Transport for NSW

Western Harbour Tunnel and Warringah Freeway Upgrade Modification 2 - TBM construction methodology

Country of the Gammerayal, and Wangal clans of the Darug Nation

July 2023
Revision 0

Interpreter service

For languages other than English call 131 450
Arabic • Greek • Hindi • Mandarin • Vietnamese

طلب خدمة الترجمة الشفهية للغات غير الإنجليزية اتصل بالرقم 131 450

Για υπηρεσίες διερμηνείας σε άλλες γλώσσες εκτός από τα Αγγλικά καλέστε το **131 450**

अंग्रेज़ी के अतिरिक्त अन्य भाषाओं के लिए दुभाषिया सेवा **131 450** पर कॉल करें

获取英语以外的其他语言口译协助服务可以致电 **131 450**

Để có dịch vụ thông ngôn cho các ngôn ngữ khác tiếng Anh, gọi số **131 450**

Acknowledgement of Country

Transport for NSW acknowledges the Gammeraygal and Wangal clans of the Darug Nation, the traditional custodians of the land on which the Western Harbour Tunnel and Warringah Freeway Upgrade is being delivered. Transport for NSW acknowledge that our proposed construction support site located at Emu Plains is on Dharug country.

We pay our respects to their Elders past and present and celebrate the diversity of Aboriginal peoples' and their ongoing cultures and connections to the lands and waters of NSW.

Many of the transport routes we use today – from rail lines, to roads, to water crossings – follow the traditional Songlines, trade routes and ceremonial paths in Country that our nation's First Peoples followed for tens of thousands of years.

Transport for NSW is committed to honouring Aboriginal peoples' cultural and spiritual connections to the land, waters and seas and their rich contribution to society.

Approval and authorisation

Title	Western Harbour Tunnel and Warringah Freeway Upgrade Modification 2 - TBM construction methodology
Prepared by	Hutchison Weller on behalf of Acciona
Accepted on behalf of Transport for NSW by:	Mark Russell
Signed	
Date:	14/07/2023

Declaration

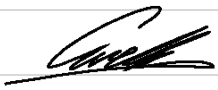
Report prepared by:			
Name	Aidann Stathis		
Qualifications:	BLAS, Masters of Environment (Environmental Management)		
Address:	Hutchison Weller Pty Ltd 13/357 Military Road, Mosman, NSW, 2088		
Name:	Mark Hather		
Qualifications	BSc, Masters of Environmental Planning		
Company	MCAL Environmental Consulting Pty Ltd		
Name:	Cameron Weller		
Qualifications:	BSc (Applied Geography) Hons. Masters Environmental Law		
Address:	Hutchison Weller Pty Ltd 13/357 Military Road, Mosman, NSW, 2088		
Responsible person:			
Name:	Mark Russell Senior Manager, Environment and Sustainability Transport for NSW		
Address:	Locked Bag 928, North Sydney NSW 2059 ABN 18 804 239 602		
Proposed development:			
Western Harbour Tunnel and Warringah Freeway Upgrade – TBM Solution			
Address of the land on which the infrastructure to which the report relates is to be carried out:			
Land within the Inner West, North Sydney, Willoughby and Penrith local government areas as described within the Modification Report.			
Description of the proposed modified project to which the report relates:			
Changes to the construction methodology for crossing Sydney Harbour; from the approved immersed tube tunnel (IMT) to deeper driven tunnels by tunnel boring machines (TBM). The proposed modified project also includes an additional construction support site at Emu Plains (WHT13). WHT13 will be used as the primary facility for pre-casting and storage of tunnel lining segments and culverts.			
Modification Report prepared by:			
A Modification Report for the project is attached and is prepared in accordance with section 180 of the *Environmental Planning and Assessment Regulation 2021*.			
Declaration:	I certify that I have prepared this Modification Report to comply with Section 180 of the *Environmental Planning and Assessment Regulation, 2021*. To the best of my knowledge this Modification Report contains all available information that is relevant to the assessment of the proposed modified project and the information contained in the Modification Report is neither false nor misleading.		
Signatures:			
Name:	Mark Hather	Cameron Weller	Aidann Stathis
Date:	14/07/2023	14/07/2023	14/07/2023

Table of contents

List of tables

List of figures

List of Appendices

Appendix A	**Updated project description**
Appendix B1	**Revised Conditions of Approval**
Appendix B2	**Revised environmental management measures**
Appendix C1	**Updated statutory compliance table**
Appendix C2	**Options analysis**
Appendix D	**Technical Working Paper: Traffic and transport - construction**
Appendix E	**Technical Working Paper: Traffic and transport - operation**
Appendix F1	**Technical Working Paper: Construction noise and vibration - TBM**
Appendix F2	**Technical Working Paper: Construction noise and vibration - Emu Plains**
Appendix G	**Technical Working Paper: Air quality - operation**
Appendix H	**Human health review – air quality**
Appendix I	**Non-Aboriginal heritage – Emu Plains**
Appendix J	**Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) Stage 1 Assessment**
Appendix K1	**Technical Working Paper: Groundwater and settlement**
Appendix K2	**Technical Working Paper: Preliminary Site Investigation - Emu Plains**
Appendix L	**Technical Working Paper: Flooding - Emu Plains**
Appendix M	**Biodiversity Development Assessment Report - Emu Plains**
Appendix N	**Technical Working Paper: Social Impact Assessment**
Appendix O	**Pre-exhibition Consultation Report**

