that public health is not put at risk, the NSW Government has placed controls on the extraction and use of groundwater in some areas within the study area (via a Temporary Water Restrictions Order). Under the order, the project site is located in Botany Groundwater Management Area 2. Domestic bore water use and the extraction of groundwater for industrial purposes is prohibited in this area.

Other contamination issues

PFAS

Sydney Airport has been identified as one of several airport sites that have had extensive historical use of PFAS within aqueous film forming foams. Preliminary results of sampling within the Sydney Airport and Botany industrial area have indicated the presence of PFAS within surface water, groundwater, sediments and animal biota (eg fish). While the historical use of PFAS-containing firefighting foam at Sydney Airport has contributed to the presence of PFAS in this area, the EPA has noted that the number of potential sources of PFAS makes it difficult to attribute the presence of PFAS to individual sources.

Areas of potential contamination

A number of other potentially contaminating activities and land uses are located within or around the project site, including:

- Service stations or car rental facilities with fuel pumps, which have the potential to cause soil and groundwater contamination due to leaks and spillage of fuel – contaminants of potential concern at these sites include petroleum hydrocarbons and heavy metals
- Workshops, recycling facilities and chemical and dangerous goods storage, which have the potential to cause soil and groundwater contamination
- Historical landfilling operations, which have potentially resulted in the importation of fill material containing metals, asbestos and other contaminants
- The presence of buildings and structures that may contain hazardous materials such as asbestos and lead
- Contamination associated with rail activities that may be present in ballast and formation materials and soils within and next to the rail corridor (such as heavy metals, polycyclic aromatic hydrocarbons and asbestos).

5.6.2 Summary of potential issues

Construction

A key potential contamination issue for the project is the interaction with the former Tempe Tip site. The project site crosses the former tip site and construction activities will disturb the site. Potential issues at this site, which will be considered during design and assessment, include:

- Disturbance of the capping layer
- Potential impacts to the leachate and gas management systems
- Disturbance/mobilisation of landfilled materials and contaminants.

Following construction, the capping layer and the leachate containment and gas collection system would be reinstated.

Other potential contamination issues include:

- Disturbance/mobilisation of contaminated sediments in Alexandra Canal, particularly as a result of any piers in the canal (associated with the proposed bridges) or construction in the banks of the canal
- Interaction with potentially contaminated soils and groundwater, including disturbance and potential migration/mobilisation of contaminants (such as PFAS)
- Accidental discharge of potentially contaminated groundwater
- Dewatering, management and disposal of contaminated groundwater
- Management and disposal of contaminated soils
- Contamination of soils and groundwater due to spills or leaks of fuels, oils or other hazardous substances
- Direct contact and/or inhalation of contaminated soil and/or groundwater by site workers (potential hazard and risk impacts are considered further in section 6.5).

Operation

Potential issues during operation include:

- Disturbing/mobilising bed sediments in Alexandra Canal as a result of the operation of new stormwater outlets
- Impacts on the leachate management system at the former Tempe Tip site, including managing additional stormwater runoff. The leachate containment and gas collection system would be modified as required during construction to address this potential issue and accommodate the project.

5.6.3 Proposed further assessment

A detailed site assessment will be undertaken to assess the potential impacts of construction and provide measures to manage contamination. The assessment will include:

- Confirming areas of contamination including known contaminated sites and areas of potential contamination
- Soil, sediment and groundwater sampling at select locations in accordance with the requirements of the EPA, NSW Heritage Office, Sydney Water and relevant guidelines (listed below)
- Assessing the potential impacts of disturbing contaminated sites, considering potential receptors and exposure pathways
- Reviewing remediation works and site infrastructure associated with the former Tempe Tip site and assessing potential construction and operational impacts
- Identifying mitigation measures to address potential contamination impacts consistent with relevant regulations and guidelines
- Preparing a conceptual strategy for managing contamination, including at the former Tempe Tip site, Alexandra Canal and other areas of known or potential contamination (if required).

The assessment would be undertaken in accordance with relevant guidelines and requirements, including:

- Guidelines for Consultants Reporting on Contaminated Sites (OEH 2011)
- Guidelines on the Duty to Report Contamination under the *Contaminated Land Management Act 1997* (EPA 2015)
- Guidelines for the Assessment and Management of Groundwater Contamination (DEC 2007)
- Contaminated Sites: Sampling Design Guidelines (EPA 1995)
- National Environment Protection (Assessment of Site Contamination) Measure 1999 (as amended in 2013)
- PFAS National Environmental Management Plan (Heads of EPAs Australia and New Zealand (HEPA) 2018).

5.7 Hydrology, flooding and water quality

5.7.1 Overview

Catchments, watercourses and hydrology

The study area is located in the Botany Bay catchment area, which includes two river catchments – the Cooks River catchment and the Georges River catchment. Some areas within the Botany Bay catchment also drain directly to the bay.

The Cooks River catchment has an area of about 102 square kilometres, of which the majority is highly developed. Cooks River is about 23 kilometres long and flows from Chullora to Botany Bay where it discharges near Sydney Airport.

Alexandra Canal is one of the main tributaries of Cooks River and the main watercourse in the vicinity of the project site. The canal is a four kilometre long constructed watercourse located between Huntley Street in Alexandria and Cooks River in Tempe. It discharges to Cooks River to the southwest of the project site near the Tempe Recreation Reserve. The canal's catchment is fully developed.

A constructed pond is located on Sydney Airport land adjacent to the project site. The pond provides a flood detention/mitigation and spill control function. The project site crosses the channel that connects the pond to the canal.

The Tempe Wetlands, located in Tempe Lands, also provide temporary detention for flood waters.

Catchments, watercourses and waterbodies in the study area are shown on Figure 5.3.

Land drainage across the project site is generally in a south-westerly direction towards Alexandra Canal, Cooks River and Botany Bay. Most of the catchment and surrounding area consists of impervious surfaces, with some open space areas including Tempe Recreation Reserve and surrounds.

Groundwater

The study area is underlain by the Botany Sand Beds aquifer, an extensive alluvial and coastal sand bed aquifer extending north and east from Botany Bay to Surry Hills and Centennial Park. The groundwater within the aquifer is relatively shallow (about one to two metres below the ground surface) and the aquifer is readily recharged by rainfall. Groundwater generally flows in a northeast to southwest direction, from around Centennial Park to Botany Bay.

Groundwater in the study area is particularly vulnerable to contamination as a result of the permeability and shallow depth of the aquifer. As described in section 5.6.1, groundwater in the study area is contaminated and some areas are subject to a Temporary Water Restrictions Order. Groundwater in the study area is regulated by the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011.

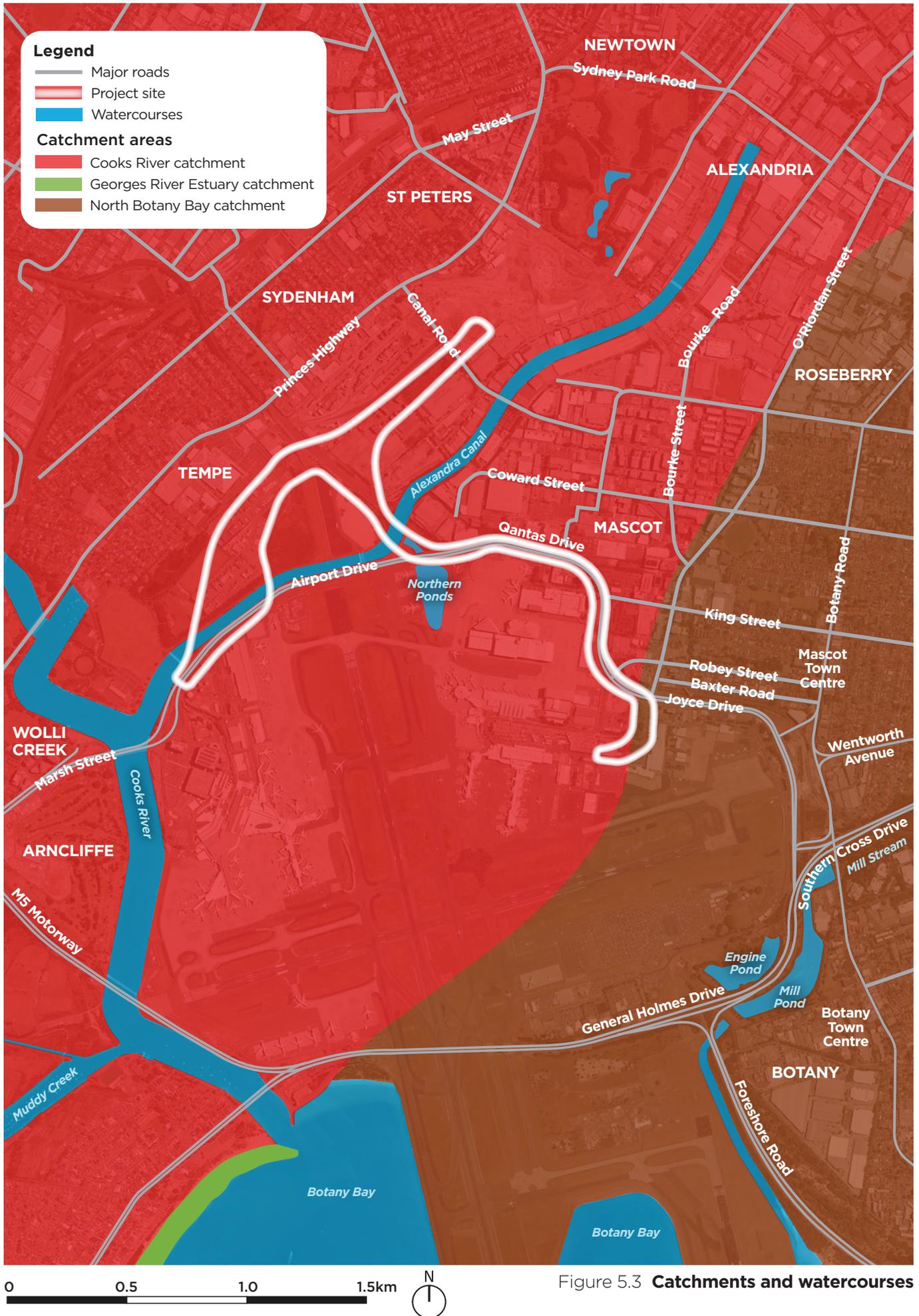


Figure 5.3 **Catchments and watercourses**

Flooding

Flood risk areas are associated with low lying areas around watercourses, with the main risk associated with short term 'flash flooding' due to overland flow (Cardno 2014).

Preliminary flood modelling was undertaken to support the initial stages of design development. The hydraulic model developed for the WestConnex New M5 project was updated to include Inner West Council's stormwater drainage system on the western side of Alexandra Canal. This system controls flooding along Airport and Qantas drives and in the vicinity of the rail overbridges at Robey and O'Riordan streets.

Preliminary modelling indicates that significant flooding would occur at the following locations during a 100 year average recurrence interval storm event:

- Low-lying areas on the western side of Alexandra Canal, north of the Port Botany Rail Line, where inundation in the range of 0.1 to 0.7 metres (and up to one metre in some locations) is predicted
- Low-lying areas on the western side of Alexandra Canal, south of the Port Botany Rail Line and near the Northern Lands carpark, where inundation in the range of 0.6 to 0.8 metres is predicted
- Grassed areas in the northern part of Sydney Airport between the runways, taxiways and aprons, where inundation in the range of 0.2 to 0.5 metres is predicted
- Tempe Wetlands, where inundation greater than one metre is predicted
- To the north and west of Tempe Recreation Reserve, where inundation in the range of 0.1 to 0.9 metres is predicted.

Flood planning areas are areas of high flood hazard that can pose a risk to safety or properties. Flood planning areas defined by relevant local environmental plans in the study area (the Marrickville LEP 2011 and the Rockdale LEP 2011) include areas:

- To the west of Alexandra Canal, towards Canal Road in the north, Princes Highway in the west and the Port Botany Rail Line in the south
- Along the western bank of Alexandra Canal between Tempe Recreation Reserve and the Port Botany Rail Line
- In Tempe Recreation Reserve and to the east of South Street in Tempe
- In the western part of Sydney Airport, nears Cooks River and Alexandra Canal.

Water quality

Water quality in the Cooks River and Georges River catchments has been affected by historical land uses, particularly industrial activities. Sewage overflows, rubbish dumping and stormwater pollution continue to affect water quality.

Water quality in Cooks River is generally considered to be poor and unfit for contact by humans (Cooks River Alliance 2014). The main sources of poor water quality within the river are wastewater overflows, illegal dumping and litter. The Cooks River Alliance Management Plan 2014 targets, amongst other objectives, the improvement of water quality.

Water quality at Foreshore Beach (located to the southeast of the project site) is monitored as part of OEH's Beachwatch Program. The most recent annual Beachwatch report (OEH 2017a) noted that water quality at Foreshore Beach is very poor.

As described in section 5.6.1, sampling undertaken within the Sydney Airport and Botany industrial area has indicated the presence of PFAS within surface water, groundwater, sediments and animal biota (eg fish).

5.7.2 Summary of potential issues

Construction

Potential surface water and groundwater quality issues as a result of the presence of contamination are considered in section 5.6.2.

Surface water

Potential issues during construction include:

- Sedimentation of local and downstream watercourses and waterbodies, including Alexandra Canal, Tempe Wetlands, Cooks River and Botany Bay, as a result of soil disturbance, erosion and sediment-laden runoff
- Exposure of actual or potential acid sulfate soils (described in section 6.3), which may generate acidic runoff and affect water quality
- Impacts on surface and groundwater quality as a result of the contamination issues considered in section 5.6.2.

The project includes new bridges across Alexandra Canal. The need for piers within or close to the canal is currently being determined as part of the design process. Works within the canal, including any piers, would have the potential to disturb contaminated sediments in the bed of the canal and impact water quality. The project would also involve construction of drainage structures/outlets within the canal banks, which may affect water quality in the canal if inadequately managed.

Groundwater

There is the potential for shallow groundwater to be encountered during excavation and the construction of piers and other sub-surface infrastructure. Dewatering of excavations may cause temporary local drawdown of the groundwater table, impacting sub-surface flows and potentially the stability of any nearby structures.

Flooding

Construction has the potential to result in the following issues:

- Changes to overland flows and drainage pathways as a result of the disruption of existing flow patterns and infrastructure
- Changes to flooding regimes and behaviour upstream or downstream of the location of temporary construction infrastructure and compounds
- Impairment or modification of existing drainage infrastructure.

Construction may result in temporary impacts to the behaviour of local surface water systems. These impacts could include a temporary loss of floodplain storage and temporary redistribution of flood flows as a result of the presence of stockpiles and other works within flow paths. These impacts would generally be short term and temporary.

Flooding of sections of the project site may occur during high intensity rainfall events.

Operation

Surface water

Potential issues include:

- Stormwater runoff from road or pavement surfaces, which typically contain oils and greases, petrochemicals and heavy metals resulting from vehicle leaks, operational wear, road and vehicle wear and atmospheric deposition, impacting surface water quality
- Greater quantities of stormwater resulting in increased flow velocities, which may increase scouring of soils and affect water quality in receiving watercourses
- Spills or leaks of fuels and/or oils from vehicle accidents impacting surface water quality.

The project would be designed to address these issues and minimise the potential for operational impacts to water quality.

Groundwater

The project would be designed to minimise the potential for operational impacts to groundwater.

Flooding

A key operational issue relates to the presence of additional infrastructure within or in the vicinity of watercourses or areas of flood risk, which may exacerbate existing flooding conditions. This is an issue for the design of the bridges over Alexandra Canal. The presence of new structures, such as piers and drainage infrastructure, could affect upstream and downstream flows and flood behaviour, change the duration and extent of inundation and lead to scouring downstream.

Operation also has the potential to result in:

- Changes to impervious areas and/or the catchment area of existing drainage infrastructure due to installation and alteration of existing infrastructure
- Reduction in floodplain storage, which could impact flood levels and behaviour
- Impacts on existing flood evacuation routes and flood risk areas.

The project would be designed to address these issues and minimise the potential for flooding impacts.

5.7.3 Proposed further assessment

Surface water

A water quality assessment will be undertaken to assess the potential impacts of construction and operation. It will include:

- Reviewing historical surface water quality data, with consideration of any supplementary data collected specifically for the project
- Considering potential changes to surface water quality, which would be estimated in terms of annual pollutant loads under existing and future (with project) conditions, including water sensitive urban design considerations
- Assessing modified discharge volumes, durations and velocities
- Assessing the potential impacts to surface water hydrology, including natural processes within watercourses that affect the health of any aquatic systems and landscape health

- Considering relevant guidelines, including the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ 2000a), Using the ANZECC Guidelines and Water Quality Objectives in NSW (DEC 2006d) and the Approved Methods for the Sampling and Analysis of Water Pollutants in NSW (DEC 2004)
- Identifying mitigation measures.

Groundwater

A groundwater assessment will be undertaken focusing on the potential impacts during construction. It will include:

- Reviewing historical groundwater levels and quality data, with consideration of additional supplementary data collected specifically for the project
- Reviewing field survey and assessment results for other studies to establish baseline groundwater conditions and sensitive receptors
- Estimating potential changes in groundwater level and quality using a conceptual groundwater model
- Considering the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011 and the NSW Aquifer Interference Policy (NSW Office of Water 2012b)
- Assessing the potential impacts to sensitive receptors, including groundwater dependent ecosystems, and the interaction of surface water, groundwater and flooding impacts
- Identifying mitigation measures.

Flooding

A hydrology and flooding assessment will be undertaken to assess the potential impacts of construction and operation. It will include:

- Describing baseline flooding characteristics and behaviour, including flood depth and velocities, flood risk areas and emergency evacuation routes
- Modelling a range of storm events, with consideration of climate change effects
- Considering applicable council floodplain risk management plans and the NSW Government's Floodplain Development Manual (DIPNR 2005)
- Describing any changes resulting from the project relative to baseline conditions
- Assessing the potential impacts on existing flooding and drainage characteristics using relevant descriptors, with reference to a range of design storm events
- Identifying mitigation measures.

5.8 Non-Aboriginal heritage

5.8.1 Overview

The study area has a long history of settlement and development, with significant historical features and activities including agriculture, modification of the Cooks River and Sheas Creek, dredging and reclamation, Sydney's drinking water supply, development of Sydney Airport and other transport infrastructure, and residential and industrial development.

Heritage list and database searches

The following heritage lists and databases were searched in April 2018:

- World Heritage List
- Australian heritage lists (under the EPBC Act):
 - National Heritage List
 - Commonwealth Heritage List
- Register of the National Estate (it is noted that this is now an archival list and is not a statutory heritage register)
- NSW heritage lists (under the Heritage Act 1977):
 - NSW State Heritage Register (SHR)
 - Section 170 (s170) NSW Government agency heritage and conservation registers
- Local heritage lists (under local environmental plans (LEPs) including:
 - Botany Bay Local Environmental Plan 2013 (the Botany Bay LEP)
 - Marrickville Local Environmental Plan 2011 (the Marrickville LEP)
 - Sydney Local Environmental Plan 2012 (the Sydney LEP).

Heritage listed items

No items on the World, Commonwealth or National heritage lists are located within or close to the project site. The closest of these items is the Sydney Airport Air Traffic Control Tower, which is located about 1.5 kilometres south of the project site. This item is listed on the EPBC Act's Commonwealth Heritage List.

Heritage listed items of State and local significance within and in the vicinity of the project site (within about 100 metres) are summarised in Table 5.4. The locations of these items are shown on Figure 5.4. Four listed items of State and/or local significance are located within the project site:

- Alexandra Canal
- Cooks River Container Terminal
- Mascot (O'Riordan Street) underbridge
- Mascot (Robey Street) underbridge.

Items listed on the non-statutory Register of the National Estate located within and in the vicinity of the project site are shown on Figure 5.4 and summarised in Table 5.4.

No listed heritage conservation areas are located within or close to the project site.



Figure 5.4 Non-Aboriginal heritage items

Table 5.4 Heritage listed items

Item name	Listings	Location	Approx. distance to project site	Map ref (Figure 5.4)
Items listed on the State Heritage Register				
Alexandra Canal	SHR (01621) ('Alexandra Canal') Sydney Water s170 register (4571712) ('Alexandra Canal') Botany Bay LEP (I1) ('Alexandra Canal (including Sandstone Embankment') Marrickville LEP (I270) ('Alexandra Canal') Sydney LEP (2420542), ('Alexandra Canal (Between Cooks River and Huntley Street) Including Interior')	Mascot, St Peters and Tempe (the SHR listed item extends from 200 m south of Huntley Street in Alexandria through the study area to the Cooks River)	In project site	1
Other listed items				
Cooks River Container Terminal	NSW Ports s170 register (4560046) and Marrickville LEP (I366)	20 Canal Road, St Peters	In project site	2
Cooks River Container Terminal: <ul style="list-style-type: none"> • Electric Overhead Travelling Crane • Lay Down Points Level • McS Hr T Administration Building • Pre Cast Concrete Hut 1 • Pre Cast Concrete Hut 2 	NSW Ports s170 register (varies)	20 Canal Road, St Peters	Potentially within the project site ¹	2
3 Mascot (O'Riordan Street) underbridge	Transport for NSW (RailCorp) s170 register (4801830)	O'Riordan Street at the rail corridor	Adjacent to the project site	3
4 Mascot (Robey Street) underbridge	Transport for NSW (RailCorp) s170 register (4801848)	Robey Street at the rail corridor	In project site	4

Item name	Listings	Location	Approx. distance to project site	Map ref (Figure 5.4)
5 Mascot (Sheas Creek) underbridge	Transport for NSW (RailCorp) s170 register	Crosses Alexandra Canal about 150 metres north of Airport Drive	In project site	5
Items on the Register of the National Estate				
6 St Peters Brickpit Geological Site	Register of the National Estate	At the corner of Canal Road and Princes Highway (on the St Peters interchange site)	In project site	6
7 Sydney (Kingsford Smith) Airport Group	Register of the National Estate (interim) ²	Mascot	In project site	7
1 Alexandra Canal	Register of the National Estate (interim) ²	Mascot, St Peters, Tempe	In project site	1

Notes:

1. Further investigations are required to confirm the location of the items significant to the listing of the Cooks River container terminal relevant to the project site. Initial investigations indicate that the project site is located within the curtilage of the NSW Ports listed item (4560046), with the individually listed aspects located outside the project site.
2. Items are listed as 'interim' items as they were proposed to be included on the register prior to its closure.

