Western Harbour Tunnel and Warringah Freeway Upgrade

State Significant Infrastructure Assessment SSI 8863

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Cover image: Sydney Harbour Bridge and North Sydney (TfNSW)

Glossary

Abbreviation	Definition
AHD	Australian Height Datum
AQIA	Air Quality Impact Assessment
BCA	Building Code of Australia
BC Act	*Biodiversity Conservation Act 2016*
CBD	Central Business District
CIV	Capital Investment Value
CPP	Community Participation Plan
Council	Inner West, North Sydney or Willoughby City
CSSI	Critical State Significant Infrastructure
Crown Lands	Crown Lands, DPIE
Department	Department of Planning, Industry and Environment (DPIE)
DPI	Department of Primary Industries, DPIE
DRG	Division of Resources and Geoscience, DPIE
EESG	Environment, Energy and Science Group, DPIE
EIS	Environmental Impact Statement
EPA	Environment Protection Authority
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	Environmental Planning and Assessment Regulation 2000
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPI	Environmental Planning Instrument
EPL	Environment Protection Licence
ESD	Ecologically Sustainable Development
FRNSW	Fire and Rescue NSW
Heritage	Heritage NSW, Department of Premier and Cabinet

ITM	Immersed Tube Method
LEP	Local Environmental Plan
Minister	Minister for Planning and Public Spaces
NCA	Noise Catchment Area
NPWS	National Parks & Wildlife Service, DPIE
NRAR	Natural Resources Access Regulator, DPIE
OCSE	Office of the Chief Scientist and Engineer
OEMP	Operational Environmental Management Plan
Planning Secretary	Secretary of the Department of Planning, Industry and Environment
POEO Act	*Protection of the Environment Operations Act 1999*
RMS	Roads and Maritime Services, TfNSW
SEARs	Planning Secretary's Environmental Assessment Requirements
Planning Secretary	Secretary of the Department of Planning, Industry and Environment
SEPP	State Environmental Planning Policy
SRD SEPP	State Environmental Planning Policy (State and Regional Development) 2011
SSD	State Significant Development
SSI	State Significant Infrastructure
TfNSW	Transport for NSW
WFU	Warringah Freeway Upgrade

Executive Summary

Transport for NSW (the Proponent) is seeking approval to construct and operate the Western Harbour Tunnel and Warringah Freeway Upgrade (the project). The project includes twin motorway tunnels under Sydney Harbour approximately 6.5 kilometres in length linking the M4-M5 Link at Rozelle with the Warringah Freeway at North Sydney and Cammeray, and the construction of associated motorway facilities and ventilation outlet at Cammeray. The project includes the upgrade of the Warringah Freeway between Milsons Point and Naremburn, including the tie-in of the Western Harbour Tunnel connections, lane reconfiguration, upgraded interchanges at Falcon Street (Cammeray) and High Street (North Sydney), and active transport infrastructure. It also involves changes, such as intersection amendments, to streets surrounding the Warringah Freeway and the relocation of the existing bus layover infrastructure (between Miller Street and Ernest Street Cammeray) to within the widened section of the Warringah Freeway near the Cammeray Golf Course and on the Cahill Expressway at Milsons Point.

The project is an important component of the Government's transport infrastructure plan to provide efficient road network links and improved connections for motorists between Sydney's inner west, north and CBD.

The project complies with the objects of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and is consistent with the Government's key priorities and transport planning framework. The project is Critical State Significant Infrastructure under section 5.13 of the EP&A Act. The Minister for Planning and Public Spaces is the approval authority.

The potential environmental impacts of construction and operation are considered acceptable, subject to implementation of appropriate mitigation and management measures, and the enforcement of the Department's conditions of approval.

Engagement with the community

The Department undertook a range of discussions with the community, including attending community information sessions held by the Proponent during the exhibition period, and met with community groups including ANZAC Park Public School and Cammeray Golf Club, and North Sydney and Willoughby City Councils, during its assessment.

The EIS was exhibited between Wednesday 29 January 2020 and Monday 30 March 2020 (62 days) and resulted in the receipt of 1454 submissions from 1082 individual submitters (not including late submissions provided to the Proponent for consideration following the conclusion of the exhibition period). Of the submitters, 13 were NSW Government agencies, five were local councils, 48 were interest groups, and 1016 were community members.

The key issues raised by the community (including in submissions) included air quality and health impacts from unfiltered ventilation outlets, traffic and public transport impacts, noise impacts and the impacts on health from interrupted sleep, loss of parking, justification for the project, short duration of the exhibition period, construction fatigue, loss of public open space and tree canopy, and length and complexity of the EIS.

Key Assessment issues

The Department, in its assessment of the project including review of submissions received, identified the key issues as traffic and transport, noise and vibration; air quality, place and urban design and non-Aboriginal heritage.

Traffic and transport

The traffic and transport outcomes for this project focus the largest improvements on private vehicles at a regional level and on key arterial routes, such as existing harbour crossings (including Sydney Harbour Bridge, Sydney Harbour Tunnel and Anzac Bridge). There would be adverse local traffic impacts, particularly at North Sydney. There are some direct public transport initiatives, such as bus lanes, but these are limited with the stated broader public transport improvements in the EIS not forming part of the project. The Department has recommended conditions to ensure local traffic impacts are subject to further review and refinement, and initiatives are identified to ensure that bus travel times are not eroded over time.

Construction traffic impacts are considered to be manageable; however, the Department is concerned with the limited consideration of parking impacts during construction and operation and has recommended conditions to address this matter.

Noise and vibration

The primary noise issue associated with the project is managing construction noise impacts as part of the Warringah Freeway Upgrade. Works along the Warringah Freeway would be required to be undertaken out of hours due to the significant traffic disruption. The implementation of the Proponent's Noise Insulation Program to assist in reducing both construction and operational noise as early as practicable is supported. The Department has recommended that out of hour works along the Warringah Freeway be undertaken in accordance with specific criteria to ensure appropriate respite is provided to receivers. The criteria would be incorporated into an Environmental Protection Licence (EPL) and may be changed through the EPL process should the Proponent demonstrate to the Environment Protection Authority (EPA) that further extended hours can be appropriately managed.

During its operational phase, the project is predicted to decrease road traffic noise levels at most receiver locations except for an area surrounding the surface connection to City West Link at Rozelle and areas adjoining the upgraded area of the Warringah Freeway, which would be provided with operational noise mitigation.

Air quality

The Department has considered air quality impacts during the construction and operation stages, and considered advice and recommendations from its independent air quality consultant, NSW Health, EPA and Office of the Chief Scientist and Engineer.

In line with the NSW Government reforms for regulation of emissions from tunnel ventilation facilities, the NSW Chief Health Officer provided a statement on the potential health impacts of the predicted emissions, stating that it considers that potential air pollution-related health effects from the project are likely to be a result of changes in volumes of traffic on the surface road network and not a result of the tunnel ventilation outlets. The Advisory Committee on Tunnel Air Quality has also provided a statement indicating that the air quality assessment constitutes a thorough review of high quality.

Based on the outcomes of the air quality assessment, the operational air quality outcomes for the project (both in-tunnel and adjacent to the ventilation facilities) are considered acceptable, with improvements in some areas resulting from traffic moving from surface roads to underground. The Department has recommended limits on in-tunnel and ventilation outlet concentrations of key pollutants and for an Air Quality Community Consultative Committee to be established including representatives from the community and local councils. The Committee would have a consultative role on the siting of monitoring locations.

Place and urban design

The place based outcomes for the project are limited when compared to other major transport projects in the region such as Sydney Metro – Chatswood to Sydenham and the WestConnex projects. This is partly due to the project being delivered in a constrained corridor, particularly the Warringah Freeway Upgrade component which limits design alternatives.

The Department acknowledges that the Proponent has sought to address these impacts through the provision of enhanced public space designs and facilities at Berrys Bay and Yurulbin Park. However, there is a concern that these proposals do not adequately reflect the impacts of the project. To address these issues the Department has sought the provision of improved active transport facilities and greater connectivity through a comprehensive review process, which will also address any deficiencies in the proposed facilities.

The overall design of the project would be improved through the recommended design review process and specific outcomes required in locations where the Department considers the proposed impacts need to be further refined. The Department also considers that the Proponent should continue to refine its design to meet the objectives of the North Sydney Integrated Transport Plan.

Groundwater and settlement

Groundwater would be intercepted during the construction of the project, which would result in groundwater drawdown, potential settlement and contaminant migration, and the need to adequately treat intercepted groundwater prior to disposal. While groundwater can be appropriately managed to reduce associated impacts, there is a need for the assessment to be refined during detailed design. This process would be informed by recommended conditions in relation to monitoring and further modelling.

In relation to settlement, the project is not expected to have significant impacts. Notwithstanding, the Department has recommended settlement-related conditions including preparation of a geotechnical model to refine the settlement predictions, settlement criteria and settlement monitoring. In addition, the Department has recommended establishing an Independent Property Impact Assessment Panel with responsibility for resolving property damage disputes.

Non-Aboriginal heritage

Construction of the project would result in direct and indirect impacts to 19 non-Aboriginal heritage items (including groups of items or conservation areas) with the majority being indirect and having minor impacts. Two buildings within heritage conservation areas would be demolished, and heritage areas that are currently open space would be used as construction sites and reinstated following construction.

The Department considered the heritage impacts in the context of the overall benefits of project. The Proponent's commitments to manage and reduce heritage impacts, and the Department's recommended conditions, would ensure that heritage impacts are appropriately managed and minimised to the greatest extent practicable.

Contents

1 Introduction

Transport for NSW (TfNSW) (the Proponent) proposes to construct the Western Harbour Tunnel and Warringah Freeway Upgrade (the project), which involves two main components:

- a new crossing of Sydney Harbour via two separate tolled motorway tunnels connecting the Westconnex (M4-M5 Link) at Rozelle and the Warringah Freeway at North Sydney (Western Harbour Tunnel)
- upgrade and integration works along the existing Warringah Freeway, to connect new motorway infrastructure with the existing road network and provide infrastructure required for future connections to the Beaches Link and Gore Hill Freeway Connection project (the Warringah Freeway Upgrade).

The project forms part of the Western Harbour Tunnel and Beaches Link program of works (see **Figure 1**). While Beaches Link and Gore Hill Freeway Connection projects are subject to separate environmental assessment and approval process, together the projects would provide additional road network capacity across Sydney Harbour, improve transport connectivity to the Northern Beaches and provide benefits for freight, public transport and private road users.

The Western Harbour Tunnel would involve a western bypass of Sydney's CBD, providing an alternative to the Sydney Harbour Bridge, Western Distributor and ANZAC Bridge, and the Sydney Harbour Tunnel. The Warringah Freeway Upgrade would involve widening in parts, and associated surface road and intersection improvements. The provision of a continuous dedicated southbound bus lane would benefit public transport on the Warringah Freeway, providing direct bus access to North Sydney from the north.

The Western Harbour Tunnel would commence at the Rozelle Interchange, pass under Balmain and Birchgrove, then across Sydney Harbour between Birchgrove and Balls Head Reserve and continue under Waverton and North Sydney to link directly with the Warringah Freeway north of the Falcon Street overpass. The Warringah Freeway Upgrade would be carried out on the Warringah Freeway from Fitzroy Street at Milsons Point to Willoughby Road at Naremburn. Upgrade works include improvements to bridges that cross the freeway, upgrades to surrounding roads and shared user facilities.

The Western Harbour Tunnel and Warringah Freeway Upgrade project is identified as a priority initiative in Infrastructure Australia's Australian Infrastructure Plan (2018) in recognition of its importance in addressing urban congestion on Sydney's arterial road network and augmenting critical cross-harbour capacity and connectivity to the Northern Beaches. The project was also listed as a "committed" initiative (subject to final business case) in Future Transport Strategy 2056, the NSW Government's long-term vision for Sydney's transport network, released in January 2018.

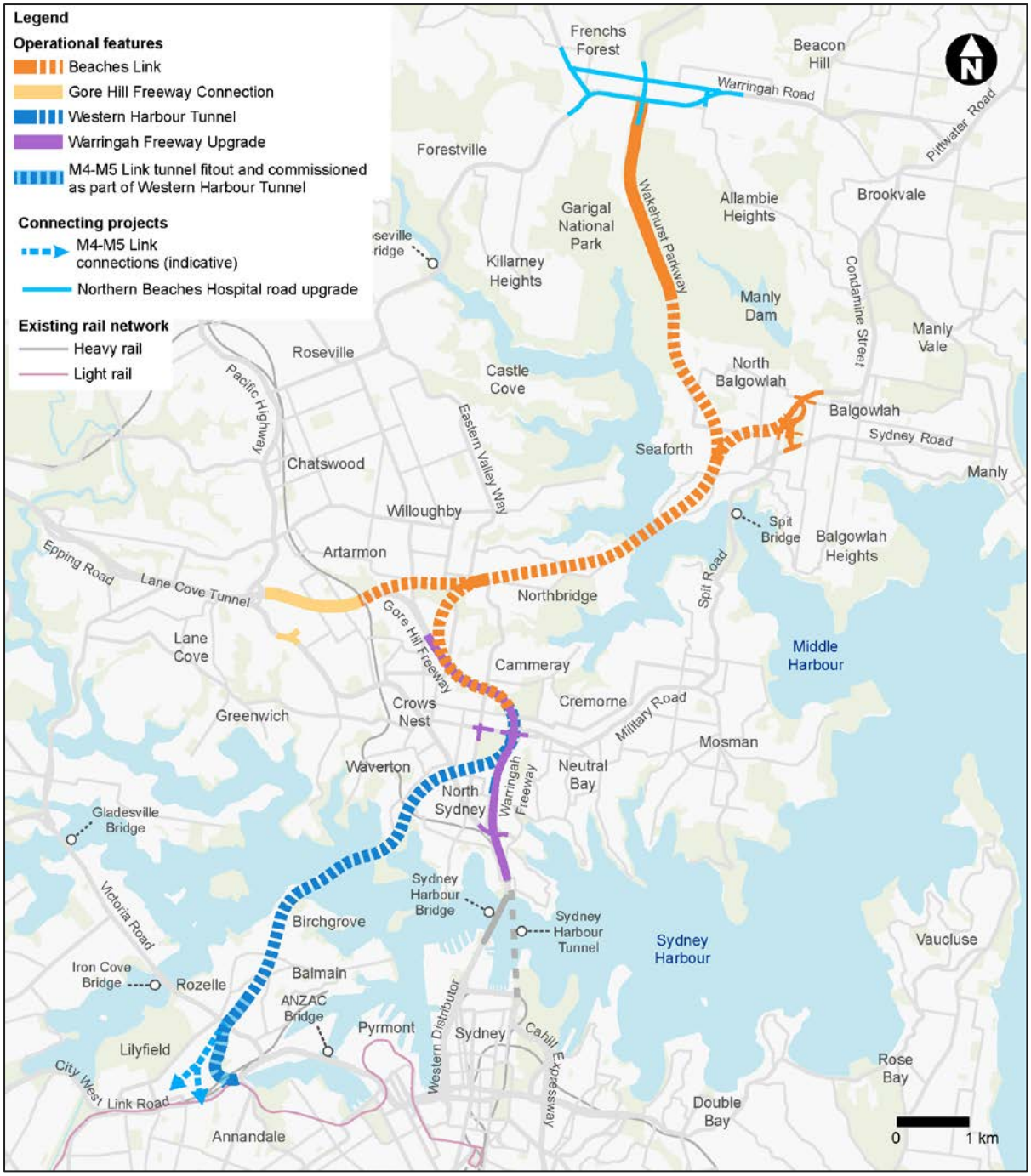


Figure 1 | The Western Harbour Tunnel and Beaches Link program of works (Source: EIS)

2 Project

The project would provide a link between the M4-M5 Link at Rozelle and the Warringah Freeway at North Sydney via a new crossing of Sydney Harbour and bypassing the Sydney CBD, and upgrade of the freeway and surrounding roads. A connection would also be provided to the future Beaches Link and Gore Hill Freeway Connection project at Cammeray (subject to separate planning assessment and approval).

Key project components are described in **Table 1**.

Table 1 | Main Components of the Project

Aspect	Description
Western Harbour Tunnel (mainline tunnels)	Twin tunnels approximately 6.5 km long with three lanes in each direction, passing under the suburbs of Rozelle, Balmain, Birchgrove, Waverton, North Sydney and Cammeray (with depths ranging between 21 metres below Lilyfield to 73 metres below Balmain). Tunnels would mostly be excavated by road header tunnelling equipment, except the new crossing under Sydney Harbour (between Birchgrove and Waverton) which would be constructed by installing two immersed tube tunnels about 630 metres in length and located on the harbour bed.
Tunnel to tunnel connections	Tunnels would connect to the stub tunnels constructed as part of the approved M4-M5 Link at Rozelle. Stub tunnels from the mainline tunnels at Cammeray would be constructed for a future connection to the mainline tunnels of the Beaches Link and Gore Hill Connection project.
Surface connections	At Rozelle, on and off ramps connect to the mainline tunnels at City West Link. The on and off ramps would be constructed as part of the approved M4-M5 Link project and the project would carry out fit out and commissioning. At North Sydney and Cammeray on and off ramps connect: • from the northbound mainline tunnel to the Warringah Freeway • from the Warringah Freeway to the southbound mainline tunnel • an off-ramp from the northbound tunnel to Falcon Street, North Sydney • an on ramp from Berry Street, North Sydney to the southbound tunnel.
Upgrade of Warringah Freeway	Upgrade and reconfiguration of the Warringah Freeway between Sydney Harbour Bridge, Milsons Point to Willoughby Road, Naremburn. Separation and rationalisation of traffic flows, including through traffic to and from Western Harbour Tunnel, through traffic to and from Sydney Harbour Bridge and Sydney Harbour Tunnel, and local distributor traffic to and from the Lower North Shore. Cut and cover and trough structures required for the Western Harbour Tunnel and the Beaches Link and Gore Hill Freeway Connection project within the road corridor.
Upgrades to interchanges	Upgrade of the High Street, North Sydney interchange, including widening High Street bridge, a new northbound ramp to the Warringah Freeway and conversion of the intersection of High Street/Alfred Street North intersection to traffic signals.

	Upgrade of the Falcon Street interchange to a diverging diamond configuration, bridge widening and a reconfigured signalised interchange.
New, modified and relocated bridges	Widening of High Street bridge (part of High Street interchange upgrade). Modification and widening of Mount Street Bridge. A new underpass beneath Mount Street as part of the dedicated southbound bus lane. A new bridge as part of Alfred Street North off ramp from Warringah Freeway, spanning new dedicated southbound bus lane and connecting southbound carriageways of the Warringah Freeway to Cahill Expressway and High Street. Modification and minor widening of the Falcon Street bridge (part of the Falcon Street interchange upgrade). Modification of Ernest Street bridge. A new underpass beneath Ernest Street as part of a dedicated southbound bus lane and the new Warringah Freeway connection from the proposed Beaches Link and Gore Hill Freeway Connection project. A new bridge to connect Brook Street/Miller Street with the Warringah Freeway, spanning the new dedicated southbound bus lane. Replacement of the Ridge Street and Falcon Street shared user bridges spanning the Warringah Freeway.
Upgrades and changes to the surrounding road network around Warringah Freeway	Conversion of intersection at the High Street/Alfred Street north intersection to traffic signals. Along the Pacific Highway, median works between Arthur Street and Denison Street to accommodate changes to lane arrangements. Changes to turning movements at the intersection of Pacific Highway with Walker and Blue Streets. Capacity and configuration works along Alfred Street north, including the realignment of Alfred Street north between Wyagdon Street and the Ridge Street shared user bridge. Reconfiguration of Alfred Street north to provide new off ramps from the Warringah Freeway to the High Street interchange. Kerb works, an additional eastbound lane and a new section of clearway on Berry Street, as well as changes to the intersection with Miller Street. Changes to the Pacific Highway/Berry Street intersection. Changes to lane configuration along Arthur Street. Changes to turning movements, lane configurations and traffic signals along Falcon Street to integrate with the Falcon Street interchange upgrade and Western Harbour Tunnel off ramp to Falcon Street. Changes to the Falcon Street/Miller Street intersection. Provision of a new signalised intersection and changes to turning movements at the intersection of Miller and Amherst Street in Cammeray. Changes to parking arrangements and restrictions along some sections of High Street, Miller Street and Berry Street in North Sydney, Clark Road and West Street in Crows Nest, Ben Boyd Road in Neutral Bay, and Miller Street and Amherst Street in Cammeray. Removal of the current traffic flow arrangement along the Warringah Freeway and the Mount and Ernest Street interchanges.

Public and active transport infrastructure	The mainline tunnels have been designed to be used by buses, including the taller double-decker bus services within general traffic lanes. Pedestrian and cyclist traffic is not permitted to use the Western Harbour Tunnel or associated ramps. New and upgraded pedestrian and cyclist infrastructure, including replacement of the Ridge and Falcon Street shared user bridges, a new shared user bridge to the north of Ernest Street and a new dedicated cycleway between Ernest Street and Miller Street. Relocation of the existing bus layover on the Warringah Freeway from north of Ernest Street to within the widened section of the Warringah Freeway near the Cammeray Golf Course and the Cahill Expressway at Milsons Point. A dedicated southbound bus lane along the Warringah Freeway from near Miller Street to the southernmost extent of the project near the Sydney Harbour Bridge, removing the need for buses and general traffic to weave.
Operational facilities and ancillary infrastructure	Motorway facilities at Rozelle Interchange and Warringah Freeway, including: • fitout and commissioning of a ventilation outlet at the Rozelle Interchange and the motorway facilities centre (separately approved and constructed as part of the M4-M5 Link). • construction of ventilation facilities within the Warringah Freeway corridor, north of Ernest Street. A motorway control centre at Waltham Street, in the Artarmon industrial area. Tunnel ancillary facilities (deluge and hydrant pump system for firefighting) at the Warringah Freeway in Cammeray. Tunnel ventilation systems including jet fans within the tunnels, axial fans within the motorway facilities to extract and supply air to/from the tunnels via ventilation tunnels, ventilation outlets to disperse tunnel air to the atmosphere, and air quality monitoring systems to monitor and control the ventilation system. Groundwater and tunnel drainage management and treatment, including a wastewater treatment plant at the Rozelle Interchange. Signage (static and variable message signage), tolling, fire and life safety systems, lighting, emergency evacuation and emergency smoke extraction infrastructure. Closed Circuit Television (CCTV) and other traffic management systems. Environmental controls such as noise mitigation, surface drainage, utility connections and modifications, landscape treatments.
Temporary works	Temporary facilities to support construction, including construction ancillary sites and work sites. Temporary closure of Birchgrove Ferry Wharf during construction.

The project would not include ongoing maintenance activities during operation, or the future use of residual land occupied or affected by project construction.

2.1 Project area / site description

The project is located between the Rozelle Interchange (M4-M5 Link) and Cammeray, as shown in **Figure 2** to **Figure 7**. The vertical alignment of the mainline tunnels is shown in **Figure 8** and a cross-section provided as **Figure 9**. An indicative long section of the immersed tube tunnel crossing Sydney Harbour is shown in **Figure 10**.

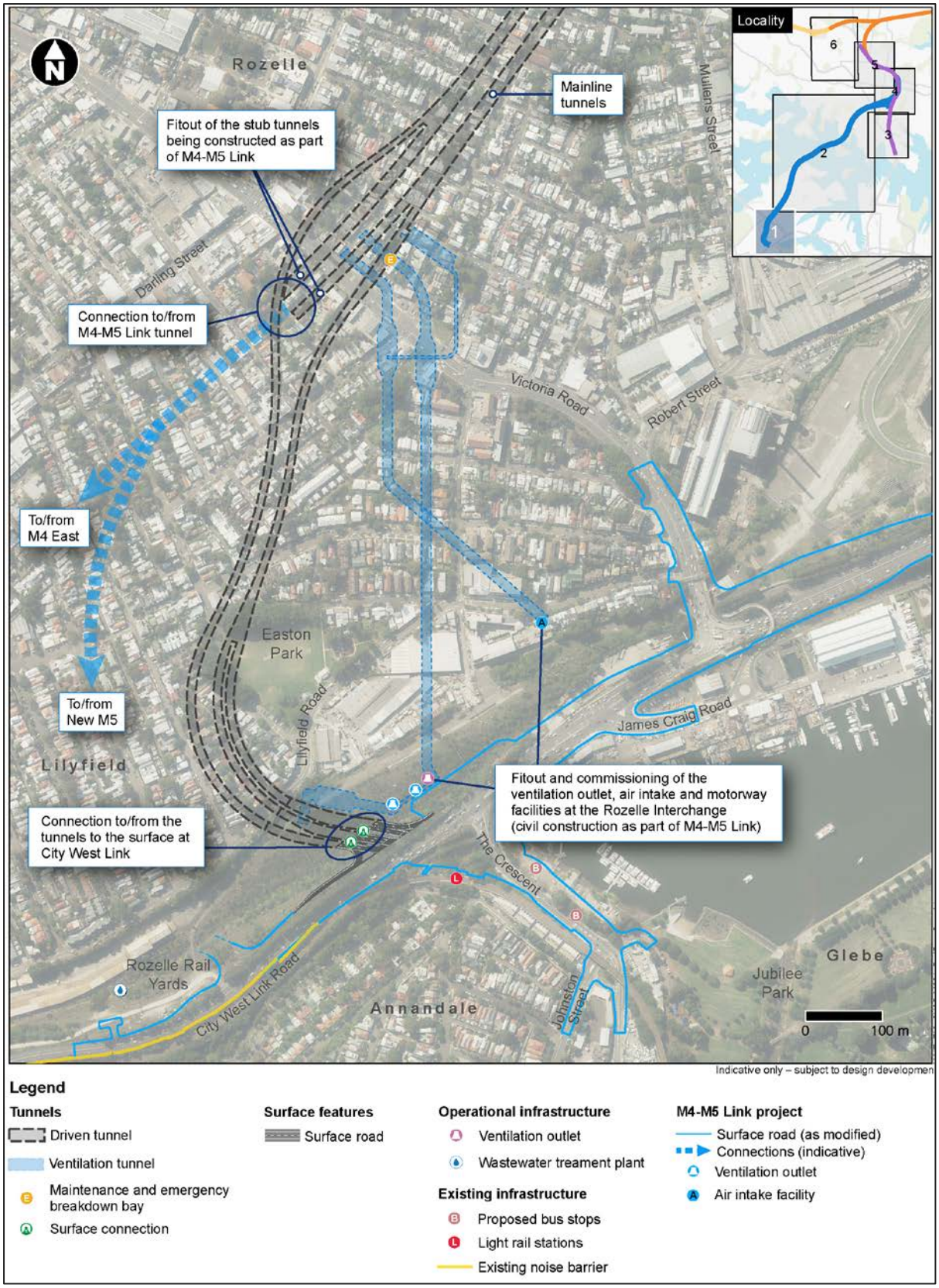


Figure 2 | Project Layout: Rozelle Interchange (Source: EIS)

Figure 3 | Project Layout: Sydney Harbour crossing (Source: EIS)

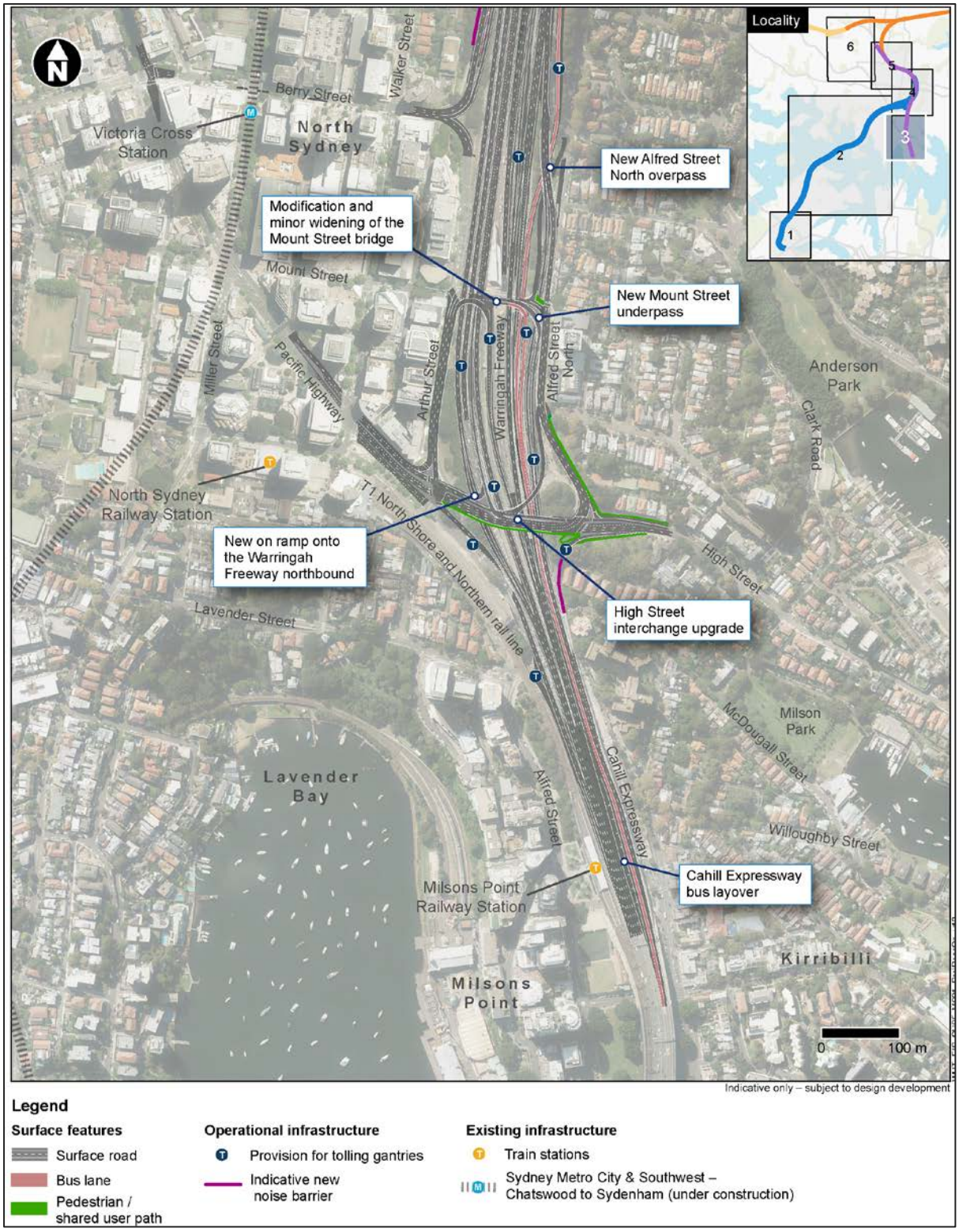


Figure 4 | Project Layout: Surface Road upgrades (Source: EIS)

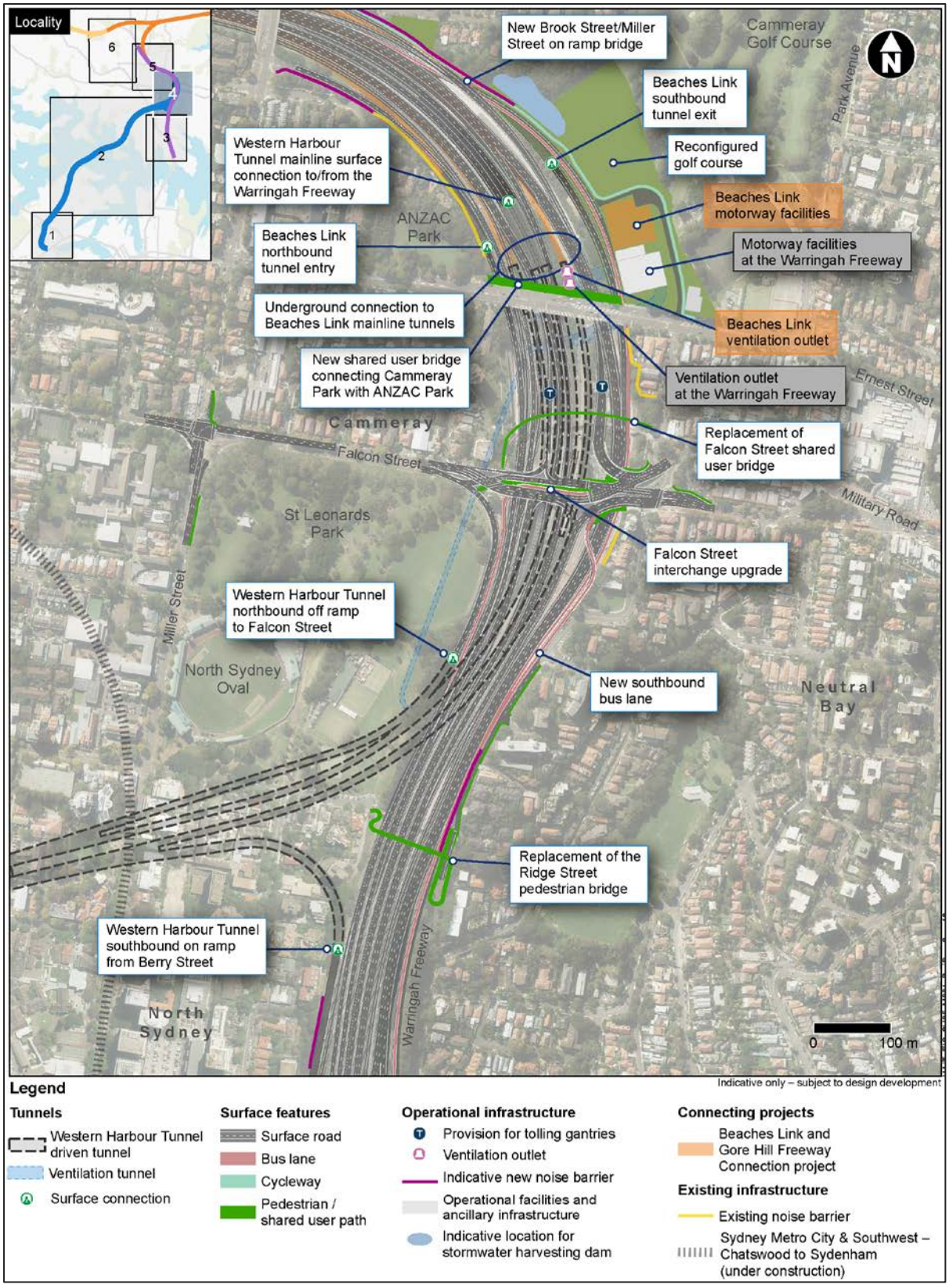


Figure 5 | Project Layout: Mainline surface connection to Warringah Freeway (Source: EIS)

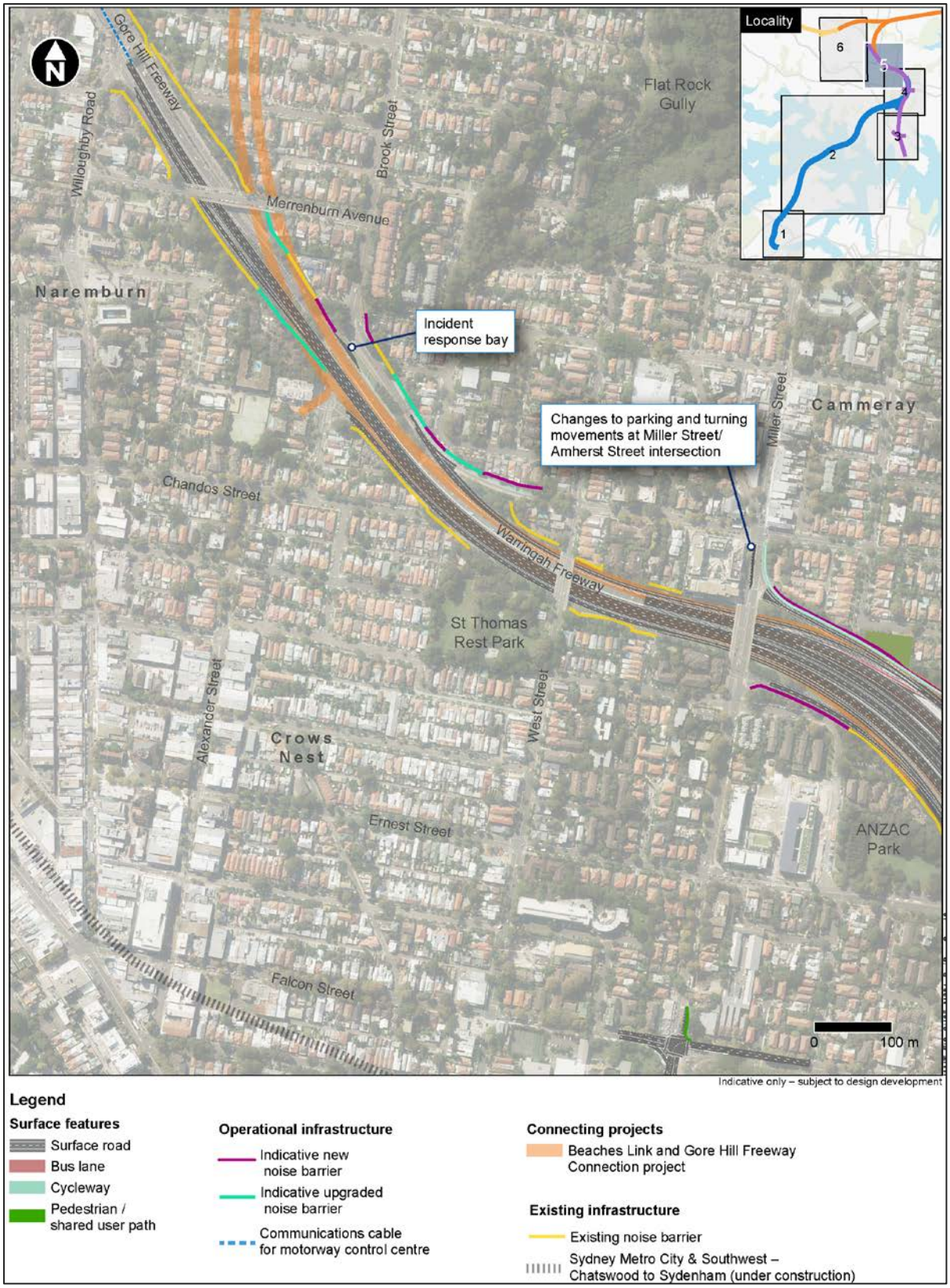


Figure 6 | Project Layout: Surface road changes to Miller St (Source: EIS)

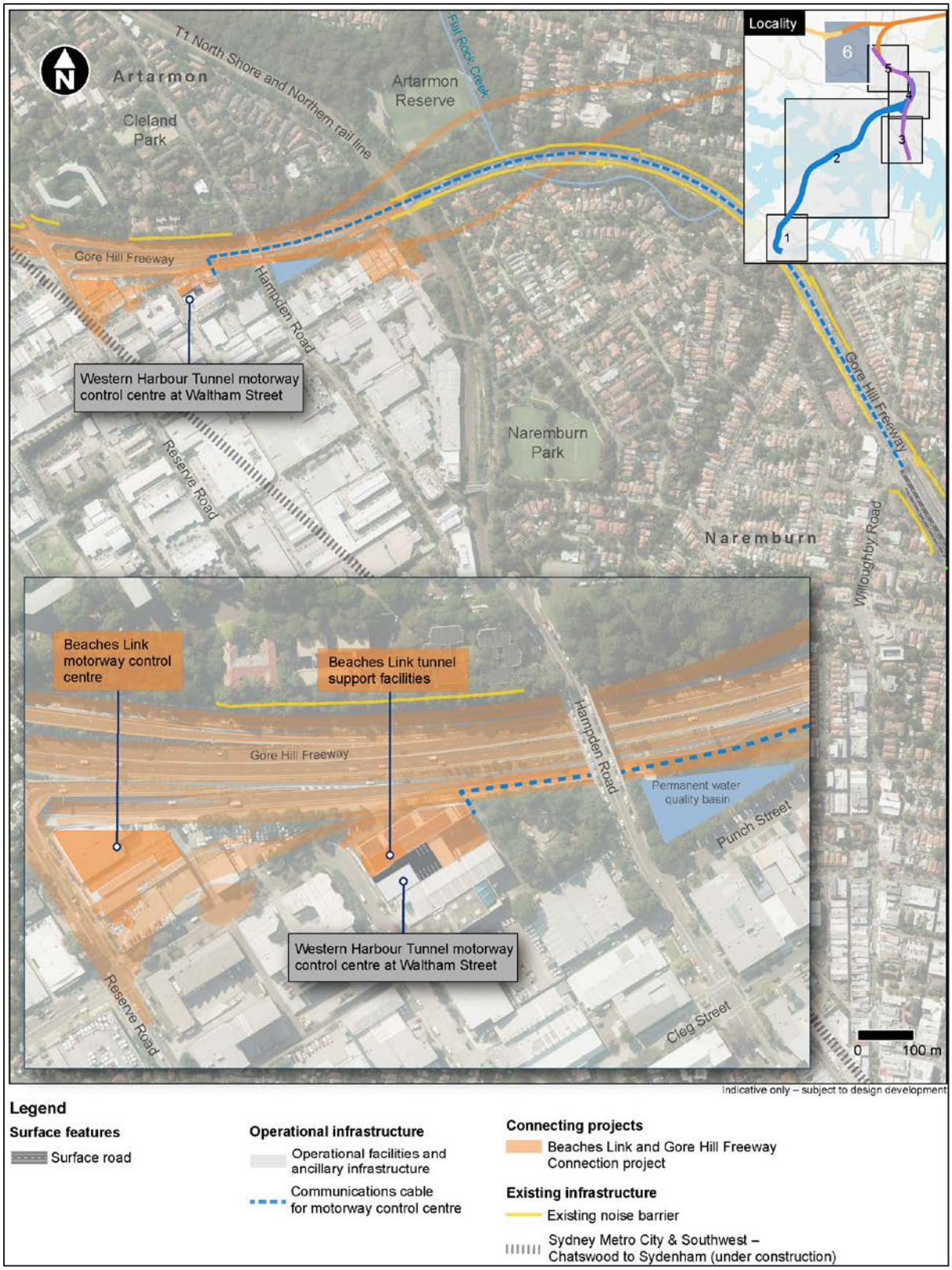


Figure 7 | Project Layout: Proposed Beaches Link tunnel ancillary sites (Source: EIS)