Glossary of terms and abbreviations

Term	Meaning
AEP	Average exceedance probability
AHIMS	Aboriginal Heritage Information Management System
Approved Project	Western Harbour Tunnel and Warringah Freeway as approved by the Minister for Planning and Public Spaces on 21 January 2021
AQIA	Air quality impact assessment
AQMS	Air quality monitoring station
BAM	Biodiversity Assessment Method
BC Act	*Biodiversity Conservation Act 2016*
BL	Beaches Link
CNVG	Construction Noise and Vibration Guideline
CSSI	Critical State Significant Infrastructure
dB	Unweighted sound pressure level in decibels
dBA	A weighted sound pressure level in decibels
DS	Do-something (Traffic model)
DSC	Do-something cumulative (Traffic model)
DPE	Department of Planning and Environment
EMM	Environmental Management Measure
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)*
EPL	Environment Protection Licence
HIA	Health impact assessment
IAQM	Institute of Air Quality Management
ICNG	Interim Construction Noise Guideline
IMT	Immersed tube
LCZ	Landscape Character Zones
LoS	Level of Service
Modification 1	Wicks Road Construction Support Site Modification
Minister's Conditions of Approval	The Conditions of Approval issued by the Minister for Planning and Public Spaces for the Western Harbour Tunnel and Warringah Freeway Upgrade
MNES	Matters of National Environmental Significance
KTP	Key Threatening Process
NCA	Noise Catchment Area
NCG	Noise Criteria Guideline
NML	Noise Management Level

Term	Meaning
NPfI	Noise Policy for Industry
OOHW	Out of Hours Work
PCT	NSW Plant Community Type
PMST	Protected Matters Search Tool
PPV	Peak Particle Velocity
Project EIS	Western Harbour Tunnel and Warringah Freeway Environmental Impact Statement (January 2020)
PSI	Preliminary Site Investigation
RBL	Rating Background Noise Level
REMM	Revised Environmental Management Measures
RWC	Regulatory Worst Case (Air Quality)
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SIA	Social Impact Assessment
SSI	State Significant Infrastructure
STP	Slurry treatment plant
Subject Land	The areas within or the combined areas of the Emu Plains construction support site and any indirect and prescribed impacts to which the BAM has been applied
TBM	Tunnel Boring Machine
TfNSW	Transport for NSW
VML	Vibration Management Levels
WFU	Warringah Freeway Upgrade
WHT	Western Harbour Tunnel
WHT Stage 1	Construction of tunnels between Rozelle and Birchgrove
WHT Stage 2	Construction of tunnels between Birchgrove and North Sydney (and under Sydney Harbour)

Executive Summary

Transport for NSW proposes to modify the approved Western Harbour Tunnel and Warringah Freeway Upgrade project (the Approved Project). The Approved Project, including the proposed modifications (the proposed modified project), would be located on the traditional lands of the Gammeraygal, and Wangal clans of the Darug Nation within the Inner West and North Sydney local government areas. The proposed construction support site located at Emu Plains is on Dharug country within the Penrith local government area.

The Approved Project consists of two main components:

- A new crossing of Sydney Harbour, involving twin tolled motorway tunnels connecting the M4-M5 Link at Rozelle and the Warringah Freeway at North Sydney (the Western Harbour Tunnel)
- Upgrade and integration works along the existing Warringah Freeway, including infrastructure required for connections to the WHT and future Beaches Link and Gore Hill Freeway Connection project (the Warringah Freeway Upgrade).

The Minister for Planning and Public Spaces approved the Project under Section 5.19 of the Environmental Planning and Assessment Act, 1979 (EP&A Act) on 21 January 2021 (SSI 8863). Early and preparatory works for the project started in March 2021, the main works on the Warringah Freeway Upgrade component of the project started in May 2022, the first stage of the Western Harbour Tunnel component of the project from Rozelle to Birchgrove started in January 2023, and the second and final stage from Birchgrove to Cammeray (including the section below Sydney Harbour) is anticipated to commence in the second half of 2023. The proposed modified project would form part of the main construction works relating to the second stage of the Western Harbour Tunnel component of the project.

Transport for NSW is proposing to modify the Approved Project to change the method of construction across Sydney Harbour from a roadheader and immersed tube tunnel (IMT) design with transition structures at both ends of the harbour crossing, to a tunnel boring machine (TBM) methodology (proposed modified project). The change in construction methodology will also require a change in support activities, including the reconfiguration and removal of some construction support sites and an additional construction support site at Emu Plains for the manufacture of precast segments for lining the tunnel.

This Modification Report describes and assesses the potential impacts of the proposed modified project and identifies how these impacts would be managed and mitigated.

What modifications are proposed?

Since approval was granted for the project, ACCIONA has been appointed on behalf of Transport for NSW to construct the 4.2 km section of tunnel between Birchgrove and Cammeray, including the crossing below Sydney Harbour). Design development and construction planning has progressed since the assessment contained in the Project EIS, with major improvements in the construction solution to better balance environmental impacts with construction capabilities.