Other items of heritage significance

The Sydney Airport Master Plan 2033 (SACL 2014a) notes that Sydney Airport is one of the oldest continually operating airports in the world (operating since 1924). The master plan notes that there is heritage value associated with the land on which the airport is located, and that airport land has played host to a number of significant pieces of industrial and water supply infrastructure. The master plan and the Sydney Airport Environment Strategy 2013–2018 (SACL 2014b) note the need to consider the potential for impacts on identified items of heritage value on the airport site. These items are identified in the heritage management plan for Sydney Airport prepared by Godden Mackay Logan in 2009.

Other items of potential heritage significance may be identified during the non-Aboriginal heritage assessment. There is also the potential for archaeological remains of earlier habitation and development/land uses to be located within or close to the project site. This would be confirmed during the assessment.

5.8.2 Summary of potential issues

Construction

Construction has the potential to affect the heritage items described in section 5.8.1 and any areas of archaeological significance within or in the vicinity of the project site. Potential impacts include:

- Physical impact on an item or its curtilage
- Impacts to the fabric of items as a result of vibration generated by construction in the vicinity of the item
- Temporary impacts to views to or from an item.

Of particular note is the potential for impacts to Alexandra Canal, which is listed on the SHR, Sydney Water's s170 register and three LEPs. The project includes a number of bridges across the canal. The need for piers within or close to the canal is currently being determined as part of the design process; such structures would have the potential for physical impacts to the canal. The project would also involve construction of drainage structures/outlets within the existing sandstone embankment walls, which have heritage significance.

The consistency of the project with the conservation management plan for Alexandra Canal (prepared by the NSW Department of Commerce in 2004) and the significance of the canal will be key considerations during the design and EIS/draft MDP process. Issues that will be subject to detailed consideration include the:

- Aesthetics of the canal
- Consistency with the industrial landscape of the canal
- Materials that form the bed/banks of the canal
- 'Open sky' character of the canal
- Cumulative impacts of additional bridges over the canal.

Other issues include the potential for:

- Impacts to airport elements with heritage value, as noted by the heritage management plan for Sydney Airport
- Cumulative impacts to Alexandra Canal and the St Peters Brickpit Geological Site taking into account the impacts of the WestConnex New M5 project, including construction of St Peters interchange
- Potential for impacts to the Cooks River container terminal and the separately listed items.

Operation

The main issues for consideration include the potential for impacts on:

- The character of Alexandra Canal as a result of the introduction of a number of new bridges within a relatively short distance (less than 1.5 kilometres), which would affect the open sky character of the canal
- Views to or from heritage items as a result of the presence of operational infrastructure
- The curtilage of any item.

Depending on the final location and design of the project and associated infrastructure there would be opportunities to avoid and/or minimise the potential for impacts to heritage.

5.8.3 Proposed further assessment

A non-Aboriginal heritage impact assessment will be undertaken to assess the potential impacts of construction and operation. It will involve:

- Searches of heritage databases and a review of relevant literature, including consideration of the conservation management plan for Alexandra Canal and the heritage management plan for Sydney Airport
- Identifying areas of potential archaeological significance
- Assessing heritage significance in accordance with relevant guidelines including the Burra Charter (Australia ICOMOS 2013), Assessing Heritage Significance (Heritage Office 2001), Statements of Heritage Impact (Heritage Office 2002) and Assessing Significance for Historical Archaeological Sites and Relics (NSW Heritage Division 2009)

- Assessing potential impacts to items of local, state, National and Commonwealth heritage significance, including Alexandra Canal and the Cooks River container terminal
- Carrying out an archaeological assessment, where required, to determine the presence of potential non-Aboriginal archaeological items and the potential impacts of the project
- Consulting with relevant stakeholders, including the Office of Environment and Heritage (NSW Heritage Division), Heritage Council of NSW, SACL, local councils and the Australian Department of the Environment and Energy
- Identifying mitigation measures.

5.9 Aboriginal heritage

5.9.1 Overview

Aboriginal heritage context

The study area is located within the traditional country of the Darug language group. Darug territory extends from the Hawkesbury River in the north to Appin in the south and west into the Blue Mountains. Gameygal (or Camerigal) is the band of the Darug group that are believed to have occupied the areas around Botany Bay in the vicinity of the project site. The study area is on the lands of the Metropolitan Local Aboriginal Land Council.

Since early European settlement, the study area has been subject to significant disturbance and development. Items and sites of Aboriginal heritage significance are most likely to occur in areas associated with water sources. As a result, there is the potential for sites to be located in the vicinity of the original alignment of Shea's Creek (which was located in the study area near where Alexandra Canal is now). The greatest potential for intact features of conservation significance would be in undisturbed soils buried beneath fill material.

Existing recorded items and values

A search of the NSW Aboriginal Heritage Information Management Sydney (AHIMS), undertaken in March 2018, identified one listed site within 500 metres of the project site. This site (45-6-0751) is located about 250 metres from the project site, however the AHIMS record indicates that it has been destroyed.

Alexandra Canal has been identified as having Aboriginal heritage values. This is identified in the Sydney Water Section 170 heritage register listing (item 4571712), which notes that 'the discovery of the butchered Dugong, Aboriginal axes and the remains of an ancient forest in this area that were uncovered during construction have revealed both a species and a food source of Aboriginal occupation in the Botany basin and a scientific understanding to the changing sea levels along the area'.

Areas of potential archaeological deposits

As part of the previous design stages for Sydney Gateway, Roads and Maritime undertook an Aboriginal archaeological survey of the project site in accordance with Stage 2 of Roads and Maritime's Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI). Surveys were undertaken by archaeologists with Aboriginal stakeholders in September 2016. The surveys identified two areas of potential archaeological deposits in the vicinity of the project site. These areas are located on the:

- Southern side of the Port Botany Rail Line north of Airport Drive on the eastern side of Alexandra Canal
- Northern side of the Port Botany Rail Line on the western side of Alexandra Canal.

These areas are located partially or wholly within the project site.

Listed sites and potential archaeological deposits are shown on Figure 5.5.

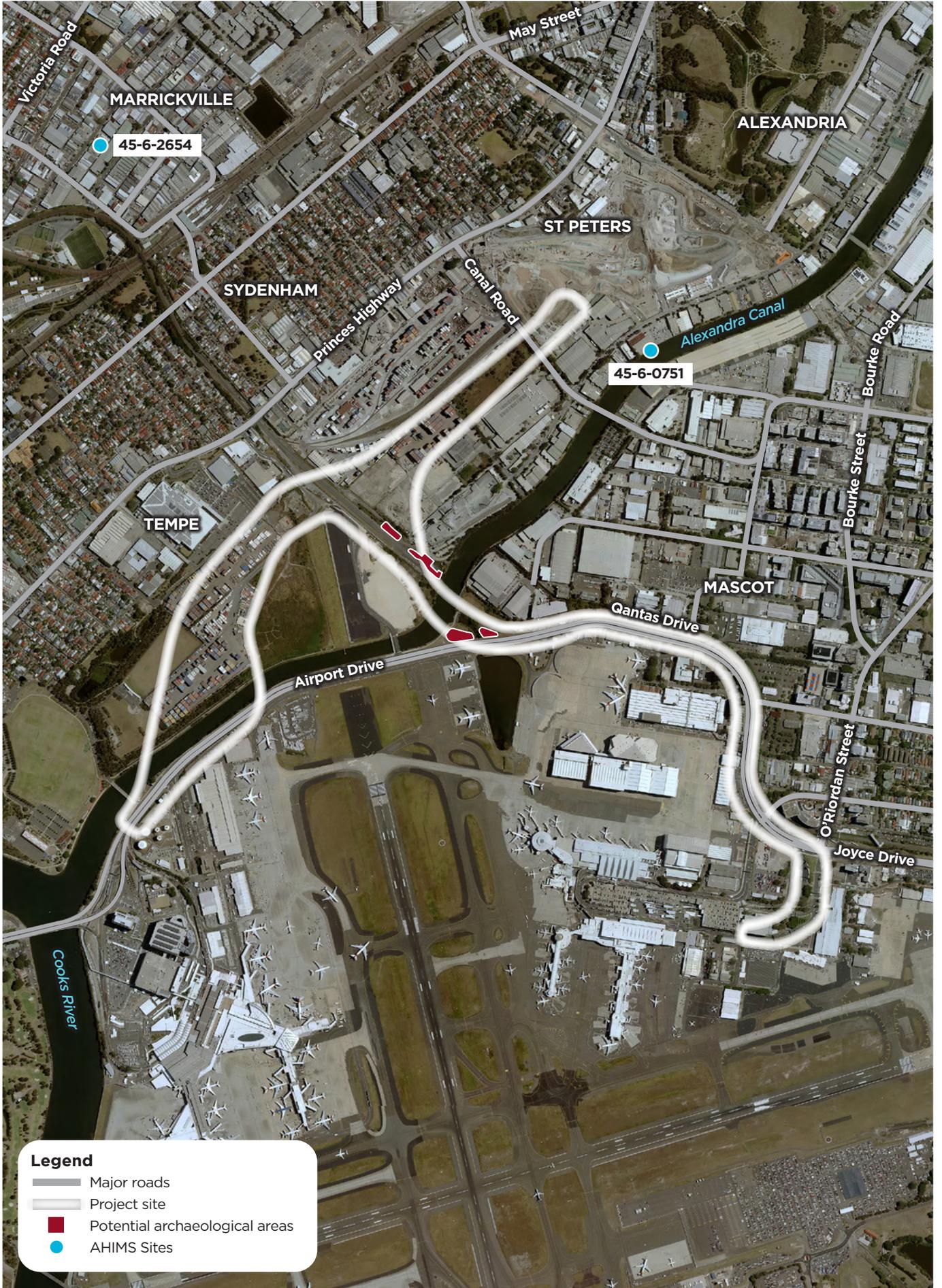


Figure 5.5 **Aboriginal heritage**

Native title

There are no native title claims relevant to the study area.

5.9.2 Summary of potential issues

Construction

Potential impacts would be limited to the construction phase. Although the project would not impact any listed Aboriginal sites, there is the potential for impacts on the identified areas of potential archaeological deposits. Further archaeological survey work (as recommended by the Stage 2 PACHCI) and assessment will be undertaken for the EIS/draft MDP to determine the extent of potential impacts and ensure that any impacts are assessed and managed appropriately.

Operation

No impacts are predicted during operation.

5.9.3 Proposed further assessment

An Aboriginal cultural heritage assessment will be undertaken, including completion of a Stage 3 PACHCI assessment. The assessment will involve:

- Undertaking PACHCI Stage 3 consultation in accordance with the requirements of PACHCI and Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW 2010a)
- Preparing a draft excavation methodology for the Stage 3 PACHCI assessment, including consultation with registered Aboriginal parties
- Completing updated database searches and reviewing previous investigations/assessments
- Reviewing land use history and other relevant information to understand the activities that may have affected the preservation of Aboriginal archaeological deposits
- Identifying mitigation measures
- Preparing a cultural heritage assessment report (CHAR).

The assessment report will be prepared in accordance with:

- PACHCI
- Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW 2010a)
- Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales (DECCW 2010b).

5.10 Land use, social and business impacts

5.10.1 Overview

Characteristic of its inner urban location, the study area includes a varied mix of transport, industrial, commercial, residential and recreation land uses and facilities. The study area is located in three suburbs (St Peters, Mascot and Tempe), each with differing characteristics, community structures and resources.

The populations of these suburbs, based on data from the Australian Bureau of Statistics 2016 Census, are:

- St Peters – 3,145 people
- Tempe – 3,552 people
- Mascot – 14,772 people.

Land use

The main land uses in the study area are described below and are shown on Figure 5.6.

Transport and freight related uses

Sydney Airport is generally located to the south of the project site. Since 1921, when the Commonwealth Government purchased land in Mascot for the purpose of creating a public airfield, the airport has been progressively modified and expanded. Sydney Airport now occupies an area of around 907 hectares. Airport and Qantas drives and parts of Joyce Drive are located on airport land. To the east of Alexandra Canal, the majority of the project site is located on Sydney Airport land (shown on Figure 1.3). There are also areas of airport land located on the western side of Alexandra Canal.

Development and land use within Sydney Airport land must occur in accordance with the Sydney Airport Master Plan. The Preliminary Draft Sydney Airport Master Plan 2039 (SACL 2018) was released in August 2018. When finalised, it will replace the Sydney Airport Master Plan 2033 (SACL 2014a). The Preliminary Draft Sydney Airport Master Plan 2039 also includes mention of Sydney Gateway as a key project that would deliver a number of improvements to access to and from the airport.

The Sydney Airport Master Plan (SACL 2014a) provides land use zonings for Sydney Airport land. To the west of Alexandra Canal, Sydney Airport land in the project site is currently zoned AD3 (Airport logistics and support) by the master plan. To the east of the canal, airport land in the project site is zoned AD3 and AD2 (Airport terminal and support services). Under the master plan, roads are a permissible use in both these zones (SACL 2014a).

Other transport and freight related land uses in the study area include roads, passenger rail (the Sydney Trains T8 Airport and South Line), the Port Botany Rail Line and the Cooks River Intermodal Terminal. Further information is provided in section 5.2.1.

A large car park used by Sydney Airport staff (the northern lands car park) is located on airport land on the western side of Alexandra Canal. The car park is connected to Airport Drive via the Nigel Love Bridge.

Commercial and industrial

A range of commercial and industrial land uses, including a number of airline (eg Qantas) and freight related businesses and premises, are located in the northern part of the study area. These areas are located broadly to the east of Princes Highway in St Peters and to the west of O’Riordan Street in Mascot. This area is located on either side of Alexandra Canal and extends north through Alexandria towards the Sydney central business district.

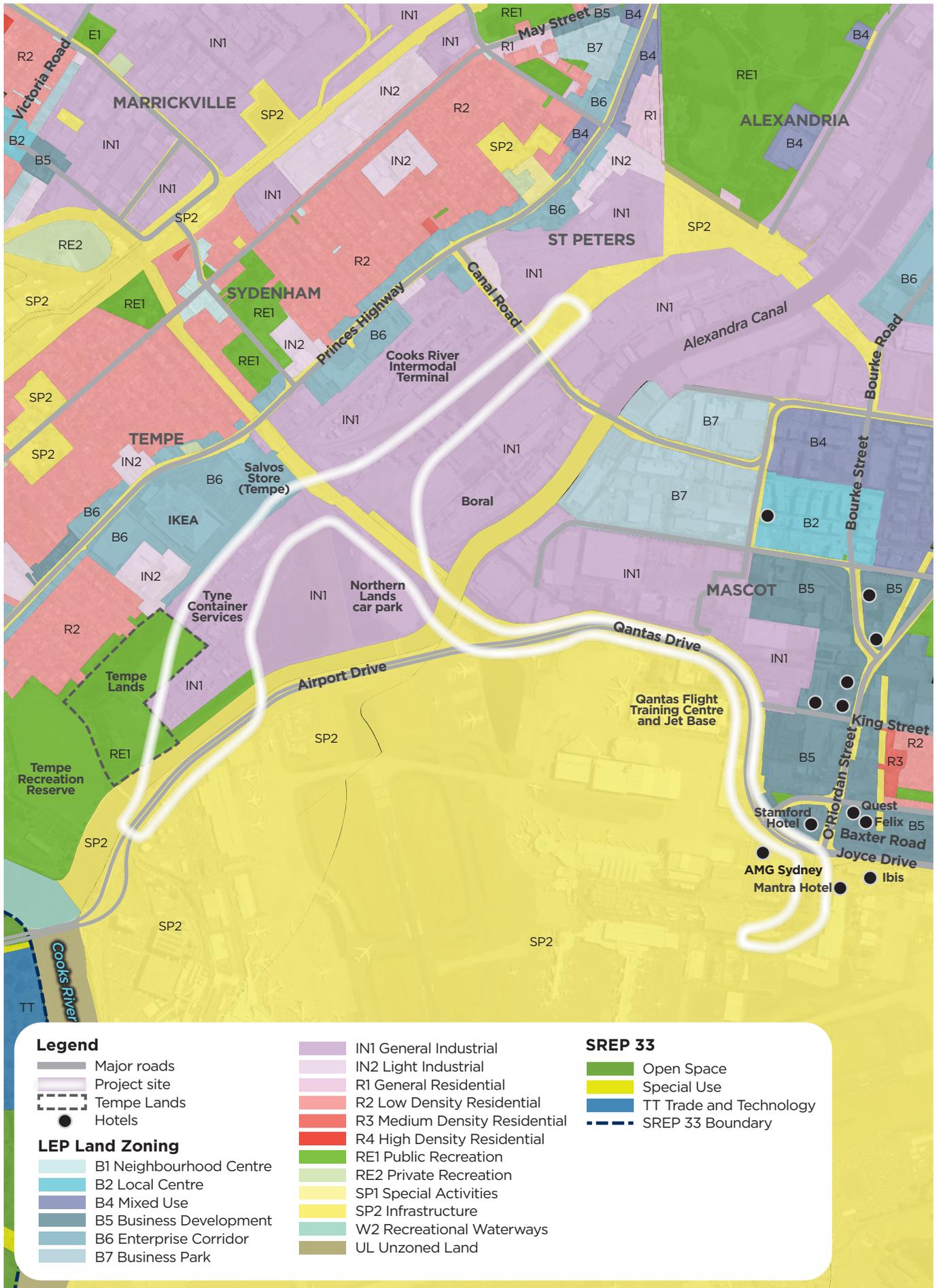


Figure 5.6 Land Use

Accommodation

A number of hotels are located in Mascot and at Sydney Airport. In the immediate vicinity of the project site these include:

- Stamford Plaza, located at the intersection of Qantas Drive and O’Riordan Street on the northern side of the Port Botany Rail Line
- Ibis and Mantra hotels, located adjacent to the project site at the intersection of Joyce and Sir Reginald Ansett drives
- Felix and Quest hotels, located close to the project site at the intersection of O’Riordan Street and Baxter Road.

The locations of these hotels are shown on Figure 5.6. There is also a hotel development site located on Qantas Drive between Seventh and Ninth streets.

Residential

The main areas of residential land uses are located at the south-western and eastern ends of the project site in Tempe and Mascot. As noted in section 5.3.1, the closest residences are located about 100 to 200 metres from the project site.

In the north of the study area, areas of traditional detached housing interspersed with low rise apartment buildings are located in Mascot to the east of O’Riordan Street. Areas to the west of O’Riordan Street, particularly in the vicinity of Mascot Station, are undergoing urban renewal, with a number of high-rise apartment and mixed use buildings developed, proposed or under construction.

Open space/recreation

Open space and recreation facilities are located at the Tempe Recreation Reserve and Tempe Lands in the vicinity of the south-western end of the project site (shown in Figure 5.6). Tempe Lands consists of land owned by Inner West Council that was formally part of the Tempe Tip site. The land was remediated and now contains a number of open space and recreation facilities (including the Tempe Golf Range and Academy, dog exercise area and Tempe Wetlands). Community sporting and recreation facilities in this area include:

- Robyn Webster Sports Centre
- Sporting fields/ovals
- Tempe Golf Range and Academy (privately operated)
- Fenced off-leash dog exercise area
- Open space area
- Wetland area (Tempe Wetlands) and walking paths
- BBQ and picnic facilities
- Playground
- Shared paths connecting to the path along the southern side of Alexandra Canal via a bridge over the canal
- Car parking facilities.

A number of sporting groups and community organisations use these facilities.

Community facilities

Community facilities near the project site are shown on Figure 5.6. The main community facilities in the immediate vicinity of the project site are the Tempe Recreation Reserve and Tempe Lands.

Mascot Public School is located about 600 metres to the north of the project site.

Business and economic characteristics

As described in section 2.1, Sydney Airport and Port Botany are two of the most important infrastructure assets in Sydney and Australia as a whole. The airport, port and businesses in the surrounding area are significant generators of economic activity. The area around and including Sydney Airport and Port Botany is one of the largest employment areas in Sydney. The airport itself generates a significant amount of employment including airport, airline, associated services and support staff. Further information on the economic significance of the airport and port, and the predicted growth in passengers, freight and employment, is provided in section 2.1.

Commercial/industrial premises and businesses located in close proximity to the project site include the following (shown on Figure 5.6):

- Boral's St Peters concrete and recycling facility, located at the northern end of the project site off Burrows Road
- Tyne Container Services, located to the south of the Port Botany Rail Line in Tempe, on part of the former Tempe Tip site (accessed via Swamp Road) – the project site passes through this site
- Maritime Container Services' operations at the Cooks River Intermodal Terminal
- Ikea's Tempe store, located off Princes Highway and adjacent to the project site
- Salvos Tempe store, located off Bellevue Street and adjacent to the project site
- AMG Sydney, a large car sales showroom and service centre, located at the corner of Qantas and Sir Reginald Ansett drives adjacent to the project site
- A number of large advertising billboards are located between Qantas and Joyce drives and the Port Botany Rail Line.

5.10.2 Summary of potential issues

Pre-construction

Full or partial property acquisition to accommodate construction of the proposed infrastructure and ancillary facilities would occur prior to construction commencing. The amount of acquisition and associated property impacts would be refined and confirmed during detailed design in consultation with landowners and occupants. All acquisitions would be conducted in accordance with the Roads and Maritime Land Acquisition Policy and the *Land Acquisition (Just Terms) Compensation Act 1991*.

