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Beaches Link and Gore Hill Freeway Connection

Scoping Report

NSW GOVERNMENT

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Executive summary

Introduction and need

The Western Harbour Tunnel and Beaches Link is a NSW Government initiative to provide additional road network capacity across Sydney Harbour and to improve connectivity with Sydney's northern beaches. The Western Harbour Tunnel and Beaches Link program of works includes:

- The Western Harbour Tunnel and Warringah Freeway Upgrade project, comprising a new tolled motorway tunnel connection across Sydney Harbour, and the Warringah Freeway Upgrade to integrate the new motorway infrastructure with the existing road network and to connect to the Beaches Link and Gore Hill Freeway Connection
- The Beaches Link and Gore Hill Freeway Connection, including a new tolled motorway tunnel connection from the Warringah Freeway to Balgowlah and Frenchs Forest, and upgrade and integration works to connect to the Gore Hill Freeway.

This scoping report relates to the Beaches Link and Gore Hill Freeway Connection (the project). A separate application and scoping report has been prepared for the Western Harbour Tunnel and Warringah Freeway Upgrade project.

The project would involve construction and operation of a 7.5 kilometre, tolled twin tunnel motorway to improve transport connections to the Northern Beaches, reduce road congestion, improve amenity and provide better access to employment centres.

When completed Beaches Link and Gore Hill Freeway Connection would provide important travel time benefits. In particular Beaches Link would bypass 18 sets of traffic lights on the alternative route via Roseville Bridge, for journeys from the new Northern Beaches Hospital precinct at Frenches Forest to the Warringah Freeway at North Sydney. Between Balgowlah and North Sydney, the Beaches Link would bypass 19 traffic lights compared to the existing route via the Spit Bridge and Military Road.

Beaches Link aims to accommodate the growing transport needs of Sydney, strengthen access between the Northern Beaches and commercial and employment centres of the Sydney CBD, North Sydney, Artarmon, Macquarie Park and the west and north west, improving growth opportunities and supporting local business. It is also designed to enhance the resilience of the road network by proving alternate north-south and east-west linkages to reduce congestion and potential gridlock in the event of incidents on the road network.

Project development and construction

The Beaches Link and the Gore Hill Freeway Connection (the project) would comprise:

- Twin tolled motorway tunnels connecting the Warringah Freeway at Cammeray and the Gore Hill Freeway at Artarmon to the Burnt Bridge Creek Deviation at Balgowlah and the Wakehurst Parkway at Seaforth (the Beaches Link). The Beaches Link would include upgrade works along Wakehurst Parkway and the road network around the Burnt Bridge Creek Deviation
- Connection and integration works along the existing Gore Hill Freeway at Artarmon (the Gore Hill Freeway Connection).

A reference design forming the basis of the environmental impact statement for the project is currently being developed taking into account community and stakeholder feedback and the outcomes of environmental investigations.

The project is expected to take around five to six years to build.

Planning and assessment process

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

Roads and Maritime, as the proponent, has formed the view that the project is likely to significantly affect the environment. On this basis, the project is declared to be State significant infrastructure under section 115U (2) of the *Environmental Planning and Assessment Act 1979* EP&A Act by reason of the operation of clause 14 and clause 1 of Schedule 3 of the *State Environmental Planning Policy (State and Regional Development) 2011* (S&RD SEPP).

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

Key environmental issues

Based on environmental investigations that have been carried out to date, and feedback received from the community and other stakeholders, key assessment issues for the project have been identified as:

- Traffic and transport, including road safety
- Air quality, including in-tunnel and ambient air quality
- Noise and vibration
- Human health risks
- Biodiversity, including aquatic and terrestrial biodiversity
- Aboriginal heritage
- Cumulative impacts.

Proposed scope of the environmental impact statement

The environmental impact statement would be prepared in accordance with the EP&A Act and in particular in accordance with the Secretary's Environmental Assessment Requirements (SEARs). In general terms this would include:

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

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Abbreviations and Glossary

Terms	Definition
AHIMS	Aboriginal Heritage Information Management System
ANZECC	Australian and New Zealand Environment Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASRIS	Australian Soil Resource Information System
BC Act	*Biodiversity Conservation Act 2016*
BTEX	Benzene, toluene, ethylbenzene and xylene
CBD	Central business district
CO	Carbon monoxide
DEC	Department of Environment and Conservation (former)
DECCW	Department of Environment, Climate Change and Water (former)
DP&E	Department of Planning and Environment
EPA	Environment Protection Agency
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
Flood tide delta	The bulge of sand formed at the landward mouth of tidal inlets as a result of flow expansion.
FM Act	*Fisheries Management Act 1994*
LGA	Local government area
NO_x	Oxides of nitrogen
NSW	New South Wales
O_3	Ozone
OEH	Office of Environment and Heritage
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PM	Particulate matter
Roads and Maritime	Roads and Maritime Services

SEARs	Secretary’s Environmental Assessment Requirements
SO_2	Sulfur dioxide
TBT	Tributyltin
TRH	Total recoverable hydrocarbons
Tunnel portal	The entry/exit structures at each end of a tunnel
VOC	Volatile organic compounds

1 Introduction

1.1 Overview of the Western Harbour Tunnel and Beaches Link

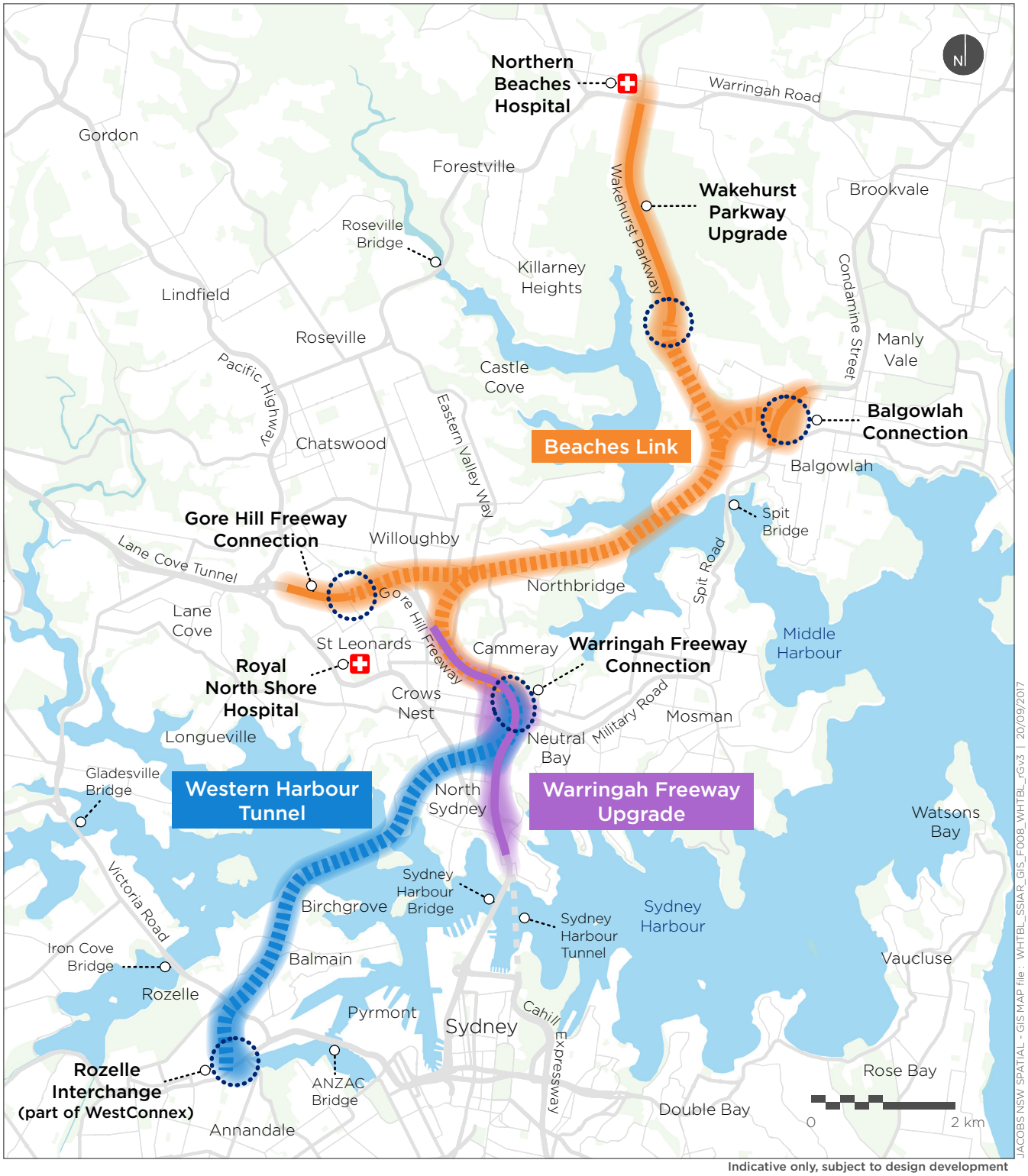
The Western Harbour Tunnel and Beaches Link is a NSW Government initiative to provide additional road network capacity across Sydney Harbour and to improve connectivity with Sydney's northern beaches. The Western Harbour Tunnel and Beaches Link program of works includes:

- The Western Harbour Tunnel and Warringah Freeway Upgrade project, comprising a new tolled motorway tunnel connection across Sydney Harbour, and the Warringah Freeway Upgrade to integrate the new motorway infrastructure with the existing road network and to connect to the Beaches Link and Gore Hill Freeway Connection
- The Beaches Link and Gore Hill Freeway Connection, including a new tolled motorway tunnel connection from the Warringah Freeway to Balgowlah and Frenchs Forest, and upgrade and integration works to connect to the Gore Hill Freeway.

The components of the Western Harbour Tunnel and Beaches Link program of works are shown in Figure 1-1.

Together the Western Harbour Tunnel and Beaches Link program of works would form a new integrated north-south motorway connection that would reduce congestion, improve journey times, support rapid movement of people and freight, and enhance the resilience of the road network across Sydney. These key benefits are discussed further in Section 2.1.

The Western Harbour Tunnel and Warringah Freeway project and the Beaches Link and Gore Hill Freeway Connection project may be delivered as two separate but coordinated construction packages. The two projects would be subject to separate and coordinated State significant infrastructure applications. This scoping report relates to the Beaches Link and Gore Hill Freeway Connection project.



Indicative only, subject to design development

Key

- Western Harbour Tunnel design development corridor
- Warringah Freeway Upgrade design development corridor
- Beaches Link design development corridor
- Indicative connection to surface
- Indicative surface
- Indicative tunnel
- Road network
- Park
- Water

Figure 1-1 The Western Harbour Tunnel and Beaches Link program of works

1.2 Overview of the project

Roads and Maritime Services (Roads and Maritime) proposes to construct and operate the Beaches Link and the Gore Hill Freeway Connection (the project), which would comprise:

- Twin tolled motorway tunnels connecting the Warringah Freeway at Cammeray and the Gore Hill Freeway at Artarmon to the Burnt Bridge Creek Deviation at Balgowlah and the Wakehurst Parkway at Seaforth (the Beaches Link). The Beaches Link would include upgrade works along Wakehurst Parkway and the road network around the Burnt Bridge Creek Deviation
- Connection and integration works along the existing Gore Hill Freeway at Artarmon (the Gore Hill Freeway Connection).

Figure 1-1 shows the regional context of the project with a more detailed description of the project provided in Chapter 4. The project would not directly impact on Garigal National Park adjacent to Wakehurst Parkway.

The project would create an important by-pass of Military Road/Spit Road and strengthen access between the Northern Beaches and key commercial and employment centres. It would provide an alternative to existing arterial connections including Warringah Road, Military Road/Spit Road and the Spit Bridge (refer to Figure 1-2). It would support freight movements, bus movements, improve amenity and provide better access to employment. Further information on the strategic context and need for the project is provided in Section 2.1.

Figure 1-2 The Spit Bridge

1.3 Statutory process

The project is State significant infrastructure and requires approval from the Minister for Planning under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

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

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

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

Clause 1(1) of Schedule 3 of the S&RD SEPP identifies as State significant infrastructure, general public authority activities for infrastructure or other development (but for Part 5.1 of the Act and within meaning of Part 5 of the Act) would be an activity for which the proponent is also the determining authority and would, in the opinion of the proponent require an environmental impact statement to be obtained under Part 5 of the Act.

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

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

1.4 Purpose of this scoping report

This scoping report has been prepared by Roads and Maritime to describe the project, to consider the potential environmental issues associated with its construction and operation and to, identify likely impacts for further investigation and assessment.

This report satisfies three main statutory purposes:

- To support a State Significant Infrastructure application under section 115X of the EP&A Act
- To assist the Secretary of Department of Planning and Environment in preparing the secretary's environmental assessment requirements (SEARs) for the project under section 115Y of the EP&A Act
- To address the requirements set out in clause 192 of the *Environmental Planning and Assessment Regulation 2000* for applications seeking approval of the Minister for Planning to carry out State significant infrastructure (refer to Attachment A).

This report will be made publicly available on the Department of Planning and Environment website and on the Roads and Maritime website.

2 Background

2.1 Strategic context and project need

2.1.1 Overview

The project is part of the NSW Government's commitment to deliver the Western Harbour Tunnel and Beaches Link program of works in line with the *Draft Future Transport Strategy 2056* (NSW Government, 2017), the *NSW State Infrastructure Strategy* (Infrastructure NSW, 2012), the *Long Term Transport Master Plan* (Transport for NSW 2012) and the *Infrastructure Priority List* (Infrastructure Australia, 2016). The project would support the vision presented in *A Plan for Growing Sydney* (NSW Government, 2014a) of Sydney as a strong global city and the economic capital of Australia.

The Beaches Link and Gore Hill Freeway Connection (the project), as part of this program of works, would support the objectives of these strategies and plans by:

- Enabling new strategic road links, including connection with the Western Harbour Tunnel and Warringah Freeway Upgrade project
- Reducing travel times and improving road network reliability
- Improving transport connectivity to and from the Northern Beaches
- Supporting growth and productivity in key economic areas of Sydney by improving access and supporting freight and public transport movements
- Enabling improvements in urban amenity of arterial roads that perform a 'place' function including Military Road/Spit Road, Mona Vale and Warringah Road.

The project would reduce congestion, improve transport connectivity and improve network performance and efficiency enabling sustained growth and productivity across Sydney's Global Economic Corridor and into the Northern Beaches (refer to Figure 2-2). The Global Economic Corridor is one of Australia's most important economic clusters accounting for around 41 per cent (or $195 billion) of NSW's gross regional product (NSW Government, 2014a). The project would also provide a strategic response to growing network congestion and enhance the resilience of the road network across Sydney

2.1.2 Project need

In Sydney, peak period congestion on existing transport routes and modes is already a significant challenge. The size of Sydney means that it is reliant on strategic centres across the metropolitan area to provide services and employment, including over 40 per cent of Sydney's jobs. Each day more than 630,000 trips are made to the Sydney CBD and over 1.2 million daily journeys pass through and around it (Transport for NSW, 2013a). As Sydney's population grows from 4.3 million to an estimated six million by 2031, so will the pressure on access to these strategic centres. Consequently, improvements to existing transport networks and creation of new transport connections will be essential.

Existing arterial road connections to Sydney's Northern Beaches, including Military Road/Spit Road, Mona Vale Road and Warringah Road, also currently experience high levels of traffic congestion. This congestion adversely affects transport connectivity, travel times, economic prosperity and local amenity for both road users and local communities. To address current congestion and to provide improved connectivity to the Northern Beaches for the benefit of local communities and businesses, additional road network capacity is required.

A new road network connection would:

- Increase transport capacity and improve private and public transport journey times to and from Sydney's Northern Beaches
- Improve access to the Northern Beaches with a new connection to Sydney's existing motorway network
- Reduce congestion on key arterial roads, including Military Road/Spit Road, Mona Vale Road and Warringah Road
- Integrate with the existing arterial road network, including Wakehurst Parkway and Burnt Bridge Creek Deviation/Sydney Road
- Reduce environmental, social and amenity impacts associated with existing and future congestion.

There is currently poor connectivity between the Northern Beaches and wider metropolitan area, characterised by long and unreliable road and public transport journey times. As well as hindering daily access for residents and businesses traveling between the region and other parts of Sydney, this restricts opportunities for growth in the strategic centres of Dee Why, Brookvale and the Northern Beaches Hospital Precinct.

The project would increase connectivity with the Global Economic Corridor, Global Sydney and other strategic centres by providing additional capacity across Middle Harbour, relieving congestion on existing key routes and providing connections to other key existing and future proposed transport projects.

There are limited existing arterial road connections to the Northern Beaches, which contributes to high levels of congestion, long and unreliable journey times and, consequently, poor accessibility to and from the region. Existing key arterial road corridors servicing the Northern Beaches are:

- Mona Vale Road
- Warringah Road
- Military Road/Spit Road.

The region is particularly reliant on Warringah Road (via the Roseville Bridge) and Spit Road/Military Road (via the Spit Bridge). These roads currently carry around 70 per cent of all inter-regional journeys to and from the Northern Beaches, and are affected by significant congestion.

Freight connectivity to the region is also currently constrained due to vehicles over 19 metres being prohibited from using Military Road and the eastern end of Warringah Road. For these larger vehicles, journeys to areas such as Dee Why and Brookvale via Mona Vale Road and Pittwater Road can be up to 20 kilometres longer than the most direct road network route.

Long and unreliable public transport times currently result from congestion and can inhibit access to and from the Northern Beaches. Journeys from the Sydney CBD to Mona Vale by bus currently average around 83 minutes in peak hours. The Northern Beaches B-Line Program is being implemented to improve the performance of bus services in the short to medium term. However, additional road network capacity is required to provide a longer-term solution to road congestion and impacts on bus travel times. By shifting congested traffic from surface arterial roads, the project would also facilitate a greater range of options for enhancing or expanding bus services.

The project would transfer traffic from Military Road/Spit Road corridor and Warringah Road into the new motorway tunnels. This transfer of traffic would reduce congestion on surface arterial roads and would improve amenity along these roads for local communities and businesses.

2.1.3 Historic context

The strategic development of the Western Harbour Tunnel and Beaches Link program of works extends back to the 1930s when the need for additional capacity across Sydney Harbour was identified as part of the development of the Warringah Transport Corridor. The Warringah Transport Corridor north of Sydney Harbour is an early form of the current Beaches Link and Gore Hill Freeway Connection project.

Timelines for the historic development of the Warringah Transport Corridor are provided in Table 2-1.

Table 2-1 Historic development of the Warringah Transport Corridor

Timeframe	Development of the Warringah Transport Corridor
1930s	Plans were developed for a new Warringah Transport Corridor to the Northern Beaches.
1953	The Warringah Transport Corridor was adopted by the State Government as part of the Main Road Development Plan 1953.
1968	A review of the Main Road Development Plan 1953 was carried out in the Sydney Regional Outline Plan (NSW State Planning Authority, 1968) and further studies were recommended.
1974	The Sydney Area Transportation Study recommended that the Warringah Freeway be part of the long term road network in Sydney.
1983	The Commission of Inquiry into the Warringah Transport Corridor found that a new surface road to the Northern Beaches in the identified corridor would result in unacceptable levels of community and environmental impacts. The Inquiry noted that the feasibility of the proposal would be improved by future tunnelling technology alleviating some of the potential environmental and community impacts.
1985	The Burnt Bridge Creek Deviation at Balgowlah opened to traffic as the first component of the Warringah Transport Corridor.
2012	The NSW Long Term Transport Master Plan (Transport for NSW, 2014) proposed a new harbour crossing and a bus tunnel bypassing Military Road.
2014	Commitments were made in the NSW State Infrastructure Strategy Update 2014 (Infrastructure NSW, 2014) that the Government would commence work on an additional harbour crossing and would further review and develop Beaches Link.
2015-2016	Transport for NSW and Roads and Maritime carried out preliminary work to establish the viability and high level conceptual design for the Western Harbour Tunnel and Beaches Link program of work.
2016	The draft North District Plan released by the Greater Sydney Commission identified the Western Harbour Tunnel and Beaches Link program of works as an important initiative to improve connections and access to and from northern Sydney.
2017	In March 2017, the NSW Government announced the commencement of a comprehensive community engagement program to inform the development of designs for the Western Harbour Tunnel and Beaches Link program of works.
2017	Roads and Maritime carries out community and stakeholder engagement, preliminary environmental investigations and further design development for the Western Harbour Tunnel and Beaches Link program of works.

Timeframe	Development of the Warringah Transport Corridor
2017	In October 2017, the Draft Future Transport 2056 was released which is an update of the 2012 Long Term Transport Master Plan. The Western Harbour Tunnel and Beaches Link project is identified as a Committed initiative (within 0-10 years, subject to the final business case).

2.1.4 Strategic context

The justification for the project within the context of strategic policy documents is outlined below. Further detail on these key strategic policy documents and relevance to the project is provided in Attachment B.

State priorities: NSW Making it happen

State Priorities: NSW Making it happen (NSW Government, 2015) sets out 12 priorities with 30 targets to measure and deliver projects that create a stronger, healthier and safer NSW. Under the building infrastructure priority, there is a target of improving road travel reliability – 90 per cent of peak travel on key travel roads on time. The project would contribute to this target through:

- Improving travel times and reliability on key transport corridors (Military Road/Spit Road corridor and, Warringah Road corridor)
- Improving the resilience of the transport network.

NSW Long Term Transport Master Plan

The *NSW Long Term Transport Masterplan* (Transport for NSW, 2012) identifies locations of significant congestion on the Sydney road network and sets out a 20-year plan to improve transport in NSW. One of the key priorities identified is filling the 'missing links' in the motorway network to reduce the congestion and consequent trip delays that adversely impact across the Sydney road network.

In particular, the Mona Vale to CBD corridor is identified in the *NSW Long Term Transport Masterplan* as one of the most congested strategic transport corridors in NSW. The significant congestion, particularly along Spit Road/Military Road, affects both passenger vehicles and buses. This congestion reduces the effectiveness and attractiveness of public transport and creates a significant limitation on the prosperity and development of the Northern Beaches.

The project would increase road network capacity across Middle Harbour. This additional capacity would relieve congestion on key corridors such as Spit Road/Military Road (refer to Figure 2-1) and would alleviate current limitations on access to the Northern Beaches.

The priorities identified in the *NSW Long Term Transport Master Plan* to investigate additional road network capacity through the Mona Vale to Sydney CBD corridor are also reflected in *Rebuilding NSW State Infrastructure Strategy 2014* (NSW Government, 2014b) and *A Plan for Growing Sydney (2014)* (NSW Government, 2014a). *A Plan for Growing Sydney* shows how the project would fit with existing and potential future transport links and modes across Sydney (refer to Figure 2-2).

Other strategic planning policies

Other NSW policies and plans for transport relevant to the project include:

- Draft *North District Plan* (Greater Sydney Commission, 2016)
- *Sydney's Bus Future* (Transport for NSW, 2013b)
- *Sydney's Cycling Future* (Transport for NSW, 2013c)
- Draft *NSW Roads Plan* (Transport for NSW, undated)
- *Northern Beaches Transport Action Plan* (Transport for NSW, 2016).

Further detail on the relevance of these plans to the Beaches Link and Gore Hill Freeway Connection is included in Attachment B.

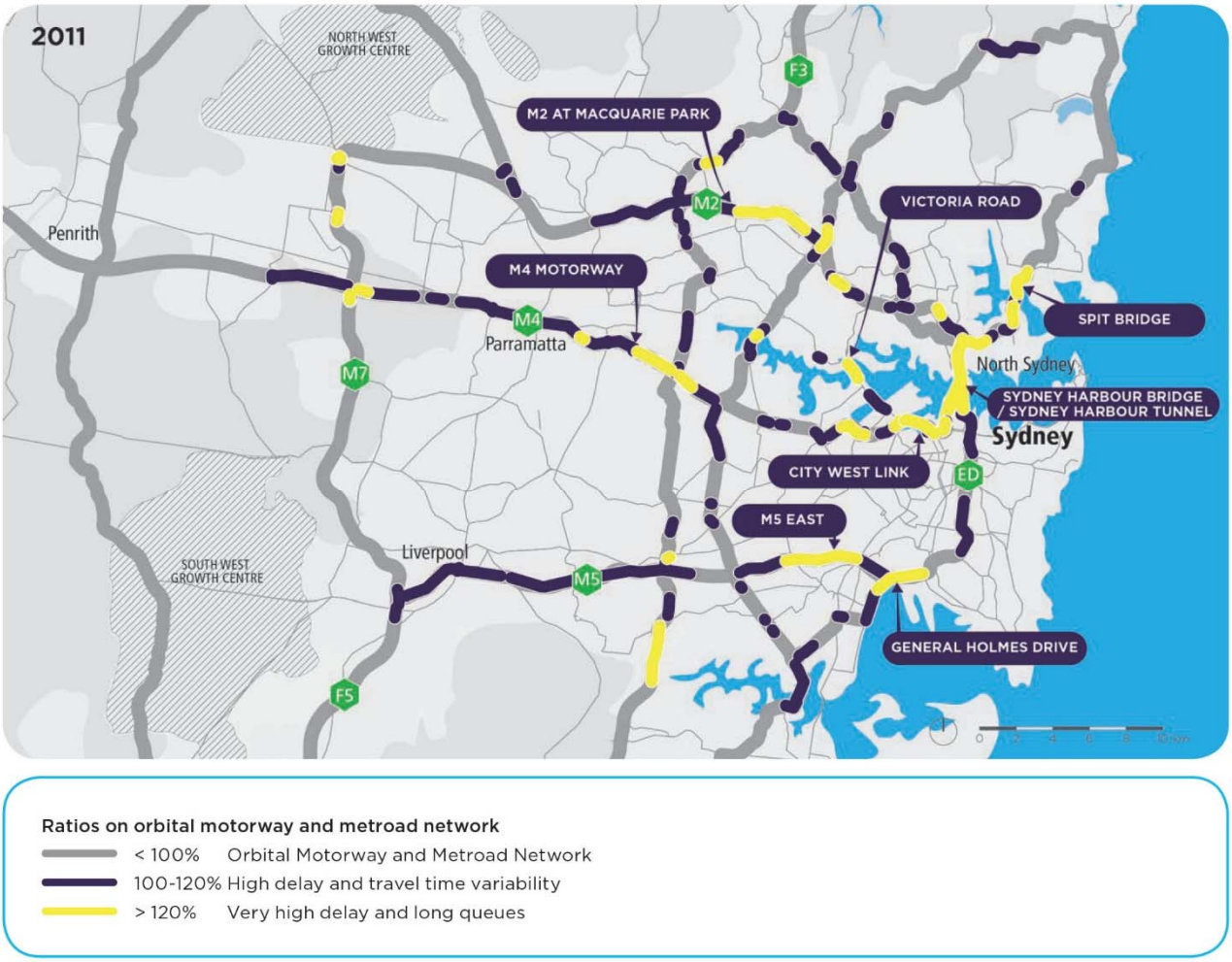


Figure 2-1 Sydney road network performance in 2011 (AM peak) showing congestion hot spots

(Source: *NSW Long Term Transport Masterplan*)

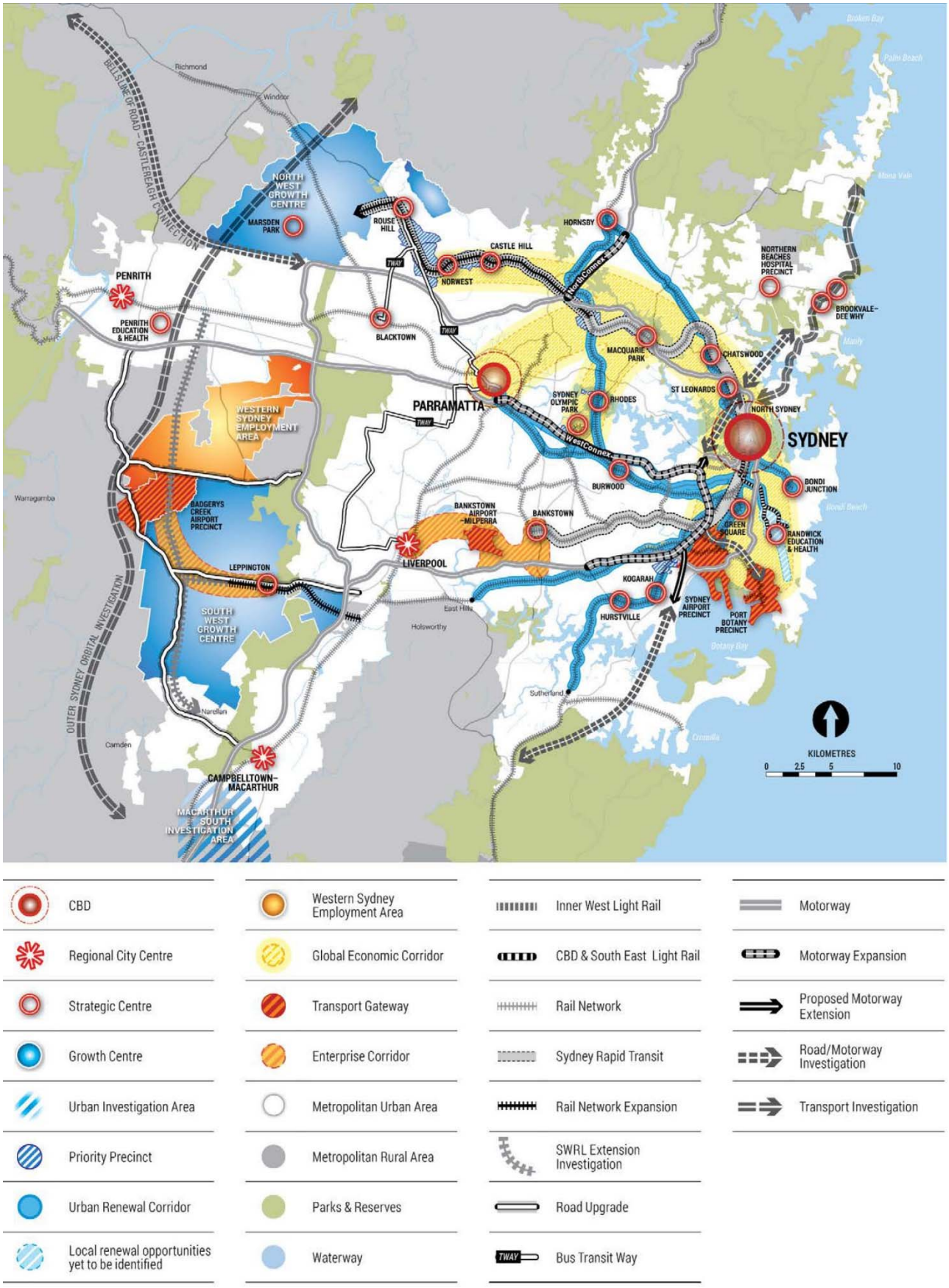


Figure 2-2 Existing and potential future transport links and modes across Sydney

(Source: *A Plan for Growing Sydney*)

2.2 Project objectives

Project objectives have been identified to address the need as described above. These objectives for the project are grouped according to the key road network issues and project need outlined in Section 2.1. The objectives for the project (refer to Table 2-2) have been grouped according to the key focus areas of transport, economic productivity, city shaping, community and environment.