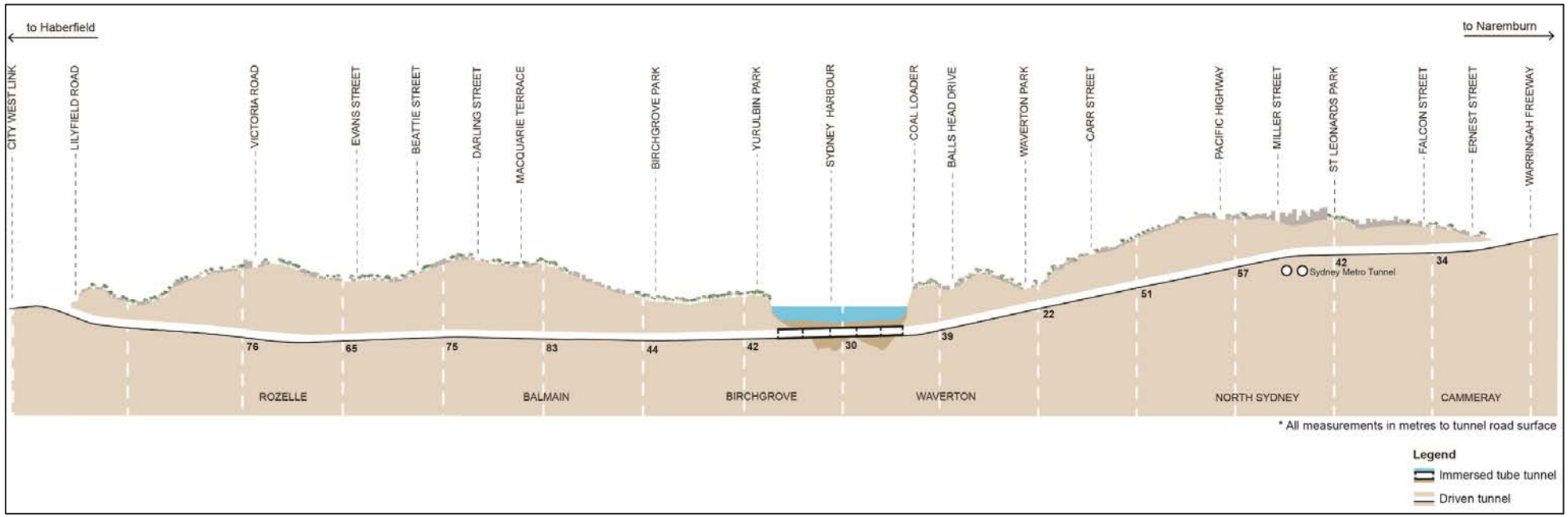


Figure 8 | Vertical alignment of Mainline Tunnels (Source: EIS)

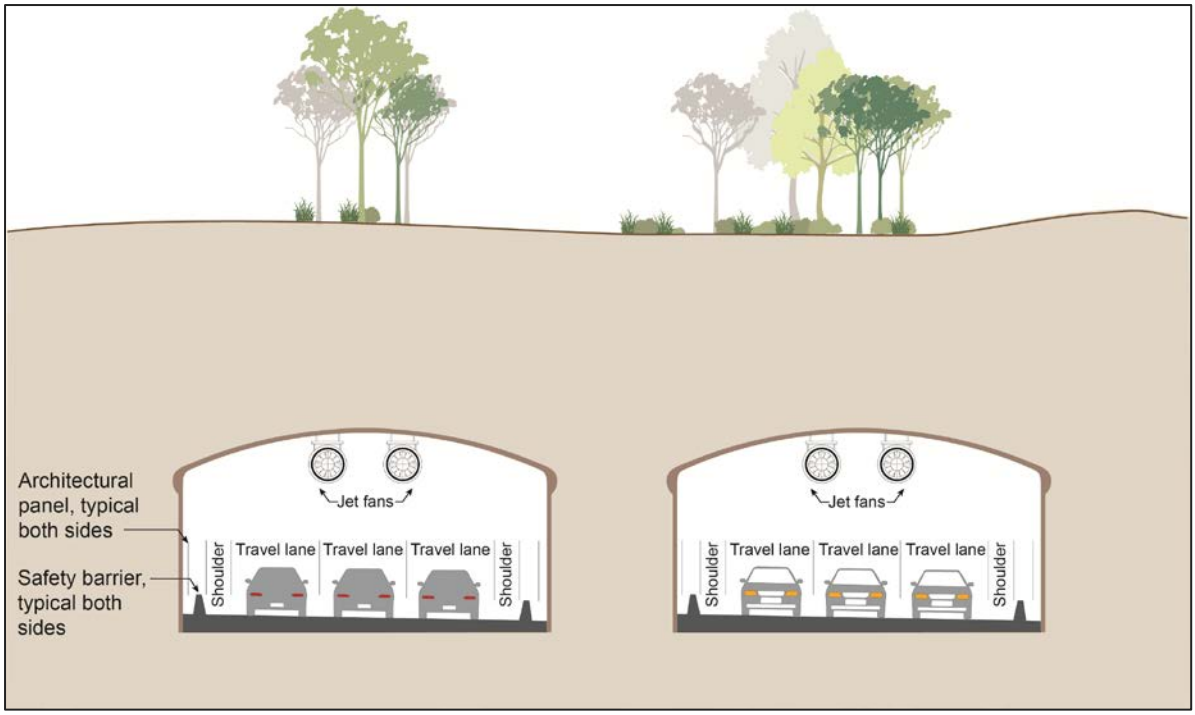


Figure 9 | Cross section of Mainline Tunnels (Source: EIS)

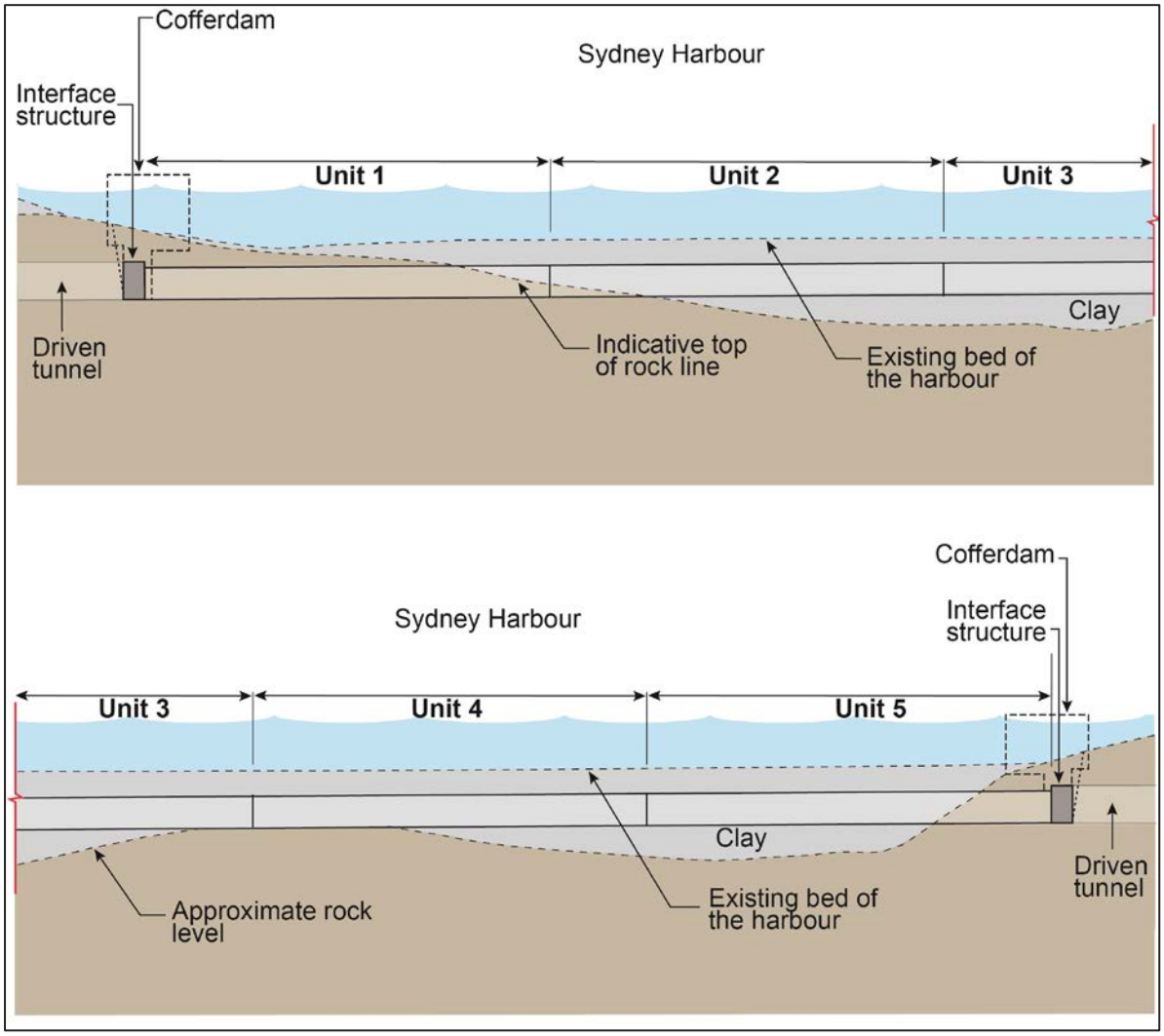


Figure 10 | Indicative long section of Immersed tube tunnel crossing of Sydney Harbour (Source: EIS)

The project includes a tunnel connection between the Western Harbour Tunnel component and the Beaches Link and Gore Hill Freeway Connection project at Cammeray, as shown in **Figure 11**.

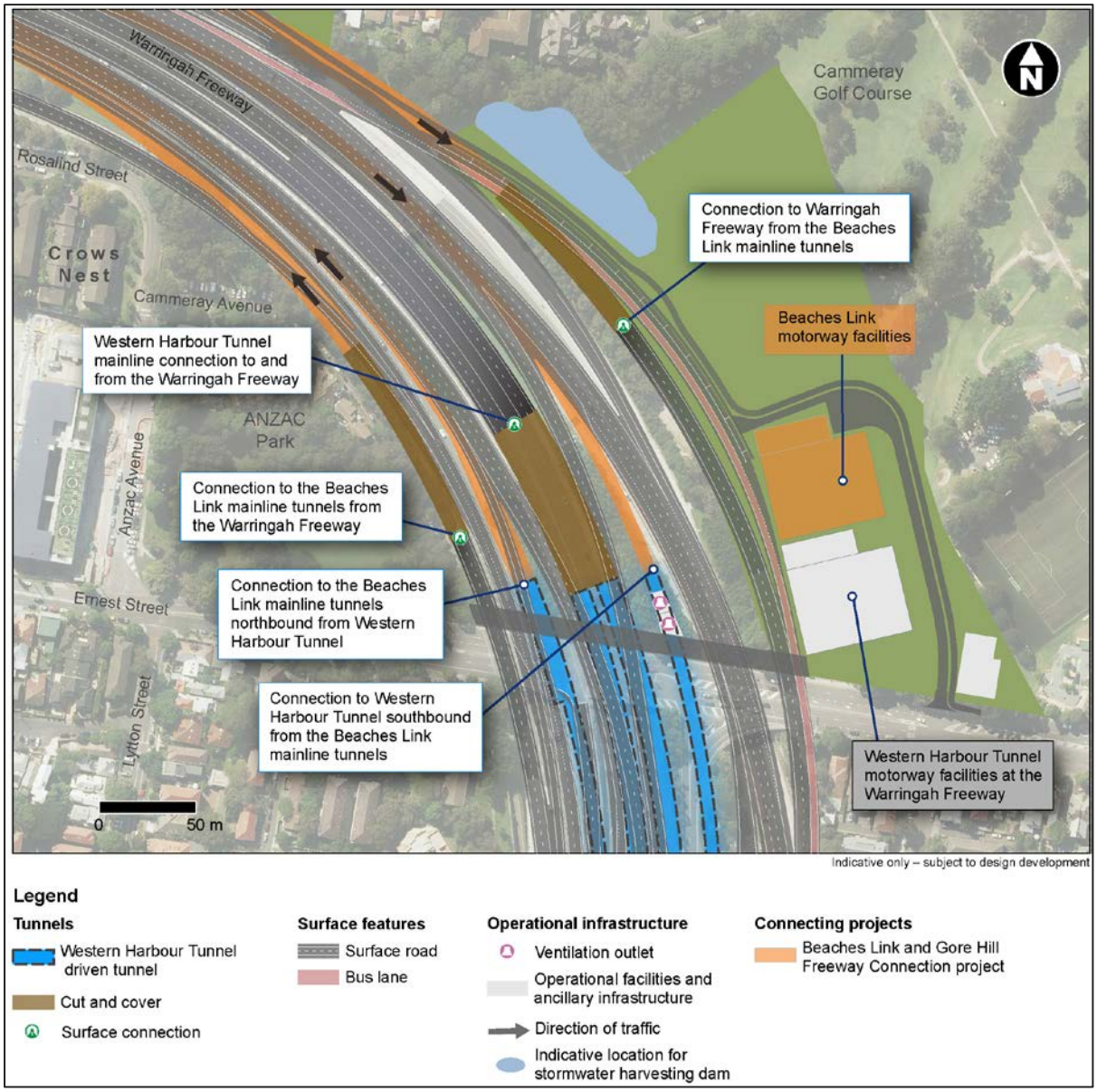


Figure 11 | Indicative Tunnel to Tunnel Connection at Cammeray (Source: EIS)

Depending on the timing of the construction of the mainline tunnels, the tunnel connection between projects may be constructed:

- at or around the same time,
- constructed consecutively, or
- at different times.

If the project is constructed first, stub tunnels would be constructed at Cammeray. However, if the Beaches Link and Gore Hill Freeway Connection project is constructed first, that project would construct stub tunnels at Cammeray for the Western Harbour Tunnel to connect to in the future.

The project removes the current traffic tidal flow arrangement along the Warringah Freeway and Mount and Ernest Street interchanges. The existing tidal flow arrangement on the Sydney Harbour Bridge would not be affected.

2.2 Construction works

An overview of construction works is provided in **Table 2**. These works would be supported by 19 construction ancillary sites as well as a mooring site within Sydney Harbour off Yurulbin Point, Birchgrove. Indicative locations of construction ancillary sites are shown in **Figure 12**.

Table 2 | Construction works overview

Aspect	Description
Enabling works	Property acquisition Existing condition surveys for buildings and infrastructure Land remediation (where required) Relocation, adjustment, and protection of utilities and services Heritage investigations, protections, salvage and/or conservation Temporary relocation of swing moorings at Berrys Bay Relocation of *Baragoola* and *M.V. Cape Don* vessels within Sydney Harbour
Early works and site establishment	Vegetation clearing and demolition of existing structures Installation of site environmental management controls (fencing, noise attenuation, soil and erosion control) Traffic management controls, adjustments to road signage, relocation of bus stops Construction of access roads, provision of property access, temporary relocation of pedestrian and cycle paths and adjustments to intersections Earthworks to level construction ancillary sites, in preparation for site work, and installation of site facilities Building construction ancillary sites (including temporary access), acoustic sheds and associated access decline acoustic enclosures
Construction of Western Harbour Tunnel component	Excavation of tunnel access declines or shafts Construction of driven tunnels Construction of cut and cover and trough structures Construction of transition structures between driven tunnels and immersed tube units Construction of immersed tube tunnel units Dredging to form a trench for the immersed tube tunnel units Installation of immersed tube tunnel units Civil finishing and fitout of the tunnels, including pavements works to tie in to surface roads in Rozelle, North Sydney and Cammeray Construction of operational facilities (tunnel ventilation systems, motorway control centre at Artarmon, tunnel ancillary facilities at Cammeray, wastewater treatment plant and substation at Rozelle, motorway tolling infrastructure) Testing and commissioning
Surface road works	Earthworks and bridgeworks Construction of retaining walls Construction and installation of stormwater and cross drainage Pavement works and line marking Utilities installation and relocation Tolling gantries and associated infrastructure Installation of road furniture, lighting, signage, and noise barriers

Testing, commissioning, and site rehabilitation	Testing of plant and equipment, commissioning the project Backfill of access declines and shafts Removal of construction ancillary sites Landscaping and rehabilitation of disturbed areas Removal of temporary environmental and traffic controls

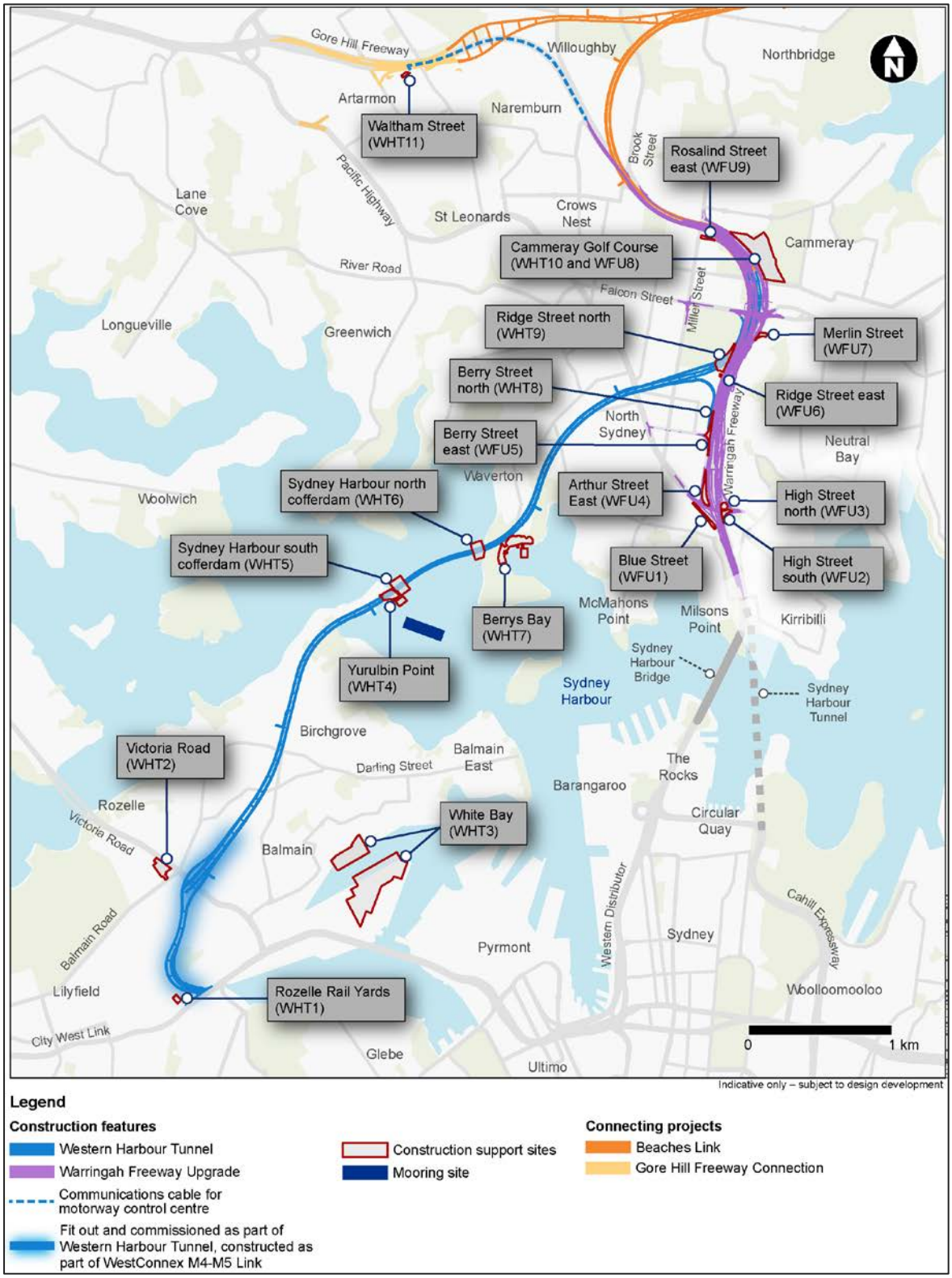


Figure 12 | Construction Ancillary Sites (Source: EIS)

2.3 Timing

Construction is scheduled to start following project approval, and continue for approximately six years, with operations expected to commence in 2027. Early works and site establishment will be carried out first with substantial construction planned to commence in 2021. An indicative construction program (including construction stages and timing) is shown in **Figure 13**.

Construction activity	Indicative Construction Program																											
	2021				2022				2023				2024				2025				2026				2027			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
early works and site establishment																												
Construction of the Warringah Freeway upgrade component																												
Construction of driven tunnels																												
Immersed Tube tunnel works including preparation, construction, installation, fitout and reinstatement																												
Tunnel fitout and finishing works																												
Construction of operational facilities																												
Testing and commissioning																												
Site clean-up and demobilisation																												

Figure 13 | Indicative Construction Program (Source: TfNSW)

3 Strategic context

3.1 Project justification

The project is close to the Sydney CBD and some of the busiest roads in Australia. The Sydney Harbour Bridge carries 165,000 vehicles per day and over 79,000 bus passengers; the Warringah Freeway carries over 240,000 vehicles per day; and the Sydney Harbour Tunnel, as the eighth busiest road in NSW, carries over 94,000 vehicles per day. With the large number of users that rely on these corridors, incidents on harbour crossings and their approaches impact on journey times for freight, buses, taxis and private vehicles resulting in time delays and deterioration of reliability. With limited alternative routes, incidents take a long time to clear and often cause widespread delays across the broader network, as illustrated by **Figure 14**. Without action, the Proponent has stated that the annual cost of incidents (excluding congestion) on this corridor would be more than $66 million per year by 2036.

Figure 14 | Incidents on Sydney Harbour Bridge and Warringah Freeway corridor (2014-2017) (Source: EIS)

Over time, the demand to bypass the CBD has become greater than the demand to access the CBD. Therefore, the roads which surround the CBD, including Sydney Harbour Bridge, Sydney Harbour Tunnel, ANZAC Bridge, Western Distributor and the Warringah Freeway, serve conflicting functions of providing local access to the CBD as well as a bypass route for through traffic (shown on **Figure 15**).

The EIS states that the project facilitates improved capacity, reliability and journey time performance of the critical cross-harbour transport corridors near the Sydney CBD. The provision of an additional crossing to the west of the Sydney Harbour Bridge would also provide increased network capacity and connectivity and travel time savings for freight, further serving the growth of Sydney's Eastern Economic Corridor.

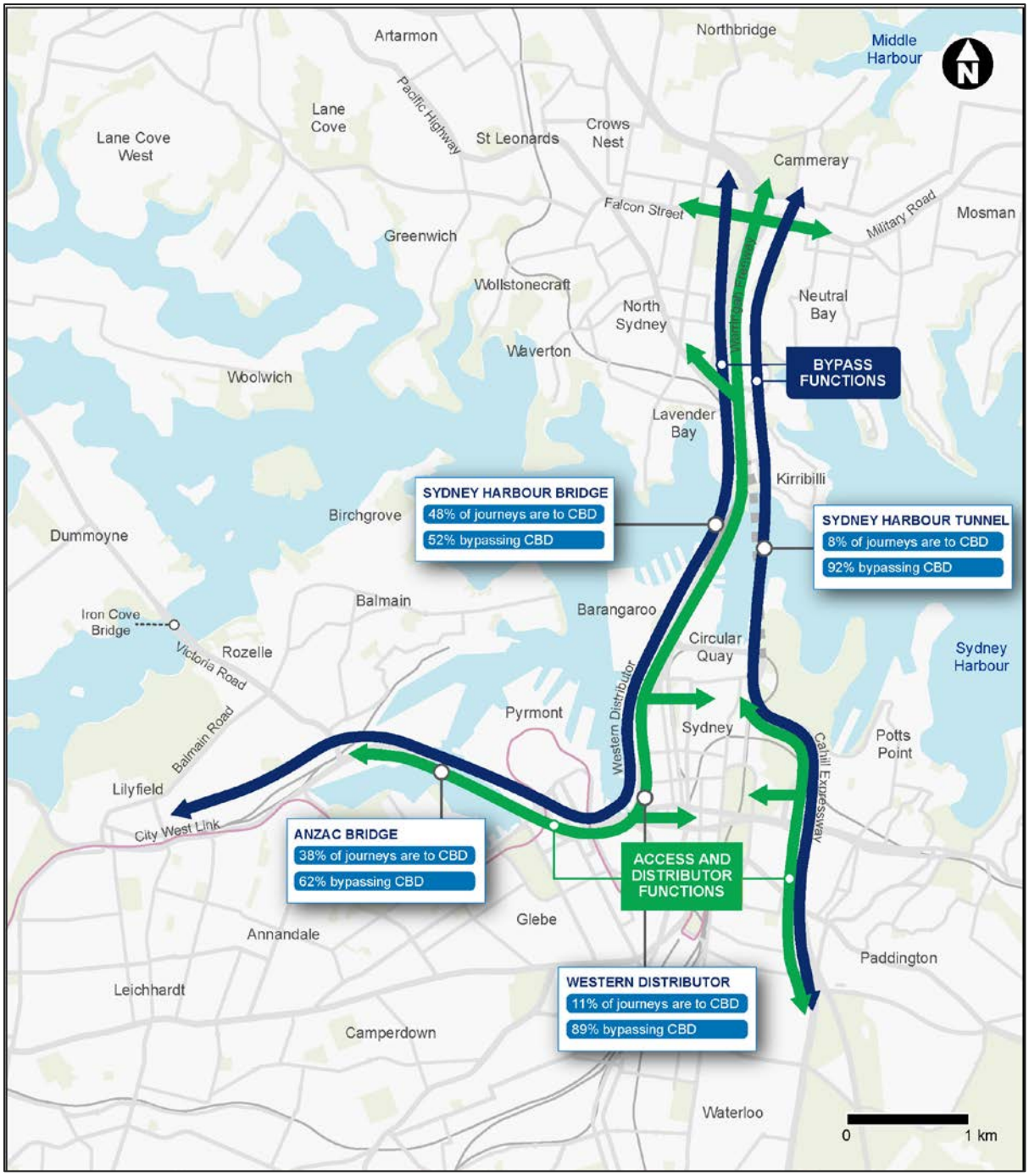


Figure 15 | Function of critical road corridor around the Harbour CBD (Source: EIS)

The Western Harbour Tunnel and Warringah Freeway Upgrade project has been influenced and informed by strategic plans and policies for transport, freight and city planning endorsed by the NSW Government. An important aspect of *Future Transport 2056* (NSW Government, 2018) is economic and social performance and the strategy identifies the project as being "committed" within the next 10 years stating that it will support key movements by road, including public transport, private vehicles and freight. The project is consistent with NSW strategic planning policy and framework, including:

- Australian Infrastructure Plan: Priorities and Reforms for Our Nation's Future (Infrastructure Australia, 2016) and the Infrastructure Priority List (Infrastructure Australia, 2018), which

recognises the project as a priority initiative due to its importance in addressing urban congestion

- State Infrastructure Strategy 2018-2038 (Infrastructure NSW, 2018), which states that subject to the business case, the NSW Government should invest in the project to complete a western CBD bypass and inner urban motorway network
- Greater Sydney Region Plan – A Metropolis of Three Cities (Greater Sydney Commission, 2018), which states that the project (together with Beaches Link and Gore Hill Freeway Connection) would improve accessibility from the Northern Beaches to the CBD and reduce through traffic within the CBD ensuring its economic strength and global competitiveness
- North District Plan (Greater Sydney Commission, 2018), which states that the project would provide improved connections and faster access to the CBD to bolster business and jobs growth
- Eastern City District Plan (Greater Sydney Commission 2018), which states that the project would improve movement through the District and access to strategic centres
- NSW Freight and Ports Plan 2018-2023 (Transport for NSW, 2018), which promotes the investment and management of freight to increase efficiency, connectivity and access.

The key project benefits, in conjunction with the future Beaches Link and Gore Hill Freeway Connection, include:

- reduced congestion on distributor roads around the CBD, reducing the conflict between access and bypass functions and improving the efficiency of existing corridors, as shown on **Figure 16**
- faster and more reliable cross-harbour journeys, particularly for traffic bypassing the CBD, as illustrated by **Figure 17**
- improved productivity along the Eastern Economic Corridor, due to improved journey times
- increased resilience for the cross-harbour transport corridors by reducing the economic impact of incidents
- improved traffic performance on the Warringah Freeway to support long-term increased demand
- improved urban amenity from reduced congestion on arterial roads, high streets and local roads.

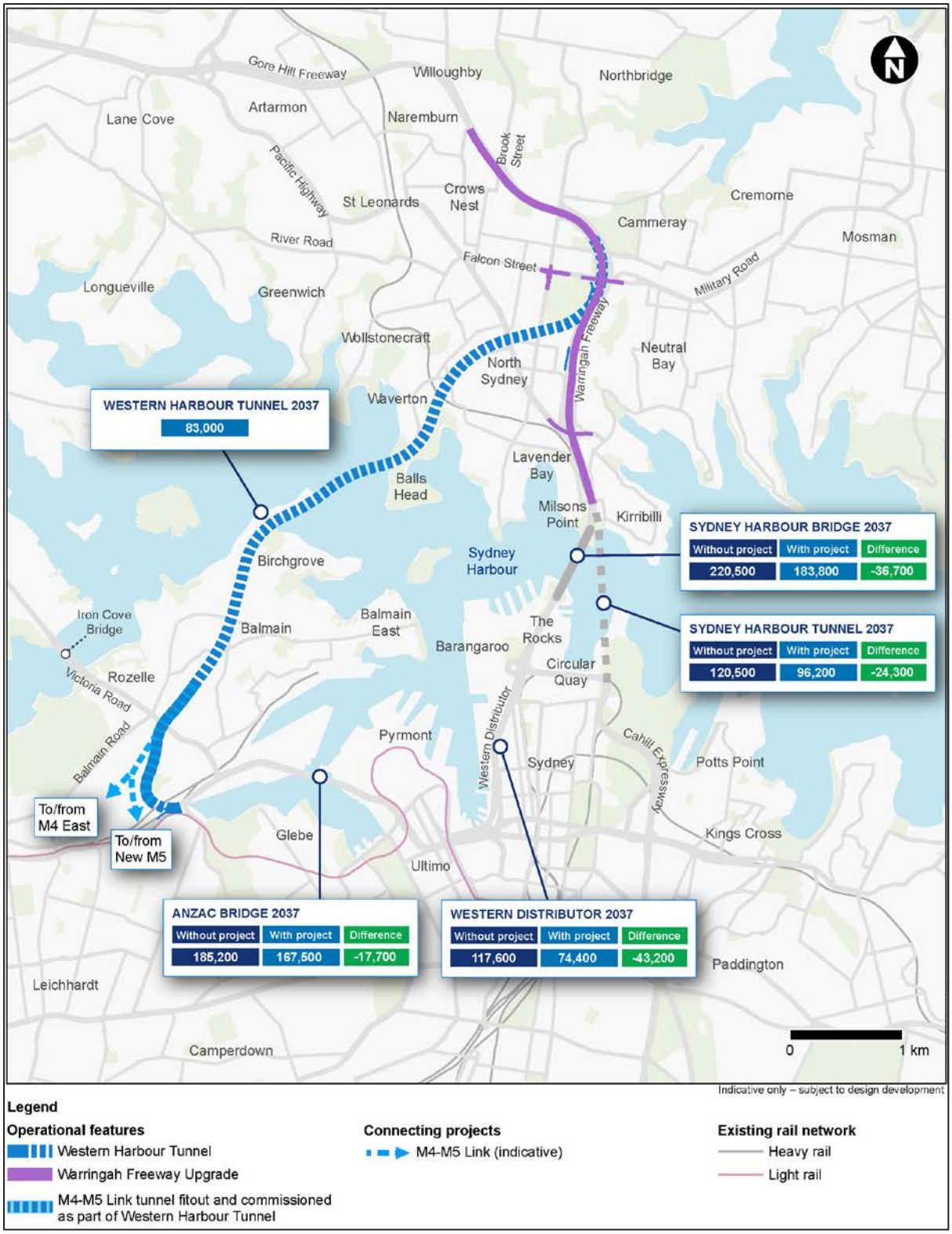
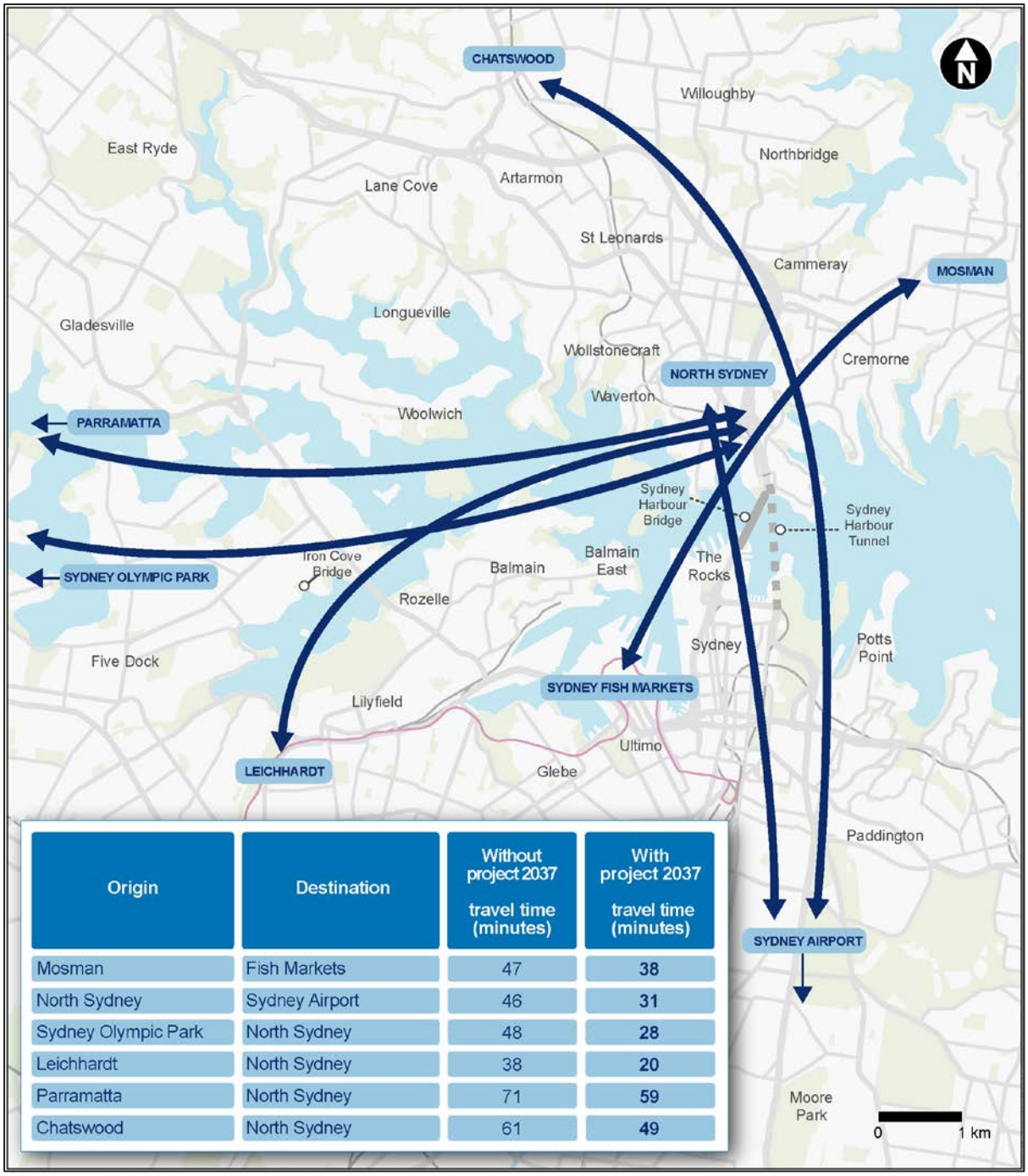


Figure 16 | Change in average weekday traffic demands (two way) on key road corridors by 2037 (Source: EIS)



Origin	Destination	Without project 2037 travel time (minutes)	With project 2037 travel time (minutes)
Mosman	Fish Markets	47	38
North Sydney	Sydney Airport	46	31
Sydney Olympic Park	North Sydney	48	28
Leichhardt	North Sydney	38	20
Parramatta	North Sydney	71	59
Chatswood	North Sydney	61	49

Figure 17 | Change in journey times in the AM peak as a result of the project by 2037 (Source: EIS)

3.2 Project development and alternatives

Travel demand management, improvements to the capacity of existing harbour crossings, and arterial road network and improvements to alternative transport modes, were considered as alternatives to a new motorway (the project).

Travel demand initiatives alone would require considerable changes in social attitude and travel behaviours and with Sydney's growing population were not considered a viable alternative to reduce the level of demand on the road network.

Increases to road capacity on Sydney Harbour Bridge are not considered feasible because of engineering and physical constraints and the significant heritage, visual and tourist values of the bridge. Engineering and physical constraints also limit capacity improvements to the Sydney Harbour Tunnel. Increasing capacity of existing crossings would also have limited benefit due to the constraints from the approaches, particularly on the southern side of the harbour on the Western Distributor and ANZAC Bridge.

Improvements to public transport, such as Sydney Metro City and South are being undertaken, but alone they are not sufficient to provide the level of additional cross-harbour capacity that is required. They do, however, complement other forms of transport.

The provision of a new crossing of Sydney Harbour (the project) is designed to relieve congestion, redistribute traffic and cater for the various journeys demanded by users and future population growth. The project would also improve southbound bus movements on the Warringah Freeway and deliver new strategic connections to the north which may include the development of new express bus routes.

Four corridor alternatives were assessed for a new tunnelled motorway cross-harbour connection and included brown, red, orange and blue options, as shown on **Figure 18**.

The corridor alternatives were:

- brown – crossing of Sydney Harbour between Rozelle and North Ryde, generally under Victoria Road and Gladesville Bridge to connect to the M2 Motorway corridor near East Ryde. This option would bypass the Lane Cove Tunnel and Warringah Freeway
- red – crossing of Sydney Harbour between Balmain East and McMahons Point via Goat Island to connect to the Warringah Freeway and future Beaches Link and Gore Hill Freeway Connection at Cammeray. Due to the alignment and poor geology, the tunnel would need to cross under the Sydney Metro City and Southwest tunnels resulting in a deep tunnel requiring long spiral ramps to connect to North Sydney
- orange – a similar crossing of the harbour to the red option, however the tunnel would connect to the Gore Hill Freeway at Naremburn rather than the Warringah Freeway at Cammeray
- blue – a shallow crossing of the harbour between Birchgrove and Waverton connecting to the Warringah Freeway near the Cammeray Golf Course and the future Beaches Link and Gore Hill Freeway Connection via underground ramps. The tunnel would pass over the Sydney Metro City and Southwest tunnels north of the Victoria Cross station. This option would result in the shortest harbour crossing.

The corridor options were evaluated against technical, environmental and planning criteria including connectivity and performance, constructability and design, community and environment and economic factors. The blue corridor was identified as the preferred corridor alignment for the project.

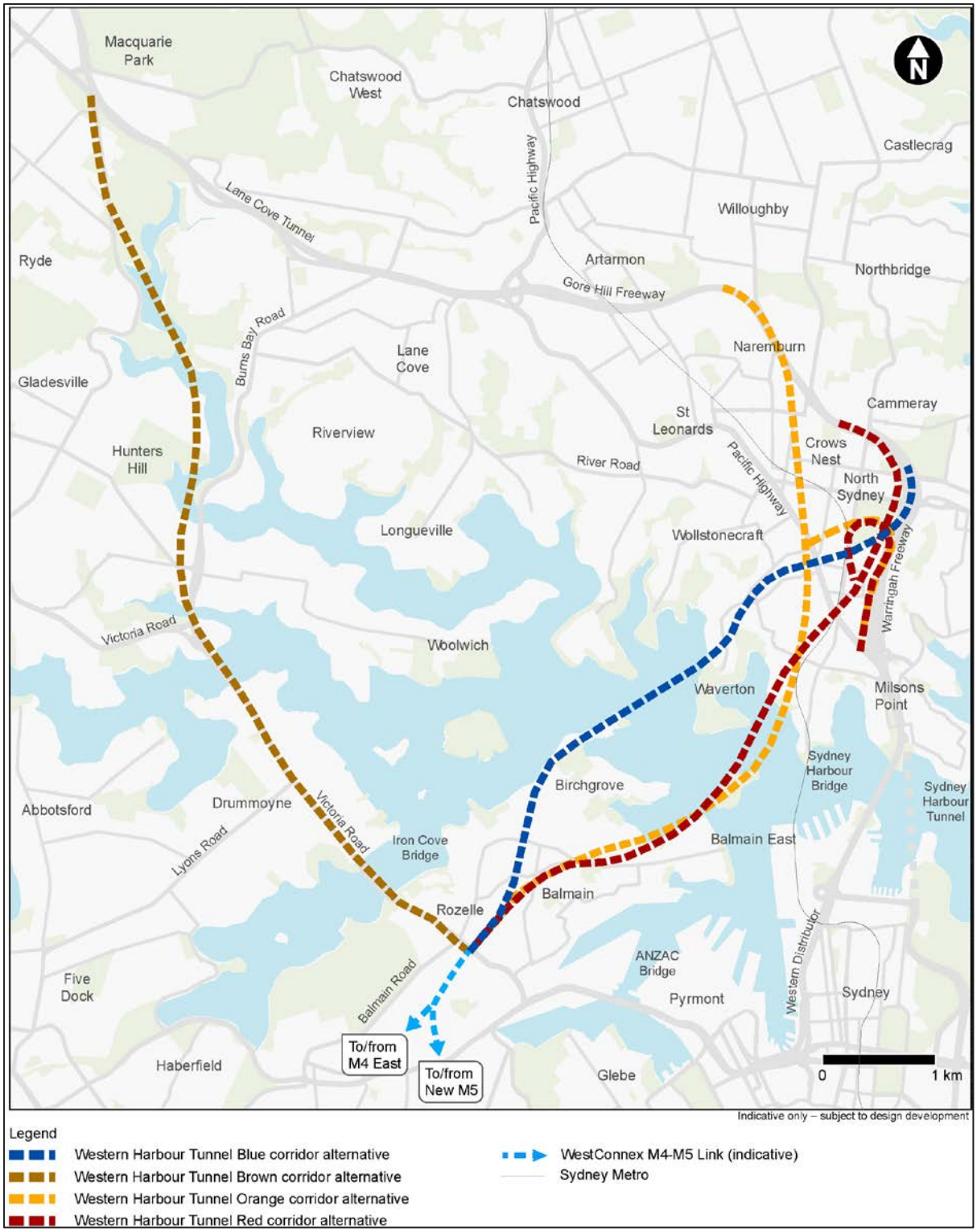


Figure 18 | Corridor alternatives (Source: EIS)

3.3 Other developments

A number of developments in the study area could contribute to cumulative impacts, particularly during the construction phase. Major projects near the current project, with concurrent or consecutive construction timeframes, and those that are approved (including those that have not yet started

construction, are currently being constructed or recently completed) or proposed (and currently under assessment) includes:

- Beaches Link and Gore Hill Freeway Connection - Waverton, North Sydney/Cammeray
- Sydney Metro City and Southwest (Chatswood to Sydenham) - Rozelle/White Bay, Waverton, North Sydney/Cammeray
- M4-M5 Link - Rozelle/White Bay
- Sydney Metro West - Rozelle/White Bay
- construction and redevelopment projects at Wenona School, Shore School, St Aloysius College and Loreto Kirribilli - North Sydney
- commercial and hotel development on Berry and Walker Street - North Sydney
- Glebe Island Concrete Batching Plant and Glebe Island Multi-User Facility - Rozelle/White Bay
- Sydney Fish Market - Rozelle/Blackwattle Bay.