Temporary leases of some areas may also be required to facilitate construction and the location of work areas and construction facilities. Existing land uses, site accessibility and potential opportunities to co-locate temporary use areas with operational infrastructure would be considered when determining the size and location of construction facilities. If the land required is not owned by the NSW Government, discussions would be held with the affected owner concerning the purchase or lease of the land required.

Construction

The need to occupy land for construction purposes would result in a temporary change in land use, with existing land uses making way for construction uses. Direct impacts on land use would include the presence of construction equipment, plant, vehicles, compounds and work sites. The use of land for construction would reduce the availability and extent of some land use types. For example, the use of some areas within Tempe Lands would reduce the availability of open space.

Construction has the potential to result in the following social and business issues:

- Impacts associated with property acquisition, including uncertainty for affected land and business owners about the acquisition process and the potential need to relocate some or all of their operations
- Changes to connectivity and access for some residents, visitors, businesses and employees, including as a result of diversions/changes to access in the immediate vicinity of the project site and any changes to how the Sydney Airport terminals are accessed during construction
- Impacts to community and business amenity, including as a result of changes to traffic, noise, air quality and the visual environment
- Impacts to Tempe Recreation Reserve and Tempe Lands, including restrictions on the use of some areas and amenity impacts for users
- Employment and business opportunities as a result of the generation of construction related jobs, revenue for businesses providing construction facilities and resources, and increased patronage for some businesses providing services for employees in the vicinity of the project site
- Temporary impacts to some billboards, including any changes in location or visibility.

As noted in section 4.3, construction also has the potential to affect utilities within and close to the project site (including communications, power, water and wastewater utilities). The approach to managing affected utilities will be confirmed as part of design development and described in the EIS/draft MDP.

Operation

Operational impacts to land use would mainly affect those areas of the project site to the west of Alexandra Canal. The use of land occupied by the project site would change from the existing uses (described in section 5.10.1) to transport uses (road). Potential social and business issues include:

- Impacts to businesses and land owners occupying land subject to property acquisition
- Impacts on the amount, connectivity and functionality of open space and recreation uses in Tempe Lands and the resulting loss of open space (currently used by the Tempe Golf Range and Academy and the dog exercise area) in an area where there is already a shortage of open space (if the loss cannot be offset)
- Impacts on amenity and the use of other nearby community facilities and areas within the Tempe Recreation Reserve and Tempe Lands as a result of the presence of the project
- Changes to land use and future development potential, including as a result of any severance or sterilisation of land
- Impacts to the advertising billboards along Qantas Drive
- Changes to connectivity and access in and around the project site
- Impacts to community and business amenity, including as a result of changes to traffic, noise, air quality and the visual environment.

The project would offer transport, access and economic benefits for Sydney Airport, Port Botany and surrounding businesses. The project also has the potential to benefit the Mascot and Botany communities by reducing the proportion of heavy vehicles using local roads.

5.10.3 Proposed further assessment

Land use and property

A land use and property assessment will be undertaken to assess the potential impacts of construction and operation. It will include:

- Identifying land uses, ownership and existing access arrangements
- Reviewing relevant planning instruments, regional plans, land use strategies and open space strategies and plans
- Considering future land uses where these are identified in strategic planning documents
- Confirming acquisition requirements
- Assessing potential impacts on land use and property during construction and operation
- Considering potential impacts to utilities and how these would be managed during construction
- Identifying mitigation measures, including potential opportunities to enhance or upgrade open space within Tempe Lands or provision of new areas of open space.

Social

A social impact assessment will be undertaken to assess the potential impacts of construction and operation. It will include:

- Analysing available community data, including from the Australian Bureau of Statistics 2016 Census, NSW Bureau of Crime Statistics and Research, and Inner West, Bayside and City of Sydney councils
- Reviewing the characteristics of communities in the study area and preparing a profile of communities with the potential to be affected by the project
- Identifying community facilities in the study area
- Analysing the outcomes of community consultation in relation to community values (including the values attached to places or facilities), issues and concerns
- Reviewing the results of other relevant specialist assessments
- Assessing the potential impacts and benefits of the project during construction and operation
- Identifying mitigation measures
- Considering cumulative social impacts from construction and operation of the project and other projects within the same time period and/or area.

The assessment will follow the Environmental Planning and Impact Assessment Practice Note N05 – Socio-Economic Impact Assessment (Roads and Maritime 2013a).

Business

A business impact assessment will be undertaken to assess the potential impacts of construction and operation. It will include:

- Describing the existing business and economic environment
- Reviewing background information and relevant data from the Australian Bureau of Statistics, Transport for NSW's Transport Performance and Analytics unit, and Inner West and Bayside councils
- Identifying businesses with the potential to be affected by the project and describing how they might be impacted, including a survey of representative businesses
- Reviewing the results of other specialist assessments

- Assessing the potential impacts and benefits of the project
- Identifying mitigation measures
- Considering cumulative impacts to businesses from construction and operation of the project and other projects within the same time period and/or area.

5.11 Urban design, landscape character and visual amenity

5.11.1 Overview

The landscape and visual environment of the study area is characterised by its highly developed urban nature. The landscape is dominated by Sydney Airport and its facilities, which include large expanses of open and paved areas (the runways and surrounding land), roads, large terminal and freight facilities, and various other buildings and infrastructure. The airport is highly visible from numerous viewpoints in the study area.

The heritage listed Alexandra Canal also contributes to the character of the study area, bisecting the study area and project site in a roughly north–south direction. Views to the canal are available from a number of locations, including from Tempe Recreation Reserve, from the shared path along the canal and from Airport Drive.

Other landscape and visual characteristics are influenced by the existing land uses described in section 5.10.1. Key influences on the character of the project site and study area include:

- Port Botany Rail Line
- Tempe Recreation Reserve and Tempe Lands
- Freight logistics and container storage areas to the west of Alexandra Canal
- Large commercial and industrial buildings (such as Ikea in Tempe, numerous commercial buildings in Mascot and the hotels near the airport)
- The mixed use character of Mascot between Alexandra Canal and O’Riordan Street
- Low-rise residential areas to the west and east of the project site.

Sensitive visual receivers in the vicinity of the project site include:

- Motorists, pedestrians and cyclists, including those using shared paths near the project site
- Residents within apartment buildings or individual dwellings that have clear views of the project site
- Guests staying at hotels that have clear views of the project site
- Workers in commercial buildings that have clear views of the project site
- Users of Tempe Recreation Reserve and community facilities within Tempe Lands.

5.11.2 Summary of potential issues

Pre-construction/detailed design

Consistent with the role and visibility of the project, urban design, including the appearance and visual form of the project, has been and would continue to be an important consideration in the design process. An urban design and landscape concept is being prepared to support the design in accordance with Beyond the Pavement - Urban Design Policy, Procedures and Design Principles (Roads and Maritime 2014)

(Beyond the Pavement). Beyond the Pavement identifies the following urban design principles for 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.

The urban design and landscape concept will define the urban design vision and objectives, and provide design concepts, strategies and principles for the detailed design. It will also consider opportunities to incorporate place-making considerations in the design. Place-making is becoming an integral component of the urban design process. Place-making can be defined as a multi-faceted approach to the planning, design and management of public spaces, which aims to create public spaces that promote people's health, happiness and well-being. Place-making aims to create places for people with meaning and identity (Hammonds 2011).

Construction

The project would result in temporary visual impacts during construction. These impacts would be experienced by sensitive visual receivers in the vicinity of the construction works and from areas with views of the project site.

During construction, visible elements would include work sites, operational infrastructure under construction, machinery and equipment, fencing, stockpiles, waste materials, compounds and lighting (during night works).

There would also be a reduction in green space in Tempe as a result of the works in Tempe Lands.

Operation

The project would introduce new road infrastructure into the study area, which would be visible from a number of viewpoints. Potential visual and landscape issues include:

- The visibility and appearance of new infrastructure from sensitive receivers, particularly:
 - Bridges and elevated sections
 - Billboards and signage, including any change to the location or form of the existing billboards
 - Any urban design features relating to the 'gateway' function of the project
 - Any permanent noise mitigation measures, such as noise barriers
- Impacts on the landscape characteristics and visual amenity of Tempe Recreation Reserve and Tempe Lands
- Impacts on the character and appearance of Alexandra Canal as a result of the proposed new bridges, including the provision of any piers within the canal
- Removal of mature trees and vegetation in some areas
- Integration with the design of adjoining and nearby projects and developments, including St Peters interchange, the Port Botany Rail Duplication and developments at Sydney Airport.

The visual impact would depend on the proposed design features and treatments and the location of sensitive receivers.

5.11.3 Proposed further assessment

Urban design and place-making

A comprehensive urban design and place-making analysis will be undertaken as an input to the design and EIS/draft MDP. It will include:

- Considering the existing urban context and infrastructure (including built form and public domain conditions, landscape elements, and existing and proposed services)
- Recognising the significance of the study area in terms of its gateway function
- Identifying how functional 'place' outcomes of public benefit would be achieved
- Giving consideration to adjacent areas identified for future urban renewal
- Identifying urban design strategies and opportunities to achieve high quality landscaping, streetscapes, architecture and design, and enhance healthy, cohesive and inclusive communities, including in relation to accessibility and connectivity
- Identifying opportunities to enhance the visual, recreational and biodiversity values of Tempe Lands
- Identifying opportunities to recognise the heritage significance of Alexandra Canal
- Identifying opportunities to recognise the Aboriginal cultural heritage significance of the study area
- Considering residual land, identifying opportunities to use surplus or residual land, particularly for the provision of community space
- Considering the use of crime prevention through environmental design (CPTED) design principles for elements including lighting, shared paths, signage and landscaping
- Exploring opportunities to enhance the immediate and broader urban context.

The assessment will be undertaken with reference to the following:

- Beyond the Pavement
- Better Placed (Government Architect NSW 2017)
- Bridge Aesthetics: Design guidelines to improve the appearance of bridges in NSW (Roads and Maritime 2012).

Visual impact assessment

A landscape character and visual impact assessment will be undertaken to assess the potential impacts of construction and operation. It will include:

- Identifying the existing landscape and features, including the existing landscape character, visual catchments and sensitive viewpoints and receivers
- Reviewing the design principles, objectives, urban design considerations and design features
- Assessing the impacts of construction and operation in accordance with the Environmental Impact Assessment Guidance Note – Guidelines for landscape character and visual impact assessment (EIA-N04) (Roads and Maritime 2013b)
- Identifying mitigation measures, including consideration of measures to mitigate the potential visual impacts on open space and recreation areas in Tempe.

5.12 Cumulative impacts

5.12.1 Overview

Sydney Gateway

In general terms, the assessment of cumulative impacts needs to consider the issues specific to each component of Sydney Gateway (the Sydney Gateway Motorway road project and the Port Botany Rail Duplication) when grouped together. The approach will differ according to the characteristics of each issue and for construction and operation. The overall approach will be to consider the following cumulative scenarios:

- Construction of both projects together
- Both projects operating concurrently.

Other major infrastructure projects

Other major infrastructure projects occurring within and around the study area and the broader transport network would have the potential for cumulative impacts with the project. Table 5.5 lists projects approved or under construction that would be considered as part of the cumulative impact assessment. Other projects or programs that would also be considered (consistent with the level of information available) include larger developments around the project site and developments identified by the Sydney Airport Master Plan.

Table 5.5 Major infrastructure projects

Project	Description	Project status
WestConnex New M5	A new section of the M5 South Western Motorway including a new interchange at St Peters.	Construction ongoing to 2020
WestConnex M4-M5 Link	A new inner western bypass of the Sydney central business district connecting the M4 and M5.	Construction ongoing to 2023
Airport East works	Upgrading roads east of the Sydney Airport, including removing the rail level crossing at General Holmes Drive and constructing a road underpass.	Construction ongoing to 2018
Airport North works	Upgrading roads to the north of Sydney Airport	Construction ongoing to 2019
F6 Extension – New M5 Arncliffe to President Avenue, Kogarah	Construction of two twin motorway tunnels between the New M5 at Arncliffe and President Avenue at Kogarah.	Application submitted 2017 Expected to take four years to construct
Sydney Metro City and South West; Sydenham to Bankstown	The upgrade and conversion of 10 Sydney Trains stations between Marrickville and Bankstown to metro standards.	2018-2024

5.12.2 Summary of potential issues

Construction

Concurrent construction of the project, the Port Botany Rail Duplication and the projects outlined in Table 5.5 has the potential to result in adverse cumulative impacts. Cumulative impacts would be largely related to traffic, transport and access, noise and vibration, air quality, social and business impacts and visual impacts.

Operation

The simultaneous operation of the project, the Port Botany Rail Duplication and other significant infrastructure projects has the potential to generate both impact and benefits.

The operation of the project, together with projects listed in Table 5.5, would offer the potential for cumulative traffic and transport benefits. This would include benefits in relation to the transport of freight and improving access to Sydney Airport and Port Botany from the regional road network.

The majority of adverse impacts would be localised and would largely be related to amenity impacts on the local community. This may potentially include impacts to local traffic conditions, noise and vibration, air quality, social and business impacts and impacts to visual amenity.

5.12.3 Proposed further assessment

The EIS/draft MDP will include an assessment of potential cumulative impacts and benefits. The assessment will consider the potential for cumulative impacts of the project with the Port Botany Rail Duplication, as well as other projects in the study area (approved or under construction), with a particular focus on WestConnex projects and the F6. It will also include consideration of the cumulative benefits of the operation of both Sydney Gateway projects together, and the operation of Sydney Gateway with other key road and rail projects.

Any impacts or interrelationships identified will be used to develop mitigation strategies to minimise and manage cumulative impacts during construction and operation.

6. Other environmental issues

6.1 Overview

Other environmental issues listed in this section 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 mitigation measures. It is considered unlikely these would be key issues for the project; however, further assessment would be carried out as part of the EIS/draft MDP. Measures to minimise and mitigate the potential impacts would be documented in the EIS/draft MDP.

6.2 Biodiversity

6.2.1 Overview

Most of the study area consists of disturbed land, which has been subject to historical vegetation clearing, reclamation, development, landscaping and weed invasion. The main area of biodiversity value near the project site are located at Tempe Lands. Other areas are located further to the southwest at Cooks River, and further to the southeast at the Botany Wetlands.

Table 6.1 provides an overview of the biodiversity values of the study area. Figure 6.1 shows the locations of threatened species and communities mapped within the study area. Appendix C provides a summary of threatened flora and fauna (listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) and/or the EPBC Act) mapped within 10 kilometres of the project site.

Table 6.1 Overview of biodiversity values

Category	Description
Threatened fauna	<p>Seventy-five threatened fauna species and two threatened fauna populations listed under the EPBC Act and/or the BC Act, or potential habitat for these species, have been recorded or are predicted to occur within 10 km of the project site. Key listed threatened fauna populations include:</p> <p>Green and Golden Bell Frog</p> <p>A key population of the Green and Golden Bell Frog (<i>Litoria aurea</i>), which is listed as an endangered species under the BC Act and as a vulnerable species under the EPBC Act, is associated with the Lower Cooks River area. The key population incorporates the sub-population within the wetlands near Marsh Street in Arncliffe and a small sub-population in Rosebery, as well as areas where the species was previously known to occur, including wetlands associated with Shea's Creek (Alexandra Canal) and Mill Stream in Botany (DECC 2008). No individuals were recorded at Tempe Wetlands during various targeted surveys in recent years. The management plan for the key population notes that Alexandra Canal could provide a link between the two remaining populations if rehabilitated (DECC 2008).</p> <p>Long-nosed Bandicoot</p> <p>The Long-nosed Bandicoot Population in inner western Sydney (<i>Perameles nasuta</i>), is listed as an endangered population under the BC Act. This species has been mainly recorded at Dulwich Hill, Lewisham and Leichhardt.</p>
Threatened flora	<p>Forty-three threatened flora species and one threatened flora population have been recorded or are predicted to occur within 10 km of the project site.</p>

Category	Description
Threatened ecological communities	<p>Twenty-three listed threatened ecological communities have been recorded or are predicted to occur within 10 km of the project site. The location of threatened communities is shown on Figure 6.1. Communities near the project site are described below.</p> <p>Swamp Oak Floodplain Forest</p> <p>One threatened ecological community (Swamp Oak Floodplain Forest) has been mapped and ground-truthed in the vicinity of the project site to the northwest of Alexandra Canal in Tempe Lands.</p> <p>The community ‘Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East corner bioregions’ is listed under the BC Act as an endangered ecological community. Better condition stands of this community have recently been listed under the EPBC Act as ‘Coastal Swamp Oak (<i>Casuarina glauca</i>) Forest of South-east Queensland and New South Wales endangered ecological community’. The area of Swamp Oak Floodplain Forest near the project site may be commensurate with the EPBC Act listed community. Further surveys would be undertaken to confirm the extent, condition and conservation status of this community.</p> <p>Coastal Saltmarsh</p> <p>Coastal Saltmarsh, which is listed as an endangered ecological community under the BC Act and as a vulnerable ecological community under the EPBC Act, is likely to occur downstream of the project site along the Cooks River.</p>
Migratory and marine species	<p>Twenty-four listed migratory and/or marine species have been recorded or are predicted to occur within 10 km of the project site. There are many records of migratory waders in the wetland areas near the project site (described below).</p>
Wetlands	<p>Tempe Wetlands</p> <p>Part of the south-western end of the project site is located within the Tempe Lands (refer to section 5.10.1 and Figure 5.6). The Tempe Lands include areas of artificial freshwater and brackish (slightly salty) wetlands known as the Tempe Wetlands. The Tempe Wetlands are located near the project site.</p> <p>Other wetlands</p> <p>Other wetlands located in the study area are described below. These areas would not be directly impacted by the project.</p> <p><i>Botany Wetlands</i></p> <p>The Botany Wetlands (also known as Botany Water Reserves or Botany Swamps) are located about 1 km to the southeast of the project site. The Botany Wetlands is the largest coastal freshwater lakes complex and largest freshwater wetland in Sydney. The Botany Wetlands is a nationally important wetland, listed in the Directory of Important Wetlands in Australia. It is listed as ‘a good example of a wetland type occurring within a biogeographic region in Australia’ and ‘of outstanding historical or cultural significance.’</p> <p><i>Rockdale Wetlands Corridor</i></p> <p>The Rockdale Wetlands Corridor, a remnant of the once extensive wetlands located along the western shore of Botany Bay, is located around 1.3 km to the south of the project site. The corridor extends from Cooks River to Sans Souci. Eve Street Marsh, which is located at the northern end of the Rockdale Wetlands Corridor, is listed on the directory of important wetlands in Australia.</p>

Category	Description
	<p><i>Towra Point Wetlands</i></p> <p>Towra Point Wetlands is located about 8.5 km south of the project site on the opposite side of Botany Bay. The wetland is designated as a wetland of international importance (a Ramsar site) and is the largest wetland of its type in the Sydney Basin Bioregion.</p>
Aquatic habitat	The project site crosses Alexandra Canal and is located near the Cooks River, which is mapped as key fish habitat. Other areas of potential aquatic habitat include the Tempe Wetlands.
Groundwater dependent ecosystems	The Freshwater Wetlands at Eastlakes is the closest groundwater dependent ecosystem to the project site, located about 1 km to the east of the project site within the Lakes golf course and Botany Wetlands.
Mature trees	There are a number of mature planted trees along the northern side of Qantas Drive. These trees may provide some feeding and roosting resources for wildlife.
Wildlife corridors and connectivity	Tempe Lands is located within land mapped as a wildlife corridor by the Marrickville LEP.
Priority weeds	There is the potential for a range of priority weeds declared under the <i>Biosecurity Act 2015</i> as well as environmental weeds to be present in the study area.

6.2.2 Summary of potential issues

Construction

Given the developed nature of the majority of the study area, the project would have limited potential to impact biodiversity. The main potential for direct impacts would be to the area of Swamp Oak Floodplain Forest at Tempe Lands, identified as part of surveys undertaken by SMEC in 2016, and to mature trees along Qantas Drive. Other potential issues include:

- Potential for indirect impacts to Tempe Wetlands
- Potential for indirect impacts to aquatic habitats downstream of the project site as a result of changes to hydrology, water quality and groundwater
- Impacts on mature street trees and associated impacts on foraging habitat for Grey-headed Flying-fox
- Impacts to connectivity between habitat areas
- Mortality of fauna during construction
- Indirect impacts on areas downstream of the project site
- Introduction and/or spread of priority weeds and other invasive species.

Operation

Potential biodiversity issues during operation include:

- Polluted runoff or contamination from spills, which could affect watercourses, wetland areas or downstream areas
- Spread or introduction of weeds into remnant vegetation and wetland areas near the project site.