Table 2-2 Project objectives

Focus area	Objective
Transport	• Improve travel times and reliability between the Northern Beaches and other regions of Sydney • Improve travel times and reliability for bus services travelling between the Northern Beaches and the Global Economic Corridor • Improve road safety by reducing road network congestion.
Productivity	• Support the future growth and productivity of Global Sydney by improving access to labour markets in other regions of Sydney • Improve the efficiency of connections between businesses and suppliers in Northern Beaches and other regions of Sydney • Improve access from the Northern Beaches to key employment and business centres in the Global Economic Corridor and other parts of Sydney • Facilitate growth in business and commercial activity in the strategic centres of the Northern Beaches.
City shaping	• Enable improvements to amenity along Military Road/Spit Road and Warringah Road by reducing congestion • Support sustainable growth on the Northern Beaches.
Community and environment	• Minimise property acquisition • Minimise adverse impacts on the environment and the community during construction and operation • Enhance community amenity.

2.3 Selection of the preferred project

2.3.1 Strategic alternatives

The following strategic alternatives have been considered against their ability to deliver on the identified project objectives:

- Base case (‘do nothing’)
- Improvements to the existing arterial road network
- Improvements to public transport
- Construction and operation of a new motorway connection (the project).

Base case

The base case option is to do nothing and to rely on the continued operation of the existing road network to meet future transport demand. As outlined in Section 2.1, the existing road network is significantly congested along Military Road/Spit Road, Warringah Road and Mona Vale Road, particularly during peak periods. As Sydney’s population continues to grow, this network vulnerability to congestion and significant delay will worsen with significant congestion incidents likely to become more frequent. Accordingly, this option would not meet the project objectives and

would adversely impact on the future economy, opportunities for economic growth, amenity, environment and competitiveness of Sydney as a global city.

The base case option has been rejected as a viable strategic alternative because it would not address the identified project need or adequately satisfy the project objectives.

Improvements to the existing arterial road network

Roads and Maritime currently has an extensive program of new and upgraded road projects underway and planned across Sydney to address congestion and to improve travel times.

Information on these projects can be found on the Roads and Maritime website (www.rms.nsw.gov.au/projects/index.html) and in Sydney include:

- The Easing Sydney's Congestion Program, including the M4 Smart Motorway, the Parramatta Congestion Improvement Program, and the accelerated Pinch Point and Clearways Programs
- The Northern Beaches Hospital road upgrade project
- Intersection improvements on Mona Vale Road and Forest Way, Terrey Hills
- The WestConnex program of works, delivered through the Sydney Motorway Corporation, including the M4 Widening and M4 East, the New M5, the M4-M5 Link and Sydney Gateway
- The NorthConnex project
- Planning for the new M12 motorway and improved connectivity around the future Badgerys Creek airport
- Upgrades to The Northern Road, Bringelly Road, Narellan Road and Schofields Road
- Planning for the future F6 extension
- Planning for the potential future Outer Sydney Orbital.

Many investigations have been conducted in the past into ways to increase the capacity of the Spit Bridge. There have also been investigations into various smaller upgrades to the Military Road/Spit Road corridor, including tidal flow, peak period parking restrictions, introduction of bus lanes and T3 lanes and reductions in Spit Bridge opening times. Each of these investigations has considered opportunities to increase road network capacity along the corridor.

Attempts to design new or upgraded bridge crossings at The Spit have been more challenging. To date, no feasible options for substantial improvement to the capacity of the existing road network around The Spit have been identified. Options to significantly reduce congestion and travel times would result in significant land acquisition and unacceptable levels of environmental and social impact. This is consistent with the findings of the 1983 Commission of Inquiry into the Warringah Transport Corridor which identified that new surface arterial road to the Northern Beaches would result in an unacceptable level of impact.

Accordingly, the option of substantial new improvements to the existing arterial road network connecting to the Northern Beaches has been rejected as a strategic alternative.

Improvements to public transport

The NSW Government, through Transport for NSW is currently planning and delivering a series of new and upgraded public transport connections consistent with the suite of transport projects outlined in the *NSW Long Term Transport Masterplan* (Transport for NSW, 2012).

Information on these projects can be found on the Transport for NSW website (www.transport.nsw.gov.au/projects/current-projects) and in Sydney include:

- Delivery of the Northern Beaches Bus Service Plan (Northern Beaches B-Line) from Neutral Bay to Newport

- Delivery of the Sydney Metro City & Southwest project to provide a new passenger rail connection across Sydney Harbour and connectivity to the north-west and south-west of Sydney
- Delivery of the CBD and South East Light Rail project, from Circular Quay to Randwick and Kingsford
- The Sydney's Ferry Fleet program, including additional ferries and increased ferry services
- The More Trains, More Services Program to boost passenger rail services and improve infrastructure over the next three years
- Upgrades to existing train stations as part of the Transport Access Program, including at Arncliffe, Berala, Blacktown, Croydon, Edgecliff, Harris Park, Heathcote, Jannali, Leura, Narwee, Panania, Pendle Hill, Penrith, Toongabbie, Wentworth Falls and Wentworthville
- Delivery of the New Intercity Fleet to improve passenger rail services between Sydney and the Central Coast, Newcastle, the Blue Mountains and the South Coast
- Planning for Sydney Metro West to provide a new passenger rail connection between the Sydney CBD and Parramatta
- Upgrades to commuter car parking at stations across the Sydney passenger rail network
- Planning for a potential future extension of the South West Rail Link.

Some of these projects, particularly the Northern Beaches B-Line, may contribute to relieving congestion on the existing road network. However, these projects would not be sufficient to fully resolve existing congestion and capacity constraints.

Given the complexity of journey patterns within the Sydney metropolitan area and the dispersed nature of origin and destination points for an individual journey, not all journeys can be catered for with public transport. The project would complement existing and future public transport projects, providing additional cross harbour capacity whilst catering for the diverse array of journeys and future population growth.

Construction and operation of the new motorway

Construction and operation of a new arterial road to the Northern Beaches has been discussed since the 1930s when a surface road corridor, requiring a new bridge over Middle Harbour, was gazetted in the Cumberland Plan. While this surface road corridor was abandoned in 1983 due to unacceptable environmental and social impacts, more recently several potential alternative routes for a new motorway have been further considered. These alternatives have focused on tunnel designs to avoid impacts on the surface environment.

A new motorway tunnel connection would:

- Increase road network capacity
- Improve resilience of the road network
- Reduce peak period congestion along arterial corridors connecting to the Northern Beaches
- Improve travel times between key centres for all vehicles (including buses).

By improving travel times and reliability in peak periods, new motorway tunnels would also make buses a more attractive transport option, supporting future mode shift to public transport. New motorway tunnels would also allow new public transport routes to be developed in response to diverse travel demands and support new social and economic development such as the emerging Northern Beaches Hospital precinct in Frenchs Forest.

Following identification of the preferred strategic alternative a number of different route and tunnel crossing options were considered. These options are discussed further in sections 2.3.2 and 2.3.3.

2.3.2 Corridor options

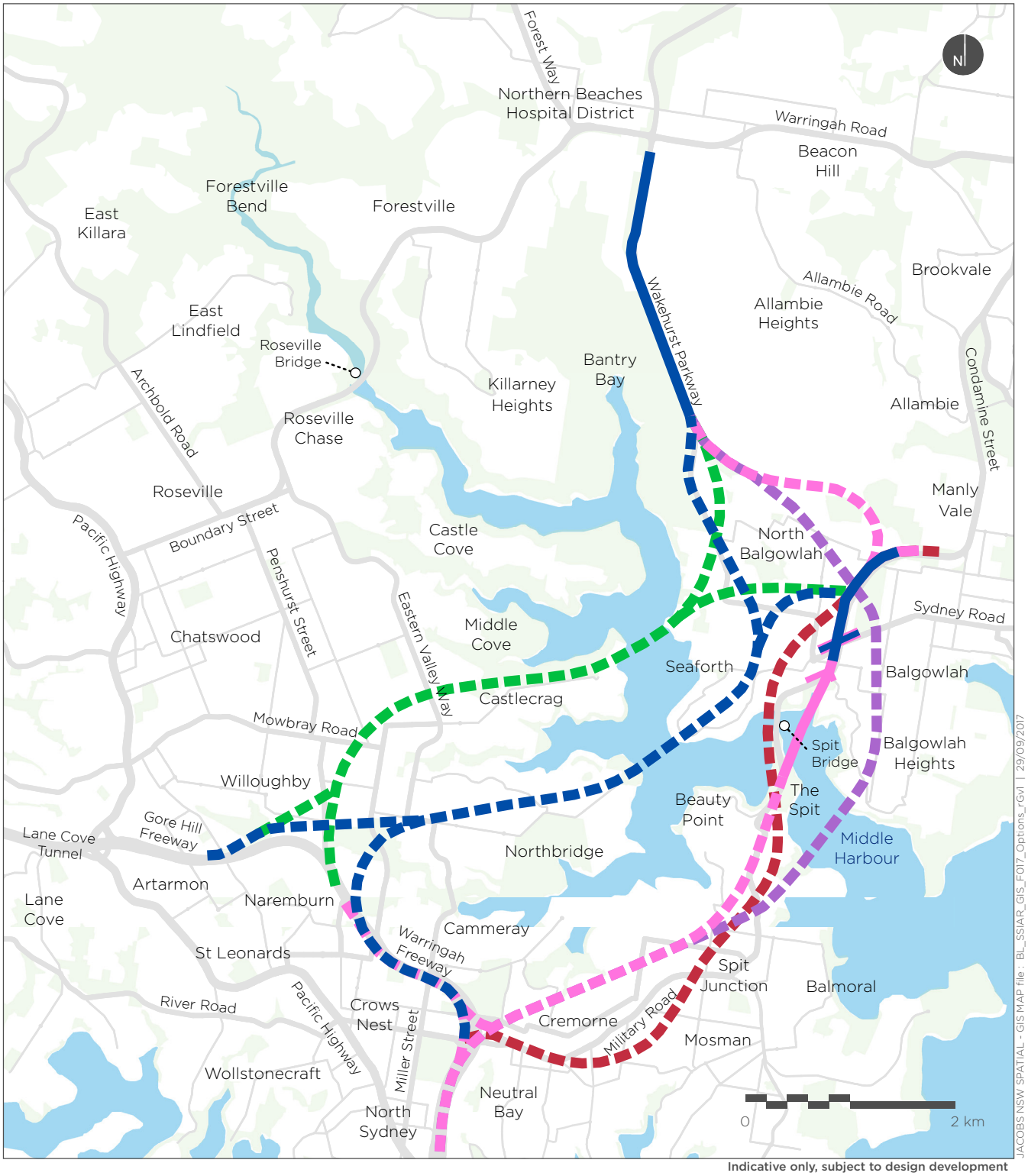
The two main options for providing a new motorway connection to the Northern Beaches include tunnels or a surface road. Construction of a surface road connection was considered in detail during the 1983 Commission of Inquiry into the Warringah Transport Corridor. The inquiry concluded that a surface road connection would be unacceptable based on adverse impacts to the natural, built and social environments.

A new motorway connection to the Northern Beaches would need to cross Middle Harbour, either by tunnel or through construction of a new bridge. Because of the highly developed suburban setting and visual sensitivity of the Middle Harbour environment, a bridge option was discounted early in the options evaluation process. A tunnel solution would provide similar connectivity and design outcomes as a bridge crossing whilst avoiding or minimising visual, air quality, noise and property acquisition impacts.

Five main corridors were considered for a new motorway tunnel connection to the Northern Beaches, as shown in Figure 2-3. The corridor options were identified as the blue option, the pink option, the purple option, the green option and the red option.

The five main corridors were evaluated to identify the most technically, socially and environmentally acceptable tunnel corridor option with the most efficient transport connections. Key factors contributing to the identification and evaluation of these four main corridors were:

- Geology, geotechnical stability and suitability for tunnel construction
- Tunnel depth, tunnel geometry and ability to achieve acceptable road gradients
- Connectivity with the existing road network, particularly the motorway and arterial road networks at Warringah Freeway, Gore Hill Freeway, Wakehurst Parkway and Burnt Bridge Creek Deviation/ Sydney Road
- Opportunities to minimise the need for property disturbance and acquisition
- Opportunities to avoid or minimise impacts on the natural, built and social environments.



Indicative only, subject to design development

Key

- Blue option corridor
- Green option corridor
- Pink option corridor
- Purple option corridor
- Red option corridor
- Surface
- Tunnel
- Road network
- Park
- Water

Figure 2-3 Beaches Link and Gore Hill Freeway Connection main corridor options

Pink corridor option

The pink corridor option included a tunnel connection from the Warringah Freeway, North Sydney, passing beneath Neutral Bay, Cremorne and Mosman. The crossing of Middle Harbour included a new bridge around the current alignment of Spit Bridge with surface connections to the Burnt Bridge Creek Deviation. A second tunnel connection was included to connect the Burnt Bridge Creek Deviation with the Wakehurst Parkway.

The surface components of this corridor option allowed for a reduction in cost relative to complete tunnel options. However, and as discussed above, the surface components introduced undesirable impacts on the natural, built and social environments. These impacts included visual and landscape impacts, additional air quality and noise impacts from surface traffic and greater land acquisition and property impacts compared with other corridor options.

The pink corridor option was rejected based principally on potential surface impacts and the complexity of connection to the Warringah Freeway around Falcon Street.

Purple corridor option

The purple option comprised a tunnel connection under Neutral Bay, Cremorne and Mosman and a shallow crossing of Middle Harbour to the east of the Spit Bridge. From Clontarf, the tunnel connection continued north to the Burnt Bridge Creek Deviation at Balgowlah and then onto the Wakehurst Parkway at Seaforth. The purple option was the longest of the five corridor options.

Key disadvantages of the purple corridor option compared with other options included:

- The significant length of tunnelling required for the option, with resulting adverse impacts on project cost, tunnel ventilation requirements and the motorist experience
- The potential need for significant excavation of the sand bar at the entrance to Middle Harbour
- The complexity of connection to the Warringah Freeway around Falcon Street
- Limited availability of suitable surface construction sites.

The purple corridor option was rejected following consideration of these issues compared with other corridor options.

Red corridor option

The red corridor option comprised a tunnel connection under Neutral Bay, Cremorne and Mosman with a crossing of Middle Harbour to the west of the Spit Bridge. This corridor option connected to North Sydney via an intersection at Falcon Street, which would have likely required signalisation.

The red corridor option was rejected based mainly on traffic management issues around the connection at Falcon Street. Road network and traffic management outcomes at this location were suboptimal compared with other corridor options.

Green corridor option

The green corridor option included connectivity with both the Warringah Freeway and the Gore Hill Freeway, with a tunnel connection under Willoughby, Castlecrag and Seaforth. At Seaforth, the corridor divided to connect with the Wakehurst Parkway to the north and Burnt Bridge Creek Deviation to the east.

The geology around the Middle Harbour crossing point, between Sugarloaf Point and Pickering Point meant that the tunnels would have required steep gradients. These steep gradients would have likely resulted in undesirable traffic performance and increased ventilation requirements. The green corridor option was rejected mainly for these reasons.

Blue corridor option

The blue corridor option was similar to the green corridor option, with connections to the Warringah Freeway and the Gore Hill Freeway in the west and the Wakehurst Parkway and Burnt Bridge Creek Deviation in the east. The blue corridor option followed a more southerly alignment, passing under Northbridge and crossing Middle Harbour near Seaforth Bluff.

The Middle Harbour crossing point exhibited more desirable geology than identified for the green corridor option, allowing for lower tunnel gradients. These flatter tunnel gradients provided for better traffic performance and safety, and better in-tunnel air quality. Other advantages of the blue corridor option compared with other options included:

- Better road network connectivity, particularly around the Warringah Freeway and Gore Hill Freeway
- Shorter tunnel lengths with flatter tunnel gradients
- Better availability of potential construction sites along the corridor
- Reduced environmental impacts compared with some of the other options, particularly the pink corridor option and the purple corridor option.

On the basis of its superior performance relative to other corridor options, the blue corridor option was identified as the preferred corridor to be carried forward for further route alignment design development (refer to Section 2.3.3).

2.3.3 Route options within the preferred corridor

Following identification of the blue corridor option as the preferred corridor for the Beaches Link and Gore Hill Freeway Connection, further project development work has included:

- Community and stakeholder engagement to identify key issues to be taken into account in the design of the project (refer to Chapter **Error! Reference source not found.**)
- Environmental investigations along the corridor, including desktop and field investigations to identify key environmental issues
- More detailed design development taking into account community and stakeholder feedback and the outcomes of environmental investigations.

Project design development is currently underway with the aim of developing a reference design which will form the basis of an environmental impact statement for the project. The project design will continue to develop including:

- In response to ongoing community and stakeholder engagement
- To address impacts identified during the preparation of the environmental impact statement and issues that may be raised during the statutory approvals process for the project
- Innovation through procurement of the detailed design and construction contractor(s) for the project.

Key design aspects currently being considered for the project include:

- Construction methodology, including whether the tunnels would be constructed with roadheaders and/or tunnel boring machines
- The horizontal and vertical alignments of the project tunnels
- Design and configuration of tunnel ventilation systems
- Locations of construction sites.

Construction methodology

Road tunnels are usually constructed using roadheaders, tunnel boring machines or a combination of the two.

Roadheaders are made up of rotating cutting heads mounted on a boom or similar structure. They can be used to cut away rock in a desired shape and tunnel cross sectional area. Tunnel boring machines are larger, and comprise a rotating circular cutting wheel that excavates rock to produce a circular tunnel cross sectional area. Examples of roadheaders and tunnel boring machines are shown in Figure 2-4. The indicative profiles of the Beaches Link and Gore Hill Freeway Connection tunnels if roadheaders or tunnel boring machines are used are shown in Figure 2-5.

Figure 2-4 Examples of a tunnel boring machine (left) and a roadheader (right)

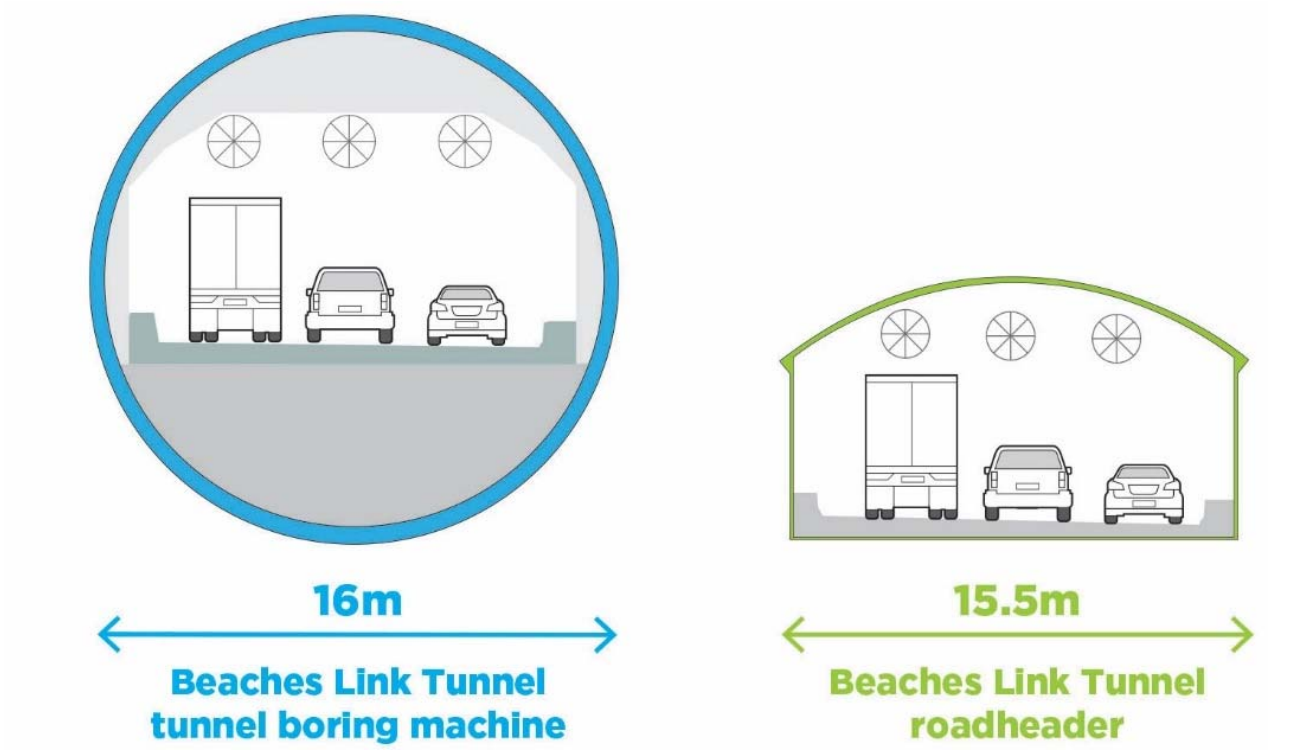


Figure 2-5 Comparison of tunnel profiles using a tunnel boring machine (left) and a roadheader (right)

Geology and geotechnical conditions are the key factors that determine whether roadheaders or tunnel boring machines are most appropriate for construction of tunnels. A decision to use either tunnel boring machines or roadheaders would therefore affect design aspects such as horizontal and vertical alignments (refer below). Other factors that would influence this decision include:

- Size and availability of surface access sites for tunnelling – tunnel boring machines usually require larger access sites than roadheaders
- The need for intermediate surface construction and access sites - depending on the length of tunnel, roadheaders may require intermediate surface construction and access sites. Tunnel boring machines can usually construct much longer tunnels without the need for intermediate surface access points
- Spoil generation and handling – due to their larger cross sectional area, tunnel boring machines usually produce more spoil than roadheaders
- Construction cost – tunnel boring machines are usually more expensive to operate than roadheaders.

Design options for the mined components of the project tunnels currently include construction with roadheaders, tunnel boring machines or a combination of the two. A preferred construction methodology would be identified and included in the environmental impact statement for the project.

Horizontal and vertical alignments

Within the preferred blue corridor option, design development for the project is currently considering different horizontal and vertical alignments for the project tunnels.

The horizontal and vertical alignments of the tunnels are constrained by the need to connect with the Warringah Freeway near North Sydney, the Gore Hill Freeway at Artarmon, Wakehurst Parkway at Seaforth and Burnt Bridge Creek/Sydney Road at Balgowlah. Local topography along the project corridor also varies significantly, adding to the complexity of tunnel design and selection of construction methodology. However, between these points there is some flexibility in both the horizontal and vertical alignments of the tunnels. Different alignments are currently being considered, taking into account:

- Construction methodology, including the use of roadheaders or tunnel boring machines
- Local geological and geotechnical conditions
- Tunnel geometry, gradient and traffic performance
- The required length of mainline tunnels and ramps, noting that shorter tunnels are preferable in terms of cost and construction program.

The geology under Middle Harbour is mostly rock at depth that is overlain by sediments. Depending on the vertical alignment of the tunnels, they may need to be constructed through rock, through sediment or a combination of these. Tunnelling through rock, and particularly Hawkesbury Sandstone, is preferred because it is a strong, stable material. However, Hawkesbury Sandstone and other rock materials can be deep under the harbour and there is a balance between the preference to tunnel through rock and the gradient of the tunnels. The gradient of the tunnels affects traffic performance, in-tunnel air quality and ventilation design.

Shallower tunnel options would encounter soft sediments and softer, more weathered rock, which may require strengthening and stabilisation. If required, stabilisation techniques such as grouting may be necessary for tunnel vertical alignments that pass through these areas.

An alternative to tunnelling through rock or sediment would be to place precast tunnel units on top, or within the top layers, of harbour rock and sediments. This alternative would involve excavation

to create a trough through the rock and sediments, and installation of precast immersed tube tunnel (IMT) units within the trough. Stabilising works, such as piles installed under the immersed tube tunnel to support it, may be required if sediments are soft and geotechnically weak.

Figure 2-6 shows the three main options for the vertical alignment of the Middle Harbour tunnels:

- A deep tunnel, completely within rock (green)
- A shallower tunnel, with parts of the tunnel in softer, weathered rock or sediment (light blue)
- An immersed tube tunnel lying on top or within the top layers of softer, weathered rock and sediments (dark blue).

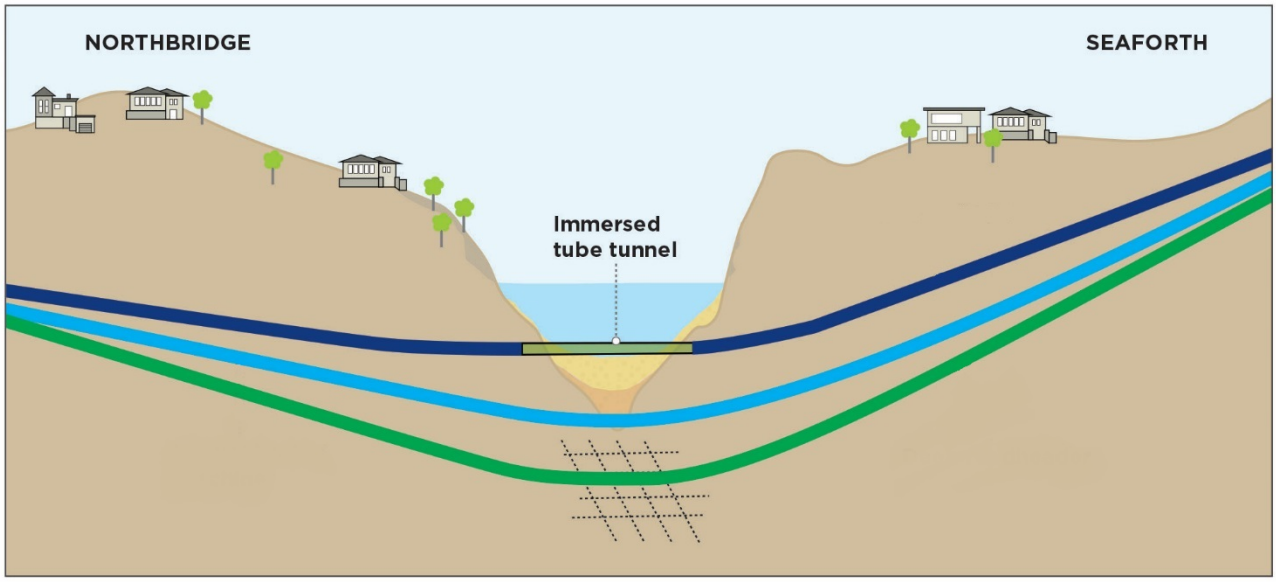


Figure 2-6 Main vertical alignment options for Middle Harbour tunnels

If immersed tube tunnels are required, they would be constructed by placing a series of pre-cast tunnel segments, with backfilling around the tunnel using aggregate materials. Relatively small volumes of excess sediments excavated to form the immersed tube tunnel trough would require disposal, either on land if the materials are contaminated or offshore in a disposal area approved under the *Environment Protection (Sea Dumping) Act 1981*. This is the same construction methodology and sediment disposal approach adopted for construction of the existing Sydney Harbour Tunnel in the early 1990s (refer to Figure 2-7).

Figure 2-7 Construction of the Sydney Harbour Tunnel immersed tube tunnel in the early 1990s

Tunnel ventilation systems

The project tunnels would require ventilation systems to stringent meet in-tunnel air quality criteria for the protection of motorists, and to effectively capture, manage and disperse vehicle emissions.

Consistent with most of the road tunnels around the world, the project tunnels would be longitudinally ventilated. Longitudinal ventilation relies mainly on the piston effect generated by vehicles travelling through the tunnels to move tunnel air forward, with additional mechanical ventilation provided by jet fans installed in the tunnel ceiling where required. Air would be drawn into each tunnel via the entry portal and would gather vehicle emissions as the air passes along the tunnel length. Before the tunnel air reaches the exit portal, it would be directed through a ventilation facility using fans and effectively dispersed into the atmosphere. Release of tunnel air from the exit portals (also known as portal emissions) are not proposed as part of the project. Tunnel ventilation fans would be used to prevent portal emissions under normal operating conditions.

The tunnel ventilation systems, including the number and location of ventilation outlets, are currently being developed as part of the project design. The ventilation systems would be designed to achieve acceptable in-tunnel and ambient air quality. Ventilation facilities would be located to minimise impacts on the surface, including avoiding sensitive environments and minimising the need for acquisition and property impacts.

Construction sites

In addition to the surface disturbance areas required for the Gore Hill Freeway Connection and surface road works, a series of temporary construction compounds would be required along the project alignment. The construction compounds would be needed to support tunnelling and surface works. The number, sizes and locations of construction compounds would depend on whether roadheaders or tunnel boring machines are used to construct the project, as well as the final horizontal and vertical alignments of the tunnels.

Construction compound sites may include activities such as construction laydown and staging areas, concrete batching and distribution, component casting works, worker facilities and amenities, and vehicle parking.

Environmental investigations and stakeholder feedback are currently being used to inform the identification of appropriate construction compound sites. Key factors being applied to identification of construction compound sites include:

- Locating the construction compound sites as close as possible to project construction areas
- Avoiding sensitive environmental and community locations where possible
- Maximising opportunities for direct access to arterial roads for construction traffic, and avoiding the need to use local residential streets if possible
- Minimising property disturbance and acquisition requirements, particularly in residential areas
- Minimising the extent and duration of construction impacts.

Construction compound sites will continue to be developed, and will be presented as part of the environmental impact statement. Because of the nature of the project and its location across Middle Harbour, options to locate some construction compounds on water as well as on dry land will be considered.

3 Consultation

3.1 Overview

Engagement with local communities and stakeholders began in March 2017, following the announcement of the Western Harbour Tunnel and Beaches Link program of works by the NSW Government. The key aim of engagement activities has been to gather community and stakeholder feedback to be taken into account in the design of the project and the subsequent environmental impact statement.

Engagement activities are ongoing, and will continue during the preparation and exhibition of the environmental impact statement.

Key stakeholders for the project include (but are not necessarily limited to):

- State agencies including the Department of Planning and Environment, Environment Protection Authority, Ministry of Health, Department of Primary Industries, Office of Environment and Heritage and Transport for NSW
- The Commonwealth Department of the Environment and Energy if referral or approval is required under the *Environment Protection and Biodiversity Conservation Act 1999*
- Local government, including the Inner West, North Sydney, Mosman, Willoughby, Lane Cove, City of Sydney and Northern Beaches Councils
- Road users, cyclists and pedestrians
- Aboriginal stakeholders
- Utility and service providers
- Local businesses and industry groups
- Directly affected residents and communities
- The broader community.

This chapter describes the consultation activities conducted to date, and activities proposed during preparation of the environmental impact statement.

3.2 Engagement objectives

The key communication objectives for the Beaches Link and Western Harbour Tunnel program of works include:

- Inform interested and affected communities and stakeholders about the design, development and potential impacts of the projects
- Seek feedback from communities and stakeholders on issues important to them, to be taken into account during design, development and environmental impact assessment of the projects
- Identify opportunities to avoid or minimise impacts on the natural, social and built environments including ideas from communities and stakeholders
- Establish clear, consistent and transparent lines of communication between the project team and communities and stakeholders
- Respond to community and stakeholder queries, concerns and requests for information
- Provide updates on field investigations, design development and progress of the environmental impact assessment process.

3.3 Community engagement activities to date

Community engagement activities began in March 2017. Since that time, a series of information and feedback activities have been conducted through several different media. These activities are summarised in Table 3-1.