Strategic planning, including Bays Precinct Urban Transformation Plan, Waverton Peninsula Strategic Masterplan, Ward Street Precinct Plan (North Sydney) and St Leonards Park Landscape Masterplan could also result in cumulative impacts.

4 Statutory Context

4.1 State significance

Western Harbour Tunnel and Upgrade of the Warringah Freeway is Critical State significant infrastructure (CSSI) pursuant to section 5.13 of the *Environmental Planning and Assessment Act, 1979* (EP&A Act). The Minister for Planning and Public Spaces is the approval authority for the project.

4.2 Permissibility

The project is for the purpose of a road or road infrastructure facility and is development permitted without consent, in accordance with clause 94 of State Environmental Planning Policy (Infrastructure) 2007 (the Infrastructure SEPP).

4.3 Mandatory Matters for Consideration

4.3.1 Environmental Planning Instruments

In accordance with section 5.22(2) of the EP&A Act, the only environmental planning instruments that apply to the project are the Infrastructure SEPP (insofar as it relates to the declaration of development that does not require consent) and State Environmental Planning Policy (State and Regional Development) 2011 (which declares infrastructure as State significant infrastructure (SSI)). No other environmental planning instruments apply.

4.3.2 Objects of the *Environmental Planning and Assessment Act 1979*

The determination must have regard to the objects of the EP&A Act, which the Department has considered:

- ecologically sustainable development (ESD) (see **Section 4.3.3 and 6**)
- social and economic welfare (see **Section 6)**
- protection of the environment, including in relation to biodiversity, traffic, noise and vibration, air quality, surface and groundwater hydrology, urban design, amenity and socio-economic issues (see **Section 6**)
- sustainable management of built and cultural heritage, including Aboriginal cultural heritage (see **Section 6**)
- good design and amenity of the built environment (see **Section 6**)
- promote the sharing of the responsibility for environmental planning and assessment between the different levels of government (see **Section 5**)
- community participation in the assessment of the project (see **Section 5**).

4.3.3 Ecologically Sustainable Development

The EP&A Act adopts the definition of ESD found in the *Protection of the Environment Administration Act 1991* (POEA Act) and the Environmental Planning and Assessment Regulation 2000. Section 6(2) POEA Act states that ESD requires the effective integration of economic and environmental considerations in the decision-making process and that ESD be achieved through the implementation of the following four principles and programs:

- precautionary principle
- inter-generational equity
- conservation of biological diversity and ecological integrity
- improved valuation, pricing and incentive mechanisms.

Project objectives which guide the delivery and operation of the project contribute to the sustainability of the project and the meeting of ESD principles. In addition to the objectives, the Proponent addressed the above principles directly in the EIS (see **Chapter 25**) and has identified a broad range of mitigation measures to manage impacts associated with these issues.

The Department has recommended conditions requiring that a Sustainability Strategy be prepared for the project to achieve a minimum “Excellent” “Design” and “As built” rating under the Infrastructure Sustainable Council of Australia infrastructure rating tool.

The precautionary principle is applied throughout the EIS and the Department considers the assessment and the range of mitigation measures adequately adopt this principle. The Department notes that the project has been designed to meet the needs of both the current and future generations with a design life of approximately 100 years, to increase the resilience and capacity of the road network to cater for population growth. In relation to the conservation of biological diversity and ecological integrity, the design of the project has sought to identify, avoid, minimise and mitigate ecological impacts.

The Department is satisfied that the valuation and pricing of the environmental resources associated with the project have been adequately undertaken and internalised through the project design and mitigation measures. The Department also notes that the detailed design stage of the project will further refine the design and associated measures.

4.4 Biodiversity Development Assessment Report

Section 7.9(2) of the *Biodiversity Conservation Act 2016* (BC Act) requires all SSI applications to be accompanied by a Biodiversity Development Assessment Report (BDAR) unless the Planning Agency Head and the Environment Agency Head determine that the proposed development is not likely to have any significant impact on biodiversity values.

A BDAR was prepared for the project. The majority of the project footprint and surrounding area is highly urbanised, disturbed and in poor ecological condition. Approximately 7.3 hectares of vegetation will be cleared, comprising native plantings, planted medians, non-native species and weeds. No significant impact would occur to any threatened flora species or any threatened ecological communities. No riparian vegetation would be removed, and no in-stream works would be undertaken.

The construction phase of the project may result in noise and vibration impacts on a known roosting site of the Large Bent-wing Bat within the coal loader tunnels at Waverton. The species is listed as vulnerable under the BC Act and the breeding habitat is identified as a potential serious and irreversible impact entity under the Biodiversity Assessment Method (BAM). Adaptive strategies would be developed to minimise potential adverse impacts.

No other threatened fauna species would be directly affected.

The Proponent has committed to a number of management measures during the construction phase to manage indirect impacts on threatened marine species in Sydney Harbour including marine mammals and their habitats.

Further assessment of biodiversity is provided in **Section 6.7.**

4.5 Other approvals

The construction of the project is subject to an environment protection licence (EPL) issued by the Environment Protection Authority (EPA) under the *Protection of the Environment Operations Act 1997*. Operation of the proposed ventilation outlets is also subject to an EPL.

Other approvals that may be necessary to carry out the project, include:

- a Sea Dumping Permit under the Commonwealth's *Environment Protection (Sea Dumping) Act 1981* for the disposal of uncontaminated dredged spoil and tunnel spoil to the designated offshore disposal site located in Commonwealth waters. Offshore sea disposal would be undertaken outside of NSW and therefore the Proponent would seek the required permit separately
- an approval from the Secretary of the Commonwealth Department of Infrastructure, Transport, Cities and Regional Development under the *Airports Act 1996* to allow the plume from the ventilation outlet and motorway facilities at the Rozelle Interchange and Warringah Freeway to penetrate "prescribed airspace", which includes part of either an obstruction limitation surface (OLS) or procedures for air navigations systems operations (PANS-OPS) surface for Sydney Airport.

5 Engagement

5.1 Department's engagement

Under section 5.28(1)(c) of the EP&A Act, the Planning Secretary is required to make the EIS publicly available. The EIS was made publicly available from Wednesday 29 January 2020 until Monday 30 March 2020 (62 days) on the Department's website and electronically at NSW Service Centres. Hard copies of the EIS were exhibited at the following locations:

- Nature Conservation Council – Level 14, 338 Pitt Street, Sydney (electronically only on USB)
- Transport for NSW – 20-44 Ennis Road, Milsons Point
- Balmain Library – 370 Darling Street, Balmain
- Leichhardt Library – 23 Norton Street, Leichhardt
- Leichhardt Customer Service Centre – 7-15 Wetherill Street, Leichhardt
- North Sydney Council – 200 Miller Street, North Sydney
- Stanton Library – 234 Miller Street, North Sydney
- Chatswood Library – 409 Victoria Avenue, Chatswood
- Willoughby City Council – Level 4, 31 Victor Street, Chatswood
- Department of Planning, Industry and Environment – 12 Darcy Street, Parramatta.

The Department advertised the EIS public exhibition in the Sydney Morning Herald, The Daily Telegraph, Inner West Times, Mosman Daily and North Shore Times, and notified State and local government authorities of the exhibition.

The Department undertook site inspections on 31 May 2018, 17 January 2020 and 27 August 2020 of the proposed alignment, to obtain a comprehensive understanding of the surrounding environment, its sensitivities and issues raised in submissions.

Representatives from the Department also attended community information sessions held by the Proponent during the exhibition period to provide information on the planning process and attended council briefings. Issues raised with Department staff during this community consultation included air quality and health impacts from unfiltered ventilation outlets; traffic impacts during construction and operation; noise impacts during construction and the impacts on health from interrupted sleep; loss of parking; justification for the project; short duration of the exhibition period; construction fatigue concerns; loss of public open space; and length and complexity of the EIS.

The Department also met with the community, including a local community group and Cammeray Golf Club, North Sydney Council, Willoughby City Council and various State agencies during its assessment of the project.

Community engagement

North Sydney Council

Following receipt of the Response to Submissions, the Department met Council staff and discussed Council's comments on the project. The main discussion points included the delivery of the North Sydney Integrated Transport Plan (NSITP), enhancements to the active transport network, and provision of public open space.

Willoughby City Council

Following the receipt of the Response to Submissions, the Department met Council staff and discussed Council's comments on the project. The main discussion points included increased traffic volumes along Willoughby Road, and the need for enhanced active transport networks.

ANZAC Park Public School P&C

The Department met representatives of the Anzac Park Public School Parents and Citizens Association to address outstanding concerns on the project. Matters discussed included the Department's assessment process and the role of the Minister for Planning and Public Spaces as the approval authority.

The Department clarified air quality impacts relating to operational monitoring requirements; filtration of ventilation facilities and emissions requirements; construction noise management and the potential role of an Independent Acoustic Advisor (AA) who would review and assist with scheduling construction activities; provision of appropriate mitigation and provide advice to the community; and local traffic impacts, including the delivery of the North Sydney Integrated Transport Plan.

Cammeray Golf Club

The Department met with representatives of the Cammeray Golf Club to learn about the impacts to the club as result of the project. The club advised that it members would no longer be eligible for a Golf Australia handicap due to the project permanently reducing the length of the course below minimum standards. As result the club is investigating a future master planning process.

5.2 Summary of submissions

During the exhibition period, the Department received a total of 1454 submissions from 1082 individual submitters (not including late submissions provided to the Proponent for consideration following the conclusion of the exhibition period). Of the submitters, 13 were NSW Government agencies, five were local council, 48 were interest groups, and 1016 were community members (a number made more than one submission). A summary of the submissions is provided in **Table 3** and **Table 4**, and a link to the full copy of the submissions is provided in **Appendix C**.

Table 3 | Summary of Government Agency Submissions

Submitter	Number	Position
Government Agencies		
Crown Lands	1	Advice
Department of Primary Industries (DPI) - Agriculture	1	Advice
Department of Planning, Industry & Environment (DPIE) – Water Group & NRAR	1	Advice
Environment, Energy & Sciences Group (EESG)	1	Advice
EPA	1	Advice
DPI Fisheries	1	Advice
Fire & Rescue NSW	1	Advice
Heritage Council of NSW	1	Advice

NSW Health	1	Advice
Port Authority of NSW	1	Advice
Office of the Chief Scientist & Engineer	1	Advice
Sydney Harbour Federation Trust	1	Advice
Sydney Water	1	Advice
Total Agency submissions	**13**	

Table 4 | Summary of Submissions from Individual Submitters

Submitter	Number	Position
Local council		
Inner West Council	1	Object
North Sydney Council	1	Object
Willoughby Council	1	Comment
City of Sydney Council	1	Object
Mosman Council	1	Comment
Special Interest Groups and Community Members		
	968	Object
	19	Support
	77	Comment
TOTAL	**1069**	

5.3 Key issues raised – Government Agencies

Office of the Chief Scientist and Engineer engaged two independent experts to review the EIS on its behalf. It was noted:

- Euro 6 emissions legislation is being adopted in Australia from 2021, however it is unclear when the adoption of this emission standard would occur. It is noted that with this assumption the in-tunnel emissions in 2017 and 2037 may be higher than presented in the EIS
- Given that the in-tunnel emissions will be subject to regulatory limits, the emissions increase would not affect the in-tunnel concentrations.

Environment Protection Authority (EPA) noted:

- that the EIS included significant detail on the mitigation options available to receivers that will experience adverse noise impacts from the operation of the project. However, the major design details that influence the overall noise levels at these receivers have been deferred to detailed design
- there was limited information provided in the EIS on the groundwater monitoring data, waste generation and disposal, and additional water quality assessment is required to assess water discharging from construction sites

- concerns regarding air quality modelling, including the meteorological data and sites used, that traffic flow rates for the 'regulatory worst case' scenario were not fully justified, and further analysis of elevated receptors is required
- modelling and transport of dissolved contaminants from dredged material needs to be undertaken.

NSW Health noted:

- sensitivity analysis presented in the EIS demonstrated that underestimation of expected traffic flows has the potential to underestimate future $PM_{2.5}$ levels
- TfNSW must demonstrate that the ventilation system has sufficient capacity to achieve the optimal environmental outcome in the event that there is more traffic than expected in the tunnels
- increasing the height of the ventilation outlets above the currently proposed heights should be considered, to help disperse pollutants
- regular monitoring and review of the success of dust suppression measures are vital to mitigate the impacts of construction dust on the local population
- there is emerging evidence of the health impacts from environmental noise
- there is limited detailed information regarding the construction noise exceedances and proposed mitigation measures, and as such it is not possible to comment on these.

Environment, Energy and Sciences Group (EESG):

- raised concerns regarding potential flood impacts on other properties, and the potential that the project could flood Sydney Harbour Tunnel portals
- suggested that pre-clearing surveys for micro-bats be undertaken for all buildings and structures to be demolished or refurbished that have the potential for roosting habitat
- noted potential impacts on the Large Bent-winged Bat (*Miniopterus orianae oceasesis*) as a result of tunnelling under the Coal Loader site at Waverton, an important winter roosting site for the bats
- noted that there is an inconsistency in the depth of the tunnels under the Coal Loader in the EIS and BDAR. This should be clarified, along with the predicted ground-borne noise considered in the BDAR
- sought clarification on whether the dam within the Cammeray Golf Course is potential habitat for native fauna
- supports the removal of invasive species, though it requested the Response to Submissions detail the number of trees impacted by the project and be broken down into local native species; non-local native species; invasive / weed species; and exotic species.

Heritage NSW commented that the:

- project would directly impact four State Heritage Register (SHR) listed items: The Sydney Harbour Bridge approaches and viaducts; Milsons Point Railway Station group; St Leonards Park; and North Sydney Sewer Vent
- project has potential to indirectly impact another four SHR listed items: Glebe Island Bridge; Railway Electricity tunnel under Sydney Harbour; Tarella (house) 3 Amherst St Cammeray; and Raywell (house) 144 Louisa Road Birchgrove
- the project would directly and indirectly impact on two SHR nominated sites: Yurulbin Park in Birchgrove and the Balls Head Coal Loader Complex in Waverton

Port Authority of NSW provided the following comments raising concern regarding:

- the traffic generation at White Bay and the impact it may have on Port operations, particularly given the discrepancy noted between the Proponent's modelling and some recent traffic counts undertaken by the Authority
- the EIS not presenting sufficient information regarding the extent and significance of contaminated material to be handled at WHT3 (White Bay)
- the potential impacts to nearby residential receivers and Port activities from the handling of contaminated materials at WHT3 (e.g. odour), does not assess $PM_{2.5}$ impacts or cumulative impacts from other projects within White Bay
- requested additional information on the maritime movements between White Bay and the two coffer dam sites, and additional information on the potential groundwater drawdown around Glebe Island and White Bay.

DPIE Water Group and NRAR: raised concerns about the hydrogeological modelling and requested additional geological cross sections and long sections of the tunnel be provided, along with a schematic of the hydrogeological model for several locations along the alignment.

Sydney Harbour Federation Trust: commented that access must be maintained to all sites the Trust manages across Sydney Harbour, and that the Trust be informed regarding works that may impact on these sites.

DPI Fisheries: raised concerns that the project impacts on the endangered Whites Seahorse, the vulnerable Black Rock Cod and seagrass beds need to be mitigated. This should be done prior to and during construction, ensuring that species are removed from construction sites and relocated to suitable alternative habitat nearby.

Sydney Water provided the following comments:

- need to protect, monitor and have continual access to and use of Sydney Water assets during construction and operation, and requested they be consulted during detailed design to ensure Sydney Water can maintain services to its customers
- raised concern over the potential impact on assets, and that the project may restrict the ability of Sydney Water to provide future flood mitigation services
- requested clarification on the potential impact to the structural integrity of its assets as a result of groundwater drawdown
- advised that Sydney Water's stormwater quality targets would apply when a connection to its asset is required.

DPI Agriculture, Fire & Rescue NSW and **Crown Lands** made no comments on the project.

5.4 Key issues raised – local councils

Inner West Council provided the following comments:

- noted in its submission that only a small portion of the project is within its Local Government Area (LGA), and limited its submission to impacts within the LGA

- raised a number of concerns relating to the proposed construction site in Yurulbin Point, including impacts from workers parking along Louisa Road and at Birchgrove Oval; loss of open space and trees; impacts to the ferry service from Yurulbin Point, and that options to move the ferry stop should occur prior to any works commencing; barge movements and the risks involved in the construction of the cofferdams; and cultural heritage impacts
- raised objections relating to the use of the former Balmain Leagues Club site as a dive site and the use of White Bay/Glebe Island by multiple government and other projects. These objections include: the amenity impacts to adjacent homes, shops and schools; delays to the redevelopment of the 'Tigers' site; and cumulative road safety and congestion impacts on Victoria Road and City West Link from WestConnex, the project and other projects in Rozelle
- raised concerns about dredging and handling of contaminated material from the harbour floor
- all workers at the Yurulbin Point site must use public transport or be ferried to/from the site from White Bay
- the ventilation outlets must be filtered
- requested that the NSW Government develop an integrated master plan for the White Bay/Glebe Island site
- council is supportive of the Cumulative Traffic Working Group established to oversee and coordinate cumulative growth of construction traffic in the area, and requests its inclusion on the working group.

North Sydney Council: objects to the project, and provided the following comments:

- raised concern regarding traffic impacts around North Sydney, and stated that the project is inconsistent with Council's plans for Berry Street
- raised concern that the proposed works would funnel traffic along the Pacific Highway, instead of the current split of traffic down both the Pacific Highway and Falcon Street
- the project would result in congested local roads and increase congestion through the North Sydney CBD, which would make it difficult for Council to 'pedestrianise' parts of the CBD as outlined in the North Sydney CBD Transport Masterplan (2018)
- scope of the project should be revised to include the delivery of the North Sydney Integrated Transport Plan
- objected to the permanent loss of 73 parking spaces along Alfred Street North, and to construction impacts on residents of Alfred Street North and surrounding streets
- objected to both the temporary and permanent loss of open space within the LGA
- requested that the roof of the Motorway Operational Centre in Cammeray Golf Course be a green roof, providing a green connection across the Warringah Freeway from the construction of a land bridge linking Cammeray Golf Course and ANZAC Park, and another land bridge connecting ANZAC Park with Jefferson Jackson Reserve
- requested to lead the design of the community open space for the Berrys Bay site following construction, and requested a replacement path linking Carradah Park and Balls Head Road be provided prior to construction, to ensure access to open space during construction
- objected to the loss of its stormwater harvesting facility located within the Cammeray Golf Course, and stated that consideration should be given to reducing the amount of potable water being used, and that the project should use more non-potable water sources over potable water sources
- raised concerns relating to heritage impacts at Berrys Bay and Whale Rock

- raised concerns relating to dredging of Sydney Harbour and potential impacts to heritage items and environmental impacts from dredging contaminated material
- raised concerns relating to the unfiltered ventilation outlets, stating they should be filtered
- the project should deliver new walking or cycling infrastructure, not just replace what is impacted by the project
- visual representations of the final structures are either from a distance or obscured and do not give a true representation on the size, scale and design of the structures.

Willoughby City Council: provided the following comments:

- notes the project prioritises cars over other forms of public transport and active transport
- noted the relationship between the project and the proposed Beaches Link project, which is yet to be publicly exhibited, and stated that no aspect of the Beaches Link project should be permitted without it first being exhibited and assessed
- raised concerns regarding construction traffic impacts; construction noise impacts; noise abatement programs should be extended to include properties within the Willoughby LGA; impacts and conflicts with school children and construction traffic; health impacts from construction dust and from the unfiltered ventilation outlets
- raised concerns regarding operational impacts of the project, including: limited operational performance improvements as a result of the project; a number of intersections perform at a lower standard in the 'Do Something' option when compared to the 'Do Minimum' option; the option to convert transit lanes along the Gore Hill Freeway to regular lanes (which downgrades the road performance, as the transit lanes provide public transport priority over single occupant vehicle movements); the project would lead to other roads being used to access the tunnel portals, leading to 'rat-running' and lowering road safety along those streets
- objected to the loss of public open space
- requested the project provide a reliable and safe road based public transport link between the Gore Hill Freeway and the Sydney CBD; provide a connected, reliable and safe bicycle transport link between the Gore Hill Freeway and Milsons Point; and provide a connected, reliable and safe pedestrian link across the Gore Hill Freeway / Warringah Freeway at Naremburn.

City of Sydney: objected to the project and provided the following comments:

- continued to object to tolled motorway projects, where the investment is on private vehicle rather than promoting investment in public transport
- disputes the veracity of the benefits attributed to the project, particularly the travel time savings as a result of bypassing the Sydney CBD
- to unlock any benefits from WestConnex, there should be development of a road network logic that focusses on creating a bypass for traffic around (or under) the city via a motorway network; prioritising and improving public transport access and active transport to the city; and reallocating road space to public and active transport modes.

Mosman Council: stated that while it does not object to the project, both the project and the proposed Beaches Link project should be assessed together in order to achieve the cumulative environmental benefits predicted. Council commented:

- the EIS does not contain the means to return streets to local communities

- considered that the Ernest Street ramps should remain, as their removal would impact Mosman residents
- raised concerns on the effect of emissions from the tunnel's ventilation outlets on the health and wellbeing of the surrounding community.

5.5 Key issues raised – community, special interest groups and organisations

The Department received submissions from 1020 individual community members and 48 interest groups, including local schools, parent and citizens group, precinct groups, owners' corporations, Bicycle NSW, Bike North, WestProtects and community groups. Some community members and groups made more than one submission.

The submissions covered a range of issues and the main issues are summarised below by theme.

Traffic and transport

Construction impacts

- large volumes of heavy and light vehicles on local and arterial roads, impacting on residents accessing properties
- changes to access and egress points for local communities, from the location of construction ancillary sites
- 'rat-running' by locals and visitors trying to access properties or other locations while avoiding construction ancillary sites
- concerns for the safety of school children with the large volumes of construction traffic, as several schools do not have convenient signalised crossings
- concern for the loss of parking as construction workers would park on local streets. The project needs to provide car parking for all workers, and a shuttle bus or similar service should be provided to get workers to the construction ancillary sites
- temporary closure of Birchgrove Wharf and no alternatives have been committed to, only a commitment to 'investigate' alternatives, and no additional bus services are proposed to be added during the temporary closure
- the number of construction ancillary sites required should be reconsidered to reduce traffic impacts on local communities.

Operational impacts

- unacceptable changes of access to and from the Sydney Harbour Bridge and Sydney Harbour Tunnel, resulting in rat-runs
- potential for two-way tolling on Sydney Harbour Bridge and Sydney Harbour Tunnel
- permanent removal of car parking spaces along several streets including Alfred Street North
- elevated bus lane on eastern side of the Warringah Freeway brings buses closer to properties
- North Sydney Council plans to 'pedestrianise' parts of the North Sydney CBD, however the project is in direct conflict with this by the creation of major access roads to the Western Harbour Tunnel through the middle of the North Sydney CBD
- new Victoria Cross Metro Station will have thousands of passengers accessing and exiting the station at the Miller Street / Berry Street intersection. This will impact on the functionality

of Berry Street as a main access point to the Western Harbour Tunnel, which will in turn create a potential conflict between pedestrians and vehicles
- only minimal positive impact to traffic, the travel time saving of a few minutes does not justify the impact
- number of intersections in the North Sydney area that deteriorate to a Level of Service (LoS) F as a result of the project, including key major intersections
- rerouting of the B-line buses into North Sydney, instead of across the harbour into the Sydney CBD will further impact on traffic flows in the North Sydney CBD. The project should provide an underground loop road for buses.

Noise and vibration

Construction impacts

- Warringah Freeway will require most work to be undertaken outside standard construction hours, with significant impacts to residents adjacent to the freeway
- noise abatement should be provided for schools impacted by construction noise, and no construction carried out during exam periods
- construction noise travelling across water (Snails Bay, Berrys Bay) will impact on properties not identified to be noise impacted, as noise from small residential projects travels across the water
- noise and vibration impact from pile driving activities associated with the coffer dams will impact on nearby properties
- construction traffic noise, particularly in residential areas, will impact residents
- number of construction ancillary sites required is excessive, and should be reduced to reduce noise impacts to nearby properties
- impacts to properties from vibration and associated settlement from tunnelling.

Operational impacts

- requests for more noise walls, in different locations, and changes in height and type of the noise walls to better protect residents from noise
- acoustic treatments should be for all impacted properties, why are some buildings not getting it when they have the same noise levels
- increases in operational traffic noise, particularly from the expanded Warringah Freeway and the elevated bus lane; the bus lane should use ‘quiet pavement’ and have opaque noise walls installed along its eastern side.

Air quality

Construction impacts

- dust impacts during construction, potentially toxic waste and silica being disturbed during construction
- dust suppression measures are not 100% effective, what will be the long-term health impacts to those exposed
- impacts to children’s health from trucks idling outside of schools
- odour impacts from the handling of dredged contaminated sediments at White Bay
- no spoil should be stockpiled outside of acoustic sheds, all material should be handled inside the sheds.

Operational impacts

- ventilation outlets must be filtered, many other countries around the world filter tunnels, if filtration does not happen or is not able to be retrofitted, diesel vehicles should be banned from using the tunnels, as other countries do
- impacts to people, particularly children and the elderly from unfiltered ventilation outlets
- use of the EURO 6 in the modelling, when the Australian Government has not adopted that standard. As a result, the modelling is underpredicting the actual air quality impacts
- assessment of air quality should include the proposed Beaches Link tunnel as it will also be emitted through the ventilation outlet in Cammeray
- the National Environment Protection (Ambient Air Quality) Measure (NEPM) criterion for fine particulate matter ($PM_{2.5}$) (annual) is being lowered from 8µg/m^3 to 7µg/m^3 by 2025. This new criterion comes into force prior to the tunnel opening, so the modelling using 8µg/m^3 is misleading
- tunnels should be closed when the air quality index (AQI) reaches hazardous level (AQI 200), which occurred over several days during the 2019-2020 bushfires
- monitoring of ambient air quality should commence prior to construction, rather than 12 months prior to operation, as this may result in the base data not being reflective of actual conditions
- there must be more than two years of monitoring of the ventilation outlets once the tunnels are operational.

Public open space

- no loss of public open space, rather there should be an increase in public open space
- project should provide multiple land bridges across the Warringah Freeway, reconnecting the North Sydney area, and a land bridge connecting Cammeray Golf Course with ANZAC Park
- temporary loss of access to Yurulbin Park, Berrys Bay and other parks during construction is not acceptable
- questions were raised about the condition and final design of the parks post construction
- all trees that are removed must be replaced with mature trees and not seedlings
- project facilities in Cammeray Golf Course should be underground to provide the community with more open space.

Tunnel depth

- impacts to properties from vibration, particularly around Balmain/Birchgrove and Waverton, where there are older properties on shallow or no foundations
- tunnel depths should be measured from the roof of the tunnel and not the surface of the road
- WestConnex tunnel depths became much shallower during construction. Therefore, the community has no confidence that the depths of the Western Harbour Tunnels will remain as described in the EIS
- concern regarding impacts to older properties along Louisa Road, Birchgrove and that there are properties below road level that will be impacted by the tunnel
- width of 50m limit for dilapidation surveys is too narrow, it should be increased to up to 300m either side of the tunnels. This ensures that all properties impacted by the tunnelling are assessed, as many properties further away from the WestConnex tunnels were impacted by tunnelling

- Commitment that the project or Government will rectify all damage caused by tunnelling.

Dredging

- impacts on air quality and odour of dredging contaminated material from the harbour, and the treatment of the contaminated material at White Bay on nearby residents
- alternatives to using immersed tubes must be considered, including constructing under the harbour, which would mean that the harbour bed would not require dredging, and the contaminated material can stay in place
- by discounting boring, TfNSW is putting driver amenity above environmental impacts without a cost / benefit analysis
- Sydney Metro discounted impacts to the harbour bed due to environmental concerns
- the report outlining the levels of contaminants in the harbour bed has not been published as it is 'commercial in confidence', therefore the community cannot review and comment on the impacts that dredging may have on the environment and on people
- negative impacts to marine species from dredging, including from the dredge plume, potential boat strike and being caught in the cofferdams
- impacts to human health from the dredging of contaminated material, impacts to humans from contact with the water, from swimming in the Dawn Fraser pool or from sailing boat races
- use of full depth silt curtains deemed not appropriate due to tidal currents and boat movements, why are the shallower depth curtains appropriate.

Heritage impacts

- impacts to heritage listed items including houses, Yurulbin Point, the Coal Loader and St Leonards Park
- impacts to Whale Rock and other Aboriginal cultural heritage sites yet to be assessed
- requirement for specific vibration criteria to protect heritage items.

Justification and procedure

- no published Business Case for the project, and it is low on the Infrastructure NSW priority list
- no published cost estimates
- Beaches Link and Gore Hill Freeway Connection is not included in Western Harbour Tunnel EIS. These two projects should be assessed as one project, to fully understand the true impact to communities
- calls for the suspension of the exhibition during COVID-19 and that all submissions received be included when the project is re-exhibited after the COVID-19 crisis
- communication engagement sessions were cancelled, and the community could not engage with each other due to social distancing requirements
- no real assessment of alternatives to the project such as public transport
- impact to property values
- use of out of date data that does not consider the B-line bus service, or the Sydney Metro City and Southwest being operational prior to the operation of the tunnels
- use of incorrect data when considering the number of children attending schools in the LGA, states 100 when the schools have close to or in excess of 1000 pupils each.

Climate change and sustainability

- use of potable water in a time of drought is irresponsible
- increase in CO_2 emissions as a result of the project, is not sustainable and does not align with the NSW Government's commitment to reducing greenhouse gas emissions
- the government should be considering mass transport solutions that produce less CO_2 emissions, and are more effective at moving large volumes of people
- consideration of more remote working would mean that this project is no longer required.

A number of community submissions raised issues associated with construction impacts on Flat Rock Gully and Flat Rock Creek. These issues relate to the Beaches Link and Gore Hill Freeway project and are out of scope of this assessment.

A breakdown of the issues raised in community submissions is illustrated in **Figure 19**. Matters related to project funding and tolling are outside the scope of this assessment.

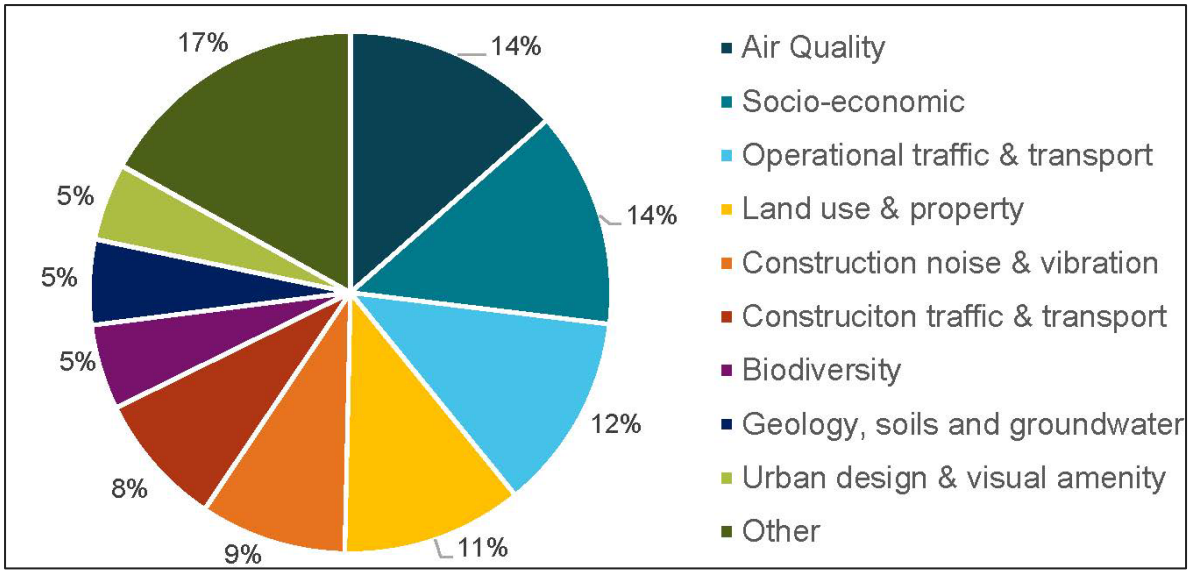


Figure 19 | Types of environmental issues raised in community submissions (Source: RtS)

5.6 Response to submissions

Following completion of the public exhibition period, the Department directed the Proponent to prepare a response to the submissions received. The Proponent's Response to Submission (RtS) report (**Appendix D**) was made publicly available on the Department's website on 15 September 2020 and forwarded to the relevant agencies and councils for comment.

The Proponent made a number of refinements to the project, including:

- a commitment to providing a replacement service for commuters impacted by the temporary closure of Birchgrove Ferry Wharf during construction. Temporary closure of the wharf will not occur until the replacement service is operational
- a commitment to relocate the historic vessels *M.V Cape Don* and *Baragoola,* currently moored at Balls Head, to a suitable alternative berthing nearby before the commencement of construction, in consultation with the vessel owners and associated community groups
- subject to a timely agreement between Cammeray Golf Club and North Sydney Council regarding a suitable alternate location, the Proponent would install a new permanent

replacement stormwater storage dam (and associated infrastructure) within the golf course, prior to decommissioning the existing dam

- discharge from wastewater treatment plants will be required to meet relevant discharge criteria, including the:
  - relevant physical and chemical stressors set out in ANZECC/ARMCANZ 2000;
  - ANZG (2018) 90 per cent species protection levels for toxicants generally with the exception of those toxicants known to bioaccumulate, which will be treated to meet the ANZG (2018) 95 per cent species protection levels
  - draft ANZG default guideline values for iron (in fresh and marine water) and zinc (in marine water) which are likely to be finalized in October 2020.
- commitment to investigate, during detailed design, opportunities to reduce or offset the permanent loss of long stay parking spaces along Alfred Street North, Neutral Bay.

In addition, the RtS stated that the project is proposed to be staged to limit concurrent activities and contribute to an earlier completion date, as follows:

- Stage 1 – Early and enabling works:
  - critical utility installation, relocation and protection
  - Cammeray Golf Course reconfiguration adjustment works
  - Cammeray dam water harvesting scheme
  - relocation of the historic vessels *M. V Don* and *Baragoola.*
- Stage 2 – Warringah Freeway Upgrade project
- Stage 3 – Western Harbour Tunnel project.

Stage 1 is proposed to commence before construction of the main works (Stage 2 and 3).

Submissions received after the closure of exhibition, for example from the Australian Institute of Landscape Architects, while not addressed in the Response to Submissions Report, have been considered by the Department in its assessment of the project.

6 Assessment

The Department, in its assessment of the project including submissions received, identified the key issues as traffic and transport, noise and vibration, air quality, place and urban design, groundwater and settlement, and non-Aboriginal heritage (**Sections 6.1 to 6.6** respectively). Other issues considered are discussed in **Section 6.7**.

6.1 Traffic and transport

The traffic and transport outcomes for this project focus the largest improvements to private vehicles at a regional level and on key arterial routes, such as existing harbour crossings (including Sydney Harbour Bridge, Sydney Harbour Tunnel and Anzac Bridge). There would be adverse local traffic impacts, particularly at North Sydney. There are some direct public transport initiatives, such as bus lanes, but these are limited with the stated broader public transport improvements in the EIS not forming part of the project. The Department has recommended conditions to ensure local traffic impacts are subject to further review and refinement, and initiatives are identified to ensure that bus travel times are not eroded over time.

Construction traffic impacts are considered to be manageable; however, the Department is concerned with the limited consideration of parking impacts during construction and operation and has recommended conditions to address this matter.

Overview

The Western Harbour Tunnel would provide a new underground motorway connection between the WestConnex M4-M5 Link (Rozelle Interchange) at Rozelle and the existing Warringah Freeway at North Sydney. This provides an additional north-south traffic corridor and increased road capacity across Sydney Harbour to reduce congestion on existing crossings, particularly the Sydney Harbour Bridge and Sydney Harbour Tunnel. Together with the upgrade of the Warringah Freeway, the project aims to reduce travel times, increase reliability, connectivity and accessibility, and improve road network safety.

A multi-tiered traffic modelling approach was adopted, using the Sydney Strategic Travel Model, Sydney Motorway Planning Model, microsimulation traffic models for Rozelle, Warringah Freeway, Gore Hill Freeway, and intersection models in each area to outline potential changes in travel patterns and to estimate the performance of the road network under different scenarios. Scenarios included assumptions on land use change, introduction of transport infrastructure, induced traffic, road tolls and traffic impacts with and without the project. The modelled scenarios are outlined in **Table 5**.

An independent traffic consultant (Bitzios Consulting) was engaged to assist the Department in undertaking a technical review of the Proponent's traffic and transport assessment. The review report is provided in **Appendix F**.

Table 5 | Modelled traffic scenarios (Source: EIS)

Scenario	Description	2016	2027	2037
Base year	Traffic model scenario for calibration purposes and quantification of existing network performance.	x		
"Do minimum"	Traffic model scenario with approved and under construction motorway projects (NorthConnex and WestConnex) but without Western Harbour Tunnel and Warringah Freeway Upgrade, Beaches Link and Gore Hill Freeway Connection, Sydney Gateway and M6 Extension (Stage 1) projects. Also reflects operational effects of approved and under construction major public transport projects (Sydney Metro City and Southwest).		x	x
"Do something"	Traffic model scenario with NorthConnex, WestConnex, Western Harbour Tunnel and Warringah Freeway Upgrade projects but without Beaches Link and Gore Hill Freeway Connection, Sydney Gateway and M6 Extension (Stage 1) projects. Also includes Sydney Metro City and Southwest.		x	x
"Do something cumulative"	Traffic model scenario with NorthConnex, WestConnex, Western Harbour Tunnel and Warringah Freeway Upgrade, Beaches Link and Gore Hill Freeway Connection, Sydney Gateway and M6 Extension (Stage 1) projects. Also includes Sydney Metro City and Southwest.		x	x

The project area includes some of the busiest roads in Sydney with significant congestion during peak periods or as a result of incidents

The Proponent's traffic assessment focused on future year traffic (2027 year of opening, and 2037 ten years later) to assess the performance of the road network with the implementation of the project, particularly traffic conditions around Rozelle, Warringah Freeway and Gore Hill Freeway/Artarmon. The assessment of existing road network conditions was based on the following:

- network performance based on overall traffic flows and congestion
- travel times based on average speeds along key routes
- intersection performance based on level of service (LoS)
- road safety and crash history based on crash data collected over the last five years.

Peak hour traffic volumes for locations in these specific areas are outlined in **Table 6**.

Table 6 | Year 2016 peak hour traffic volumes (Source: EIS)

Road	Direction	Morning peak hour		Evening peak hour	
		Volume (vehicles)	Heavy vehicles (%)	Volume (vehicles)	Heavy vehicles (%)
Rozelle and surrounds					
City West Link west of The Cres.	Eastbound Westbound	2630 1660	4% 7%	2350 2140	3% 6%
James Craig Road south of The Cres.	Eastbound Westbound	260 140	5% 5%	120 140	3% 3%
The Crescent west of Victoria Rd	Eastbound Westbound	3590 2390	5% 6%	2950 3090	3% 5%

Victoria Rd north of The Cres.	Northbound Southbound	2090 4060	6% 6%	3710 2930	5% 5%
Warringah Freeway and surrounds					
Pacific Hwy south of Walker St	Northbound Southbound	2100 380	4% 13%	1410 580	11% 6%
Pacific Hwy south of Bay Rd	Northbound Southbound	690 1100	8% 7%	800 950	7% 3%
Berry St east of Walker St	Eastbound Westbound	1650 -	7% -	2390 -	4% -
Falcon St east of Miller St	Eastbound Westbound	1250 1170	2% 6%	1350 1110	6% 5%
Miller St north of Ernest S	Northbound Southbound	470 1050	6% 4%	730 1060	8% 3%
Ernest St east of Miller St	Eastbound Westbound	1070 1050	4% 1%	1380 870	4% 2%
Ernest St west of Merlin St	Eastbound Westbound	650 2070	3% 1%	2000 990	1% 1%
Arthur St north of Pacific Hwy	Northbound Southbound	800 -	2% -	610 -	1% -
Alfred St north of Mount St	Northbound Southbound	40 1420	9% 1%	30 730	0% 3%
Falcon St west of Merlin St	Eastbound Westbound	2330 3140	7% 6%	2910 2110	5% 8%
Walker St north of Pacific Hwy	Northbound Southbound	830 290	3% 2%	650 360	2% 3%
Brook St south of Merrenburn Ave	Northbound Southbound	720 2070	9% 2%	1660 1020	2% 6%
Gore Hill Freeway and surrounds					
Reserve Rd north of Dickson Ave	Northbound Southbound	520 1210	8% 3%	1140 610	1% 2%
Reserve Rd north of Frederick St	Northbound Southbound	320 690	10% 3%	670 490	3% 1%
Frederick St east of Reserve Rd	Eastbound Westbound	440 360	5% 8%	560 420	1% 5%
Herbert St north of Frederick St	Northbound Southbound	250 530	3% 3%	440 500	1% 2%
Reserve Rd south of Barton Rd	Northbound Southbound	350 470	3% 2%	640 410	1% 1%

The City West Link and Victoria Road through Rozelle are two of the busiest corridors in Sydney. They provide the main access to and from the Sydney CBD for people travelling and working in Sydney's West, Inner West and Lower North Shore, many of whom use ANZAC Bridge, Western Distributor and the Sydney Harbour Bridge. Congestion and delays on these corridors are common during peak periods, with delays experienced due to capacity constraints, particular at intersections.

The Warringah Freeway is the busiest section of motorway in NSW, providing access to and from the Sydney CBD, southern Sydney, Inner West, Northern Beaches and North Shore, and carries high

traffic volumes at all times of the day. Congestion and delays are highest during the morning peak period with queues often extending as far north as Miller Street. Queuing and congestion are also experienced on Berry Street, Mount Street, High Street and the Pacific Highway from traffic attempting to access the freeway.