The proposed changes to the Approved Project would be:

- Changes to the tunnelling method to cross Sydney Harbour from an IMT solution to a tunnel excavated using a TBM between Birchgrove and Waverton.
- Changes to the construction of a section of driven tunnel additional chamber excavation for the TBM underground launch site (adjacent to Birchgrove Park) and additional TBM receival chamber (adjacent to Carradah Park).
- Changes to the road alignment (vertical and horizontal) between the new TBM launch chamber at Birchgrove and Cammeray to accommodate the changes in design and construction methodology.
- Changes to the Rozelle Rail Yards construction support site (WHT1) cut and cover section (now referred to as the City West Link Portal construction support site (WHT12)).
- Changes to the White Bay construction support site (WHT3), including no longer using the northern portion of the site (now referred to as the Glebe Island construction support site (WHT3)).
- Changes to the Ridge Street North construction support site (WHT9) to allow for tunnel operations including spoil handling.
- An additional construction support site at Emu Plains (WHT13) for the manufacture of precast segments for lining of the tunnel. This site would be located within the existing Boral Quarry site, located in Railway Street, Emu Plains.

Key features of the proposed modified project are shown on Figure E 1 and Figure E 2.

The changes in construction methodology would also result in the removal of a number of major construction sites and other activities. These would include:

- Removal of dredging activities in Sydney Harbour and the large-scale IMT fabrication activities previously proposed at the White Bay construction support site (WHT3).
- Removal of the approved construction support sites at:
  - Yurulbin Point (WHT4)
  - Sydney Harbour south cofferdam (WHT5)
  - Sydney Harbour north cofferdam (WHT6)
  - Berrys Bay (WHT7)
  - Victoria Road (WHT2).

The location of the construction support sites that would now be removed are also shown on Figure E 1.

Figure E 1 Overview of the proposed modified project alignment and removed construction sites.

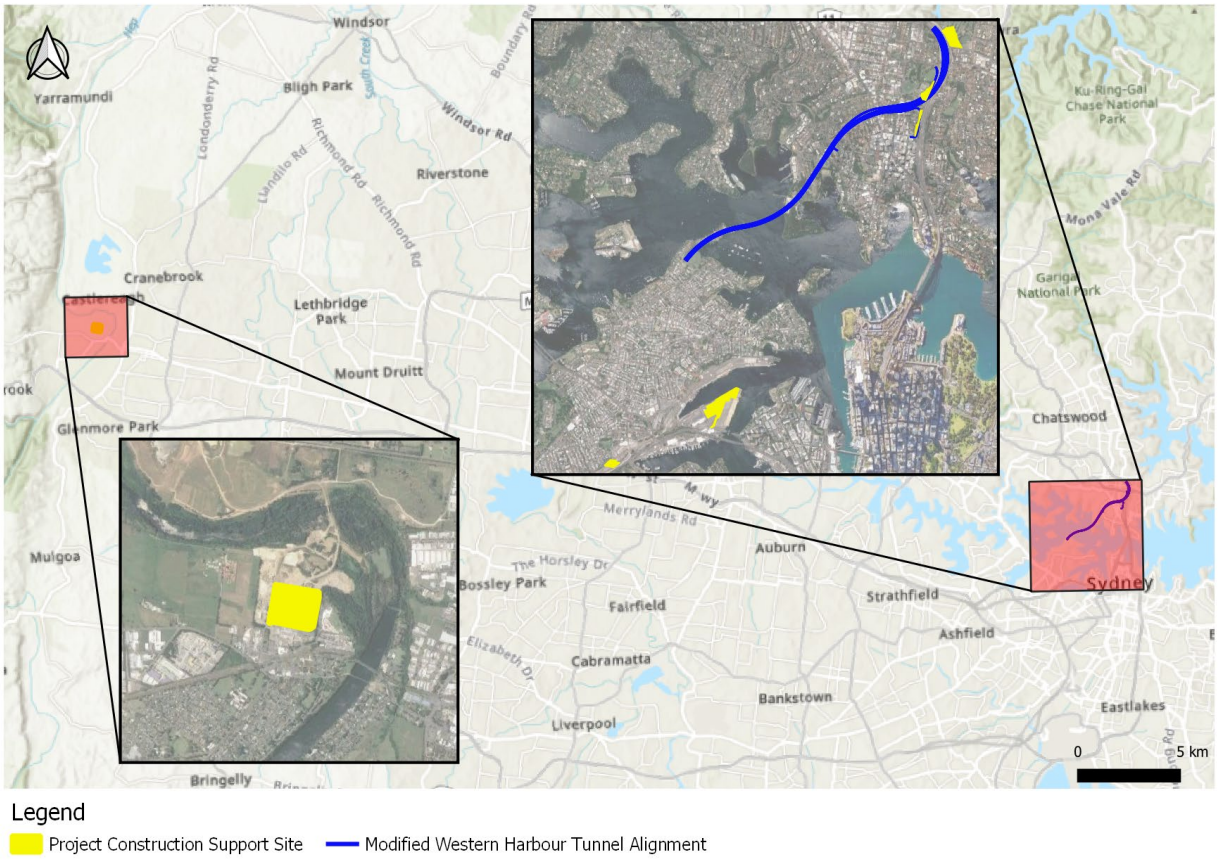


Figure E 2 Locational context of the key elements of the proposed modified project.