Table 3-1 Engagement activities during concept design feedback period – 16 March to 31 July 2017*

Activity	Commencement	Detail
General project information and feedback channels		
Project website	April 2017	http://www.rms.nsw.gov.au/projects/sydney-north/western-harbour-tunnel-beaches-link/index.html
Project email address	March 2017	Around 700 emails sent to the project email account: motorwaydevelopment@rms.nsw.gov.au
Project 1800 number	March 2017	Around 1,000 telephone calls received via the project information line: 1800 789 297
Letterbox drops	April 2017	Over 330,000 project fact sheets and community feedback session information flyers delivered.
Online community engagement map	April 2017	Over 1,700 comments posted on specific topics by members of the community
Hosted events		
Community Feedback Session attended by project team and technical specialists	April 2017	Sixteen sessions attended by more than 2,100 people at the following locations: • The Mosman Club (twice) • McMahons Point Community Centre (twice) • Chatswood Club (twice) • Balmain Town Hall (twice) • Manly-Warringah Leagues Club (twice) • Northbridge Bowling Club (twice) • North Sydney Oval Function Centre (twice) • Seaforth Community Centre (once) • Fred Hutley Hall, North Sydney Council Chambers (once).

Activity	Commencement	Detail
Pop up information displays	June 2017	Twelve displays in major shopping centres attended by more than 700 people including: • Birkenhead Point Shopping Centre (twice) • Warringah Mall (four times) • Balgowlah Stockland (twice) • Chatswood Westfield (four times).
Direct engagement with individual stakeholders		
Meetings with residents and stakeholders	March	More than 25 meetings were attended by more than 1,000 people
Door knocks	March 2017	Over 1,500 residences
Notifications of field work		
Marine geotechnical notifications	April 2017	More than 170 notifications to properties in the vicinity of the proposed harbour crossings
Land based geotechnical notifications	May 2017	Over 5,500 notifications and more than 1,200 doorknocks
Noise monitoring installation notifications	May 2017	More than 590 notifications and more than 470 doorknocks
Air quality monitoring station installations	July 2017	More than 50 notifications and more than 40 doorknocks
Media		
Newspaper advertisements	April 2017	More than 89 half page advertisements, placed in the local media in the weeks preceding the community feedback sessions
Media releases	16 March 2017 and 6 April 2017	Media releases were issued by the NSW government to coincide with the preferred corridor and start of field investigation announcements.
Facebook	April 2017	Reach of over 169,000 people through two direct project related Facebook posts on the Roads and Maritime Facebook page, as well as a broadly targeted Facebook advertising campaign.

*Note: all feedback received from members of the community and stakeholders since 31 July has been included in the project data base and is being taken into consideration in the ongoing development of the proposal. Community and stakeholder engagement will be ongoing throughout the planning process.

3.4 Engagement with other stakeholders

As well as community engagement, meetings have been held with State and local government representatives, local precinct committees and interest groups to provide project information and receive feedback about issues or concerns. These meetings have included workshops and briefings with:

- Local councils, including Inner West, City of Sydney, North Sydney, Willoughby, Lane Cove, Mosman and Northern Beaches
- State Government agencies, including Transport for NSW, Sydney Coordination Office, Department of Planning and Environment, Office of Environment and Heritage, Environment Protection Authority, Infrastructure NSW, Department of Primary Industries, National Parks and Wildlife Service, Department of Premier and Cabinet, NSW Treasury, Port Authority of New South Wales, UrbanGrowth NSW, Greater Sydney Commission, Sydney Motorways Corporation, Transport Management Centre, and Sydney Trains
- Commonwealth Government agencies, including: Sydney Harbour Federation Trust and the Royal Australian Navy
- Utilities and service providers, including: Jemena, Ausgrid, Sydney Water Corporation, Vivo Energy and the National Broadband Network
- Harbour transport and other stakeholders, including: HMAS Waterhen Commanding Officer and Ship's Commanders, Harbour City Ferries, Captain Cook Cruises, Fantasea Cruises and Mosman Rowers Club
- Major project teams, including Northern Beaches Hospital, Sydney Metro and West Metro, WestConnex Stage 3 (M4-M5 Link) and B-Line
- The Lane Cove Tunnel concessionaire
- Community and recreation groups including Waverton Precinct Committee, Kirribilli Precinct Committee, Northbridge Progress Association, North Sydney Council community forum, Northern Beaches Council Sustainable Transport Forum, Seaforth residents group, Balgowlah residents group/s, Balmain-Birchgrove residents group, North Sydney-Cammeray community meeting, and various school representatives and parents and citizens committees along the project corridor.

3.5 Feedback received to date

Comments received from the community and stakeholders have been collated according to number of comments per key topic in Table 3-2.

Table 3-2 Number of comments for key topics

Topic	Key topics raised	Number of comments
1	Location and operation of tunnel ventilation system	1068
2	Design - tunnel entry and exit portals, alignment, road connections	653
3	Transport mode, public transport alternatives	526
4	Potential property impacts	501
5	Construction impacts and locations	383
6	Request for more project information	327

Topic	Key topics raised	Number of comments
7	Potential impact on local streets, rat runs, local road safety	312
8	Suggested design changes	275
9	Geotechnical testing	273
10	Satisfaction with engagement	151
11	Impacts on flora	145
12	Project cost and tolling	97
13	Support for project	89
14	Congestion	86
15	Dissatisfaction with engagement process	81
16	Impacts on fauna	81
17	Noise impacts	73
18	Cycling, cycleway facilities, active transport	61
19	Oppose project	59
20	Integration with other proposed infrastructure	21
21	Visual amenity	21
22	Environmental impact assessment and approval process	18
23	Aboriginal heritage	14
24	Impact on community amenity	8
25	Project timing	6

Key issues and feedback identified through engagement with the community and stakeholders to date is summarised in Table 3-3. Feedback has also been gathered on a spatial basis through an interactive feedback map at http://www.rms.nsw.gov.au/projects/sydney-north/western-harbour-tunnel-beaches-link/consultation-map.html. Feedback has been used to assist in the identification of key and other issues considered in this report.

Table 3-3 Key issues and feedback received to date

Category of issue/feedback	Details
Strategic need, justification and cost	General concerns raised were in relation to the development of a motorway rather than public transport initiatives. Alternatives including a heavy or metro rail line, a light rail connection and additional bus services were suggested. Some comments suggested that the tunnels should incorporate both road and rail transport. Broad comment was made that the proposal should form part of a wider, integrated transport plan at the Sydney-wide level, as well as at the local level (eg feedback on the need for North Sydney transport mode integration). A significant number of community representatives and stakeholders indicated support for the project but expressed concern over the uncertainty and/or timing of it proceeding. The cost of the project was raised by some stakeholders, including whether money spent on the project might be better used for public transport. Other stakeholders expressed support for the project but were concerned around tolling levels. Some stakeholders stated that they support the project but do not agree with 'private public partnership' delivery models.
Project design	Further information was sought by the community on design development and feedback provided on project design, including: • Tunnel depth, width and alignment, particularly depth of tunnels beneath residential properties • Locations for tunnel portals, on and off ramps, and ventilation outlets • Harbour crossing construction methodologies and potential impacts • Warringah Freeway and Gore Hill Freeway designs including ramp and portal locations. For those community members located broadly near potential portal locations, consistent feedback was that the portals should be located further away from residential areas. Some feedback was given supporting a tunnel but proposing significantly different alignments (eg tunnel beneath Mosman; Western Harbour Tunnel with direct connection to Lane Cove tunnel etc). Some community members sought information on the grade of the tunnels and expressed concern around steep grades and resultant increases in vehicle emissions.

Category of issue/feedback	Details
Property acquisition impacts, local amenity and property value	Questions were raised about the need for property acquisition and the acquisition process. General views expressed included that acquisition of private properties should be avoided. A number of residents close to the preferred route inquired about hardship acquisitions. Similar concern was expressed by some residents who may live close to potential construction compound sites and permanent infrastructure, but whose properties may not be acquired. Reassurance was sought that the project team would minimise impacts on properties near permanent works (eg through noise abatement structures, landscaping, noise treatments on properties). Broad concerns were raised about the potential for the project to adversely affect property values, particularly in locations near portals and ventilation facilities. Some concerns were also raised about the implications of tunnels on the integrity and resultant change to the value of properties on the surface. Information was requested and concerns expressed around the potential for subsurface property acquisitions. Common questions were around the level of compensation payable for such acquisitions, and the potential impacts on future development of properties with tunnels below.
Construction compound sites and spoil removal	Concerns were raised about the potential locations for construction compounds. Specific sites referred to in feedback included: • General sites on water or along the foreshore • Birchgrove Oval/Birchgrove Park, Birchgrove • Yurulbin Park, Birchgrove • Berrys Bay foreshore/Coal Loader, Waverton • Waverton Park, Waverton • St Leonards Park, North Sydney • ANZAC Park, Cammeray • Cammeray Golf Course, Cammeray • Hallstrom Park/Bicentennial Reserve, Willoughby • Flat Rock Baseball Diamond, Willoughby

Category of issue/feedback	Details
	• Artarmon Reserve, Artarmon • Tunks Park, Northbridge • Northbridge Oval/Northbridge Golf Club, Northbridge • Balgowlah Golf Club, Balgowlah • Balgowlah Oval, Balgowlah • Seaforth Oval, Seaforth • Burnt Bridge Creek, North Balgowlah/Seaforth • Garigal National Park, Seaforth • Manly War Memorial Park/Manly Dam, Allambie Heights. The key theme of the feedback was that there is limited open space in suburbs around the preferred route and loss of such open space should be minimised. Concerns were expressed around the potential for compound noise, vibration, dust and traffic impacts due to spoil removal. Information was sought on proposed plans to minimise spoil removal through local streets, and queried where spoil would be sent and how it would be disposed of. Strong support was expressed for spoil removal via water transport if feasible.
Environmental and technical field investigations	Further information was sought and feedback was provided on environmental field investigations, including terrestrial and marine geotechnical work. Questions were also raised around the location of geotechnical sites as they relate to a final tunnel alignment. Comments were collected from some community members concerned that geotechnical drilling would impact on property structures. This included concerns around potential noise and vibration from geotechnical work. Concerns were also expressed around field investigations and impacts on flora, fauna and indigenous heritage.
Environmental and heritage concerns	Broader environmental concerns were expressed around: • Impacts of waterway crossings on marine/estuarine ecology • Impacts on flora and fauna along and around Wakehurst Parkway • Impacts of tunnels on subsurface ground conditions, groundwater etc • Impacts of tunnel portals on environmental assets (eg Burnt Bridge Creek)

Category of issue/feedback	Details
	• General environmental impacts of motorways (ie emissions from cars and impacts on climate change). A number of concerns were expressed around heritage considerations including Aboriginal and non-Aboriginal heritage. Key areas where heritage concerns were raised included: • North Sydney heritage buildings • Balmain-Birchgrove heritage buildings • St Leonards Park, North Sydney • Birchgrove Oval, Birchgrove • Aboriginal heritage sites (eg, along Wakehurst Parkway and the Clive Park shoreline in Northbridge) • Garigal National Park • Manly Dam • Manly-Warringah War Memorial Park.
Traffic and road user impacts, public transport and active transport	Concerns were raised about existing congestion and road safety, including whether the project would be effective in addressing these issues. Feedback connected with comments on the strategic need and justification for the project was provided, including whether a public transport initiative should be favoured. Some community members expressed support for the project overall but suggested local traffic impacts need to be mitigated, for instance: • Reducing rat runs on local streets by motorists attempting to access tunnel portals • Local traffic controls/traffic calming measures in residential areas to complement the motorway • Avoiding funnelling of traffic into the tunnels (ie no closure of local streets designed to generate motorway traffic). Consistent feedback was provided on the need to minimise construction traffic on local streets. A substantial number of questions were raised around spoil removal via trucks versus water transport. A significant number of questions were raised around whether the tunnels would be designed to accommodate buses, including double deck buses. Questions were also asked around the inclusion of

Category of issue/feedback	Details
	bus lanes or bus priority systems in the tunnels. Consistent questions were also raised about whether the tunnels could, or should, accommodate light of heavy rail infrastructure. Community members also sought information on whether active transport options could be incorporated in the project, with a cycleway along the Wakehurst Parkway commonly requested. Some members of the community and other stakeholders mentioned the need to duplicate Wakehurst Parkway further north, beyond the current scope of the project (ie north of the Warringah Road intersection, to Oxford Falls).
Air quality	Concerns were raised about air quality and potential human health risks, including the location of tunnel ventilation facilities. Specific sites referred to in feedback included: • Ventilation facilities at Rozelle, including those for WestConnex and for the project • Ventilation facilities in the Cammeray, Artarmon, Seaforth and Balgowlah areas • Concerns, in response to erroneous media coverage, around ventilation outlets in areas where no ventilation facilities are planned (eg Birchgrove, North Sydney, Northbridge). Specific concerns were raised by sporting groups around potential location of ventilation facilities near sports grounds and by members of the community in relation to the potential location of ventilation outlets in proximity to residential areas. Community members also raised concerns about the suitability of ventilation outlet locations given local topography in certain areas (eg Balgowlah). Concern raised by community members in Balmain-Birchgrove-Rozelle area around the potential for additional ventilation outlets at Rozelle (ie in addition to those proposed to be constructed as part of the Rozelle Interchange/M4-M5 Link). Consistent feedback was provided by community members that filtration systems should be considered/adopted as part of the tunnel ventilation systems. Community members sought more clarity on how tunnel ventilation systems currently work, with more detailed information requested on why filtration is not commonly used.

Category of issue/feedback	Details
Noise and vibration	Concerns were raised over the duration and intensity of construction noise, including on residential and other sensitive receivers. Specific concerns related to: • Impacts of tunnels directly beneath residential properties and impacts of tunnelling equipment • Impacts of surface works (eg construction of ramps and portals within close proximity to residential areas) • Impacts of work in harbour crossings on properties near the shoreline. Community members requested more information on hours of work, and duration of work at individual sites. Concerns were also raised around impacts on the structural integrity of properties, with more information requested on property condition assessment surveys and compensation for affected properties. Detailed information was sought by community members on the likelihood of feeling vibration and hearing noise if the tunnelling equipment is directly below a residence. Information was sought on what mitigation measures could be put in place to reduce these impacts.
Engagement process	Some community members expressed a broad view that the level of consultation was appropriate and well implemented given the early concept design stage of the project. Other community members expressed a view that more detailed information on the alignment and infrastructure was required as part of the engagement process.

3.6 Future engagement activities

The general project information and feedback mechanisms summarised in Table 3-1 would continue to be available during design development and preparation of the environmental impact statement. These mechanisms would be complemented with direct community and stakeholder engagement activities focused on:

- Providing information and project updates at key stages during design development and preparation of the environmental impact statement
- Engagement with affected landowners and community groups about the project and key design decisions that may impact them
- Engagement and coordination with transport and other infrastructure providers, particularly around project interfaces and in relation to cumulative impacts
- Engagement with regulatory agencies during preparation of the environmental impact statement to ensure a complete and robust environmental impact statement.

Key phases of engagement activities would include:

- Around the making of the State significant infrastructure application to which this scoping report relates
- Around key design decision points
- Generally during the preparation of the environmental impact statement
- Around the time of public release of the environmental impact statement for comment
- In response to key issues raised in submissions made in response to the environmental impact statement, including direct engagement with community and stakeholders over specific issues of concern where relevant
- Ongoing during delivery of the project.

The environmental impact statement would include details of issues raised during engagement with the community and other stakeholders. It would also clearly identify where these issues have been responded to through the design development process and the environmental impact statement.

4 Project description

4.1 Overview and key elements

Roads and Maritime proposes to construct and operate the Beaches Link and Gore Hill Freeway Connection (the project), which would comprise:

- New twin tolled motorway tunnels connecting the Warringah Freeway at Cammeray and the Gore Hill Freeway at Artarmon with the Wakehurst Parkway at Seaforth and the Burnt Bridge Creek Deviation/Sydney Road at Balgowlah (the Beaches Link)
- Connection and integration works along the existing Gore Hill Freeway (the Gore Hill Freeway Connection).

The project forms part of the larger Western Harbour Tunnel and Beaches Link program of works.

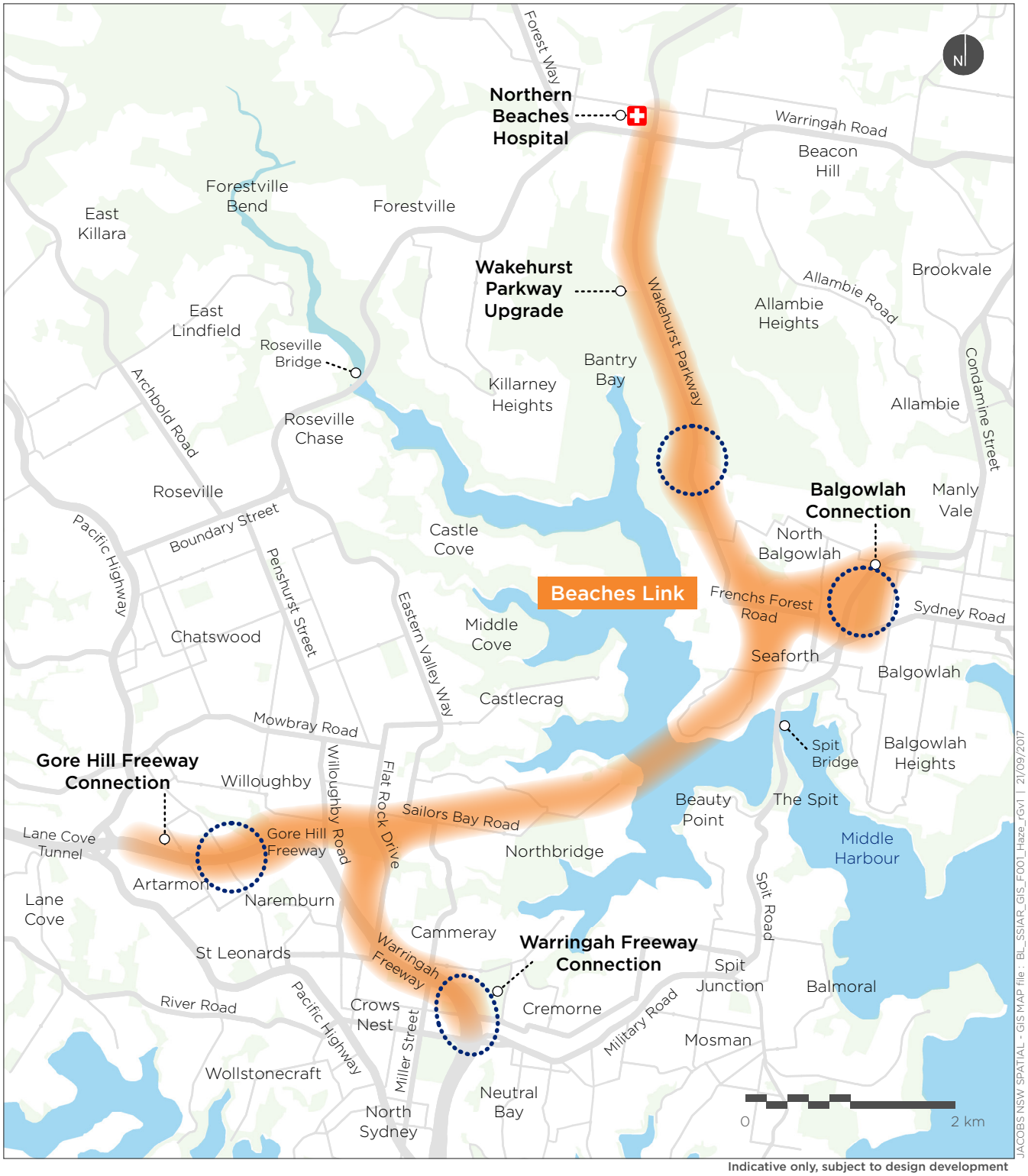
The design of the project is currently being developed, taking into account the outcomes of community and stakeholder engagement and environmental field investigations. The design development corridors being considered during design development for the Beaches Link and Gore Hill Freeway Connection are shown in Figure 4-1. The project is being designed within these corridors.

Further details of the Beaches Link and the Gore Hill Freeway Upgrade are provided in Section 4.2 and Section 4.3. Potential construction methodologies and construction program are discussed in Section 4.4.

4.2 Beaches Link

Key elements of the Beaches Link component of the project would include:

- Twin tolled motorway tunnels connecting the Warringah Freeway at Cammeray and the Gore Hill Freeway at Artarmon with the Wakehurst Parkway at Seaforth and the Burnt Bridge Creek Deviation/Sydney Road at Balgowlah. Each tunnel would be around 7.5 kilometres in length
- Works to connect the tunnels to the Gore Hill Freeway (including integration with the Gore Hill Freeway Connection)
- Works to connect the tunnels to the Warringah Freeway (including integration with the Warringah Freeway Upgrade) and the Western Harbour Tunnel
- Works to connect the tunnels to the Burnt Bridge Creek Deviation/Sydney Road and to connect and integrate with the surface road network at Balgowlah
- Works to connect the tunnels to the Wakehurst Parkway at Seaforth and to upgrade the Wakehurst Parkway between Seaforth and Warringah Road at Frenchs Forest
- New bridge structures or modifications to existing bridge structures
- Ancillary operational facilities including a motorway control centre, ventilation and air supply facilities, groundwater and drainage management and treatment systems, signage, tolling, fire and life safety, lighting emergency evacuation and emergency smoke extraction infrastructure
- Surface drainage, utilities and service connections and modifications
- New and upgraded pedestrian and cyclist infrastructure around surface connections.



Indicative only, subject to design development

Key

- Beaches Link design development corridor
- Indicative connection to surface
- Road network
- Park
- Water

Figure 4-1 Beaches Link and Gore Hill Freeway Connection design development corridor

4.2.1 Motorway tunnels

The twin mainline tunnels between the Warringah Freeway at Cammeray and Gore Hill Freeway at Artarmon, and the Wakehurst Parkway at Seaforth and the Burnt Bridge Creek Deviation/ Sydney Road at Balgowlah would be around 7.5 kilometres in length.

The mainline tunnels would commence at the Warringah Freeway at Cammeray, with ramp connections also provided between the mainline tunnels and the Gore Hill Freeway at Artarmon. The ramps would meet the mainline tunnels around Willoughby/Northbridge, with the mainline tunnels continuing under Naremburn and Northbridge. The tunnels would cross Middle Harbour around Northbridge and Seaforth Bluff, before dividing around the north-east of Seaforth. The northern branch of the mainline tunnels would continue north to connect to the Wakehurst Parkway and the southern branch would continue to the east to connect to the Burnt Bridge Creek Deviation/Sydney Road.

The tunnels would be provided with ventilation, lighting, signage and electronic visual surveillance and safety communication systems to allow communication with drivers. The posted speed limit within the motorway tunnels would be 80 km/h.

As discussed in Section 2.3.3, options under investigation for construction of the mainline tunnels include use of roadheaders, tunnel boring machines or a combination of the two. Depending on the depth of the tunnels, an immersed tube tunnel (IMT) component may be included as part of the project.

4.2.2 Connection to the Warringah Freeway and Western Harbour Tunnel

The project would connect to the Warringah Freeway and Western Harbour Tunnel at Cammeray. The mainline tunnels would connect to dive structures forming part of the Warringah Freeway Upgrade component of the Western Harbour Tunnel and Warringah Freeway Upgrade project.

Depending on the timing of construction of the Warringah Freeway Upgrade and the Beaches Link, construction activities in and around the Warringah Freeway corridor may be carried out at the same time with appropriate coordination and staging. Otherwise, the Warringah Freeway Upgrade works would be completed and made suitable for future connection of the Beaches Link project.

4.2.3 Connection to the Gore Hill Freeway

The project would connect to the Gore Hill Freeway with ramps between the mainline tunnels around Willoughby/Northbridge and the Gore Hill Freeway to the west of the North Shore railway line. Surface works to connect and integrate the ramps with the Gore Hill Freeway and the surrounding road network would comprise the Gore Hill Freeway Connection component of the project (refer to Section 4.3).

4.2.4 Connection to the Wakehurst Parkway

The mainline tunnels would connect to the Wakehurst Parkway at Seaforth. Options for the location of the tunnel surface connection and associated tunnel portals are currently being investigated as part of the design development process.

The Wakehurst Parkway is currently two lanes wide. As part of the project, the section of Wakehurst Parkway between the tunnel portals and Warringah Road would be upgraded to two lanes in each direction. This upgrade would provide capacity to accommodate the project and to complement separate road upgrades to Warringah Road (currently being delivered as part of the Northern Beaches Hospital connectivity and network enhancements project). The Wakehurst Parkway upgrade works would not encroach into the Garigal National Park to the west.

The following works would also be carried out as part of the upgrade works along the Wakehurst Parkway:

- New pedestrian and cyclist infrastructure along the Wakehurst Parkway from around the tunnel portals to Warringah Road
- Replacement of the existing pedestrian overpass and bus stops
- New tunnel ventilation system and building
- Fauna crossings (underpasses and/or overpasses).

4.2.5 Connection to the Burnt Bridge Creek Deviation/Sydney Road

The mainline tunnels would connect to Burnt Bridge Creek Deviation/Sydney Road at Balgowlah. Options for the location of the tunnel surface connection and associated tunnel portals are currently being investigated as part of the design development process. Subject to ongoing design development, a bridging structure over Burnt Bridge Creek may be required and realignment of the creek may also be needed.

Upgrades to surface roads in Balgowlah near the connection with the Burnt Bridge Creek Deviation/Sydney Road would be required to integrate the project with the existing road network.

4.2.6 Ancillary operational facilities

Ancillary operational facilities for the project tunnel would comprise:

- Surface infrastructure, including:
  - A motorway control centre
  - An operational water treatment facility to manage and treat water from the tunnels, if required, prior to discharge
  - Ventilation facilities, including ventilation outlets and tunnel air intake infrastructure
  - Tolling infrastructure
  - Electricity supply infrastructure including project substations
  - Surface lighting and signage
  - Surface drainage works.

- In-tunnel infrastructure, including:
  - Emergency shoulders and breakdown bays
  - Tunnel cross passages for motorist egress and access for emergency services in the event of an incident in the tunnels
  - Firefighting suppression and firefighting systems
  - In-tunnel ventilation systems, including ventilation fans and connections with surface ventilation facilities
  - In-tunnel drainage, sumps and connections with the surface water treatment facility
  - In-tunnel lighting and signage
  - Tunnel monitoring systems
  - Electricity supply and communications infrastructure.

The locations and sizes of ancillary operational facilities are currently being developed taking into account technical and access requirements, existing land use, potential environmental impacts and amenity issues for the surrounding community. Ancillary operational facilities would be detailed and assessed in the environmental impact statement.

4.2.7 Pedestrian and cyclist infrastructure

Where the project affects existing pedestrian and cyclist infrastructure, new or upgraded facilities would be included in the project design to deliver an equivalent or better outcome than currently exists. Pedestrians and cyclists would not be permitted in the mainline tunnels.

4.3 Gore Hill Freeway Connection

The Gore Hill Freeway Connection component of the project would include surface works along the existing Gore Hill Freeway to connect and integrate the project with the existing surface road network. The works would be carried out to the west of the North Shore railway line and would include:

- Portal and dive structures to connect to the Beaches Link component of the project
- New traffic lanes and reconfiguration of existing traffic lanes
- New bridge structures or modifications to existing bridge structures
- Relocated pedestrian and cyclist infrastructure.

4.4 Construction

The Beaches Link and Gore Hill Freeway Connection components of the project may be delivered as separate but coordinated construction packages. A more detailed staging plan and construction coordination measures would be presented in the environmental impact statement.

4.4.1 Timing

The project is expected to take around five to six years to build. A more detailed construction program, including anticipated staging of construction activities, would be included in the environmental impact statement.

4.4.2 Methodology

Construction methodologies are currently being considered as part of the design development for the project. This includes whether mined tunnels would be constructed with roadheaders or tunnel boring machines or both.

Indicative construction activities and methodologies would be comparable to other recent motorway tunnel projects and would include:

- Establishment of construction compounds including demolition, fencing, installation of site facilities, relocation and protection of utilities, installation acoustic sheds, and construction of temporary buildings and wharves
- Construction of mainline tunnels, intersections and roadside infrastructure
- Management and haulage of spoil during tunnelling and excavation activities by truck and/ or barge
- Demolition, modification and construction of bridges and other civil engineering structures, such as portals, retaining walls, pedestrian paths and bridges, cycleways, culverts, noise barriers, fencing, fauna underpasses and overpasses, tolling gantries, lighting and signage
- Modifications to surface roads including lane upgrades and modifications, changes to signalisation and intersection works
- Subject to harbour crossing methods, management of temporary marine based activities, including land and water access and construction sites
- Construction and delivery of pre-cast elements if the project includes an immersed tube tunnel component

- Environmental management and pollution control measures for the project
- Tunnel fitout and utilities connections.

As discussed in Section 2.3.3, deeper parts of the project tunnels would be constructed with roadheaders or tunnel boring machines, or a combination of the two. Troughs and cut and cover construction methods would be required at shallower sections, such as near the tunnel portals. Other excavation activities likely to be carried out include the creation of cross passages and caverns or shafts for other support infrastructure.

Early works required for site preparation such as minor road work, land acquisition, fencing, demolition, site clearance, utilities installation and adjustments, management of contamination and site set up would generally be conducted separately to the main project works and would be subject to separate approvals (if required).

4.4.3 Construction hours

Where feasible and reasonable, construction activities would be carried out during standard construction hours. Two key components of the project that may require works outside standard construction hours include:

- Tunnelling, tunnel spoil handling and transport
- Works affecting or adjacent to live traffic lanes on the Warringah Freeway, Gore Hill Freeway, Burnt Bridge Creek Deviation, Sydney Road and Wakehurst Parkway.

Continuous works can reduce the construction program by up to two thirds relative to standard construction hours based on availability of construction times alone. In most cases, tunnelling would be carried out at significant depths below the surface and would not lead to surface impacts.

Tunnelling would generate significant volumes of tunnel spoil. To avoid and minimise surface disturbance in a highly developed urban corridor, construction compound sites would cover the smallest area necessary to support construction activities. Because of this, there would be limited space available for storage of tunnelling spoil on construction compound sites. Handling and transport of spoil may therefore need to be conducted up to 24 hours per day, seven days per week at some sites to handle material produced from continuous tunnelling activities. This could be for a period of up to two years at tunnelling compound sites depending on final construction planning.

Warringah Freeway, Gore Hill Freeway, the Wakehurst Parkway and Burnt Bridge Creek Deviation/ Sydney Road carry significant volumes of traffic for most of the day. Most works on these roads would be carried out during the evening and night time periods to ensure the safety of construction workers and to avoid major disruptions to traffic. A more detailed construction program and staging plan would be developed and presented in the environmental impact statement aimed at minimising traffic disruptions caused by temporary lane closures and minimising impacts on surrounding communities.

Other construction activities that may be required outside of standard construction work hours include:

- Transport of large plant, equipment, prefabricated structures or materials
- Marine based work where necessary due to tide, wind, harbour traffic or barge stability control issues
- Utility installations or relocations to minimise utility downtime or to prevent adverse impacts to the relevant utility, road network or other sensitive service or site
- Works required to be conducted out of standard hours for emergency or safety reasons

- Works that can be constructed without impacting sensitive receivers, or where (following consultation with affected receivers) works are conducted in order to reduce the total duration of impacts from the proposed activity.

4.4.4 Construction sites and compounds

Surface disturbance during construction of the project would include:

- Construction sites within the footprint of the project
- Construction compounds, including a series of locations along the project corridor used to support construction. Construction compounds would include tunnel declines and shaft, staging and laydown areas, concrete batching and casting, spoil and materials handling activities, worker facilities and vehicle parking.

Construction compound locations would be identified where feasible and reasonable to minimise surface impacts. As discussed in Section 2.3.3, construction compounds would be identified with the aim of:

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

Tunnel construction using roadheaders usually requires a greater number of construction compound sites. Tunnelling with tunnel boring machines usually requires fewer but larger construction compound sites. For construction on waterways, as may be required for installation of an immersed tube tunnel, construction compound sites may be required on water or in close proximity to the shore.