The Gore Hill Freeway connects the M2 Motorway corridor with the M1 Motorway corridor through Artarmon and Willoughby and carries high volumes of traffic throughout the day with the highest volumes heading southbound in the morning peak and northbound in the evening peak to and from the Warringah Freeway.

A LoS assessment was undertaken for key intersections, with LoS A representing optimum conditions and LoS F the worst. The 2016 LoS performance for 29 key intersections is provided in **Appendix G, Table G1**. The intersection performance results show that within the Rozelle area, most intersections along Victoria Road and City West Link experience a poor LoS particularly during peak hour as a result of high through traffic volumes and cross-street traffic, and many are close to capacity.

Similarly, a number of intersections near the Warringah Freeway operate poorly, particularly Mount Street/Arthur Street and Clark Road/High Street which provide primary access to the freeway and Sydney Harbour Bridge. Further west, the intersection of Epping Road/Longueville Road/Parklands Avenue at Lane Cove performs poorly during peak traffic periods due to its limited capacity from high eastbound traffic volumes that conflict with right turn traffic from Longueville Road heading towards the freeway. These delays are compounded by buses that stop at the Lane Cove Interchange, blocking traffic from turning into Longueville Road.

Vehicles travelling in the same direction accounted for the most common crash type along all three corridors.

There are extensive harbour maritime activities in the project area

The maritime footprint adopted for the assessment included:

- Outer Sydney Harbour – wide waterway between Sydney Heads, Sydney Opera House at Bennelong Point and Admiralty House at Kirribilli Point
- Inner Sydney Harbour – high traffic area between Outer Sydney Harbour, Yurulbin Point and Manns Point, including Circular Quay, Darling Harbour and the Bays Precinct/White Bay
- Parramatta River and Lane Cove River – rivers that extend upstream of Yurulbin Point and merge at Greenwich Point.

Ferry services are provided from wharves in the harbour and Captain Cook Cruises operates a Lane Cove to City service Monday to Friday, stopping at Birchgrove Ferry Wharf during the private school term. Commercial operations are mainly confined to the Bays Precinct or nearby Darling Harbour and Balmain, and includes commercial adventure vessels, water taxis and cruise ships. There are two cruise passenger terminals, the Overseas Passenger Terminal at Circular Quay and the White Bay Cruise Terminal which caters for ships that can pass under the Sydney Harbour Bridge.

The harbour also caters for charter companies and various recreational water activities. Being a working harbour, it includes a fuel terminal at Gore Cove and common user berths located near the project where refuelling activities, servicing marine construction, emergency and planned maintenance, and facilitating harbour events and functions occur.

6.1.1 Construction

Issue

Impacts to road performance during construction are relatively limited for a project this complex

Construction works associated with the project will create congestion on the surrounding road network through the introduction of additional heavy and light construction vehicles. Impacts on intersection and midblock performance is relatively limited for a project of this scale, with Level of Service (LoS) being maintained or reduced by one grade when compared to the base case (without construction vehicles). In relation to mid-block (between traffic lights) performance, traffic demand is forecast to be at or above capacity (LoS F) on City West Link (both directions) during both peaks, The Crescent west of Victoria Road in both directions during both peaks, Victoria Road north of The Crescent northbound in the evening peak, and on Victoria Road north of The Crescent southbound in the morning peak.

North of the harbour, all intersections and interchanges would operate at the same level of service as the base scenario and the mid-block traffic performance on key roads is considered acceptable

Nineteen construction ancillary sites were assessed in the EIS (**Figure 12)**, as well as a harbour mooring site off Yurulbin Point. Temporary, partial or complete road closures of local streets would be required for each construction ancillary site with access predominantly from arterial roads, rather than local roads. Access routes, and forecast daily peak light and heavy vehicle movements for each construction ancillary site, is detailed in **Appendix G, Table G2**.

Construction parking will be provided at a limited number of construction ancillary sites with a shuttle bus transfer proposed from the White Bay site

While carparking for construction workers would be provided at some construction ancillary sites (WHT1, WHT3, WFU1 to WFU5, WFU to WFU9 and WHT7 to WHT10), details regarding the number of spaces were not provided in the EIS. The Proponent advises a car parking area would be provided at the White Bay construction ancillary site, and shuttle bus transfers between construction ancillary sites would occur. The construction workforce would also be encouraged to use public transport. The Proponent has committed to incorporating these measures into a construction traffic management plan.

Local road, access, and parking impacts will occur during construction

The Victoria Road/Wellington Street intersection would be modified to accommodate traffic movements generated from the Victoria Road construction ancillary site (WHT2), allowing vehicles to exit the site and travel southbound. The car park on Waterloo Street at Rozelle would be removed; however, because the car park has only been in operation for approximately two years, the Proponent consideres that local businesses would be able to adapt to this change.

The Yurulbin Park construction ancillary site (WHT4) would require the existing car park to be temporarily closed, resulting in the loss of five to six parking spaces. While there would be limited traffic movements to and from this site during peak construction, the Proponent stated that movements from this site are planned to occur primarily during site establishment and early works, a period of approximately 12 months.

The construction vehicle route for the Berrys Bay construction ancillary site (WHT7) comprises local roads, Bay Road and Balls Head Road. While tunnel spoil would be taken from the site by barge, 210

light and 55 heavy vehicle movements per day are anticipated on these roads to/from the Pacific Highway through Waverton.

Parking spaces would be removed to establish and operate construction ancillary sites for the tunnel and freeway upgrade north of the harbour. Twelve parking spaces would be removed from Ridge Street at its eastern end, 10 from Ernest Street to provide access to the Cammeray Golf Course construction site (WHT10 and WFU8), and up to 10 spaces removed for the Rosalind Street site (WFU9). In addition, works associated with the Ridge Street pedestrian bridge, Alfred Street North realignment and Mount Street interchange would result in the permanent removal of 73 long-stay parking spaces on Alfred Street North, including 47 spaces between Wyagdon and Ridge Streets and 49 spaces between Ridge Street and Whaling Road (23 of which would be replaced on completion of the works). Temporary long-term closure of sections of Alfred Street North would require access to properties to be maintained via existing U-turn facilities or alternatives routes.

Temporary closures of the Warringah Freeway will occur at night to limit traffic impacts

To ensure construction safety, full closure of the Warringah Freeway would be required for short periods for activities such as resheeting, installation of bridge spans and demolition of kerbs and medians. Short-term closures would generally occur at night, and impacts would be minimised through an extensive communication strategy to notify the community and motorists of the closures and detour routes. Generally, traffic would be directed to roads that form part of the regional and state road network, and have capacity to accommodate the additional volume. Traffic and demand management measures would be required to mitigate impacts, similar to those currently undertaken during scheduled maintenance works.

Impacts on maritime transport will be managed through replacement services, marine traffic management and engagement with the Port Authority of NSW and the Harbour Master

Temporary closure of the Birchgrove Ferry Wharf for 2.5 years and partial closure of the harbour between Birchgrove and Berrys Bay would impact ferry services, particularly the F3 Parramatta River route, the F8 Cockatoo Island route and the Lane Cove to City Captain Cook Cruises service. The Proponent has stated that a replacement service for commuters impacted by the temporary closure would be determined during construction planning, and closure of the existing wharf would not occur until a replacement service is operational. Ferries would still be able to travel through Birchgrove and Berrys Bay during partial harbour closure with speed restrictions imposed and/or movements carried out under escort. Partial harbour closures would be short term and carried out in consultation with the Port Authority NSW, Transport for NSW and other stakeholders including recreational users of the harbour and operators of large vessels such as oil tankers. Moorings located at Berrys Bay would require temporary relocation and consultation would occur with vessel owners.

Construction vessel movements would not interfere with port operations or navigation of seagoing ships and ferries, unless prior approval is obtained from the Harbour Master. Cruise liners, cargo ships and bulk carriers that berth at White Bay and Glebe Island would be informed of the scheduled works and use of White Bay as a construction ancillary site. The contractor would manage barge movements to ensure impacts are minimised. Impacts on other users, such as commercial fishing vessels, water taxis, charter companies and government organisations, would be related to a minor increase in travel time resulting from imposed speed restrictions. The Proponent has committed to the preparation of a Marine Works Management Plan and Marine Traffic Management Plan which would be approved by the Harbour Master prior to the commencement of construction.

Submissions

Community and interest group submissions

Key issues raised in public submissions regarding construction traffic included:

- construction worker parking on local roads
- concerns for safety of school children from increased heavy vehicle movements
- loss of parking due to construction and concern for the safety of pedestrians and cyclists in the vicinity of construction ancillary sites
- loss of foreshore access to Berrys Bay
- excessive heavy vehicle movements in local streets and narrow steep roads
- extended absence of ferry services from the temporary closure of Birchgrove Ferry wharf
- construction traffic to be limited to specific routes
- impact to recreational water activities.

Government agency and Council submissions

Port Authority of NSW raised concerns about the reliance on one day of traffic data to assess the James Craig Road/The Crescent intersection, due to wide variations in traffic generation that occurs based on the size of a cruise ship in port, the type of visit (turnaround, transit or part exchange) and the potential for both the White Bay Cruise Terminal and White Bay Berth 4 to be occupied by cruise ships at any one time. The Authority also noted it is unclear how the intersection would perform during the remainder of the Glebe Island/White Bay port precinct related peak, which is between 9.00 am and 12 noon, and noted discrepancies between intersection performance results provided in the EIS.

Inner West Council raised potential negative impacts from the relocation of the Birchgrove Ferry wharf; worker parking impacts in the vicinity of construction ancillary sites; increased truck movements along Victoria Road, Johnston and Booth Streets and associated traffic congestion leading to a deterioration of intersection performance; active transport impacts; worker parking pressures and removal of the existing car park at Rozelle; traffic diversions to local streets and rat-running; cumulative traffic impacts from other projects at or around White Bay and Glebe Island; and increased congestion and road safety impacts from heavy vehicle access via James Craig Road/The Crescent intersection and City West Link.

North Sydney Council highlighted the disruption and flow on traffic impacts that would occur during partial and full closure of the Warringah Freeway; the changes to parking conditions on Alfred Street North; active transport impacts; the increased construction traffic on local roads; and the projected cumulative construction traffic impacts on intersection performance which may result in traffic diversions or rat-running onto the local road network.

Mosman Council raised the closure of the Ernest Street ramp as a concern for traffic seeking to access Sydney Harbour Bridge; and the potential impacts to Mosman residents.

Willoughby City Council raised concerns including congestion; parking demand; road safety; and accessibility. Council considered there was a particular need to manage vulnerable road users including pedestrians and cyclists during construction activities from the adjustment/modification to a number of important connections along and across the Warringah Freeway; to manage time of day heavy vehicle access; reduced speed limits; information to stakeholders and the local community and multi-agency traffic and transport meetings.

Consideration

Route and volume restrictions will assist in managing local traffic impacts

The Department acknowledges there will be unavoidable traffic impacts during construction due to the scope and extensive nature of the works required and cumulative construction impacts with other major infrastructure projects, particularly around Rozelle. However, the expected impacts would be reduced as most construction ancillary sites have direct access to the arterial road network. The Department also notes that a Cumulative Traffic Working Group has been established with key stakeholders to manage traffic impacts from multiple projects that would occur around Rozelle/Glebe Island.

While the EIS identified access points to construction ancillary sites, the location of haulage routes was limited, and truck marshalling areas were not defined. The Department recommends a number of conditions requiring additional construction vehicle routes be approved by the Planning Secretary and included in the Traffic, Transport and Access Management CEMP sub-plan. Additional information must include swept path analysis, road dilapidation surveys and measures to avoid, where practicable, the use of roads past schools, aged care and child care facilities.

Key local impacts around construction sites relate to traffic congestion from access/egress to/from sites, construction workers taking residential parking spaces in surrounding streets, and the accessibility and amenity impacts from street and park closures on residents and visitors. Due to the high density of Birchgrove, and the narrow configuration and congested nature of the existing streets, particularly near Yurulbin Point, the Department has recommended a condition to limit construction vehicle access (including light vehicles) to this construction site, with the majority of access by barge.

Adherence to this condition minimises potential impacts to the accessibility and use of the adjacent Birchgrove Oval. Similarly, due to the steep gradient and narrow nature of the local roads that lead to the Berrys Bay construction ancillary site, and potential traffic and noise impacts that could result from the use of this site, the Department has recommended a condition to only permit access of construction vehicles between 10:00pm and 7:00am if the sleep disturbance criteria can be met.

Local parking impacts will be reviewed during detailed design, and the Department has recommended that the Proponent minimise loss of parking spaces and provide alternate arrangements for workers

Several construction ancillary sites would provide parking for construction workers. However, the number of spaces has not been quantified and the Proponent has stated it cannot accommodate parking for the full construction workforce at these sites. Where insufficient on-site parking is available workers may park on surrounding streets. There was limited information provided in the EIS and the RtS on the resultant impacts from the loss of on street parking. While it is recognised that detailed site planning may not have been undertaken and would be reviewed as the design is refined, a large number of submissions identified this as an issue of concern, and the Department agrees the impacts need to be appropriately managed.

The Department notes that resident parking schemes are currently implemented in some areas of the project, which discourage construction workers from parking in local streets. Notwithstanding, the Department considers that specific conditions are warranted regarding this issue, to limit parking impacts and protect residential amenity. The Department has recommended conditions requiring the Proponent minimise impacts to public roads and provide alternative arrangements for workers where construction sites cannot accommodate the entire construction workforce. The Proponent must also

prepare a Construction Parking and Access Strategy, for the approval of the Planning Secretary, to identify and mitigate impacts resulting from on and off-street parking changes. Initiatives such as reducing workforce parking on local roads and use of shuttle bus services must be included in the Strategy.

The reconfiguration of the Warringah Freeway bus lane and the realignment, widening and temporary closure of sections of Alfred Street North to accommodate the freeway works, would impact existing parking supply and resident access. The EIS states that access would be maintained during construction via existing u-turn facilities, or alternative routes on the local road network. While the Proponent confirmed a net loss in parking of 73 on-street spaces in this area, no parking alternatives have been provided. The Department does not support the loss of these spaces and has recommended that this loss be reviewed and minimised during detailed design.

Replacement public transport service must be provided prior to the closure of Birchgrove Ferry Wharf

Concerns around the wharf closure were raised in a number of submissions, with many stating that walking to the adjacent ferry wharf or a bus stop (1.7 kilometres) away (as suggested by the Proponent) was unacceptable. The Department understands that the closure of the wharf impacts a number of frequent services and approximately 65 commuters per day, and therefore recommended a condition requiring an alternate public transport service be provided prior to the closure of the wharf. This is likely to be in the form of a road-based service.

6.1.2 Operational Traffic

Issue

The project would provide a connection between WestConnex M4-M5 Link at Rozelle and the existing Warringah Freeway at North Sydney, and upgrade and integration works along the freeway to enable connections to the future Beaches Link and Gore Hill Freeway Connection near Artarmon. Its aim is to provide additional road and network capacity across Sydney Harbour and to improve accessibility, travel times and travel reliability across the harbour.

As part of the Warringah Freeway Upgrade, a number of road network changes (including parking) and access restrictions are proposed. **Table 7** outlines these arrangements.

Table 7 | Access and parking restrictions for operational traffic (Source: EIS)

Location	Description
Mount Street Interchange, North Sydney	• Current tidal flow arrangement would be removed.
Falcon Street interchange, North Sydney	• Access from the Warringah Freeway northbound to Falcon Street westbound removed. • Access from Falcon Street southbound to Cahill Expressway southbound removed. • Access between the tolled north-facing ramps at Falcon Street and Brook Street removed, traffic will be required to travel via the local road network.
Ernest Street Interchange, Cammeray	• Access from Ernest Street to the Sydney Harbour Bridge (Bradfield Highway only) southbound would be removed. • Access to Ernest Street from the Sydney Harbour Bridge (Cahill Expressway and Bradfield Highway) northbound would be removed.

	• Access to/from Ernest Street would only be possible to/from Sydney Harbour Tunnel.
Miller Street, Cammeray	• Access between Sydney Harbour Tunnel northbound and the Miller Street off ramp would be removed (this movement would use the Ernest Street interchange). • Right turn from Miller Street northbound to Berry Street eastbound would be banned for general traffic. Buses would still be permitted to make the right turn. • Parking restrictions would be implemented along the northbound carriageway of Miller Street, between the Pacific Highway and Berry Street.
Brook Street, Crows Nest/Cammeray	• Access between the Sydney Harbour Tunnel and Brook Street would be removed.
Alfred Street North southbound off ramp to Alfred Street North (northbound), Alfred Street North, Cammeray	• Access from the southbound off ramp to travel northbound on Alfred Street North would be removed, and traffic would be required to exit the Warringah Freeway at Falcon Street or continue to High Street and travel via the local road network around Neutral Bay to access Alfred Street North. • Permanent removal of 47 parking spaces between Wyagdon Street and Ridge Street. • Permanent removal of 26 parking spaces between Ridge Street and Whaling Road.
Berry Street, North Sydney	• Access to Falcon Street eastbound or the Warringah Freeway northbound would be removed. Traffic wanting to access Falcon Street eastbound or the Warringah Freeway northbound would be required to use the new High Street northbound ramp or the Falcon Street interchange. • Permanent removal of all parking on Berry Street by extension of the existing eastbound clearway during the AM and PM peak periods to create a continuous clearway between the Pacific Highway and Arthur Street.
High Street, North Sydney	• Existing kerbside parking on High Street, near the intersection of Clark Road and High Street, North Sydney, would be prohibited during AM and PM peak periods.
Clark Road, North Sydney	• Existing kerbside parking on Clark Road, on approach to the intersection of High Street, North Sydney, would be prohibited during AM and PM peak periods.
Arthur Street, North Sydney	• On street parking on Arthur Street would be removed to establish new northbound kerbside traffic lane. • Existing bus lane would be removed.
West Street, Crows Nest, Ben Boyd Road, Neutral Bay	• Parking restrictions would be implemented along the northbound and southbound carriageway of West Street, on approach to the intersection with Falcon Street. • Parking restrictions would be implemented along the northbound and southbound carriageways of Ben Boyd Road, on approach to the intersection with Military Road.
Amherst Street, Cammeray	• Right turn movements from Amherst Street westbound into Miller Street northbound, and from Amherst Street eastbound into Miller Street southbound, would be prohibited during AM and PM peak periods. • Parking restrictions would be extended westbound from about 50 metres to about 100 metres between Miller Street and Tarella Place. • Parking restrictions would be extended eastbound from about 60 metres to about 100 metres between Miller Street and Ixion Lane.

The Proponent's assessment of operational impacts has considered future road network performance without the project ("Do Minimum" scenario), future road network performance in 2027 (at project opening) and 2037 (10 years after opening) with only the project ("Do Something" scenario). A cumulative assessment considering the performance of the network with the Beaches Link and Gore Hill Freeway Connection project completed ("Do Something Cumulative" scenario) was also undertaken. The "Do Something" scenario is the focus of this report.

Assessment of future road network performance was based on the following performance measures:

- network performance based on vehicle hours of travel (VHT), vehicle kilometres of travel (VKT) and average network speed
- intersection performance based on intersection level of service (LoS)
- general traffic and bus travel times for key corridors.

The project provides regional traffic and associated time saving benefits through increased road capacity and traffic redistribution

Modelling shows that future traffic performance with the project results in travel time savings of up to 15 minutes between strategic centres when crossing the harbour during peak periods. This increases the accessibility of these centres and the catchment of residents who can access them within the 30-minute city window envisaged by the Greater Sydney Commission. Improved bus priority would mean existing bus services would save up to 20 minutes travel time crossing Sydney Harbour. However, some delay would occur at interface precincts at either end of the project.

The greatest improvement would be for trips between North Sydney and Rozelle, which would result in a reduction of travel times of up to 75 per cent. Travel times would also be reduced for trips via Sydney Harbour Tunnel, mainly as a result of decreased congestion and longer distance north-south trips transferring to the WestConnex – Western Harbour Tunnel corridor.

Reductions in heavy vehicle volumes are forecast on Sydney Harbour Bridge, Sydney Harbour Tunnel, ANZAC and Gladesville Bridges, with the largest reduction being the Sydney Harbour Bridge (55 per cent and 28 per cent reduction respectively in the morning and evening peak periods).

Forecast daily VKT and VHT under the "Do Something" scenario shows that the project would improve network productivity, with an increase in motorway daily VKT and a decrease in daily VHT meaning that the road network would accommodate more or longer trips in shorter time. The midblock LoS for the main carriageways of the tunnel and associated ramps would range between A and C in 2027 and reduce from B to D by 2037. Roads that have reduced daily traffic demands would include Victoria Road, Western Distributor/ANZAC Bridge, Bradfield Highway, Cahill Expressway and Sydney Harbour Tunnel, leading to improved road safety and a reduction in annual crashes of around 375 across the network per year.

Local traffic performance reductions are expected in a number of specific locations

The project will have negative impacts in specific locations, including through the Gore Hill and Artarmon area, and near The City West Link portal:

- average travel speeds would decrease by up to 25 per cent through the Gore Hill and Artarmon area in the morning peak, and 12 per cent in the evening peak, from the growth in traffic demand from the Pacific Highway to the Gore Hill Freeway and Warringah Freeway. This would result in an exceedance of capacity of the on ramp from the Pacific Highway in the

morning peak by 2027 and increased queuing on the Pacific Highway which is currently arranged as a single general traffic lane and a single T2 transit lane. The Proponent has stated that it would need to monitor network conditions in this area to identify any realised impacts and if they materially impact performance during peak periods, may necessitate the conversion of the existing T2 transit lanes

- the intersection of The Crescent/City West Link would experience minor increased delays in the evening peak, due to additional movements from the tunnel portal in this location. Queuing at this intersection would also affect the intersections of the City West Link with James Craig Road (LoS B to C), Catherine Street (LoS B to D) and Balmain Road (LoS D to E)
- the intersection of Victoria Road/Robert Street would operate marginally worse deteriorating from a LoS B to C in the morning peak but would still perform acceptably.

Intersections along the Pacific `Highway and in the North Sydney area would also generally operate with longer delays. Intersections that would deteriorate in performance by more than one LoS category due to the project when comparing 2037 Do Minimum with 2037 Do Something include:

- Brook Street/Warringah Freeway on and off ramps (PM - LoS B to D)
- Brook Street/Meerenburn Avenue (PM - LoS A to D)
- Amherst Street/West Street (AM and PM - LoS A to F)
- Amherst Street/Miller Street (PM – LoS C to E)
- Miller Street/Falcon Street (PM – LoS D to F)
- Falcon Street/Warringah Freeway ramps (AM – LoS B to D)
- Military Road/Ben Boyd Road (AM – LoS B to F)
- Falcon Street/Merlin Street (AM – LoS C to F)
- Ernest Street/Ben Boyd Road (AM – LoS A to C)
- Pacific Highway/Bay Road (PM – LoS C to F)
- Miller Street/McLaren Street (PM – LoS D to F).

Travel times between destinations will benefit from the project

Forecast road-based travel times between destinations on key routes are provided in **Figure 20** and **Figure 21** for the morning and evening peak periods, respectively. These figures show that the project increases accessibility across Sydney Harbour. The reduction in travel times would also facilitate a reduction in travel times for road-based public transport, particularly if express buses operate through the Western Harbour Tunnel.

There would be no operational impacts to maritime movements and activities from the project, as all relocated moorings would be reinstated following the completion of construction.

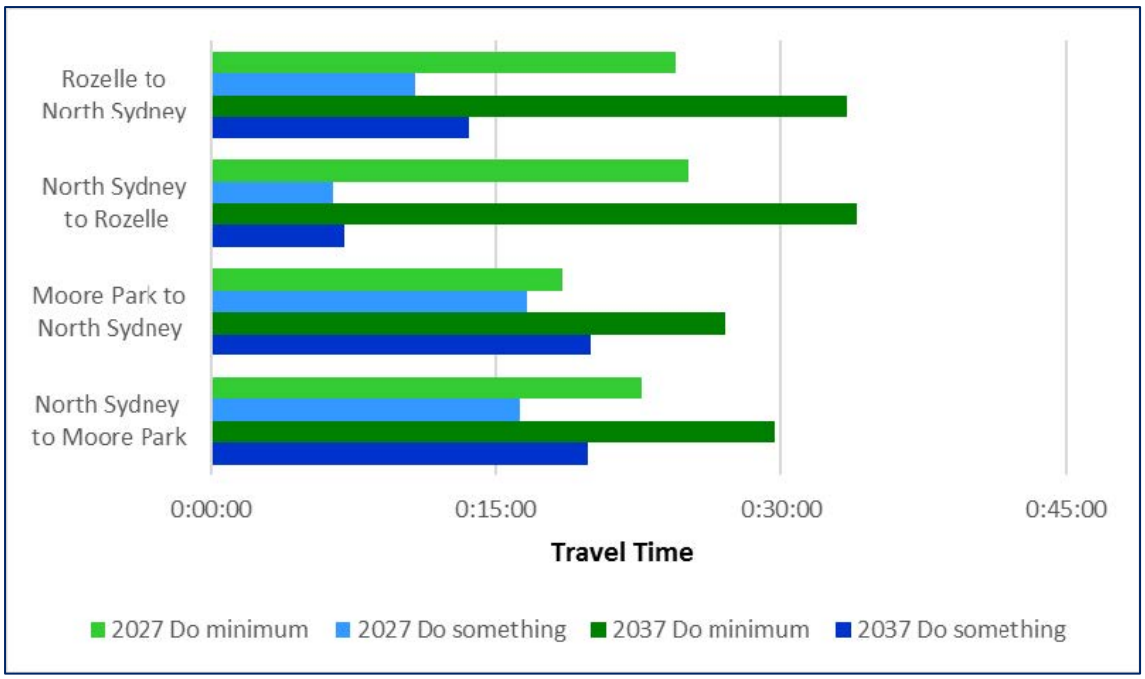


Figure 20 | Modelled "Do Minimum" and "Do Something" morning peak hour travel times along key corridors (Source: EIS)

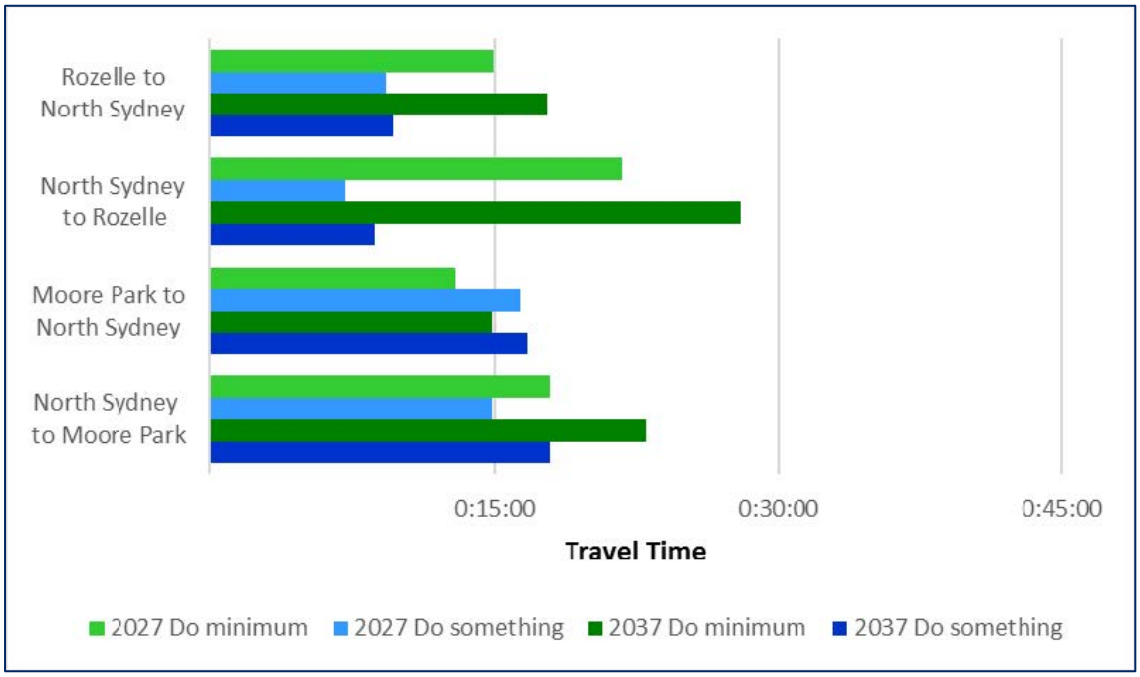


Figure 21 | Modelled "Do Minimum" and "Do Something" evening peak hour travel times along key corridors (Source: EIS)

Changes to bus times reflect general traffic performance changes

Travel times for buses on the Gore Hill Freeway to Sydney Harbour Bridge would improve, particularly southbound during the AM peak due to reconfiguration of the bus lane on the Warringah Freeway between Miller Street and the Cahill Expressway. Existing services could save up to 20 minutes of travel time crossing Sydney Harbour as a result of improved bus priority and reduced traffic conflicts on the freeway. Travel times for buses to and from Falcon Street would also improve. Travel times on bus routes through North Sydney on the Pacific Highway would increase during peak periods, mainly due to congestion between Berry and Miller Streets.

Travel times from the Lane Cove Tunnel and Longueville Road to Gore Hill Freeway would increase during both peak periods, but be more pronounced in the morning peak. However, buses benefit from travel time savings on the Warringah Freeway and Sydney Harbour crossings. Travel times for other trips along Gore Hill Freeway would remain unchanged as a result of the project.

Southbound bus travel times during the morning peak on Victoria Road would improve with the project from the reduced congestion on ANZAC Bridge and Western Distributor; however, counter-peak northbound travel times between the ANZAC Bridge and Evans Street are forecast to increase. Evening peak bus travel times on Victoria Road would not substantially change as a result of the project.

Submissions

Community and interest group submissions

Key issues raised regarding operational traffic included:

- connectivity and accessibility issues from the North Shore to the Warringah Freeway and Sydney Harbour Bridge
- increased use of rat runs in local streets to go to/from preferred harbour crossings as a result of accessibility changes from the project
- accessibility changes increasing traffic and congestion of other streets, e.g. Ben Boyd Road, Military Road; Willoughby Road; and increasing travel time to access properties
- inclusion of public transport lanes within the tunnel
- no meaningful improvements in travel times with many savings over-stated
- potential two-way tolling on other harbour crossings (Sydney Harbour Bridge and Tunnel)
- impacts on access and permanent loss of parking
- conflict of more traffic on Berry/Miller Streets and the operation of the Victoria Cross Metro station with resultant amenity and traffic safety impacts to pedestrians
- cycling has been largely ignored as part of the project
- traffic performance of intersections and congestion should be improved by the project, not worsened
- project will increase induced demand and traffic on local streets
- objection to removal of existing right turn movements
- no assessment of impacts from increased traffic on Grafton Street, Cammeray Road and Ernest Street, all of which will be used to access the Miller Street entrance to the Sydney Harbour Bridge
- traffic impact to North Sydney will limit its growth potential and its plans to pedestrianise certain areas of the city
- rerouting of B Line buses off the Warringah Freeway at Kirribilli to North Sydney Station, Victoria Cross Station; dedicated bus lanes are required in North Sydney to service both railway stations (North Sydney and Victoria Cross).

Government agency and Council submissions

Inner West Council raised concerns about there being no detailed assessment of traffic increases on local streets and other impacts including road safety and congestion, particularly those near Johnston Street; increased traffic along Parramatta Road and City West Link conflicting with plans for Parramatta Road that would improve public transport; EIS does not plan for necessary works at key

intersections and considers that these plans should be exhibited and considered as part of the project; consider incentivising drivers to continue to utilise the tunnels to the south and west using WestConnex through tolling differences; concerned about the 14% or more increase in traffic through Rozelle and only minor improvements in peak hour traffic as a result of the project.

North Sydney Council raised concerns about additional traffic on Berry Street, Miller Street, Falcon Street and Pacific Highway (south of Falcon Street) and reductions in levels of service at key intersections; channelling access between Ernest Street and Sydney Harbour Tunnel is also considered to result in more traffic on Military Road; increases in traffic and access arrangements from the project are such that State and local initiatives like Miller Place will either be unable to occur or require significant amendment as a result of the project; considers the project won't deliver on congestion reduction objectives and non-motorway options should be explored; reduced availability of short term public parking. Council considers that some of the travel time improvements along the Warringah Freeway corridor will be from the shift to Metro in the corridor and not solely from the project.

Council considers that increases in congestion at the Berry Street/Walker Street, Berry Street/Miller Street and Pacific Highway/Berry Street intersections will make it impossible to deliver planned road closures, pedestrianisation and major place improvements in the North Sydney CBD including Miller Place and considers that the proposed changes to road access and network arrangements (e.g. Warringah Freeway/Falcon Street slip lane removal and widening of Berry Street) are inconsistent with directions previously agreed through the North Sydney Integrated Transport Plan.

Mosman Council supports the ramps at Ernest Street interchange remaining open.

City of Sydney Council states that the project does not adhere to NSW Government transport policy and raised a number of traffic concerns including what improvements were being planned for Sydney CBD from the removal of through traffic; how will the growth in vehicles, queuing in motorways, limiting traffic induction be managed; impacts from additional vehicles connecting to the CBD and what improvements will be made to the surface (street network and places) as a result of the diversion of through traffic around and under the city. Council considered that any travel time savings would be eroded over time as a result of induced demand and that the NSW Government should provide a commitment to the reallocation of road space for public transport, walking and cycling on major road access routes to and from the city including on ANZAC Bridge, Sydney Harbour Bridge and Western Distributor (e.g. bus lanes in both directions on ANZAC Bridge and Sydney Harbour Bridge) to serve the Victoria Road and Inner West corridors.

Willoughby City Council stated that there were deficiencies for some modes with the current design and considered that motor vehicles should not be prioritised and that the project should support public and active transport movement more effectively. The removal of the northbound T2 Transit lane on Warringah Freeway is not supported.

The notion that worsening impacts at a local context is acceptable due to the overall benefits provided by the whole project is not supported, as Council considers that this will lead to the transfer of traffic problems and ultimately the costs associated with their resolution, to Council. Council also raised the following concerns and outlined a number of improvement opportunities:

- strongly opposed any measures that may reduce the place character of local centres such as along Willoughby Road and Penshurst Streets such as new extended clearway restrictions

- review the design between Sydney Harbour Tunnel and Gore Hill Freeway/Pacific Highway Interchange to ensure improved safety and efficiency
- use of non-State roads by regional traffic for rat-running leading to a lowering of road safety
- proposed changes to the local road network in the Artarmon Industrial Area without Council input or approval
- increase in regional traffic using Willoughby Road and Penshurst Street
- the need for the project to provide road based public transport, a bicycle transport link and a pedestrian link across the Gore Hill/Warringah Freeway, Naremburn.

Consideration

The Proponent is required to review and implement local traffic management measures

The project would result in through traffic improvements in the Rozelle area and surrounds, as through traffic would be underground between the M4-M5 Link and the Western Harbour Tunnel. Similarly, the project would reduce traffic and travel times on major north-south routes in the Warringah Freeway and surrounds. Notwithstanding the regional benefits of shifting through traffic underground and reducing traffic on surface roads, the project would result in localised congestion in specific areas:

- at tunnel access points in Rozelle and at The Crescent/City West Link and The Crescent/Johnston Street intersections
- in North Sydney, with more traffic and delays on Miller Street, Falcon Street, western end of Military Road, Berry and Mount Streets and intersections along the Pacific Highway
- along the Gore Hill Freeway, with potential queue-back congestion on Longueville Road through Lane Cove.

To address potential local traffic impacts, the Department has recommended that the Proponent prepare a Road Network Performance Plan prior to operation of the project in consultation with the relevant councils. This will require the Proponent to review the predicted localised traffic impacts as a consequence of the project and to implement local road improvements to manage these impacts. This will also include data from the reviews undertaken for WestConnex projects (M4-M5 Link and M8).

In accordance with best practice, the Department has also recommended that the Proponent undertake Operational Road Network Performance Reviews at 12 months, and again within five years after the commencement of operation, to confirm the operational traffic impacts of the project on surrounding arterial roads and major intersections and to confirm whether the local road improvements identified in the Road Network Performance Plan are adequate.

In relation to intersection performance (particularly in the vicinity of Cammeray and North Sydney), the Department notes future performance would likely improve if the Beaches Link and Gore Hill Freeway Connection is built, as traffic would continue within the tunnels rather than exiting to surface roads. However, as the Beaches Link and Gore Hill Freeway Connection is subject to separate assessment, and to ensure that impacts resulting from congestion at these intersections are appropriately managed, the Department has recommended that the Road Network Performance Plan for the project expressly take into account these intersections, impacts of rat-running through local roads and traffic movements and congestion at various intersections in North Sydney and Cammeray.

The outcomes for Victoria Cross Station Precinct and North Sydney Integrated Transport Plan must be considered during detailed design

To address concerns regarding the impact the project may have on major place improvements within the North Sydney CBD, the Department has also recommended that detailed design must consider the delivery outcomes proposed by Sydney Metro for the Victoria Cross Station Precinct or other strategic plans relating to the North Sydney CBD. The Department notes the Proponent's RtS acknowledged that the North Sydney Integrated Transport Program is ongoing, and a number of scenarios are currently being tested to support place-based outcomes. The Proponent stated any changes to the project as a result of the Program would be considered during further design development and may require additional traffic and transport modelling and potentially further approvals by the Minister. The Department supports this approach.

Loss of parking would impact some residents and businesses and some access changes will increase travel times

Parking loss in the operational phase of the project, associated with intersection upgrades and peak period clearways particularly in North Sydney, are considered to be manageable, and the Department accepts that these parking spaces cannot be reinstated as they are required for efficient flow of traffic on the network.

A number of submissions were concerned about changes to accessibility associated with the removal of the U-turn facility from the Warringah Freeway southbound off ramp to Alfred Street North northbound. Removal of the U-turn means that this traffic would be required to continue southwards along the Warringah Freeway off ramp to the High Street interchange, turn right towards North Sydney, turn right into Arthur Street and then cross the freeway on Mount Street and then turn left and utilise a new off ramp into Alfred Street North, involving an extra one kilometre of travel. While the additional travel required is not a positive outcome, accessibility will be maintained.

Freeway widening in this area may also directly impact on residential access. Therefore, the Department has recommended all reasonably practicable measures must be implemented to maintain pedestrian and vehicle access near businesses and affected properties, and any property access physically affected by the project must be reinstated to at least an equivalent standard (unless otherwise agreed by the landowner or occupier).

Further review and action are required to maintain the public transport benefits of the project

While the project is primarily focused on delivering improvements to the regional road network, the Department considers that the project could do more to deliver a more holistic and integrated transport outcome. In relation to public transport, the Department acknowledges the provision of a dedicated southbound bus lane along the Warringah Freeway; however, this is the extent of specific public transport infrastructure as part of the project.

The overall benefits to bus travel times are delivered through regional traffic improvements, but bus travel times are subject to local traffic impacts and delays. A number of submissions raised these concerns, however, the Proponent did not amend the design or make additional commitments to improve road-based public transport as part of the RtS, instead stating that the project formed one part of a complementary integrated multi-modal strategy being delivered by the NSW Government and provided opportunities for new express bus services.

In this respect, and with consideration of the aim of the project to improve public transport, the Department considers that the Proponent should have included more detailed analysis and committed to further public transport initiatives. Bus travel time improvements are primarily reliant on general traffic improvements – any degradation in this environment also impacts public transport reliability and journey times. The Department has therefore recommended that the Proponent undertake a review and identify actions that can be undertaken to ensure bus travel times and performance are maintained over time.

6.2 Noise and Vibration

The primary noise issue associated with the project is managing construction noise impacts as part of the Warringah Freeway Upgrade. Works along the Warringah Freeway would be required to be undertaken out of hours due to the potential for significant traffic disruption. The implementation of the Proponent's Noise Insulation Program to assist in reducing both construction and operational noise as early as practicable is supported. The Department has recommended that out of hour works along the Warringah Freeway be undertaken in accordance with specific criteria to ensure appropriate respite is provided to residents. The criteria would be incorporated into an Environmental Protection Licence (EPL) and may be changed through the EPL process should the Proponent demonstrate to the Environment Protection Authority (EPA) that further extended hours can be appropriately managed.

During its operational phase, the project is predicted to decrease road traffic noise levels at most receiver locations, except for an area surrounding the surface connection to City West Link at Rozelle and areas adjoining the upgraded area of the Warringah Freeway, which will be provided operational noise mitigation.

Issue

The project footprint and surrounds are characterised by mostly residential development, except small areas of commercial and industrial land use around White Bay, Waverton, North Sydney and Artarmon. The noise environment is mostly influenced by traffic noise from major roads including City West Link, Victoria Road, Pacific Highway and the Warringah Freeway, aircraft noise and passenger rail services from the T1 Northern Line.

In most locations, construction noise impacts are comparable to other major transport projects in an urbanised environment and the Proponent has committed to applying a range of standard noise mitigation measures, for example establishing acoustic sheds for tunnelling sites. These commitments are reinforced by recommended conditions of approval that require the Proponent to undertake a proactive approach to engaging with the community to mitigate and manage construction noise.

However, works along the Warringah Freeway pose a significant challenge in relation to construction noise impacts on adjoining residences, as a significant proportion of the works are required to be undertaken outside of standard construction hours. To partly address these impacts, the Proponent has commenced and will continue the implementation of its Noise Insulation Program. However, this program will not fully mitigate the expected construction noise impacts.

Significant out of hours works are proposed due to constrained environments, particularly along the Warringah Freeway

Construction works would be undertaken during the standard hours of 7.00 am to 6.00 pm Monday to Friday and 8.00 am to 1.00 pm on Saturdays. However, for the Warringah Freeway Upgrade component, extensive out of hours works are proposed to minimise disruption to traffic movements. In addition, tunnelling, dredging and excavation of the bed of the harbour, barge movements to remove spoil and the transport of the immersed tube tunnel elements and immersed tube tunnel construction (placement) would occur 24 hours a day, seven days a week. **Table 8** provides a summary of when certain activities are planned to occur.

In relation to the Warringah Freeway Upgrade component, due to the importance of the Freeway to the greater Sydney road network, access to work areas may not be possible before the evening, and therefore construction would need to happen at night. Where this is required, work is proposed to occur for around five nights a week, and be staged along the road corridor to manage impacts on receivers at any one location. Not all activities that will be carried out on site were considered in the noise modelling, however, the most noise-intensive activities were modelled to determine worst case impacts. The high number of residential apartment buildings close to the freeway would result in large numbers of receivers being adversely impacted by construction noise.