The proposed changes have been identified as a construction solution that better balances environmental impacts with construction capabilities. The approval of the proposed modified project would greatly reduce environmental impacts associated with harbourside construction sites, including the removal of four major construction support sites surrounding or in Sydney Harbour, and associated works. It would also remove Victoria Road construction support site (WHT2) and replace surface activities at the Rozelle Rail Yards construction support site (WHT1) with an underground construction site (City West Link Portals (WHT12)) that enables a more complete area of Rozelle Parklands to be given back to the public.

The proposed modified project would avoid or reduce key issues associated with non-Aboriginal Cultural Heritage, Aboriginal Cultural Heritage, biodiversity, water quality, socio-economic and hazards and other key risks associated with the currently approved IMT method for crossing Sydney Harbour.

The additional construction support site at Emu Plains (WHT13) is required to support the TBM operations, as the primary site for manufacture of the concrete segments for lining the tunnel. This site would have advantages over the Glebe Island construction support site (WHT3) with respect to available space and its location in an industrial facility, and hence reduced potential disruption to supply as well as reduced potential environmental risks.

The proposed modified project would result in changes only to the construction methodology and therefore would not represent a change in the strategic context, objectives or need for the project. It would continue to support the current needs and future growth of the Eastern Harbour City and Eastern Economic Corridor through an efficient transport network fundamental to the liveability, productivity and sustainability of Greater Sydney. It would continue to be consistent with the Greater Sydney Region Plan, the Future Transport Strategy (Transport for NSW, 2022) and the State Infrastructure Strategy 2018 – 2038 (Infrastructure NSW, 2018) with respect to aligning land use, transport and infrastructure outcomes for Greater Sydney.

The proposed modified project is therefore considered to provide an overall benefit to the delivery of the Approved Project and would be in the public interest.

What is the approval process?

The Secretary of the Department of Planning and Environment (DPE) issued Secretary's environmental assessment requirements (SEARs) for the Western Harbour Tunnel and Warringah Freeway Upgrade in December 2017. Notably, the Scoping Report (which formed the basis for the issuing of SEARs for the Approved Project) identified a roadheader and/or TBM as the then likely tunnelling method for crossing Sydney Harbour. The Project EIS was exhibited in early 2020 and a Project Submissions Report (RtS) was submitted to DPE in September 2020.

On 9 November 2020 the Minister for Planning and Public Spaces declared the project to be Critical State Significant Infrastructure (CSSI) under section 5.13 of the EP&A Act. The project was accordingly subject to assessment and approval in accordance with Division 5.2, Part 5 of the EP&A Act. The Minister for Planning and Public Spaces approved the project under section 5.19 of the EP&A Act on 21 January 2021 (SSI 8863).

Not all of the proposed changes can be accommodated within the existing project approval. As such, a Modification Report is required to be prepared in accordance with section 5.25 of the EP&A Act and the relevant provisions of the Environmental Planning and Assessment Regulation 2021 (EP&A Reg), having regard to DPE's State Significant Infrastructure and State Significant Project Guidelines including Preparing a Modification Report – Appendix F to the SSI Guidelines (DPIE, 2022).

DPE will prepare an assessment report for consideration by the Minister for Planning and Public Spaces, who will then decide whether to approve the proposed modified project.

What are the main community and stakeholder views?

Community and stakeholder consultation has been, and will continue to be, an integral component of the development of the Project. The exhibition of the Project EIS identified a number of key issues of concern which would be of relevance to the proposed modification. This included impacts on air quality (operation), construction traffic, construction noise and vibration, loss of public open space, dredging and impacts on air quality and odours, non-Aboriginal heritage impacts and the increase in CO_2 emissions. Overall, the proposed modified project would have a beneficial or neutral impact on the majority of these community concerns.

Community and stakeholder views in regard to the proposed Modification are generally positive in relation to the removal of impacts to the community or neutral where changes are minor with respect to the Project as a whole.

Consideration of community views will continue with the public exhibition of this Modification Report. A response to community submissions raised from the public exhibition of this Modification Report will also be addressed before seeking planning approval.

What are the main beneficial and adverse impacts compared to the Approved Project?

The proposed modified project would only relate to changes to the construction method. In this regard, all impacts requiring further assessment (with the exception of air quality and traffic) relate to potential construction stage impacts. Given the slight changes in the tunnel alignment, some minor changes to air quality and traffic during operation have been identified and have been included in the assessment.

A summary of the main beneficial and adverse impacts of the proposed modified project for the changes associated with tunnelling and Sydney Harbour crossing works, and the proposed new Emu Plains construction support site (WHT13) is provided in Table E1.

Table E 1 Major beneficial and adverse impacts of the proposed modified project compared with the Approved Project.