Where possible, proposed worksite locations would be selected to minimise environmental and social impacts. Where it is not possible to avoid environmental or social impacts entirely, every effort would be made to minimise worksite footprint and to ensure that long-term or permanent impacts are minimised.

Proposed worksite locations would be selected so that there is adequate access by road or water to allow transport of materials and removal of spoil with minimal impact to residential areas and local roads. Construction ancillary facilities would generally be located close to tunnel portals to provide tunnelling support.

In the vicinity of Wakehurst Parkway at Frenchs Forest, there may be opportunities to use compounds previously utilised by the Northern Beaches Hospital connectivity and network enhancements project, to minimise the scale of cumulative environmental impacts. This potential opportunity is currently being investigated. If feasible, details of shared construction sites including staging and management would be presented in the environmental impact statement.

The final location of construction facilities would be determined during development of the preferred project design and would be assessed within the environmental impact statement.

5 Key assessment issues

5.1 Overview

Key assessment issues are those that are likely to require preparation of detailed assessments because of the severity or extent of potential impacts, or because of community and stakeholder interest in the issue. Key assessment issues are distinguished from other important assessment issues (refer to Chapter 5.8) which may not require detailed assessments.

Based on environmental investigations that have been carried out to date, and feedback received from the community and other stakeholders, key assessment issues for the project have been identified as:

- Traffic and transport, including road safety
- Air quality, including in-tunnel and ambient air quality
- Noise and vibration
- Human health risks
- Biodiversity, including aquatic and terrestrial biodiversity
- Aboriginal heritage
- Cumulative impacts.

These key assessment issues are discussed in the following sections. Other assessment issues are outlined in Chapter 5.8.

5.2 Transport and traffic

This section identifies the potential traffic and transport impact of the project on the local and regional road network during construction and operation including public transport, pedestrians and cyclists. This section also considers potential impacts on maritime traffic within Middle Harbour.

5.2.1 Overview

Road network and performance

Figure 5-1 shows the major transport infrastructure within and around the design development corridor.

The Northern Beaches is connected to the rest of Sydney by three main road corridors connected to the Warringah Freeway and Pacific Highway:

- Mona Vale Road (A3)
- Warringah Road (A38)
- Military Road/Spit Road (A8).

Details of these road corridors and current traffic volumes are provided in Table 5-1. The region is particularly reliant on Warringah Road (A38) via Roseville Bridge and Military Road/Spit Road (A8) via the Spit Bridge. These roads currently carry around 70 per cent of all inter-regional journeys to and from the Northern Beaches, with volumes forecast to increase with population growth in the future.

Travel speeds are well below posted speed limits for most arterial roads in the region. For example, existing travel speeds on Military Road/Spit Road are typically below 13 km/h during the afternoon peak period.

Current limited accessibility contributes to high levels of congestion, long and unreliable journey times and poor accessibility to and from the region. High levels of congestion also contribute to higher rates of traffic incidents compared with free flowing traffic conditions.

Table 5-1 Main road corridors connecting Northern Beaches with Sydney

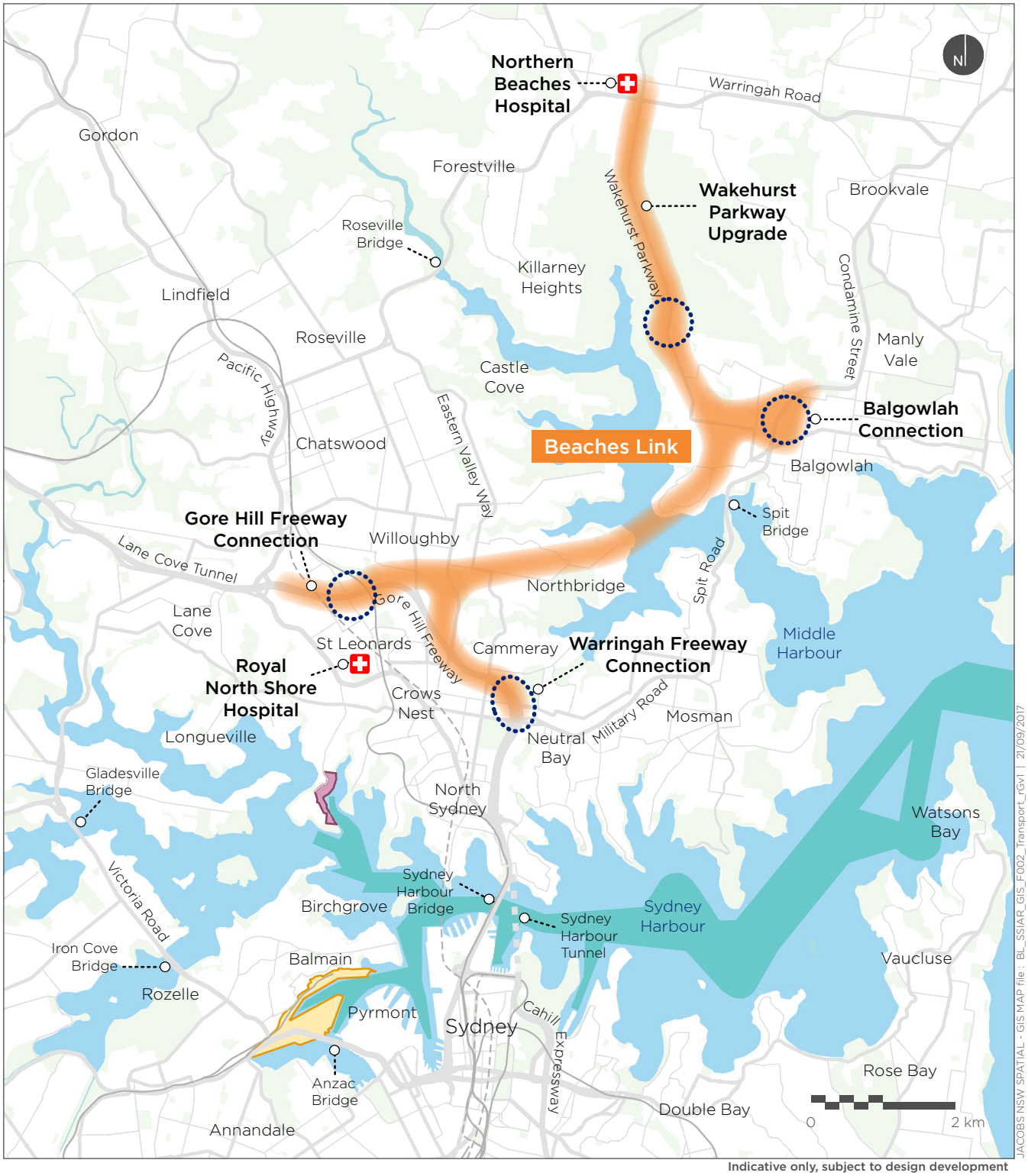
Road corridor	Description	Annual average daily traffic
Mona Vale Road (A3)	Mona Vale Road connects from the Pacific Highway at Pymble and passes through St Ives, Terrey Hills and Ingleside before connecting with Pittwater Road at Mona Vale. Mona Vale Road is connected to the Hills M2 Motorway south of the Pacific Highway via Ryde Road.	Mona Vale Road (west of Forest Way): • 28,000 (eastbound) • 28,000 (westbound)
Warringah Road (A38)	Warringah Road connects from the Pacific Highway at Roseville and passes through Castle Cove, Forestville, Frenchs Forest and Beacon Hill before connecting with Pittwater Road at Dee Why. Warringah Road is connected to the Hills M2 Motorway/ Lane Cove Tunnel via the Pacific Highway and Delhi Road.	Roseville Bridge: • 33,000 (eastbound) • 34,000 (westbound)
Military Road/Spit Road (A8)	Military Road/ Spit Road connects from the Warringah Freeway at North Sydney/Cammeray and passes through Neutral Bay, Cremorne, Mosman and Seaforth before becoming the Burnt Bridge Creek Deviation at Balgowlah. Further connectivity to the Northern Beaches is provided via the Burnt Bridge Creek Deviation, Condamine Street and Pittwater Road.	Spit Bridge: • 32,400 (eastbound) • 31,200 (westbound)

In the west, the Beaches Link would connect to the Gore Hill Freeway, which would be upgraded through the Gore Hill Freeway Connection. Further connectivity to the Hills M2 Motorway would be provided via the Lane Cove Tunnel. Key intersections around the Gore Hill Freeway Connection include:

- The Gore Hill Freeway/Reserve Road interchange
- The Hills M2 Motorway/Pacific Highway interchange.

The Beaches Link would also connect to the Warringah Freeway, which would be reconfigured through the Warringah Freeway Upgrade. Key intersections in this area include:

- Ernest Street/Park Avenue
- Falcon Street/Miller Street
- Miller Street/Warringah Freeway ramps
- Falcon Street/Warringah Freeway interchange.



Indicative only, subject to design development

Key

- Beaches Link design development corridor
- Indicative connection to surface
- Indicative shipping channel
- White Bay and Glebe Island port precinct
- Fuel terminal at Greenwich
- Road network
- Existing rail
- Approved rail
- Park
- Water

Figure 5-1 Major transport infrastructure around the design development corridor

In Balgowlah, the Beaches Link would connect with the surface road network around the Burnt Bridge Creek Deviation/Sydney Road. Key intersections in this area include:

- Burnt Bridge Creek Deviation/Sydney Road
- Burnt Bridge Creek Deviation/Condamine Street
- Condamine Street/Kenneth Road
- Condamine Street/Balgowlah Road
- Sydney Road/Frenchs Forest Road/Ethel Street (roundabout).

The Wakehurst Parkway would be upgraded and widened as part of the project, and would be integrated with works being carried out to upgrade the surface road network around the Northern Beaches Hospital. Key intersections in this area include:

- Wakehurst Parkway/Burnt Street
- Wakehurst Parkway/Judith Street
- Wakehurst Parkway/Kirkwood Street
- Wakehurst Parkway/Warringah Road.

Commercial shipping operations

The main areas for port freight and logistics within Sydney Harbour are located within the Sydney Harbour port precinct which is focused around Glebe Island and White Bay (refer to Figure 5-1). Middle Harbour does not cater for any major commercial shipping operations.

The majority of maritime traffic in Middle Harbour is associated with recreational and sporting activities. Harbour-based recreational and sporting activities are outlined further in Section 6.5.

Public transport

Rail

The Northern Beaches region is not currently serviced by rail. The closest rail connectivity for the region is provided by the T1 North Shore rail line, with major stations at North Sydney, St Leonards, Chatswood and Hornsby.

Buses

Buses services are the main mode of public transport within and to/from the Northern Beaches. Most bus services to the region travel along Military Road/Spit Road, Burnt Bridge Creek Deviation and Pittwater Road. Warringah Road is an important secondary corridor for bus services. Buses currently account for 36 per cent of journeys to the Sydney CBD. Journeys by bus are currently long, with the average peak hour travel time for bus journeys between Mona Vale and the Sydney CBD being 83 minutes.

The NSW Government is currently delivering the Northern Beaches Bus Service Plan (Northern Beaches B-Line) to provide more frequent and reliable bus services to the Northern Beaches. Northern Beaches B-Line involves a series of improvements works including:

- A new B-Line double decker bus fleet for improved on-board capacity and comfort
- Roadworks including new bus lanes, bus bays, minor lane widening and other road improvements to support bus services
- Eleven modern B-Line stops at Newport, Mona Vale, Warriewood, Narrabeen, Collaroy, Dee Why, Brookvale, Manly Vale, Spit Junction (Mosman), Neutral Bay Junction and Sydney CBD, including real-time passenger information and improved facilities for customers.

- Six new commuter car parks at Mona Vale, Warriewood, Narrabeen, Dee Why, Brookvale and Manly Vale providing around 900 spaces, as well as bicycle parking, to encourage customers to park and ride
- Works to ensure integrated pedestrian and bicycle links to commuter car parks and B-Line stops
- Modifications to the bus network to provide for a turn-up-and-go B-Line service with at least a 10 minute frequency during the day.

The Northern Beaches B-Line would travel along Military Road/Spit Road, Burnt Bridge Creek Deviation, Condamine Street and Pittwater Road. The Beaches Link would be complementary to the Northern Beaches B-Line project, particularly through a reduction in surface road congestion.

Existing bus infrastructure through the design development corridor includes on-street bus priority infrastructure, typically in the form of bus lanes and T2 transit lanes. Bus lanes are provided in both the northbound and southbound direction of the Burnt Bridge Creek Deviation with the southbound bus lane extending along Manly Road towards the Spit Bridge.

Ferry

The F1 Manly ferry route services the region with connectivity from Circular Quay to Manly.

Active transport

The majority of cycling infrastructure within the design development corridor is provided for recreational purposes in places such as parks and open space. Many of the cycle routes on the road network within and surrounding the design development corridor are within the on-road environment.

The pedestrian network within the design development corridor is extensive, predominantly comprising footpaths along both sides of roads. In addition to footpaths along roads, there are a number of dedicated pedestrian links, in particular:

- Off-road/shared path adjacent to Burnt Bridge Creek Deviation
- Off-road/shared path over the Spit Bridge
- Off-road/shared path adjacent to the Gore Hill Freeway.

5.2.2 Summary of potential issues

Key potential traffic and transport assessment issues for the project include:

- During construction:
  - Generation of construction traffic
  - Changes to the surface road network and access arrangements
  - If an immersed tube tunnel design is pursued, potential interactions with commercial shipping operations and ferry services.
- During operation:
  - Changes in the distribution of traffic across the road network, with potential changes in traffic performance and road safety.

Construction

Construction of the project would require the use of heavy vehicles to deliver construction plant, equipment and materials as well as for the removal of waste, including general construction waste, office waste and spoil from tunnelling activities. If an immersed tube tunnel design is progressed, sediment volumes generated during the construction of the tunnels would likely be removed by barge rather than by road.

Heavy vehicle movements during the tunnelling stage may occur from some sites on an up to 24-hour basis.

Surface construction works, including ancillary works, portal works and tie-ins to the surrounding road network, as well as the establishment of construction sites and compounds would result in changes or modifications to:

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

Accordingly, the project would affect the surrounding road network during construction as a result of:

- Changes in intersection and/or traffic performance on the surrounding road network due to heavy vehicle movements associated with construction and spoil removal, narrowing of lanes, speed restrictions and/or temporary road closures. Some of these impacts would be reduced if an immersed tube tunnel is progressed and sediment volumes removed from harbour construction sites using barges rather than road transport
- Potential impacts to road users, including buses, pedestrians and cyclists during construction due to temporary road arrangements or the close proximity of construction activities to normal traffic
- Temporary disruptions and delays to traffic and public transport services, including buses as a result of speed restrictions and/or potential temporary road closures
- Temporary changes to property access, including provision of alternative access arrangements.

Construction of the crossing of Middle Harbour may affect marine traffic, particularly if an immersed tube tunnel design is pursued. Within Middle Harbour this is likely to be restricted to private and recreational marine traffic, with potential impacts on commercial shipping operations and ferry services only arising outside Middle Harbour. Relevant construction activities include:

- Establishment and use of cofferdam sites within the harbour
- Movement of plant and equipment on water to the cofferdam sites
- Removal of sediment volumes from cofferdam sites by barge
- Establishment of shore sites to support construction activities on the harbour.

Temporary exclusion zones and speed limits may be required around harbour and shore construction sites, resulting in temporary disruptions and/or delays to recreational boating.

Operation

The project would provide a new motorway standard connection to the Northern Beaches. The project would deliver important transport benefits, including:

- Faster, safer and more reliable journeys to the Northern Beaches, resulting in significant reductions in trip times for buses and other vehicles
- Reduced congestion on the Military Road/Spit Road and Warringah Road, improving traffic flow and journey times for buses, freight and other vehicles accessing the North Beaches, enhancing road safety and improving local amenity
- Strengthened road network reliability and increase resilience to disruption from accidents or incidents on the network
- Significant opportunities to enhance bus operations with new faster routes for express buses and or new routes to meet expanding transport needs
- Opportunities for urban renewal and creation of better environments for active transport.

The integration of the project into the existing road network would result in a redistribution of traffic. Subject to more detailed traffic modelling, this redistribution of traffic is likely to lead to reduced traffic volumes on some routes including Military Road/Spit Road and Warringah Road. Other routes, particularly those around access points to the project, may experience an increase in traffic volumes.

During operation the project would have no impact on commercial shipping operations, ferry services or recreational boating.

5.2.3 Proposed further assessments

A detailed construction and operational traffic and transport assessment would be prepared as part of the environmental impact statement to identify. The assessment would be prepared in accordance with *Guide to Traffic Generating Developments Version 2.2* (Roads and Traffic Authority, 2002).

The construction traffic and transport assessment would include (as a minimum):

- Potential traffic and transport impacts on the road network, including consideration of public transport impacts, as well as pedestrian and cyclist access throughout construction of the project
- Potential cumulative impacts with other major transport and infrastructure projects in the vicinity of the project
- Potential construction traffic impacts including spoil haulage, route identification, details of the construction fleet, the nature of existing traffic, and the need to close, divert or otherwise reconfigure elements of the road network associated with construction of the project
- Potential impacts on commercial shipping operations and ferry services as result of marine based construction (if required)
- Mitigation and management measures to ensure that impacts are maintained within acceptable limits.

The operational traffic and transport assessment would include (as a minimum):

- Assessment of existing local and regional traffic volumes and traffic patterns against forecast volumes and potential changes to traffic patterns associated with the project
- Traffic modelling including for the opening year, being the year of completion of the project, and 10 years from the anticipated opening date
- Direct and indirect operational traffic impacts on the local and regional road network, including consideration of freight and public transport users, and implications for pedestrians and cyclists
- A road safety analysis
- Mitigation and management measures to ensure that impacts are maintained within acceptable limits.

5.3 Air quality

This section identifies the potential impact of the project on local and in-tunnel air quality during construction and operation.

5.3.1 Overview

The NSW Government established an Advisory Committee on Tunnel Air Quality to provide guidance and recommendations on the scientific and engineering issues for road tunnel ventilation design and operation based on NSW, national and international experience. The Advisory Committee has published several technical papers since being established in 2013. These technical papers have been used to provide an overview of the existing air quality in Sydney and the policy framework relevant to a project such as this. Recommendations from the Advisory Committee would be considered further during project design development and preparation of the environmental impact statement.

Ambient air quality in Sydney is monitored by a network of 15 monitoring stations operated by the Office of Environment and Heritage. These stations are located to record air quality data representative of that experienced by the general population within the Sydney region. The data is recorded continuously and available to the public online in near real-time. Data from the Office of Environment and Heritage monitoring stations is typically supplemented with additional monitoring carried out for individual projects. The Western Harbour Tunnel and Beaches Link program of works has installed project-specific air quality monitoring stations, and will also draw on data collected for other projects.

The *NSW State of the Environment 2015* states air quality in NSW has improved significantly since the 1980s due to initiatives that have reduced urban air pollution from industry, businesses, homes and motor vehicles (EPA, 2015). However, motor vehicle emissions remain a major source of urban air pollution, with exposure to air pollution linked to a range of health outcomes (refer to Section 5.5). The main pollutants in motor vehicle emissions include carbon monoxide (CO), oxides of nitrogen (NO_x), volatile organic compounds (VOCs), particulate matter (PM, including PM_{10}, $PM_{2.5}$ and ultra fine fractions) and sulfur dioxide (SO_2). Oxides of nitrogen and volatile organic compounds react in the atmosphere to form photochemical smog.

Air quality in Sydney is good by national and international standards. Carbon monoxide, nitrogen dioxide and sulfur dioxide concentrations are consistently well below the national standards. However, ozone and particulate matter concentrations occasionally exceed the national standards in the Sydney region, with no apparent downward trend in the concentrations of these pollutants (Advisory Committee on Tunnel Air Quality, 2014).

Ozone is a major component of photochemical smog and forms in the lower atmosphere during warm and sunny conditions. Peak ozone levels in Sydney are therefore typically observed between November and March (Advisory Committee on Tunnel Air Quality, 2014). While all parts of Sydney can experience ozone concentrations above the national standards, the west and south-west regions are most often exposed (EPA, 2015).

While motor vehicles are contributors to particulate matter, there are many other sources of particles from both natural processes (eg bushfires or dust storms) and human activities. Particulate matter concentrations in Sydney have exceeded national air quality standards on up to 18 days a year from 2012 to 2014 (EPA, 2015).

5.3.2 Summary of potential issues

Key potential air quality assessment issues for the project include:

- During construction:
  - Generation of dust and emissions from construction plant and equipment
  - If an immersed tube tunnel design is pursued, potential odour emissions from the handling of sediments.
- During operation:
  - In-tunnel air quality
  - Changes in ambient air quality as a result of changes in surface traffic distribution and emissions from ventilation facilities (including potential cumulative impacts associated with the Western Harbour Tunnel and Warringah Freeway Upgrade project).

Construction

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

- Temporary increases in emissions of gases and particulate matter associated construction vehicles, plant and machinery. This would include temporary ventilation systems within the tunnel during construction
- Temporary increases in dust which may occur as a result of earthworks, vegetation clearance, use of the ancillary concrete batching plant, heavy vehicle movements, general construction and stockpiling activities
- Temporary generation of odour during handling and disposal of sediments, if an immersed tube tunnel design is pursued.

The potential impacts of increased dust and emissions would depend on the scale and intensity of the construction activity, quantities of the material handled, weather and the proximity of sensitive receivers. Any impacts would be temporary and relatively short-lived.

Operation

During operation of the project, potential air quality impacts would be associated with motor vehicle emissions (specifically, products of combustion as well as non-exhaust emissions such as dust generated from the road surface). Air quality is relevant to the in-tunnel atmosphere, emissions from surface roads and the operation of ventilation facilities.

In-tunnel air quality

Ensuring stringent in-tunnel air quality outcomes are achieved is a fundamental design objective for the project. The project's tunnel ventilation systems are being designed to ensure that established in-tunnel air quality criteria are met under all normal operating conditions. In February 2016, the Advisory Committee on Tunnel Air Quality released an in-tunnel air quality (nitrogen dioxide) policy for all new road tunnels over one kilometre in length. The policy acknowledges the past reductions in CO emissions per vehicle due to improved vehicle technology have been more significant than reductions of NO_2 and sets a tunnel average criterion for NO_2 concentrations.

The NO_2 criterion of 0.5 parts per million (ppm) compares favourably to international in-tunnel NO_2 design guidelines which range between 0.4 ppm and 1.0 ppm. The tunnel ventilation system would be designed and operated to meet the new NO_2 in-tunnel air quality criterion as well as visibility requirements.

Ambient air quality

Potential local air quality impacts from the project would arise from changes in the distribution of surface traffic (including both increases and decreases in traffic volumes) and the operation of tunnel ventilation facilities. Air quality impact assessments that have been previously prepared for

NorthConnex and the WestConnex projects have shown that most air quality impacts from motorway tunnel projects come from changes in surface traffic, rather than from operation of ventilation facilities.

Surface road related air quality impacts may be experienced where existing surface roads are subject to significant changes in traffic flows or volumes and could result in a potential increase or decrease in near roadside air pollutant concentrations. For example, the reduction in traffic congestion along surface roads has the potential to deliver air quality improvements to areas along key arterial roads. These local effects would be the subject of further investigation as described below in Section 5.3.3.

The project would require ventilation facilities for the tunnels. Ventilation facilities aim to effectively disperse tunnel emissions to ensure that established ambient air quality criteria are not exceeded. Ventilation facilities would be located to also minimise impacts on the surface, including avoiding sensitive environments and minimising the need for acquisition and property impacts.

Air quality impacts from ventilation facilities would be subject to detailed investigations and assessment as described below in Section 5.3.3 and would build on recent experiences on other major road tunnel projects and recommendations from the Advisory Committee on Tunnel Air Quality. The assessment would be based on the location and design characteristics of the facilities, emissions to air, buildings and land use, prevailing weather and topographical effects to determine any changes in air pollutant concentrations at sensitive receivers.

5.3.3 Proposed further assessments

A detailed air quality impact assessment would be prepared as part of the environmental impact statement. This assessment would identify the potential impacts of both construction and operation of the project. The assessment would be prepared in accordance with *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016).

Specifically, the assessment would include (as a minimum):

- Qualitative assessment of proposed surface works and worksites with consideration of mitigation and management measures to reduce and minimise the emission of dust, odour and other pollutants during construction
- Quantitative prediction and assessment of the operational air quality impacts of the project, with consideration of local dispersion conditions, existing background levels of pollutants, managed air emissions, and changes in vehicle emissions on surface roads
- The use of background monitoring data from existing air quality monitoring stations, in addition to data collected from project-specific air quality monitoring stations
- Cumulative local and regional air quality impact assessment
- Cumulative assessment of the impact associated with in-tunnel air quality when travelling through multiple tunnels resulting in exposure for longer periods of time
- Mitigation and management measures to ensure that impacts are maintained within acceptable limits.

5.4 Noise and vibration

This section identifies the potential noise and vibration impacts of the project on the acoustic amenity of local communities and the structural integrity of buildings and other structures during construction and operation.

5.4.1 Overview

The project would be located in a developed suburban setting, with areas of medium to high density residential, commercial and light and heavy industrial land development. The design development corridor is also characterised by a series of recreational, health and educational developments. The majority of the project would be located at significant depth below the ground, which would inherently reduce the potential for noise and vibration impacts on surface development during construction and operation.

The environment around the connection of the Beaches Link with the Warringah Freeway is dominated by traffic noise from the freeway, and surrounding arterial roads. North Sydney, Milsons Point and Kirribilli include a series of elevated commercial and residential receiver locations. The northern parts of North Sydney, Cammeray and Crows Nest are less densely developed, and include important recreational and open space areas such as St Leonards Park and the Cammeray Golf Course. Several schools are also located in this area.

The Gore Hill Freeway Connection would be located between the Artarmon industrial area to the south and the residential suburb of Artarmon to the north. The noise environment in this area is dominated by traffic noise from the Gore Hill Freeway, with other contributions from industrial activities and rail noise from the T1 North Shore rail line.

The area around the connection to Burnt Bridge Creek/ Sydney Road is mainly residential suburban in nature, with some commercial development. The noise environment in this area is dominated by traffic noise from the Burnt Bridge Creek Deviation, Sydney Road and Manly Road. The Northern Beaches Secondary College is an important sensitive noise receiver south of Sydney Road and the Balgowlah Golf Club.

The upgrade works along the Wakehurst Parkway would be carried out in a relatively quiet environment. The Beaches Link tunnel would connect to The Wakehurst Parkway around the northern extent of the residential suburbs of Seaforth and North Balgowlah. North of this point, most land along The Wakehurst Parkway comprises the Garigal National Park to the west and the Wakehurst Golf Club and Manly Reservoir to the east. The principal noise source in this area is traffic on the Wakehurst Parkway.

5.4.2 Summary of potential issues

Key potential noise and vibration assessment issues for the project include:

- During construction:
  - Noise and vibration generated by surface works, including construction traffic noise
  - Vibration and ground-borne noise generated by tunnelling activities, particularly in areas where the tunnels would be constructed close to the surface
  - If an immersed tube tunnel design is pursued, noise generated by construction activities on the harbour, including the movement of barges and other vessels.

- During operation:
  - Changes in traffic noise as a result of changes in surface traffic distribution
  - Noise generated by fixed operational facilities, including ventilation facilities, water treatment infrastructure, substations and the motorway control centre.

Construction

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

Construction works during the evening and night time periods would be required, with the potential for tunnelling and associated above ground support activities (including spoil haulage via road and barge) to occur 24 hours per day, seven days per week. The majority of surface works at the interchanges would be conducted during the evening and night time periods for safety and operational reasons, particularly for the Warringah Freeway Upgrade component of the project.

The construction of the project could result in the following potential airborne noise and vibration issues:

- Airborne noise impacts from surface works including at interchanges and connections at the Wakehurst Parkway, Burnt Bridge Creek Deviation, Gore Hill and Warringah Freeway
- Airborne noise impacts from construction ventilation systems, worksites, cofferdams and any open cut sections of the project
- Construction road traffic noise from the use of heavy vehicles
- Construction maritime traffic noise from the potential use of barges and support vessels
- Cumulative impacts including those associated with construction of the Western Harbour Tunnel and Warringah Freeway Upgrade project.

Potential ground borne noise and vibration issues include:

- Ground-borne noise impacts from tunnelling and piling
- Potential vibration impacts on buildings near to surface works, or buildings near to, or above, the tunnel alignment
- Potential vibration impacts on buildings generated by blasting and rock breaking activities, which may be required depending on the geological conditions encountered
- Potential impacts to heritage items and vibration sensitive developments (such as some health facilities) due to vibration and settlement associated with tunnelling or surface works.

Operation

The project would result in a significant reduction in surface traffic, with these vehicles redistributed to the project tunnels. As a result, it is anticipated that the project would result in a reduction in surface traffic noise and an improvement in acoustic amenity along those surface roads experiencing reduced traffic volumes.

The main operational noise impacts from the project would arise from traffic using new or upgraded surface road infrastructure or where traffic volumes on surface roads would change as a result of the project. This would include the potential for traffic noise break out from the tunnel portals.

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

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

5.4.3 Proposed further assessments

A detailed construction and operational noise and vibration impact assessment would be carried out as part of the environmental impact statement. The assessment would identify and assess noise and vibration impacts on surrounding sensitive receivers and land uses, and the potential impacts on the structural integrity of buildings and items, such as heritage items.

The following guidelines would be considered as relevant during the preparation of the noise and vibration assessment:

- *Interim Construction Noise Guideline* (DECC, 2009)
- *Assessing Vibration: a technical guideline* (DEC, 2006a)
- *Construction Noise and Vibration Guideline* (RMS 2016a)
- *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (ANZECC, 1990)
- *British Standard BS7385-2:1993 Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration*
- *German Standard DIN 4150-3: 1999-2 Structural Vibration – Part 3: Effects of vibration on structures*
- *NSW Road Noise Policy* (DECCW, 2011)
- *NSW Industrial Noise Policy* (EPA, 2000)
- *Noise Mitigation Guideline* (RMS, 2015a)
- *Noise Criteria Guideline* (RMS, 2015b)
- *Noise Model Validation* Guideline (RMS 2016b).

The noise and vibration assessment would include (as a minimum):

- Identification of potentially affected noise and vibration sensitive receivers
- Development of project-specific construction noise management levels and construction vibration goals
- Assessment of out of hours work required during construction
- Assessment of airborne and ground-borne noise and vibration impacts from the construction of the project on identified residential and other sensitive receivers including the duration of impact and the potential use of blasting as part of the tunnelling methodology (if required)
- Assessment of road traffic noise from the use of heavy vehicles and equipment during the construction of the project
- Assessment of maritime traffic noise from the use of barges and support vessels during the construction of the project, if works on the harbour are required
- Assessment of noise impacts from the operation of the project on identified residential and other sensitive receivers at the year of opening and 10 years after opening
- Cumulative assessment of potential construction noise and vibration impacts due to other developments in the vicinity, such as WestConnex
- Mitigation and management measures to ensure that impacts are maintained within acceptable limits.

5.5 Human health risks

This section describes the human health considerations relevant to the project. This includes the potential health impacts and benefits of the project and the possible risks of the project to the health of local communities and individuals.

5.5.1 Overview

The existing health of the community around the design development corridor is influenced by a range of factors including age, socio-economic status, employment, education, individual lifestyle factors, genetic predisposition and access to health and social care.