Construction noise impacts from Western Harbour Tunnel works are consistent with a project of this scale and exceedances of Noise Management Levels would occur

The noise assessment predicted that Noise Management Levels (NML) would be exceeded in a number of locations during standard construction hours, which is typical for a construction project of this scale in a highly urban environment. Noise from early works and site establishment activities will have the greatest impact with some receivers likely to be highly noise affected. Out of hours works would generally meet NMLs in most locations except for works associated with tunnel construction and fitout activities from the Victoria Road construction ancillary site and the preparation of foundations and the placement of immersed tube tunnel elements for the Sydney Harbour crossing. Notwithstanding this, maximum noise levels would exceed screening and awakening criteria and impact many receivers.

Table 8 | Construction activities (Source: EIS)

Location and Activity	Construction hours	Approximate duration of works	Comments and Justification
Tunnel construction ancillary sites			
Rozelle Rail Yards (WHT1), Victoria Road (WHT2), Yurulbin Point (WHT4), Berrys Bay (WHT7), Cammeray Golf Course (WHT10)			
Early works/ site establishment	Standard and OOHW where works are required in public road corridor	12 to18 months	• Activities requiring the temporary possession of roads, or to accommodate road network requirements, may need to be carried out outside standard daytime work hours.
Decline/shaft excavation	Standard	Up to 6 months	
Tunnel construction support	Standard and OOHW to support 24 hour tunnelling	Up to 24 months	• Concrete deliveries for ground support may occur outside standard hours to enable concreting to be completed safely. • Underground works and deliveries to the tunnel would be carried out up to 24 hrs a day. • Spoil handling and loading of barges within the acoustic shed at Yurulbin Point and at Berrys Bay would be carried out outside standard hours. • Limited deliveries would occur at night, via barge, to support tunnelling works.
Tunnel mechanical and electrical fitout	Standard	Up to 30 months	
Tunnel commissioning and site rehabilitation	Standard	Up to 24 months	
Construction of permanent operational facilities	Standard	Up to 24 months	
Surface works in the Warringah Freeway and surrounds			
Warringah Freeway Upgrade construction ancillary sites – Blue Street (WFU1), High Street south (WFU2), High Street north (WFU3), Arthur Street east (WFU4) , Berry Street east (WFU5), Ridge Street east (WFU6), Merlin Street (WFU7), Cammeray Golf Course (WFU8), Rosalind Street east (WFU9), Western Harbour Tunnel construction ancillary sites – Berry Street north (WHT8), Ridge Street north (WHT9), Waltham Street (WHT11), road works.			
Early works	Standard and OOHW	4 to 5 months	• Where possible, works would be programmed during standard hours, however, large sections of works across the project, particularly associated with the Warringah Freeway are required to
Utilities, sewerage and local area upgrade works	Standard and OOHW	Up to 30 months	

Road work	Standard and OOHW for road tie ins	Up to 42 months	take place outside standard construction hours due to the requirement for a Road Occupancy Licence.
Bridge and concrete works	Standard and OOHW	Up to 24 months	
Motorway facilities	Standard and OOHW	Up to 24 months	
Mainline tunnelling			
Rozelle to Birchgrove, Berrys Bay to North Sydney			
Mainline tunnels: Heading	24 hours	Up to 24 months	• Works in tunnels and other underground activities would occur 24 hrs per day, 7 days per week.
Mainline tunnels: Benching	Up to 24 hours	Up to 24 months	
Cross passages	Up to 24 hours	Up to 24 months	
Mechanical/electrical fitout	24 hours	Up to 24 months	
White Bay construction ancillary site			
Early works / site establishment, wharf construction	Standard	9 months	
Cast of immersed tube tunnel elements	Standard	Up to 6 months	
Spoil handling / treatment, tunnelling support deliveries.	Standard and OOHW to support 24 hour tunnelling	Up to 33 months	• Spoil handling would be undertaken 24 hrs a day, 7 days per week to support tunnelling. • Some deliveries would be required during evening and night time to support casting of immersed tube tunnel units and construction activities at Yurulbin Point and Berrys Bay.
Sydney Harbour Crossing			
Sydney Harbour south cofferdam WHT 5, Sydney Harbour north cofferdam (WHT6), Snails Bay temporary mooring site			
Coffer dam construction	Standard	Up to 18 months	• Rock hammering and piling would only occur during standard hours, however, due to harbour navigation and safety requirements, dewatering of cofferdams and removal of cofferdam structures may occur 24 hrs a day, 7 days per week.

Dredging	Standard and OOHW	12 months	• Trailer suction hopper dredging would occur 24 hrs a day, 7 days per week to minimise disruption to vessel movements and manage lengthy vessel turnaround times.
Immersed tube tunnel immersion	Standard and OOHW	12 to 15 months	• Immersed tube tunnel installation would take between 24 to 48 hours for each unit.

Noise modelling described in the EIS to predict noise impacts is conservative as it assumes all equipment at a given site is operating simultaneously, with a worst case intensity and orientation. The worst case scenario would not typically occur, with actual noise levels expected to be lower than those predicted. The worst case noise scenario was predicted for construction ancillary sites, however for surface road works (for example, those on the Warringah Freeway), a reasonable typical (where the loudest plant and equipment are not being used) scenario was additionally assessed. Noise treatment measures and management methods were identified and incorporated into the noise models.

Construction noise impacts from the Warringah Freeway Upgrade are significant and have the potential to have a major disturbance on the adjoining community

Construction works associated with the Warringah Freeway Upgrade include both major roadworks undertaken along the freeway corridor and from construction ancillary sites, some of which also support the construction of the Western Harbour Tunnel. Residential receivers (around North Sydney, Neutral Bay, Cammeray and Crows Nest) are predicted to be highly noise affected during out of hours roadwork. A large number (almost 21,000) of residential receivers will be impacted by sleep disturbance and around 3,000 receivers will potentially be awakened as a result. Additionally, a number of residential receivers will be impacted by noise from activities within construction ancillary sites (**Appendix H**).

In addition to impacts on residential receivers, other sensitive receivers in the vicinity of the works include educational facilities, childcare centres, places of worship and commercial premises. The noise assessment predicted that construction NMLs would be exceeded in many locations around the corridor and some receivers will be impacted by multiple types of works and during multiple periods in the construction program.

To reduce noise impacts, the Proponent has committed to the implementation of feasible and reasonable measures including but not limited to the provision of acoustic sheds, site hoardings and portable noise barriers, limiting the use of noisy equipment, scheduling works during less sensitive time periods where possible and respite offers. Where the implementation of these measures are not feasible and reasonable, or they do not sufficiently reduce noise levels, at-receiver property treatment is the only mitigation option.

To mitigate the impact of operational and construction noise at eligible properties, the Proponent has developed a Noise Insulation Program for the Warringah Freeway Upgrade to outline how at-property noise treatments would be implemented. The program has been initiated by the Proponent and includes:

- eligibility criteria
- an outline of potential treatment types
- potential limitations to property treatment
- the communication and engagement approach with property owners and the delivery process.

The Department notes that in excess of 1350 residents have been offered treatment and that installation has commenced with the expectation that a majority of residents will have received treatment prior to Warringah Freeway Upgrade works commencing in Q4 2021.

Ground-borne noise and vibration impacts will occur with exceedances expected when tunnelling is in close proximity to residential and other receivers

Mainline tunnelling activities would be undertaken by roadheaders and rock-hammers, and blasting may be used to assist with excavation of tunnels and cross passages. These activities will generate ground-borne noise (noise from vibration). The ICNG sets out internal ground-borne levels for evening and night-time periods of 40 dBA and 35 dBA, respectively.

The use of roadheaders and rock-hammers would exceed the ground-borne noise levels at a number of residential receivers, although more receivers would be impacted by rock-hammering. Up to 776 residential receivers could experience ground-borne noise of between 35 and 40 dBA, 460 residential receivers between 40 and 45 dBA and 271 residential receivers over 45 dBA, as well as potential impacts to 32 other sensitive receivers and three commercial/industrial receivers. The Proponent stated that rock-hammering would be programmed outside evening and night time periods to avoid these impacts. Ground-borne noise generally occurs when tunnelling is close to the receiver and then drops away as tunnelling moves further away.

In addition to ground-borne noise from tunnelling activities, vibration impacts could occur from early works, site establishment, piling and excavation for decline access construction particularly in the vicinity of Rozelle, Victoria Road, Yurulbin Point, Berrys Bay and Cammeray construction ancillary sites. In some cases, these impacts could cause exceedances of the cosmetic damage and human response criteria, particularly where structures are located within minimum working distances. The Proponent has committed to undertake structural surveys where required. Where impacts to receivers occur outside standard construction hours, the Proponent has advised that specific notification and alternative accommodation may be offered.

Operation of the project will result in increases to noise levels which will require mitigation

The noise assessment indicates that the project is predicted to typically decrease road traffic noise at most receiver locations except 478 receiver buildings identified as eligible for consideration for additional noise mitigation. These buildings are located around the surface connection to City West Link at Rozelle and along the Warringah Freeway as a result of road realignment and widening, which will locate traffic closer to residential receivers in these areas.

While noise barriers were considered at various locations, they were not deemed to be reasonable and feasible at Rozelle, and therefore are only proposed at locations along the Warringah Freeway. The use of quieter pavement in select areas would help to reduce road traffic noise levels. Where these measures are not sufficient to reduce noise levels at residential receivers, the Proponent has committed to provide at-property treatment.

Noise impacts from operational facilities (ventilation outlets, motorway control centre and wastewater treatment plant) have been predicted to comply with the relevant project noise levels, except receivers in Rozelle where an exceedance of 3 dBA is predicted. The Proponent has committed to reviewing final noise predictions from fixed facilities, and the need for noise mitigation, during detailed design when actual types, makes and models of plant and equipment are known.

Submissions

Community and special interest group submissions

Key issues raised in the public submissions included:

- construction noise and vibration impacts including to heritage properties; inability to work from home; impacts on shift workers; physical and mental health; impact on children's education
- vibration impacts on adjacent residences from operation of new bus lane
- implementation of strict curfews to limit noisy activities close to residential receivers and noise free Sundays
- unacceptable noise and increased stress and health impacts from night construction
- affected zone for dilapidation surveys should be 250 metres either side of tunnel as in Victoria not 50 metres
- mitigation measures not adequately described
- construction fatigue impacts – more years of disruption to already stressed communities
- installation of noise walls before construction commences to protect surrounding residents
- cumulative noise impacts
- no assessment was undertaken on the impact on Little Zaks Academy.

Government agency and Council submissions

EPA considered that the assessment adequately considered the noise and vibration risks associated with the project and supports the development of a robust community engagement plan for construction, but considers that the community is not fully aware of how changes to noise levels and traffic in the area will be managed as many design details and operation of mitigation are yet to be determined.

The EPA recommended conditions of approval, including the consideration of cumulative noise impacts of approved SSD and SSI projects, the appointment of a heritage specialist on methods and locations for installing equipment used for vibration, movement and noise monitoring at heritage-listed structures, specific consultation with receivers identified as being highly noise affected to determine appropriate respite, not timetabling noise generating works during sensitive periods in the vicinity of potentially affected sensitive receivers unless other reasonable arrangements are made, and requiring that all acoustic sheds be erected as soon as site establishment works are completed and before undertaking any works which are required to be conducted within the sheds.

Heritage NSW recommended that a Construction Noise and Vibration Management Plan (CNVMP) be prepared for the project to include specific mitigation and compensation measures for St Leonards Park, North Sydney Sewer Vent, Glebe Island Bridge, Railway Electricity tunnel under Sydney Harbour, Tarella and Raywell residences, and that monitoring and compliance measures be identified and implemented.

Port Authority of NSW raised concerns with cumulative noise from the construction ancillary site at White Bay with concurrent projects including M4-M5 Link, Sydney Metro West, Glebe Island Concrete Batching Plant and Aggregate Handling Facility, Glebe Island Multi-User Facility and Sydney Fish Markets Stages 1 and 2, and requested that the Construction Environmental Management Plan include a detailed CNVMP, reflecting detailed design refinements to site layout, methods, equipment and construction hours and any mitigation and management measures different to those outlined and assessed in the EIS.

NSW Health raised concerns about the health impacts of noise, however, stated that it was not possible to comment on intended mitigation measures as this information was not provided as part of the EIS. NSW Health considers all reasonable options to minimise noise exposure to receivers should be explored and prioritised.

Inner West Council expressed concern over the noise and vibration impacts from the four proposed construction ancillary sites in its Council area particularly from shallow tunnelling near Yurulbin Point, the high number of heavy vehicles trying to access the Victoria Road construction ancillary site every day, and the cumulative noise impacts on residents next to White Bay.

North Sydney Council understands that Construction Noise and Vibration Management Plans will be prepared as well as an Out of Hours Works Protocol and a Blast Management Strategy. However, it is concerned that none of these have been provided at the EIS stage and it is difficult to ascertain from the assessment the actual construction noise and vibration levels that will be experienced, how the impacts will be managed/mitigated, and the outcomes expected from mitigation including the number of receivers that may benefit. In terms of operational noise, Council considered that the assessment did not account for induced demand, and challenged the assumption that the project would result in less traffic noise compared to the "Do Minimum" scenario from traffic being moved from existing surface roads into the tunnels.

City of Sydney Council, Willoughby City Council and **Mosman Council** did not raise any noise and vibration concerns.

Consideration

Construction noise impacts will be reduced through a comprehensive range of both physical mitigation and management measures

The Department considers that construction impacts are unavoidable for a project of this magnitude, and that construction noise impacts will be significant unless extensive and appropriate noise mitigation and management measures are implemented to protect the surrounding community.

To minimise traffic impacts, significant construction activities will require night-works, increasing the potential for adverse construction noise impacts to residents. The Proponent has committed to implement a number of mitigation and management measures to reduce construction noise, which the Department supports. These measures are similar to those applied on other road and large infrastructure projects and can be effective in reducing noise impacts. The measures specific to this project include (but not limited to):

- using acoustic sheds and covers at tunnelling sites
- acoustically treated plant or enclosures for wastewater treatment plants, substations and ventilation plant
- temporary noise barriers around a number of construction ancillary sites
- limiting night-works over consecutive nights in the same location to manage impacts on sensitive receivers at one location
- programming loud construction activities to standard hours or shifted to less sensitive out of hour periods (i.e. evening)
- coordinating works between construction sites to minimise cumulative noise impacts

- standard mitigation measures which include the selection of appropriate plant and equipment, respite offers, alternative accommodation and extensive community consultation in accordance with the Construction Noise and Vibration Guideline (CNVG) (RMS, 2016).

The Department also notes that the Proponent's RtS assessed the impacts on Little Zac's Academy, Rozelle which was absent in the EIS, and addressed many of the comments raised in the submissions.

Notwithstanding the commitment from the Proponent regarding specific measures, the Department considers the Proponent must also implement industry best practice construction measures to ensure noise levels are minimised and has recommended a condition to this effect. These practices include, but are not limited to:

- the use of low sound power level equipment
- early evening occupation of road carriageways and construction sites
- scheduling of the noisiest work before 11.00 pm Sunday to Thursday and before 12 midnight Friday and Saturday
- temporary noise barriers around noisy equipment and activities such as rock hammering and concrete cutting
- the use of alternate construction and demolition techniques.

In addition, the Department has recommended that operational noise mitigation measures, as identified in the Operational Noise Review, that will not be physically affected by work must be implemented during construction.

Standard construction hours have been adjusted to provide flexibility to work scheduling

Standard Saturday construction hours are 8.00 am to 1.00 pm. However, the Department considers that activities on a Saturday can conclude at 6.00 pm and has recommended this as a condition. The extension of Saturday hours provides the Proponent with greater flexibility to schedule a full day of work on Saturdays and may reduce the need for out-of-hour requests.

Notwithstanding these construction hours, the Department expects the Proponent to be aware of the need to reduce noise and vibration impacts on the local community and sensitive receivers as part of day to day construction measures. In relation to this, and in response to comments by the EPA, the Department has recommended noise generating work in the vicinity of schools etc that results in noise levels above NMLs not be timetabled within sensitive periods, unless other reasonable arrangements with affected institutions are made at no cost to the affected institution.

To minimise noise impacts at construction ancillary sites, the Proponent must proactively engage with the community on respite and further noise management measures

The Department acknowledges that the establishment and operation of construction support sites is critical to the delivery of the project, and many operate 24 hours a day, and that the proposed mitigation measures at these sites are reflective of current practice. These sites will result in high noise impacts, particularly during site establishment, when noise impacts cannot be fully mitigated with acoustic barriers and when excavation works are close to the surface.

To improve the mitigation and management of noise throughout the construction period and during these high noise events, the Department has recommended that the Proponent implement a proactive

approach to community consultation, construction planning and respite, and the early application of operational noise mitigation measures to further reduce construction noise impacts.

In addition, the Department requires Construction Noise and Vibration Impact Statements to be prepared and implemented in areas where surrounding residences are to be highly noise impacted. Each Statement is required to include specific mitigation measures that would be implemented for the duration of work.

In relation to truck movements from these sites and associated noise, the Department is generally satisfied that these impacts are acceptable in locations that already have significant traffic volumes and heavy vehicle movements. However, in certain locations such as at Berry Bay, the Department does not agree with the Proponent's suggested actions, and has limited truck movements at night to prevent sleep disturbance, unless suitable mitigation is provided.

A proactive approach to noise management is recommended, to ensure the community is provided appropriate respite from out of hours construction

The Department acknowledges the need for works to occur outside of standard construction hours, however, a proactive approach to managing noise impacts is necessary considering existing construction fatigue, particularly around Rozelle.

With the exception of Warringah Freeway Upgrade works, addressed separately in this report, proposed night and evening activities could impact on residential amenity. Spoil handling would occur 24 hours a day at the Victoria Road, Berrys Bay and Cammeray Golf Course construction ancillary sites within the acoustic shed enclosures.

Trailer suction hopper dredging would occur 24 hours a day, however, due to the turnaround times between the crossing site and the disposal site, dredging in the vicinity of receivers is expected to last approximately 25 minutes three times a night. The immersion of the tunnel units would also occur at night, but this activity is expected to only last 24-48 hours per unit and noise generated from this activity would be short-term. Other activities such as utility relocations, line marking, road pavement and widening, may also occur at night to minimise traffic impacts on the road network, and the resultant noise levels from these activities are expected to be high.

The project is subject to an EPL. Works outside standard construction hours are subject to review by the EPA. For works that are not subject to an EPL, the review of the need for the works and their management will be addressed as part of an Out-of-Hours Protocol to be approved by the Planning Secretary. The Protocol must outline the process for preparing, assessing, managing and approving work not subject to an EPL, and facilitate the identification of mitigation measures and notification requirements for high and low risk out-of-hours works.

Notwithstanding measures that may be implemented by the Proponent, the Department considers provision of appropriate respite is important. Respite periods should be clearly communicated, and the community should be able to have input into how respite is implemented during construction, and has recommended a condition to this effect. To assist the community in its consideration of respite periods, and the EPA and Department in their consideration of requests for approval of out-of-hours works, a schedule of the works will need to be provided. Co-ordination of respite would also be required with other projects or utility relocation works, to avoid consecutive night-time works and ensure that respite periods are in fact provided.

Noise impacts associated with the Warringah Freeway Upgrade will be mitigated through the implementation of a Noise Insulation Program and applying criteria to ensure appropriate respite

The Warringah Freeway is one of the busiest roads in Australia, carrying approximately 240,000 vehicles per day, including more than 30,000 bus passengers. Due to its importance to the greater Sydney road network, construction works within the road corridor that require closure of one or more traffic lanes can only occur with Road Occupancy Licence(s) in place. A significant number of residential receivers near the Warringah Freeway already experience high operational traffic noise levels, and many of these are eligible (but have yet to receive) noise mitigation as part of the existing TfNSW Noise Abatement Program (which does not form part of this project). These receivers can expect extended construction activities of approximately five years as part of the Warringah Freeway Upgrade. To provide greater certainty in the timely implementation of the NIP and improved outcomes for the community, the Department has recommended implementation timeframes and improved mitigation options.

The Proponent has suggested that the need to obtain a Road Occupancy Licence as a reason to undertake construction out of hours, and has indicated that an approach specifically tailored for receivers is being developed to manage out of hours construction works. The Department also notes that the EIS and RtS did not provide detail regarding this approach. This position is not supported by both the Department and the EPA. Road Occupancy Licences are issued under the *Roads Act* with a focus on road efficiency and with negligible consideration of environmental impacts and community amenity. In addition, the Department and the EPA are not prepared to endorse a noise management approach that has not been subject to community consultation.

As such, the Department has recommended that out of hours works along the Warringah Freeway be undertaken in accordance with specific criteria to ensure appropriate respite is provided to receivers. These criteria will be incorporated into an EPL and may be changed through the EPL process, should the Proponent demonstrate to the EPA that extended hours can be appropriately managed.

Ground-borne construction noise and vibration can be appropriately managed

The generation of ground-borne noise, predominantly from tunnelling activities, may cause exceedances of NMLs in some areas along the tunnel alignment, however the Department is satisfied that the relatively short duration of impacts and the Proponent's mitigation measures are generally adequate. These measures include confining vibration intensive construction works (i.e. rock-hammering) to less sensitive daytime periods, and monitoring ground-borne noise levels. Regardless, the Department has recommended additional mitigation measures be applied when ground-borne noise levels are exceeded.

Construction vibration can impact on human comfort and the structural integrity of adjacent buildings, particularly heritage buildings. The Department is satisfied that the Proponent has identified vibration-generating activities that are likely to cause discomfort to the surrounding community and/or property damage. While the Department considers that the Proponent has identified appropriate safeguards to manage vibration impacts, these can be strengthened through:

- compliance with applicable construction vibration criteria
- preparation of a land use survey prior to works, to identify properties that are sensitive to construction vibration
- pre- and post- construction dilapidation surveys

- rectification of damage cause by the construction of the project
- measures and procedures to minimise construction vibration impacts.

Blasting may be carried out as part of the project. Any blasting would be subject to stringent processes and limits, including community engagement, time limits (standard construction hours), trial blasting, and must be carried out to meet relevant criteria so that there is not unacceptable noise and vibration impacts to the community. These works would also be subject to an EPL.

An independent Acoustic Advisor will provide greater confidence in the management and mitigation of noise impacts

The Department supports the Proponent's proposal to engage an independent Acoustic Advisor to oversee construction noise and vibration planning, management, monitoring and mitigation. This initiative, required by the Department in recent infrastructure approvals, provides the Department, EPA, and the community with greater confidence that the Proponent is improving outcomes in its detailed noise reviews and application of noise mitigation measures.

The Acoustic Advisor will be required to provide information to the Planning Secretary on the noise impacts from the project, and advise the Proponent on how to reduce these impacts. The Proponent also intends to expand the role to include expertise in construction engineering so that the advisor can interrogate proposed construction planning and methodology to ensure that the construction contractor is implementing best practice construction methods and mitigation measures. In addition, the Department has recommended that a Community Complaints Mediator be appointed to assist in resolving any concerns that individuals or businesses may have, including noise and vibration complaints.

In addition, the Department has also recommended that a Public Liaison Officer be available at construction ancillary sites and utility work to assist the public with questions / complaints they may have during construction. The Public Liaison Officer must be available at all times that work is occurring and help to responding to noise and vibration issues or complaints.

Operational noise mitigation measures are reviewed and compliance monitored by the Department

Various traffic scenarios were assessed to identify traffic noise impacts from the project. The results show that many receivers along the Warringah Freeway already experience high traffic noise levels. The project is predicted to decrease the number of sensitive receivers that exceed the relevant noise criteria when compared to the "Do minimum" traffic scenario (without the project). New noise barriers are proposed along the Warringah Freeway corridor, as well as proposed extensions in length and height to existing barriers.

In the area around the surface connection to the City West Link, however, the project is predicted to increase the number of receivers impacted by road traffic noise, as people travel to and from the surrounding area to use the tunnels.

After taking into account mitigation such as low noise pavement and new and extended noise barriers, approximately 369 receivers would be eligible for additional mitigation (in the form of at-property treatment) in the area around the Warringah Freeway (subject to further design refinement). Approximately 166 receivers in Johnston Street and The Crescent in Annandale have been identified as potentially being eligible for noise mitigation as a result of exceedances of the cumulative traffic noise criteria (>2 dB from multiple projects), and these impacts would be confirmed during detailed

design. Receivers near the City West Link at Rozelle would receive mitigation in accordance with the conditions of approval for the WestConnex M4-M5 Link (condition E87).

The Department has required the Proponent prepare an Operational Noise Review to determine the final noise mitigation measures, which are then subject to noise monitoring and compliance, with the application of further mitigation measures if required. The Department is also concerned with the application of noise mitigation measures that can deteriorate over time, in particular low noise road pavement, and has recommended that road surfaces are maintained to ensure that noise mitigation properties continue to be achieved.

6.3 Air Quality

The Department has considered air quality impacts during the construction and operation stages, including advice and recommendations from its independent air quality consultant, NSW Health, EPA and Office of the Chief Scientist and Engineer.

In line with the Government's reforms for the regulation of emissions from tunnel ventilation facilities, the NSW Chief Health Officer provided a statement on potential health impacts of the predicted emissions. It considers any potential air pollution-related health effects from the project are likely to be a result of changes in volumes of traffic on the surface road network, and not a result of the tunnel ventilation outlets. The Advisory Committee on Tunnel Air Quality also provided a statement indicating that the air quality assessment constitutes a thorough review of high quality.

Based on the outcomes of the air quality assessment, the operational air quality outcomes for the project (both in-tunnel and adjacent to the ventilation facilities) are considered acceptable, with improvements in some areas from traffic moving from surface roads to underground. The Department has recommended limits on in-tunnel and ventilation outlet concentrations of key pollutants, and for an Air Quality Community Consultative Committee (AQCCC) to be established with representatives from the community and local council(s). The AQCCC would have a consultative role on the siting of monitoring locations.

Issue

Air quality, and its potential impacts on the local community, are an important issue in the design, construction and operation of motorway and road tunnelling projects.

Construction dust and odour impacts can be satisfactorily mitigated and managed

Dust emissions and odour from the treatment and stockpiling of dredged harbour sediments at White Bay are the main potential air quality issues during construction. In relation to odour, the assessment concluded that the predicted 99th percentile odour concentrations at all sensitive receivers are below the 2 OU (odour unit) criterion, and well below the theoretical level of detection of 1 OU. While the sensitivity of area, and potential emission magnitude, varies between the types of construction activities undertaken (e.g demolition, earthworks, general construction and track-out by vehicles), off-site dust impacts can be effectively mitigated at the source using a range of industry standard management measures (suppressing dust and/or modifying activities, and ceasing work during adverse weather conditions).

In tunnel air quality criteria can be satisfactorily met, and ambient air quality levels are primarily related to existing background pollutant levels

Operational air quality assessment considered vehicle emissions from the tunnel ventilation system and surface roads. Tunnel ventilation systems would be installed to ensure in-tunnel air quality is protected in terms of human health and amenity, to avoid portal emissions and to manage smoke in the event of a fire from an incident in the tunnels. Emissions generated from traffic using the tunnels would be vented through two ventilation outlets – southbound emissions would be vented at Rozelle (through facilities being built for the M4-M5 link) and northbound traffic emissions at Cammeray. The ventilation outlet at Rozelle would be located adjacent to the Rozelle Interchange and the City West Link in the former Rozelle Rail Yards and the outlet at Cammeray would be next to the Warringah Freeway and the Cammeray Golf Course.

Potential sources of air pollution, in the context of tunnel ventilation, are vehicle emissions and particulate matter (PM) generated from vehicle movements (from fuel combustion and from vehicle wear and tear including from brakes and tyre wear). These pollutants include volatile organic compounds (VOCs) and sulphur dioxide, however the leading indicators in terms of human health are carbon monoxide (CO), oxides of nitrogen (NOx), with nitrogen dioxide (NO_2) being the primary pollutant of interest and PM for visibility.

The operational assessment considered emissions from both tunnel ventilation outlets and surface roads and considered the cumulative impacts of these and background pollutant concentrations. Multiple simulated traffic scenarios were assessed based on expected traffic volumes using the tunnels; theoretical maximum traffic volumes (based on its design capacity at different average speeds); and a breakdown or incident in the tunnels. The assessment concluded that the tunnel ventilation system would maintain in-tunnel air quality well within operational limits for all scenarios modelled. The predicted in-tunnel NO_2 emission limit of 0.5 parts per million (ppm) (rolling 15-minute average) and limits for CO and visibility for the worst-case northbound route through the tunnel would be achieved, during all variable speed operations and all breakdown and major incident scenarios.

In relation to ambient air quality (receivers at ground level) for key pollutants, the assessment determined total ground-level concentration for comparison against relevant impact assessment criteria; the change in total ground-level concentration (calculated as the difference between the “Do something” and “Do minimum” scenarios); and the concentrations of the background, surface road and ventilation outlet sources to the total ground-level concentration. Results for residential, worker and recreational receivers (RWR) indicate that, for the majority of pollutants and receivers, relevant air criteria would be reduced or met. In those circumstances where criteria are not met, the exceedances are related to high pollutant background levels with contributions from the project being minimal.

The assessment also indicated a redistribution of air quality impacts, with the spatial changes showing that the $PM_{2.5}$ annual mean concentration as a result of the project would decrease along the Western Distributor, Sydney Harbour Bridge and Warringah Freeway due to decreased traffic demand. For the cumulative scenarios where the Beaches Link and Gore Hill Freeway Connection was included, there would be reductions in $PM_{2.5}$ annual mean concentrations along Military Road, Spit Road, Manly Road and Warringah Road due to decreased traffic volumes.

Air quality impacts associated with elevated receivers are minor and less than at ground level receivers

The potential air quality impacts of the project were assessed for elevated receivers with a focus on annual mean and maximum 24-hour $PM_{2.5}$ concentrations. Changes in annual mean and maximum 24-hour $PM_{2.5}$ concentrations at all RWR receiver locations (whether an existing building exists or not) and at receiver locations with an existing building at the height are outlined in **Table 9** and **Table 10** respectively.

Table 9 | Changes in annual mean PM2.5 concentrations at elevated receiver locations ("Do something cumulative" 2037 compared with "Do minimum" 2037) (Source: EIS)

Height	Maximum increase in $PM_{2.5}$ concentration at RWR receiver locations ($\mu g/m^3$)(1)	No. of RWR receiver locations with an increase of more than 0.1 $\mu g/m^3$(1)	Maximum increase in $PM_{2.5}$ concentration at RWR receiver locations ($\mu g/m^3$)(2)	No. of RWR receiver locations with an increase of more than 0.1 $\mu g/m^3$(2)
Ground level	0.58	1554 (4.4%)	0.58	1554
10 metres	0.37	998 (2.8%)	0.18	25
20 metres	0.24	590 (1.7%)	0.09	0
30 metres	0.48	447 (1.3%)	0.13	2
45 metres	2.06	499 (1.4%)	0.05	0

Note: (1) assumes all RWR receiver locations exist at all heights irrespective of building heights at those locations
(2) only includes existing buildings that exist at each height.

Table 10 | Changes in maximum 24-hour PM2.5 concentrations at elevated receiver locations ("Do something cumulative" 2037 compared with "Do minimum" 2037) (Source: EIS)

Height	Maximum increase in $PM_{2.5}$ concentration at RWR receiver locations ($\mu g/m^3$)(1)	No. of RWR receiver locations with an increase of more than 0.5 $\mu g/m^3$(1)	Maximum increase in $PM_{2.5}$ concentration at RWR receiver locations ($\mu g/m^3$)(2)	No. of RWR receiver locations with an increase of more than 0.5 $\mu g/m^3$(2)
Ground level	2.20	919 (2.6%)	2.20	919
10 metres	2.07	253 (0.7%)	1.61	43
20 metres	1.46	575 (1.6%)	0.44	0
30 metres	8.67	537 (1.5%)	1.01	2
45 metres	9.02	620 (1.8%)	0.36	0

Note: (1) assumes all RWR receiver locations exist at all heights irrespective of building heights at those locations
(2) only includes existing buildings that exist at each height.

Table 9 and **Table 10** show that there are predicted impacts for potential future buildings above 20 metres in height within 300 metres of the ventilation outlets. However, further investigation would be required at rezoning or development application stages. Within 300 metres of the outlet at Cammeray, current planning controls restrict buildings to below 20 metres.

The project will result in an overall decrease in pollutant levels to the community

The health risk assessment included a detailed review of what impacts could occur, who may be exposed to these impacts and whether there is potential for these impacts to result in adverse health effects or positive benefits within the local community. The health risk assessment concluded that the project is expected to result in a decrease in total pollutant levels within the community, including a redistribution of impacts associated with vehicle emissions, specifically for those emissions from vehicles using surface roads. For most of the community, the resultant impacts from the project would mean no change or an improvement (i.e. decreased pollutant concentrations and health impacts), however for some areas located near key surface roads, a small increase in pollutant concentration may occur but these have been assessed and are considered tolerable/acceptable.

Statement and Review of Tunnel Air Emissions identified acceptable assessment methods and outcomes

The NSW Chief Health Officer engaged Åke Sjödin from the Air Pollution and Abatement Strategies Unit at the IVL Swedish Environmental Research Institute, and Dr Ian Longley, Air Quality Scientist from the New Zealand National Institute of Water & Atmospheric Research, to review the air quality assessment on behalf of the Office of the NSW Chief Scientist and Engineer and the Advisory Committee for Tunnel Air Quality (ACTAQ).

The ACTAQ advises that data used, and methods followed, are logical and reasonable and that the air quality assessment constituted a thorough review of high quality. The NSW Chief Health Officer noted that any potential air pollution-related health effects from the project are likely to be primarily from changes in traffic volumes on the surface road network and not from the tunnel ventilation outlets, and that the project would provide an overall improvement in air quality in the vicinity of the project.

Submissions

Community and interest group submissions

Key issues raised in the public submissions included:

- reduced air quality and associated impacts on health, particularly vehicle emissions from unfiltered ventilation outlets and from surface roads
- dust emissions during construction, including potential silicosis impacts from sandstone dust
- tunnel ventilation design and the spacing of ventilation outlets
- ventilation outlets for both this project and the proposed Beaches Link and Gore Hill Freeway Connection being located at Cammeray
- the adequacy of the air quality assessment and the under-estimated population of schools in the modelling
- ongoing monitoring of local ambient and in-tunnel air quality
- freeway buses leaving engines idling which will increase pollution
- the already high levels of air pollutants for residents close to the freeway.

Government agency and Council submissions

EPA considered that the air quality assessment adequately addressed the requirements of the SEARs and was conducted in accordance with EPA's guidelines. However, it raised a number of information deficiencies including in relation to: meteorological data; flow rates in the regulatory worst

case; the evaluation of elevated receivers; clarification regarding the impacts on annual average $PM_{2.5}$ levels; emission model verification; ventilation outlet temperatures; fleet profile assuming Euro6, total hydrocarbons (THC) and PM_{10} emissions.

NSW Health requires the Proponent to demonstrate that the ventilation system has enough capacity to achieve optimal environmental outcomes in the event that there is more traffic than expected. Increasing the height of the outlets above the currently proposed height should be considered, to help disperse pollutants in addition to maximising exit velocity and ventilation rates, where practical, to benefit local air quality. In relation to in-tunnel air quality, the predictions show that NO_2 levels barely comply under worst case traffic, suggesting that there is no excess capacity to achieve recommended criteria if the modelling has under-estimated pollutant levels. For construction dust, NSW Health considers that regular monitoring and review of dust suppression methods are vital to mitigate construction dust impacts, particularly to sensitive receivers.

NSW Chief Scientist and Engineer appointed two international experts to review the operational air quality assessment. The conclusions of the review stated that the assessment was of high quality, addressed the major issues for a project of this scale and the methods followed were logical and reasonable. The review indicated that the project (as assessed) seems to deliver a small improvement in ambient air quality at a majority of receivers, and a slight worsening in air quality at a minority of receivers, broadly in response to the redistribution of surface road traffic, with large reductions expected on the Warringah Freeway and Western Distributor. The review stated that while the EIS indicated that induced traffic growth is included in the modelling no information was provided regarding the sensitivity of the air quality impacts of the project on that induced demand, nor the magnitude of the potential error in predictions of traffic.

Port Authority of NSW was concerned that the construction air quality assessment did not assess $PM_{2.5}$ impacts or undertake a cumulative quantitative assessment of particles and other pollutants from the project and other projects/proposals in the White Bay area that have the potential to generate air emissions. In addition, concerns were raised regarding the extent and significance of contaminated material to be transferred to and handled at WHT3 and the possible impacts to nearby residential areas from potential odour and volatile emissions.

Inner West Council states that the project is at odds with current government policy including the Greater Region Sydney Plan and Future Transport 2056 which supports net-zero emissions by 2060 including a promotion of low-emission vehicles as it considers that the project would create traffic growth. Council has strong concerns about unfiltered ventilation outlets and supports recommendation 13 from the 2018 Parliamentary Inquiry into WestConnex that the NSW Government install filtration systems on all current and future motorway tunnels, in order to reduce the level of pollutants emitted from ventilation stacks. Council is concerned about the cumulative air quality impacts in Rozelle, particularly from the operation of WestConnex's Victoria Road site, future emissions from the Victoria Road outlet and diesel and dust emissions from the operation of WHT2.

North Sydney Council considers the methodology used to predict impacts in the air quality assessment to be flawed as it assumes that background air quality growth will continue on its current trajectory (under a no project scenario). The modelling results are represented as a portion or measure above projected air quality. Council also considers that not filtering the ventilation stacks does not align with the SEARs "to minimise air quality impacts to minimise risks to human health and the environment to the greatest extent practicable" and believes the additional cost to do so would be

negligible. There is a need to implement real time dust monitoring for construction sites and other high-risk areas.

Mosman Council raised concerns regarding the effect of emissions from the tunnel's ventilation outlets on the health and wellbeing of the surrounding community and is seeking confirmation that air quality will be considered to ensure the health and amenity of surrounding neighbourhoods is maintained.

Consideration

To assist in the consideration and assessment of air quality impacts and obtain independent expert analysis of the air quality assessment, the Department engaged Todoroski Air Sciences Pty Ltd to undertake a specialist review. The review report is provided in **Appendix I**.

Air quality and odour impacts can be effectively managed during construction

The Department accepts the Proponent's conclusion that construction air quality and odour impacts can be effectively managed by implementing the committed measures including:

- implementing dust suppression and/or management measures, including the use of water carts, dust sweepers, sprinklers, dust screens, site exit controls (e.g. wheel washing systems and rumble grids), stabilisation of stockpiles, covering vehicle loads, minimising exposed areas, adjustment of activities during unfavourable weather conditions where possible and undertaking site inspections to monitor compliance
- handling, stockpiling and treating dredged material when wet to minimise odour emissions
- managing dust and air quality complaints in accordance with a complaints handling process and implementing corrective actions, where required, in a timely manner.

In relation to potential odour impacts on adjacent sensitive receivers, particularly those near WHT3, the independent reviewer stated that the assessment methods used by the Proponent can underestimate potential odour emission rates. Notwithstanding, the Proponent has stated that after berthing of the barges at White Bay, lime and/or an inorganic polymer would be mixed with the dredged material prior to offloading for the management of odour and to make the material spadeable. While on the barges, the dredged material would be wet thereby significantly reducing potential odour emissions. The generation of odour from this material is considered to be low, given implementation of the above measures, and that the barges would be located some distance from the nearest sensitive receiver. Additionally, the Department has recommended a condition requiring the preparation of Construction Air Quality and Odour Management and Monitoring plans.

Risks to worker health from silica dust can be managed to ensure compliance with the relevant work health and safety guidelines, and it is anticipated that there would not be any broader silica dust impacts in the community.

The choice of air quality model is appropriate for the project

External air quality impacts were modelled using the GRAMM-GRAL model system. The approach was subject to detailed review by both international air quality experts (on behalf of the NSW Chief Scientist and Engineer) and the Department's independent peer reviewer, who all advised the approach used is adequate for assessing impacts due to the project. The Department is satisfied that the model provides suitable prediction levels of the likely air quality impacts during project operation.

The project would not have significant adverse impacts on air quality

The Department is satisfied that the project is unlikely to result in significant adverse impacts on ambient air quality or significant increases in health risks. The Department has recommended that ambient air quality monitoring be undertaken to enable the observation of any changes in air quality, and to compare these changes with the EIS predictions. In addition, maximum air concentrations for key pollutants have been recommended consistent with the National Environmental Protection Measures for ambient air quality.

The assessment modelled a number of scenarios including a cumulative scenario comprising the project combined with traffic from the existing network, Beaches Link and Gore Hill Freeway Connection, full WestConnex projects, Sydney Gateway, and the M6 Extension, with 24-hour operations of the project for expected day to day traffic demand and worst-case traffic volumes.

The model predicted air quality impacts to 35,490 RWR receiver locations and 42 sensitive community receivers. The results indicated that air quality impacts would reduce in some areas, due to reduced traffic numbers and congestion, and would slightly increase in other areas. The predicted concentrations of all key pollutants were generally dominated by the existing background concentration levels and predicted changes were more a result of changes in traffic volumes on the surface road network, rather than the tunnel ventilation outlets. For short term air quality criteria (1-hour NO_2, 24-hour PM_{10} and 24-hour $PM_{2.5}$), exceedances were predicted to occur with and without the project. However, the number of receivers with exceedances decreased slightly with the project and in the cumulative traffic scenarios. A summary of the predicted maximum increases in key pollutant levels is summarised in **Table 11**.

The predicted 1-hour NO_2 and 24-hour $PM_{2.5}$ concentrations are dominated by background contributions from heavily trafficked roads. Concentrations are elevated at some receivers, with the highest levels of 1-hour NO_2 predicted along Manly Road at The Spit which currently experiences elevated levels of vehicle emissions (with traffic volumes of around 65,000 vehicles per day), while increases in concentrations were also predicted along the Warringah Freeway, Falcon Street, Gore Hill Freeway and Victoria Road in Rozelle.

The largest increase in maximum 24-hour mean $PM_{2.5}$ concentration (of 2.1 µg/m^3) occurred at The Spit. It is predicted, however, that this area would experience reductions in both 1-hour NO_2, annual mean NO_2 concentrations and maximum 24-hour mean $PM_{2.5}$ in the 2027 cumulative scenario, with the operation of the Beaches Link and Gore Hill Freeway Connection project.