Environmental aspect	Major benefits compared to the Approved Project	Adverse impacts compared to the Approved Project	
		Changes to tunnelling and Sydney Harbour crossing works	**Emu Plains construction support site (WHT13)**
Traffic and transport - construction	Removes: • construction traffic impacts on Bay Road and Balls Head Road. • the need to close the Birchgrove Ferry Wharf. • all marine traffic impacts in Sydney Harbour, including navigational. restrictions and marine speed limits. • impacts on moorings in Berry's Bay and Snail's Bay	• Minor increase in heavy vehicle traffic on City West Link. • A very minor increase (less than 1 minute) in travel times between City West Link and Pyrmont. • A minor deterioration in performance at the intersection of The Crescent/City West Link (from D to E) during the PM peak. Many other intersections would operate at an improved level of performance. • Increase in on-site parking would increase light vehicle movements on Ridge Street by around 230 vehicles per day.	• Negligible impacts with respect to traffic network and intersection performance. • Some six parking spaces on Lee Street in Emu Plains may need to be removed to allow truck turning movements. These changes would have very minor impact on the demand for parking.
Traffic and transport - operation	No additional benefits compared to the Approved Project.	Very minor changes (positive and adverse) to the performance of some intersections.	Not applicable as this site would no longer be required after construction completion.

Environmental aspect	Major benefits compared to the Approved Project	Adverse impacts compared to the Approved Project	
		Changes to tunnelling and Sydney Harbour crossing works	**Emu Plains construction support site (WHT13)**
Noise and vibration - construction	Removes: • all construction noise associated with five major construction support sites. • noise impacts associated with dredging and disposal operation, including operating trailer suction hopper barges during non-standard construction hours. • Noise exceedances of ground borne NMLs associated with the main TBM tunnelling works. Reduces: • noise levels around the Glebe Island construction support site and the Ridge Street North construction support site	• Exceedances of the ground-borne noise management levels and vibration management levels at sensitive residential buildings during evening and night periods for other activities. These would be generally comparable with the Approved Project. The duration of any such exceedances would be only a few days for tunnelling when progressing along the alignment. • The construction of the new launch and receival chamber is expected to result in a number of further exceedances of the NMLs should rock breaking be required. If so, mitigation such as offers of alternative accommodation would be provided.	• Possible noise exceedances are predicted during civil earthworks (around 3-4 months) including at CathWest Innovation College and Penola Catholic College. Consultation and monitoring during this time will be a requirement to ensure the amenity (particular for students) is not affected. Periods of respite and relocating activities further back from the boundary and/or not using the noisiest equipment on the eastern boundary, should result in predicted noise meeting the noise management levels. • For ongoing operational activities, there would be no exceedances for day, evening, or night periods with the possible exception of one residential receiver. Mitigation options would be determined directly with this receiver.
Air quality - construction	Removes: • impacts associated with odours from dredging and barging of dredged material. Operation of the Emu Plains construction support site (WHT13) is expected to have a positive impact on local air quality when compared to the existing conditions, as a large proportion of the site will be either covered by the casting sheds or by hardstand.	No additional adverse impacts identified beyond those assessed for the Approved Project.	Potential dust emissions during construction and associated residual risks would be low to medium without mitigation. With standard and well proven mitigation measures, these risks would be reduced to low.

Environmental aspect	Major benefits compared to the Approved Project	Adverse impacts compared to the Approved Project	
		Changes to tunnelling and Sydney Harbour crossing works	Emu Plains construction support site (WHT13)
Air quality / Health impacts-operation	No additional benefits compared to the Approved Project.	• Negligible change to impacts on air quality when compared to the Approved Project. • No change to the assessment of health impacts from those presented in the Project EIS.	Not applicable as this site would no longer be required after construction completion.
Geology, soils, contamination, and groundwater	Removes: • risks associated with potentially contaminated marine sediments disturbed by dredging in Sydney Harbour. • the requirement for ongoing dewatering beneath Birchgrove Peninsula (including Yurulbin Park). Reduces: • risks associated with potentially contaminated material within Birchgrove peninsula and at Berry's Bay • potential groundwater impacts to receptors.	The proposed increase in excavation geometry for the TBM launch chambers and receival chambers may increase groundwater inflow and potential for settlement but would still comply with the conditions of approval for the Approved Project.	Residual contamination is expected to be of low risk. Additional investigation of the site will be required to further assess the moderate and high contamination risk associated with historic fill and potential migration of groundwater from industrial facilities nearby.

Environmental aspect	Major benefits compared to the Approved Project	Adverse impacts compared to the Approved Project	
		Changes to tunnelling and Sydney Harbour crossing works	Emu Plains construction support site (WHT13)
Socio-economics	Removes: • impacts on accessibility for marine users, both businesses, passengers, and recreational users. • impacts to local amenity and character due to the construction of the temporary cofferdams and on the north and south side of the harbour. • impacts to social infrastructure and meeting places of Yurulbin Park, Birchgrove Wharf, Waverton Park, and the Coal Loader Centre for Sustainability. • impacts to businesses within Berrys Bay such as Sydney Harbour Yacht Charter. The Emu Plains construction support site (WHT13) would provide for the diversification of job locations and include Western Sydney.	• There would be a new social impact associated with increase in construction hours– however with a low negative risk. • At the Ridge Street North construction support site (WHT 9) there would be a new social impact associated with a change in amenity and aesthetics with the new acoustic shed. This has been assessed as a low negative risk. • There would be a slight reduction in social impacts due to an increase in available parking at the Ridge Street construction support site.	There would be some new negative impacts associated with increased operating hours and increased heavy vehicle movements. However, the residual impacts significance would be low.
Urban design and visual amenity	Removes: • visual amenity impacts to residents that adjoined or had views of the four removed Harbour-side construction sites. • visual amenity impacts to community and waterway users along the Sydney Harbour foreshore from harbour-side construction sites. • visual amenity risks associated with dredging.	The addition of the acoustic shed at the Ridge Street North construction support site (WHT9) would lead to minor changes to viewpoints experienced however, these would not be inconsistent with what was assessed for the Project EIS.	The proposed site is located within an existing quarry and in an industrial area. Changes to the existing visual environment would be minimal.