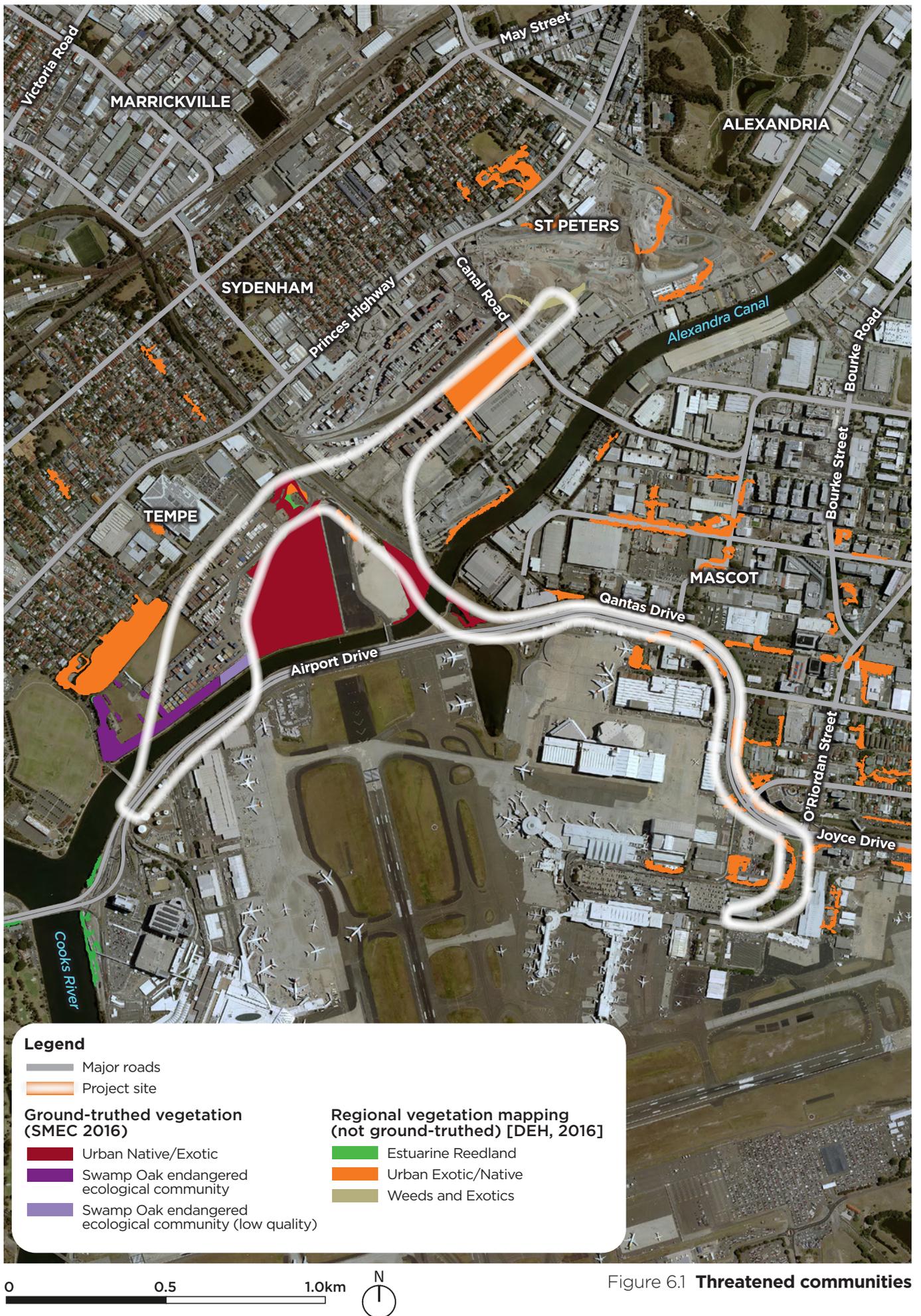


Figure 6.1 **Threatened communities**

6.2.3 Proposed further assessment

A biodiversity development assessment report will be prepared in accordance with the provisions of the BC Act and relevant guidelines and requirements, including:

- The Biodiversity Assessment Method (OEH 2017b)
- Policy and guidelines for fish habitat conservation and management (DPI 2013)
- Risk assessment guidelines for groundwater dependent ecosystems (NSW Office of Water 2012a).

The assessment will include:

- Reviewing existing information and database records
- Conducting staged field surveys, including vegetation mapping, plot/transects, threatened flora searches, and fauna and fauna habitat surveys
- Identifying the extent of native vegetation within and adjoining the project site
- Assessing the potential impacts on biodiversity, including impacts on threatened species, populations and ecological communities and habitat
- Identifying mitigation measures
- Identifying impacts requiring offsetting, and the requirements and options for offsetting
- Conducting assessments of significance pursuant to the EPBC Act significant impact guidelines for impacts on matters of national environmental significance, and the NSW *Fisheries Management Act 1994* for threatened aquatic biota (if required).

6.3 Soils, landform and geology

6.3.1 Overview

Topography and geology

The study area is relatively flat and low-lying, with gentle undulations ranging in elevation from about zero to 30 metres Australian Height Datum.

The study area is in the Botany Basin, which is a subregion of the Sydney Basin. The underlying geology consists of a mixture of peat, sandy peat, mud, coarse quartz sand with varying amounts of shell fragments and medium to fine grained marine sand with podsoils. This reflects the mixed marine and river delta history of the area.

Reclamation and stabilisation of the Sydney Airport lands altered the original southern drainage channel networks of Sheas Creek and Cooks River, which were diverted around the airport. Other influences on landform include drainage and reclamation of the original swamps, estuaries and wetlands that surrounded Botany Bay, landfill activities and extensive cut/fill works.

A band of Ashfield Shale (Rwa) underlies a series of low crests running northeast to southwest, parallel to the western part of the project site. Ashfield shale comprises black to dark grey shale and laminate. Minor occurrences of Hawkesbury Sandstone (Rh) are also mapped to the west of the Cooks River.

Most the study area is mapped as 'disturbed terrain', which extends across Sydney Airport land, the lower reaches of the Cooks River, Alexandra Canal, Mascot and into Tempe and St Peters. Disturbed terrain is described as areas extensively disturbed by human activity, including complete disturbance, removal or burial of original soils.

Introduced fill, including dredged estuarine sand and mud, demolition rubble, industrial and household waste is also found in many areas.

Soils

Soil landscapes within the study area predominantly consist of disturbed terrain, with the exception of the north-western extent of the project site, which is underlain by the residual Blacktown soil landscape. The key characteristics of these soil landscapes are listed in Table 6.2.

Table 6.2 Soil landscapes

Soil landscape	Characteristics	Erosion/mass movement potential
Disturbed terrain	Original soil materials have been removed, greatly disturbed or buried, and landfill including soil, rock, building and waste materials may have been added. Variable relief and slopes.	Dependent on the nature of the disturbed soil or fill. Could result in mass movement hazard, low fertility, soil impermeability and poor drainage. Source of sedimentation and groundwater contamination.
Blacktown (residual landscape)	Shallow to moderately deep (<1 m) Red and Brown Podzolic Soils. Occurs on gently undulating rises on Wianmatta Group Shales.	Moderately reactive, highly plastic soil with poor drainage. No appreciable erosion occurs on this unit as the land surface within the project site is generally paved.

Saline soils

Areas prone to salinity are usually at low positions in the landscape, such as in valley floors and along floodplains. The OEH NSW Soil and Land Information System contains data points identifying evidence of soil salinity where soils have been sampled previously. A review of this database indicated that no salting was evident at sample locations in the vicinity of the project site (within one kilometre).

Acid sulfate soils

Most of the low-lying areas surrounding Alexandra Canal are mapped as potentially containing acid sulfate soils. Acid sulfate soils and potential acid sulfate soils are naturally occurring soils containing iron sulfides. On exposure to air, iron sulfides oxidise and create sulfuric acid. This increase in acidity can result in the mobilisation of aluminium, iron and manganese from the soils.

Table 6.3 lists the acid sulfate classifications of land within and in the vicinity of the project site. The classifications are based on NSW Government acid sulfate soil risk mapping.

Table 6.3 Acid sulfate soil classifications

Location	Class	Work which would potentially expose acid sulfate soils
Alexandra Canal	1	Any works or any work below natural ground.
Qantas Drive – Alexandra Canal to Kent Road	2	Work beyond the natural ground surface and work by which the water table is likely to be lowered.
Qantas Drive – Kent Road to O’Riordan Street	2/3	Work beyond one metre below natural ground surface and work by which the water table is likely to be lowered one metre below natural ground surface.
Airport Drive and Link Road near Terminal 1	2/3	
Canal Road to Alexandra Canal	3	

6.3.2 Summary of potential issues

Construction

Potential issues associated with excavation and ground disturbance activities include:

- Erosion of exposed soil and stockpiled materials
- Exposure of soil containing acid sulfides to oxygen, resulting in the production and mobilisation of sulfuric acid
- Potential for localised changes to landform such as earth embankments and cut or fill areas
- Dust generation from excavation, backfilling and vehicle movements over exposed soil.

Potential issues due to the disturbance and exposure of contaminated soils are considered in section 5.6. Potential water quality issues associated with the mobilisation of sediments into receiving watercourses are considered in section 5.7.

Operation

Operation is not likely to result in any significant impacts on soils, topography or geology. The risk of soil erosion during operation would be minimal, as all areas impacted during construction would be sealed or rehabilitated and landscaped to prevent soil erosion from occurring.

6.3.3 Proposed further assessment

The assessment will include:

- Assessing the risk of soil erosion and sedimentation
- Assessing the potential impact of acid sulfate soils in accordance with the Guidelines for the Management of Acid Sulfate Materials (RTA 2005) and Part 4 (Acid sulfate soils) of the Waste classification guidelines (EPA 2014b)
- Considering the potential impacts of soil exposure during earthworks, which may result in soil erosion and off-site transport of eroded sediments to receiving waterways
- Identifying mitigation measures.

6.4 Resources and waste

6.4.1 Overview

The main legislation relevant to the management of waste in NSW are the *Protection of the Environment Operations Act 1997* (POEO Act), the *Protection of the Environment Operations (Waste) Regulation 2014* (Waste Regulation) and the *Waste Avoidance and Resource Recovery Act 2001* (the WARR Act).

The POEO Act establishes the procedures for environmental control and for issuing environmental protection licences covering issues such as waste. The Waste Regulation regulates matters such as the obligations of consignors (producers and agents), transporters and receivers of waste in relation to waste transport licensing and tracking requirements.

The WARR Act aims to ensure that waste management options are considered against the following waste management hierarchy:

1. Avoidance of unnecessary resource consumption
2. Resource recovery (including reuse, reprocessing, recycling and energy recovery)
3. Disposal.

To support the hierarchy, the *NSW Waste Avoidance and Resource Recovery Strategy 2014–21* (EPA 2014a) provides a framework and targets for waste management and recycling in NSW. Roads and Maritime has a general responsibility to support these targets by:

- Implementing complementary policies and programs, including sustainable procurement
- Incorporating resource recovery and waste reduction objectives into its operations
- Complying with relevant regulations.

It is an offence under the Waste Regulation to transport waste generated in NSW more than 150 kilometres from the place of generation for disposal, unless the waste is transported to one of the two lawful disposal facilities nearest to the place of generation.

The movement of controlled waste is also regulated by the *National Environment Protection (Movement of Controlled Waste between States and Territories) Measure 1998*.

Waste definition and classification

Schedule 5 of the POEO Act defines the characteristics of a 'waste'. The classifications that apply to waste in NSW and the descriptions of each are provided by the POEO Act and the Waste Regulation and supporting guidelines, including the *Waste Classification Guidelines* (EPA 2014b). Many waste types are pre-classified under the POEO Act and do not require testing. However, if a waste is not pre-classified, it may need to be tested to determine its classification.

6.4.2 Summary of potential issues

Construction

Resources

Large quantities of materials would be required to construct the project, including concrete, asphalt, steel, gravel, sand, aggregate and road base. These would be sourced from relevant quarries, manufacturers and suppliers.

Construction water would also be required for activities such as compaction of pavement materials and dust suppression. Potable water could be sourced from within or outside the study area and from potable water supplies. The final estimated volume, source and quality for construction water would be documented in the EIS/draft MDP.

Waste

The majority of waste associated with the project would be generated during construction and may include:

- Excavation waste (spoil)
- Demolition waste (if required)
- Wastewater
- Hazardous waste/contaminated spoil

- Vegetation waste
- Liquid waste (including contaminated groundwater)
- Other construction waste
- General wastes from site workers and personnel.

Wastes would be managed in accordance with the waste provisions contained within the POEO Act and, where reused off site, would comply with relevant EPA resource recovery exemptions.

As described in section 5.6, contaminated material is likely to be encountered at a number of locations within the project site, including within the former Tempe Tip site. Contaminated materials and sediments would be managed in accordance with the recommendations of the contamination assessment (described in section 5.6.3).

Other issues include:

- Identifying waste management and disposal options that meet legislative and stakeholder requirements
- Developing a waste management strategy for the project
- Aligning the approach to resource and waste management with the sustainability drivers for the project (described in section 6.6)
- Potential impact on resource availability as a result of resource use requirements.

Operation

The volume of wastes generated during operation would be considerably lower than during construction. Wastes would be typical of similar road facilities. Wastes would be managed by the implementation of standard waste management strategies.

6.4.3 Proposed further assessment

The EIS will provide further details on resource and waste management for the project, including:

- Estimating the quantity of key waste types that may be generated
- Identifying the approximate resource requirements for the project, including estimation of key materials and water requirements
- Identifying a management hierarchy to reduce the volume of spoil needing to be disposed
- Identifying the availability of materials from the region, including from quarries, potential material suppliers and reuse of materials
- Identifying available potable water supplies
- Assessing the potential waste management approach and impacts, in consultation with relevant agencies
- Summarising the approach to managing contaminated soil (consistent with the outcomes of the contamination assessment)
- Identifying mitigation measures
- Identifying opportunities to use recycled materials provided they are fit for purpose and meet engineering requirements.

6.5 Risks, health and safety

6.5.1 Overview

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

The main potential risks in the study area relate to Sydney Airport and its operations. The potential for risks to the operation of the airport and aviation safety is a key issue that needs to be considered during the design of the project and by the EIS/draft MDP. Further information is provided in section 5.5.

This section considers other potential risks that may affect human health and safety during construction and operation. Other issues relate to:

- Hazardous materials and dangerous goods
- Risks to the safety of workers and the community within and in the vicinity of the project site
- The potential for health impacts associated with changes to the noise and air environment.

6.5.2 Summary of potential issues

Construction

Potential issues during construction include:

- Risks associated with the accidental release of dangerous or hazardous materials to the environment due to improper handling or storage, or in the event of a vehicle or construction equipment incident
- Risk of exposure to contaminated soil and groundwater via direct contact and/or inhalation, particularly near the former Tempe Tip site
- Risks associated with the accidental release of contaminated groundwater or soil to the environment
- Risks of exposure to increased levels of noise and dust from work sites and construction vehicles
- Risks associated with accidental interference and damage to live underground services
- Risk of exposure to hazardous materials during any building and structure demolition
- Changes to vehicle, cyclist and pedestrian routes and access resulting in unsafe conditions or potentially affecting emergency services access
- Flash flooding or inundation of construction work areas during heavy rainfall

Other construction activities could result in impacts to the health and safety of site workers, users, visitors and the local community if improperly managed. These include:

- Working within an operating road environment
- Working within a rail corridor
- Operation of vehicles and construction equipment on site
- Transportation of equipment, excavated spoil and material to and from site
- Construction failures or incidents resulting in flooding, inundation or excavation collapse.

In addition to the above, there is the potential for risks to pedestrians/public safety resulting from unauthorised access to construction work areas.

NSW workplace safety laws require construction sites to have adequate site security, which includes appropriate fencing. All construction work would be isolated from the general public. The construction contractor/s would need to ensure that construction sites are secure at all times and take all possible actions to prevent entry by unauthorised persons.

Health and safety risks during construction would be managed by the implementation of standard workplace health and safety requirements. A work health and safety management plan, and safe work method statements, would be developed in accordance with regulatory requirements.

Operation

Potential issues during operation include:

- Storage, handling and transport of dangerous goods and hazardous materials during operation
- Risks associated with the accidental release of dangerous or hazardous materials to the environment in the event of a vehicle accident
- Exacerbation of flooding and inundation of low lying areas during extreme rainfall events due to the project
- The potential for health impacts or benefits associated with changes to the noise and air environment

6.5.3 Proposed further assessment

A risks and health assessment will be undertaken for the EIS/draft MDP. The assessment will include:

- Reviewing the relevant regulatory framework and applicable guidelines, including:
 - Australian Code for the Transport of Dangerous Goods by Road & Rail (National Transport Commission 2017)
 - NSW Dangerous Goods (Road and Rail Transport) Regulation 2009
 - Managing asbestos in or on soil (WorkCover NSW 2014)
 - Hazardous and Offensive Development Application Guidelines: Applying SEPP 33 (Department of Planning 2011) (Applying SEPP 33)
- Identifying construction and operational activities with the potential to cause impacts to off-site receivers
- Considering the potential impacts associated with hazardous materials, as defined by Applying SEPP 33
- Describing the design features of the project that would manage risk and hazards during the operational stage
- Qualitatively assessing potential impacts, including reviewing the results of the contamination assessment, noise and vibration assessment and the air quality assessment in relation to the potential for health impacts
- Identifying mitigation measures.

6.6 Sustainability

6.6.1 Overview

In NSW, the concept of ecologically sustainable development was introduced into planning and development legislation by the EP&A Act. One of the objectives of the EP&A Act is 'to facilitate ecologically sustainable development by integrating relevant economic, environmental and social considerations in decision-making about environmental planning and assessment'.

In accordance with schedule 2 (clause 7(1)(f)) of the Regulation, an EIS is required to include ‘the reasons justifying the carrying out of the development, activity or infrastructure in the manner proposed, having regard to ... the principles of ecologically sustainable development set out in subclause (4)’

The Infrastructure Sustainability Council of Australia (ISCA) is the peak industry body for advancing sustainability outcomes in infrastructure through its Infrastructure Sustainability Rating Tool. For infrastructure projects, ‘infrastructure sustainability’ is defined by ISCA as ‘infrastructure that is designed, constructed and operated to optimise environmental, social and economic outcomes over the long term’.

Roads and Maritime is committed to embedding sustainability considerations into its business. Roads and Maritime’s Environmental Sustainability Strategy 2015–19 (Roads and Maritime 2016) aims to maximise project benefits through effective stakeholder engagement and integration of sustainability considerations throughout all phases of the project lifecycle. Specifically, the strategy aims to:

- Contribute to a more sustainable transport system in NSW
- Reduce the environmental footprint of their own activities
- Minimise the resources used to build and maintain road and maritime infrastructure
- Reduce the environmental impacts associated with the goods and services purchased and help improve the sustainability performance of organisations Roads and Maritime does business with.

6.6.2 Summary of potential issues

Construction

Construction issues relating to sustainability outcomes include:

- Environmental impacts as a result of construction activities (eg water quality, contaminated land, heritage and biodiversity impacts)
- Managing the generation of waste and discharges to air, land and water
- Consumption of electricity, fuel, water and materials for construction activities
- Management and disposal of contaminated soils and groundwater
- Scope 1, 2 and 3 greenhouse gas emissions generated during construction
- Social and community impacts including amenity, access and health and safety
- Sustainable procurement of goods and services with consideration of whole of life impacts and opportunities to maximise social benefits
- Communication and engagement with stakeholders and the public.

Operation

Operational issues relating to sustainability outcomes include:

- Consumption of electricity, fuel and materials for operation and maintenance activities
- Sustainable procurement over the life of the infrastructure
- Climate change mitigation and adaptation measures over the life of the infrastructure
- Ongoing management associated with contaminated sites, particularly the former Tempe Tip site
- Greenhouse gas emissions associated with energy use and vehicle transportation during operation
- Ongoing social considerations related to community connections, permanent changes to access to public areas (parks and recreational areas) and urban design strategies to enhance liveability.

6.6.3 Proposed further assessment

A preliminary sustainability assessment will be undertaken. The assessment will provide a framework to implement sustainability objectives and targets during design and construction. The assessment will demonstrate the relationship between the sustainability vision, commitments, guiding principles and broader NSW Government sustainability instruments. It will also identify target ISCA design and as-built ratings.

6.7 Climate change and greenhouse gas

6.7.1 Overview

Greenhouse gas

The NSW Government Resource Efficiency Policy (OEH 2014), requires agencies to meet the challenge of reducing energy, water and waste and to help tackle greenhouse gas emissions through renewable energy use. Roads and Maritime's corporate commitment to sustainability is articulated in the Roads and Maritime Environmental Sustainability Strategy 2015–9 (Roads and Maritime 2016), which includes the objective to minimise energy use and reduce greenhouse gas emissions.

Based on National Greenhouse Gas Inventory data for the year to December 2017, the transport sector was the second largest contributor to Australia's greenhouse gas emissions (19 per cent of emissions) after energy for electricity (Department of the Environment and Energy 2018). Greenhouse gas emission sources listed in the Australian Government's reporting legislation include:

- Carbon dioxide (CO₂)
- Sulfur hexafluoride (SF₆)
- Methane (CH₄)
- Nitrous oxide (N₂O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs).

Emissions of these greenhouse gas emission sources can be categorised as Scope 1, 2 or 3 emissions:

- Scope one emissions, also referred to as direct emissions, are emissions that would be generated directly by the project, such as by the combustion of fuels used to power plant, equipment and vehicles on site during construction
- Scope two emissions, also referred to as indirect emissions, are emissions generated by the consumption of electricity generated off-site and used by the project, such as the electricity used to power street lighting and electronic signage
- Scope three emissions, also referred to as indirect upstream emissions, are emissions generated in the wider economy including as a result of energy associated with construction materials and vehicles travelling on the completed road. Examples of scope three emissions include:
 - Emissions associated with offsite mining and production of materials, such as concrete, asphalt, steel and aggregates used in the construction and maintenance of the road
 - Emissions from the combustion of fuel when transporting material
 - Emissions from the vehicles using the road network.

Climate change

Climate change has the potential to alter the frequency, intensity and distribution of extreme weather-related natural hazards. These include more intense and frequent heat waves, droughts, floods and storm surges. The risk of climate change impacts on infrastructure (including the project) needs to be considered as part of the design process, as structures need to be designed to last for long periods and be resilient to climate change.

Roads and Maritime's Environmental Sustainability Strategy 2015-19 includes as an objective that the design and construction of transport infrastructure should be resilient to climate change impacts.

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, understanding the most likely and 'worst case' implications of climate change are typically considered during the design and environmental assessment for such projects.

6.7.2 Summary of potential issues

Greenhouse gases

Construction would contribute to greenhouse gas emissions either directly or indirectly through the following activities:

- Fuel consumption for transporting materials to site and the operation of construction plant and site vehicles
- Soil and waste removal
- Vegetation removal (if required)
- Electricity used to power construction plant and site offices
- Indirect greenhouse gas emissions – for example, through embodied energy of construction materials and their supply chains (such as concrete and steel), or through the generation of electricity for consumption by the project
- Decomposition of waste.