Population profile

The socio-economic statistics for the local government areas in the design development corridor indicate that the design development corridor has a low level of disadvantage compared to other regions in NSW. The design development corridor has a relatively small indigenous population, relatively low proportion of people from non-English speaking background, lower unemployment

rates, median weekly household income levels in excess of the Greater Sydney average and a lower proportion of social housing rentals (Australian Bureau of Statistics, 2016). The local government areas in the design development corridor have a similar or slightly higher percentage of residents over 70 when compared to the greater Sydney area of nine per cent.

Existing health of population

The project would be located within the Northern Sydney Local Health District which includes the area north of the Sydney Harbour to the Hawkesbury River. Selected health statistics for this health district from HealthStats NSW (NSW Ministry of Health, 2016), indicate that the district has the highest life expectancy of the NSW health districts. Obesity, alcohol consumption, smoking rates, and levels of physical activity are relevant lifestyle factors that affect health. Of the 15 health districts in NSW, Northern Sydney has a lower than average percentage of the population that are overweight or obese, lower than average rate of alcohol consumption at levels posing a long-term risk to health and lower than average percentage of smokers aged 16 years and over. The district has a higher than average percentage of the population with adequate physical activity and a lower than average incidence of respiratory disease deaths.

Sensitive receivers

The project would pass through or under largely residential land uses. There are also a number of sensitive receivers in the design development corridor that are likely to be more sensitive to changes in the environment and potential health impacts. This includes children, the elderly or those with existing health conditions. Sensitive receiver locations include schools, childcare facilities, hospitals and aged care facilities.

Environmental factors

A range of environmental factors influence human health including air quality, noise and vibration, soil and water quality, and environmental hazards. Existing air quality, noise and vibration, soil and water quality in the design development corridor is described in Section 5.3, Section 5.4 and Section 6.3 respectively.

Hazards and risks

Hazards and risks associated with the project have the potential to affect the surrounding environment and human health. Existing hazards in the design development corridor that are relevant to the project include road traffic hazards associated with the existing road corridors and environmental hazards such as extreme weather events. Extreme weather events that have the potential to affect human health include extreme heat days, bushfires, storms and flooding. The intensity and frequency of these events is expected to increase as a result of climate change.

5.5.2 Summary of potential issues

The health and safety impacts from the project may be direct or indirect and short or long term. Direct impacts arise from the exposure to pollutants including air, water, soil and noise, or as a result of safety incidents during construction or operation. Indirect impacts may arise from the project's influence on the determinants of health such as access, amenity or economic impacts.

The project would result in changes to air quality and the noise environment, which would include increases in some areas and decreases in others. Because of this, some areas are likely to experience a reduction in health risks and others will experience slight increases in health risks. The human health risk assessments for NorthConnex and the WestConnex projects have shown that motorway tunnels typically result in an overall reduction in health risks by removing traffic noise and air emissions sources from surface roads.

Changes in the urban environment also have the potential to result in impacts to health, primarily due to increased levels of stress and anxiety associated with rapid changes in the community.

Construction

Potential health and safety impacts associated with construction of the project may include:

- Direct effects on the health and safety of the population, for example:
  - Exposure to increased noise levels from worksites, surface work and construction vehicles.
  - Increases in dust which may occur as a result of earthworks, vegetation clearance, use of the concrete batching plant, general construction and stockpiling activities
  - Increases in air emissions from construction traffic and machinery at surface sites
  - Environmental and human health risks associated with the accidental release of hazardous materials due to improper handling or storage, or in the event of a traffic or vessel accident resulting in the release of hazardous material
  - Exposure to contaminants arising from disturbance of contaminated sediments during dredging in Middle Harbour, if required
  - Potential impacts to water quality including recreational areas immediately adjacent to construction sites in Middle Harbour
  - Temporary loss of recreational areas as a result of establishing and operating worksites
  - Work health and safety hazards to construction workers, road users or the general public that may arise due to a traffic incident, tunnel collapse, flooding or inundation during construction, or extreme weather during harbour-based work
  - Changed traffic and pedestrian access resulting in unsafe conditions or potentially affecting emergency services access
  - Rupture or interference with underground services during construction resulting in injury to workers or the public
- Indirect beneficial and adverse health effects arising from changes to access to workplaces, recreational areas (open space) and amenities.

Operation

Operation of the project has the potential to result in the following health and safety outcomes:

- Improved connectivity between major health facilities, including the Northern Beaches Hospital, the Royal North Shore Hospital and the Royal Prince Alfred Hospital (with the Western Harbour Tunnel and Warringah Freeway Upgrade project)
- Beneficial or adverse health effects arising from decreases or increases in noise exposure during operation
- Beneficial or adverse health effects arising from decreases or increases in air pollutants during operation
- Changes in access and amenity from changes to the local road network due to increased traffic volumes and/or road closures or access restrictions
- Environmental and human health risks associated with traffic incidents.

There may also be indirect beneficial and adverse health impacts arising from changed access to workplaces, recreational areas or amenities.

5.5.3 Proposed further assessments

A health risk assessment would be carried out as part of the environmental impact statement in accordance with the following guidelines:

- *Environmental Health Risk Assessment, Guidelines for assessing human health risks from environmental hazards* (enHealth, 2012)
- *Health Impact Assessment: A practical guide* (NSW Health, 2007).

Specifically, the assessment would include (as a minimum):

- A description of the existing health of the population in and around the design development corridor
- Assessment of changes in health risks as a consequence of the project, including in relation to air quality, noise and social changes
- Environmental hazards and associated health risks and their distribution in and around the design development corridor
- Indirect health effects arising from changes to social infrastructure or access
- Measures to minimise negative health impacts and maximise health benefits.

5.6 Biodiversity

This section identifies the potential impact of the project on terrestrial and marine biodiversity during construction and operation. Marine biodiversity would be relevant if works on the harbour, including installation of an immersed tube tunnel are pursued.

5.6.1 Overview

A desktop environmental assessment including database searches has been conducted to identify terrestrial and marine biodiversity values in the design development corridor. Preliminary field surveys have been conducted to supplement desktop information and inform ongoing design development.

The focus of the marine ecology review to date has been on nearshore intertidal and subtidal areas at sites in Middle Harbour. Impacts to these areas would be highly dependent on the preferred harbour crossing option and construction method. Potential impacts on marine biodiversity would be relevant if an immersed tube tunnel design is pursued.

Terrestrial environment

Landscape features

The design development corridor occurs within the Sydney Metropolitan area which is one of the most disturbed areas within the Sydney Basin bioregion; having been altered due to urban growth and development. The majority of the design development corridor occurs within cleared land which has been subject to vegetation clearing or weed invasion. There are some areas of remnant, regrowth and planted vegetation that occur within the design development corridor.

The most significant wildlife corridor in the locality occurs in proximity to the Wakehurst Parkway, including the Garigal National Park. The Wakehurst Parkway already largely severs this corridor, although linkages still exist between Garigal National Park and the native vegetation associated with Manly Reservoir. Other local-scale fauna habitat connectivity is provided by the tributaries of Flat Rock Creek and Burnt Bridge Creek.

Vegetation communities

Based on vegetation mapping published by the Office of Environment and Heritage, seven native vegetation communities (plant community types (PCTs)) and four highly disturbed vegetation types with little or no native vegetation have been identified within the project development corridor. This vegetation is shown in Figure 5-2 to Figure 5-5 and summarised in Table 5-2.

One of the vegetation communities listed in Table 5-2 corresponds to a threatened ecological community under the *Biodiversity Conservation Act 2016* (NSW) (BC Act). None of the PCTs correspond to a threatened ecological community under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act).

Table 5-2 Plant community types within the design development corridor

PCT No.	BVT No.	Description	Threatened ecological community
1841	ME59	Smooth-barked Apple – Turpentine – Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region	No
1845	ME61	Smooth-barked Apple – Red Bloodwood – Blackbutt tall open forest on shale sandstone transition soils in eastern Sydney	No
1776	ME64	Smooth-barked Apple – Red Bloodwood open forest on enriched sandstone slopes around Sydney and the Central Coast	No
1250	ME012	Sydney Peppermint – Smooth-barked Apple – Red Bloodwood shrubby open forest on slopes of moist sandstone gullies, eastern Sydney Basin Bioregion	No
1783	ME106	Red Bloodwood – Scribbly Gum/Old-man Banksia open forest on sandstone ridges of northern Sydney and the Central Coast	No
1786	ME98	Red Bloodwood – Silvertop Ash – Stringybark open forest on ironstone in the Sydney region	Duffys Forest listed under BC Act
1782	ME67	Dwarf Apple - Broad-leaved Scribbly Gum - Sydney Peppermint low open woodland on sandstone ridges with subtle enrichment in northern Sydney	No

Threatened flora species

Results of the threatened species database searches have identified several threatened flora species listed under the BC Act and EPBC Act as having the potential to occur or likely to occur in the design development corridor and surrounds.

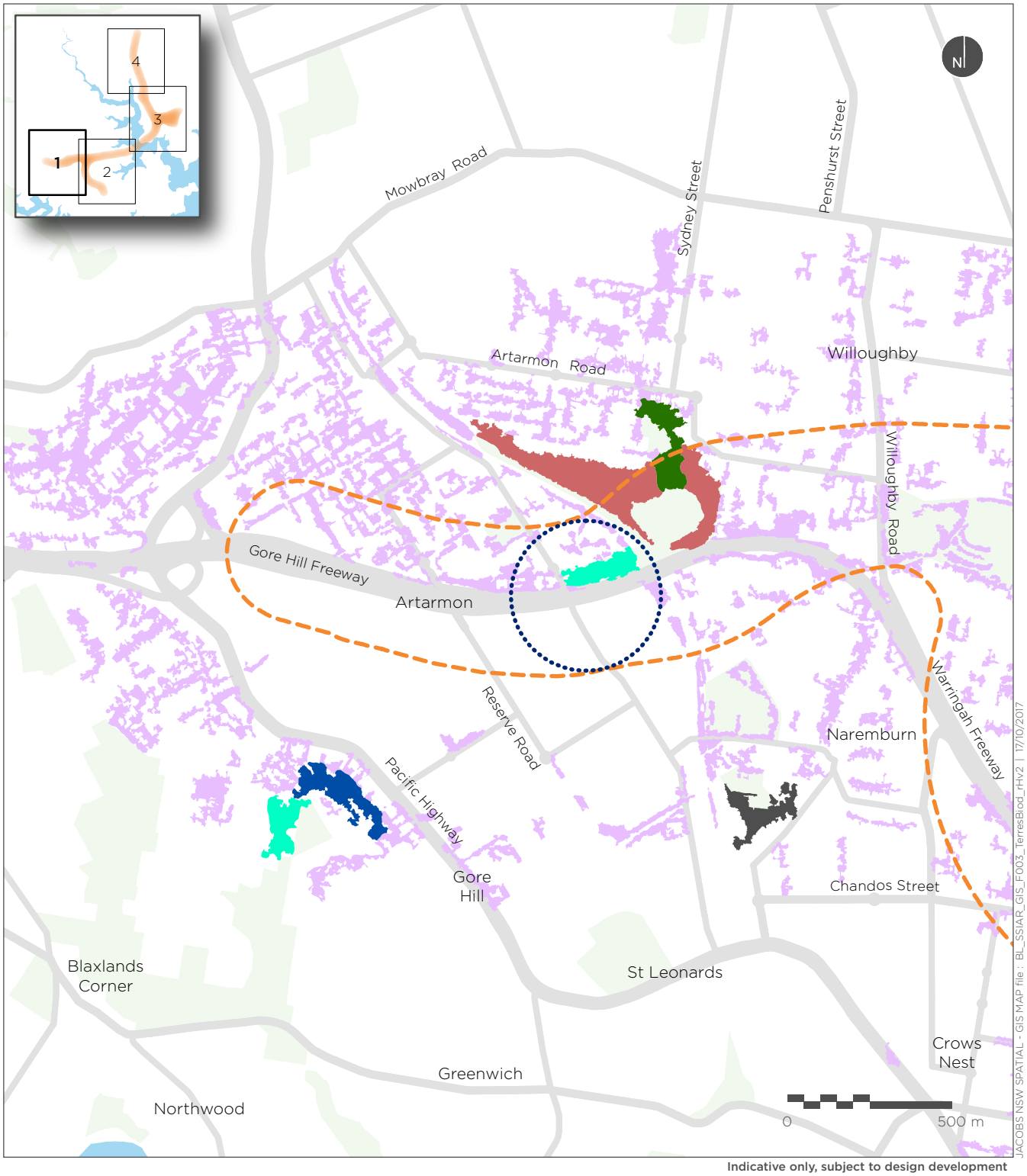
Three threatened flora species have been recorded during the field surveys to date:

- Sunshine Wattle (*Acacia terminalis* subsp. *Terminalis*) (endangered under the BC and EPBC Act)
- Netted Bottle Brush (*Callistemon linearifolius*) (vulnerable under the BC Act)
- Magenta Lilly Pilly (*Syzygium paniculatum*) (endangered under the BC and EPBC Act).

These species occur around the Burnt Bridge Creek Deviation and the Wakehurst Parkway. Some individuals located within highly disturbed areas are likely to be planted horticultural specimens.

The EPBC Act listed critically endangered flora species, Seaforth Mintbush (*Prostanthera marifolia*) is known to occur within Roads and Maritime owned property adjoining the Wakehurst Parkway. The presence of this species in the design development corridor will be confirmed through targeted seasonal flora surveys.

Angus's Onion Orchid (*Microtis angusii*) (listed as endangered under the EPBC Act) has also been recorded near Seaforth Oval. Vegetation types that provide potential habitat for this species occur within the design development corridor.



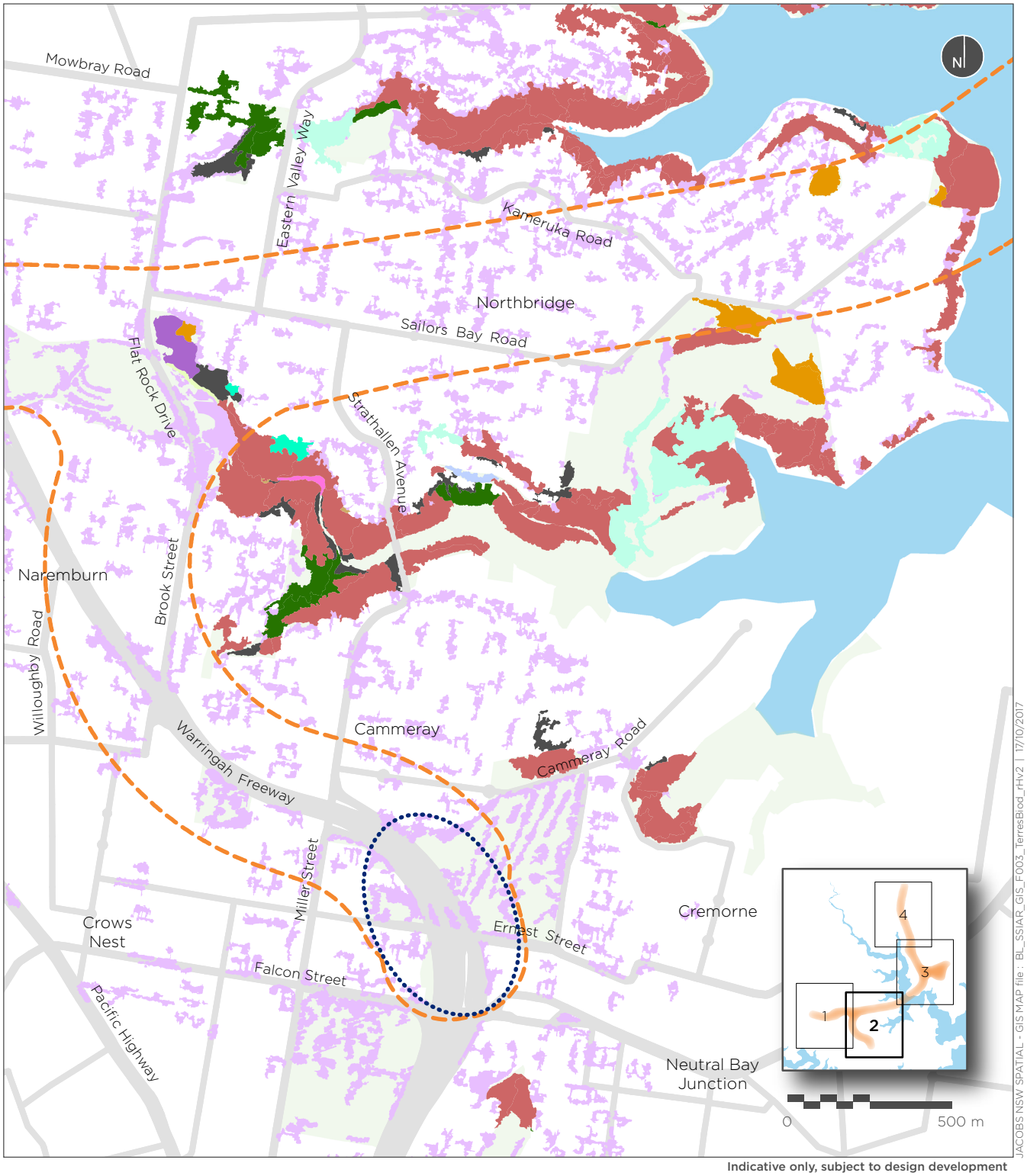
Key

- Beaches Link design development corridor
- Indicative connection to surface
- Road network
- Park
- Water

Plant community types within 500m of the design development corridor (OEH: SydneyMetroArea v3 2016)

- 1237: Blue Gum High Forest
- 1776: Coastal Enriched Sandstone Dry Forest
- 1778: Coastal Sandstone Foreshores Forest
- 1841: Coastal Enriched Sandstone Moist Forest
- Urban Exotic/Native
- Weeds and Exotics

Figure 5-2 Threatened vegetation communities and other biodiversity features (1 of 4)



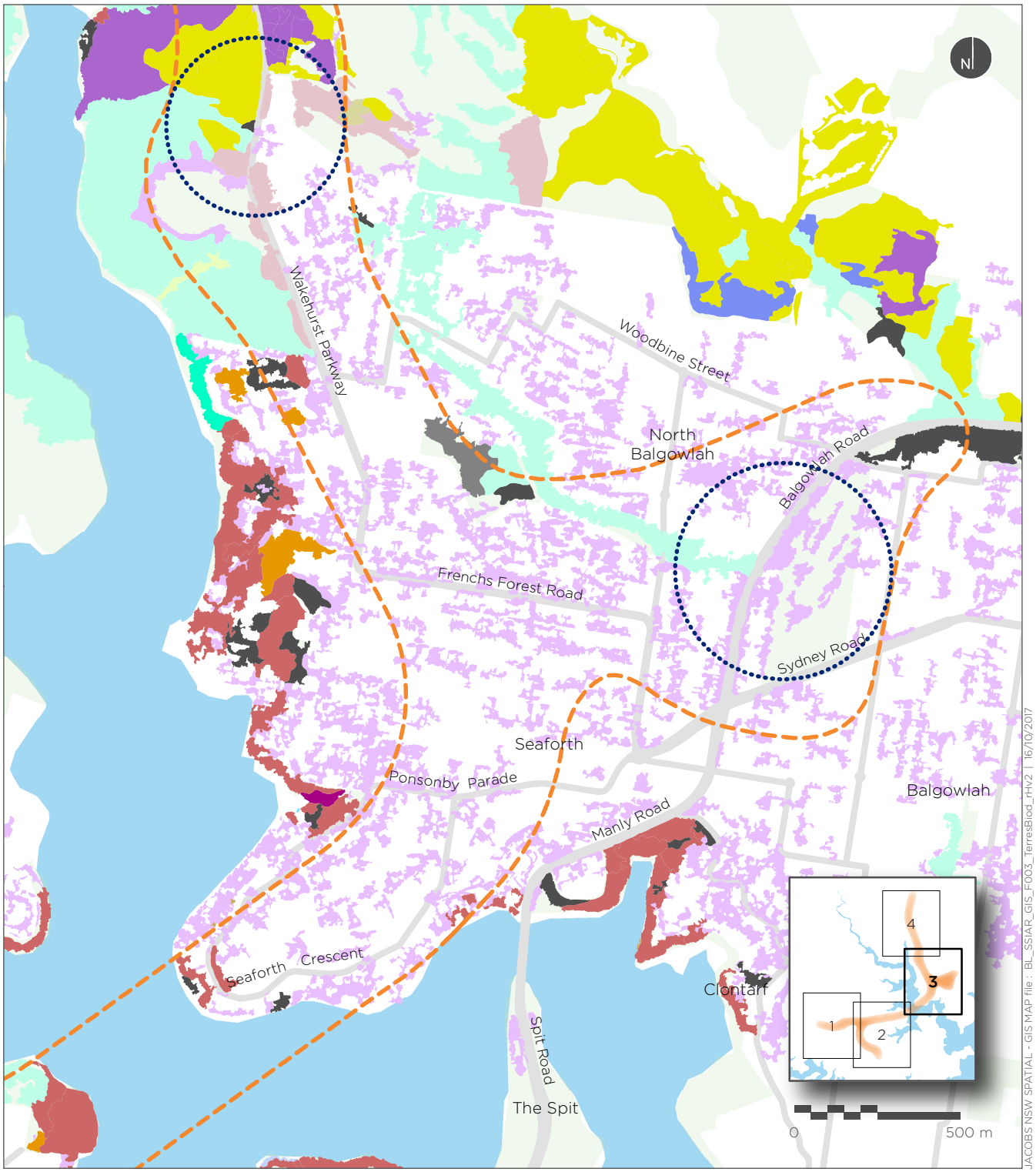
Key

- Beaches Link design development corridor
- Indicative connection to surface
- Road network
- Park
- Water

Plant community types within 500m of the design development corridor (OEH: SydneyMetroArea v3 2016)

- 1126: Estuarine Saltmarsh
- 1234: Estuarine Swamp Oak Forest
- 1250: Coastal Sandstone Gully Forest
- 1776: Coastal Enriched Sandstone Dry Forest
- 1778: Coastal Sandstone Foreshores Forest
- 1780: Coastal Sandstone Riparian Forest
- 1782: Hornsby Enriched Sandstone Exposed Woodland
- 1824: Coastal Sandstone Heath-Mallee
- 1828: Coastal Sandstone Gallery Rainforest
- 1841: Coastal Enriched Sandstone Moist Forest
- 920: Estuarine Mangrove Forest
- Rock
- Urban Exotic/Native
- Weeds and Exotics

Figure 5-3 Threatened vegetation communities and other biodiversity features (2 of 4)



Indicative only, subject to design development

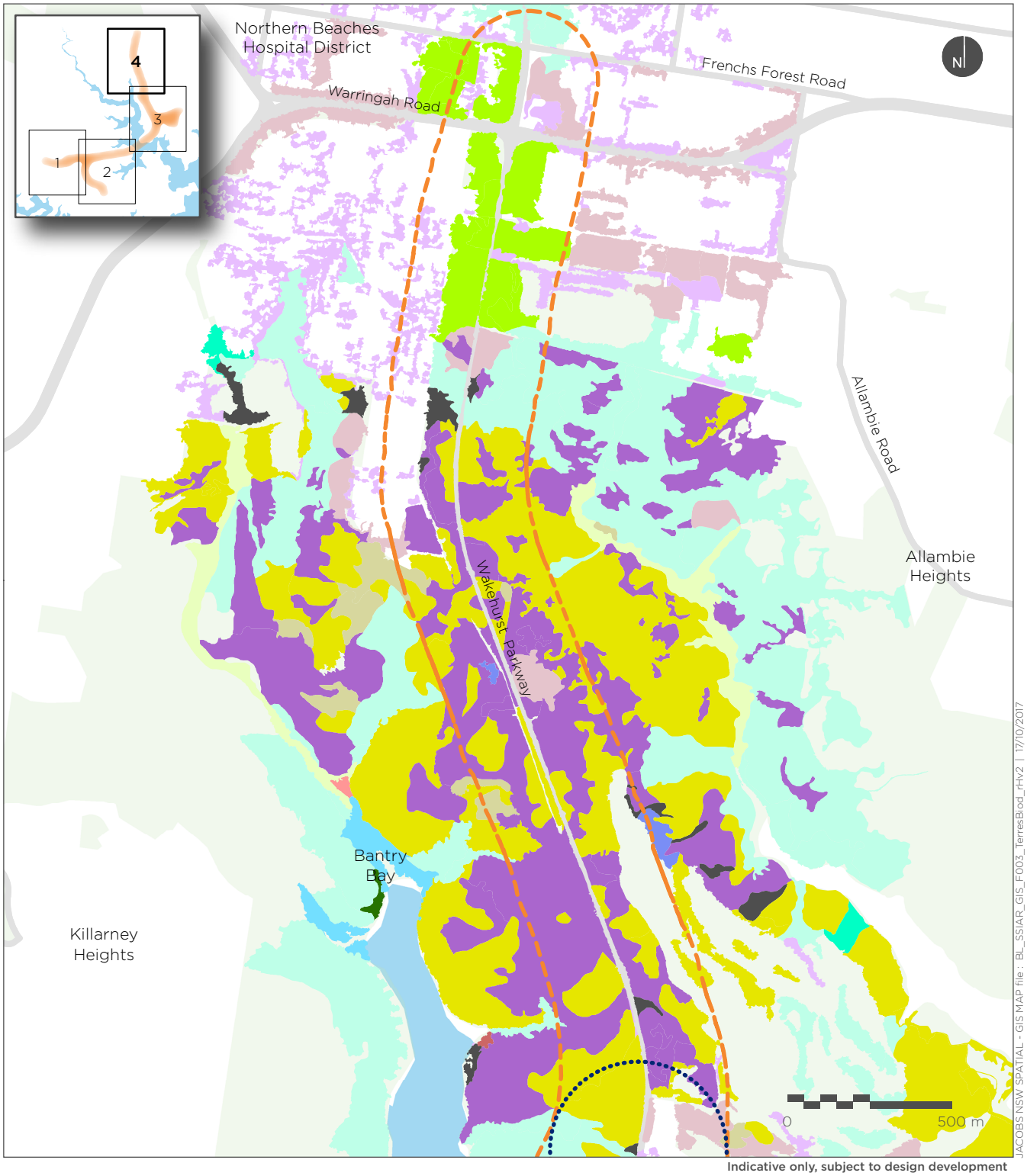
Key

- Beaches Link design development corridor
- Indicative connection to surface
- Road network
- Park
- Water

Plant community types within 500m of the design development corridor (OEH: SydneyMetroArea v3 2016)

- 1234: Estuarine Swamp Oak Forest
- 1250: Coastal Sandstone Gully Forest
- 1776: Coastal Enriched Sandstone Dry Forest
- 1778: Coastal Sandstone Foreshores Forest
- 1780: Coastal Sandstone Riparian Forest
- 1782: Hornsby Enriched Sandstone Exposed Woodland
- 1783: Sydney North Exposed Sandstone Woodland
- 1786: Sydney Ironstone Bloodwood-Silvertop Ash Forest
- 1803: Coastal Upland Damp Heath Swamp
- 1824: Coastal Sandstone Heath-Mallee
- 1833: Coastal Escarpment Littoral Rainforest
- 881: Coastal Sandstone Rock Plate Heath
- 920: Estuarine Mangrove Forest
- Rock
- Undifferentiated Regenerating Shrubs
- Urban Exotic/Native
- Weeds and Exotics

Figure 5-4 Threatened vegetation communities and other biodiversity features (3 of 4)



Key

- Beaches Link design development corridor
- Indicative connection to surface
- Road network
- Park
- Water

Plant community types within 500m of the design development corridor (OEH: SydneyMetroArea v3 2016)

- 1126: Estuarine Saltmarsh
- 1250: Coastal Sandstone Gully Forest
- 1776: Coastal Enriched Sandstone Dry Forest
- 1778: Coastal Sandstone Foreshores Forest
- 1780: Coastal Sandstone Riparian Forest
- 1783: Sydney North Exposed Sandstone Woodland
- 1786: Sydney Ironstone Bloodwood-Silvertop Ash Forest
- 1803: Coastal Upland Damp Heath Swamp
- 1824: Coastal Sandstone Heath-Mallee
- 1841: Coastal Enriched Sandstone Moist Forest
- 1845: Coastal Shale-Sandstone Forest
- 881: Coastal Sandstone Rock Plate Heath
- 920: Estuarine Mangrove Forest
- Urban Exotic/Native
- Weeds and Exotics

Figure 5-5 Threatened vegetation communities and other biodiversity features (4 of 4)

Fauna habitat

Terrestrial fauna habitat within the design development corridor consists of a variety of different resource types including foraging, roosting, dispersal, breeding and refuge habitat. Foraging resources include flowering Angophora, Backhousia, Banksia, Callistemon, Corymbia and Eucalyptus species which provide nourishment for nectivorous birds and mammals such as the threatened Eastern Pygmy Possum (*Cercartetus nanus*).

Native canopy trees provide potential foraging habitat for threatened species such as the Koala (*Phascolarctos cinereus)*, and small trees and shrubs with the dense upper and lower-mid-storey may provide refuge for small insectivorous birds. Fruit-producing shrubs are foraging resources for threatened frugivorous species such as the Superb Fruit-dove (*Ptilinopus superbus*) and Grey-headed Flying-fox (*Pteropus poliocephalus*). Remnant native vegetation throughout the design development corridor may provide foraging and dispersal habitat for the threatened Spotted-tailed Quoll (*Dasyurus maculatus*) which is carnivorous and feeds on reptiles, bandicoots, possums and other small prey, and the Southern Brown Bandicoot (*Isoodon obesulus obesulus*) and Long Nosed Bandicoot (*Perameles nasuta*) which feed on insects, fungi and the roots of monocots within the leaf litter on the forest and heathland floor.

Large areas of the design development corridor are highly disturbed and vegetation is relatively fragmented. Native remnant vegetation that is well connected between habitat fragments or has a relatively large extent and limited disturbance (such as along Wakehurst Parkway) would provide the greatest fauna habitat for locally occurring species and thus would have the highest ecological value.

Threatened fauna species

Results of the threatened species database searches have identified several threatened fauna species under the BC Act and EPBC Act as having the potential to occur or likely to occur within the design development corridor and surrounds.

A Grey-headed Flying-fox camp has been identified within proximity to the design development corridor (500 metres) near the Burnt Creek Deviation (Ecosure, 2016). Grey-headed Flying-fox is listed as vulnerable under the EPBC Act and BC Act. The current alignment design does not disturb vegetation within the identified camp area, however, further investigations would need to be carried out to determine the potential extent of disturbance to the species and camp.

Five threatened fauna species have been recorded during previous surveys within or in close proximity to the design development corridor, including:

- Red Crown Toadlet (*Pseudophryne australis)* – listed as vulnerable under the BC Act
- Spotted-tailed Quoll (*Dasyurus maculatus)* – listed as vulnerable under the BC Act and endangered under the EPBC Act
- Powerful Owl (*Ninox strenua)* listed as vulnerable the BC Act
- Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis)* – listed as vulnerable under the BC Act
- Grey-headed Flying-fox – listed as vulnerable BC Act and EPBC Act.

Three threatened species have been recorded within design development corridor during recent surveys which included the Grey-headed Flying-fox (*Pteropus poliocephalus*), Powerful Owl (*Ninox strenua*) and Rosenberg's Goanna (*Varanus rosenbergi*).

Three species listed as migratory species under the EPBC Act have been identified as having a moderate likelihood of occurrence within the design development corridor, based on the habitat recorded:

- Common Sandpiper (*Actitis hypoleucos*)
- White-Throated Needle Tail (*Hirundapus caudacutus*)
- Eastern Osprey (*Pandion cristatus syn. P. haliaetus*).