Table 11 | Summary of the Predicted Maximum Increases in Pollutant Levels (Source: EIS)

Pollutant	Air Quality Goal	Time Period	Highest concentration in any scenario	Maximum project concentration surface roads	Maximum project concentration ventilation outlet	Largest increase at any receiver in any scenario
Carbon monoxide (CO)	30 mg/m^3	1 hour	5.5 mg/m^3 (background 3.13 mg/m^3)	2.39 mg/m^3 (combined road, portal and vent)	<0.1 mg/m^3	0.9 mg/m^3

	10 mg/m^3	Maximum rolling 8 hour mean	3.13 mg/m^3	16 per cent	0 or negligible	0.09 mg/m^3
Comment: No exceedances of the carbon monoxide air quality goal, with the 1-hour and maximum rolling 8 hour mean concentrations well below the criteria at all receivers.						
Nitrogen Dioxide (NO_2)	62 µg/m^3	Annual mean	37.7 mg/m^3	22 µg/m^3	0.6 µg/m^3	2.9 µg/m^3
	246 µg/m^3	Maximum 1-hour mean	**445** µg/m^3 (background 187 µg/m^3)	258 µg/m^3 (combined road, portal and vent)	60 µg/m^3	128 µg/m^3
Comment: NO_2 Annual Mean goal not exceeded at any community or RWR receivers. More than 97% of receivers were between 13 and 25 µg/m^3. Only 0.8% of receivers had an increase greater than 1.0 µg/m^3. NO_2 maximum 1-hour mean air quality goal not exceeded at any community receivers, however, goal exceeded at 201 RWR receivers (0.6% of all receivers) but this is reduced to 183 receivers (0.5%) with the project in 2027 and decreased further to 86 receivers (0.2%) for the Do Something Cumulative Scenario in 2037.						
PM_{10}	25 µg/m^3	Annual mean	23.5 µg/m^3	6.6 µg/m^3 Average 0.8-0.9 µg/m^3	0.3 µg/m^3	0.8 µg/m^3
	50 µg/m^3	Maximum 24-hour mean	**70** µg/m^3 (background 48 µg/m^3)	22 µg/m^3 (combined road, portal and vent)	1.3-1.6 µg/m^3	4.4 µg/m^3
Comment: PM_{10} Annual Mean goal not exceeded at any receivers. There was an increase in concentrations at 43-52% of receivers with the project and in the cumulative scenarios; however, increases of over 0.5 µg/m^3 occurred at only a very small proportion of receivers. The PM_{10} Maximum 24-hour mean goal exceeded at all RWR receivers with an increase in concentration predicted at 36-46% of RWR receivers (depending on the scenario). Less than 10% of RWR receivers (depending on scenario) had an increase greater than 0.5 µg/m^3.						
$PM_{2.5}$	8 µg/m^3	Annual mean	**11.9** µg/m^3	4.1 µg/m^3	0.18 µg/m^3	0.6 µg/m^3
	25 µg/m^3	Maximum 24-hour mean	**35.1** µg/m^3 (background 22.1 µg/m^3)	13 µg/m^3 (combined road, portal and vent)	1.0 µg/m^3	2.1 µg/m^3
Comment: Background $PM_{2.5}$ concentrations exceeded the annual mean goal for all receivers. An increase in concentration was predicted at 41-70% of RWR receivers (depending on the scenario considered). An increase greater than 0.1 µg/m^3 was predicted at 4-5% of RWR receivers. The $PM_{2.5}$ maximum 24-hour mean goal would increase at between 36-50% of receivers (depending on the scenario) with the largest increase being 2.1 µg/m^3 for the 2027 Do Something scenario and the largest decrease 6.3 µg/m^3 for the 2037 Do Something Cumulative scenario. The number of RWR receivers exceeding the air quality goal reduced with the project.						

* RWR: residential, worker and recreational receivers

Contour plots showing the changes in the maximum 1-hour NO_2 and maximum 24-hour mean $PM_{2.5}$ concentrations in the 2037 cumulative scenario (2037 Do Something Cumulative minus the 2037 Do Minimum scenario) are provided in **Figure 22** and **Figure 23** and show notable reductions in concentrations along the existing surface routes.

The Proponent stated that the combination of conservative factors used in the assessment, including traffic volumes, vehicle emissions and background levels, has contributed to the high predictions and the Department accepts that such levels would be unlikely to occur. Similarly, the high maximum 24-hour mean PM_{10} and $PM_{2.5}$ concentrations are due to high background levels (as outlined in **Table 11**) and the conservative assessment approach.

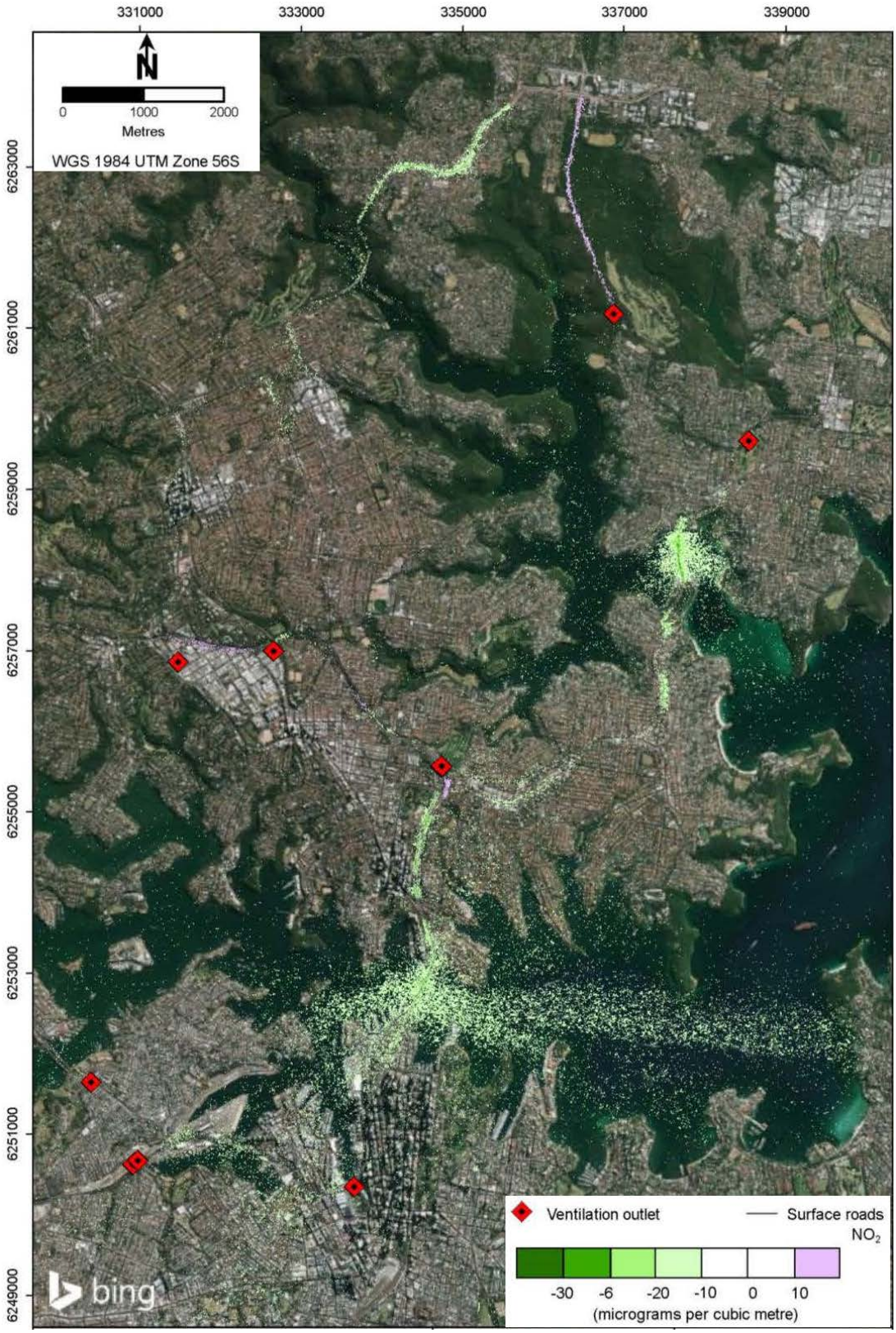


Figure 22 | Contour plot of change in maximum 1-hour NO2 concentrations in the 2037 cumulative scenario (2037-DSC minus 2037-DM) (Source: EIS)

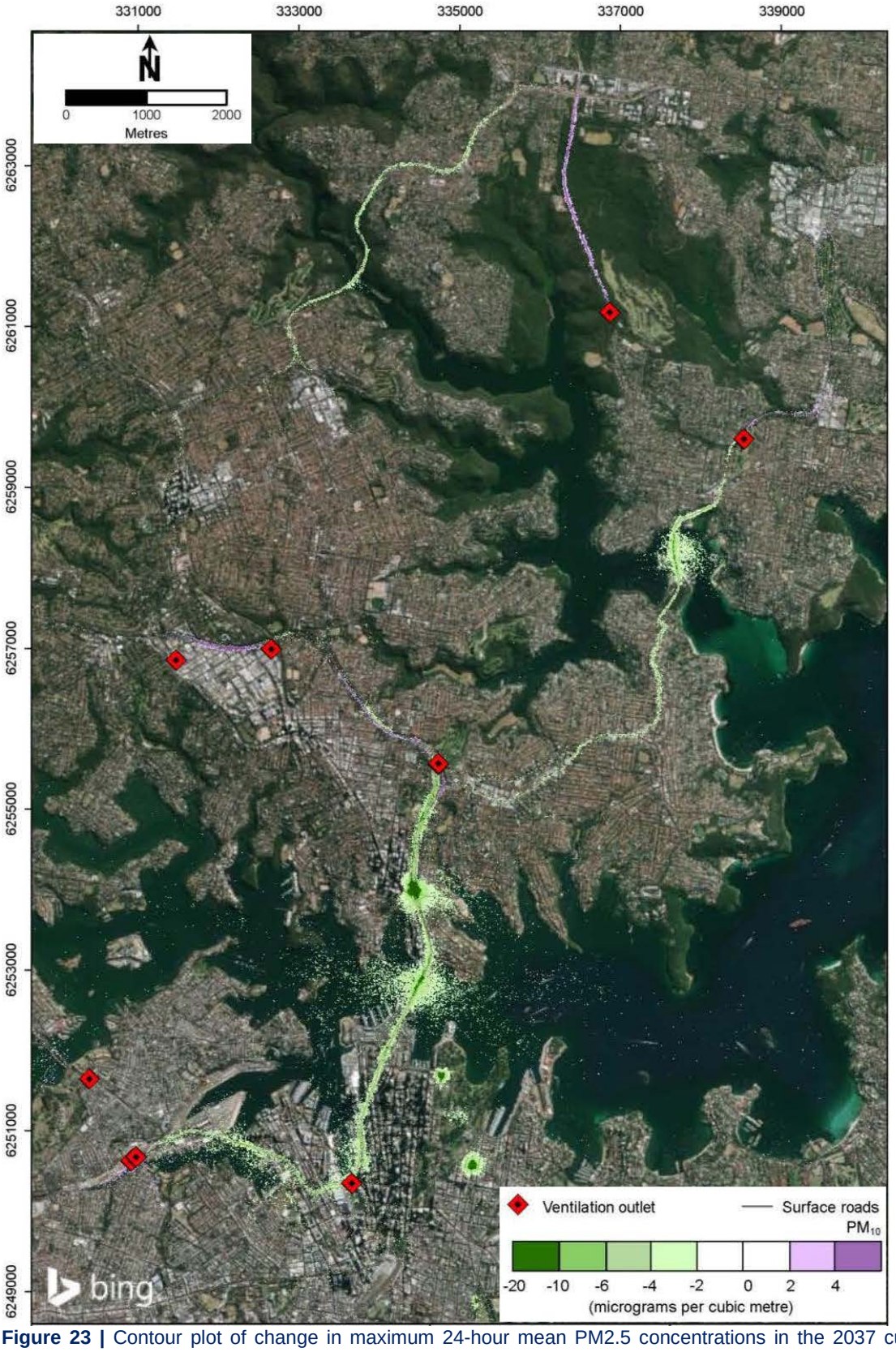


Figure 23 | Contour plot of change in maximum 24-hour mean PM2.5 concentrations in the 2037 cumulative scenario (2037-DSC minus 2037-DM) (Source: EIS)

The human health risk assessment indicates that the maximum increases to risk during operation of the project as a result of changes in ambient air quality are acceptable. The health assessment further states that the elevated levels of NO_2 listed in **Table 11** are not considered to be representative of

exposure concentrations due to the combined effect of the approach adopted in the assessment for converting NO_x to NO_2 (that over-estimates short term 1-hour average concentrations). Even when the less stringent Euro 5 emission requirements (as opposed to the future Euro 6 emission requirements) are applied for tunnel emissions, the outlets would not account for exceedances of the air quality criteria. This was clarified by the Proponent in its RtS.

Compliance with criteria to be subject to extensive monitoring and reporting

The Department has addressed the concerns raised by the public and local councils regarding ambient air quality impacts through compliance-based conditions requiring effective monitoring and reporting including:

- provision of real time air quality data recorded at air quality monitoring stations
- independent external auditing and other quality assurance measures for monitoring data
- reporting to the Department and relevant agencies when external air quality goals are exceeded.

Consistent with other motorway tunnel projects, the Department has recommended the establishment of an Air Quality Community Consultative Committee (AQCCC), comprising representatives from the community and relevant local councils. The Department considers that such participation would benefit the operation of the project as the AQCCC would provide input into the location of ambient air quality monitoring sites and review any air quality reports.

The tunnel ventilation design and operation is required to meet comprehensive air quality criteria

The Department is satisfied that the project and its ventilation system can be designed and operated to avoid portal emissions, reduce pollution concentrations within the tunnel and ensure air quality standards are met under all traffic scenarios. Further, the number and location of ventilation and emergency exhaust outlets, fresh air intakes and tunnel ventilation fans would be designed to ensure air quality within the tunnel is maintained. The ventilation system would be automatically controlled based on real-time air velocity and air quality data.

To ensure that design outcomes are met, the Department has recommended in-tunnel air quality limits for the three parameters of NO_2, CO and visibility (PM). The recommended conditions would also reinforce that the ventilation systems are designed, constructed and operated to only release emissions from the ventilation outlets, not from portals or tunnel ancillary facilities (except in an emergency). The Department has also recommended conditions for monitoring in-tunnel air quality, notification and reporting requirements in the event that in-tunnel air quality limits are exceeded.

Numerous submissions raised the issue of the ventilation outlets being spaced too far apart, and the proposed co-location of the project's northbound outlet with the future Beaches Link southbound outlet at Cammeray. The approach of co-locating ventilation outlets was adopted in the recent M6 Extension project, where outlets for the M6 (Stage 1) and M8 tunnel projects are located within the Arncliffe Ventilation Facility. The co-location of the outlets for projects is not considered to be problematic and can lead to enhanced buoyancy of pollutants and therefore greater dispersion. The cumulative air quality impacts of the co-location, however, must be considered in the final design of the outlets.

In tunnel air quality will not have a significant impact on driver health

The health assessment considered a range of tunnel travel distances, where users of the Western Harbour Tunnel may also use part or all of other connecting tunnels for their trip. This may include Beaches Link tunnels, WestConnex and the M6 Extension. A conservative approach was taken, and consideration was given to the use of the full network including a 30-kilometre trip (from the M8 portal to the Wakehurst Parkway), and a 28 kilometre trip (from the M6 Extension to the Wakehurst Parkway). The maximum 1-hour average concentration of CO in the tunnel is predicted to be six ppm in all scenarios, including the worst case, which is lower than the health-based WHO guideline of 25 ppm and lower than 34 ppm established by the USEPA. The maximum in-tunnel concentrations of NO_2 at any point in the tunnel would vary from 0.1 ppm at the tunnel entry to just under 0.5 ppm at the exit at North Sydney or Warringah Freeway when travelling northbound (when travelling between 77-80 km/hr in mainline tunnel and 55-63 km/hr on ramps).

The average exposure of the whole trip is estimated at 0.24 ppm (with windows down) and lower concentrations with the windows up and vehicle ventilation on recirculation. The assessment identified that average NO_2 concentrations would generally be less than 0.15 ppm but could increase to up to 0.7 ppm during periods of high traffic volumes with a high proportion of heavy vehicles. However even at these levels, the average concentration inside the vehicle when ventilation was on recirculation, would be less than 0.2 ppm.

NSW Health recommended that messaging signage be included at the entrance, and throughout the tunnels, to instruct tunnel users to close windows and turn on recirculated air to mitigate risks for tunnel users, particularly those sensitive to NO_2. The Department agrees, and has recommended a condition to this effect.

The project has been designed to meet air quality standards without filtration

The assessment demonstrates that the design of the tunnel and its efficient operation can allow relevant air criteria to be met. The Department also notes that emitting in-tunnel air pollutants through an elevated ventilation outlet, via a mechanical ventilation system, is a verified practice for managing major road tunnels worldwide. The Department has recommended a condition, similar to that for other major road tunnels, requiring the ventilation system to be designed to avoid emissions from the entry and exit portals (except in emergency situations) and to periodically test to ensure that air quality discharge limits are being met.

The majority of submissions received relating to air quality, including those from Inner West Council, North Sydney Council and Mosman Council, raised concerns about not filtering the ventilation outlets and the potential adverse health impacts from increased levels of pollutants being emitted in a concentrated location from the ventilation outlets, particularly those at Cammeray. The air quality assessment predicted that the maximum contribution from the ventilation outlets would be minimal during all likely traffic scenarios. This was supported by the independent air quality review.

Elevated ventilation outlets are more effective at dispersal and dilution of air pollution than portal emissions and are key to achieving acceptable air quality at surrounding receivers. This conclusion was also supported by the independent air quality reviewer, which stated that by improving traffic flows, the quantity of traffic emissions can be reduced. By dispersing the emissions from ventilation outlets into a larger volume of air than can occur for surface road emissions, the ambient ground level pollutant levels across the area can be improved overall.

In February 2018, the NSW Premier announced that all future road ventilation outlets would be regulated by the EPA. Requirements relating to emission concentrations, monitoring and reporting are now included in the EPL. The Department has therefore recommended conditions which require the Proponent to monitor ventilation outlet emissions and set strict limits on the emission of NO_x, PM (solid particles), CO and volatile organic carbons (VOC). Recommended conditions also include requirements for notification and reporting to the EPA, NSW Health and the Department where emission levels exceed the recommended limits. The EPA has reviewed the worst-case scenario and is satisfied that the ventilation outlet emission limits proposed in the recommended instrument of approval are suitable.

Overall, the Department is satisfied that the predicted external air quality impacts are acceptable, but considers that the Proponent should continue to review and refine its tunnel ventilation design to reduce the level and concentration of pollutants. The Department has therefore also recommended that the design of the ventilation system allow for future modifications or retrofitting with minimal disruption, should policies be introduced and/or strengthened that would require this.

The Department has also recommended that an Air Quality Independent Reviewer be appointed. The AQIR would be approved by the Department and would be required to review and endorse the adequacy of the in-tunnel and ventilation outlet air design and air quality monitoring requirements. This independent oversight would provide confidence to the Department, EPA and the community that the project has been designed so that it can be operated to meet the stipulated air quality criteria.

There are no significant air quality impacts to elevated receivers

The modelling for elevated receivers, such as high-rise residential buildings, did not identify any significant impacts. It is also unlikely, based on current development controls, that future buildings would be affected.

Air quality impacts to elevated receivers was raised as an issue of concern in both public submissions and submissions from the EPA and Council, particularly in relation to future high-density development surrounding ventilation outlets. The depiction of tall buildings near ventilation outlets, potential wake effects associated with buildings, and impacts on receivers within the building, was considered by the independent air quality specialist.

Modelled concentrations for project impacts from surface roads were predicted at four elevated receiver heights above ground level (10, 20, 30 and 45 metres (whether an existing building existed at this height or not)) for annual mean and maximum 24-hour mean $PM_{2.5}$ concentrations. The largest increases in annual mean $PM_{2.5}$ concentrations at modelled receivers at these heights are 0.37, 0.24, 0.48 and 2.06 µg/m^3 respectively and for maximum 24-hour mean $PM_{2.5}$ concentrations, 2.07, 1.46. 8.67 and 9.02 µg/m^3 respectively. The results indicate that there are no significant adverse impacts at existing buildings at any height, however there is potential for adverse impacts for future buildings above 20 metres high within 300 metres of the ventilation outlets.

Current planning controls for restrict buildings to below 20 metres within 300 metres of the Warringah Freeway ventilation outlet location, but there are no planning restrictions near the Rozelle Interchange outlet. The Department considers that all future medium and high-rise development adjacent to the ventilation facilities should consider the impacts from, and their impact on, air dispersal from the ventilation outlets. It has therefore recommended a condition requiring the Proponent to assist the relevant council in developing required air quality guidance to manage future development in the vicinity of the ventilation outlets.

6.4 Place and Urban Design

The place based outcomes for the project are limited when compared to other major transport projects in the region such as Sydney Metro – Chatswood to Sydenham and the WestConnex projects. This is partly with the project being delivered in a constrained corridor, particularly the Warringah Freeway Upgrade component which limits design alternatives, and the inherent tension between positive place outcomes and motorway projects.

The Department acknowledges that the Proponent has sought to address these impacts through the provision of enhanced public space designs and facilities at Berrys Bay and Yurulbin Park. However, there is a concern that these proposals do not adequately reflect the impacts of the project. To address these issues the Department has sought the provision of improved active transport facilities and greater connectivity through a comprehensive review process, which will also address any deficiencies in the proposed facilities.

The overall design of the project will be improved through the recommended design review process and specific outcomes required in locations where the Department considers the proposed impacts need to be further refined. The Department also considers that the proponent should continue to refine its design to meet the objectives of the North Sydney Integrated Transport Plan.

Issue

The Proponent assessed the urban design, landscape character and visual impacts of the project based on a strategic urban design framework it developed for the project

The key areas to be visually impacted by the project include areas within the vicinity of the Warringah Freeway Upgrade works, Yurulbin Park at Birchgrove, Berrys Bay, and Cammeray Golf Course. These impacts include temporary and permanent removal and modification of public open space, direct views of the project alignment, new active transport bridges and loss of trees.

Upgrades along the Warringah Freeway will have visual impacts to adjoining residents

The Proponent's assessment identified several moderate-high and high visual impact ratings which are expected at properties in the adjoining residential suburbs and public areas during construction and operation of the project. This is primarily due to existing vegetative screening along the Warringah Freeway being removed to allow for additional traffic lanes (including the reconfiguration of the bus transit lane), and the inclusion of operational infrastructure into the landscape.

The highest visual impacts are likely to occur at properties along Alfred Street North due to the installation of a new southbound bus on-ramp from Falcon Street, a dedicated bus lane, a general traffic overpass that would run adjacent to Alfred Street North, and the replacement of the Ridge Street pedestrian overpass as shown in **Figure 24**.

Other areas that would experience high visual impacts are residents that would have line of sight to the new operational motorway facilities (at Cammeray Golf Course) and the ventilation outlet in the road corridor north of the Ernest Street bridge. Visual impacts at Rozelle Rail Yards are considered negligible as the visual impacts of the tunnel portal are in keeping with the visual setting of the M4-M5 Link Rozelle Interchange. The works to be undertaken for the Western Harbour Tunnel at the Rozelle Rail Yards under this approval include the fitout of the tunnel and ventilation facility, impacts of which were assessed under the M4-M5 Link approval.

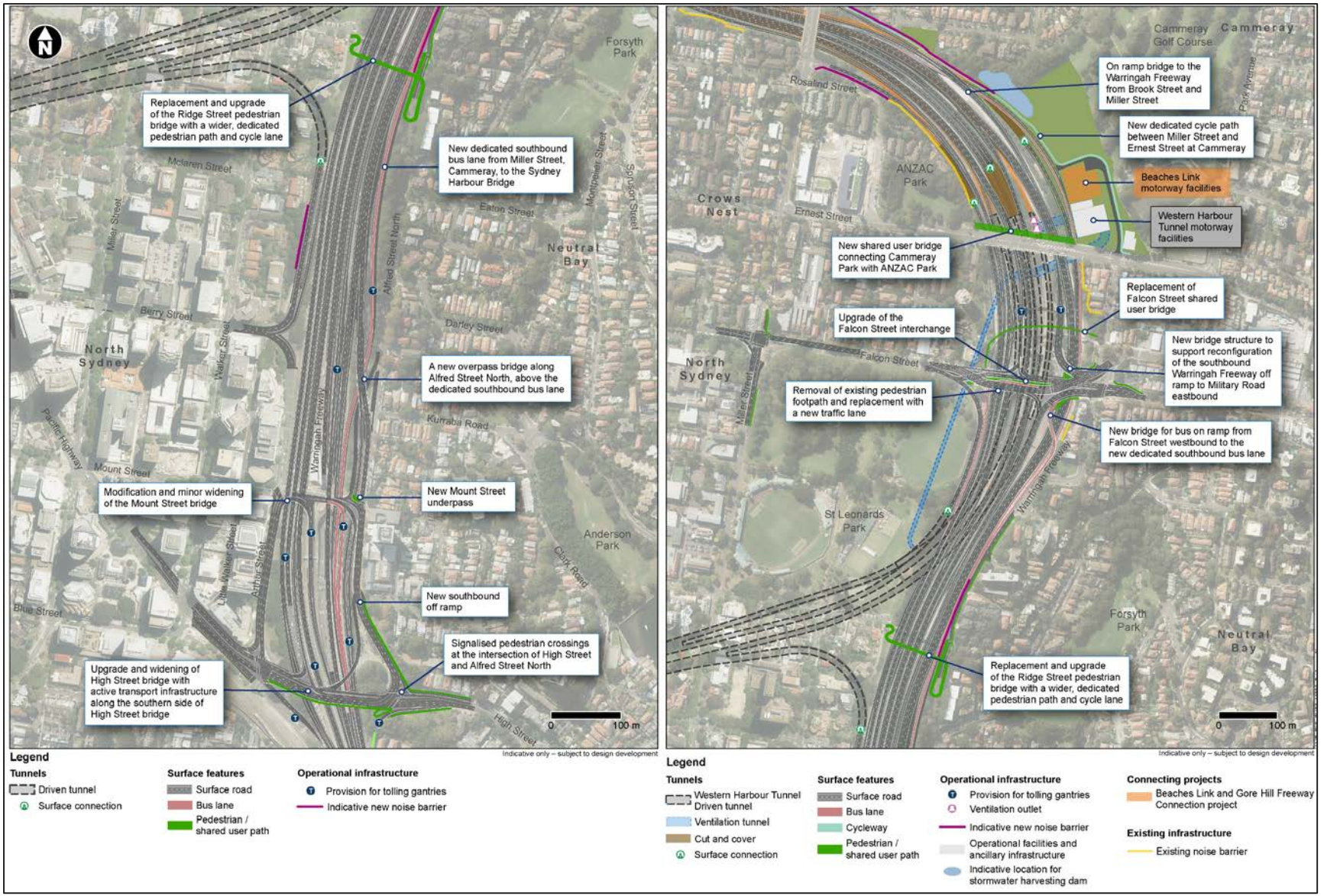


Figure 24 | New infrastructure along the Warringah Freeway (Source: EIS)

The project would have both temporary and permanent impacts to public space, including Cammeray Golf Course

The project includes a variety of temporary construction ancillary sites and permanent operational facilities, and new roads constructed on land that is currently public open space. Temporary impacts during construction would occur at Yurulbin Park, St Leonards Park, ANZAC Park and Cammeray Golf Course. Impacts to currently fragmented open space at High Street and Merlin Street Reserve would also occur.

Permanent impacts to public open space occur at St Leonards Park and Cammeray Golf Course due to widening of the Warringah Freeway, and the placement of the motorway and ventilation facilities, respectively.

The Proponent states the temporary and permanent impacts to open space have been designed to reduce the need for property acquisition. The Proponent has also identified that benefits of the project include opportunities to enhance the local community by improving shared user connections and providing new public open space at St Leonards Park, Berry's Bay and the Ernest Street Shared User path. Impacts to a small portion of Anzac Park would occur as a result of flood mitigating drainage works, enabling the park to continue being used as public open space during construction. The foreshore land at Berry's Bay is proposed to be delivered, in consultation with key stakeholders, as a new public open space following its use during construction.

The visual impacts of the construction ancillary site at Yurulbin Park would result in high impacts to the dwellings along Louisa Road and Wharf Road from increased built form and loss of vegetation. After the project is complete, and Yurulbin Park is no longer needed as a construction ancillary site, the park would be reinstated, in collaboration with the original landscape architect who designed the park. The Proponent has stated that the landscape architect identified deficiencies in their original park design and has prepared a revised landscape plan (as seen in **Figure 25**).

A motorway facilities building, new access road, and active transport link between Miller Street and Ernest Street is also proposed (as seen in **Figure 26**). The result of these new permanent facilities would require the golf course to be reconfigured into a shortened course and to a lower standard. The Proponent is in discussions with the golf club on how to address these impacts.

Limited pedestrian and cyclist infrastructure is proposed

The Proponent would provide alternative routes for pedestrian and cyclists where routes/paths are physically affected by construction works. The impacts to pedestrian and cyclist access are expected to be moderate and manageable.

The project would reinstate the Ridge Street and Falcon Street active transport bridges across the Warringah Freeway to allow for the reconfiguration of traffic lanes. New active transport links are proposed at Ernest Street and High Street and a cycle link is proposed between Ernest Street and Miller Street (as seen in **Figure 26**).

Figure 25 | Yurulbin Park upgrade sketch (Source: EIS)

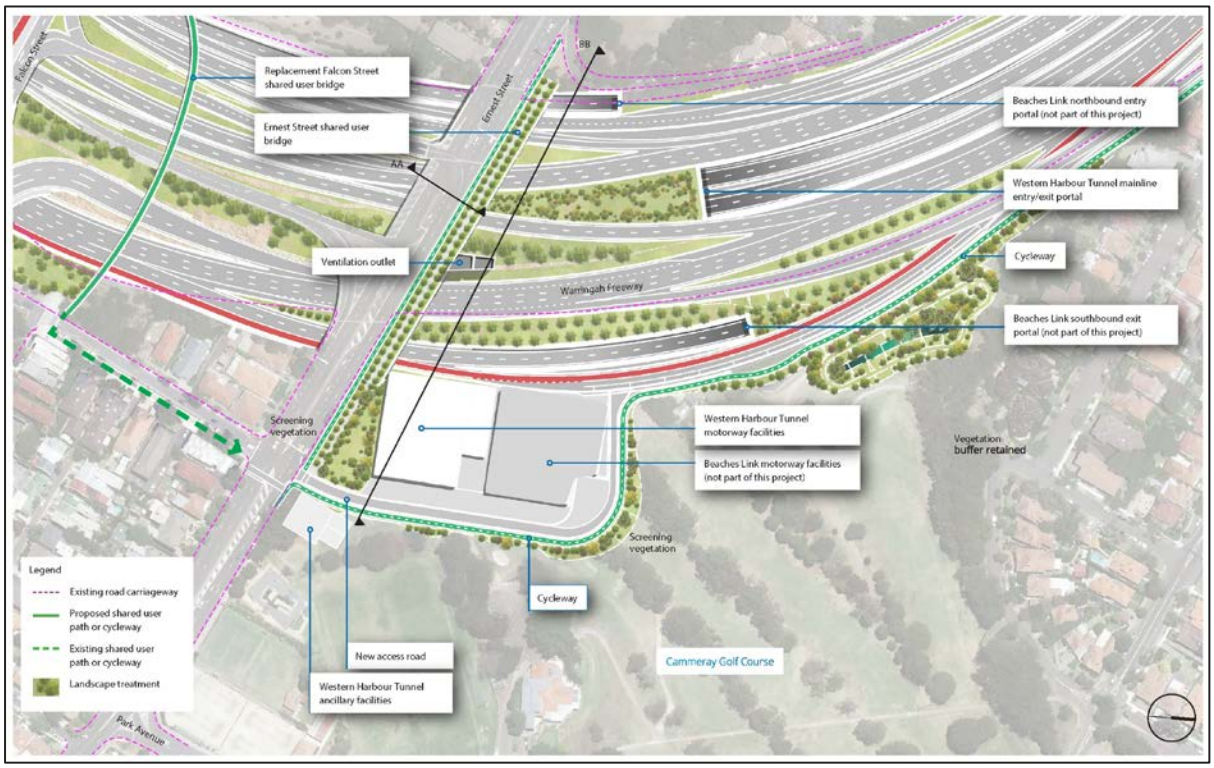


Figure 26 | Cammeray Golf Course Concept Plan (Source: EIS)

Submissions

Community and special interest group submissions

Issues raised in public submissions included:

- lighting impacts within the North Sydney LGA, including in Cammeray and Neutral Bay
- land impacted at Cammeray Golf Course must be returned to open space or the golf course reinstated
- no net-loss of public open space should occur and impacts to vegetative screening
- the proposed Alfred Street North overpass would have visual impact to adjacent residents and to the Whaling Road Heritage Precinct
- loss of on street parking
- operational facilities at Cammeray Golf Course should be designed to be underground and include a green roof
- visual impacts of acoustic sheds on adjacent properties
- use of Yurulbin Park as a construction site including a lack of mitigation from the construction works and the replacement of impacted trees with mature trees to reduce visual impact
- concerns regarding the long-term maintenance of trees planted as part of the project
- a land bridge should be constructed across the Warringah Freeway to provide new public open space
- the proposed Falcon Street bus overpass would have visual and traffic noise impacts to adjoining residents
- insufficient active transport linkages are proposed across the Warringah Freeway and the Harbour Bridge.

Government agency and Council submissions

North Sydney Council raised concerns regarding:

- inadequacy of information provided within the EIS not fully addressing the SEARs
- perspectives of photomontages are distant from features and are obscured by vegetation
- removal of vegetation, open space and visual impacts along the project corridor from residential, heritage conservation areas and public open space areas.

Inner West Council raised concerns around:

- loss of public open space, trees and features of value at Yurulbin Park
- lack of detail of temporary structures to be installed at the Victoria Road construction ancillary site, reducing the ability for visual impacts to be verified
- Urban Design objectives listed would be undermined by motorways and enhanced by public transport.

Willoughby City Council noted the:

- loss of public open space
- possibility of introducing land bridges over major roads that incorporate enhanced pedestrian access
- need to retain or replace trees like those that require removal in and around the Warringah Freeway.

Consideration

High quality design outcomes would be informed through place, design and landscape planning and independent review

The project would have a high visual impact, particularly in relation to works being undertaken for the Warringah Freeway Upgrade. To ensure these impacts are minimised, the detailed design of the project will be subject to independent design review and approval.

The Proponent has committed to developing a Place, Design and Landscape Plan (PDLP) to ensure the detailed design of the built form, public open space and landscape design components of the project are informed by the Urban Design Framework (UDF) of the project. The UDF would inform the urban design and establish the benchmarks for the project. The UDF urban design objectives are:

- identity and user experience
- integrated design
- connectivity and legibility
- urban renewal and liveability
- living environments
- sustainability.

The PDLP would also include details of where vegetation would be retained, where planting is proposed and how Aboriginal and non-Aboriginal heritage interpretation and public art would be incorporated into the design of built features. As the project would have significant impacts to place and community cohesion, the Department has recommended a condition requiring the preparation of a Place and Design Landscape Plan, in consultation with relevant councils.

The Proponent established a Design Review Panel that met during the reference design, and during preparation of the EIS. However, the Panel was not reformed during the preparation of the RtS, with its last meeting occurring in April 2018. In consultation with the Government Architect NSW, the Department considers that the project would benefit from an independent Design Review Panel to provide design advice on the PDLP, key design elements, and on the structures and flyovers across the Warringah Freeway, and has recommended a condition to this effect. The Panel would be chaired by the Government Architect (or nominee) and consist of qualified, experienced and independent professionals in the fields of urban design and placemaking, landscape architecture, architecture, Aboriginal cultural heritage and non-Aboriginal cultural heritage.

The widening of the Warringah Freeway would introduce a number of amenity impacts to adjoining areas and residences, including:

- Kuraba Road/Alfred Street North overpass, with high visual and amenity impacts to residents and impacts on the Whaling Road HCA (as seen in **Figure 27**)
- Merlin Street, as a result of the close proximity of the new Falcon Street bus ramp and the associated removal of screening vegetation (as shown in **Figure 28**).

Figure 27 | Kurraba Road/Alfred Street North Overpass and dedicated bus lane (Source: EIS)

Figure 28 | Falcon Street bus on ramp (Source: TfNSW community interactive website)

In relation to the Kurraba Road/Alfred Street North Overpass, while the structure is a significant new inclusion within the landscape, the Department considers that the visual impact would be reduced over time, with screening vegetation and high quality urban design of the bridge. The design of the bridge would be included and assessed as part of the PDLP process.

Specifically, the impacts to 4 Merlin Street from the Falcon Street on ramp, are considered to be significant, with the project being approximately 10m from the building and at an elevated height thus introducing visual, lighting and noise impacts. Accordingly, the Department has recommended a condition to ensure that these impacts are appropriately mitigated or offset during detailed design in consultation with the property owner.

Lighting impacts can be managed using the proposed mitigation measures

The Department acknowledges the issues raised in submissions received from the public regarding the potential impacts from light pollution to properties along the Warringah Freeway, including Cammeray Golf Course, during both construction and operation. Due to the existing light spill from the Warringah Freeway, the surrounding properties already experience light impacts. However, many of these would be exacerbated by construction ancillary sites along the Warringah Freeway during out of hours works. During operation, additional moderate light impacts would result from the inclusion of new built features, including the overpass at Alfred Street North, shared user bridge between Ridge Street and Alfred Street North, and the Cammeray Motorway Facilities.

Mitigation measures would be implemented by the Proponent to manage residual night lighting impacts to affected properties. The Department has also recommended that the Proponent construct and operate the project with the objective of minimising light spill, and be consistent with the relevant Australian Standards.

A net-increase in public open space is required

The project will impact a number of areas of open space that are actively used by the community. While the Department's assessment has identified that there may not be a net loss, it considers it prudent to include a condition to ensure the project provides an increase in open space.

The project would have a significant impact on several areas of public open space, with temporary impacts during construction at Yurulbin Park, Berrys Bay, St Leonards Park and Anzac Park, and permanent impacts at Cammeray Golf Course. The permanent impacts at Cammeray Golf Course requires reconfiguration of the golf course to ensure it can still operate as a 9-hole course, while approximately 15,000m^2 of public open space would be permanently lost. This impact is exacerbated by the proposed Beaches Link and Gore Hill Freeway Connection project which proposes to co-locate a motorway facilities building within the Golf Course site (approximately another 10,000m^2).

The Proponent has committed to providing additional public open space at Berrys Bay, with approximately 15,800m^2 new public open space provided. Yurulbin Park would be reinstated following the completion of construction activities, including design input from the original landscape architect. Reinstatement of the south-eastern corner of St Leonards Park has also been proposed and rehabilitation of the site would be undertaken in consultation with North Sydney Council.

A new Ernest Street shared user path is proposed which would provide a further 1,800m^2 of public open space. This initiative is supported by the Department. However, the Department does not agree with the Proponent that this should be counted towards providing an increase in open space as it

does not meet the requirements of usable open space under the draft NSW Public Space Charter (DPIE 2020).

The Proponent has committed to identifying further opportunities for public open space during detailed design. While some additional public open space would be provided, the Department remains concerned about the net loss of public open space that would occur as a result of the project. In this regard, and to ensure that the loss of existing public open space is offset with usable public open space, the Department has recommended a condition requiring the provision of a net-increase in publicly accessible and useable public open space.

Berrys Bay would be redeveloped into new public space in consultation with the community and council

The development of open space and facilities at Berrys Bay is a key open space impact initiative. To ensure this is appropriately developed and implemented, the Proponent has committed to actively engaging with the community and North Sydney Council.

Once construction at the site is complete, the Proponent would ensure approximately 15,800m^2 of public open space is returned to the community. A reference group would be established with key stakeholders including council, the community and independent experts to develop the final layout of the area. The Proponent has stated that one of the urban design requirements for the site is the views across Berrys Bay from nearby residential dwellings are not impacted post-construction. The Proponent's visual impact assessment indicates that the operational landscape character impacts from the site are expected to be negligible.

North Sydney Council expressed a desire to lead the community consultation and preparation of design plans for future public open space at Berrys Bay. Council also requested that the NSW Government fund the creation of the parkland as outlined in Council's plans for the parkland. To facilitate the conversion of this land to new publicly accessible foreshore, the Department has recommended a condition requiring an appropriately qualified landscape architect design the new public open space in consultation with North Sydney Council and the NSW Government Architect. The new Berrys Bay area would also provide an extended path along the foreshore linking Carradah Park with Balls Head Road. The final design of Berrys Bay would form part of the PDLP.

The reconfiguration of Cammeray Golf Course must consider the current playing standard

Land acquisition at Cammeray Golf Course may impact the viability of the golf club. The Department considers that the reconfiguration of the golf course must ensure that an equal playing standard is provided, or that this be offset with other facilities or services.

A motorway facilities building, new access road, and active transport link between Miller Street and Ernest Street, would be provided at the Cammeray Golf Course site (as seen in **Figure 26**). As a result of these new permanent facilities, the existing golf course is to be reconfigured.

The motorway facility would result in a loss of approximately 15,000m^2 of public open space at Cammeray Golf Course. The projected total loss of open space at the golf course, including the Beaches Link and Gore Hill Freeway Connection project, would be approximately 25,000m^2.

The Department considers that the Proponent's commitments in relation to the impacts at the golf course are insufficient, as replacement open space is occurring primarily at Berrys Bay and not in the general location of the loss. This impacts the functionality and viability of the golf club. The

Department understands that the provision of additional open space at this location would be costly, if provided through a land bridge connecting Anzac Park and the golf course, or through the acquisition of adjoining private property (primarily residences). In its acceptance of these arguments, the Department considers these impacts should then be offset through maintenance of current golfing standards or improved facilities, such as improved active transport accessibility to other open space.

Following discussions with the Cammeray Golf Club, the Department has recommended a condition to facilitate the establishment of a course which meets the current playing standard, or provision of alternate resources or facilities to offset this impact.

Yurulbin Park will be redesigned by the original architect to achieve the intended vision of the park

The Proponent has committed to engaging the original landscape architect of Yurulbin Park, Bruce Mackenzie and Associates, who were responsible for the original design of the park. The current park features 1970's landscape architecture whilst retaining elements of the working shipyards. However, due to constraints when the park was first developed, the soil depths and subsurface drainage were not suitable for the long-term growth of some of the trees. The park would be redesigned in-line with recommendations from the original landscape architect and incorporate elements from its use as an construction ancillary site.

The engagement of the original landscape architect is supported, and the Department is generally satisfied that the proposed mitigation measures provide a suitable beneficial outcome for both the park and the community.

A condition has been recommended which requires the Proponent to include the design for the park in the PDLP. The design must incorporate Aboriginal art, interpretative landscape features to illustrate former uses of the park, adequate soil depths, provision of a viewing platform, safe and compliant access to the ferry wharf and consideration of the *Disability Discrimination Act 1992*. The condition also requires the design to be delivered and the park returned to public open space as soon as practicable following the site's use for construction.