The key sources of greenhouse gas emissions during operation include:

- Fuel consumed by vehicles travelling along the road
- Road maintenance activities (fuel and materials)
- Electricity used to power control systems such as computer systems, signage and lighting.

Contributors to operational emissions would be road users, with the emissions contribution determined by factors in the final design of road grades, intersections and the stop/start of traffic. This would be assessed during the design phase of the project.

Climate change

Due to the relatively short timeframe of the construction phase, the impacts of climate change are expected to be minimal. However, there are several key climate change risks to road projects associated with increasing temperatures and rainfall intensity, which may result in the following:

- Damage to road surfaces during extreme temperature events
- Increased potential for localised flooding impact on road infrastructure and potential increases in road maintenance activities and costs, especially in areas considered to have an elevated flood risk or within flood management areas (described in section 5.7)

- Increased risk of road closures due to flooding and inundation
- Drainage and stormwater impact
- Erosion impact, resulting in sediment loss from the site
- Watercourse impacts, including changes to channel structures and other characteristics resulting from changes in hydrological conditions and any associated ecological impacts.

Risks to infrastructure associated with climate change may also generate 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 depend on road transport
- Increased maintenance and replacement costs
- Increased liability resulting from damage to road infrastructure
- Higher insurance costs for road authorities.

6.7.3 Proposed further assessment

Greenhouse gases

A greenhouse gas assessment will be undertaken to assess the potential impacts of construction and operation. It will include:

- Identifying the sources of greenhouse gas emissions associated with the construction, operation and maintenance of the project
- Quantifying the greenhouse gas emissions associated with each greenhouse gas source (such as fuel consumed, electricity and construction materials)
- Presenting greenhouse gas emissions associated with the construction, operation and maintenance of the project
- Identifying mitigation measures.

Project-specific energy targets will be established, consistent with the NSW Government's target of 20 per cent renewable energy by 2020 (identified as goal 22 in NSW 2021) and the ISCA Infrastructure Sustainability Rating Tool card. This would include:

- Implementation of identified energy reduction activities across all emission scopes
- Investigating further opportunities for renewable energy use.

The greenhouse gas assessment will be undertaken with regard to:

- The Greenhouse Gas Protocol (World Council for Sustainable Business Development and World Resources Institute 2004)
- Greenhouse Gas Assessment Workbook for Road Projects (Transport Authorities Greenhouse Group 2013).
- National Greenhouse Accounts Factors (Department of the Environment and Energy 2017).
- The National Greenhouse and Energy Reporting scheme, established by the Commonwealth National Greenhouse and Energy Reporting Act 2007
- AS/ISO 14064.1–2006 Greenhouse gases Part 1: Specification with guidance at the organisation level for quantification and reporting of greenhouse gas emissions and removals

Climate change

A climate change risk assessment will be undertaken in accordance with Roads and Maritime's Draft Technical Guide: Climate Change Adaptation for the State Road Network (Roads and Maritime 2015c). It will include:

- Identifying existing climate change variables, such as temperature, rainfall and extreme events
- Identifying potential climate change scenarios, based on the latest climate science, and broadly identifying how each climate variable may change over the design life of the project
- A risk assessment of potential climate change impacts during the construction and operational phases of the project, using the Australian Standard for climate change risk assessment and AS/NZS Risk Management
- Identifying approaches to managing climate change risks.

7. Conclusion

7.1 Summary

Roads and Maritime and SACL propose to build the Sydney Gateway road project, to provide new direct high capacity road connections linking the Sydney motorway network with Sydney Airport. The project would comprise new and upgraded sections of road connecting to the airport terminals. It would also include new bridges over Alexandra Canal and other ancillary infrastructure and road connections. The new connections and increased road capacity will help improve traffic flow to Sydney Airport, towards Port Botany and beyond, making the movement of people and goods easier, safer and faster.

The project forms part of Sydney Gateway, a NSW and Australian Government initiative to improve road and freight rail transport through the important economic gateways of Sydney Airport and Port Botany.

In accordance with the EP&A Act, the project is State significant infrastructure and needs approval from the NSW Minister for Planning. The project is also major airport development under the Airports Act and needs approval from the Australian Minister for Infrastructure, Transport and Regional Development. A combined EIS and draft MDP will be prepared to support the application for approval under the EP&A Act and the Airports Act.

As part of the first step in the approvals process for the project, this report supports an application to the NSW Minister for Planning seeking the SEARs for the EIS. Roads and Maritime will prepare the EIS in accordance with the SEARs and the minimum form and content requirements set out in clauses 6 and 7 of schedule 2 of the Regulation. The draft MDP will be prepared by Roads and Maritime on behalf of SACL in accordance with the requirements of section 91 of the Airports Act.

This report has identified that the key environmental issues for the project are:

- Traffic, transport and access
- Noise and vibration
- Air quality
- Aviation safety
- Contamination
- Hydrology, flooding and water quality
- Non-Aboriginal heritage
- Aboriginal heritage
- Land use, social and business impacts
- Urban design, landscape character and visual amenity
- Cumulative impacts.

These issues, together with the other issues identified by the report, will be assessed in the EIS/draft MDP.

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Abbreviations and glossary

AHIMS	Aboriginal Heritage Information Management System
Airports Act	Commonwealth <i>Airports Act 1996</i>
ARTC	Australian Rail Track Corporation
Aquifer	A groundwater bearing formation sufficiently permeable to transmit and yield groundwater or water bearing rock.
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
CASA	Civil Aviation Safety Authority
CLM Act	NSW <i>Contaminated Land Management Act 1997</i>
Construction compound	An area used as the base for construction activities, usually for the storage of plant, equipment and materials, and/or construction site offices and worker facilities.
EIS	Environmental impact statement
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPA	NSW Environment Protection Authority
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
High intensity approach lights	A series of lights located on a strip of land in Tempe that provides visual guidance to aircraft approaching Sydney Airport's north–south runway
Interchange	A road junction that typically uses grade separation, and one or more ramps, to permit traffic on at least one main road to pass through the junction without directly crossing another traffic stream.
ISCA	Infrastructure Sustainability Council of Australia
LEP	Local environmental plan
MDP	Major development plan
OEH	NSW Office of Environment and Heritage
OLS	Obstacle limitation surface - an invisible surface that defines the airspace surrounding an airport that must be protected from obstacles to ensure that aircraft flying in good weather during the initial and final stages of flight, or in the vicinity of the airport, can do so safely.
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation (Roads and Maritime 2011)
PANS-OPS	Procedures for Navigational Services – Aircraft Operations Surfaces. The PANS-OPS surface protects aircraft flying into and out of the airport when the flight is guided solely by instruments in conditions of poor visibility. The PANS-OPS surface is generally situated above the OLS.

PFAS	Per-and poly-fluoroalkyl substances, which are manufactured chemicals used in products that resist heat, oil, stains and water. There are many types of PFAS, with the best known examples being perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), which were used in some fire-fighting foams.
Port Botany Rail Line	A dedicated freight rail line that forms part of the Sydney Freight Network. The line extends from near Marrickville Station to Port Botany.
Prescribed airspace	The airspace above any part of either the OLS or the PANS-OPS surfaces for Sydney Airport. The prescribed airspace is regulated under the Commonwealth <i>Airports Act 1996</i> .
Project	The construction and operation of the Sydney Gateway road project.
Project site	The area that would be directly affected by construction (also known as the construction footprint). It includes the location of operational project infrastructure, the area that would be directly disturbed by the movement of construction plant and machinery, and the location of the storage areas/compounds etc, that would be used to construct that infrastructure.
the Regulation	NSW Environmental Planning and Assessment Regulation 2000
Roads and Maritime	Roads and Maritime Services
SACL	Sydney Airport Corporation Limited
SEARs	Secretary's environmental assessment requirements
Sensitive receivers	Land uses and activities that are sensitive to potential noise, vibration, air and visual impacts, such as residential dwellings, schools and recreation areas
SEPP	State environmental planning policy
SHR	State heritage register
Spoil	Material generated by excavation.
State significant infrastructure	Major transport and services infrastructure considered to have State significance as a result of size, economic value or potential impacts.
Study area	The study area is defined as the wider area including and surrounding the project site, with the potential to be directly or indirectly affected by the project (eg by noise and vibration, visual or traffic impacts).
Sydney Airport land	Commonwealth-owned land leased to Sydney Airport Corporation Limited
Sydney Gateway	A NSW Government initiative to respond to the forecast growth of Sydney Airport and Port Botany. Sydney Gateway comprises a road and rail component, consisting of: <ul style="list-style-type: none"> • Road connections to Sydney Airport's domestic and international airport terminals from the Sydney motorway network at St Peters interchange (being delivered by Roads and Maritime Services) • Duplication of a three-kilometre long section of the Port Botany rail line (being delivered by ARTC).
Terminal 1	Sydney Airport's international terminal

Terminal 2	One of Sydney Airport's two domestic terminals, used by number of domestic and regional airlines including Virgin Australia, Jetstar and Rex.
Terminal 3	Qantas's domestic terminal
Terminals 2/3	Sydney Airport's domestic terminals
TEU	Twenty foot equivalent units (used to describe cargo capacity)
WARR Act	NSW Waste Avoidance and Resource Recovery Act 2001
Waste	Waste is defined by the EPA as any matter (whether liquid, solid, gaseous or radioactive) that is discharged, emitted or deposited in the environment in such volume, constituency or manner as to cause an alteration to the environment.
WestConnex	WestConnex is a 33 kilometre long, predominantly underground, motorway currently under construction in Sydney. The WestConnex program of works includes widening and extension of the M4 Western Motorway (the M4 Widening project); construction of two tunnels connecting Homebush Bay Drive with Wattle Street and Parramatta Road at Haberfield (M4 East); a new section of the M5 South Western Motorway including a new interchange at St Peters (the New M5 project); and a new inner western bypass of the Sydney central business district connecting the M4 and M5 (the M4-M5 Link project).

Appendix A

Major development plan requirements

Major development plan content requirements

Section 91 of the Commonwealth *Airports Act 1996* provides the required contents of a major development plan:

- (1) A major development plan, or a draft of such a plan, must set out:
 - (a) the airport-lessee company's objectives for the development; and
 - (b) the airport-lessee company's assessment of the extent to which the future needs of civil aviation users of the airport, and other users of the airport, will be met by the development; and
 - (c) a detailed outline of the development; and
 - (ca) whether or not the development is consistent with the airport lease for the airport; and
 - (d) if a final master plan for the airport is in force—whether or not the development is consistent with the final master plan; and
 - (e) if the development could affect noise exposure levels at the airport—the effect that the development would be likely to have on those levels; and
 - (ea) if the development could affect flight paths at the airport—the effect that the development would be likely to have on those flight paths; and
 - (f) the airport-lessee company's plans, developed following consultations with the airlines that use the airport, local government bodies in the vicinity of the airport and—if the airport is a joint user airport—the Defence Department, for managing aircraft noise intrusion in areas forecast to be subject to exposure above the significant ANEF levels; and
 - (g) an outline of the approvals that the airport-lessee company, or any other person, has sought, is seeking or proposes to seek under Division 5 or Part 12 in respect of elements of the development; and
 - (ga) the likely effect of the proposed developments that are set out in the major development plan, or the draft of the major development plan, on:
 - (i) traffic flows at the airport and surrounding the airport; and
 - (ii) employment levels at the airport; and
 - (iii) the local and regional economy and community, including an analysis of how the proposed developments fit within the local planning schemes for commercial and retail development in the adjacent area; and
 - (h) the airport-lessee company's assessment of the environmental impacts that might reasonably be expected to be associated with the development; and
 - (j) the airport-lessee company's plans for dealing with the environmental impacts mentioned in paragraph (h) (including plans for ameliorating or preventing environmental impacts); and
 - (k) if the plan relates to a sensitive development—the exceptional circumstances that the airport-lessee company claims will justify the development of the sensitive development at the airport; and
 - (l) such other matters (if any) as are specified in the regulations.

Appendix B

Requirements of clause 192 of the Environmental Planning and Assessment Regulation 2000

Requirements of clause 192 of the Environmental Planning and Assessment Regulation 2000

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

- Details of any approval that would, but for section 5.23 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), be required for the carrying out of the State significant infrastructure, and
- Details of any authorisations that must be given under section 5.24 of the EP&A Act if the application is approved, and
- 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.

These requirements are addressed below.

Approvals would otherwise apply

Approvals that may be required to carry out State significant infrastructure, if not for section 5.23 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 5.23 does not remove the need to obtain an aquifer interference approval under the *Water Management Act 2000*.

Authorisations if the application is approved

Authorisations that may be required for the project under section 5.24 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*.

State significant infrastructure statement

Clause 14(1) of State Environmental Planning Policy (State and Regional Development) 2011 (the State and Regional Development SEPP) provides that development is State significant infrastructure, pursuant to section 5.12(2) of the EP&A Act, if it is permissible without development consent under Part 4 of the Act by virtue of the operation of a State environmental planning policy, and it is specified in the categories of development in Schedule 3.

Clause 94(1) of State Environmental Planning Policy (Infrastructure) 2007 (the Infrastructure SEPP) permits development for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent. The project meets the definitions of road and road infrastructure facilities provided in clauses 93 and 94(2) of the Infrastructure SEPP.

Schedule 3 (item 1) of the State and Regional Development SEPP ('general public authority activities') includes 'Infrastructure or other development that (but for Division 5.2 of the Act and within the 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 determined that the project has the potential to significantly impact the environment and therefore requires preparation of an EIS. As a result, the project falls under item 1 of Schedule 3.

Appendix C

Species search results

Table C.1 Threatened ecological communities known or predicted to occur within 10 kilometres of the project site

Name	BC Act status	EPBC Act status	Habitat association
Agnes Banks Woodland in the Sydney Basin Bioregion	CE	E	Most remnants occur near Agnes Banks in Penrith LGA, on eastern bank of the Hawkesbury River. Occurs on aeolian sands overlaying Tertiary alluviums. Structure varies from low woodland on higher ridges to sedgeland in low-lying depressions. Characteristic species include Hard-leaved Scribbly Gum, Narrow-leaved Apple and Old-man Banksia.
Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions	E		Associated with coastal sand plains on deep, freely draining to damp sandy soils on flat to moderate slopes within a few km of the sea and below 100 masl. Known from Sutherland south to Bega Valley LGA. Variable structure with a dense to open tree canopy from 5 - 20 m tall, dependant on exposure and disturbance history. Characteristic species include Bangalay and Coast Banksia over an open sclerophyllous or mesophyllous shrub stratum, with an understorey of grasses, forbs and/or sedges.
Blue Gum High Forest in the Sydney Basin Bioregion	CE	CE	Occurs on the Hornsby Plateau, north eastern edge of the Cumberland Plain with most remnants in Hornsby, Ku-ring-gai and Baulkham Hills LGAs. Typically occurs in high rainfall areas on fertile soils derived from Wianamatta shale. Grades into Sydney Turpentine-Ironbark Forest at lower rainfall areas. Moist, tall open forest characterised by Sydney Blue Gum and Blackbutt. Usually has small tree layer of Native Daphne, Blueberry Ash and Forest Oak over a low, open shrub layer and an understorey of grasses, herbs and ferns.
Blue Mountains Shale Cap Forest in the Sydney Basin Bioregion	E	CE	Found on deep fertile soils formed on Wianamatta Shale, on moist sheltered sites at lower to middle altitudes of the Blue Mountains and Wollemi areas. Extensive occurrences of shale are at Springwood, Berambing to Kurrangong Heights, Mountain Lagoon and Colo Heights. Characteristic tree species of this ecological community are Mountain Blue Gum, Monkey Gum and Turpentine. The structure of the community was originally tall open forest to open forest, depending on site conditions and history, but as a result of partial clearance may now exist as woodland or as groups of remnant trees.
Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion	V	E	Occurs almost exclusively on soils derived from Tertiary alluvium, or on sites located on adjoining shale or Holocene alluvium, with known occurrences in the Bankstown, Blacktown, Campbelltown, Hawkesbury, Liverpool and Penrith LGAs. Typically on sandy soils and on slightly higher ground than Castlereagh Ironbark Forest or Shale Gravel Transition Forest (Tozer 2003). Dominated by Parramatta Red Gum, Narrow-leaved Apple and Hard-leaved Scribbly Gum. A small tree stratum of <i>Melaleuca decora</i> is sometimes present, generally in areas with poorer drainage. It has a well-developed sclerophyllous shrub stratum over a diverse range of forbs.
Castlereagh Swamp Woodland Community	E		Occurs Castlereagh and Holsworthy areas on the Cumberland Plain on alluvial soils, often in poorly drained depressions. Low woodland characterised by dense stands of <i>Melaleuca decora</i> along with other canopy trees, such as Parramatta Red Gum. Poorly developed shrub layer of juvenile <i>Melaleucas</i> over waterlogging tolerant groundcover species such as Indian Pennywort, <i>Juncus usitatus</i> and Branched Goodenia.
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	V	Occurs on landward side of mangrove stands in intertidal zones along the shores of estuaries and lagoons that are permanently or intermittently open to the sea. Characterised by <i>Baumea juncea</i> , Sea Rush, Samphire, Sand Couch, Streaked Arrowgrass, <i>Isolepis nodosa</i> , Creeping Brookweed, Swamp Weed, Seablite and Prickly Couch, with occasional scattered mangroves occurring throughout the saltmarsh. Saltpans and tall reeds may also occur.

Name	BC Act status	EPBC Act status	Habitat association
Coastal Upland Swamp in the Sydney Basin Bioregion	E	E	Includes open graminoid heath, sedgeland and tall scrub associated with periodically waterlogged soils on the Hawkesbury sandstone plateaus. Generally associated with soils that are acidic and vary from yellow or grey mineral sandy loams with a shallow organic horizon to highly organic spongy black peat soils with pallid subsoils. May include tall open scrubs, tall closed scrubs, closed heaths, open graminoid heaths, sedgelands and fernlands.
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	E	CE	Occurs on the Cumberland Plain with the most extensive stands in Castlereagh and Holsworthy areas. Smaller remnants in Kemps Creek area and eastern section of the Cumberland Plain. Ranges from open forest to low woodland, with a canopy dominated by Red Ironbark and <i>Melaleuca decora</i> along with other species of eucalypt. Dense shrubby understorey of Prickly-leaved Paperbark, Peach Heath and Fabaceae sp. over sparse ground layer of grasses and herbs.
Cumberland Plain Woodland in the Sydney Basin Bioregion	CE	CE	Grassy woodland/forest endemic to the hills and plains of the Cumberland Plain. Canopy typically dominated by Grey Box, and Forest Red Gum, with Narrow-leaved Ironbark, Spotted Gum and Thin-leaved Stringybark occurring less frequently. Shrub layer dominated by Blackthorn, and grasses such as <i>Themeda australis</i> and Weeping Grass.
Duffys Forest Ecological Community in the Sydney Basin Bioregion	E		Extensively fragmented distribution, occurring primarily within Warringah, and Ku-ring-gai Local Government Areas (LGA) with minor occurrences in the Pittwater, Manly and Hornsby LGAs. Occurs in association with shale lenses and lateritic soils in Hawkesbury Sandstone. Rock outcrops are usually absent from this community, except on the fringes, where it adjoins typical sandstone vegetation, generally characterised by extensive sandstone outcrops. Situated on ridgetops, plateaus and upper slopes, but may also occur on mid-slopes or benches downslope of Sydney Sandstone Ridgetop Woodland.
Eastern Suburbs Banksia Scrub in the Sydney Basin Bioregion	E	E	Surviving stands total 146 hectares. Found in the LGA's of Botany, Randwick, Waverly and Manly. Occurs in disjunct patches of nutrient poor aeolian dune sand (OEH 2013). Predominantly a sclerophyllous heath or scrub community with some remnants containing small patches of woodland (OEH 2013).
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E		Occurs in coastal areas subject to periodic flooding with standing fresh water for at least part of the year. Typically on silts, muds or humic loams below 20 m elevation in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes. Structure and composition varies spatially and temporally depending on the water regime, though is usually dominated by herbaceous plants and has few woody species.
Hygrocybeae Community of Lane Cove Bushland Park in the Sydney Basin Bioregion	CE		Hygrocybeae Community of Lane Cove Bushland Park is an assemblage of more than 20 species of fungi in the family Hygrophoraceae (Fungi, Basidiomycota, Agaricales, Hygrophoraceae; OEH 2014). Restricted to a core zone along Gore Creek catchment and Lane Cove LGA. Most of the species live in warm temperate gallery rainforest centred on the banks of the north-eastern arm of Gore Creek and its tributaries in Lane Cove Bushland Park (OEH 2014).
Kurnell Dune Forest in the Sutherland Shire and City of Rockdale	E		Occurs within the Kurnell Peninsula, near Bundeena and at Leo Smith Reserve. A low open sclerophyll forest community with a distinctive moist forest component in its flora. The community occupies coastal dune sand and is often found in association with areas of sclerophyll heath and scrub. Characteristic sclerophyll tree and shrub species include Sydney Red Gum, Heath-leaved Banksia, Old-man Banksia,