However, the habitat present is not likely to be 'important habitat' for any migratory species as defined under the EPBC Act Significant Impact Guidelines.

Freshwater aquatic and riparian habitats

Freshwater waterways within or near the design development corridor include:

- Flat Rock Creek at Naremburn
- Burnt Bridge Creek at Balgowlah
- Numerous unnamed and unmapped streams which intersect the design development corridor along Wakehurst Parkway.

Riparian habitats within the design development corridor may provide habitat for migratory species, common wetland avifauna, amphibians, reptiles and fishes. Some of these aquatic and riparian habitats are ponds, creeks and unnamed drainage channels. Due to the heavily urbanised surrounding environment, many of these aquatic habitats and riparian areas are likely to be degraded which may limit the occurrence of native fish and environmentally sensitive amphibian species. Riparian vegetation may contain habitat for a number commonly occurring amphibians, reptiles and mammals that are well situated to disturbed environments.

Marine environment

Marine habitat features

Middle Harbour is part of Port Jackson which is extensively modified and more than 50 per cent of the shoreline has been replaced by artificial structures. The intertidal and subtidal habitats in the design development corridor within Middle Harbour are directly affected by stormwater and urban run-off from adjacent land.

Nearshore sub tidal habitats of Middle Harbour include rocky reefs and soft bottoms (including seagrass meadows, brown algae (*Sargassum sp.*) and bare sediment). Intertidal habitats of Middle Harbour relevant to the design development corridor include rocky shores and artificial structures, and soft bottoms (including sandy beaches, mudflats and mangroves). Marine habitat features are shown in Figure 5-6.

Within the design development corridor in Middle Harbour, reef habitat complexity is moderate to low. This includes the steep natural sandstone boulder reefs from the northern shore of the Spit Bridge around to Bradys Point, headlands at Quakers Hat and Fig Tree Point and Sailors Bay and south of Sugarloaf Point.

According to *NSW DPI Policy and Guidelines for Fish Habitat Conservation and Management* (Department of Primary Industries, 2013), fish habitats in the design development corridor are likely to be classified as 'Type 1 highly sensitive key fish habitat' (Clive Park, Northbridge) or 'Type 2 moderately sensitive key fish habitat' (Pearl Bay, Mosman and Seaforth Bluff, Seaforth). The waterway class for the locations in the design development corridor is classified as 'Class 1 major fish habitat'.

Listed species, populations and communities

Database searches identified a number of species listed under the BC Act, NSW *Fisheries Management Act 1994* (FM Act) and/or the EPBC Act, as potentially occurring within the marine habitats of the design development corridor, including:

- Cetaceans (mainly dolphins)
- Several species of marine turtles, fish, sharks, shore birds and sea birds
- Syngnathiformes (including species of seahorses, pipefishes, seadragons, pipehorses, ghostpipefish and seamoths) accounting for 25 of the species potentially occurring within the design development corridor. These species are often found in association with seagrass beds or rocky reefs. No critical habitat for these species is mapped within the design development corridor
- Black Cod (*Epinephelus daemelii*), listed as vulnerable under the EPBC Act. This species resides on rocky reefs and has the potential to occur within the design development corridor.

Seagrasses provide habitat for fish and other aquatic fauna, are a source of food for fish and other aquatic fauna, serve as nursery grounds that underpin productivity in commercial and recreational fisheries, help to reduce erosion, recycle nutrients and improve water quality.

Based on vegetation mapping, seagrass meadows (PCT 1913) have been identified within and adjacent to the design development corridor, as shown in Figure 5-6. Preliminary field investigations have identified seagrass species in the design development corridor, including:

- Eelgrass or Ribbonweed (*Zostera capricorni*)
- Strapweed (*Posidonia australis*).

Other seagrass species in Middle Harbour, outside the design development corridor include Paddleweed (*Halophila ovalis*).

Strapweed (*Posidonia australis*) is listed as an endangered population under the FM Act and an endangered ecological community under the EPBC Act. This species has been mapped at several locations close to the shore through Middle Harbour, including patches along the headland at Northbridge, Beauty Point, Bradys Point and areas within Peach Tree Bay. None of these patches are greater than one hectare in area and therefore do not meet the definition of the endangered ecological community under the EPBC Act.

5.6.2 Summary of potential issues

Terrestrial biodiversity

The project has the potential to impact on terrestrial biodiversity, including EPBC Act and BC Act listed threatened species, populations and communities. Direct or indirect impacts on terrestrial biodiversity would be mostly associated with areas of surface disturbance during construction along the Wakehurst Parkway, Burnt Bridge Creek Deviation/ Sydney Road and the Gore Hill Freeway. Potential impacts may result from:

- Vegetation clearance associated with surface works for road widening, tunnel portal construction and worksites, including potential loss of fauna connectivity
- Mortality of fauna during both the construction and operation of the project
- Introduction and/or spread of noxious weeds and other invasive species
- Impacts to groundwater levels during construction and operation and associated impacts to groundwater dependent ecosystems

- Mobilisation of sediments into urban drainage lines and potential pollution from materials used in the process of construction and operation, resulting in downstream impacts to aquatic species and communities
- Loss of urban street trees and other planted vegetation adjacent to existing roads and in public areas.

The project would be located outside Garigal National Park boundary, located to the west of the project footprint at Seaforth and Frenchs Forest.

Marine biodiversity

If works on Middle Harbour, including installation of an immersed tube tunnel, are pursued as part of the project there is potential to impact marine biodiversity, including EPBC Act, BC Act and FM Act listed threatened species, populations and communities. Potential impacts may result from:

- Removal of marine vegetation resulting in habitat loss and loss of connectivity for marine fauna species
- Changes to marine habitats during construction and operation of the project
- Creation of a turbidity plume during dredging and support vessel movements in shallow water resulting in impacts on water quality (with resulting impacts to marine biota) and deposition of sediments in marine habitats
- Mortality of sessile fauna during construction of cofferdams and dredging activities
- Ship strike and entrainment of marine fauna in construction equipment
- Disturbance and removal of benthic fauna during construction
- Introduction of pest species
- Impacts on water quality associated with marine oil spills or disturbance of contaminated sediments.

Figure 5-6 Marine biodiversity features within and surrounding the design development corridor

5.6.3 Proposed further assessments

Terrestrial biodiversity assessments

A detailed terrestrial biodiversity assessment would be prepared as part of the environmental impact statement for the project. The assessment would be carried out in accordance with the requirements of the *Biodiversity Conservation Act 2016* and the *Biodiversity Assessment Method* (BAM). The *EPBC Act Significant Impact Guidelines* (Australian Government Department of the Environment, 2013) would also be applied to the assessment of impacts on threatened species and ecological communities listed under the EPBC Act.

The terrestrial biodiversity assessment would (as a minimum):

- Identification of listed flora and fauna species, habitat, populations and ecological communities (including groundwater dependent ecosystems) that may be affected by the project
- Assessment of the direct and indirect impacts of the project on terrestrial flora and fauna species, populations, ecological communities and their habitats, and groundwater dependent ecosystems
- Assessment of the significance of the impacts of the project on listed species, ecological communities and populations listed under the EPBC Act, the BC Act and FM Act and groundwater dependent ecosystems that occur or are considered likely to occur
- Identification of mitigation and offset measures, determined in accordance with the Biodiversity Assessment Method and the EPBC Act Environmental Offsets Policy, if necessary.

Marine biodiversity assessments

A detailed marine biodiversity assessment would be prepared as part of the environmental impact statement for the project following the *Policy and Guidelines for Fish Habitat Conservation and Management* (Department of Primary Industries, 2013) and the *Fisheries NSW policy and guidelines for fish habitat conservation and management (Update 2013)*. The *Environment Protection and Biodiversity Conservation Act 1999 Significant Impact Guidelines* (Department of the Environment, 2013) would also be applied to the assessment of impacts on threatened species and ecological communities listed under the EPBC Act.

The marine biodiversity assessment would in include (as a minimum):

- Identification of listed marine flora and fauna species, habitat, populations and ecological communities that occur or are considered likely to occur
- Assessment of the potential direct and indirect impacts of the project on marine flora and fauna species, populations, ecological communities and their habitats, and groundwater dependent ecosystems
- Assessment of the significance of the potential impacts of the project on species, ecological communities and populations listed under the EPBC Act, the BC Act and FM Act that occur or are considered likely to occur in the design development corridor
- Identification of mitigation and offset measures determined in accordance with the *Fisheries NSW policy and guidelines for fish habitat conservation and management (Update 2013)*.

5.7 Aboriginal cultural heritage

This section identifies the potential impacts of the project on the Aboriginal cultural heritage values of the design development corridor during construction and operation.

5.7.1 Overview

History

Occupation within NSW has been continuous since 45,000 years ago (OEH, 2017) years ago and is represented by abundant archaeological evidence. Within the Sydney area, evidence has been dated back to around 30,000 years at Parramatta and Garigal National Park, adjacent the northern section of project, includes one of the oldest known Aboriginal occupation sites at Bantry Bay.

Over this time period, Sydney Harbour (including Middle Harbour) has changed significantly. Sydney Harbour estuary is a drowned river valley, which occurred some 17,000 years ago. As such, the design development corridor either side of the harbour crossing would have been the middle-upper slopes of the ancient river valley and the climate and vegetation would have been significantly different than the current landscape. Aboriginal occupation may have occurred along the areas adjacent to Middle Creek, utilising food, water and raw materials available in the deep valley.

The underlying geology of the design development corridor consists of Hawkesbury Sandstone and Ashfield Shale. Evidence of Aboriginal use of Hawkesbury Sandstone in the Sydney area includes occupation deposits in natural shelter formations created by weathering processes in exposed sandstone, grinding grooves where edge-ground stone axes were manufactured or maintained, and rock engravings or pigment motifs that were applied to exposed sandstone.

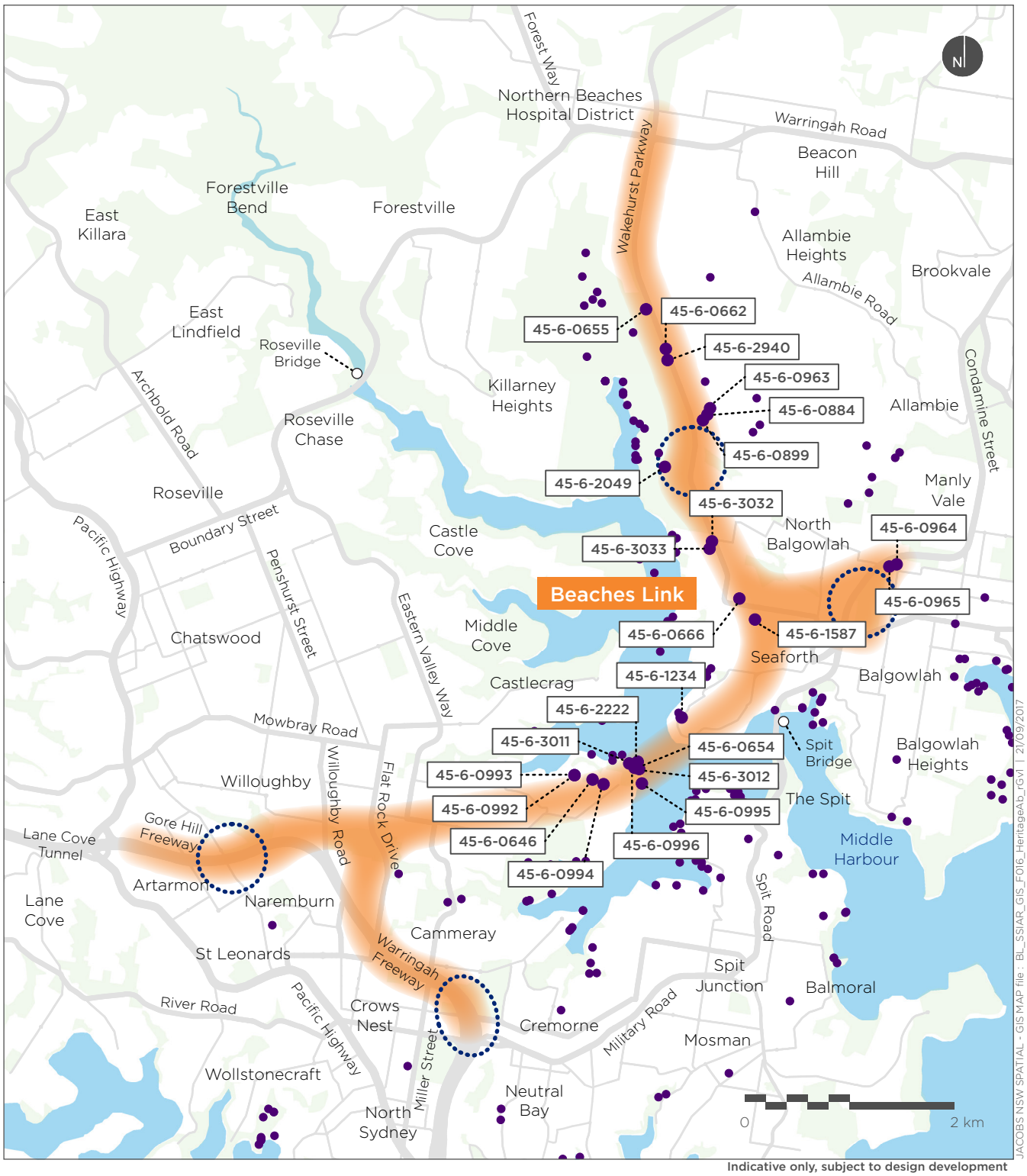
It is likely that numerous small, ephemeral drainage channels would have been present in the design development corridor. However, many of these have been altered or destroyed with European development. Multiple smaller watercourses are located within and adjacent to the design development corridor such as Flat Rock Creek and Burnt Bridge Creek. Burnt Bridge Creek is one of three freshwater feeder creeks for the Manly Lagoon catchment.

The design development corridor is located across a landscape of varying subsistence resources. Archaeological and historical records indicate that marine and estuarine resources formed an important part of the subsistence activities of the Aboriginal people that inhabited the Sydney Harbour area. Shell middens have been identified virtually everywhere along the foreshore from Manly to Mosman and other evidence of Aboriginal occupation of the foreshore is abundant (AMBS, 2005). Historically, people living in the Sydney Harbour area relied on catching fish and a variety of other marine animals for subsistence. Shellfish not only formed an important subsistence resource, but were also utilised as fish-hooks, shafted onto spears, used for repairing spears, and for cutting (Attenbrow, 2010).

Registered Aboriginal heritage sites

Searches of the NSW Office of Environment and Heritage's Aboriginal Heritage Information System (AHIMS) and preliminary field surveys have been carried out to identify registered Aboriginal heritage sites within and surrounding the design development corridor. The results of the AHIMS database search are shown in Figure 5-7.

The majority of registered sites within and around the design development are rock engravings, shelters with art and/or middens and burials. These types of Aboriginal heritage sites are highly significant in terms of their cultural and archaeological value and rarity in the Sydney region.



Indicative only, subject to design development

Key

- Beaches Link design development corridor
- Indicative connection to surface
- AHIMS sites
- Road network
- Park
- Water

Figure 5-7 Registered Aboriginal heritage items within the vicinity of the design development corridor

Archaeological and cultural potential

There is potential for additional heritage sites and objects to occur across the landscape. Archaeological potential is assessed through the identification of underlying geology and proximity of resources, past land uses and the evaluation of the impact that subsequent activities have had on the land and the likelihood that evidence of the past has survived. Areas associated with the project which may have archaeological potential include:

- Areas with outcropping or underlying sandstone bedrock (eg Flat Rock Creek, Burnt Bridge Creek, Wakehurst Parkway) may have the potential for engravings, grinding grooves or shelter formations with occupation deposits and/or art
- Foreshore areas (eg Clive Park) may have the potential for shell middens and open campsites in addition to evidence of early maritime and residential uses
- Areas where old growth trees occur may have the potential for Aboriginal scarring on tree trunks.

Despite the impacts to the Aboriginal community following European colonisation, Aboriginal community connections to the area and culture in the central Sydney area are strong and ongoing. In addition to the registered archaeological sites and areas of Aboriginal archaeological potential identified above, cultural features may also be present. Cultural features could have spiritual, natural resource usage, historical, social, educational or other type of significance and may not necessarily be associated with sites or objects or be observable features.

5.7.2 Summary of potential issues

Construction

The project has the potential to impact on areas of Aboriginal cultural heritage significance through:

- Direct disturbance of surface areas of Aboriginal heritage or cultural significance
- Indirect disturbance through ground settlement or vibration impacts during construction, particularly tunnelling works.

Operation

Operational impacts on Aboriginal cultural heritage are not anticipated as widespread ground disturbance/excavation would be restricted to the construction phase.

5.7.3 Proposed further assessments

A detailed Aboriginal cultural heritage assessment would be prepared as part of the environmental impact statement. The assessment would be prepared in accordance with the following guidelines:

- *Guide to investigating, assessing and reporting on Aboriginal Cultural Heritage in NSW* (OEH, 2011)
- *Aboriginal Cultural Heritage Consultation requirements for proponents* (DECCW, 2010a)
- *Code of practice for archaeological investigation of Aboriginal objects in NSW* (DECCW, 2010b)
- *Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (Roads and Maritime 2011).

The Aboriginal cultural heritage assessment would include (as a minimum):

- Identification of the potential for the project to disturb Aboriginal heritage (sites, objects, remains, values, features or places)
- Assessment of the significance of the heritage to the Aboriginal community in consultation with relevant stakeholders
- Assessment of the extent and significance of impact as a result of construction and/or operation of the project
- Identification of requirements for in situ conservation of items and/or areas (as appropriate), the need for further archaeological testing and/or detailed archaeological excavations
- Mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) in accordance with relevant guidelines.

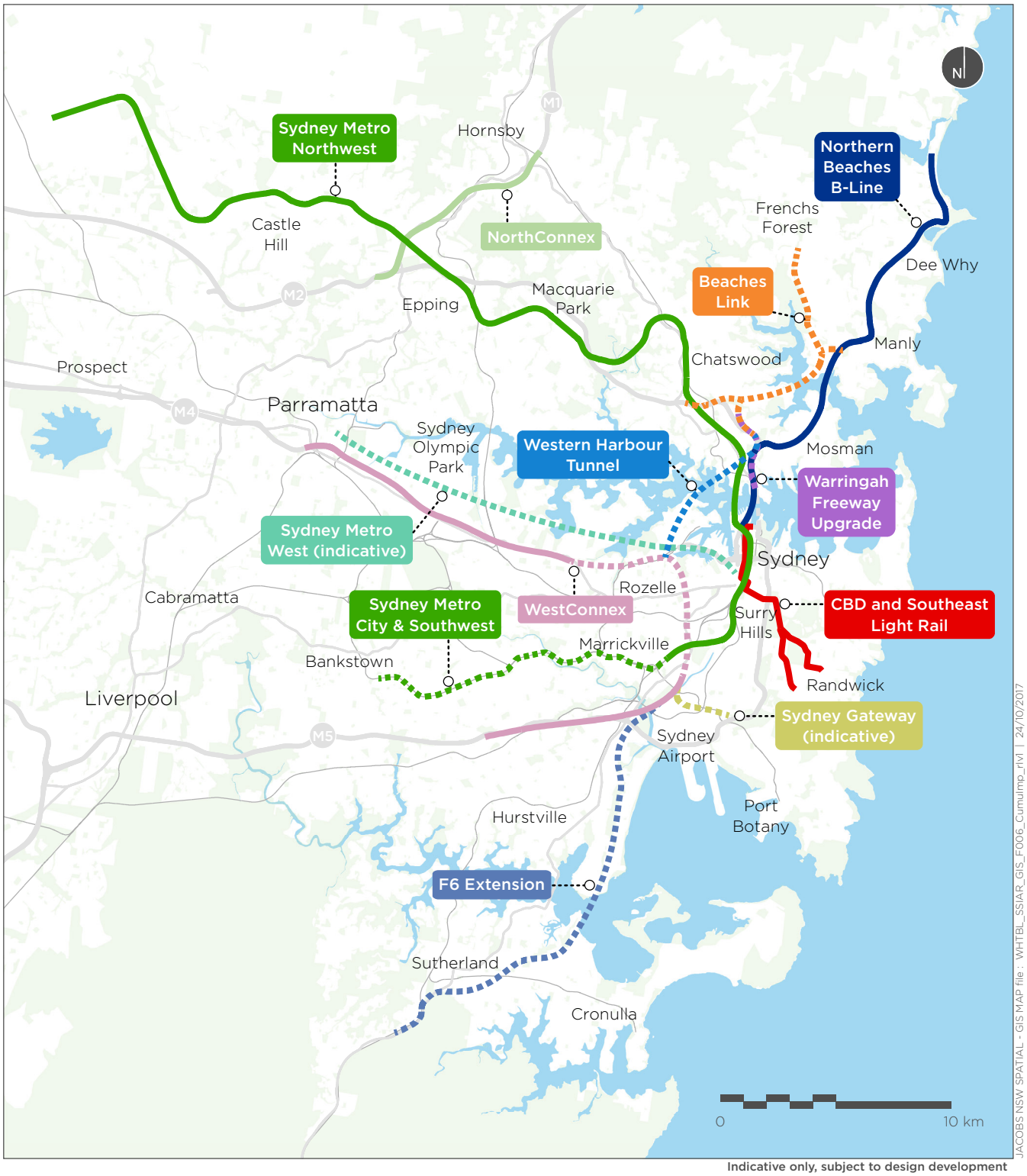
5.8 Cumulative impacts

This section provides an overview of the potential cumulative impacts that may arise during construction and operation of the project as a result of other major infrastructure projects occurring in proximity to and in similar timeframes to the project.

5.8.1 Overview

Cumulative impacts may arise for each of the key assessment issues and other assessment issues identified in this scoping report.

A desktop review has been carried out to identify other projects within the Sydney region that may interact spatially and/or temporally with the project, resulting in cumulative impacts. Relevant projects and construction programs are shown in Figure 5-8 and summarised in Table 5-3.



Indicative only, subject to design development

Key

- Western Harbour Tunnel
- Warringah Freeway Upgrade
- Beaches Link
- Sydney Metro
- Indicative Sydney Metro West
- CBD and Southeast Light Rail
- WestConnex
- NorthConnex
- F6 Extension
- Indicative Sydney Gateway
- Northern Beaches B-Line
- Approved
- Proposed
- Road network
- Rail
- Park
- Water

Figure 5-8 Sydney region projects with potential for cumulative impacts with Beaches Link and Gore Hill Freeway Connection

Table 5-3 Sydney region projects with potential for cumulative impacts with and Gore Hill Freeway Connection

Project	Construction Timing	Description
Western Harbour Tunnel and Warringah Freeway Upgrade	2019 - 2025	The Western Harbour Tunnel is a 7 kilometre in tunnel motorway between Rozelle and North Sydney, including an upgrade to the Warringah Freeway at North Sydney. The Western Harbour Tunnel and Beaches Link program of works are part of an overall motorway program, connecting at the Warringah Freeway.
WestConnex M4 East	2016-2019	This project will extend the M4 through two new 5.5 kilometre tunnels from Homebush to Haberfield. The project does not overlap spatially with Beaches Link and Gore Hill Freeway Connection, however as a large tunnelling project in the Sydney area there may be cumulative traffic impacts as a result of surface works and changes to access.
WestConnex M4-M5 Link	2019-2023	This project includes new twin 9.2 kilometre motorway tunnels between the M4 East at Haberfield and the New M5 at St Peters. The project includes tunnel stubs in the vicinity of the Rozelle Interchange to allow for a potential future connection to the Western Harbour Tunnel.
WestConnex New M5	2016-2020	The New M5 will provide twin underground motorway tunnels, nine kilometres long, from Kingsgrove to a new St Peters Interchange. This project does not overlap spatially with Beaches Link and Gore Hill Freeway Connection however as a large tunnelling project in the Sydney area there may be cumulative traffic impacts as a result of surface works and changes to access.
Sydney Gateway	Operational by 2023	Sydney Gateway will consist of a new road link between the WestConnex St Peters Interchange and Sydney Airport, with connections to Port Botany. This project does not overlap spatially with Beaches Link and Gore Hill Freeway Connection, however as a large road project in the Sydney area there may be cumulative traffic impacts as a result of surface works and changes to access.
F6 Extension	Proposed project	Roads and Maritime has been conducting a study into developing a link between the M1 Princes Motorway and the Sydney Motorway Network.
Northern Beaches Hospital Road Upgrade project	2015-2018	This project includes: • Widening of Frenchs Forest Road between Forest Way and Allambie Road, and intersection with Wakehurst Parkway. • Widening and intersection upgrades along Forest Way between Warringah Road and south of Adams Street. • An additional four lanes on Warringah Road. • Beaches Link and Gore Hill Freeway Connection includes widening of Wakehurst Parkway up to the intersection with the Northern Beaches Hospital Road works south of Warringah Road.

Project	Construction Timing	Description
Sydney Metro City & Southwest	2017-2024	Sydney Metro is a new metro railway Bella Vista and Bankstown through the Sydney CBD. This includes new tunnels and stations. The construction of Sydney Metro City & Southwest between Chatswood and Sydenham may result in cumulative traffic, air quality and noise impacts in the North Sydney area.
Bays Precinct in Sydney Harbour	2015-2022 onward	The Bays Precinct Urban Transformation Program includes proposed development in White Bay, Rozelle Bay and Blackwattle Bay integrating port, maritime, employment, housing, public space and recreation uses. Glebe Island, adjacent to White Bay, will be used as spoil handling area for Beaches Link and Gore Hill Freeway Connection, prior to the commencement of works for the Bays Precinct in 2022.
CBD and Southeast Light Rail	Operational by early 2019	This project involves a new light rail line extending from Circular Quay along George Street to Central Station, through Surry Hills to Moore Park, then to Kensington and Kingsford via ANZAC Parade and Randwick via Alison Road and High Street. The project includes a maintenance depot in the Rozelle Rail Yards.
NorthConnex and Hornsby Quarry	2015-2019	NorthConnex is a nine kilometre tunnel that will link the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at West Pennant Hills. A substantial proportion of tunnel spoil from the NorthConnex project will be placed at Hornsby Quarry. The project is approximately 12 kilometres northwest of Beaches Link and Gore Hill Freeway Connection.
Northern Beaches B-Line 2016-2017	Operational in late 2017	The B-Line program includes new bus lanes, bus bays, lane widening and commuter carparks to deliver transport improvements for the Northern Beaches. Beaches Link and Gore Hill Freeway Connection would support the operation of the B-Line program.
Barangaroo	Current to 2024	The Barangaroo precinct is a 22 hectare development site at the western edge of the Sydney Harbour. The precinct is a mixed use development including parkland, commercial office buildings and residential apartments. The project does not overlap spatially with Beaches Link and Gore Hill Freeway Connection however as a major infrastructure project occurring in the Sydney region, cumulative impacts such as construction traffic may be relevant considerations.
Sydney Metro West	Proposed project	A proposed underground metro railway would link the Parramatta and Sydney CBD with potential stations at Parramatta, Sydney Olympic Park, Bays Precinct and Sydney CBD. The potential alignment for this project would be in close proximity to the Western Harbour Tunnel and WestConnex M4-M5 Link near Rozelle.

5.8.2 Summary of potential issues

Potential cumulative impacts may occur at the local scale due to project elements occurring at the same location, or there could be regional impacts or benefits arising from projects in the same region. The projects identified in Table 5-3 occur within the greater Sydney metropolitan area and some would include construction works within or adjacent to the project.

Construction

Potential cumulative impacts arising from the project in combination with other major infrastructure projects include the following:

- Temporary traffic disruption and access changes as a result of major construction projects throughout Sydney.
- Air quality and human health impacts from dust generation during construction where projects occur in close proximity and similar timeframes.
- Noise and vibration impacts where construction is to occur in a similar location for example the connection of the project to Warringah Road overlaps with the Northern Beaches Hospital Road Upgrade project – potentially resulting in an extension of the timeframe over which noise impacts will occur.
- Property acquisition and changes to land use.
- Socio-economic impacts from temporary use of recreational areas and open space for construction of major projects.
- Socio-economic benefits arising from employment opportunities and economic growth generated by the construction of major infrastructure projects in the Sydney area
- Construction of the project will generate greenhouse gases which will be cumulative to the greenhouse gases generated by other major and minor infrastructure projects in the Sydney area
- Cumulative traffic impacts may arise from transport of spoil and materials, from other infrastructure projects in the Sydney region. Opportunities for waste reuse may also be affected due to the significant volumes of waste material generated from the project in combination with other projects.

Operation

Operation of the project simultaneously with other large road infrastructure projects and residential developments identified in Table 5-3 has the potential to generate cumulative impacts. Such cumulative impacts would be localised and would be largely related to amenity impacts on local residents, the local community and users of recreational areas within and in the vicinity of the project corridor. This may potentially include impacts to local traffic conditions, noise and vibration, air quality and human health, social and economic impacts as well as impacts to visual amenity. Cumulative groundwater impacts may also occur and would need to be investigated further as part of the environmental impact statement.

5.8.3 Proposed further assessment

Further assessment of cumulative impacts would be carried out as part of the environmental impact statement. This would include (as a minimum):

- Review of current or planned projects in the vicinity of the project for which construction may occur over a similar period
- Specialist studies for the project environmental impact statement will consider the potential for cumulative impacts arising from the project in combination with the impacts of other projects
- Identification of mitigation measures where needed for cumulative impacts.

6 Other assessment issues

6.1 Overview

This section discusses other important issues that would be assessed as part of the environmental impact statement, in addition to the key issues identified in Chapter 5.

6.2 Non-Aboriginal heritage

This section identifies the potential impact of the project on non-Aboriginal heritage values of the design development corridor during construction and operation.

6.2.1 Overview

Early history

Initial European settlement in Sydney was concentrated on the southern side of Sydney Harbour around Sydney Cove. The exploration of the upper waterways of Sydney Harbour, including Middle Harbour, commenced shortly after the arrival of the colonists at Sydney Cove.

The first recorded land grants in Seaforth were made in 1837. Numerous other land grants followed in the region, including land purchased by Peter Ellery opposite Seaforth at The Spit. Ellery was frequently asked to ferry travellers from Seaforth to The Spit. By the 1850s he was running a ferry service, providing much needed access across Middle Harbour. In 1871 the government replaced this service with a public ferry and in 1888 a steam cable ferry was installed (McAteer, 2006).

Manly remained relatively isolated until Henry Gilbert Smith, the founder of the village, arrived in 1853. Prior to this, a small group of local people managed to make a living in the region through fishing and farming. The development of Manly was slow initially, but by 1880 it had become a thriving seaside resort. The construction of Spit Bridge in 1924 was instrumental in creating a more accessible route to the Northern Beaches region (Curby, 2001).

As settlement at Seaforth, The Spit and Manly increased so did maritime related transport activities within Middle Harbour. This included construction of a number of sea walls, jetties, boat slips and boatsheds, particularly around the development of The Spit.

The European history of the central section of the design development corridor dates back to the 1820s. Land grants were apportioned for European farming on the Middle Head peninsular from this period. Increasing subdivision of these land grants ultimately led to the development of Mosman as a residential suburb by the end of the 19th century.

The European history of the northern section of the design development corridor dates back to 1828 when the government surveyor, Sir Thomas Mitchell, produced a plan for a potential township just a few kilometres north of Milsons Point. The proposed township was accepted and by 1838 a basic design had been produced which included the present east-west layout of McLaren, Berry and Mount Streets, the north-south layout of Miller and Walker Streets and the 40 acre site of St Leonards Park (originally known as ‘The Reserve’). The township of St Leonards was officially gazetted in 1838.