Active transport links and connections to be investigated further and enhanced

The active transport measures proposed by the Proponent are limited, and there is uncertainty on the adequacy of the project addressing both existing and future demand and addressing impacts to open space. Accordingly, the Department has recommended that the Proponent undertake a comprehensive review of the active transport components of the project.

A new shared user path is proposed to be provided alongside the existing Ernest Street Bridge to link the existing active transport connection between Cremorne and Anzac Park. Details of how the path would tie into active transport connections on the western side of the Warringah Freeway were not provided. Another new active transport link would be provided along the existing High Street bridge to provide a link between Kirribilli and North Sydney CBD.

Although the project would provide public benefit through some limited upgraded active transport facilities, a number of submissions from the community, special interest groups and councils requested improvements to the existing network and new active transport facilities provided around and across the Freeway corridor. This approach is supported by the Department, which considers that the proposed active transport infrastructure is limited in its scope and it is unclear how it responds to both current and future demand.

In assessing this matter, the Department was also mindful that not all impacts to open space will be addressed in proximity to the impact location, and enhanced active transport facilities can be considered an appropriate way to offset the impacts and provide improved place outcomes. The Department also consulted with councils and GANSW on how the provision of active transport infrastructure could tie in with the existing green grid network and the active transport networks around North Sydney. As a result, the Department has recommended a condition requiring the Proponent to undertake an Active Transport Network Review, to the address gaps or deficiencies within the existing and proposed active transport network. This review would also address a number of specific impacts, such as the provision of a new active transport link to Cammeray Golf Course, and to reinstate the existing path that is proposed to be removed as part of the construction of the new operational facilities.

Pedestrian and active transport crossings of the diverging diamond intersection at Falcon Street are to be reviewed to improve travel times for pedestrians and cyclists

The Falcon Street intersection is proposed to be reconfigured into a diverging diamond intersection (**Figure 29**). The proposed design would increase the number of crossing points for pedestrians and cyclists, which is compounded by the removal of the existing Falcon Street underpass (linking Merlin Street North Sydney with Merlin Street at Neutral Bay). The increased crossing points would increase the time to cross this intersection. The greatest increase in crossing points is between Falcon Street North at the landing point of the Falcon Street Shared User Bridge and St Leonards Park. Active transport users are required to cross at 2 pedestrian crossings in the current configuration of the intersection. The proposed diverging diamond intersection would require active transport users to cross at 4 points.

The proposed inclusion of a shared user path that connects Merlin Street (north of Military Road) to St Leonards Park (via four pedestrian crossings) provides a secondary route to the Falcon Street shared user bridge. As such, the shared user bridge would likely be the preferred route by both pedestrians and cyclists due to its separation from road traffic.

The Department has recommended that the Proponent investigate alternative interchange crossing options as the impacts to active transport from the additional crossing points and the removal of the eastern underpass is likely to increase journey times. The investigation must consider an overpass over the interchange, a reduction in number of crossings, or priority phasing of traffic lights for pedestrians and cyclists.

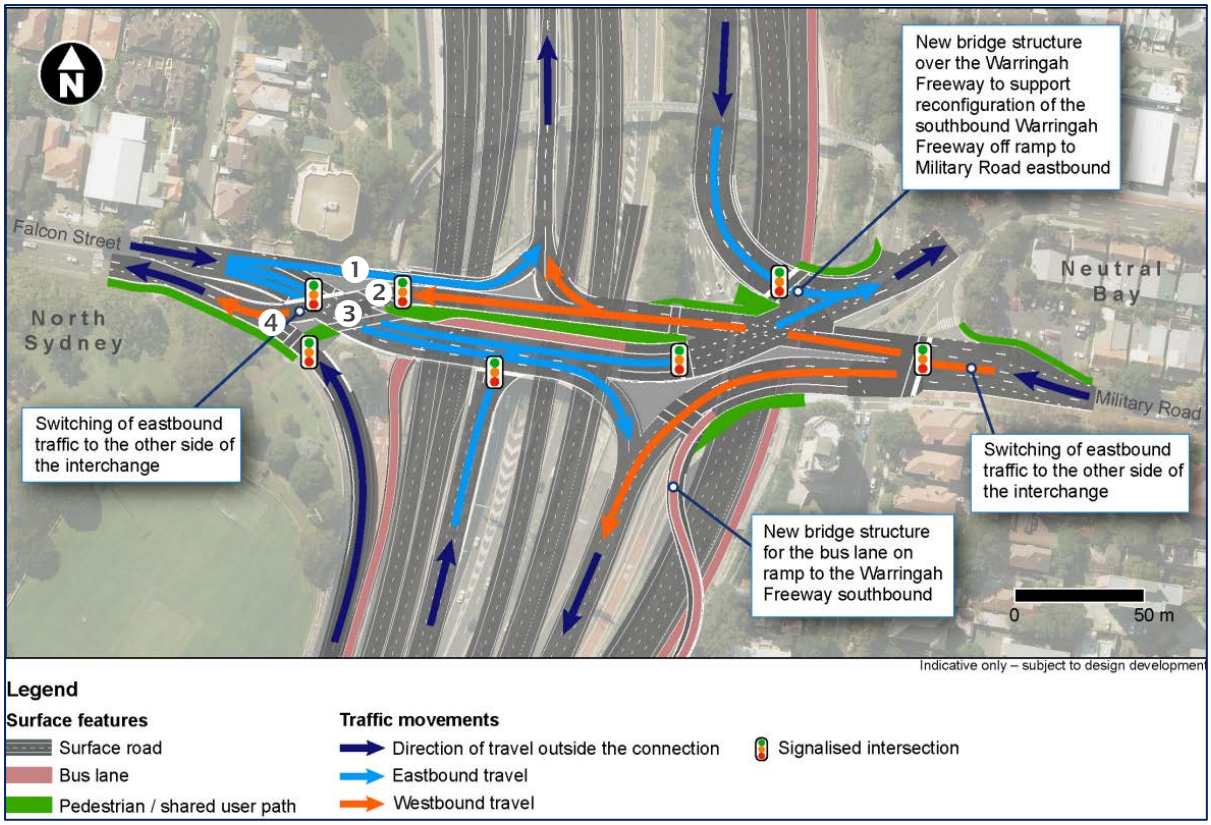


Figure 29 | Falcon Street diverging diamond interchange and new crossing points numbered (Source: EIS)

The Proponent must continue to engage in the development of the North Sydney Integrated Transport Plan to improve pedestrian access and public domain improvements

The NSITP is being prepared by TfNSW, in consultation with North Sydney Council, the Greater Sydney Commission, Sydney Metro and the Government Architect NSW. The NSITP is being developed in response to the new Sydney Metro station at Victoria Cross in North Sydney CBD to provide greater pedestrian access and public domain improvements in North Sydney CBD. Objectives of the NSITP include:

- ensuring transport infrastructure and services are supportive of complementary urban development and place-making outcomes that provide better places for people
- promotion of sustainable transport choices by enhancing walking, cycling and public transport.

The Sydney Metro – Chatswood to Sydenham approval requires Sydney Metro prepare an Interchange Access Plan for the Victoria Cross station which would detail the final design of transport and access facilities and services at the station, including integration of public domain and transport initiatives around and at the station.

The Department supports the broad objectives of the NSTIP and considers that the project is not fully compatible with the objectives of these processes by funnelling traffic through parts of North Sydney, in particular Berry Street. The Department understands that the Proponent is working to reduce its impact at North Sydney and is supportive of this ongoing work. It is the Department's position that the Proponent should continue to engage in the development of the NSTIP to allow plans for improved pedestrian access and public domain improvements be achieved to the greatest extent practicable.

6.5 Groundwater and Settlement

Groundwater will be intercepted during construction of the project, which will result in groundwater drawdown, potential for settlement and contaminant migration, and the need to adequately treat groundwater prior to disposal. While it is expected that groundwater can be managed to reduce associated impacts, there is a need for the assessment to be refined during detailed design. This process will be informed by recommended conditions in relation to further modelling and monitoring.

In relation to settlement, the project is not expected to have significant impacts. Notwithstanding, the Department has recommended settlement-related conditions including the preparation of a geotechnical model to refine the settlement predictions, settlement criteria and settlement monitoring. In addition, the Department has recommended the establishment of an Independent Property Impact Assessment Panel with responsibility for resolving property damage disputes.

Issue

To address geological features in the Hawkesbury Sandstone aquifer, the tunnels will incorporate a range of groundwater management designs

The Hawkesbury Sandstone aquifer can be up to 250 metres thick in the Sydney Region and covers most of the project alignment. The solid geology is crossed by a number of geological features that may impact groundwater flow including dykes and geological faults. Dykes cross the alignment at Balls Head and another runs parallel to the alignment at Yurulbin Park. Other dykes are anticipated to intercept the alignment at Waverton and Rozelle. The nearest major fault zone to the project is the Luna Park Fault Zone which is likely to run parallel to the project in Cammeray.

The tunnels would be supported by permanent rock bolts, shotcrete and a ‘cast in-situ’ concrete lining system, depending on the geotechnical and hydrogeological conditions. About 93 per cent of the tunnel would comprise a typical drained tunnel where the lining would comprise permanent shotcrete. Three per cent of the tunnel (where the alignment is below sea level on either side of the immersed tube tunnel) is expected to use a waterproof umbrella system where the crown of the tunnels would be finished with inner lining and the remaining four per cent would be fully lined with a waterproof membrane to control potentially higher inflows. The fully lined tunnel section would not require ongoing drainage or dewatering as the lining reduces groundwater drawdown.

Groundwater interception would be greatest during construction and average inflows would meet acceptable limits

Groundwater has the potential to be intercepted during construction. Impacts are identified as:

- tunnel inflows and associated flooding
- groundwater drawdown, including potential for saltwater intrusion, contaminant migration from contaminated sites, activation of acid sulfate soils and the decline in the groundwater baseflow to surface water features.

The maximum drawdown and inflows would occur when tunnel excavation is complete, and before measures to mitigate inflows have been installed (such as tanked sections, permanent tunnel lining such as reinforced concrete and waterproofing membrane). The greatest volumes are predicted to occur around the harbour crossing areas. Average inflows for each year of construction would be below the acceptable limit of 1 L/s/km and comparable to other tunnels built in Sydney including the

Eastern Distributor (1 L/s/km), M5 East Motorway (0.9 L/s/km), Epping to Chatswood rail tunnel (0.9 L/s/km), and Lane Cove Tunnel (varied between 1.7 L/s/km between 2001 to 2004 to 0.6 L/s/km in 2011).

At the end of tunnel construction, the maximum drawdown is predicted to be around 20 metres above the Rozelle ventilation tunnels and 15 metres in the vicinity of the Victoria Road access decline. Predicted drawdown would be less north of the harbour with a maximum of three metres in Waverton and North Sydney.

Settlement will occur across the project but is not expected to have significant impacts

In addition, ground movement may occur as a result of settlement induced from groundwater drawdown. **Table 12** shows the maximum predicted surface settlement along the tunnel alignment.

Table 12 | Maximum predicted surface settlement (Source: EIS)

Location	Maximum stress redistribution induced settlement (mm)	Maximum groundwater drawdown induced settlement (mm)	Maximum total settlement (mm)
Waverton Coal Loader	25-30	Less than 5	25-30
Rozelle ventilation tunnels	5-10	Less than 5	10-15
Victoria Road access decline	10-15	10-15	25-30
Berrys Bay access decline	5-10	Less than 5	10-15
Mainline tunnels between Rozelle and Western Harbour crossing	10-15	5-10	20-25
Mainline tunnels between Rozelle and Western Harbour Tunnel crossing (tanked section)	50-55	5-10	55-60
Mainline tunnels between Western Harbour Tunnel crossing and Warringah Freeway	30-35	Less than 5	35-40
Warringah Freeway portal	50-55	Less than 5	55-60
Cammeray ventilation tunnel	5-25	Less than 5	5-25

The tanked section of the tunnel (i.e. the areas that require control of higher levels of groundwater ingress) of the mainline alignment are expected to experience long-term surface settlement of around 55-60 mm, which is considered a ‘moderate’ degree of severity. All other project components are expected to be subject to settlement of 40 mm or less, or ‘slight’ degree of severity under relevant guidelines. No buildings were found to be in the ‘slight’ to ‘very severe’ damage categories, while 106 buildings along the alignment were categorised within the ‘very slight’ damage category.

Building/structure conditions surveys would be carried out prior to the commencement of construction and settlement impacts caused by the project would be rectified.

Intercepted groundwater would be discharged after being treated to meet water quality standards

Groundwater that flows into existing underground structures in Sydney is generally high in iron, may contain manganese and other contaminants, relatively high salinity and a slightly acidic pH.

During operation, tunnel water would therefore need to be treated to comply with applicable guidelines and spill controls, and water quality monitoring must be implemented to manage operational impacts on receiving waters, though potential impacts are expected to be negligible. Groundwater collected during operation would be transferred to a central water treatment plant prior to being discharged to the stormwater system. Discharge water quality would be determined in consultation with EPA, DPIE (Water) and Sydney Water.

Groundwater uses are limited within the project area

The regional water table typically mimics the topography, ultimately discharging to surface drainage features and Sydney Harbour. The depth to the water table varies. While there are no Water Access Licence users within 2.5 kilometres of the project, there are three bores installed for abstractive use – GW023150.1.1 located in Cremorne used for irrigation, GW108991.1.1 located in Waverton used for water supply and GW109209.1.1 in Birchgrove, also used for water supply. A moderate to high potential groundwater dependent ecosystem (Coastal Sandstone Gully Forest, Sandstone Riparian Scrub and Coastal Sand Forest) is located in the lower reaches of Flat Rock Creek and along Quarry Creek, around 400 metres from the northern end of the Warringah Freeway Upgrade.

The Department engaged an independent hydrodynamics expert (the University of NSW's Water Research Laboratory (WRL)) to assist the Department by undertaking a technical review of a number of the Proponent's assessments including groundwater. The review report is provided in **Appendix J**.

Submissions

Community and special interest group submissions

Key issues raised in the public submissions included:

- opportunities for water trucks to collect wastewater from the water treatment plant for distribution to areas on the Balmain peninsula impacted by groundwater drawdown
- concerns regarding settlement risk and damage to property.

Government agency and Council submissions

EPA considered there was insufficient information regarding groundwater monitoring in the EIS. Specifically, they were concerned about the sampling of groundwater undertaken, stating that baseline monitoring of hydrological attributes had not been satisfied.

In addition, the EPA stated that the full analytical results (monthly samples) in the EIS indicated that monitoring was not undertaken at regular intervals and should be updated.

Both the EPA and DPIE Water recommended that a Groundwater Monitoring Program be undertaken during the project's construction, which would include mitigation measures where results of monitoring indicated adverse impacts or levels above relevant criteria. In addition, an Operational Groundwater

Monitoring Program with monitoring should continue for a minimum of five years following the completion of the tunnels.

Sydney Water notes 'after 100 years of operation, predicted drawdown magnitudes are similar to end of construction, with a maximum drawdown of about 40 metres in Rozelle (particularly Easton Park, an area of environmental interest for contamination)' and sought further clarification to understand the potential for groundwater drawdown generally to impact the structural integrity of its assets.

Port Authority of NSW stated that the EIS predicted groundwater drawdown in parts of the Glebe Island and White Bay port facility during construction and operation, which can cause impacts such as activation of acid sulfate soils, impacting the integrity of underground structures, and potentially leading to migration of contamination. The Authority requested the proposed groundwater monitoring program be designed to allow any groundwater drawdown at the port facility to be identified and for the Authority to be informed of groundwater drawdown at the port facility during construction or operation based upon continuous monitoring results.

DPIE Water requested more detailed explanation of the grouting and sealing extent being proposed to seal the tunnel lengths at the connections with the submerged tunnel installations, to understand the restriction of groundwater ingress and saline water intrusion and for the tunnel access declines regarding the mitigation of groundwater inflow. DPIE Water recommended that further groundwater modelling be undertaken to revise the existing model and to include uncertainty and sensitivity analysis; and that make good provisions be applied where monitoring indicates impacts to local groundwater bores.

Inner West Council had concerns about damage to buildings as a result of tunnelling and ground movement from settlement induced from groundwater drawdown and noted the maximum predicted surface settlement from Rozelle ventilation tunnels as being 10-15mm and the Victoria Road access decline as 25-30mm. The Council considered that notwithstanding these impacts are categorised as 'slight', this could result in extensive damage given the number of properties potentially affected.

North Sydney Council had concerns with the predicted settlement that may occur at Berrys Bay and the potential impact to the Coal Loader structures given their age and the substantial investment Council has made in the redevelopment of this area as part of the nation's maritime heritage. It recommended that an independent dilapidation survey of the Coal Loader facility be undertaken in the event of damage occurring as a result of construction.

Council also requested further details regarding the final disposal location for contaminated material as this may lead to further impacts on the local community from truck and/or barge movements and questioned the quantity of contaminated material that would be stored/stockpiled and the anticipated time period prior to its disposal. Council also raised groundwater and tunnel drainage management and treatment systems and required that groundwater infiltration is treated at construction wastewater treatment plants prior to reuse or discharge.

Willoughby City Council raised the issue of wastewater generated from groundwater infiltration to the tunnel and questioned the water testing and treatment plan that would be implemented prior to its discharge.

Consideration

Extensive groundwater monitoring will be undertaken prior, during, and after construction

The Proponent has committed to continue the existing groundwater monitoring program to inform detailed design and construction planning, as requested by the EPA. The frequency of monitoring will be monthly for six months prior to construction (for baseline data) until twelve months post construction. The Department generally supports this approach, however has recommended a condition that the Proponent prepare a Groundwater Monitoring Program for construction. This would outline what mitigation measures would be implemented where results of monitoring indicate adverse impacts or levels above relevant criteria; and to implement an Operational Groundwater Monitoring Program with monitoring to continue for a minimum of ten years (not 12 months as proposed by the Proponent) following the completion of the tunnels. The collection of data over an extended period would provide extensive and valuable information for future projects.

The Proponent will be required to mitigate excessive groundwater drawdown

In relation to drawdown, the Department has recommended the Proponent implement 'make good' provisions where the decline in groundwater levels exceeds two metres, in accordance with the *NSW Aquifer Interference Policy* (as this requirement is not met for GW109209 as a result of the project). The Proponent would have to monitor the water level within existing bores and undertake periodic measurements to establish baseline conditions. This requirement has been included as part of the Groundwater Monitoring Program to be implemented prior to and during construction.

Groundwater modelling is required to further define groundwater and associated contaminant movement

The Department has recommended the Proponent undertake further modelling of groundwater drawdown, tunnel inflows and potential saline water migration (using particle tracking) prior to finalising the detailed design of the project. While the Proponent considered that groundwater inflows would be below 1 L/s/km on average, the Department has made this requirement a condition to limit groundwater flows into the tunnel. The Department has further clarified through this condition that the limit is required to be achieved across any given kilometre and not determined by averaging groundwater inflows across the length of the tunnels.

The results of the modelling must be documented in a Groundwater Modelling Report and include a quantitative analysis of model uncertainty for predictions of drawdown induced settlement and contaminant mobilisation. To ensure that the risk associated with potentially contaminated groundwater migration can be appropriately managed, the modelling would also require quantitative predictions of the changes in groundwater gradient magnitude and direction at identified contaminated sites due to construction and operation, and to - additional mitigation measures that would be implemented to mitigate groundwater impacts not previously identified.

The Department has also recommended that the modelling report be peer reviewed by an independent expert (as agreed to by DPIE Water) to ensure that the detailed requirements of the condition are met. In addition, the recommended condition requires that both the modelling report and the peer review report be submitted to the Planning Secretary for information prior to finalising the tunnel design and that the data used in the modelling be provided to DPIE Water.

The project will need to meet established settlement criteria and will be subject to independent property review

The loss of groundwater due to inflows to the tunnels will result in localised groundwater drawdown which may result in ground movement or settlement. Ground movement investigations indicate that there may be potential settlement of greater than 40mm around the Warringah Freeway portal and around 30-35mm around the Rozelle portal which was assessed as 'slight' severity under the relevant guidelines. No buildings were found to be in the 'slight' to 'very severe' damage categories.

The Proponent has stated that detailed predictive settlement models will be developed for areas of concern to guide the tunnel design and construction methodology, including the selection of options to minimise settlement where required. An Independent Property Impact Assessment Panel, comprising geotechnical and engineering experts, is proposed to be established prior to the commencement of works to independently verify building condition reports, resolve property damage disputes and establish ongoing settlement monitoring requirements. The Proponent has committed to undertaking building/structure condition surveys for properties and heritage assets within the zone of influence for potential settlement, prior to the commencement of construction.

To ensure a proactive and conservative approach is adopted, the Department has recommended settlement-related conditions (inclusive of both groundwater and tunnel-induced settlement) including the preparation of a geotechnical model which would be used to refine the settlement predictions, settlement criteria and settlement monitoring. This is similar to the approach adopted for the management of settlement risks for other large tunnelling projects (WestConnex M4-M5 and M6).

While the Proponent has stated that an Independent Property Impact Assessment Panel will be established, the Department has formalised this as a recommended condition including when the Panel must be established, what experts it must comprise, its responsibilities regarding the independent review of pre- and post-construction condition survey reports, and the resolution of potential property damage disputes.

Groundwater will need to be treated prior to reuse or discharge

Activities and materials used during tunnel construction have the potential to impact on groundwater quality and include drilling/cutting fluids required for road header operations and particulate material from tunnelling leading to an increase in suspended solids and cement pollution from the application of shotcrete, grouting or the in-situ casting of concrete. While the contaminant risk is considered to be low, the likelihood of contaminated groundwater migrating away from the tunnel is very low as the tunnel would act as a drain and the groundwater would flow towards it. Regardless of the low risk during construction, the Proponent proposes to adopt the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018* (ANZG 2018) 90 per cent species protection level as the project construction discharge criteria, except toxicants known to bioaccumulate which will be treated to meet the 95 percent species protection level.

During operation, impacts on groundwater quality could arise from groundwater drawdown and resultant potential impacts from saltwater intrusion, contaminant migration from contaminated sites and activation of acid sulfate soils. Groundwater would be collected from drained station excavations and caverns and transferred to a centralised water treatment plant at Rozelle prior to disposal to stormwater. To ensure that all wastewater from the project is appropriately treated, the wastewater treatment plant at Rozelle would be required to meet the guideline values for the relevant physical

and chemical stressors set out in the ANZG (2018) 95 per cent species protection levels for toxicants and the ANZG (2018) 99 per cent species protection levels for toxicants known to bioaccumulate.

The proposed approach to meet the above criteria is supported by the EPA. To ensure wastewater is treated before discharged, the Department has formalised the Proponent's commitments into recommended conditions to be met for construction and operational discharges.

6.6 Non-Aboriginal Heritage

Construction of the project would result in direct and indirect impacts to 19 non-Aboriginal heritage items, groups of items, or conservation areas, with the majority being indirect and having negligible-minor impacts. Two buildings within heritage conservation areas would be demolished, and heritage areas that are currently open space would be used as construction sites and reinstated following construction.

The Department considered the relatively minor heritage impacts in the context of the overall benefits of the project. The Proponent's commitments for managing and reducing heritage impacts, in association with the Department's recommended conditions, would ensure that heritage impacts are appropriately managed and minimised to the greatest extent practicable.

Issue

The study area includes a significant number of heritage items; however, the project has avoided direct and significant impacts to most items

A total of 239 heritage items were identified in the study area for the project. These items comprise the Sydney Opera House Buffer Zone (World heritage listed), Sydney Harbour Bridge (Nationally listed), 10 State listed and 227 locally listed items. The construction of the project would result in either no impacts (including the Sydney Opera House Buffer Zone), or a minor/negligible impact to most of these items, including the Sydney Harbour Bridge and all State listed heritage items. Cammeray Park including the Golf course will experience a moderate level of impact and Yurulbin Park is predicted to experience a major impact; both of which are locally listed heritage items.

A summary of the project's impacts is provided in **Table 13.**

Table 13 | Impacted heritage items (Source: EIS)

Impacted Heritage Item	Location	Heritage Listing	Type of Impact
Commonwealth and State heritage listings			
Sydney Harbour Bridge approaches and viaducts	Milsons Point / Dawes Point	National Heritage List, State Heritage Register (SHR), North Sydney Local Environment Plan (LEP) 2013, TfNSW s170 Heritage and Conservation Register (s170 Register), Register of the National Estate, National Trust of Australia Register	Minor – roadworks, toll gantry construction, construction ancillary sites, vehicle and machinery operation, aesthetic, social and visual
State heritage listings			

St Leonards Park group	North Sydney	SHR, North Sydney LEP 2013, Register of the National Estate, National Trust of Australia Register	Minor – vehicle and machinery operation, noise wall construction, vibration, settlement, visual and social
Local heritage listings			
Yurulbin Park	Birchgrove	Leichardt LEP 2013, under consideration for elevation to State heritage listing	Major – construction ancillary site establishment, vehicle and machinery operation, vegetation removal, settlement, visual, social and aesthetic
Former Balls Head Coal Loader	North Sydney	North Sydney LEP 2013, SREP 2005, Register of the National Estate, under consideration for elevation to State heritage listing	Minor – vibration and settlement
Woodleys Shipyard	Waverton	North Sydney LEP 2013, TfNSW s170 Register, SREP 2005	Minor – construction ancillary site establishment, vehicle and machinery operation, vegetation removal, use of heritage item, settlement, visual, social and aesthetic
BP Site	Waverton	North Sydney LEP 2013, TfNSW s170 Register, SREP 2005	Minor – construction ancillary site establishment, vehicle and machinery operation, vegetation removal, use of heritage item, settlement, visual, social and aesthetic
North Sydney Bus Shelters	North Sydney, Waverton, Kirribilli	North Sydney LEP 2013	Minor – temporary relocation, vehicle and machinery operation and settlement
Cammeray Park and Golf Course	Cammeray	North Sydney LEP 2013	Moderate – partial acquisition, roadworks, vehicle and machinery operation, vibration, settlement, visual and social
Cammeray, Holtermann A and The Valley heritage conservation areas (HCA)	Cammeray, Crows Nest, Rozelle	Leichardt LEP 2013, North Sydney LEP 2013	Minor – demolition of buildings, construction ancillary site, settlement, vibration and visual

The remaining heritage items not identified in **Table 13** would either be not impacted, experience a negligible impact, be indirectly impacted as a result of vibration or settlement impacts, or from visual

impacts. These impacts can be managed through standard construction practices, mitigation measures or redesigning elements of permanent infrastructure to be less intrusive.

Submissions

Community submissions

The community raised concerns regarding:

- impacts to local and State listed heritage items, particularly the temporary use of construction sites at St Leonards Park, Cammeray Park and Golf Course, Balls Head Coal Loader and Yurulbin Park and the requirement for specific vibration criteria to protect heritage items
- tunnelling vibration and settlement impacts to heritage conservation areas and historic private homes across the alignment
- impacts to maritime heritage, including Woodleys Shipyard Slipway 1 and maritime archaeology between Waverton and Birchgrove.

Government agency and Council submissions

North Sydney Council noted concerns:

- disagrees with the impact rating to heritage items
- proximity of the cofferdam and vibration and settlement impacts on the Coal Loader
- permanent and significant impacts to the curtilage of St Leonards Park
- potential and significant impacts to the curtilage of the Sewer Vent
- visual impacts to the character of the northeastern Holtermann Estate A Conservation Area, Ridge Street Conservation Area and Ridge Street Conservation Area
- no consideration of Conservation Management Plans for St Leonards Park, Former Coal Loader Platform and Waverton Peninsula Industrial Sites
- relocation of the heritage vessels and maintaining access to the vessels by community groups.

Council also recommended the conditions require the preparation of dilapidation studies, site-specific management plans, and archaeological studies of terrestrial and marine based items.

Heritage NSW provided comments around:

- the project's direct and indirect impacts to state heritage items including recently nominated heritage items
- tolling gantries would need to be refined to minimise impacts to the Sydney Harbour Bridge
- construction ancillary sites will have temporary visual impacts to heritage items
- vibration and settlement impacts to heritage items
- provision of at property noise mitigation will have a physical impact to the Tarella house
- requested the preparation of a Construction Noise and Vibration Management Plan (CNVMP), unexpected find protocol, site-specific heritage management plans, archival recordings, excavation reports and updated excavation methodologies.

Consideration

Impacts to the Sydney Harbour Bridge approach are minor, and all permanent infrastructure associated with the project must be designed to have minimal impacts to the heritage significance of the item

The Proponent states that the project would result in minor-moderate impacts to the Sydney Harbour Bridge curtilage. As part of its consideration, the Proponent undertook an assessment against the relevant significant impact criteria in Significant Impact Guidelines 1.1: Matters of National Environment Significance (Department of the Environment, 2013) and determined that the project would not have a significant impact on the Sydney Harbour Bridge.

The Department notes during construction, temporary visual impacts from hoarding, construction activities and ancillary sites within the vicinity of the Sydney Harbour Bridge would be visible within the curtilage of the item. The Department notes that the indirect visual impacts from road upgrade works would be temporary in nature, and with the implementation of management conditions, impacts are considered to be acceptable.

The provision of tolling gantries on the Bradfield Highway side of the Lavender Street railway arch would be located within the item's State heritage curtilage, and result in an indirect visual impact on the item's visual significance. The Proponent has committed to designing the toll gantry as to not physically touch or impact the Lavender Street arch and minimise visual obstruction and have consideration of the significant heritage setting. The Department understands that while this impact is permanent, the tolling gantry would remain subservient to any heritage elements nearby.

Further to the Proponent's commitments, the Department notes the Commonwealth and State significance of the item and that the proposed tolling gantry is visually connected with it. In response to concerns raised by Heritage NSW, the Department has recommended permanent infrastructure should be sensitively designed to the highest standard in consultation with Heritage NSW and be designed consistently with the recently endorsed *Sydney Harbour Bridge Conservation Management Plan*, and has recommended a condition to that effect. The design will also be reviewed by an independent design review panel as part of the development of the Place, Design and Landscape Plan, which will detail the final finishes of all permanent infrastructure.

Yurulbin Park would experience major impacts; however, these are offset with a new park to be designed in consultation with the park's original landscape architect

Yurulbin Park is a locally listed heritage item due to the former use as the Morrison and Sinclair Shipyard which operated at the site from the 1920s to 1970s.

Yurulbin Park would experience a major impact due to the establishment of a construction ancillary site, necessary to facilitate works at the southern cofferdam and transition zone between tunnel and Immersed Tube Tunnel. Major and irreversible impacts include the permanent loss of some heritage features and archaeology from major earthworks and excavation.

Community submissions raised concern over the predicted impacts to the park including loss of trees, and Heritage NSW advised the park is under consideration for listing on the State heritage register.

Although impacts to Yurulbin Park are expected to be major, design of the construction site layout would be undertaken in consultation with the park's original architect Bruce Mackenzie. This would allow significant features of the park to be protected, and enhance the existing character and original

design intent as much as possible. Opportunities to temporarily remove, store and reinstate certain elements such as stone flagging, stone walls and steps would be investigated, and trees retained where possible. The Proponent has committed to archaeological investigation of the park and archival recording.

Following use of the site as a construction ancillary site, the Proponent has committed to rehabilitating the area and returning it to public open space in consultation with Bruce McKenzie. The Department supports this approach, and notes additional features may be incorporated to celebrate the park's use as a construction ancillary site for the project. A condition has been recommended requiring plans for the park be included in the Place Design and Landscape Plan.

The Department considers the impacts to this item, although significant, would not impact its overall heritage significance and are acceptable subject to the implementation of mitigation measures to protect key elements during construction, and commitments made to reinstate the park following construction.

Configuration of construction infrastructure will avoid permanent impacts to State significant archaeology, and significant heritage features at Berrys Bay including marine heritage items

The layout of the Berrys Bay construction ancillary site has been designed to avoid areas of potential State significant archaeology and protect and retain some contributory heritage features including stone cuttings and masonry walls. The Proponent has committed to undertake archaeological investigations at the Berrys Bay BP Site. The Department has recommended conditions regarding excavation, archaeology and artefact management, noting the potential archaeological significance of the BP Site, consistent with the comments received from Heritage NSW. With the implementation of these measures, the Department is satisfied the impact on potential State significant archaeology at the site is manageable.

As the Proponent intends to covert this area into public open space following its use during construction, the final landscape design of Berrys Bay should be detailed in the Place, Design and Landscape Plan. The Plan would be prepared in consultation with North Sydney Council, the community and Independent Design Review Panel, to ensure heritage features are preserved and incorporated into the final design. The Department considers through this design and consultation process, the key heritage elements of the area can be delivered through a well-designed public open space and heritage interpretation signage.

Impacts to the Balls Head Coal Loader are indirect and can be minimised with appropriate monitoring and mitigation

The establishment of the support barges for cofferdam construction would require piling, and plant and equipment placed on the support barges would include a large crane. The cofferdam and supporting infrastructure would be positioned to avoid direct impacts on the lower walkway and dolphins of the heritage item. The Proponent has committed to implementing safe working distances and buffer zones from maritime heritage items, including a 15m exclusion zone around the wharf.

Though the project would have no direct impacts, Heritage NSW recommended enhanced vibration monitoring and mitigation measures to manage any residual impacts to the Coal Loader. Heritage NSW advises enhanced measures are required, as the Coal Loader is currently being considered for listing on the State heritage register. To address the concerns of Heritage NSW, a condition is recommended that requires enhanced requirements for baseline and period monitoring of the item to

measure impacts from vibration and settlement. The Department is confident that vibration or settlement can be managed, as has been demonstrated on other projects such as Sydney Metro works at Martin Place. In addition, a condition has been imposed that the Coal Loader must not be directly impacted unless approved by the Department in consultation with Heritage NSW.

Relocation of the heritage vessels SS Baragoola and M.V. Cape Don to an appropriate site is required to ensure they are not impacted by construction activities

Prior to construction works commencing, the heritage vessels SS Baragoola and M.V. Cape Don would be relocated to ensure they are not impacted during construction. This approach is supported by the Department provided the new mooring locations to these vessels are easily accessible to the community groups that are currently undertaking restoration of these vessels.

To ensure the relocation process occurs prior to construction, the Department has recommended a condition requiring the Proponent to relocate the vessels to a suitable location accessible by community groups.

Temporary impacts on St Leonards Park would occur in a non-landscaped section of the park, avoiding direct impacts to heritage features

St Leonards Park is a State heritage listed 19th Century park in North Sydney. A non-landscaped section of the park along the eastern interface with the Warringah Freeway would be impacted by excavation and cut and cover structure construction. Predicted impacts would be temporary and limited to during construction. There are not expected to be direct or permanent impacts to the heritage significance of the item.

The Department acknowledges community concern over the use of a portion of the park for construction activities but notes this impact would be confined to a small section of the park that is currently underutilised due to its undulating nature.

A condition has been recommended requiring the area impacted to be reinstated as open space in consultation with North Sydney Council as soon as construction activities are complete at this site. The Department is satisfied the heritage significance of St Leonards Park would not be significantly impacted by the project.

The retention of building facades reduces visual impacts on Darling Street, Rozelle

Establishing the Victoria Road construction ancillary site requires the demolition of 697 and 699 Darling Street Rozelle, which contribute to the local character of The Valley HCA. In response to comments made by Inner West Council, and to ensure the local character of Darling Street is maintained, a condition has been recommended to retain these building facades. The Department is satisfied the impacts on the HCA are minor, as the area's local character can be maintained with the retention of the facades and the visual impact of the ancillary site is reduced during construction.

Cammeray Park and Golf Course would be impacted; however, the Proponent would work with the Golf Club to ensure the viability of the club is maintained

The locally listed Cammeray Golf Course is predicted to experience a moderate impact due to the establishment of a construction ancillary site and as a motorway operations control centre on the western portion of this site.

The project will acquire land within the curtilage of the item for construction and operational infrastructure. Although the acquisition and construction of the project is a permanent impact, the Proponent has committed to reinstating and restoring temporarily used land following completion of construction activities.

The Department acknowledges submissions received relating to the loss of public open space, and has recommended conditions requiring the reinstatement of active transport links, and that the Proponent work with the Golf Club to ensure impacts are offset. The Department considers the heritage impacts, while permanent, are acceptable subject to the implementation of design commitments, mitigation measures and recommended conditions.

6.7 Other issues

The Proponent assessed the potential impacts of the project in relation to Aboriginal heritage, biodiversity, dredging and contamination, flooding and hydrology, land use, property and socio-economic, surface water quality, sustainability and climate change, hazards and risk, and waste management. The Department considers that the Proponent has adequately assessed these issues and that they can generally be managed through the Proponent's environmental management measures and conditions of approval.

Table 14 summarises the Department's consideration and recommended conditions.

Table 14 | Department's consideration of other issues

Issue	Findings	Recommendations
Aboriginal heritage	The project sites are generally highly disturbed, except for areas of remnant bushland around Balls Head and Birchgrove. Six sites of Aboriginal cultural significance may be indirectly impacted by settlement and vibration impacts, with Waverton Park Cave predicted to experience moderate impacts. Two of the sites at Birchgrove have high significance. Three areas of potential moderate to high significance submerged Aboriginal archaeology near Balls Head may be impacted from dredging and cofferdam construction. Registered Aboriginal Parties did not raise any objections and supported the Proponent's archaeological methodology. Heritage NSW reviewed the EIS and cultural heritage and raised concerns regarding vibration and subsidence impacts to Whale Rock. The Proponent has committed to undertaking structural assessments and, if required, vibration monitoring and condition surveys for at-risk sites of Aboriginal cultural significance. For potential maritime Aboriginal sites, further geophysical surveys may be undertaken before	Recommended conditions include: • requiring the Proponent to address any unexpected heritage items found during excavation works • to take all reasonable steps to not harm, modify or otherwise impact Aboriginal objects.

	construction if deemed necessary by a marine archaeologist. The Department is satisfied with the Proponent's mitigation measures for the protection of sites of Aboriginal cultural significance.	
Biodiversity	**Terrestrial Biodiversity** Approximately 7.3 ha of vegetation would be cleared within the Warringah Freeway road reserve and at the supporting construction ancillary sites at Cammeray Golf Course, Yurulbin Point Park and Berrys Bay. Of this, 0.13 ha is classed as native vegetation community requiring offsetting under the *Biodiversity Conservation Act 2016* (BC Act). Native vegetation impacts would be offset in accordance with the requirements of the BC Act. Field surveys identified three BC Act listed threatened fauna species within the study area including the Large Bent-winged Bat *(Miniopterus orianae oceanensis)* recorded within one of the coal loader tunnels in Waverton; Grey-headed Flying-fox (*Pteropus poliocephalus*); and White-bellied Sea Eagle (*Haliaeetus leucogaster*), with the latter two Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed species. No foraging habit associated with these species will be cleared or impacted. The Large Bent-winged Bat may be impacted from construction noise and vibration as this species roosts in the tunnels of Balls Head Coal Loader. Up to 500 individuals roost in the tunnels during autumn and winter. Adaptive management strategies would be developed to manage any potential impacts to the Large Bent-winged Bat. This approach is supported by the Department and EESG as impacts are unknown at this point in time. Should there be any residual impacts (i.e. the species does not return to its roosting habitat) the Proponent would be required to offset the impacts to the satisfaction of EESG. The Little Penguin (Eudyptula minor), listed as endangered under the BC Act and EPBC Act, is known to occur within the construction footprint, previously recorded at Snails Bay, Berrys Bay, Balls Head Bay and the main channel of the harbour. The Department considers the project would not have significant impact to the Little Penguin as impacts to these species can be	Recommended conditions include: • an offseting requirement under the BC Act • preparation of a Fauna and Flora Management Plan detailing threatened species protection • preparation of a Large Bent-winged Bat monitoring and adaptive management plan • relocation requirements for White's seahorse • limiting turbidity impacts to seagrass • offsetting loss of marine vegetation with a ratio of 2:1.

	actively managed through the development of management and monitoring protocols, should the Little Penguin appear within the construction boundary. It is also noted that the Little Penguin nesting site is near the quarantine station south of Manly. With the implementation of the Proponent's mitigation measures and the recommended conditions, the Department is satisfied impacts to terrestrial biodiversity are acceptable. **Marine Biodiversity** The most sensitive fish habitat occurs within nearshore areas such as seagrass and subtidal rocky reef. Approximately 0.01 ha of rocky reef (habitat for Black Rockcod, vulnerable under the *Fisheries Management Act 1994* (FM Act) and EPBC Act, and White's Seahorse, listed as protected under the FM and EPBC Acts and nominated for threat-listing under the FM Act) would be removed. The Department has recommended a condition that requires that the loss of marine vegetation be offset at a ratio of 2:1 with agreement from DPI Fisheries. In addition, the proponent would be required to relocate any White's seahorse's away from construction activities. DPI Fisheries expressed concern of two small patches of seagrass (Zostera sp.), totalling approximately 0.03 ha, may be impacted by turbidity and sedimentation from dredging. To address these concerns, turbidity limits have been imposed on dredging activities (see below). The impacts to marine biodiversity are considered acceptable with the implementation of management measures, and conditions relating to the White's seahorse; limiting turbidity impacts to seagrass; and offsetting loss of marine vegetation.	
Dredging and Contamination	The construction of the harbour crossing requires a channel to be dredged into which the immersed tube sections of the tunnel would be placed. It is predicted that 965,500 m^3 of material would be dredged from the harbour floor. Based on sediment sampling, approximately 142,500 m^3 of the total material to be dredged is expected to be contaminated and lies within the top 1.5 metres of the harbour bed in the vicinity of the former coal loader near Waverton.	Recommended conditions include: • preparation of a Dredging Management Plan • preparation of a Dredging Monitoring Plan to outline the monitoring regime to be followed during all dredging operations, including trailing suction hopper and cutter suction dredging of uncontaminated material

	Material that is contaminated cannot be disposed of offshore (at the Sydney Offshore Disposal Ground), and would be barged to White Bay prior to transport by road to a disposal facility licensed to accept the material. Due to the existence of tributyltin in the dredged material proposed for land disposal, the disposal would be undertaken in accordance with the NSW EPA *Waste Materials Chemical Control Order 1989*. Clean, uncontaminated material is proposed for offshore disposal, and would be assessed by the Department of Agriculture, Water and the Environment, as part of an application under the Commonwealth's *Environment Protection* (*Sea Dumping) Act 1981*. In addition to contaminated harbour sediments, a number of moderate to high risk potential Areas of Environmental Interest (AEI) were identified which contain contaminated and potentially contaminated soils which may be exposed during construction activities, including at Yurulbin Park, the former coal loader wharf and bulk storage site at Waverton, the proposed motorway control centre in the industrial area at Artarmon, St Leonards Park and unsealed areas next to the Warringah Freeway. Contaminated groundwater may also be encountered during excavation, dewatering and tunnelling in the vicinity of these AEIs and could also be present within other areas and adjacent to the project including Easton Park at Rozelle and Waverton Park. The Proponent has committed to further investigate and manage potentially contaminated areas directly affected by the project in accordance with the requirements of the *Contaminated Land Management Act 1997*. Subject to the outcomes of these investigations, a Remediation Action Plan would be prepared and implemented where site remediation is warranted and an independent NSW EPA Site Auditor engaged where contamination is complex to review applicable contamination reports and evaluate the suitability of sites for specific uses as part of the project.	• use of silt curtains around backhoe dredging operations and in proximity to sensitive marine environments, until background water quality conditions such as turbidity are re-established • sediment concentration limits outside the silt curtain system for backhoe dredging and downstream of trailing suction hopper/cutter suction dredging operations, where the use of silt curtains would not be possible due to harbour currents • undertaking of Detailed Site Investigations • preparation of a Remedial Action Plan and accompanying Section B Site Audit Statement(s) • section A1 or A2 Site Audit Statement(s) and accompanying Site Audit Report(s) confirming the land is suitable for the intended land use • preparation of an Unexpected Finds Procedure for Contamination.
Flooding and Hydrology	The project traverses a number of highly urbanised catchments which drain to Sydney and Middle Harbour. The stormwater drainage	Conditions recommended place limits on flood inundation levels, including no inundation of floor

systems that control runoff from these catchments have been identified has having limited capacity.