Environmental aspect	Major benefits compared to the Approved Project	Adverse impacts compared to the Approved Project	
		Changes to tunnelling and Sydney Harbour crossing works	Emu Plains construction support site (WHT13)
Hazards and risks	Removes: • impacts to harbour traffic from the movement of IMT segments. • risks to IMT tunnels associated with falling and dragging anchors; sinking vessels; high currents; and propeller wash and vessel wake. • risks associated with the connection of the road header and IMT tunnels.	No additional adverse impacts have been identified.	No major adverse impacts have been identified.
Non-Aboriginal Cultural Heritage	Removes direct and indirect impacts nine 'significant heritage items': 1. Glebe Island Bridge 2. The Valley Heritage Conservation Area 3. Railway electricity tunnel under Sydney Harbour 4. Yurulbin Park 5. Long Nose Point Wharf 6. Balls Head Reserve 7. M.V Cape Don 8. Former BP site 9. Former Woodleys Shipyard and NSW Torpedo Corps Slipway.	No additional adverse impacts identified beyond those assessed for the Approved Project.	No adverse impacts identified.

Environmental aspect	Major benefits compared to the Approved Project	Adverse impacts compared to the Approved Project	
		Changes to tunnelling and Sydney Harbour crossing works	Emu Plains construction support site (WHT13)
Aboriginal Cultural Heritage	Removed potential indirect impacts to seven Aboriginal sites: 1. Quarantine Cave: Waverton 2. Coal Loader 1 3. Whale Rock 4. 5 Hands Shelter 5. Shed Cave 6. Yerroulbin Cave 7. Long Nose Point.	No additional adverse impacts identified beyond those assessed for the Approved Project.	No adverse impacts identified.
Hydrodynamics and water quality	Removes: • impacts to water quality associated with the Harbour-side construction support sites. • water quality impacts associated with dredging in Sydney Harbour.	No additional adverse impacts identified beyond those assessed for the Approved Project.	• At a regional level, there would be negligible flood impacts. • At a local level some additional impacts are expected but these would be largely contained to the site.

Environmental aspect	Major benefits compared to the Approved Project	Adverse impacts compared to the Approved Project	
		Changes to tunnelling and Sydney Harbour crossing works	Emu Plains construction support site (WHT13)
Biodiversity	Removes: • all impacts on biodiversity at Yurulbin Point and Berry's Bay. • potential impacts to Little Penguins and White-bellied Sea Eagle associated with dredging. • the need to remove 10.51 hectares of deepwater soft sediment habitat. • the need to remove 0.01 hectares of habitat for the Black Rockcod and White's Seahorse. • the need to remove around 0.03 hectares of seagrass. Reduces: • potential indirect impacts (noise and vibration) to microbat colonies recorded within one of the coal loader tunnels in Waverton.	No additional adverse impacts.	• Requires the removal of approximately 1.31 hectares of a Plant Community Type; Coastal Valleys Swamp Oak Riparian Forest. This removal would have minimal impact on biodiversity values. • Assumed presence has also been identified for the Southern Myotis. • Small offset requirements for impacts on biodiversity have been identified. • Indirect impacts (from noise and lighting) would be minor.
Land use and property	Removes the need to occupy public parkland for the establishment of construction sites at Yurulbin Point and Berry's Bay.	No additional adverse impacts.	No adverse impacts.
Resource use and waste management (whole of project)	Removes: • contaminated dredged sediment from the waste stream. Reduces: • water demand with the removal of five construction support sites • the volume of spoil generation.	There would be an increase in the amount of electricity required – for operation of the TBMs. From a total energy demand perspective, the increase in electricity demand would be offset by a significant reduction in the use of diesel.	

Environmental aspect	Major benefits compared to the Approved Project	Adverse impacts compared to the Approved Project	
		Changes to tunnelling and Sydney Harbour crossing works	**Emu Plains construction support site (WHT13)**
Climate change risk and greenhouse gas (whole of project)	Reduces the amount of embodied greenhouse gas emissions compared to the tender IMT Methodology.	• No change to the climate change risks identified for the Approved Project • With respect to greenhouse gas emissions: - Additional electricity consumption with the use of the TBM. - Reduced consumption of concrete and cement. - Reduced consumption of diesel with removal of marine movements. Overall, there would be a reduction in greenhouse gas emissions.	
Sustainability	No additional benefits compared to the Approved Project.	The sustainability outcomes identified for the Approved Project would also apply to the proposed modified project.	
Cumulative impacts	Reduction in cumulative impacts in the Waverton and Birchgrove areas, as well as on Sydney Harbour.	No additional adverse impacts.	Impacts from the Emu Plains construction site (WHT13) would be managed such that any cumulative impacts (particularly with the adjacent Boral site) would be mitigated and managed to achieve the outcomes consistent with the assessment.