During the first half of the 20th Century the motor car became an essential means of transport for people of every walk of life and social standing. Throughout the later half of the 20th Century, millions of dollars were spent upgrading existing roads and adding a system of freeways and motorways to help ease the growing congestion of traffic.

The original Spit Bridge replaced a punt service in 1924. Complete with a roadway, footway and tram tracks, it was built as a temporary measure only, but worked well, even though it was designed and constructed in a space of less than 12 months. The current bridge, a higher, 4-lane structure with a single-leaf electrically operated bascule span, replaced the earlier structure in 1949.

Initial plans for a freeway into the Manly Warringah area showed a crossing via Castlecrag, then later Castle Cove. The first stage of the Warringah Freeway was opened in June 1968 taking traffic off the Harbour Bridge to the suburbs of the North Shore without having to negotiate local traffic in North Sydney. The freeway was later extended as far as Lane Cove and called the Gore Hill freeway. It was not until 1992 when the Gore Hill Freeway was added to connect the Warringah Freeway to the Pacific Highway at Lane Cove, that the road officially became part of Australia's Highway 1.

Registered heritage sites and conservation areas

A search of online heritage databases and registers identified four items listed on the State Heritage Register within the vicinity of major surface works (refer to Figure 6-1):

- Walter Burley Griffin Incinerator (SHR 00084)
- Tarella (SHR 00270)
- North Sydney Sewer Vent (SHR 01641)
- St Leonards Park (SHR 01941)

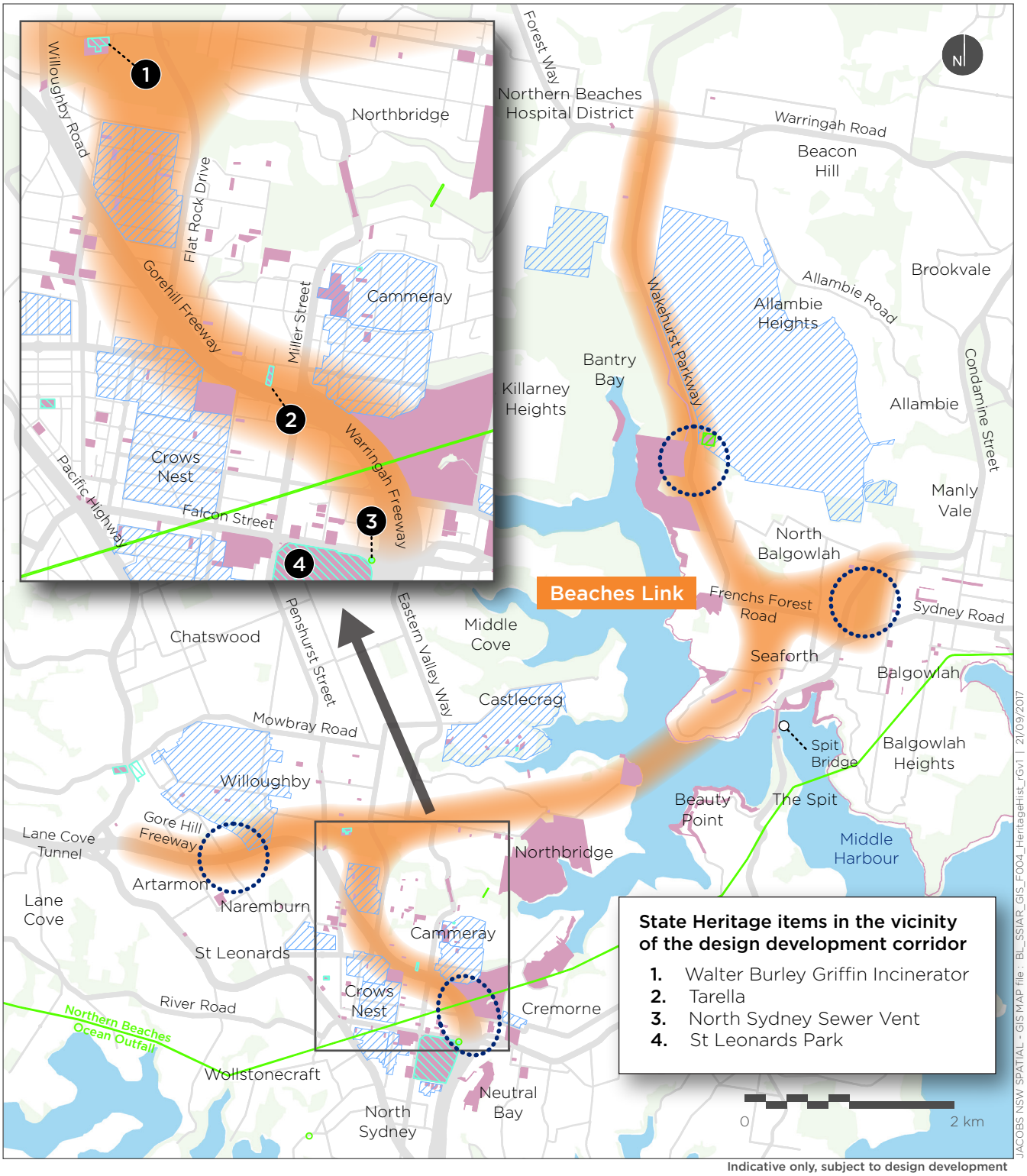
No heritage items listed on the World or Commonwealth Heritage Lists are within 100 metres of the project. Similarly, no registered maritime heritage sites including shipwrecks are located within 100 metres of the project. A number of local heritage items are located within about 100 metres of major surface works. The majority of these sites were harbour foreshore areas, water infrastructure, houses, parks and local conversation areas at Cammeray, Holtermann Estate and Artarmon.

A number of other listed heritage items are also located above the tunnels. Searches have been focussed on areas within the vicinity of surface works, tunnel connections to the surface and waterway crossings. Although it is considered to be unlikely that vibration or settlement impacts would result from the construction and operation of the project due to the proposed tunnel depth, potential impacts on these items and will be considered as part of the environmental impact statement.

Archaeological and cultural potential

There is potential for additional heritage sites and objects to occur across the landscape. Archaeological potential is assessed through the identification of underlying geology and proximity of resources, past land uses and the evaluation of the impact that subsequent activities have had on the land and the likelihood that evidence of the past has survived. Areas associated with project which may have archaeological potential include:

- Foreshore areas may have the potential for evidence of early maritime and residential uses (southern shore of Middle Harbour to the south and east of The Spit)
- Areas of early residential subdivisions, eg St Leonards may have evidence of early European occupation, including rubbish dumps, building foundations, wells and cesspits.



Indicative only, subject to design development

Key

- Beaches Link design development corridor
- Indicative connection to surface
- State Heritage Register curtliage within 500m of the design development corridor
- Section 170 heritage within 500m of the design development corridor
- LEP Heritage Items within 500m of the design development corridor
- LEP Heritage Conservation Areas within 500m of the design development corridor
- Road network
- Park
- Water

Figure 6-1 Heritage items within about 100 metres of the design development corridor

6.2.2 Summary of potential issues

Construction

There is the potential for direct and indirect impacts to non-Aboriginal heritage items, conservation areas and maritime archaeology to occur during the construction of the project, including to a State heritage item. Potential construction impacts could include:

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

Operation

Potential impacts on non-Aboriginal heritage during operation may be associated with:

- The establishment of new project infrastructure that detracts from the values of a heritage item and or changes the visual outlook from a heritage item.
- Physical impacts on the item or within the curtilage of the item as a result of architectural treatment to buildings for operational noise attenuation.

6.2.3 Proposed further assessments

A detailed non-Aboriginal heritage assessment would be prepared as part of the environmental impact statement. The assessment would be prepared in accordance with the following guidelines:

- *The Burra Charter* (Australia ICOMOS, 2013)
- *Assessing Heritage Significance* (NSW Heritage Office, 2001)
- *Statements of Heritage Impact* (NSW Heritage Office, 1996)
- *Criteria for the assessment of excavation directors* (NSW Heritage Council, 2011)
- *Assessing significance for historical archaeological sites and relics* (NSW Heritage Branch 2009).

The non-Aboriginal heritage assessment would include (as a minimum):

- Identification of items and areas of heritage significance (including wrecks and submerged heritage) that would be materially affected by the project during its construction and operation, by field survey and research, including any buildings, works, relics, gardens, landscapes, views, trees or places of heritage significance
- Assessment of the potential impacts on the values, settings and integrity of heritage areas and items and archaeological resources located near the project, including items both above and below ground and submerged, where such potential exists, the likely significance of those impacts.

The assessment would outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) in accordance with relevant guidelines.

6.3 Soil and water quality

This section identified potential impacts of the project on soils and sediments (terrestrial and marine), water quality and coastal processes within Sydney Harbour such as wave climate, sediment transport patterns, tides and currents.

6.3.1 Overview

The Sydney Harbour estuary is a drowned river valley, characterised by steep sided banks carved into Sydney sandstone between 25 and 29 million years ago. Around 17,000 years ago, the sea level rose, flooding the river valley and forming a flood tide delta. By 8,000 years ago, sea level stood at five metres below present and the sea reached its present position about 6,000 years ago. The Sydney Harbour estuary, is about 30 kilometres in length, ranging in width from around 60 metres near the headwaters to about three kilometres approaching the estuary mouth. Middle Harbour Creek makes up one of the four principal estuary tributaries and Middle Harbour forms the northern arm of Sydney Harbour (Hedge et al., 2013).

Geology

The project would be located within the Sydney Basin. The bedrock geology along the alignment is comprised primarily of Hawkesbury Sandstone, with an outcrop of overlying Ashfield Shale at higher elevations in the North Sydney area. Quaternary alluvial and estuarine sediments within the design development corridor are associated with current and ancient watercourses.

The design development corridor crossing of Middle Harbour contains areas underlain by estuarine, marine and alluvial sediments overlying Hawkesbury Sandstone. Depths to rock over this part of the corridor are expected to be over 60 metres below sea level. The deepest sediments in the corridor are anticipated along a buried palaeovalley near Seaforth where they are inferred to be about 30 metres deep between Clive Park and Seaforth Bluff.

Soils

The *Soil Landscapes of Sydney 1:100,000 Sheet Series 9130* (Department of Conservation and Land Management 1989) indicates that the design development corridor passes through a variety of soil landscapes as described in Table 6-1.

Acid sulfate soils are not expected in most areas within the design development corridor based on the *Australian Soils Resource Information System* (ASRIS, 2011) and acid sulfate soil risk mapping published by the Office of Environment and Heritage (2013). The key exception is Sydney Harbour where there is a high probability of occurrence of acid sulfate soil material in bottom sediments.

Fill deposits are likely to be common in developed areas and are known to be present near Flat Rock Creek in Willoughby, the location of an old landfill. The landscaped area on the east side of Flat Rock Drive is situated on a former landfill up to 42 metres.

Table 6-1 Soils landscapes of the design development corridor

Name	Soil characteristics
Lambert	Strongly to moderately acidic, and are stony, have low fertility, high permeability and low available water holding capacity.
Lucas Heights	Strongly to slightly acidic, and are stony, have low fertility, high permeability and low available water holding capacity.
Gymea	Shallow to moderately deep (0.3–1 metres), on undulating to rolling rises and low hills on Hawkesbury Sandstone. Limitations of this soil landscape include localised steep slopes, high soil erosion hazards, shallow highly permeable soil and very low soil fertility.
Blacktown	Strongly acidic and hard setting, and have low fertility, high aluminium toxicity, localised salinity and sodicity, low wet strength, low permeability, and low available water holding capacity.
Disturbed terrain	Cap of sandy loam over compacted clay or waste materials and may by strongly acidic to strongly alkaline. Some limitations include low fertility, low wet strength, low availability water capability, high permeability, localised toxicity/acidity and/or alkalinity.
Hawkesbury	Shallow (<0.05 metres) discontinuous lithosols/siliceous sands associated with rock outcrops, with earthy sands and some yellow podzolic soils on the inside of benches and along rock joints and fractures. Limitations are described as extreme soil erosion hazard, mass movement hazard and steep slopes with some impermeable and plastic subsoil.

Terrestrial contamination

Online searches of the NSW EPA register of contaminated sites, list of notified sites and the public register for environment protection licences identified a number of areas of environmental concern within one kilometre of the project corridor, the majority of which are identified as service stations.

Other areas of environmental concern may occur in or adjacent to the project corridor, associated with the land uses in Table 6-2. Potential contaminants, including petroleum hydrocarbons, volatile organics, dioxins, pesticides and metals, represent potential exposure risks during the intrusive works and the handling of material collected during the works through dermal contact, ingestion, inhalation of vapours or particulate matter and environmental damage. There is also potential to encounter landfill material present that may contain organic and leachate materials and may produce methane gas.

Table 6-2 Areas of potential environmental concern

Areas of **potential** environmental concern	Contaminants of concern
Service stations, auto workshops	Total recoverable hydrocarbons (TRH), benzene, toluene, ethylbenzene and xylene (BTEX), Polycyclic aromatic hydrocarbon (PAH), metals
Boat repairs, marinas	TRH, BTEXN, volatile organic compounds (VOC), chlorinated solvents, tributyltin (TBT)
Electrical substations	TRH, polychlorinated biphenyl (PCB)
Drycleaners	Chlorinated hydrocarbons
Rail corridors	TRH, BTEX, PAH, pesticides, asbestos
Roads, road reserves	TRH, BTEX, PAH, metals
Parks, reserves, playing fields, golf courses	Pesticides, herbicides
Middle Harbour	PAH, TBT, metals
Historic fill materials	TRH, BTEX, PAH, metals, asbestos

Marine contamination

If the project includes marine works, including potentially installation of an immersed tube tunnel, contaminated sediments may be encountered. This includes the upper layers of sediment in Sydney Harbour which have historically been impacted by industrialisation and urbanisation of the catchment.

Industrialisation along Middle Harbour has been limited, especially when compared to the extensive industrialisation that the rest of Sydney Harbour has experienced in the past. Based on the historical and recent land use, potential contaminants of concern in sediments include:

- Total petroleum (recoverable) hydrocarbons
- Polycyclic aromatic hydrocarbons
- Organochlorine pesticides
- Heavy metals
- TBT (tributyltin).

Water quality

Burnt Bridge Creek and Flat Rock Creek are the two main freshwater creeks within the design development corridor. Catchments for both creeks are mix residential and commercial land uses and have been significantly altered as a result of past development. Water quality of both creeks are largely expected to be influenced by ‘point source’ water pollution such as stormwater drainage outlets and diffuse water pollution such as urban runoff that does not enter stormwater drains. Water quality is anticipated to be generally poor, typical of a heavily urbanised environment.

There are several water quality monitoring sites within Middle Harbour. The closest monitoring site to the design development corridor is at the Northbridge Baths (about 500 metres to the west). According to the State of the Beaches 2015‑2016 report (Beachwatch, 2016), the water quality at

Northbridge Baths is fair. A fair rating indicates that microbial water quality is occasionally influenced by stormwater and upstream sources in Middle Harbour particularly after rainfall. Microbial water quality has improved slightly since 2000–2001 owing to licensing of discharges from the sewerage system and improved management of stormwater.

6.3.2 Summary of potential issues

Construction

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

- Impacts to soils due to spills or leaks of fuels, oils or hazardous substances from construction work, plant and equipment and/or from vehicle incidents (hydrocarbons and heavy metals)
- Disturbance of contaminated soils, especially if surface work is carried out within land known to be contaminated, or on land which has been identified as potentially contaminated based on current and historic activities. Disturbance of contaminated soils has the potential to result in offsite pollution and ecological or human health impacts
- Disturbance of contaminated sediments in the upper layers of sediment in Sydney Harbour which have historically been impacted by industrialisation and urbanisation of their catchment. There is a risk of mobilisation of these sediments which may result in offsite pollution and impacts to marine fauna and water quality
- Exposure of soils during construction resulting in direct erosion impacts. This may lead to dirty water runoff and sedimentation in local watercourses or adjacent land
- Dirty water runoff and sedimentation of local watercourses including Willoughby Creek, as well as downstream waterbodies including Middle Harbour and Sydney Harbour
- Exposure of potential or actual acid sulfate soils, particularly in the sediments of Sydney Harbour, resulting in the production of sulfuric acid, which may become bioavailable in the environment and affect local aquatic ecosystems and water quality
- If immersed tube tunnel construction and marine based worksites are required, there is potential for the creation of turbidity in the water column resulting in impacts on water quality and deposition of sediments in marine habitat. Depending on the results of contamination investigations, there may be additional water quality impacts associated with resuspension of contaminated sediments.

Operation

During operation of the project potential for impacts relating to soil, water quality and contamination would be limited as there would not be ongoing ground disturbance. Impacts may include:

- Impacts to water quality of receiving watercourses due to the discharge of treated groundwater and other waste waters (such as tunnel wash or deluge system water). This could have an impact on the water quality of the receiving waterway, depending on the discharge volumes, treatment and the point of discharge
- Impacts to water quality of receiving watercourses due to increased runoff from roads. This would typically contain oils and greases, petrochemicals and heavy metals as a result of vehicle leaks, operational wear, road wear and atmospheric deposition. Increased flows could also lead to increased potential for scouring of soils and watercourses
- Spills or leaks of fuels and/or oils from vehicle accidents, or from operational plant and equipment.

6.3.3 Proposed further assessments

The environmental impact statement would include an assessment of potential soil, water quality and contamination impacts during construction and operation of the project. The assessment would be guided by the *NSW Water Quality and River Flow Objectives* (OEH, 2006) and would consider the following guidelines:

- *Using the ANZECC Guidelines and Water Quality Objectives in NSW* (DEC, 2006b)
- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC/ ARMCANZ, 2000)
- Other relevant catchment/water quality management objectives.

The assessment of potential water quality impacts would include (as a minimum):

- Identification of waterways that may be impacted by the construction and operation of the project, including assessment of the sensitivity of the receiving environments
- Assessment of the potential impacts to water quality including any resuspension of contaminated sediments during marine based activities
- Assessment of the risk of erosion and sedimentation in accordance with Roads and Maritime's *Erosion and Sedimentation Management Procedure* (Roads and Maritime, 2008)
- Assessment of changes to coastal processes in Sydney Harbour, including tidal flow and velocity and wave climate impacts and effects on sediment transport patterns
- Assessment of potential impacts involving acid sulfate soils in accordance with the *Acid Sulfate Soils Assessment Guidelines* (Department of Planning, 2008)
- Assessment of potential impacts involving contaminated land in accordance with *Managing Land Contamination: Planning Guidelines SEPP 55 – Remediation of Land* (Department of Urban Affairs and Planning & Environment Protection Authority, 1998) and *Guidelines for Consultants Reporting on Contaminated Sites* (Office of Environment and Heritage, 2000)
- Assessment of soil properties including the extent and severity of salinity and how it may affect groundwater resources and hydrology
- Assessment of the impact on soil and land resources including soil erosion and sediment transport
- Identification of appropriate mitigation and management measures to safeguard the environment during construction and operation.

6.4 Groundwater

This section describes the groundwater resources within the design development corridor and potential impacts of the project on groundwater.

6.4.1 Overview

Groundwater system

The design development corridor overlies four water bearing geological units as summarised in Table 6-3.

The groundwater system is expected to consist of a deep groundwater system (where groundwater flows through the underlying rock layers) and a more localised surface groundwater system (where groundwater flows through overlying residual soils and fill).

Recharge of the deep groundwater system is expected to be via either direct recharge (at locations where the bedrock is exposed) or via downward percolation through the residual soil or fill (at locations where bedrock is not exposed). The surface groundwater system is likely to be recharged

by rainfall and percolation from irrigation of residential gardens and open spaces, as well as incidental runoff from impervious surfaces such as roads and footpaths.

Table 6-3 Water bearing geological units

Geological units	Occurrence	Characteristics
Artificial fill	Along the Middle Harbour foreshores and along Flat Rock Gully	Water bearing unit supporting perched water systems but with very high variability and unpredictability
Ashfield Shale	North Sydney, Crows Nest, Cammeray	Behaves as an aquitard, very low permeability unit, high salinity
Mittagong Formation	North Sydney, Crows Nest, Cammeray	Transitional layer between Ashfield Shale and Hawkesbury Sandstone, thin, characteristics of Hawkesbury Sandstone
Hawkesbury Sandstone	Entire alignment	Semi-confined water bearing zone with highly variable hydraulic conductivity, good water quality

Groundwater levels

Groundwater monitoring bores have been installed along the design development corridor to inform the assessment of potential groundwater impacts from the project.

Groundwater monitoring has been carried out along the alignment of the Sydney Metro City and Southwest project since 2015 (Jacobs, 2015). This monitoring indicates that in the area between Chatswood and the Sydney CBD:

- In the residual soil, groundwater levels are around 2.5 metres below ground level
- In the Ashfield Shale groundwater levels are around 9.2 metres below ground level
- In the Mittagong Formation groundwater levels are around 12.9 metres below ground level
- In the Hawkesbury Sandstone, groundwater levels are around 12 to 22 metres below ground level.

Seasonal groundwater level variations are expected to occur as a response to rainfall. These fluctuations may affect the rate of groundwater inflow. Variations of groundwater levels are around 10 metres within the Hawkesbury Sandstone (GHD, 2006).

Groundwater users

The ‘PINNEENA’ database has been searched for registered bores within 2.5 kilometres of the design development corridor. One hundred and nineteen registered groundwater bores were identified. Around 17 bores are located within one kilometre of the design development corridor. Uses of these bores vary and include domestic (five), irrigation (four), monitoring (three), testing (three) and recreation (two). Of these bores, three are active, six have been converted, seven are cancelled/lapsed and one has an unknown status.

Groundwater dependent ecosystems

There are no mapped groundwater dependent ecosystems that rely on the surface expression of the regional groundwater within two kilometres of the design development corridor. However, several vegetation communities have been identified within one kilometre of the corridor that are largely sustained by processes associated with rainfall infiltration. This typically characterises the

behaviour of shallow perched water systems not connected to the deep regional groundwater system (Hawkesbury Sandstone water bearing zones).

Groundwater quality

The groundwater quality in Hawkesbury Sandstone has been described for a number of major infrastructure projects across Sydney. Generally, groundwater quality has been found to have a high iron concentration, high salinity and slight acidity. High levels of iron can pose a high level risk to human health as well as having a negative impact on the environment. High salinity levels can result in degradation in soil quality and inhibit plant growth.

Dissolved metals such as manganese may also be present as well as other contaminants associated with petrol stations or landfill leachates and leaky sewer pipes.

Groundwater quality within Ashfield Shale is reported to be of poorer quality than in Hawkesbury Sandstone and may be corrosive to construction materials, such as concrete. In areas where Hawkesbury Sandstone underlies Ashfield Shale, the groundwater quality may have a higher salinity due to leakage from the unit above.

6.4.2 Summary of potential issues

Construction

Groundwater is likely to be encountered during construction as tunnelling activities move through the water bearing geological units. Potential impacts may result from:

- Groundwater drawdown as a result of construction works may impact water levels and potentially water quality in surface water bodies. Groundwater drawdown is likely to be restricted to a relatively narrow zone along the tunnel alignment. Bores and other groundwater users within this zone may be impacted
- Discharge of treated groundwater during construction. The rates and magnitude of groundwater infiltration are anticipated to be similar to other recent tunnelling projects carried out in the Sydney Basin, including the Eastern Distributor, Cross City Tunnel, NorthConnex and M5 East Motorway tunnels.

Operation

Depending on the final design, the tunnel component of the project may either be drained, undrained or a combination of both. Where the final design is for a drained tunnel (ie a tunnel that allows ongoing groundwater inflow), local groundwater in the vicinity of the tunnel may be drawn down to the tunnel invert level. This may affect existing groundwater bores and may also result localised ground settlement, consolidation or subsidence.

6.4.3 Proposed further assessments

Geotechnical and groundwater investigations would be conducted to inform design development and the environmental impact statement. These investigations would identify the ground conditions for tunnelling across the project corridor, including further understanding of specific geological structures, potential groundwater inflows and likely propagation of groundwater drawdown.

The groundwater assessment would include (as a minimum):

- A review of historical data on groundwater levels and quality, and data collected for the project
- Estimates of groundwater inflow
- Quantitative modelling of the extent of groundwater drawdown (for transient and steady state conditions) that would occur including assessment of potential settlement issues
- Consideration of the *NSW Aquifer Interference Policy* (Office of Water, 2012a)

- Characterisation of the water quality of groundwater inflows along the tunnel to inform treatment requirements for potential discharge to surface water
- Assessment of potential mobilisation of saline groundwater, contaminated groundwater and exposure of acid sulfate soils, and the associated impacts
- Impacts to existing groundwater users, surface water features and groundwater dependent ecosystems in accordance with the *Risk Assessment Guidelines for Groundwater Dependent Ecosystems* (Office of Water, 2012b)
- Estimation of groundwater discharge volumes into local watercourses during construction and operation, and the associated impacts on water quality
- Identification of management measures during construction and operation.

6.5 Socio-economics, land use and property

This section describes the potential socio-economic, land use and property impacts of the project during construction and operation.

6.5.1 Overview

The project would be located within the local government areas of Northern Beaches, Willoughby, Mosman and North Sydney. Land uses in the design development corridor are diverse and comprise a mix of industrial, residential, commercial, and retail development as well as open space and some recreational areas.

Community profile

The design development corridor has a relatively low level of disadvantage compared to other regions in NSW. Professionals, managers and clerical and administrative workers make up the top three occupation categories in the design development corridor, with the main industries of employment being in the areas of professional, scientific and technical services, finance and insurance services, and health care and social assistance.

Critical social infrastructure

The design development corridor accommodates a wide range of community services and facilities that cater for the needs of the community, including: education facilities; health, medical and emergency services; sport, recreation and leisure facilities; and community and cultural facilities. These include both land based and harbour based facilities.

Figure 6-2 shows the locations of the major parks and recreational areas within or near the design development corridor.

Accessibility has been identified as a key factor limiting both population and economic growth in the Northern Beaches area of Sydney. This area is connected to the rest of Sydney by three major road corridors, which contributes to high levels of congestion, long and unreliable journey times and, consequently, poor accessibility to and from the region.

Business and industry

The project would be located partially within the Global Economic Corridor, which extends from Sydney Airport in the south through to Macquarie Park in the North and Sydney Olympic Park in the west. The Global Economic Corridor is considered one of Australia's most important economic clusters accounting for around 41 per cent (or $195 billion) of NSW's gross regional product (NSW Government, 2014a).

A key objective of the project, amongst other things, is to support employment growth and productivity in key employment centres by improving connectivity between the Northern Beaches and the Global Economic Corridor.

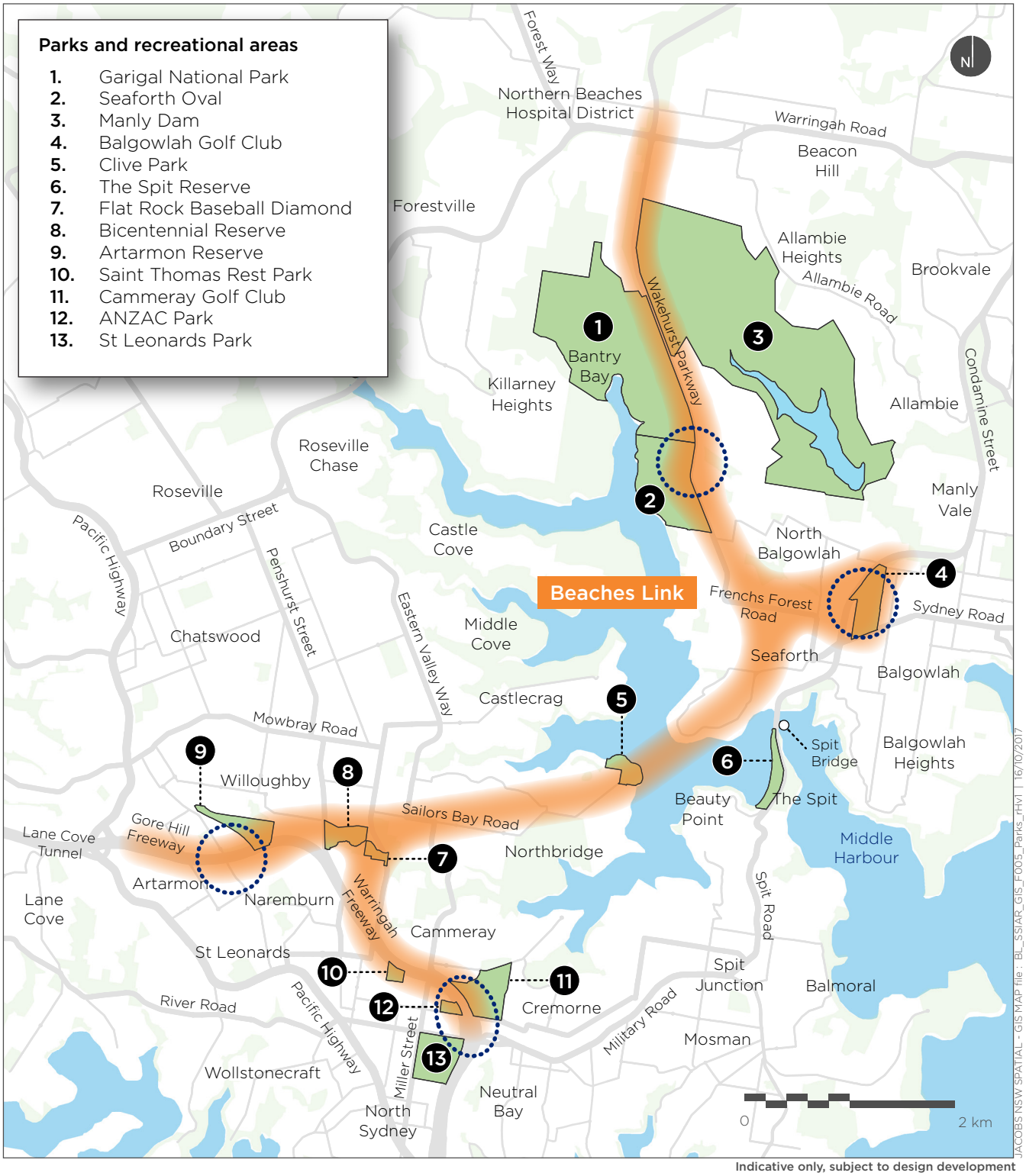


Figure 6-2 Major parks and recreational areas near the design development corridor

6.5.2 Summary of issues

Both positive and negative socio-economic, land use and property impacts are likely to occur during the construction and operation phases of the project.

Construction

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

- Disruption to access to private properties, businesses and community facilities
- Temporary loss of community open space and recreation areas or restricted access as a result of worksites
- Temporary impact to amenity for residents and road users as a result of construction work
- Temporary exclusion zones and speed limits within Sydney Harbour may impact recreational fishers in addition to rowing, sailing and other recreational water activities.

As well as these socio-economic, land use and property impacts during construction, the project also has the potential to generate socio-economic benefits during construction as a result of additional jobs created for the construction workforce and increased business turnover for some businesses in proximity to construction worksites, particularly food and beverage outlets.

Operation

Permanent or long term socio-economic, land use and property impacts of the project would include:

- Impacts associated with property acquisition, including uncertainty for owners about the property acquisition process and potential need to relocate.
- Reduced or modified access to private properties, businesses and community facilities
- Community concerns and perceptions about changes to air quality and potential health impacts for communities near tunnel portals
- Impacts to community value and sense of place as a result of loss of vegetation, impacts to heritage and potential loss of Aboriginal heritage
- Potential fragmentation of land and altered accessibility for residents and other users of these areas
- Changes in traffic flows, including movement of traffic onto adjacent local streets close to interchange locations.