Construction

The assessment found that the greatest potential for adverse impacts on flood behaviour is associated with construction ancillary sites located in Cammeray Golf Course (currently at PMF, overland flows may exceed depths of 0.5m across the Golf Course before discharging to the Warringah Freeway corridor), and land adjacent to the existing Berry Street on ramp (existing overflow ponding exceeds 1m in a 10% AEP event on the western side of the Berry Street on ramp). Existing flooding within these areas occurs after large rainfall events and surcharge from existing stormwater drainage systems.

The Proponent has committed to not worsening flood impacts on the community and other property and infrastructure during construction, up to and including the 1% AEP flood event where reasonable and feasible.

The Department is satisfied with the proposed commitment and notes that flooding experienced around the Warringah Freeway corridor is as a result of limited capacity in the stormwater drainage infrastructure. The Proponent would be required to implement appropriate local stormwater management controls to manage potential construction impacts.

Operation

During operation, increases to flooding within the Warringah Freeway corridor are predicted at the southern Warringah Freeway sag (depression) at up to 1% AEP events. The existing concrete noise wall at Anzac Park currently experiences flooding of 3.5m during a 1% AEP event, while overtopping of the wall occurs during a PMF event. Similar levels will be experienced once the project is operational. This impact is therefore considered acceptable by the Department.

Changes to flow velocities of floodwater entering the Sydney Harbour Tunnel northern portals would occur during operation, generally reducing the peak flow for all events up to the PMF, except increasing flow into the southbound during extreme storm events.

During a 1% AEP event, increases of up to 75mm would impact basement car parking and storage facilities at the already flood prone James Milson levels which are currently not inundated in a 1% AEP flood event.

	Village (Retirement and Residential Care) and increases of up to 16mm would be experienced at the rear garages of several residential properties along Hipwood Street, Kirribilli. Further detailed investigation undertaken by the Proponent at James Milson Village revealed that flood mitigation measures such as bunds are already in place to mitigate existing impacts. Peak flood levels would be increased by up to 55 millimetres in already flood prone garages on Nook Avenue during 1% AEP events. Notwithstanding, the Proponent has committed to carrying out a floor level survey to determine floor level flood impacts as a result of the project and to undertake design refinements to minimise impacts. The Department acknowledges the Proponent's conclusions and submissions made by EESG and North Sydney Council, and considers the impacts resulting from construction to be acceptable with the implementation of mitigation measures and detailed design refinements and further flood floor level investigations. To supplement these measures, limits on flood inundation levels, including no inundation of floor levels which are currently not inundated in a 1% AEP flood event has been imposed on the project.
Hazards and risk	There are potential hazards and risks from the storage, handling and transportation of hazardous and dangerous goods; damage to, or disruption of, underground utilities and services; interactions between maritime traffic and tunnel infrastructure; and potential ground movement (settlement) or geotechnical uncertainty during the main construction phases of the project. The Department considers that the identified hazards and risks during construction can be adequately managed by adhering to relevant regulations, policies, standards and legislation, and the implementation of emergency management plans as relevant. Consultation with utility providers would continue during detailed design and construction phases to mitigate the risk of unplanned and unexpected disturbance of utilities. Potential operational hazards and risks generally relate to traffic incidents. These can also be managed through the implementation of relevant regulations and standards and emergency

	management plans and response procedures developed specifically for the operation of the project.	
Land Use, Property and Socio-economic	The construction and operation of the project requires the acquisition of land below the ground surface to accommodate the mainline and ramp tunnels, temporary use of four properties (including the Balmain Leagues Club development site), full acquisition of 20 properties and partial acquisition of four properties. The majority of full acquisitions are private residential properties in Cammeray to enable the upgrade of the Warringah Freeway. All property acquisition would be undertaken in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*. The former Balmain Leagues Club site would be used as a construction ancillary site for tunnelling activities. The temporary occupation would not impact on the land use zoning or development controls that are applicable to this site. The site also includes a privately owned residential property to the north. Yurulbin Park in Birchgrove and the Birchgrove Ferry wharf would be temporarily closed and used as a construction ancillary site. Following completion of construction activities, Yurulbin Park would be reinstated and the Ferry wharf reopened. The northern foreshore of Berrys Bay would be used as a construction ancillary site, which would restrict public access during construction of the project. This area would be redeveloped into public open space and working waterfront land uses as part of the PDLP process and consultation with the community and North Sydney Council. Other open space areas to be impacted during construction include: • south-eastern section of St Leonards Park between the North Sydney Bowling Club and the Warringah Freeway corridor (construction ancillary site) • Rose Avenue Reserve (Neutral Bay), ANZAC Park (North Sydney) and Merlin Street Reserve (Neutral Bay) would also be temporarily impacted during construction. On completion of construction, all areas would be rehabilitated and returned to an equivalent (or better) state for public use.	Recommended conditions include: • all sites used for construction must be rehabilitated • open space and parkland areas must be returned as open space area as identified in the PDLP • an equivalent standard golf course, or the provision of works to offset the loss in standard, must be provided • the Proponent must provide input to the relevant Council's future development guidelines for areas near ventilation outlets in Rozelle and Cammeray.

	The south-western portion of the Cammeray Golf Course would be acquired for a construction ancillary site and operational facilities. The Proponent has committed to working with the Golf Club to manage future golf course operations. Notwithstanding the impacts outlined above, the Department considers the project would provide significant economic benefits during construction by creating 7,500 full time equivalent jobs during its five year construction. Once operational, the project would improve access and connectivity (including to employment areas), reduce congestion, improve journey times and result in improved movement of people and freight.	
Sustainability and Climate Change	The Proponent commits to meeting the Infrastructure Sustainability Council of Australia's (ISCA) Infrastructure Sustainability (IS) Rating Tool rating of 'excellent'. This would be achieved through a Sustainability Management Plan which outlines project specific initiatives to be implemented during detailed design, construction and operation. The Department considers these measures to be appropriate and supports the Proponent's commitment to achieving a rating of 'excellent'. The assessment has identified increases in ambient temperatures and heatwaves; rainfall and surface flooding; concrete carbonation and sea level rise as a moderate risk to the project as a result of climate change, but with proposed mitigation, only rainfall and surface flooding remains a medium risk. The Department has considered the proposed mitigation measure included in the project design and accepts that this would adequately address the risks of climate change to the project.	Recommended conditions include: • preparation of a Sustainability Strategy to achieve a minimum excellent 'Design' and "As built' rating under the ISCA rating tool • a Water Reuse Strategy be prepared which sets out options for the reuse of collected stormwater and groundwater during construction and operation.
Waste Management	Waste generated during construction would be predominantly from site preparation, demolition, construction of road infrastructure and landscaping, and excavated material (spoil) from tunnelling. Dredging and contaminated waste is considered above. The largest form of waste anticipated from the project would be spoil, with approximately 2.1 million cubic metres to be generated from land-based tunnel excavation. Spoil would be stockpiled at 7 construction ancillary sites. Excess spoil would be sent to disposal sites in accordance	Recommended conditions have been included for the handling, reuse and disposal of waste.

with the conditions of approval and EPL(s) governing the sites. Marine dredging would produce 900,000 cubic metres of material, and depending on whether it is contaminated, would be sent to licensed waste management facilities or disposed of offshore.

All waste created by the project would be managed in accordance with relevant waste provisions within *POEO Act 1997.*

The Department considers that waste generation and management can be adequately managed by the Proponent's proposed mitigation measures, including the standard waste management practices of reduce, reuse and recycle and recommended conditions.

7 Evaluation

The Department considers the project is in the public interest and should be approved, subject to conditions.

The Department's assessment has considered all relevant matters and objects of the *Environmental Planning and Assessment Act 1979*, the principles of ecological sustainable development, advice from government agencies and council, and strategic government policies and plans.

The project is consistent with key government policies and strategies including:

- Australian Infrastructure Plan: Priorities and Reforms for Our Nations Future
- Future Transport Strategy 2056
- State Infrastructure Strategy 2018-2038
- The Greater Sydney Region Plan - A Metropolis of Three Cities
- North District Plan
- Eastern City District Plan
- NSW Freight and Ports Plan 2018-2023.

Key benefits provided by the project include:

- reduced congestion on distributor roads around the Sydney CBD
- increased reliability of cross-harbour journeys, particularly for traffic wishing to bypass the CBD
- a third harbour crossing to reduce congestion pressure on Sydney Harbour Bridge, Sydney Harbour Tunnel and ANZAC Bridge
- improved productivity along the Eastern Economic Corridor due to improved journey times
- improved traffic performance on the Warringah Freeway and support for long-term increased demand.

In its assessment, the Department reviewed the Environmental Impact Statement, Response to Submissions, and assessed the key issues arising from the construction and operation of the project. This was undertaken with advice provided by the Proponent, public agencies and councils, and in consideration of key strategic government policies and plans.

The Proponent identified a range of environmental mitigation measures which it has committed to applying to the project. Based on its assessment, the Department has recommended conditions of approval to reinforce these commitments and address outstanding or residual impacts. The Department is satisfied that issues raised in submissions have been appropriately considered. Impacts can be mitigated, managed or offset through the implementation of the recommended conditions and the Proponent's commitments.

8 Recommendation

It is recommended that the Minister for Planning and Public Spaces:

- **considers** the findings and recommendations of this report
- **accepts and adopts** the findings and recommendations in this report as the reasons for making the decision to approve to the application
- **agrees** with the key reasons for approval listed in the notice of decision
- **grants approval** for the application in respect of SSI 8863, subject to the conditions in the attached project approval
- **signs** the attached project approval and recommended conditions of approval.

Prepared by:	**Recommended by:**	**Recommended by:**
		
Daniel Gorgioski Senior Planner Transport Assessments	**Andrew Beattie** Team Leader Transport Assessments	**Glenn Snow** Director Transport Assessments

9 Determination

The recommendation is **Adopted** / ~~**Not adopted**~~ by:

The Hon. Rob Stokes MP
Minister for Planning and Public Spaces

Appendices

Appendix A – List of referenced documents

Australian Infrastructure Plan: Priorities and Reforms for Our Nation's Future (Infrastructure Australia, 2016)

Infrastructure Priority List (Infrastructure Australia, 2018)

Future Transport Strategy 2056

State Infrastructure Strategy 2018-2038 (Infrastructure NSW, 2018)

A Metropolis of Three Cities – the Greater Sydney Region Plan (Greater Sydney Commission, 2018)

North District Plan (Greater Sydney Commission, 2018)

Eastern City District Plan (Greater Sydney Commission, 2018)

NSW Freight and Ports Plan 2018-2023 (Transport for NSW, 2018)

Western Harbour Tunnel and Warringah Freeway Upgrade Environmental Impact Statement – Volumes 1A-B and 2A-J (dated January 2020) (the EIS)

Western Harbour Tunnel and Warringah Freeway Upgrade Response to Submissions Report (dated September 2020) (the RtS).

Appendix B – Environmental Impact Statement

https://www.planningportal.nsw.gov.au/major-projects/project/10451

Appendix C – Submissions

https://www.planningportal.nsw.gov.au/major-projects/project/10451

Appendix D – Submissions Report

https://www.planningportal.nsw.gov.au/major-projects/project/10451

Appendix E – Community Views for Draft Notice of Decision

The key issues raised by the community and considered in the Planning Secretary's Assessment Report and by the decision maker include construction and operational traffic and transport, construction and operational noise and vibration, construction and operational air quality, public open space, tunnel depth and settlement, dredging, heritage, justification and procedure, climate change and sustainability.

Issue	Consideration
Traffic and Transport *Construction* • Concern over the volume of construction vehicles traversing residential areas and around schools. • Construction workers parking on local streets. • Temporary closure of Birchgrove Ferry Wharf. *Operation* • Changes in local access to and from the Sydney Harbour Bridge and Sydney Harbour Tunnel, potentially resulting in rat-runs. • Permanent removal of car parking on local streets including Alfred Street North. • Minimal travel time saving not justifying impacts. • Increasing congestion at intersections across North Sydney. • Rerouting B-line buses into North Sydney will impact on traffic flows in the North Sydney CBD.	*Assessment* • There will be traffic impacts during construction, however these impacts can be mitigated through the implementation of established management measures. • Most construction ancillary sites have direct access to the arterial road network, and although intersection delays will occur, this network is best equipped to accommodate construction vehicular traffic. • The project will reduce traffic volumes and congestion on harbour crossings, improve north-south accessibility and deliver a new western bypass of the CBD. However, the project would also result in localised congestion at tunnel portals at Rozelle, North Sydney and Gore Hill Freeway. • The project is primarily focused on delivering improvements to the regional road network and in this circumstance the Department considers that the project could improve the delivery of a more holistic and integrated transport outcome. *Recommended Conditions/Response* • The Proponent must maximise tunnel spoil disposal by non-road methods. • Restrictions on the use of local roads to access Yurulbin Point and Berrys Bay construction sites. • An alternative public transport service be provided prior to the closure of the Birchgrove ferry wharf. • Safe pedestrian and cyclist access must be maintained around construction sites or an alternative route must be provided. • Preparation and implementation of a Construction Parking and Access Strategy to manage impacts from on and off-street parking changes and construction worker parking. • Mitigate the loss of on-street parking on Alfred Street North. • Access to all properties must be maintained during construction, unless otherwise agreed with the landowner or occupier. • Prepare a Road Network Performance Plan to review the predicted localised traffic impacts as a result of the project and to implement mitigation measures to manage impacts. • Undertake Operational Road Network Performance Reviews at 12 months and at five years to confirm the operational traffic impacts of the project on surrounding arterial roads and whether the mitigation measures identified in the Road Network Performance Plan are adequate. • Undertake a Public Transport Review, identifying changes and measures to ensure bus travel times are maintained.

Noise and Vibration

Construction

- Construction noise associated with heavy vehicle movements and out-of-hours works.
- Noise abatement should be provided for impacted schools and respite during exam periods.
- Noise and vibration impact from pile driving for coffer dams.

Operation

- Unsatisfactory location of proposed noise walls.
- Inadequate provision of at-property acoustic treatments.
- Increases in operational traffic noise.

Assessment

- Construction noise and vibration impacts are unavoidable for a project of this magnitude and in a highly complex and developed urban environment. The impacts will be managed using industry best practice underpinned by a robust community consultation strategy.
- Construction noise impacts from the Warringah Freeway Upgrade are significant and have the potential to cause major disturbances on the adjoining community. Most works along the Warringah Freeway corridor can only occur at night to minimise impacts to traffic on one of Sydney's most important road corridors. The Proponent has developed a Noise Insulation Program for the Warringah Freeway Upgrade to outline how at-property noise treatments would be implemented to aid in managing night time construction noise impacts.
- The Proponent will engage an independent Acoustic Advisor, to be approved by and regularly report to the Department, to oversee construction noise and vibration planning, management, monitoring and mitigation.

Recommended Conditions/Response

- Active and ongoing consultation, flexibility in construction techniques, at source and at property mitigation, and coordinating and scheduling work to provide respite will be applied to manage noise impacts.
- Construction of the Massey to Amherst Street noise barrier in Cammeray will be undertaken early in the construction program to provide construction and operational noise benefits.
- Out of hours works would be approved and regulated through an Environment Protection Licence for work that cannot be performed during standard construction hours.
- Noise impacts associated with the Warringah Freeway Upgrade will be mitigated through the implementation at-property noise treatment in accordance with the Proponent's Noise Insulation Program and the application of criteria to ensure appropriate respite for the community.
- Noise generating work in the vicinity of sensitive receivers, including schools, that result in noise levels above noise management levels must not occur during sensitive periods such as exams.
- Operational noise mitigation measures will be subject to review and compliance monitoring.

Air Quality

- Adequacy of the air quality assessment.
- Adverse construction (dust and odour) and operational air quality impacts (emissions from ventilation outlets).
- Odour impacts from the dredged contaminated sediments.

Assessment

- A review of the air quality assessment was undertaken by the NSW Chief Health Officer and considered advice from the Office of the NSW Chief Scientist and Engineer and the Advisory Committee for Tunnel Air Quality. The Chief Health Officer noted that any potential air pollution related health effects would be primarily due to traffic on surface roads and not as a result of the tunnel ventilation outlets.
- An independent air quality consultant was engaged by the Department to assist in undertaking a technical review of the Proponent's air quality assessment.
- The Proponent has committed to implementing construction dust suppression management measures to minimise windblown dust and odour impacts.
- The Department is satisfied that the project is unlikely to result in significant adverse impacts on ambient air quality or significant increases in health risks.
- The tunnel ventilation facilities will be licensed and regulated by the EPA.

Recommended Conditions/Response

- Requiring the preparation of a Construction Air Quality and Odour Management Plan.
- Imposition of limits to the level of air pollutants discharged from the ventilation outlets.
- Appointment of an Air Quality Independent Reviewer to review and endorse the adequacy of in-tunnel ventilation and ventilation outlet design, air quality monitoring design and air quality reporting.
- Establishment of a regime of air quality monitoring and reporting with operating procedures, monitoring equipment and monitoring data reviewed by an independent auditor and other quality assurance measures.
- Provision of real time air quality data recorded at air quality monitoring stations.
- Establishment of an Air Quality Consultative Committee comprising community representatives and relevant local councils to provide comment on the location of ambient air quality monitoring sites and review air quality reports.
- Designing the ventilation system to avoid emissions from the entry and exit portals, except in emergency situations.

Land Use, Place Making, Public Open Space and Active Transport

- There should be an increase in public open space, not just no loss.
- Project should provide multiple land bridges across the Warringah Freeway.
- Temporary loss of access to Yurulbin Park, Berrys Bay and other parks during construction.
- All trees that are removed must be replaced with mature trees and not seedlings.
- Operational facilities in Cammeray Golf Course should be undergrounded to provide more open space.
- Insufficient active transport linkages across the Warringah Freeway and with the Harbour Bridge.
- The proposed Falcon Street bus overpass would have visual and amenity impacts to adjoining residents.

Assessment

- The Proponent has committed to developing a Place, Design and Landscape Plan to ensure that the detailed design of the built form, public open space and landscape design components of the project include details of where vegetation would be retained, planting is proposed and how Aboriginal and non-Aboriginal heritage interpretation and public art would be incorporated into a final design.
- The Proponent has committed to redeveloping Berrys Bay into a new public open space area in consultation with the local community and North Sydney Council. It will also provide a new path along the foreshore linking Carradah Park with Balls Head Road, as soon as practicable following the completion of construction activities at the site.
- The Department supports the Proponents commitment to engage the original landscape architect of Yurulbin Park, Bruce Mackenzie, to assist in developing the final design of the new park post construction.

Recommended Conditions/Response

- High quality design outcomes would be informed by an independent Design Review Panel and incorporated into the Place, Design and Landscape Plan.
- A net-increase in the provision of public open space is required.
- Establishment of an altered Cammeray Golf Course must provide an equivalent standard golf course or the provision of works to offset the loss in standard.
- As many existing trees as possible must be retained and replacement trees and plantings must deliver a net increase in trees and tree canopy.
- Berrys Bay would be redeveloped into a new public space in consultation with the local community and North Sydney Council.
- Yurulbin Park would be redesigned by the original landscape architect to achieve the intended vision of the park.
- St Leonards Park construction ancillary site must be rehabilitated in consultation with Council and opened to the public as soon as practicable following completion of construction.

• The project will direct traffic through North Sydney CBD which is in conflict with future pedestrianisation and strategic planning.	• Active transport links and connections to be investigated further and enhanced. • The design of the Falcon Street bus on ramp must be refined to have a greater setback to the apartments along Merlin Street, Neutral Bay. • The project must consider the delivery of the objectives proposed by the North Sydney Integrated Transport Program.
<u>Tunnel Depth</u> • Vibration impacts to properties, particularly around Balmain/Birchgrove and Waverton, where there are older properties on shallow or no foundations. • After detailed design, WestConnex tunnel depths were shallower than in the EIS, concern the same will happen on this project. • Inadequacy of 50 metre distance limit for dilapidation surveys, concern property damage will occur further away. • Commitment that the project or Government will rectify all damage caused by excavation and tunnelling.	*Assessment* • Construction vibration impacts are unavoidable for a project of this magnitude and in a highly complex and developed urban environment. The impacts will be manageable with the implementation of appropriate mitigation and management measures. • The Proponent has committed to rectifying damage to properties. • Construction of the project must be carried out generally in accordance with the EIS and the Response to Submissions. *Recommended Conditions/Response* • A geotechnical model of geological and groundwater conditions must be prepared prior to excavation and must include details of proposed construction excavation and potential impacts to properties and structures. • Offering pre-construction surveys on the current condition of surface and sub-surface properties and structures identified as at risk from settlement or vibration by the above geotechnical model, which is not limited to a 50 metre boundary. The survey and report will be undertaken by suitably qualified independent assessors. • The establishment of an Independent Property Impact Assessment Panel before works commence which must comprise geotechnical and engineering experts independent of the design and construction team to review pre and post-construction building condition survey reports and resolve disputes relating to property damage.
<u>Dredging</u> • Investigate alternative construction methods rather than immersed tubes so contaminated material is not disturbed. • Concern that the report outlining the harbour bed contamination has not been published. The community cannot review and comment on the full impacts of dredging. • Dredging impacts on marine species, including from the dredge plume, boat strikes and coffer dam trapping. • Impacts to human health from the dredging of contaminated material in the water. • Use of full depth silt curtains deemed not appropriate due to tidal	*Assessment* • The Response to Submissions Report included the *Contamination Factual Report – Marine Investigations* prepared by Douglas Partners/Golder Associates. • The backhoe dredger will be fitted with a closed environmental bucket designed to contain dredged contaminated materials, minimise suspended sediment mass and reduce turbidity while the bucket is raised up through the water column and swung over the receiving hopper barge. • Real time monitoring of the backhoe dredging and control systems will occur and dredging will not occur during strong wind conditions. • The Department supports the additional use of silt curtains to protect sensitive marine environments during dredging operations. • The Department considers that the dredging of contaminated sediment from the harbour and its transport and treatment at White Bay can be appropriately managed. *Recommended Conditions/Response* • The preparation and implementation of a Dredging and Disposal Management Plan and a Dredging Monitoring Program prior to the commencement of construction – to be approved by the Department and reviewed by the EPA and Harbour Master/Port Authority.

currents and boat movements, so why are the shallower depth curtains appropriate.	• The preparation of Detailed Site Investigation Reports prior to the commencement of works by qualified Contaminated Land Consultants certified under schemes approved by the EPA. • Limiting suspended sediment and turbidity impacts in Sydney Harbour during dredging activities. • Requiring construction activities in Sydney Harbour to be undertaken in a manner that protects nearby intertidal rocky reefs, seagrass beds and other sensitive marine habitats.
<u>Heritage</u> • Concern was raised in relation to potential impacts to heritage listed items. • Impacts to Whale Rock and other Aboriginal cultural heritage sites, yet to be assessed. • Requirement for specific vibration criteria to protect heritage items.	*Assessment* • Design of the construction site layout and reinstatement of Yurulbin Park will be undertaken in consultation with the park's original architect to protect significant features of the item and to enhance the existing character and design intent. • The Proponent has committed to formulating a site-specific conservation management plan for Yurulbin Park; archaeological investigation; to investigate the temporary removal and storage of heritage features of the item; and to retain and protect established trees where possible. • The Proponent has committed to rectify any damage to heritage items. • The Proponent has committed to open space rehabilitation of the effected parts of St Leonards Park, as well as standard vibration and settlement mitigation measures. • For Aboriginal cultural heritage sites including Whale Rock, the Proponent has committed to structural integrity assessment and, if required, vibration monitoring. For structurally unsound sites, works will be undertaken to minimise vibration levels to below 2.5mm/s. *Recommended Conditions/Response* • Requiring archival recording for the Coal Loader, St Leonards Park and Yurulbin Park. • Prohibiting destruction, modification or impact to the Coal Loader and associated maritime infrastructure. • The Proponent must conduct vibration testing before and during vibration generating activities that have the potential to impact on heritage items to identify minimum working distances to prevent cosmetic damage.
<u>Justification and Procedure</u> • No published Business Case for the project. • Beaches Link is not included in Western Harbour Tunnel EIS, these two projects should be assessed together to fully understand the true impact to communities. • Calls for the suspension of the exhibition during COVID-19 and re-exhibited after. • Communication engagement sessions cancelled, and the community could not engage with each other	*Assessment* • This project was exhibited from 29 January 2020 to 30 March 2020, a total of 62 days, more than double the legislated requirement for State Significant Infrastructure projects and primarily prior to the imposition of any Public Health Orders due to the COVID-19 Pandemic. • The Department is satisfied the views of the community were adequately heard and conveyed to the Proponent. • The Western Harbour Tunnel and Warringah Freeway Upgrade, and the Beaches Link and Gore Hill Freeway Connection Projects are components of the Western Harbour Tunnel and Beaches Link program of works and subject to separate but coordinated environmental assessment and approval processes. • This project has been endorsed by the NSW Government and is a key component of several strategic infrastructure and planning documents including *Future Transport Strategy 2056* and *A Metropolis of Three Cities – the Greater Sydney Region Plan.* • The Department considered impact to land use and property in its assessment and concluded that any impacts can be managed.

due to social distancing requirements. • No real assessment of alternatives to the project such as public transport. • Impact to property values.	*Recommended Conditions/Response* • Any damage to property as a result of the project must be rectified at no cost to the landowner within 12 months of the completion of construction.
<u>Climate Change and Sustainability</u> • Use of potable water in a time of drought. • Increase in CO_2 emissions as a result of the project is not sustainable and does not align with the NSW Government's commitment to reducing greenhouse gas emissions. • The government should be considering mass transport solutions that produce less CO_2 emissions and are more effective at moving large volumes of people. • Consideration of more remote working would mean that this project is no longer required.	*Assessment* • Various alternatives including public transport were assessed as part of the project and documented within the EIS. • The project forms part of a complementary integrated multi-modal transport strategy being implemented by the NSW Government. *Recommended Conditions/Response* • A Water Reuse Strategy to set out options for the reuse of collected stormwater and groundwater during construction and operation. • Retention of as many trees as possible, and that replacement trees must deliver a net increase in tree canopy and aim to enhance the relevant council's position with regard to the Sydney Green Grid. • Achieve a minimum "Excellent" Design and As Built rating under the Infrastructure Sustainability Council of Australia Infrastructure rating tool.

Appendix F – Independent Traffic and Transport Review

Appendix G – Existing Traffic Information and Traffic Impacts

Existing Level of Service

Table G1 | Modelled 2016 morning and evening peak hour performance at key intersections

Intersection	Morning peak hour		Evening peak hour	
	Average delay (secs)	Level of service	Average delay (secs)	Level of service
Rozelle and surrounds				
Victoria Rd/Darling St	85	F	75	F
Victoria Rd/Evans St	43	D	48	D
Victoria Rd/Robert St	49	D	>100	F
Victoria Rd/The Crescent	27	B	88	F
The Crescent/James Craig Rd	10	A	25	B
The Crescent/City West Link	21	B	55	D
The Crescent/Johnston St	42	C	89	F
City West Link/Balmain Rd	72	F	51	D
Warringah Freeway and surrounds				
Brook St/Merrenburn Ave	31	C	12	A
Miller St/Ernest St	34	C	31	C
Miller St/Falcon St	35	C	69	E
Military Rd/Ben Boyd Rd	13	A	20	B
Berry St/Walker St	32	C	50	D
Mount St/Arthur St	84	F	32	C
Mount St/Walker Street	43	D	31	C
Pacific Hwy/High St/Arthur St	53	D	19	B
Pacific Hwy/Walker St/Blue St	53	D	48	D
Pacific Hwy/Miller St/Mount St	52	D	41	C
Pacific Hwy/Berry St	9	A	11	A
Miller St/McLaren St	24	B	17	B
High Street/Clark Rd	>100	F	36	C
High St/Alfred St	60	E	18	B
Mount St/Alfred St	24	B	11	A
Ernest St/Ben Boyd Rd	11	A	16	B
Gore Hill Freeway and surrounds				
Epping Rd/Lounguevillle Rd/Parklands Ave	48	D	63	E
Longueville Rd/Pacific Hwy	42	C	36	C
Pacific Hwy/Gore Hill Freeway	23	B	23	B

Reserve Rd/Gore Hill Freeway	47	D	29	C
Reserve Rd/Dickson Rd	14	A	19	B

Access routes and construction traffic movements

Table G2 | Access routes and indicative daily and peak period construction traffic volumes (Source: EIS)

No.	Construction Ancillary Site	Proposed access routes	Peak vehicle movements per day		Morning peak vehicle movements (6am to 10am)		Evening peak vehicle movements (3pm to 7pm)	
			Light	Heavy	Light	Heavy	Light	Heavy
WHT1	Rozelle Rail Yards	City West Link	305	165	134	42	137	43
WHT2	Victoria Rd	Victoria Rd	230	420	62	111	128	111
WHT3	White Bay	James Craig Road, Port Access Rd	530	700	205	189	255	189
WHT4	Yurulbin Point	Sydney Harbour	-	-	-	-	-	-
WHT7	Berrys Bay	Balls Head Rd, Pacific Hwy	210	55	101	11	69	12
WHT8	Berry St Nth	Berry St, Warringah Fwy	130	30	20	10	18	6
WHT9	Ridge St Nth	Falcon St, Miller St, Ridge St, Warringah Fwy	165	200	64	51	67	51
WHT10	Cammeray Golf Course	Ernest St, Warringah Fwy	480	485	198	128	212	130
WFU1	Blue St	Pacific Hwy, Blue St	315	10	96	4	92	2
WFU2	High St Sth	Pacific Hwy, Alfred St, High St	80	15	17	6	13	2
WFU3	High St Nth	Pacific Hwy, Alfred St, High St	65	10	14	4	8	2
WFU4	Arthur St East	Pacific Hwy, Arthur St	135	10	28	4	23	2
WFU5	Berry St East	Berry St, Warringah Fwy	30	30	9	4	5	2
WFU6	Ridge St East	Falcon St, Miller St, Ridge St, Warringah Fwy	70	20	17	4	9	2

WFU7	Merlin St	Merlin St	150	0	40	0	35	0
WFU8	Cammeray Golf Course	Ernest St, Warringah Fwy	865	40	238	12	250	7
WFU9	Rosalind St East	Rosalind St	205	15	46	4	47	2
-	ANZAC Park	Ernest St	75	30	27	10	19	4
WHT11	Waltham Street	Dickson Ave, Waltham St	180	85	86	18	86	18

Appendix H – Noise Impacts

Table H1 summarises the worst-case noise exceedances, the number of receivers that are predicted to be highly noise affected (HNA) during out of hours roadwork activities and those that will be impacted by sleep disturbances for works associated with the Warringah Freeway Upgrade. **Table H2** outlines the number of residential receivers that may be impacted from construction ancillary sites for the Warringah Freeway Upgrade. **Table H3** shows the expected number of noise catchment areas (NCAs) with noise management level (NML) exceedances and **Table H4** outlines the predicted sleep disturbance impacts during construction of Western Harbour Tunnel.

Table H1 | Summary of worst-case exceedances during roadworks for Warringah Freeway Upgrade

Locality/Activity	OOHW construction hours (all sensitive receivers)				
	No. of NCAs with NML exceedances	Duration of works	Worst-case noise levels (dBA) and associated NCA	No. of residential buildings HNA (75 dBA or over)	No. of receivers exceeding sleep disturbance criteria/ awakening criteria
Ridge Street shared user bridge (WFU1A)					
Bridge modifications construction in traffic corridor (01)	19	12 mths	83 (17.4)	9	324 / 17
Bridge demolition/delivery of oversized plant and elements (02)	19	6 mths	91 (17.4)	0	356 / 54
Berry Street entry on ramp works (WFU1B)					
Ramp realignment and pavement works (01 and 02)	20	6 mths	90 (19.1) 86 (19.1)	17 16	21 / 31 (01) 495 / 63 (02)
Construction of WHT trough and portal (03)	18	9 mths	89 (19.1)	18	532 / 73
Alfred Street North and Mount Street interchange modification and grade separation works (WFU1C)					
Realignment of Alfred Street North between Merlin and Ridge Street (01)	19	9 mths	93 (17.4)	22	878 / 95
Widening of Waringah Freeway to the east (02 and 03)	17	6 mths	82 (17.4) 75 (17.4)	26 7	184 / 111 (02) 195 / 115 (03)
Modifications to Mount Street interchange (04)	10	24 mths	75 (17.3)	2	29 / 15
New Alfred Street North off ramp bridge (05)	16	9 mths	84 (17.4)	18	104 / 73
New Mount Street underpass (06)	15	9 mths	82 (17.3)	23	103 / 95
Warringah Freeway northbound widening (WFU1D)					
Resurfacing works (01)	14	6 mths	72 (17.2)	0	67 / 23
Falcon Street interchange upgrade (WFU1E)					
Road/bridge demolition/ construction works in major traffic	2 29 29	3 mths 6 mths 9 mths	66 (23.1) 92 (23.2) 77 (23.2)	1 6 1	328 / 42 (01) 1155 / 104 (02) 1011 / 58 (03)

corridor; Oversized deliveries (01 to 06)	21 18 29	6 mths 6 mths 18 mths	70 (17.4) 91 (23.1) 79 (23.1)	0 18 4	533 / 31 (04) 730 / 105 (05) 1116 / 114 (06)
Bridge modification/ construction Oversized deliveries (07)	26	12 mths	84 (23.1)	16	939 / 101
Bridge demolition over live traffic corridor; Oversized deliveries (08)	27	3 mths	86 (23.2)	8	940 / 106
High Street Interchange Upgrade (WFU1F)					
Widening of High Street Bridge (01 and 02)	7	18 mths	66 (17.3) 68 (17.2)	0 0	52 / 45 (01) 51 / 49 (02)
Construction of northbound ramp (03)	10	9 mths	67 (17.3)	0	47 / 13
Ramp modification works (04)	8	6 mths	66 (16.1)	0	63 / 34
Warringah Freeway northbound widening (WFU1G)					
Construction of bus lane bridge (01)	25	12 mths	92 (23.1)	8	1076 / 99
Widening Freeway southbound (02 to 04)	24 13 14	12 mths 9 mths 6 mths	88 (17.4) 87 (17.4) 78 (17.4)	7 20 28	794 /65 (02) 59 / 46 (03) 199 / 137 (04)
Retaining wall construction (05)	10	9 mths	78 (17.4)	6	81 / 66
Falcon Street to Miller Street Construction Works (WFU2H)					
Ernest Street Bridge (01 to 02)	15 14	18 mths 9 mths	84 (23.1) 76 (23.2)	3 2	120 / 8 (01) 297 / 26 (02)
Tunnel structure works (04 to 09) OOHW not typically required for 03, and only oversized deliveries for sites 10/11.	20 25 26 14 14 22 24	3 mths 3 mths 3 mths 9 mths 6 mths 6 mths 9 mths	77 (23.2) 76 (25.1) 71 (25.1) 67 (25.1) 67 (25.1) 85 (25.1) 80 (23.2)	3 1 0 0 0 10 6	117 / 13 (04) 678 / 45 (05) 827 / 62 (06) 212 / 7 (07) 116 / 21 (08) 694 / 88 (09) 617 / 45 (10)
Miller Street to Willoughby Road construction works (WFU3I)					
Warringah Freeway northbound widening works (01 to 05)	22 25 14 29 22	6 mths 6 mths 6 mths 6 mths 6 mths	89 (30.1) 90 (30.1) 81 (30.1) 90 (29.1) 83 (30.2)	17 60 24 29 5	702 / 103 (01) 630 / 144 (02) 590 / 102 (03) 1745 / 289 (04) 961 / 95 (05)
Western Harbour Tunnel Falcon Street off ramp cut and cover (WFU3J)					
Site establishment and tunnel strcture works (01)	4	18 mths	58 (20.1)	0	18 / 2
Road integration works (02)	18	18 mths	70 (17.4)	0	18 / 5
Total Expected Exceedances of Sleep Criteria					**20,786 / 3.035**

Table H2 | Number of residential receiver buildings over the NML from construction a sites for Warringah Freeway Upgrade (worst case scenario)

Localition	Daytime (standard)	Daytime (outside standard)	Evening	Night	Sleep disturbance, awakening (L_{Amax})
Blue Street (WFU1)	6	6	6	9	6
High Street south (WFU2)	0	0	0	20	21
High Street north (WFU3)	14	14	22	57	51
Arthur Street east (WFU4)	1	1	3	13	9
Berry Street east (WFU5)	0	0	0	10	7
Berry Street north (WHT8)[1]	18	18	22	31	28
Ridge Street east (WFU6)	4	4	4	15	13
Ridge Street north (WHT9)[1]	3	3	3	18	15
Merlin Street (WFU7)	1	1	5	34	33
Jefferson Jackson Reserve construction area[2]	3	3	10	72	44
Merlin Street north construction area[2]	1	2	10	59	24
Rosalind Street east (WFU9)	2	1	7	96	25

Note 1: Berry Street north and Ridge Street north construction ancillary sites are Western Harbour Tunnel sites but would also ancillary activities within or near the Warringah Freeway.
2: These are two small areas that would support the Falcon Street shared user bridge works.

Table H3 | Number of NCAs with NML exceedances during construction of Western Harbour Tunnel

Locality/Activity	Standard construction hours (all sensitive receivers)			
	No. of NCAs with NML exceedances	Duration of works	Worst-case noise levels (dBA) and associated NCA	No. of receivers HNA (75 dBA or over)
Victoria Road construction ancillary site (WHT2)				
Early works	8	6 mths	82 NCA 6.3	27
Site establishment	7	6 mths	93 NCA 6.1	22
Piling for decline and acoustic shed	2	6 mths	78 NCA 6.5	3
Surface level decline construction	4	6 mths	86 NCA 6.1	10
Tunnel construction	2	18 mths	63 NCA 6.3	0
Tunnel fitout	2	27 mths	71 NCA 6.3	0
Tunnel commission, site rehabilitation	5	15 mths	81 NCA 6.3	0
White Bay construction ancillary site (WHT3)				
Site establishment	4	9 mths	80 NCA 9.2	0
Spoil handling	1	36 mths	62 NCA 9.1	0

Yurulbin Point construction ancillary site (WHT4)				
Early works	3	12 mths	81 NCA 12.1	2
Site establishment	2	12 mths	72 NCA 12.1	0
Acoustic shed construction	2	12 mths	68 NCA 12.1	0
Shaft construction	1	6 mths	61 NCA 12.1	0
Tunnel commission/site rehabilitation	1	15 mths	63 NCA 12.1	0
Sydney Harbour Crossing construction ancillary sites (WHT5 and WHT6)				
Construction of north cofferdam	7	18 mths	64 NCA 15.1	0
Construction of south cofferdam	9	18 mths	81 NCA 12.1	6
Excavation of rock in cofferdam and trench	1	6 mths	63 NCA 12.1	0
Construction of interface structure	1	12 mths	64 NCA 12.1	0
Dredging and gravel placement	1	12 mths	59 NCA 12.1	0
Tunnel element immersion	1	15 mths	57 NCA 12.1	0
Berrys Bay construction ancillary site (WHT7)				
Early works	2	12 mths	76 NCA 14.1	1
Site establishment	2	12 mths	69 NCA 14.1	0
Acoustic shed and surface level tunnel access construction	2	12 mths	76 NCA 14.1	1
Tunnel construction (access decline and mainline tunnels)	1	15 mths	59 NCA 14.1	0
Tunnel fitout	1	30 mths	59 NCA 14.1	0
Tunnel commission/site rehabilitation	1	15 mths	63 NCA 14.1	0
Cammeray Golf Course construction ancillary site (WHT10)				
Site establishment	8	12 mths	82 NCA 26.1	12
Tunnel commission/site rehabilitation	1	15 mths	69 NCA 28.1	0

Table H4 | Summary of sleep disturbance impacts from construction of Western Harbour Tunnel

Construction Activity	No. of receivers to exceed sleep disturbance criteria	No. of receivers to exceed the awakening reaction criteria
Tunnel fitout and finishing, Rozelle Rail Yards ancillary site	36	0
Tunnel construction Victoria Road ancillary site	142	26
Tunnel fitout, Victoria Road ancillary site	210	21
Spoil handling and treatment, White Bay ancillary site	5	0
Tunnelling, Yurulbin Point ancillary site	79	9
Tunnel fitout, Yurulbin Point ancillary site	79	9
Prepare foundations, Sydney Harbour crossing ancillary site	6	0

Immerse tunnel unit elements, Sydney Harbour crossing ancillary site	102	7
Tunnelling, Berrys Bay ancillary site	25	2
Tunnel fitout, Berrys Bay ancillary site	25	2
Acoustic shed and surface level shaft/tunnel construction (Stage 3) + surface work ancillary (Stage 4), Cammeray ancillary site	32	2
Surface work ancillary (Stage 4) + tunnelling (Stage 5), Cammeray ancillary site	95	2
Surface work ancillary (Stage 5) + tunnelling (Stage 6), Cammeray ancillary site	32	2
Surface work ancillary (Stage 3) + remove spoil shed, construct motorway facilities building (Stage 7), Cammeray ancillary site	32	2
Total Expected Exceedances	**900**	**84**

Appendix I – Independent Air Quality Review

Appendix J – Independent Groundwater Review

Appendix K – Recommended Instrument of Approval