In comparison to the Approved Project, the proposed changes to the tunnelling and Sydney Harbour crossing works associated with the proposed modified project would result in an overall reduction in impacts. In particular, the removal of all dredging activities in Sydney Harbour and the removal of five construction support sites would result in substantial biodiversity, land use, maritime traffic, water quality, heritage and social impact benefits when compared to the Approved Project.

The proposed modification would introduce a new construction support site at Emu Plains (WHT13) to replace the use of the Glebe Island construction support site (WHT3) as the primary precast facility. The Emu Plains construction support site (WHT13) is located within the existing Boral Quarry site and located in an industrial area. Whilst the use of this site would raise some new impacts, they would not be of a substantive nature. Use of this site would result in better overall environmental and social outcomes than the use of the Glebe Island construction support site (WHT3) which is located in a more sensitive environment.

Overall, the proposed modification would result in a net reduction in overall environmental impacts during construction when compared to the Approved Project.

When operational, the proposed modified project would result in minimal changes to environmental impacts compared to the Approved Project. The proposed modified project would provide the same strategic project benefits and opportunities as the Approved Project.

How will residual impacts be managed

The anticipated impacts associated with the proposed modified project would be largely consistent with those assessed in the Project EIS. However, the change to the method for crossing Sydney Harbour from an IMT to a TBM would remove the need for a number of environmental mitigation measures that relate to IMT specific activities. Accordingly, these environmental management measures are no longer considered necessary, and it is proposed that they be removed. The conditions of approval and the revised environmental management measures would be adequate to address the residual environmental impacts associated with the tunnelling and Sydney Harbour works. No new or changes to other environmental management measures with respect to changes to the tunnelling method would be required.

A few additional environmental management measures would apply to the Emu Plains construction support site with respect to managing residual night-time noise from additional truck movements and safeguarding the site in the event of flooding in the region. These have been included in Appendix B2 (Revised environmental management measures).

How can I comment on this modification report?

DPE will place this Modification Report on public exhibition for 28 days. During the exhibition period, the Modification Report will be available for inspection at:

- The DPE Major Projects website.
- The Transport for NSW project website.
- Community information sessions.

A project information line and email address are available throughout the exhibition period to answer questions from the community relating to the modified project – 1800 931 189 (toll free) and whtbl@transport.nsw.gov.au.

During the exhibition period, submissions are to be made to DPE. All submissions received will be placed on the DPE Major Projects website.

Online submissions can be made by signing up and creating an account at: https://www.planningportal.nsw.gov.au/major-projects. This allows you to save a submission in progress and stay up to date with the progress of an application. Once you have signed up, search for the Western Harbour Tunnel project.

Where this isn't possible, you may send a written submission to DPE. To ensure your submission is received, both the submission and mailing envelope must be addressed to:

Director Transport Assessments
Planning and Assessment
Department of Planning and Environment
Locked Bag 5022
Parramatta NSW 2124

Your submission must include:

- Your full name and address (provide this information in a separate cover letter if you want your personal details to be withheld from publication).
- Reference to the Western Harbour Tunnel and Warringah Freeway Upgrade and SSI-8863 – Modification 2.

- A statement on whether you support or object to the proposed modified project or are simply providing comments.
- The reasons why you support or object to the proposed modified project.
- A declaration of any reportable political donations made in the previous two years. For further details, refer to https://www.planningportal.nsw.gov.au/major-projects/have-your-say.

Submissions must reach DPE by the close of the exhibition period. Please note DPE may publish any personal information you have included in your submission on the proposed modified project. Do not include any personal information in your submission that you do not want published.

Following receipt of all submissions, Transport for NSW will prepare a Response to Submissions Report which will be made publicly available on DPE's Major Projects website.

1. Introduction and background

1.1 Introduction

Transport for NSW proposes to modify the Western Harbour Tunnel and Warringah Freeway Upgrade project (the Approved Project). The Approved Project, including the proposed modifications (the proposed modified project), would be located on the traditional lands of the Gadigal, Gamaragal, Gammeraygal, and Wangal clans of the Darug Nation within the Inner West, and North Sydney local government areas. The proposed construction support site located at Emu Plains is on Dharug country within the Penrith local government area.

The Approved Project is classified as State Significant Infrastructure (SSI) under Part 5, Division 5.2 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act) and clause 94 of the former *State Environmental Planning Policy (Infrastructure) 2007* (now Section 2.108 of the *State Environmental Planning Policy (Transport and Infrastructure) 2021*). The Project was declared Critical State Significant Infrastructure (CSSI) by the then NSW Minister for Planning and Public Spaces on 9 November 2020 under Section 5.13 of the EP&A Act and section 2.15 of *State Environmental Planning Policy (Planning Systems) 2021*). Subsequently, the project was approved by the then NSW Minister for Planning and Public Spaces on 21 January 2021 (SSI 8863).