Long term socio-economic benefits directly attributable to the project would potentially include (but may not be limited to):

- Improved journey times for private vehicles, business trips and public transport
- Improved travel options for those who travel as part of work, with potential to increase productivity for business and employees by providing a more efficient route for through traffic traveling between the north and south
- Reduced costs for vehicle owners, as a result of reduced fuel consumption per journey
- Improved patronage to local businesses located on arterial and local roads as a result of less congestion
- Connectivity adjustments and improvements to active transport routes
- Reduced congestion and traffic on local roads.

6.5.3 Proposed further assessments

A detailed socio-economic assessment will be conducted as part of the environmental impact statement. The assessment would be prepared in accordance with *Environmental Planning and Impact Assessment Practice Note: Socio-economic Assessment* (Roads and Maritime, 2013a).

The socio-economic assessment would include (as a minimum):

- A description of the social and economic profile for the communities and businesses surrounding the project
- Assessment of the potential positive and negative impacts of the project on the social and economic values of the area during construction and operation
- Assessment of direct and indirect impacts on property and land use
- Identification of any community facilities that may be affected during construction or operation of the project
- Identification of appropriate mitigation and management measures.

The socio-economic assessment would be informed by the results of other specialist studies including noise and vibration, air quality and traffic and transport which will be key potential socio-economic impacts.

6.6 Urban design and visual amenity

This section describes the urban design and visual amenity considerations relevant to the project.

6.6.1 Overview

Urban design

An urban design strategy would be prepared for the project including overarching principles to ensure the project is integrated into the surrounding landscape.

The overarching principles for the strategy would be to:

- Provide an integrated urban design approach to join WestConnex and the Warringah Freeway
- Develop a theme that references geography, place and heritage
- Provide a driver experience that enhances the journey, encourages awareness, increases orientation and enhances safety.

The urban design strategy would include specific principles related to urban design, landscape, water sensitive urban design and facilities design.

The urban design strategy would be developed in accordance with *Beyond the Pavement: Urban Design Policy Procedures and Design Principles* (Roads and Maritime, 2014b). Specific initiatives would be developed for the project to improve urban and landscape design at key locations consistent with the overall urban design strategy described above.

Visual amenity

The project would be largely tunnelled, meaning that impacts on surrounding areas would be limited to connections and interface works, motorway facilities, works to local roads, landscaping and amenity improvements, and temporary work sites.

Wakehurst Parkway in the northern part of the design development corridor follows a natural ridge line and is surrounded by dense natural vegetation, with Garigal National Park to the west. The topography in north Balgowlah and Seaforth descends steeply to the Middle Harbour shoreline and

land use is predominantly residential with street plantings of mature trees. The residential shores of Middle Harbour at Seaforth are characterised by long natural shorelines containing significant cliffs, rock outcrops and native vegetation. Development occupies the upper slopes and ridgelines and the shoreline has been developed with boat sheds, wharves and jetties.

On the southern side of Middle Harbour, Clive Park is characterised by natural foreshore areas minimally impacted from development and generally well conserved and vegetated. At Northbridge, natural rocky outcrops and steep topography dominate the foreshore and residential backdrop.

Further south, the existing Warringah Freeway cuts through the area's natural ridge line, with a vertical height difference between the freeway and adjacent areas to the west and east of around 20 metres. Industrial land uses dominate the landscape to the west along the Gore Hill Freeway at Artarmon.

6.6.2 Summary of potential issues

Construction

The project would change the urban design and visual amenity of the surrounding landscape though the introduction of new infrastructure and landscaping aspects. Potential landscape and visual amenity impacts during construction would include:

- Visual impacts from active construction areas and the introduction of worksites
- Temporary impacts to views to or from heritage places
- Vegetation clearing within the project footprint
- Construction traffic management measures such as road barriers and construction lighting
- Fencing, temporary noise barriers and acoustic sheds during construction
- Light spill from worksites during out-of-hours construction.

Operation

Landscape and visual amenity impacts would be limited to surface infrastructure during operation. The internal design of the project tunnels would be developed with the aim of providing a pleasant visual experience for motorists.

Potential positive and negative visual and landscape impacts during operation would include:

- Visual impacts to existing receivers from new infrastructure such as tunnel portals, ventilation facilities, noise barriers and surface roads
- Light spill onto surrounding properties
- Removal existing trees within the project footprint and prior to project landscaping establishment
- Changed views for motorists on new infrastructure and the visual interaction between tunnels and surface roads
- Changed views to and from public land and heritage places.
- Improved visual and landscape outcomes through the design features of the project.

6.6.3 Proposed further assessments

An urban design and visual impact assessment would be carried out as part of the environmental impact statement. The assessment would consider the following guidelines:

- AS4282-1997 Control of the obtrusive effects of outdoor lighting
- *Beyond the Pavement: Urban Design Policy Procedures and Design Principles* (Roads and Maritime, 2014b)

- *Bridge Aesthetics: Design guidelines to improve the appearance of bridges in NSW* (RMS, 2012)
- *NSW Sustainable Design Guidelines Version 3.0* (Transport for NSW, 2013d)
- *Crime preventions and the assessment of development applications* (DUAC, 2001)
- *Crime Prevention through Environmental Design* (Queensland Government, 2007)
- *Disability (Access to Premises – Buildings) Standards 2010*
- *Technical guideline for Urban Green Cover in NSW* (OEH, 2015)
- *Healthy Urban Development Checklist* (NSW Health, 2009)
- *Environmental Impact Assessment Practice Note – Guidelines for Landscape Character and Visual Impact Assessment* (Roads and Maritime, 2013b).

The urban design and visual impact assessment would include (as a minimum):

- Description of the visual character of the project corridor
- Identification of the visual character and urban design of the project and its components
- Assessment of the compatibility of the project with its visual and landscape context
- Consideration of hard and soft urban design elements of the project in the context of the existing and desired future character of the area
- Assessment of the visual impacts of the project (including lighting) during construction and operation
- Identification of measures to avoid, minimise and/or mitigate potential visual and landscape impacts.

6.7 Spoil and waste management

This section describes the potential waste streams and impacts relevant to the project including management of spoil generated from tunnelling and dredging activities.

6.7.1 Overview

The largest waste stream generated by the project would be spoil associated with tunnelling activities. Around 2.4 million cubic metres of spoil could be generated if the project tunnels are constructed with roadheaders, and around 3.3 million cubic metres if tunnel boring machines are used. This waste stream would be unavoidable, and would be minimised through beneficial reuse as part of the project where possible. Depending on the construction methodology selected for the project, the spoil waste stream would include soil, rock and potentially sediments.

The spoil waste stream generated by the project that can't be beneficially reused would be managed as follows:

- Contaminated materials, sediments and wastes would be directed to an appropriately licensed waste facility
- 'Clean' spoil (virgin excavated natural materials) would be preferentially reused where viable opportunities for beneficial reuse are identified during the project's construction program. Otherwise, these materials would also be directed to an appropriately licensed waste facility
- If water based works, such as installation of an immersed tube tunnel, are pursued, marine sediments would be directed for unconfined sea disposal in accordance with a permit under the *Environment Protection (Sea Dumping) Act 1981*. An appropriate impact assessment and application for a sea disposal permit would be prepared in this case.

Other waste streams generated during construction of the project would include:

- Demolition wastes from existing structures that require removal

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

Waste streams generated during operation of the project would include:

- Wastes from operational maintenance and repair activities required over the life of the project. The type and volume of wastes generated would be dependent on the nature of the activity, but would predominantly consist of green waste, oil, road materials, as well as contaminated waste resulting from potential fuel spills and leaks
- Waste water from the tunnel deluge systems, which would form part of the fire and life safety systems
- Litter generated by road users.

6.7.2 Summary of potential issues

Impacts associated with waste generation and management would be mainly associated with the construction of the project. These may include:

- Traffic, air quality, noise and greenhouse gas impacts associated with the transport of significant waste volumes by road, rail or barge
- Potential for environmental impacts from waste handling, storage and disposal
- Contamination of soil or water from disposal of contaminated material
- Social amenity impacts such as visual impacts and odour associated with waste storage and disposal.

6.7.3 Proposed further assessments

A waste assessment would be prepared as part of the environmental impact statement. This would include (as a minimum):

- Opportunities for waste minimisation and reuse through design or construction planning
- A review of the likely waste streams and volumes from construction and operation of the project
- Preparation of a spoil management strategy identifying how spoil generated from tunnelling and possible dredging activities (subject to construction methods) would be managed during construction including likely volumes, likely nature and classification of excavated material, opportunities for recycling, potential disposal sites, stockpile management, and method(s) and transport routes. This spoil management strategy would consider the cumulative effects of spoil haulage and disposal activities associated with other Sydney based tunnel projects.
- Procedures for assessing, handling, stockpiling and disposing of potentially contaminated materials and wastewater, in accordance with the NSW Environment Protection Authority's *Waste Classification Guidelines* (EPA, 2014)
- Disposal and recycling options for each type of waste (other than spoil), including contingencies for unexpected waste volumes
- Identification of potential environmental or social impacts from the excavation, handling, storage on site and transport of waste particularly in relation to sediment/leachate control, noise and dust.

6.8 Flooding, hydrology and hydrodynamics

This section provides a description of the flooding and drainage environment and catchments and coastal processes in the design development corridor and the potential impact from construction and operation of the project.

6.8.1 Overview

Flooding and hydrology

The design development corridor is located in two main catchments – Sydney Harbour and Parramatta River catchment and Manly Lagoon catchment. Each of these main catchments consists of a number of smaller distinct sub-catchments. As a result of surface work interaction at the Burnt Bridge Creek Deviation and Gore Hill Freeway two sub-catchments are relevant to the project. Additionally, localised flooding could occur at any section of the project and connecting roads if the capacity of the drainage system is not sufficient to accommodate surface flows.

Burnt Bridge Creek catchment

The Burnt Bridge Creek catchment drains in an easterly direction from Wakehurst Parkway and has a total catchment area of about 3.4 square kilometres at Condamine Street. The main arm of Burnt Bridge Creek comprises a vegetated channel that extends from Clontarf Street in the west to Condamine Street in the east and includes culvert crossings at Brook Road, Burnt Bridge Creek Deviation and Kitchener Street. East (downstream) of Condamine Street the creek is drained by a box culvert that discharges into a vegetated channel that runs along the northern side of Manly West Park and through the Manly Golf Club before discharging into Manly Lagoon at Pittwater Road. Surrounding land uses that influence flood storage characteristics include low and medium density residential development, commercial development and large areas of open space including Balgowlah Golf Course.

While the existing culvert crossing of Burnt Bridge Creek at Burnt Bridge Creek Deviation has a flooding standard in excess of 1-in-100 year flood event, downstream sections are prone to overtopping during high flow events.

Flat Rock Creek catchment

The Flat Rock Creek catchment drains in an easterly direction from the Pacific Highway in Artarmon and has a total catchment area of about 3.9 square kilometres at Willoughby Road. The catchment is completely urbanised and the natural drainage characteristics have been altered by industrial, residential and commercial development. The construction of the Gore Hill Freeway in 1991 along the route of the original creek has altered the natural drainage system and its flood storage characteristics. The T1 North Shore rail line runs north-south through the middle reaches of the catchment.

The Gore Hill Freeway acts as an overland flow path during a 1-in-100 year flood event, conveying flow that surcharges the drainage systems that discharge toward the road corridor from the north and south.

Hydrodynamics

The Sydney Harbour estuary is a drowned river valley, characterised by steep sided banks carved into Sydney sandstone between 25 and 29 million years ago. Around 17,000 years ago, the sea level rose, flooding the river valley and forming a flood tide delta. By 8,000 years ago, sea level stood at five metres below present and the sea reached its present position about 6,000 years ago. The Sydney Harbour estuary, is about 30 kilometres in length, ranging in width from around 60 metres near the headwaters to about three kilometres approaching the estuary mouth. Middle Harbour Creek makes up one of the four principal estuary tributaries and Middle Harbour forms the northern arm of Sydney Harbour (Hedge et al., 2013).

Middle Harbour upstream of The Spit is relatively deep. Water depth is about 30 metres in the area between Northbridge and Seaforth, with depths of about seven metres on both shorelines.

6.8.2 Summary of potential issues

Construction

Flooding and hydrology

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

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

Hydrodynamics

The construction of the project has the potential to impact on hydrodynamic processes if water based works, including an immersed tube tunnel, are pursued. Potential impacts would be temporary and could include:

- Minor changes to the shoaling of waves and sediment transport patterns associated with increases in water depth from dredging
- Minor changes to wave climate (eg reduction in wave energy) which would potentially affect circulation and sediment transport patterns along the shorelines adjacent to cofferdams and worksites due to the blocking effect of the cofferdams and temporary wharf/work areas.

Waves generated by vessels or barge operations would not be expected to substantially change the wave climate in Middle Harbour. Similarly, propeller wash from vessel and barge operations is unlikely to adversely affect the stability of sediment.

Operation

Flooding and hydrology

Operation of the project has the potential to result in changes to surface hydrology and flooding characteristics due to increased impervious surfaces and/or changes to the total catchment area of existing drainage infrastructure. Increases in runoff could potentially require upgrades to existing drainage infrastructure, and may require additional mitigation measures (eg stormwater drainage basins).

Hydrodynamics

If an immersed tube tunnel design is pursued, changes in harbour bathymetry may affect hydrodynamics.

6.8.3 Proposed further assessment

The environmental impact statement would include an assessment of potential hydrology, flooding and hydrodynamic impacts during construction and operation of the project.

In addition to applicable council floodplain risk management plans, the following guidelines would be considered as relevant during the preparation of the flooding assessment:

- NSW Government's *Floodplain Development Manual* (Department of Natural Resources, 2005)
- *Practical Consideration of Climate Change - Flood risk management guideline* (DECC, 2007)

- *Australian Rainfall and Runoff: A guide to flood estimation* (Commonwealth of Australia (Geoscience Australia) 2016).

The assessment of potential hydrology and flooding impacts would include (as a minimum):

- Identification of potential impacts on stormwater quantity, change in stormwater runoff (increase or decrease) and sensitivity of downstream waters
- Identification of potential impacts as a result of changes in surface water quantity, with respect to increases or decreases in stormwater runoff and the sensitivity of the downstream waters
- Identification of any potential changes to flood levels, discharges, velocities, duration of flood inundation and flood hazards for the 1-in-20 year and 1-in-100 year flood event and the probable maximum flood, with consideration of climate change
- Identification of appropriate mitigation and management measures.

If relevant to the project, a detailed hydrodynamic and coastal processes assessment would also be prepared including (as a minimum):

- Assessment of changes to coastal processes in Sydney Harbour, including tidal flow and velocity and wave climate impacts and effects on sediment transport patterns
- Potential for the project to alter the tidal flow and water levels
- Scouring and erosion of shoreline by natural forces and vessel operations
- Potential for existing coastal processes to increase sediment plume dispersion during immersed tube tunnel construction and dredging.

6.9 Climate change risk

This section describes the potential greenhouse gas emissions and climate change risks that are relevant to the project during construction and operation.

6.9.1 Overview

Greenhouse gas

The *NSW Government Resource Efficiency Policy* (GREP) (OEH 2014c), requires agencies to meet the challenge of reducing energy, water and waste and to help tackle greenhouse gas emission through renewable energy use. Roads and Maritime Services' corporate commitment to sustainability is articulated in the *Roads and Maritime Environmental Sustainability Strategy 2015-19* (Roads and Maritime, 2015c), which includes the objective to minimise energy use and reduce greenhouse gas emissions.

The transport sector is identified as the third largest contributor to Australia's greenhouse gas emissions (Australian Government Department of the Environment, 2015), after energy for electricity and energy for stationary sources (which excludes electricity but includes fuel combusted during construction).

Greenhouse gas emissions sources can be categorised as Scope 1, 2 or 3 (Australian Government Clean Energy Regulator, 2015). Scope 1 emissions are the direct result of an activity for example from the burning of fuel in vehicles used in the construction or from the clearing of vegetation. Scope 2 emissions are indirect emissions from the use of electricity that is generated outside the project boundary. Scope 3 emissions are indirect upstream/downstream emissions generated in the wider economy due to third party supply chains and road users, for example the emissions associated with the production and transport of materials used in construction.

Climate change

The *Roads and Maritime Environmental Sustainability Strategy 2015-19* (Roads and Maritime 2015c) includes the objective to design and construct transport infrastructure to be resilient to climate change impacts.

The draft *Roads and Maritime Climate Change Adaptation for Road Networks Technical Guide* (Roads and Maritime 2016c) provides guidance for State Road Network projects which require climate change adaptations in response to changes in climate processes such as rainfall intensity and sea level rise. It has been developed considering existing Roads and Maritime processes such as risk management and environmental planning and is aligned with broader NSW Government initiatives and programs responding to climate change impacts.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Bureau of Meteorology (BoM) have released climate change projections for Australia that provide updated national and regional information on how the climate may change to the end of the 21st century.

Maximum temperatures are projected to rise by an average of 1.94 degrees Celsius by 2070. Minimum temperatures are also projected to rise by 2.02 degrees Celsius by 2070. Sydney will see an increase in minimum temperature of at least 1.44 degrees Celsius.

Annual rainfall is projected to increase by an average of 8.90 per cent by 2070. Large increases of around 18 per cent are projected across the whole of Sydney throughout summer and autumn. Winter and spring rainfall is more variable and may see decreases of around 8 per cent.

The following converging climatic trends are likely to lead to an increase in likelihood and frequency of flooding events occurring in the design development corridor, with resultant financial and social impacts:

- Increasing sea level rise (approximately 400 mm by 2050 and 900 mm by 2100)
- Increasing intensity of rainfall events (approximately two per cent by 2050 and 10 per cent by 2100)
- Increasing frequency of severe storm events and storm surge.

6.9.2 Summary of potential issues

Greenhouse gas

The construction of the project would contribute to greenhouse gas emissions either directly or indirectly through the following activities:

- Embodied energy of materials used in construction
- Transport of materials used in construction
- Combustion of fuel used in construction vehicles and machinery
- Electricity consumption at worksites
- Vegetation clearance
- Transport of spoil and waste.

Operation of the project would generate greenhouse house gas emissions through the following activities:

- Fuel consumption by vehicles using the project
- Fuels and materials used in maintenance activities
- Electricity used to power tunnel systems including tunnel ventilation, lighting and electronic equipment.

Some reductions in greenhouse generation may also be attributable to the project due to improvements in traffic flow and reduced congestion.

Climate change

Due to the relatively short timeframe of the construction phase, the impacts of climate change are expected to be minimal.

Direct climate change risks during operation include:

- Increased risk of flooding impacts to road and tunnel infrastructure, with resulting risks to operations (such as preventative closure or total asset failure) and health and safety risks
- Drainage and stormwater impacts
- Increased risk of road closures
- Increased risk of landslips and erosion
- Increased rate of deterioration of road pavements due to changes in subgrade moisture content.

Indirect climate change risks during operation include:

- Disruptions to energy supply as a result of higher temperatures leading to excessive demand and increased severity and frequency of bushfires.
- Disruptions to communications and increased length of outages due to increased frequency and intensity of extreme wind, lightning, bushfire and extreme rainfall events.

Climate change impacts have the potential to affect the operation of the infrastructure including interruption of delays to commuter and commercial traffic, increased maintenance costs, increased liability resulting from damage to road infrastructure and high insurance costs for road operators.

6.9.3 Proposed further assessment

Greenhouse gas

Assessment of the greenhouse gas emissions for the project would be carried out for construction and operation. This would include (as a minimum):

- Identification and quantification the sources of greenhouse gas emissions associated with the construction, operation and maintenance of the project
- Identification of opportunities to reduce the greenhouse gas emissions associated with the project.

The assessment of greenhouse gas emissions and identification of initiatives to reduce emissions would be developed through the project Sustainability Management Plan and would be documented in the environmental impact statement.

Climate change

A climate change risk assessment would be carried out for the project consistent with the *Australian Standard AS 5334-2013 'Climate Change Adaptation for settlements and infrastructure'* and the Roads and Maritime Risk Management Process.

The climate change risk assessment would be guided by the draft *Roads and Maritime Climate Change Adaptation for Road Networks Technical Guide* (Roads and Maritime, 2016c) and would consider the range of climate change variables over time, including temperature, rainfall and hail, sea level rise, wind speed and bushfire. The assessment would identify adaptation actions to be incorporated into the design and operation of the project.

Hydraulic modelling for the project would be prepared in accordance with *Australian Rainfall and Runoff: A guide to flood estimation* (Commonwealth of Australia (Geoscience Australia) 2016) and would consider predicted climate change impacts including the combination of sea level rise, a one per cent Annual Exceedance Probability flood event and an additional rainfall intensity.

6.10 Sustainability

This section describes relevant sustainability policy and drivers for the project and identifies how sustainability will be addressed through the design, construction and operation phases.

6.10.1 Overview

The *Roads and Maritime Environmental Sustainability Strategy 2015–19* aims to 'maximise project benefits by effective stakeholder engagement and integration of sustainability considerations throughout all phases of the project lifecycle'.

The *Roads and Maritime Sustainability in Infrastructure Design and Construction Technical Guide* (Roads and Maritime, 2016c) recognises that sustainability benefits are best achieved by integrating sustainability considerations early and throughout all project phases as a clear set of strategic sustainability objectives, targets and Key Performance Indicators (KPIs) will drive efficiency, reduce risk and improve whole of life asset sustainability performance.

The Infrastructure Sustainability Council of Australia (ISCA) is the peak industry body for advancing sustainability outcomes in infrastructure, through the Infrastructure Sustainability (IS) Rating Tool. The project will seek to achieve a best practice level of performance using market leading sustainability ratings tools using the ISCA rating tool or an equivalent level of performance using a demonstrated equivalent rating tool.

Developing and embedding a sustainability strategy at the early stages of project development is best practice and would deliver enhanced economic, social and environmental benefits compared to a traditional, compliance-based approach to sustainability. Given that a best practice approach to sustainability is business as usual for Roads and Maritime projects, it is not considered as a key issue in this report.

The project aligns with the objectives of the *NSW Long Term Transport Master Plan* including improving the quality of service, supporting economic growth and productivity and strengthening transport planning processes. The *NSW Long Term Transport Master Plan* also identifies potential new connections to bridge gaps in the Sydney motorway network by 2031, including enhanced north and south links.

The project would directly deliver on the goal of filling these identified gaps by creating a new, more reliable, north south crossing of Middle Harbour. It would also enhance capacity and resilience of existing road corridors through reducing congestion and providing alternative routes.

By facilitating improved links between residential and employment areas the project would also substantially contribute to city shaping and development for the next century. It would also contribute to enhanced liveability and amenity by improving resilience of the existing road network in congested areas and creating an improved environment for cycling, walking and public transport.

6.10.2 Summary of potential issues

Sustainability considerations for the construction and operation of large infrastructure projects include environmental, social and economic factors.

Construction

During the construction phase, key sustainability issues would include:

- Consumption of resources including energy, water and materials for construction
- Generation of greenhouse gas emissions during construction
- Generation and disposal of waste including spoil
- Social and community impacts including amenity, access and health and safety
- Heritage impacts arising from impacts to heritage places during construction
- Sustainable procurement of goods and services with consideration of whole of life impacts and opportunities to maximise social benefits
- Ecological impacts arising from vegetation clearing and marine construction works
- Communication and engagement with public stakeholders.

Operation

During the operation phase, key sustainability issues would include:

- Consumption of resources for operation including energy for ongoing tunnel ventilation and lighting
- Generation of greenhouse gases during operation, associated with energy use and vehicle transport
- Climate change mitigation and adaptation
- Ongoing social considerations related community connectedness, permanent changes to access to public areas (parks and recreational areas) and urban design strategies to enhance liveability
- Potential positive impacts associated with a more reliable and effective bus network.

6.10.3 Proposed further assessment

During detailed design, a project-specific Sustainability Management Framework and a Sustainability Implementation Plan will be prepared to guide the implementation of sustainability throughout the design and construction phases. This would include consideration of the following sustainability themes:

- Management and governance
- Using resources
- Emissions, pollution and waste
- Ecology
- People and place
- Innovation.

The Sustainability Management Framework and Sustainability Implementation Plan would identify initiatives and commitments to be implemented throughout the project lifecycle and allocate responsibility to project stakeholders.

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7 Conclusion

Roads and Maritime has formed the opinion that Beaches Link and Gore Hill Freeway Connection would be likely to significantly affect the environment and would require the preparation of an environmental impact statement under the EP&A Act. Accordingly, the project is State significant infrastructure under Part 5.1 of the EP&A Act. Approval from the Minister for Planning is required for the project.

The key environmental issues identified for the project include:

- Traffic and transport
- Air quality
- Noise and vibration
- Human health risks
- Biodiversity
- Aboriginal heritage
- Cumulative impacts.

The environmental impact statement would include the following:

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

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Attachment A

Requirements of the Environmental Planning and Assessment Regulation 2000

Requirements 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 Minister to carry out State significant infrastructure must include:

a. Details of any approval that would, but for section 115ZG of the Act, be required for the carrying out of the State significant infrastructure
b. Details of any authorisations that must be given under section 115ZH of the Act if the application is approved
c. A statement as to the basis on which the proposed infrastructure is State significant infrastructure, including, if relevant, the capital investment value of the proposed infrastructure.

Approvals that would otherwise apply

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

- Permits under Sections 201, 205 and 219 of the *Fisheries Management Act 1994*
- Approvals under Part 4 or excavation permits under Section 139 of the *Heritage Act 1977*
- Aboriginal heritage impact permits under Section 90 of the *National Parks and Wildlife Act 1974*
- Various approvals under the *Water Management Act 2000*, including water use approvals under Section 89, water management work approvals under Section 90, and activity approvals (other than aquifer interference approvals) under Section 91.

Authorisations if the application is approved

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

- An environment protection licences (EPL) under Chapter 3 of the Protection of the Environment Operations Act 1997
- Consent under Section 138 of the Roads Act 1993 from the relevant roads authority for the erection of a structure, or the carrying out of work in, on or over a public road, or the digging up or disturbance of the surface of a road.

State significant infrastructure statement

Clause 14(1) of State Environmental Planning Policy (State and Regional Development) 2011 provides that development is declared to be State significant infrastructure pursuant to section 115U(2) of the Act if it is permissible without development consent under Part 4 of the Act under a State environmental planning policy; and is specified in the categories of development in Schedule 3.

State Environmental Planning Policy (Infrastructure) (ISEPP) 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. As the project is for a road and road infrastructure facilities, and is to be carried out by Roads and Maritime, the project is permissible without development consent under Part 4 of the EP&A Act.

Schedule 3 of State Environmental Planning Policy (State and Regional Development) 2011 provides that general public authority activities for infrastructure or other development that (but for Part 5.1 of the EP&A 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 the EP&A Act.

For the Beaches Link and Gore Hill Freeway Connection, Roads and Maritime has formed the opinion that the impact of the project is likely to significantly affect the environment and would require an environmental impact statement to be obtained under Section 112 of the EP&A Act.

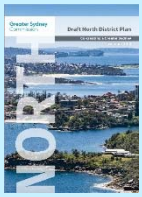
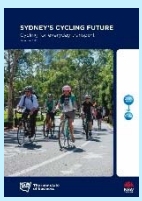
On this basis the project is State significant infrastructure. Approval from the Minister for Planning is required under section 115W of the EP&A Act.

Attachment B

Relationship of Beaches Link and Gore Hill Freeway Connection to relevant NSW Government transport and city plans

Table B-1 Relationship of Beaches Link and Gore Hill Freeway Connection to relevant NSW Government transport and city plans

Plan	Comment	Beaches Link and Gore Hill Freeway Connection
Draft Future Transport 2056		
	The Draft Future Transport Strategy is an update of the NSW Long Term Transport Master Plan (2012) and sets the 40 year vision, strategic directions and outcomes for customer mobility in NSW. It will be delivered through a series of supporting plans. The Western Harbour Tunnel and Beaches Link project is identified in the strategy as a 'Committed' project (within the next 0-10 years, subject to final business case).	The project would: • Reduce congestion on existing corridors and improve public transport reliability.
NSW Long Term Transport Master Plan		
	Identified that Sydney's most congested transport corridors include the Sydney Harbour crossings and the Military Road and Spit Road corridor – with high volume to capacity ratios and road users experiencing very long delays and queues. Identified the corridor connecting the Northern Beaches with Sydney CBD as one of six strategic transport corridors in Sydney considered highly constrained in meeting travel demand in 2011 (and also in 2031 if nothing is done).	Beaches Link would: • Provide a new Middle Harbour crossing and bypass of Military Road and Spit Road • Reduce congestion on existing corridors and improve public transport reliability Cater for increased traffic from population and employment growth in the Northern Beaches.
NSW: Making it happen		
	*NSW: Making it happen* sets out 12 priorities with 30 targets to increase accountability. One of the priorities is building infrastructure on time and on budget. Under the building infrastructure priority, there is a target of improving road travel reliability – 90 per cent of peak travel on key travel roads on time. Under the better services priority, there is a target to ensure on time running for public transport – maintain or improve reliability of public transport services over the next four years.	Beaches Link would reduce congestion on existing corridors and improve public transport reliability.
State Infrastructure Strategy Update 2014		
	Recommended further investigation of Western Harbour Tunnel and Beaches Link.	Underway
Rebuilding NSW		
	Accepts the recommendations of the State Infrastructure Strategy Update 2014 and commits to further investigation and planning of Western Harbour Tunnel and Beaches Link.	Underway

Northern Beaches Transport Action Plan		
	Commits to investigation and planning of Western Harbour Tunnel and Beaches Link.	Underway
Draft North District Plan		
	The draft District Plan sets out aspirations and proposals for Greater Sydney's North District. One of the overarching priorities for a productive North District includes accessing local jobs, goods and services within 30 minutes. The draft plan includes the Western Harbour Tunnel and Beaches Link as transport initiative that is being investigated to improve connections and access.	Underway
A Plan For Growing Sydney		
	Commits to investigation and planning of Western Harbour Tunnel and Beaches Link.	Underway
Sydney's Bus Future		
	Presents a three stage approach to improve service outcomes – focusing on improving customer experience, integrating bus services across Sydney and serving future growth. Bus initiatives, include bus rapid transit for the Northern Beaches and Victoria Road, to improve capacity and efficiency for bus users. The Northern Beaches Bus Rapid Transit (B-Line) – scheduled to start operating in late 2017 to provide more frequent and reliable services between the Northern Beaches and Sydney CBD.	Beaches Link would: • Provide a fast new route for buses (including B-Line) • Include dedicated bus priority measures at tunnel portals • Create extra capacity and options for development of new bus routes.
Sydney's Cycling Future		
	Identifies priority cycle ways to improve connection to major centres and assist in reducing congestion for trips for up to 5 km. The strategy also includes walking and cycling projects linking to public transport interchanges and stops.	Wakehurst Parkway widening to include a new shared path for pedestrians and cyclists between Warringah Road and Seaforth Oval. Reduction in congestion on surface roads would contribute to improved conditions for cyclists.

Draft NSW Roads Plan

This draft NSW Roads Plan is currently under development by Transport for NSW. The draft plan aims to provide a framework for future road planning in NSW, acknowledging the importance of transport and land, and defining strategic improvements for customers.

Beaches Link is being developed with a strong focus on minimising the project footprint, delivering city shaping enhancements and meeting customer requirements.

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