Name	BC Act status	EPBC Act status	Habitat association
			Bangalay, Swamp Mahogany, Coast Teatree and Tree Broom-heath. The moist component of the flora is characterised by species including Coffee Bush, Kangaroo Vine, Water Vine, Hairy Clerodendrum, Tuckeroo, Blueberry Ash, Hard Corkwood, Cheese Tree, Cockspur Thorn, Large Mock-Olive, Rapanea variabilis and Snake Vine.
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	CE	Occurs along the NSW coast, usually within 2 km of the ocean on a variety of substrates. Variable structure and composition, typically with closed canopy. Generally rainforest species with vines a major component.
Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	E	CE	Occurs north of the Hawkesbury River to the Qld border. Associated with a range of high-nutrient geological substrates, notably basalts and fine-grained sedimentary rocks, on coastal plains and plateaux, footslopes and foothills. Includes subtropical rainforest and related, structurally complex forms of dry rainforest. In undisturbed state has a closed canopy with high tree diversity. A range of plant growth forms are present in Lowland Rainforest, including palms, vines and vascular epiphytes. Scattered eucalypt emergents (e.g. Flooded Gum, Sydney Blue Gum) may occasionally be present.
Moist Shale Woodland in the Sydney Basin Bioregion	E	CE	Occurs on clay soils from Wianamatta Shale in the southern half of the Cumberland Plain, and is intermediate between Cumberland Plain Woodland and Western Sydney Dry Rainforest. Similar to Cumberland Plain Woodland but with more mesic shrub understorey. Dominant canopy trees include Forest Red Gum, Grey Box, Narrow-leaved Ironbark and Spotted Gum. Small trees, such as Hickory Wattle and Sydney Green Wattle are also common. The shrub layer includes Coffee Bush, Hairy Clerodendrum and Indian Weed.
Pittwater and Wagstaffe Spotted Gum Forest in the Sydney Basin Bioregion	E		Occurs entirely within Pittwater LGA on the Barrenjoey Peninsula and Western Pittwater Foreshores (OEH 2013). Remnants are typically small and on private properties and council reserves. Associated with shale derived soils and high rainfall on lower hillslopes on the Narrabeen Group. Structural form - typically open forest but may now exist as woodland or remnant trees (OEH 2013).
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E		Occurs on flats, drainage lines and river terraces of coastal floodplains where flooding is periodic and soils generally rich in silt, lack deep humic layers and have little or no saline (salt) influence. Occurs south from Port Stephens in the NSW North Coast, Sydney Basin and South East Corner bioregions. Characterised by a tall open canopy layer of eucalypts with variable species composition.
Shale Gravel Transition Forest in the Sydney Basin Bioregion	E	CE	Primarily in the northern section of the Cumberland Plain, also found in Liverpool/Holsworthy, Bankstown, Yennora, Villawood and Kemps Creek areas. Occurs primarily where shallow deposits from ancient river systems overlay shale soils, but also associated with localised concentrations of iron-hardened gravel. Open forest with canopy dominated by Red Ironbark, Grey Box and Forest Red Gum, often with small tree layer of Melaleuca decora over a sparse shrub layer. Grades into Cumberland Plain Woodland where the influence of gravel soil declines, and into Cooks River/Castlereagh Ironbark Forest or Castlereagh Scribbly Gum Woodland where gravel deposits are thick.
Shale Sandstone Transition Forest in the Sydney Basin Bioregion	CE	CE	Occurs on the edges of the Cumberland Plain where clay soils on shale intergrade with sandstone soils, or where shale caps overlay sandstone. Species composition variable depending on soil influences. Dominant tree species include Forest Red Gum, Grey Box, White Stringybark, Thin-leaved Stringybark,

Name	BC Act status	EPBC Act status	Habitat association
			Red Ironbark and Narrow-leaved Ironbark. Areas with a low sandstone influence have an understorey closer to Cumberland Plain Woodland.
Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion	E		Restricted to sheltered heads and upper slopes of gullies on transitional zones where sandstone outcrops may exist, but where soils are influenced by lateral movement of moisture, nutrients and sediment from more fertile substrates in an area bounded by Hurstville, Carss Park, Bundeena, Otford, Stanwell Tops, Darkes Forest, Punchbowl Creek and Menai. Open forest dominated by Sydney Red Gum, Sydney Peppermint and occasional Blackbutt over scattered subcanopy trees, a diverse shrub layer and well-developed groundcover of ferns, forbs, grasses and graminoids. Variable species composition.
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E		Typically occurs below 20m asl on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes on coastal floodplains of NSW. Associated with grey-black clay-loams and sandy loams, saline or sub-saline groundwater. Structure variable from open forests to scrubs or reedlands with scattered trees. Canopy dominated by Casuarina glauca (north of Bermagui) or Melaleuca ericifolia (south of Bermagui). Understorey characterised by frequent occurrences of vines, a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter.
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E		Usually occurs below 20m asl (sometimes up to 50m). Associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Characterised by open to dense tree layer of eucalypts and paperbarks, with trees up to or higher than 25 m. Includes areas of fern land and tall reed or sedge land, where trees are sparse or absent.
Sydney Freshwater Wetlands in the Sydney Basin Bioregion	E		Occurs on sand dunes and low-nutrient sandplains along coastal areas in Sydney Basin bioregion. Known from Lake Macquarie, Wyong, Gosford, Pittwater, Warringah, Woollahra, Waverly, Botany, Rockdale, Randwick, Sutherland and Wollongong LGA's. Largely restricted to freshwater swamps and swales and depressions on sand dunes and low nutrient sandplains (OEH 2013).
Sydney Turpentine-Ironbark Forest	E	CE	Occurs on the Cumberland Plain, with most remnants in Baulkham Hills, Hawkesbury, Hornsby, Kuring-gai, Parramatta, Ryde, Sutherland and Wollondilly LGAs. Open forest characterised by Turpentine, Grey Gum, Grey Ironbark and E. Thin-leaved Stringybark. In areas of high rainfall (over 1050 mm per annum) Sydney Blue Gum is more dominant. Sparse shrub stratum of Native Daphne and Elderberry Panax.
The Shorebird Community occurring on the relict tidal delta sands at Taren Point	E		Occurs on the relict marginal shoal of the Georges River between Taren Point and Shell Point in Botany Bay. Some species identified within this community can also be found foraging and roosting at other locations within Botany Bay. Includes the characteristic assemblage of the following 20 species: Bar-tailed Godwit (<i>Limosa lapponica</i>), Red Knot (<i>Calidris canutus</i>), Great Knot (<i>Calidris tenuirostris</i>), Sharp-tailed Sandpiper (<i>Calidris acuminata</i>), Curlew Sandpiper (<i>Calidris ferruginea</i>), Red-necked Stint (<i>Calidris ruficollis</i>), Common Sandpiper (<i>Actitis hypoleucos</i>), Terek Sandpiper (<i>Xenus cinereus</i>), Latham's Snipe (<i>Gallinago hardwickii</i>), Grey-tailed Tattler (<i>Heteroscelus brevipes</i>), Grey Plover (<i>Pluvialis squatarola</i>), Pacific Golden Plover (<i>Pluvialis fulva</i>), Common Greenshank (<i>Tringa nebularia</i>), Masked Lapwing (<i>Vanellus miles</i>), Marsh Sandpiper (<i>Tringa stagnatilis</i>), Ruddy Turnstone (<i>Arenaria interpres</i>), Pied Oystercatcher (<i>Haematopus longirostris</i>), Sooty Oystercatcher (<i>Haematopus fuliginosus</i>), Whimbrel (<i>Numenius phaeopus</i>), and Eastern Curlew (<i>Numenius madagascariensis</i>).

Name	BC Act status	EPBC Act status	Habitat association
Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions	E		Themeda australis is the dominant species in the Themeda Grassland on seacliffs and coastal headlands. The EEC is found on a range of substrates. Themeda australis is an extremely widespread species, but in this community it may have a distinctive appearance, being prostrate and having glaucous leaves. Coast Banksia, Coastal Rosemary and Acacia sophorae occurs as an emergent shrub or as a dense cover where they have recruited over grasslands. Smaller shrubs occur often as prostrate to dwarf forms.
Western Sydney Dry Rainforest in the Sydney Basin Bioregion	E	CE	Restricted to hilly country where it occurs on clay soils derived from Wianamatta shale on sheltered lower slopes and gullies. Very restricted and occurs mostly in the Razorback Range near Picton. Outlying occurrences at Grose Vale and Cattai. Canopy trees include Prickly-leaved Tea Tree, Hickory Wattle and Native Quince. Shrub layer includes rainforest species Large Mock-olive, Hairy Clerodendrum and Wild Yellow Jasmine. The shrub layer combines with vines to form dense thickets in sheltered locations.

Table C.2 Threatened flora species known or predicted to occur within 10 kilometres of the project site

Scientific Name	Common Name	BC Act status	EPBC Act status	Source	Habitat association
<i>Acacia bynoeana</i>	Bynoe's Wattle	E	V	1 record within 10km (OEH 2018a); Species or species' habitat may occur within 10km (DOE 2018a)	Endemic to central eastern NSW, currently known from only 34 locations, many of only 1-5 plants. Grows mainly in heath/ dry sclerophyll forest on sandy soils, prefers open, sometimes slightly disturbed sites such as trail margins, road edges, and in recently burnt open patches. Flowers September to March, and fruit matures in November.
<i>Acacia prominens</i>	Gosford Wattle, Hurstville and Kogarah Local Government Areas	EP		1 record within 10km (OEH 2018a)	Occurs at a few sites along the railway line at Penshurst, at Carss Bush Park, Carss Park and there is an unconfirmed sighting at Oatley Park, Oatley. Grows in open situations on clayey or sandy soils. Habitats mostly cleared and occurs as isolated or small groups of trees.
<i>Acacia pubescens</i>	Downy Wattle	V	V	510 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DOE 2018a)	Occurs mainly in Bankstown-Fairfield-Rookwood and Pitt Town areas, with outliers at Barden Ridge, Oakdale and Mountain Lagoon. Grows on alluviums, shales and shale/sandstone intergrades. Soils characteristically gravelly, often with ironstone. Occurs in open woodland and forest, in communities including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland. Flowers August to October.
<i>Acacia terminalis subsp. terminalis</i>	Sunshine Wattle	E	E	121 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DOE 2018a)	Occurs in near-coastal areas from northern shores of Sydney Harbour south to the northern and western shores of Botany Bay. Occurs on sandy soil on creek banks, hillslopes of in shallow soil in rock crevices and sandstone platforms on cliffs. Grows in scrub and open eucalypt woodland or forest.
<i>Allocasuarina glareicola</i>		E	E	Species or species' habitat may occur within 10km (DOE 2018a)	Primarily restricted to small populations in and around Castlereagh NR (NW Cumberland Plain), but with an outlier population at Voyager Point, Liverpool. Also reported from Holsworthy Military Area. Grows on tertiary alluvial gravels, with yellow clayey subsoil and lateritic soil. Occurs in Castlereagh open woodland.
<i>Allocasuarina portuensis</i>	Nielsen Park She-oak	E	E	50 records within 10km (OEH 2018a); Species or species' habitat may occur within 10km (DOE 2018a)	Restricted to within Nielsen Park (part of Sydney Harbour NP) in Woollahra. Cultivars have been planted throughout Sydney Harbour NP e.g. Gap Bluff, Hermit Point and Vacluse House. Originally found on a sandstone shelf approximately 20 m above the harbour, on shallow sandy soils in tall closed woodland. Has been planted in a variety of habitats.

Scientific Name	Common Name	BC Act status	EPBC Act status	Source	Habitat association
<i>Asterolasia elegans</i>		E	E	Species or species' habitat may occur within 10km (DOE 2018a)	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs, may also occur in the western part of Gosford LGA. 7 known populations. Occurs on Hawkesbury sandstone, commonly amongst rocky outcrops and boulders in sheltered forests on mid- to lower slopes and valleys.
<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	E	V	1 record within 10km (OEH 2018a); Species or species' habitat likely to occur within 10km (DOE 2018a)	Occurs from Central Coast NSW to southern Victoria. Mostly coastal but extends inland to Braidwood in southern NSW. In NSW grows in grassy dry sclerophyll woodland on clay loam or sandy soils, and less commonly in heathland on sandy loam soils (Duncan 2010).
<i>Callistemon linearifolius</i>	Netted Bottle Brush	V		10 records within 10km (OEH 2018a)	Recorded from the Georges to Hawkesbury Rivers in Sydney, and north to Nelson Bay. There is also a recent record from the northern Illawarra. In Sydney, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. Grows in dry sclerophyll forest on the coast and adjacent ranges.
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	1 record within 10km (OEH 2018a); Species or species' habitat likely to occur within 10km (DOE 2018a)	Occurs in coastal areas from East Gippsland to southern Queensland. Habitat preferences not well defined. Grows mostly in coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest. Prefers open areas in the understorey and is often found in association with Large Tongue Orchid and the Bonnet Orchid. Soils include moist sands, moist to dry clay loam and occasionally in accumulated eucalypt leaves. Flowers November-February.
<i>Darwinia biflora</i>		V	V	1 record within 10km (OEH 2018a); Species or species' habitat likely to occur within 10km (DOE 2018a)	Known from north and north-western Sydney, in the Ryde, Baulkham Hills, Hornsby and Ku-Ring-Gai LGAs. Grows on the edges of weathered shale-capped ridges, at the intergrade with Hawkesbury Sandstone. Occurs in woodland, open forest and scrub/heath. Associated overstorey species include Scribbly Gum, Red Bloodwood and/or Scaly Bark.
<i>Dillwynia tenuifolia</i>		V		3 records within 10km (OEH 2018a)	Bounded by Western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps Creek in the Liverpool Local Government Area. This population occurs on a small outlier of the Berkshire Park Soil Landscape; the site supports a transition from Castlereagh Ironbark Forest to Castlereagh Scribbly Gum Woodland.
<i>Diuris arenaria</i>	Sand Doubletail	E		1 record within 10km (OEH 2018a)	Known from Tomaree Peninsula near Newcastle, in three locations. Inhabits coastal heath and dry grassy eucalypt forest on sandy flats on clay soil.

Scientific Name	Common Name	BC Act status	EPBC Act status	Source	Habitat association
<i>Doryanthes palmeri</i>	Giant Spear Lily	V		2 records within 10km (OEH 2018a)	Giant Spear Lily occurs in far north-east NSW and south-east Queensland. In NSW, it occurs on the coastal ranges that are part of the Mt Warning Caldera. Its southern distributional limit is Mount Billen. The species is currently known from eleven sites within NSW, five of which are conservation reserves. Most populations consist of only a few hundred individuals. Giant Spear Lily occurs on exposed rocky outcrops on infertile soils or on bare rock. It grows in a narrow band of vegetation along the cliff-tops and on steep cliff-faces or rocky ledges in montane heath next to subtropical rainforest, warm temperate rainforest or wet eucalypt forest.
<i>Epacris purpurascens</i> var. <i>purpurascens</i>		V		20 records within 10km (OEH 2018a)	Occurs from Gosford in the north, Narrabeen in the east, Silverdale in the west and Avon Dam vicinity in the South. Grows in a range of sclerophyll forest, scrubs and swamps, most of which have a strong shale soil influence.
<i>Eucalyptus camfieldii</i>	Camfield's Stringybark	V	V	1 record within 10km (OEH 2018a); Species or species' habitat likely to occur within 10km (DOE 2018a)	Occurs from Raymond Terrace to Waterfall, with populations known from Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai and the Royal NP. Occurs in exposed situations on sandstone plateaus, ridges and slopes near the coast, often on the boundary of tall coastal heaths or low open woodland. It grows in shallow sandy soils overlying Hawkesbury sandstone.
<i>Eucalyptus leucoxyloides</i> subsp. <i>pruinosa</i>	Yellow Gum	V		3 records within 10km (OEH 2018a)	Restricted to several small areas between Barham and Euston. This species is not known from any protected area within NSW, though some remnants occur within State Forests along the Murray River, particularly within Campbells Island and Euston State Forests. It occurs at the bases of sandy rises and on loamy clay flats on the floodplains of the Murray River and its tributaries in the Riverina Bioregion.
<i>Eucalyptus nicholii</i>	Narrow-leaved Black Peppermint	V	V	18 records within 10km (OEH 2018a)	Naturally occurs only in New England Tablelands from Nundle to north of Tenterfield. Widely planted as urban street tree. Grows in dry grassy woodland, on shallow and infertile soils, mainly on granite.
<i>Eucalyptus scoparia</i>	Wallangarra White Gum	E	V	25 records within 10km (OEH 2018a)	Occurs mostly in Queensland with only three known occurrences in NSW near Tenterfield. In NSW it is found on well-drained granitic hilltops, slopes and outcrops, often as scattered trees in open forest and woodland.
<i>Genoplesium baueri</i>	Bauer's Midge Orchid	E	E	1 record within 10km (OEH 2018a); Species or species' habitat likely to occur within 10km (DOE 2018a)	Occurs from Ulladulla to Port Stephens, with only 13 known extant populations. Grows in sparse sclerophyll forest and moss gardens over sandstone

Scientific Name	Common Name	BC Act status	EPBC Act status	Source	Habitat association
<i>Grevillea beadleana</i>	Beadle's Grevillea	E	E	1 record within 10km (OEH 2018a)	Four disjunct populations in north-east NSW: Torrington west of Tenterfield, Oxley Wild Rivers NP, Guy Fawkes River NP and Shannon Creek southwest of Grafton. Grows in open eucalypt forest with shrubby understorey, usually on steep granite slopes at high altitudes.
<i>Hypsela sessiliflora</i>			X	1 record within 10km (OEH 2018a)	Currently known from a single location less than 10x15m on the Cumberland Plain in western Sydney. Known to grow in damp places, on the Cumberland Plain, including freshwater wetland, grassland/alluvial woodland and an alluvial woodland/shale plains woodland (Cumberland Plain Woodland) ecotone. May be an early successional species that benefits from some disturbance. Possibly out competed when overgrown by some species such as Couch.
<i>Leptospermum deanei</i>		V	V	1 record within 10km (OEH 2018a)	Occurs in NW Sydney, in the Hornsby, Warringah, Ku-ring-gai and Ryde LGAs. Grows in woodland on lower hill slopes or near creeks, in sandy alluvial soil or sand over sandstone. Occurs in riparian scrub, woodland and open forest.
<i>Macadamia tetraphylla</i>	Rough-shelled Bush Nut	V	V	4 records within 10km (OEH 2018a)	Confined chiefly to the Richmond and Tweed Rivers in north-east NSW, extending just across the border into Queensland. Grows in subtropical rainforest, usually near the coast.
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	1 record within 10km (OEH 2018a); Species or species' habitat may occur within 10km (DOE 2018a)	Scattered, disjunct populations in coastal areas from Jervis Bay to Port Macquarie, with most populations in the Gosford-Wyong areas. Grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.
<i>Melaleuca deanei</i>	Deane's Paperbark	V	V	1 record within 10km (OEH 2018a)	Occurs from Nowra- St Albans and west to the Blue Mountains, with most records in Ku-ring-gai / Berowra and Holsworthy/Wedderburn areas. Mostly grows on broad flat ridgetops, dry ridges and slopes and strongly associated with low nutrient sandy loam soils, sometimes with ironstone. Grows in heath-open forest, often in sandstone ridgetop woodland communities.
<i>Pelargonium sp. Striatellum</i>	Omeo Stork's-bill	E	E	Species or species' habitat may occur within 10km (DOE 2018a)	Omeo Storks-bill <i>Pelargonium</i> sp. (G.W. Carr 10345), syn. <i>P. striatellum</i> , is a tufted perennial forb known from only 3 locations in NSW, with two on lakebeds on the basalt plains of the Monaro and one at Lake Bathurst. It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities.
<i>Persoonia hirsuta</i>	Hairy Geebung	E	E	1 record within 10km (OEH 2018a)	Occurs within the Blue Mountains, Southern Highlands and Sydney coastal regions from Hilltop to Glen Davis and Royal NP to Gosford. Population within

Scientific Name	Common Name	BC Act status	EPBC Act status	Source	Habitat association
					the Hills Shire particularly important due to high density of plants. Grows on sandy soils in dry sclerophyll open forest, woodland and heath on sandstone up to 600m above sea level.
<i>Pimelea curviflora</i> var. <i>curviflora</i>		V	V	1 record within 10km (OEH 2018a); Species or species' habitat likely to occur within 10km (DOE 2018a)	Confined to area between north Sydney in the south and Maroota in the north-west. Former range extended to Parramatta River including Five Dock, Bellevue Hill and Manly. Grows on shale/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Often grows amongst dense grasses and sedges. Flowers October to May.
<i>Pimelea spicata</i>	Spiked Rice-flower	E	E	Species or species' habitat may occur within 10km (DOE 2018a)	Disjunct populations within the Cumberland Plain (from Mount Annan and Narellan Vale to Freemans Reach and Penrith to Georges Hall) and Illawarra (from Mt Warrigal to Gerroa) (DEC 2005). In the Cumberland Plain region, restricted to areas which support or historically supported Cumberland Plain Woodland. Grows on well-structured clay soils derived from Wianamatta Shale. In the Illawarra, grows on variable soils in close proximity to the coast on hills or coastal headlands. Inhabits coastal woodland or grassland with emergent shrubs (DEC 2005).
<i>Pomaderris prunifolia</i>	P. prunifolia in the Parramatta, Auburn, Strathfield and Bankstown Local Government Areas	EP		9 records within 10km (OEH 2018a)	Known from only 3 sites within population range: at Rydalmere, within Rookwood Cemetery and at The Crest of Bankstown. At Rydalmere occurs along a road reserve near a creek, among grass species on sandstone. At Rookwood Cemetery occurs in small gully of degraded Cooks River / Castlereagh Ironbark Forest on shale soils.
<i>Prostanthera marifolia</i>	Seaforth Mintbush	CE	CE	1 record within 10km (OEH 2018a)	Only known from a 2 x 2 km area in Seaforth, northern Sydney. Associated with the endangered Duffys Forest ecological community. Grows on deeply weathered clay-loam soils associated with ironstone and scattered shale lenses.
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	E	E	1 record within 10km (OEH 2018a); Species or species' habitat likely to occur within 10km (DOE 2018a)	Occurs in western Sydney between Picton and Freemans Reach. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils.
<i>Pterostylis</i> sp. <i>Botany Bay</i>	Botany Bay Bearded Orchid	E	E	12 records within 10km (OEH 2018a); Species or species' habitat likely to	Restricted to the Sydney region where it is known from a small number of sites within Botany Bay National Park on the Kurnell Peninsula. Occupies moist level sites on skeletal sandy soils derived from sandstone. Associated

Scientific Name	Common Name	BC Act status	EPBC Act status	Source	Habitat association
				occur within 10km (DOE 2018a)	vegetation includes coastal heath dominated by <i>Melaleuca nodosa</i> and <i>Baeckea imbricata</i> . Flowering occurs from August to September.
<i>Senecio spathulatus</i>	Coast Groundsel	E		3 records within 10km (OEH 2018a)	Coast Groundsel occurs in Nadgee Nature Reserve (Cape Howe) and between Kurnell in Sydney and Myall Lakes National Park (with a possible occurrence at Cudmirrah). Grows on frontal dunes.
<i>Senna acclinis</i>	Rainforest Cassia	E		1 record within 10km (OEH 2018a)	Coastal districts and adjacent tablelands of NSW from the Illawarra in NSW to Queensland. Grows in or on the edges of subtropical and dry rainforest (OEH 2012).
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E	V	124 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DOE 2018a)	Occurs in narrow coastal strip from Bulahdelah to Conjola State Forest. Grows in rainforest on sandy soils or stabilised Quaternary sand dunes at low altitudes in coastal areas, often in remnant littoral or gallery rainforests.
<i>Tetradlea glandulosa</i>		V		1 record within 10km (OEH 2018a)	Restricted to The Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah, and Wyong LGAs. Associated with shale-sandstone transition habitat (shale-cappings over sandstone). Occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Soils generally shallow, yellow, clayey/sandy loam, commonly with lateritic fragments. Vegetation varies from heath to open forest and is broadly equivalent to Sydney Sandstone Ridgetop Woodland community.
<i>Tetradlea juncea</i>	Black-eyed Susan	V	V	1 record within 10km (OEH 2018a)	Regarded as extinct within the Sydney area, current range from Wyong north to Bulahdelah and inland 50km to edge of Sugarloaf Range. Occurs predominately in areas of over 1000 mm annual rainfall, within dry sclerophyll forest, and sometimes heath and moist forest, with a preference for Coastal Plains Smooth-barked Apple Woodland and Coastal Plains Scribbly Gum Woodland.
<i>Thesium australe</i>	Austral Toadflax	V	V	1 record within 10km (OEH 2018a); Species or species' habitat may occur within 10km (DOE 2018a)	Found in small, scattered populations along the east coast, northern and southern tablelands. Occurs in grassland or grassy woodland, and is often found in association with Kangaroo Grass.
<i>Tinospora tinoporoides</i>	Arrow-head Vine	V		1 record within 10km (OEH 2018a)	North from the Richmond River in north-east NSW, where it is locally common in some parts of its range. Also recorded from a single location in south-east

Scientific Name	Common Name	BC Act status	EPBC Act status	Source	Habitat association
					Queensland. Wetter subtropical rainforest, including littoral rainforest, on fertile, basalt-derived soils.
<i>Wahlenbergia multicaulis</i>	Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	EP		50 records within 10km (OEH 2018a)	Found in disturbed sites and grows in a variety of habitats including forest, woodland, scrub, grassland and the edges of watercourses and wetlands. Typically occurs in damp, disturbed sites (with natural or human disturbance of various forms), typically amongst other herbs rather than in the open.
<i>Wilsonia backhousei</i>	Narrow-leafed Wilsonia	V		75 records within 10km (OEH 2018a)	In NSW it is scattered along the coast with a northern limit of Wamberal, north of Sydney. Most extensive stands at Jervis Bay. Grows on the margins of saltmarshes and lakes.
<i>Zannichellia palustris</i>		E		5 records within 10km (OEH 2018a)	Known from the Lower Hunter and Sydney Olympic Park. A submerged aquatic plant that grows in fresh or slightly saline water.

Key: CE – critically endangered, E – endangered, EP – endangered population, V – vulnerable, X - extinct

Table C.3 Threatened fauna species known or predicted to occur within 10 kilometres of the project site

Scientific name	Common name	BC Act status	EPBC Act status	Source	Habitat association
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	11 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DOE 2018a)	Widespread but uncommon over most NSW except the northwest. Favours permanent freshwater wetlands with tall dense reedbeds particularly <i>Typha</i> spp. and <i>Eleocharis</i> spp., with adjacent shallow, open water for foraging. Roosts during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails.
<i>Sternula nereis nereis</i>	Australian Fairy Tern		V	1 record within 10km (OEH 2018a); Breeding likely to occur within area (DOE 2018a)	Occurs along NSW coast. Inhabit offshore, estuarine or lake islands, wetlands, beaches and spits. Nests on coral shingle on continental islands or coral cays, on sandy islands and beaches inside estuaries and on open sandy beaches.
<i>Rostratula australis</i>	Australian Painted Snipe	E	E	4 records within 10km (OEH 2018a); Species or species' habitat likely to occur within 10km (DOE 2018a)	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.
<i>Ninox connivens</i>	Barking Owl	V		1 record within 10km (OEH 2018a)	Occurs from coast to inland slopes and plains, though is rare in dense, wet forests east of the Great Dividing Range and sparse in higher parts of the tablelands and in the arid zone. Inhabits eucalypt woodlands, open forest, swamp woodlands, and, especially in inland areas, timber along watercourses. Roosts along creek lines in dense, tall understorey foliage (e.g. in Acacia and Casuarina), or dense eucalypt canopy. Nests in hollows of large, old eucalypts including <i>Eucalyptus camaldulensis</i> , <i>Eucalyptus albens</i> , <i>Eucalyptus polyanthemos</i> and <i>Eucalyptus blakelyi</i> . Birds and mammals important prey during breeding. Territories range from 30 to 200 hectares.
<i>Esacus magnirostris</i>	Beach Stone-curlew	CE		2 records within 10km (OEH 2018a)	In NSW occurs regularly from the Manning River north, with occasional vagrants to South-east NSW and VIC. Inhabit a range of beaches, islands, reefs and in estuaries. Often seen near mangroves. Forage in the intertidal zone of beaches and estuaries, on islands, flats, banks and spits of sand, mud, gravel or rock, and among mangroves. Nests in shallow scrapes above the littoral zone, among low vegetation of grass, scattered shrubs or low trees; also among open mangroves or on sandbanks.

Scientific name	Common name	BC Act status	EPBC Act status	Source	Habitat association
<i>Ixobrychus flavicollis</i>	Black Bittern	V		6 records within 10km (OEH 2018a)	Occurs from southern NSW to Cape York and the Kimberley, and southwest WA. Inhabits terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. May occur in flooded grassland, forest, woodland, rainforest and mangroves as long as there is permanent water. Roosts by day in trees or within reeds on the ground. Nests in branches overhanging water and breeds from December to March.
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E		1 record within 10km (OEH 2018a)	In NSW, becomes increasingly uncommon south of the Northern Rivers region, and rarely occurs south of Sydney. Breeding recorded as far south as Buladelah, though most breeding in NSW occurs in the north-east. Primarily inhabits permanent freshwater wetlands and surrounding vegetation including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters. Will also forage in inter-tidal shorelines, mangrove margins and estuaries. Feeds in shallow, still water. Breeds during summer, nesting in or near a freshwater swamp.
<i>Limosa limosa</i>	Black-tailed Godwit	V	C,J,K	8 records within 10km (OEH 2018a)	The Black-tailed Godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the north and south coast, and inland. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed. It is usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats. It has also been found around muddy lakes and swamps, wet fields and sewerage treatment works.
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	V	C,J,K	3 records within 10km (OEH 2018a)	Breeds in the northern hemisphere. In the non-breeding season most common in north and north west of Australia, but is a regular visitor in small numbers to the NSW coast from Ballina to Shoalhaven Heads. Occurs on sheltered parts of the coast, favouring estuarine mudflats but also occasionally in saltmarshes, freshwater lagoons, saltworks and sewerage farms. Forage on exposed mudflats or wet sand.
<i>Burhinus grallarius</i>	Bush Stone-curlew	E		5 records within 10km (OEH 2018a)	Scattered distribution across NSW. Inhabits lowland grassy woodland and open forest and, in coastal areas, Casuarina and Melaleuca woodlands, saltmarsh and mangroves. Requires a low, sparse groundcover, some fallen timber and leaf litter, and a general lack of a shrubby understory (DEC 2006).

Scientific name	Common name	BC Act status	EPBC Act status	Source	Habitat association
<i>Calidris ferruginea</i>	Curlew Sandpiper	E	CE,C,J,K	378 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DOE 2018a)	Breeds in northern hemisphere. In Australia generally occupies littoral and estuarine habitats. In NSW mainly found in intertidal mudflats on sheltered coasts. Roosts on beaches, spits or islands on the coast/in wetlands, or in saltmarsh on rocky shores.
<i>Stagonopleura guttata</i>	Diamond Firetail	V		2 records within 10km (OEH 2018a)	Typically found west of the Great Dividing Range, but populations also occur in drier coastal areas including W Sydney, Hunter, Clarence and Snowy River valleys. Occurs in grassy eucalypt woodlands including Box Gum and Snow Gum communities, as well as open forest, mallee and natural and derived grasslands. Often found in riparian areas and occasionally in lightly wooded farmland. Nests in shrubby understorey or higher up under nests of other species.
<i>Artamus cyanopterus</i>	Dusky Woodswallow	V		19 records within 10km (OEH 2018a)	The Dusky Woodswallow is widespread from the coast to inland, including the western slopes of the Great Dividing Range and farther west. It is often recorded in woodlands and dry open sclerophyll forests, and has also been recorded in shrublands, heathlands regenerating forests and very occasionally in moist forests or rainforests. The understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, often with coarse woody debris. It is also recorded in farmland, usually at the edges of forest or woodland or in roadside remnants or wind breaks with dead timber. The nest is an open shallow untidy cup frequently built in an open hollow, crevice or stump. Although Dusky Woodswallows have large home ranges, individuals may spend most of their time in about a 2 ha range and defend an area about 50 m around the nest. Dusky Woodswallows prefer larger remnants over smaller remnants. Competitive exclusion by Noisy Miners (<i>Manorina melanocephala</i>) is a significant threat to this species.
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E	Species or species' habitat likely to occur within 10km (DOE 2018a)	Occurs in three disjunct areas of south-eastern Australia: southern Queensland/northern NSW, the Illawarra Region and in the vicinity of the NSW/Victorian border. Illawarra population comprises an estimated 1600 birds, mainly from Barren Grounds Nature Reserve, Budderoo National Park and the Jervis Bay area. Habitat characterised by dense, low vegetation including heath and open woodland with a heathy understorey. The fire history of habitat is important, and the Illawarra and southern populations reach maximum densities in habitat that have not been burnt for over 15 years.

Scientific name	Common name	BC Act status	EPBC Act status	Source	Habitat association
<i>Numenius madagascariensis</i>	Eastern Curlew		CE,C,J,K	589 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DOE 2018a)	Within Australia, the species has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. Breeds in Russia and north-eastern China. Most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets. The birds are often recorded among saltmarsh and on mudflats fringed by mangroves, and sometimes use the mangroves. The birds are also found in saltworks and sewage farms.
<i>Tyto longimembris</i>	Eastern Grass Owl	V		17 records within 10km (OEH 2018a)	Most common in N and NE Australia, but recorded in all mainland states. In NSW most likely to be resident in the NE. Inhabit areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. Nests on the ground in trodden grass, and are often accessed by tunnels through vegetation.
<i>Pezoporus wallicus wallicus</i>	Eastern Ground Parrot	V		2 records within 10km (OEH 2018a)	Occurs in high rainfall coastal and near coastal low heathlands and sedgelands, generally below one metre in height and very dense (up to 90% projected foliage cover). Ground Parrots can re-colonise burnt habitat after 1-2 years and reach maximum densities after 15-20 years without fire. Home ranges of adult birds is typically 10 ha and overlapping with other birds, while juveniles have a significantly larger home range. Ground Parrots feed mostly on seeds from a large range of plant species, which varies seasonally. eggs are laid in a shallow bowl of fine sticks and grass, well hidden under overhanging tall, coarse grass, sedge or low, heathy shrubs.
<i>Pandion cristatus</i>	Eastern Osprey	V		16 records within 10km (OEH 2018a)	Favours coastal areas, especially the mouths of large rivers, lagoons and lakes. They feed on fish over clear, open water. Breeding takes place from July to September in NSW, with nests being built high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea, though there are a handful of records from inland areas.
<i>Pachyptila turtur subantarctica</i>	Fairy Prion		V	Species or species' habitat known to occur within 10km (DOE 2018a)	The fairy prion (southern) breeds on Macquarie Island and a number of other subantarctic islands outside of Australia. The subspecies digs burrows among rocks or low vegetation in which to nest. Burrows may be dug below mat forming herbs. Fairy Prion feed by plucking food from the ocean surface. Some individuals may migrate towards New Zealand and southern Australia in winter.
<i>Petroica phoenicea</i>	Flame Robin	V		1 record within 10km (OEH 2018a)	Breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. Migrates in winter to more open

Scientific name	Common name	BC Act status	EPBC Act status	Source	Habitat association
					lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains. Forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris. Fallen logs and coarse woody debris are important habitat components. Open cup nest of plant fibres and cobweb is often built near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank.
<i>Stictonetta naevosa</i>	Freckled Duck	V		2 records within 10km (OEH 2018a)	Breeds in large, ephemeral swamps in the Murray-Darling, particularly along the Paroo and Lachlan Rivers and other Riverina rivers. In drier times moves to more permanent waters. Disperses during extensive inland droughts and may be found in coastal areas during such times. Prefers freshwater swamps/creeks with dense Cumbungi, Lignum or tea-tree. Nests in dense vegetation at or near water level.
<i>Calyptorhynchus lathamii</i>	Glossy Black-Cockatoo	V		4 records within 10km (OEH 2018a)	Widespread but uncommon from coast to southern tablelands and central western plains. Feeds almost exclusively on the seeds of Allocasuarina species. Prefers woodland and open forests, rarely away from Allocasuarina. Roost in leafy canopy trees, preferably eucalypts, usually <1km from feeding site. Nests in large (approx. 20cm) hollows in trees, stumps or limbs, usually in Eucalypts (Higgins 1999).
<i>Calidris tenuirostris</i>	Great Knot	V	CE,C,J,K	13 records within 10km (OEH 2018a); Foraging, feeding or related behaviour known to occur within area (DOE 2018a)	Breeds in northern hemisphere. In Australia, prefers sheltered coastal habitats with large intertidal mud or sandflats, including inlets, bays, harbours, estuaries and lagoons. Occasionally found on exposed reefs or rock platforms, mangroves, saltwork ponds, near-coastal swamps, saltlakes and non-tidal lagoons. Rarely occurs on inland lakes and swamps. Roosts in large groups in open areas, often at the water's edge or in shallow water close to feeding areas.
<i>Charadrius leschenaultii</i>	Greater Sand-plover	V	V,C,J,K	5 records within 10km (OEH 2018a); Foraging, feeding or related behaviour known to occur within area (DOE 2018a)	Does not breed in Australia. In NSW, recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries. Occurs mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; forage on wet ground at low tide.
<i>Thinornis rubricollis</i>	Hooded Plover	CE	V	1 record within 10km (OEH 2018a)	The Hooded Plover is endemic to southern Australia and is nowadays found mainly along the coast from south of Jervis Bay. In the late 1920s and early 1930s the species was recorded from Port Stephens but are now considered locally extinct. It has not been seen in the Sydney area since the 1940s. Occasionally, individual birds are sighted slightly further north to the

Scientific name	Common name	BC Act status	EPBC Act status	Source	Habitat association
					Shoalhaven River and Comerong Beach and one bird was sighted at Lake Illawarra in March 2001. Hooded Plovers prefer sandy ocean beaches backed by sparsely vegetated sand-dunes for shelter and nesting. Hooded Plovers display high nest site fidelity and nest solitarily. Occasionally Hooded Plovers are found on tidal bays and estuaries, rock platforms and rocky or sand-covered reefs near sandy beaches, and small beaches in lines of cliffs. They regularly use near-coastal saline and freshwater lakes and lagoons, often with saltmarsh.
<i>Charadrius mongolus</i>	Lesser Sand-plover	V	E,C,J,K	33 records within 10km (OEH 2018a); Foraging, feeding or related behaviour known to occur within area (DOE 2018a)	Does not breed in Australia. Found along the entire coast of Australia, most common in northern NSW, QLD and the Gulf of Carpentaria. Rarely recorded south of the Shoalhaven. In NSW almost entirely coastal, on beaches of sheltered bays, harbours and estuaries with large intertidal sand or mudflats, occasionally on sandy beaches, coral reefs and rock platforms.
<i>Hieraaetus morphnoides</i>	Little Eagle	V		5 records within 10km (OEH 2018a)	Occurs throughout NSW except most densely forested parts of the Dividing Range escarpment. Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring.
<i>Glossopsitta pusilla</i>	Little Lorikeet	V		4 records within 10km (OEH 2018a)	Occurs from coast to western slopes of the Great Dividing Range. Inhabits dry, open eucalypt forests and woodlands. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Feed primarily on profusely-flowering eucalypts and a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands <i>Eucalyptus albens</i> and <i>E. melliodora</i> are particularly important food sources for pollen and nectar respectively. Mostly nests in small (opening approx. 3cm) hollows in living, smooth-barked eucalypts, especially <i>Eucalyptus viminalis</i> , <i>E. blakelyi</i> and <i>E. dealbata</i> . Most breeding records are from the western slopes.
<i>Sternula albifrons</i>	Little Tern	E	C,J,K	1110 records within 10km (OEH 2018a)	In NSW occurs mainly north of Sydney, with smaller numbers south to VIC. Almost exclusively coastal, preferring sheltered environments; may occur several kilometres from the sea in harbours, inlets and rivers. Nests in low dunes or sandy beaches just above high tide mark near estuary mouths/ adjacent to coastal lakes and islands. Forage in shallow waters of estuaries,

Scientific name	Common name	BC Act status	EPBC Act status	Source	Habitat association
					coastal lagoons and lakes, also along open coasts, less often at sea, and usually within 50 m of shore.
<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo	V		2 records within 10km (OEH 2018a)	Occupies habitat in arid semi-desert scrublands, savannahs and sparse woodlands, where there is fresh surface water and large hollow trees for nesting. These birds have been recorded in forest, woodland and shrub land, including mulga, mallee, Acacia, Eucalyptus and Callitris associations. It has also been recorded in cropping areas throughout its range (Queensland Government EPA Agency, 2007). Large areas of suitable habitat are required for a viable population to exist (Webster et al undated).
<i>Tyto novaehollandiae</i>	Masked Owl	V		2 records within 10km (OEH 2018a)	Occurs across NSW except NW corner. Most common on the coast. Inhabits dry eucalypt woodlands from sea level to 1100 m. Roosts and breeds in large (>40cm) hollows and sometime caves in moist eucalypt forested gullies. Hunts along the edges of forests and roadsides. Home range between 500 ha and 1000 ha. Prey mostly terrestrial mammals but arboreal species may also be taken.
<i>Limosa lapponica menzibieri</i>	Northern Siberian Godwit		CE	Species or species' habitat may occur within 10km (DOE 2018a)	Has been recorded in the coastal areas of all Australian states. It is widespread in the Torres Strait and along the east and south-east coasts of Queensland, NSW and Victoria, including the offshore islands. Breeds in the north of Scandinavia, Russia and north-west Alaska. Found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays.
<i>Neophema chrysogaster</i>	Orange-bellied Parrot	CE	CE	1 record within 10km (OEH 2018a)	Breeds in Tasmania and migrates in winter to SE South Australia and southern Victoria. There are occasional reports from NSW, including Shellharbour, Maroubra and the Shoalhaven. In winter, usually found within 3 km of the coast in saltmarsh and strandline/ foredune vegetation. May also occur on golf-courses and other grassy areas, including improved pasture.
<i>Grantiella picta</i>	Painted Honeyeater	V	V	Species or species' habitat may occur within 10km (DOE 2018a)	Nomadic, occurring in low densities across most of NSW. Highest concentrations and almost all breeding occur on inland slopes of the Great Dividing Range. Inhabits Boree, Brigalow and Box Gum woodlands and Box-Ironbark forests. Specialist forager on the fruits of mistletoes, preferably of the Amyema genus. Nests in outer tree canopy.
<i>Haematopus longirostris</i>	Pied Oystercatcher	E		901 records within 10km (OEH 2018a)	Scattered along NSW coast. Favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide. Nests mostly on coastal or estuarine beaches; occasionally saltmarsh or grassy areas.

Scientific name	Common name	BC Act status	EPBC Act status	Source	Habitat association
<i>Ninox strenua</i>	Powerful Owl	V		254 records within 10km (OEH 2018a)	Occurs from the coast to the western slopes. Solitary and sedentary species. Inhabits a range of habitats from woodland and open sclerophyll forest to tall open wet forest and rainforest. Prefers large tracts of vegetation. Nests in large tree hollows (> 0.5 m deep), in large eucalypts (dbh 80-240 cm) that are at least 150 years old. Pairs have high fidelity to a small number of hollow-bearing nest trees and defend a large home range of 400 - 1,450 ha. Forages within open and closed woodlands as well as open areas.
<i>Calidris canutus</i>	Red Knot		E,C,J,K	86 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DOE 2018a)	Breeds in northern hemisphere. Occurs in coastal areas around Australia, with important sites in VIC, SA, WA, NT and Qld. Mainly inhabits intertidal mudflats, sandflats and sandy beaches. Occasionally seen in terrestrial saline wetlands but rarely in freshwater wetlands. Forage in soft substrates in intertidal areas.
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	CE	1 record within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DOE 2018a)	In NSW confined to two known breeding areas: the Capertee Valley and Bundarra-Barraba region. Non-breeding flocks occasionally seen in coastal areas foraging in flowering Spotted Gum and Swamp Mahogany forests, presumably in response to drought. Inhabits dry open forest and woodlands, particularly Box-Ironbark woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes.
<i>Ptilinopus regina</i>	Rose-crowned Fruit-Dove	V		1 record within 10km (OEH 2018a)	Occurs from Newcastle north to Cape York, with vagrants occasionally as far south as Victoria. Occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. Thought to be locally nomadic in response to fruit availability.
<i>Calidris alba</i>	Sanderling	V	C,J,K	18 records within 10km (OEH 2018a)	Sanderlings occur along the NSW coast, with occasional inland sightings. Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands. Roosts on bare sand, behind clumps of beach-cast kelp or in coastal dunes.
<i>Petroica boodang</i>	Scarlet Robin	V		1 record within 10km (OEH 2018a)	In NSW occurs from coast to inland slopes. Breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within open understorey of shrubs and grasses and sometimes in open areas. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. Abundant logs and coarse woody debris are important habitat components.

Scientific name	Common name	BC Act status	EPBC Act status	Source	Habitat association
<i>Tyto tenebricosa</i>	Sooty Owl	V		1 record within 10km (OEH 2018a)	Occurs in the coastal, escarpment and tablelands regions of NSW. More common in the north and absent from the western tablelands and further west. Inhabits tall, moist eucalypt forests and rainforests, and are strongly associated with sheltered gullies, particularly those with tall rainforest understorey. Roosts in tree hollows, amongst dense foliage in gullies or in caves, recesses or ledges of cliffs or banks. Nest in large (>40cm wide, 100cm deep) tree hollows in unlogged/unburnt gullies within 100m of streams or in caves.
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	V		182 records within 10km (OEH 2018a)	Evenly distributed along NSW coast, including offshore islands. Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide. Breeds almost exclusively on offshore islands, and occasionally on isolated promontories.
<i>Onychoprion fuscata</i>	Sooty Tern	V		3 records within 10km (OEH 2018a)	Occurs over tropical and subtropical seas and islands around northern NSW. Occasionally seen along coastal NSW, especially after cyclones. Breeds in sand or coral scrapes on offshore islands and cays including Lord Howe and Norfolk Islands.
<i>Circus assimilis</i>	Spotted Harrier	V		3 records within 10km (OEH 2018a)	Occurs throughout Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Inhabits grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods). Most commonly in native grassland, but also in agricultural land, foraging over open habitats including edges of inland wetlands. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn).
<i>Lophoictinia isura</i>	Square-tailed Kite	V		5 records within 10km (OEH 2018a)	Occurs across NSW, resident in North, northeast and along west-flowing rivers. Summer breeding migrant to southeast of state. Inhabits a variety of habitats including woodlands and open forests, with preference for timbered watercourses. Favours productive forests on the coastal plain, box-ironbark-gum woodlands on the inland slopes, and Coolibah/River Red Gum on the inland plains. In Sydney area nests in mature living trees within 100m of ephemeral/permanent watercourse. Large home range > 100 km ² .
<i>Ptilinopus superbus</i>	Superb Fruit-Dove	V		1 record within 10km (OEH 2018a)	Occurs mainly north from NE NSW, much less common further south and largely confined to pockets of habitat south to Moruya. Vagrants occur south to VIC and TAS. Inhabits rainforest and closed forests, may also forage in eucalypt or acacia woodland with fruit-bearing trees. Nests 5-30 m above

Scientific name	Common name	BC Act status	EPBC Act status	Source	Habitat association
					ground in rainforest/rainforest edge tree and shrub species. Part of the population migratory/nomadic.
<i>Lathamus discolor</i>	Swift Parrot	E	CE	6 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DOE 2018a)	Migratory, travelling to the mainland from March to October. Breeds in Tasmania from September to January. On the mainland, it mostly occurs in the southeast foraging on winter flowering eucalypts and lerps, with records of the species between Adelaide and Brisbane. Principal over-winter habitat is box-ironbark communities on the inland slopes and plains. Eucalyptus robusta, Corymbia maculata and C. gummifera dominated coastal forests are also important habitat.
<i>Xenus cinereus</i>	Terek Sandpiper	V	C,J,K	38 records within 10km (OEH 2018a)	The two main sites for this species in NSW are the Richmond River and Hunter River estuaries. Inhabits coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks near mangroves, also observed on rocky pools and reefs and up to 10 km inland around brackish pools. Roost communally in mangroves or dead trees. Forages in open intertidal mudflats.
<i>Neophema pulchella</i>	Turquoise Parrot	V		1 record within 10km (OEH 2018a)	Occurs from coast to inland slopes. In coastal area, most common between Hunter and Northern Rivers, and further south in S Coast. Inhabits open eucalypt woodlands and forests, typically with a grassy understorey. Favours edges of woodlands adjoining grasslands or timbered creek lines and ridges. Feeds on the seeds of native and introduced grasses and other herbs. Grasslands and open areas provide important foraging habitat for this species while woodlands provide important roosting and breeding habitat. Nests in tree hollows, logs or posts from August to December.
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	V	C	323 records within 10km (OEH 2018a)	Primarily coastal but may extend inland over major river systems. Breeds close to water, mainly in tall open forest/woodland but also in dense forest, rainforest, closed scrub or remnant trees. Usually forages over large expanses of open water, but also over open terrestrial habitats (e.g. grasslands).
<i>Epthianura albifrons</i>	White-fronted Chat	V		245 records within 10km (OEH 2018a)	This species occurs from southern Queensland to Western Australia and down to Tasmania, mostly in temperate to arid climates and very rarely in sub-tropical areas. It is found in damp open habitats, particularly wetlands containing saltmarsh areas that are bordered by open grasslands. Along the coast they are found in estuarine and marshy habitats with vegetation <1m tall, and in open grasslands and areas bordering wetlands. Inland, they are often observed in grassy plains, saltlakes and salt pans along waterway margins.

Scientific name	Common name	BC Act status	EPBC Act status	Source	Habitat association
<i>Epthianura albifrons</i>	White-fronted Chat population in the Sydney Metropolitan Catchment Management Area	EP		245 records within 10km (OEH 2018a)	There are two isolated sub-populations of White-fronted Chats currently known from the Sydney Metropolitan CMA: at Newington Nature Reserve and at Towra Point NR. This species is unlikely to cross the 25km separating these areas, or the greater distances separating other colonies outside the CMA.
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	Species or species' habitat may occur within 10km (DOE 2018a)	Occurs from the Shoalhaven north to the Queensland border. Now mostly extinct west of the Great Dividing Range, except in the Warrumbungles and Mt Kaputar. Occurs on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Diet consists of vegetation in adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat	V		157 records within 10km (OEH 2018a)	Generally occurs east of the Great Dividing Range along NSW coast (Churchill 2008). Inhabits various habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. Essentially a cave bat but may also roost in road culverts, stormwater tunnels and other man-made structures. Only 4 known maternity caves in NSW, near Wee Jasper, Bungonia, Kempsey and Texas. Females may travel hundreds of kilometres to the nearest maternal colony (Churchill 2008).
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V		1 record within 10km (OEH 2018a)	Occurs on southeast coast and ranges. Prefers tall (>20m) and wet forest with dense understorey. Absent from small remnants, preferring continuous forest but can move through cleared landscapes and may forage in open areas. Roosts in hollow trunks of Eucalypts, underneath bark or in buildings. Forages in gaps and spaces within forest, with large foraging range (12km foraging movements recorded) (Churchill 2008, Law et al 2008).
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V		13 records within 10km (OEH 2018a)	Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Forages in natural and artificial openings in vegetation, typically within a few kilometres of its roost. Roosts primarily in tree hollows but also recorded from man-made structures or under bark (Churchill 2008).
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V		3 records within 10km (OEH 2018a)	Occurs on the east coast and Great Dividing Range. Inhabits a variety of habitats from woodland to wet and dry sclerophyll forests and rainforest, also remnant paddock trees and timber-lined creeks, typically below 500m asl. Forages in relatively uncluttered areas, using natural or man-made openings in denser habitats. Usually roosts in tree hollows or fissures but also under exfoliating bark or in the roofs of old buildings. Females congregate in maternal roosts in suitable hollow trees (Hoye and Richards 2008, Churchill 2008).

Scientific name	Common name	BC Act status	EPBC Act status	Source	Habitat association
<i>Petauroides volans</i>	Greater Glider		V	Species or species' habitat may occur within 10km (DOE 2018a)	The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level. It prefers taller montane, moist eucalypt forest with relatively old trees and abundant hollows.
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	V	536 records within 10km (OEH 2018a); Roosting known to occur within 10km (DOE 2018a)	Roosts in camps within 20 km of a regular food source, typically in gullies, close to water and in vegetation with a dense canopy. Forages in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps and street trees, particularly in eucalypts, melaleucas and banksias. Highly mobile with movements largely determined by food availability (Eby and Law 2008). Will also forage in urban gardens and cultivated fruit crops.
<i>Phascolarctos cinereus</i> (combined populations of Qld, NSW and the ACT)	Koala	V	V	Species or species' habitat known to occur within 10km (DOE 2018a)	Occurs from coast to inland slopes and plains. Restricted to areas of preferred feed trees in eucalypt woodlands and forests. Home range varies depending on habitat quality, from < 2 to several hundred hectares.
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat,	V	V	Species or species' habitat likely to occur within 10km (DOE 2018a)	Occurs from the coast to the western slopes of the divide. Largest numbers of records from sandstone escarpment country in the Sydney Basin and Hunter Valley. Roosts in caves and mines and most commonly recorded from dry sclerophyll forests and woodlands. An insectivorous species that flies over the canopy or along creek beds. In southern Sydney appears to be largely restricted to the interface between sandstone escarpments and fertile valleys.
<i>Miniopterus australis</i>	Little Bentwing-bat	V		6 records within 10km (OEH 2018a)	Occurs from Cape York to Sydney. Inhabits rainforests, wet and dry sclerophyll forests, paperbark swamps and vine thickets. Only one maternity cave known in NSW, shared with Eastern Bentwing-bats at Willi Willi, near Kempsey. Outside breeding season roosts in caves, tunnels and mines and has been recorded in a tree hollow on one occasion. Forages for insects beneath the canopy of well-timbered habitats.
<i>Perameles nasuta</i>	Long-nosed Bandicoot population in inner western Sydney	EP		25 records within 10km (OEH 2018a)	Occurs within Marrickville and Canada Bay LGAs, and may also occur in the Canterbury, Ashfield and Leichhardt LGAs. Shelter mostly under older houses and buildings, and forage in parkland and backyards.
<i>Pseudomys novaehollandiae</i>	New Holland Mouse		V	Species or species' habitat may occur	Occurs in disjunct, coastal populations from Tasmania to Queensland. In NSW inhabits a variety of coastal habitats including heathland, woodland, dry sclerophyll forest with a dense shrub layer and vegetated sand.

Scientific name	Common name	BC Act status	EPBC Act status	Source	Habitat association
				within 10km (DOE 2018a)	Populations may recolonise/ increase in size in regenerating native vegetation after wildfire, clearing and sandmining. Presence strongly correlated with understorey vegetation density, and high floristic diversity in regenerating heath (Lock and Wilson 1999).
<i>Isoodon obesulus obesulus</i>	Southern Brown Bandicoot	E	E	Species or species' habitat likely to occur within 10km (DOE 2018a)	Occurs mainly in 2 areas: Ku-ring-gai Chase and Garigal National Parks N of Sydney, and far SE NSW including Ben Boyd National Park, East Boyd State Forest, Nadgee Nature Reserve, Nadgee State Forest, South East Forest and Yambulla State Forest but also occurs between these areas. Inhabits scrubby vegetation, including heath, shrubland, and heathy forest and woodland. Often associated with well-drained soils and dry heathland communities, and prefers periodically burnt areas as this increases insect abundance.
<i>Petaurus norfolcensis</i>	Southern Brown Bandicoot	V		1 record within 10km (OEH 2018a)	Occurs along the drier inland slopes as well as coastal habitats. Inhabits woodland and open forest with a Eucalyptus, Corymbia or Angophora overstorey and a shrubby understorey of Acacia or Banksia. Key habitat components include reliable winter and early-spring flowering Eucalypts, Banksia or other nectar sources, and hollow-bearing trees for roost and nest sites (van der Ree and Suckling 2008, Quin et al 2004), with social groups moving between multiple hollows. Social groups include one or two adult males and females with offspring, and have home ranges of 5-10ha within NSW (van der Ree and Suckling 2008, Kavanagh 2004).
<i>Myotis macropus</i>	Southern Myotis	V		501 records within 10km (OEH 2018a)	Mainly coastal but may occur inland along large river systems. Usually associated with permanent waterways at low elevations in flat/undulating country, usually in vegetated areas. Forages over streams and watercourses feeding on fish and insects from the water surface. Roosts in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage, typically in close proximity to water (Campbell 2011). Breeds November or December (Churchill 2008).
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	1 record within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DOE 2018a)	Inhabits a range of environments including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Den sites are in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Females occupy home ranges of up to 750 ha and males up to 3,500 ha, usually traversed along densely vegetated creek lines.
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V		6 records within 10km (OEH 2018a)	Migrates from tropics to south-east Australia in summer. Forages across a range of habitats including those with and without trees, from wet and dry

Scientific name	Common name	BC Act status	EPBC Act status	Source	Habitat association
					sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert. Roosts communally in large tree hollows and buildings.
<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E	V	Species or species' habitat likely to occur within 10km (DOE 2018a)	Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter, and spring, moving to shelters in hollows of large trees within 200m of escarpments in summer. Feeds mostly on geckos and small skinks, and occasionally on frogs and small mammals.
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Species or species' habitat may occur within 10km (DOE 2018a)	Occurs along the coast and eastern slopes of the Great Dividing Range south from Wollemi National Park. Appears to exist as 2 populations with a 100km gap in records between Jervis Bay and Eden. Northern population occurs on sandy soils supporting heath, woodland or open forest. Breeds in ephemeral to intermittent streams with persistent pools. Only infrequently moves to breeding sites, most commonly found on ridges away from creeks, several hundred metres from water.
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	13077 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DOE 2018a)	Formerly occurred from Brunswick Heads to Victoria, but >80% populations now extinct. Inhabits marshes, natural and artificial freshwater to brackish wetlands, dams and in stream wetlands. Prefers sites containing cumbungi (<i>Typha</i> spp.) or spike rushes (<i>Eleocharis</i> spp.), which are unshaded and have a grassy area and/or rubble as shelter/refuge habitat nearby. <i>Gambusia holbrooki</i> is a key threat as they feed on green and Golden Bell Frog eggs and tadpoles.
<i>Litoria raniformis</i>	Growling Grass Frog	E	V	Species or species' habitat may occur within 10km (DOE 2018a)	Currently, the species is known to exist only in isolated populations in the Coleambally Irrigation Area, the Lowbidgee floodplain and around Lake Victoria. Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat.
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V		44 records within 10km (OEH 2018a)	Restricted to Sydney Basin, from Nowra to Pokolbin and west to Mt Victoria. Inhabits heathland and open woodland on Hawkesbury and Narrabeen Sandstones, within 100m of ridgelines. Breeds in ephemeral feeder creeks or flooded depressions, requiring unpolluted water between 5.5 and 6.5 pH. Shelters under rocks, amongst masses of dense vegetation or leaf litter. Populations restricted to immediate vicinity of breeding areas.
<i>Mixophyes balbus</i>	Stuttering Frog	E	V	Species or species' habitat likely to	Occurs along the east coast of Australia. Has undergone a massive range reduction particularly in the south of its range: within the Sydney Basin, White (2008a) located only 3 populations south of Sydney and Daly et al. (2002, in White 2008a) found only 2 extant populations between Macquarie

Scientific name	Common name	BC Act status	EPBC Act status	Source	Habitat association
				occur within 10km (DOE 2018a)	Pass and Victoria. Inhabits rainforest and wet, tall, open forest. Shelter in deep leaf litter and thick understorey vegetation on the forest floor. Feeds on insects and smaller frogs, breeding in streams during summer after heavy rain. The species does not occur in areas where the riparian vegetation has been disturbed or where there have been significant upstream human impacts.
<i>Crinia tinnula</i>	Wallum Froglet	V		19 records within 10km (OEH 2018a)	Inhabits acid paperbark swamps and sedge swamps along the northern and central coast regions of NSW. It is generally not associated with disturbed habitats.
<i>Prototroctes maraena</i>	Australian Grayling		V	Species or species' habitat likely to occur within 10km (DOE 2018a)	Occurs in coastal rivers and streams south from the Shoalhaven River. Inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults. Most of their lives are spent in freshwater rivers and streams in cool, clear waters with a gravel substrate and alternating pool and riffle zones, however can also occur in turbid water. The species can penetrate well inland, being recorded over 100 km inland from the sea. (Backhouse et al 2008).
<i>Epinephelus daemeli</i>	Black Rockcod		V	Species or species' habitat likely to occur within 10km (DOE 2018a)	Found in warm temperate/sub-tropical parts of south-western Pacific. Naturally occur along NSW Coast including Lord Howe Island. Adults generally found on rocky reefs. Juveniles found in coastal rock pools and around rocky shores in estuaries. (DPI 2013).
<i>Macquaria australasica</i>	Macquarie Perch	V	E	Species or species' habitat may occur within 10km (DOE 2018a)	Occurs in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers, and in parts of the Hawkesbury and Shoalhaven catchment areas. Inhabits river and lake habitats, especially the upper reaches of rivers and their tributaries. Requires clear water with deep, rocky holes and abundant cover (including aquatic vegetation, woody debris, large boulders and overhanging banks). Spawning occurs in spring and summer in shallow upland streams or flowing sections of river systems.
<i>Pommerhelix duralensis</i>	Dural Land Snail	E	E	Species or species' habitat likely to occur within 10km (DOE 2018a)	This species is a shale-influenced habitat specialist, which occurs in low densities along the northwest fringes of the Cumberland Plain on shale-sandstone transitional landscapes. The majority of confirmed records for the species occur within The Hills Shire Local Government Area. The species is also found within the Local Government Areas of Blue Mountains City, Penrith City, Hornsby Shire and Parramatta City

Key: CE – critically endangered, E – endangered, EP – endangered population, V – vulnerable, X - extinct

Table C.4 Migratory species known or predicted to occur within 10 kilometres of the project site

Scientific name	Common name	EPBC Act status	Source
<i>Limosa lapponica</i>	Bar-tailed Godwit	C,J,K	Species or species' habitat known to occur within 10km (DOE 2018a)
<i>Monarcha melanopsis</i>	Black-faced Monarch		Species or species' habitat known to occur within 10km (DOE 2018a)
<i>Limosa limosa</i>	Black-tailed Godwit	C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Tringa nebularia</i>	Common Greenshank	C,J,K	Species or species' habitat known to occur within 10km (DOE 2018a)
<i>Actitis hypoleucos</i>	Common Sandpiper	K	Species or species' habitat known to occur within 10km (DOE 2018a)
<i>Calidris ferruginea</i>	Curlew Sandpiper	C,J,K	Species or species' habitat known to occur within 10km (DOE 2018a)
<i>Charadrius bicinctus</i>	Double-banded Plover		Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Numenius madagascariensis</i>	Eastern Curlew	C,J,K	Species or species' habitat known to occur within 10km (DOE 2018a)
<i>Calidris tenuirostris</i>	Great Knot	C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Charadrius leschenaultii</i>	Greater Sand Plover	C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Pluvialis squatarola</i>	Grey Plover	C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Tringa brevipes</i>	Grey-tailed Tattler	C,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Gallinago hardwickii</i>	Latham's Snipe	J,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Charadrius mongolus</i>	Lesser Sand Plover	C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Numenius minutus</i>	Little Curlew	C,J,K	Foraging, feeding or related behaviour likely to occur within 10km (DOE 2018a)
<i>Calidris subminuta</i>	Long-toed Stint	C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Tringa stagnatilis</i>	Marsh Sandpiper	C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Cuculus optatus</i>	Oriental Cuckoo	C	Species or species' habitat may occur within 10km (DOE 2018a)
<i>Charadrius veredus</i>	Oriental Plover	C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Pandion haliaetus</i>	Osprey		Species or species' habitat known to occur within 10km (DOE 2018a)
<i>Pluvialis fulva</i>	Pacific Golden Plover	C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Calidris melanotos</i>	Pectoral Sandpiper	J,K	Species or species' habitat known to occur within 10km (DOE 2018a)
<i>Gallinago stenura</i>	Pin-tailed Snipe	C,J,K	Foraging, feeding or related behaviour likely to occur within 10km (DOE 2018a)
<i>Calidris canutus</i>	Red Knot	C,J,K	Species or species' habitat known to occur within 10km (DOE 2018a)
<i>Calidris ruficollis</i>	Red-necked Stint	C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)

Scientific name	Common name	EPBC Act status	Source
<i>Arenaria interpres</i>	Ruddy Turnstone	C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Philomachus pugnax</i>	Ruff	C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Rhipidura rufifrons</i>	Rufous Fantail		Species or species' habitat known to occur within 10km (DOE 2018a)
<i>Calidris alba</i>	Sanderling	C,J	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Myiagra cyanoleuca</i>	Satin Flycatcher		Species or species' habitat known to occur within 10km (DOE 2018a)
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Monarcha trivirgatus</i>	Spectacled Monarch		Species or species' habitat may occur within 10km (DOE 2018a)
<i>Gallinago megala</i>	Swinhoe's Snipe	C,J,K	Foraging, feeding or related behaviour likely to occur within 10km (DOE 2018a)
<i>Xenus cinereus</i>	Terek Sandpiper	C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Tringa incana</i>	Wandering Tattler	J	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Numenius phaeopus</i>	Whimbrel	C,J,K	Foraging, feeding or related behaviour known to occur within 10km (DOE 2018a)
<i>Hirundapus caudacutus</i>	White-throated Needletail	K	Species or species' habitat known to occur within 10km (DOE 2018a)
<i>Motacilla flava</i>	Yellow Wagtail	C,J,K	Species or species' habitat known to occur within 10km (DOE 2018a)

Key: C – China-Australia Migratory Bird Agreement, J – Japan-Australia Migratory Bird Agreement, K – Republic of Korea-Australia Migratory Bird Agreement

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