Transport for NSW is proposing to modify the Approved Project to change the method of construction across Sydney Harbour from a roadheader and immersed tube tunnel (IMT) design with transition structures at both ends of the harbour crossing to a tunnel boring machine (TBM) methodology. The change in construction methodology will require a change in support activities including the reconfiguration and removal of some construction support sites and an additional construction support site. This Modification Report describes and assesses the proposed modified project and identifies updated environmental management measures where necessary for the project.

The request for modification will be formally made with the Department of Planning and Environment (DPE) with the submission of this Modification Report and subject to DPE's discretion, placed on public exhibition. If exhibited and requested by DPE, Transport for NSW will provide a submissions report to DPE that documents and responds to issues raised during the exhibition period. DPE will then prepare an assessment report for consideration by the Minister for Planning and Public Spaces. The Minister will then decide whether to approve the modified project.

1.2 Description of the Approved Project

The Western Harbour Tunnel and Warringah Freeway Upgrade Approved Project comprises two main components:

- A new crossing of Sydney Harbour involving twin tolled motorway tunnels connecting the M4-M5 Link at Rozelle and the existing Warringah Freeway at North Sydney (the WHT).
- Upgrade and integration work along the existing Warringah Freeway, including infrastructure required for connections to the WHT and future Beaches Link and Gore Hill Freeway Connection project (the Warringah Freeway Upgrade).

The Approved Project is an integrated transport solution that will make it easier, faster, and safer to get around Sydney. By creating a western bypass of the Sydney CBD, the Western Harbour Tunnel will take pressure off the Sydney Harbour Bridge, Sydney Harbour Tunnel, Anzac Bridge and Western Distributor corridors to improve transport capacity, provide new direct routes and reliability in and around Sydney Harbour.

The Approved Project is an important part of creating an integrated road and public transport network, which balances the needs of motorists and local communities and provide new levels of access to jobs, recreation, and services such as schools and hospitals.

The Approved Project will provide improved transport connections with quicker access to public transport interchanges. It will enable future opportunities for new direct bus routes between the Inner West, North Sydney, and Sydney, with seamless connections to the future Sydney Metro and Sydney Trains and a free-flowing continuous bus lane southbound on Warringah Freeway.

Key features of the WHT component of the Approved Project are shown in Figure 1-1 and would include:

- Twin mainline tunnels about 6.5 kilometres long and each accommodating three lanes of traffic in each direction, connecting the stub tunnels from the M4-M5 Link at Rozelle to the Warringah Freeway and to the future Beaches Link mainline tunnels at Cammeray. The crossing of Sydney Harbour between Birchgrove and Waverton would involve a dual, three-lane IMT.

- Connections to the stub tunnels at the M4-M5 Link project in Rozelle and to the mainline tunnels at Cammeray (for a future connection to the Beaches Link and Gore Hill Freeway Connection project).
- Surface connections at Rozelle, North Sydney, and Cammeray, including direct connections to and from the Warringah Freeway (including integration with the Warringah Freeway Upgrade), an off ramp to Falcon Street and an on ramp from Berry Street at North Sydney.
- A ventilation outlet and motorway facilities (fit out and commissioning only) at the Rozelle Interchange.
- A ventilation outlet and motorway facilities at the Warringah Freeway in Cammeray.
- Operational facilities including a motorway control centre at Waltham Street within the Artarmon industrial area and tunnel support facilities at the Warringah Freeway in Cammeray.
- Other operational infrastructure including groundwater and tunnel drainage management and treatment systems, signage, tolling infrastructure, fire and life safety systems, lighting, emergency evacuation and emergency smoke extraction infrastructure, CCTV, and other traffic management systems.

Key features of the Warringah Freeway Upgrade component of the Approved Project include:

- Upgrade and reconfiguration of the Warringah Freeway from immediately north of the Sydney Harbour Bridge through to Willoughby Road at Naremburn.
- Upgrades to interchanges at Falcon Street in Cammeray and High Street in North Sydney.
- New and upgraded pedestrian and cyclist infrastructure.
- New, modified and relocated road and shared user bridges across the Warringah Freeway.
- Connection of the Warringah Freeway to the portals for the WHT mainline tunnels and the Beaches Link tunnels via on and off ramps, which would consist of a combination of trough and cut and cover structures.
- Upgrades to existing roads around the Warringah Freeway to integrate the project with the surrounding road network.
- Upgrades and modifications to bus infrastructure, including relocation of the existing bus layover along the Warringah Freeway.
- Other operational infrastructure, including surface drainage and utility infrastructure, signage, tolling, lighting, CCTV, and other traffic management systems.

The complete description of the Approved Project is set out in the Western Harbour Tunnel and Warringah Freeway Upgrade environmental impact statement (Project EIS), dated January 2020, and Project submissions report (dated September 2020). Both the Project EIS and Project submissions report can be viewed on the DPE major projects website *https://www.planningportal.nsw.gov.au/major-projects/projects/western-harbour-tunnel-warringah-freeway-upgrade*

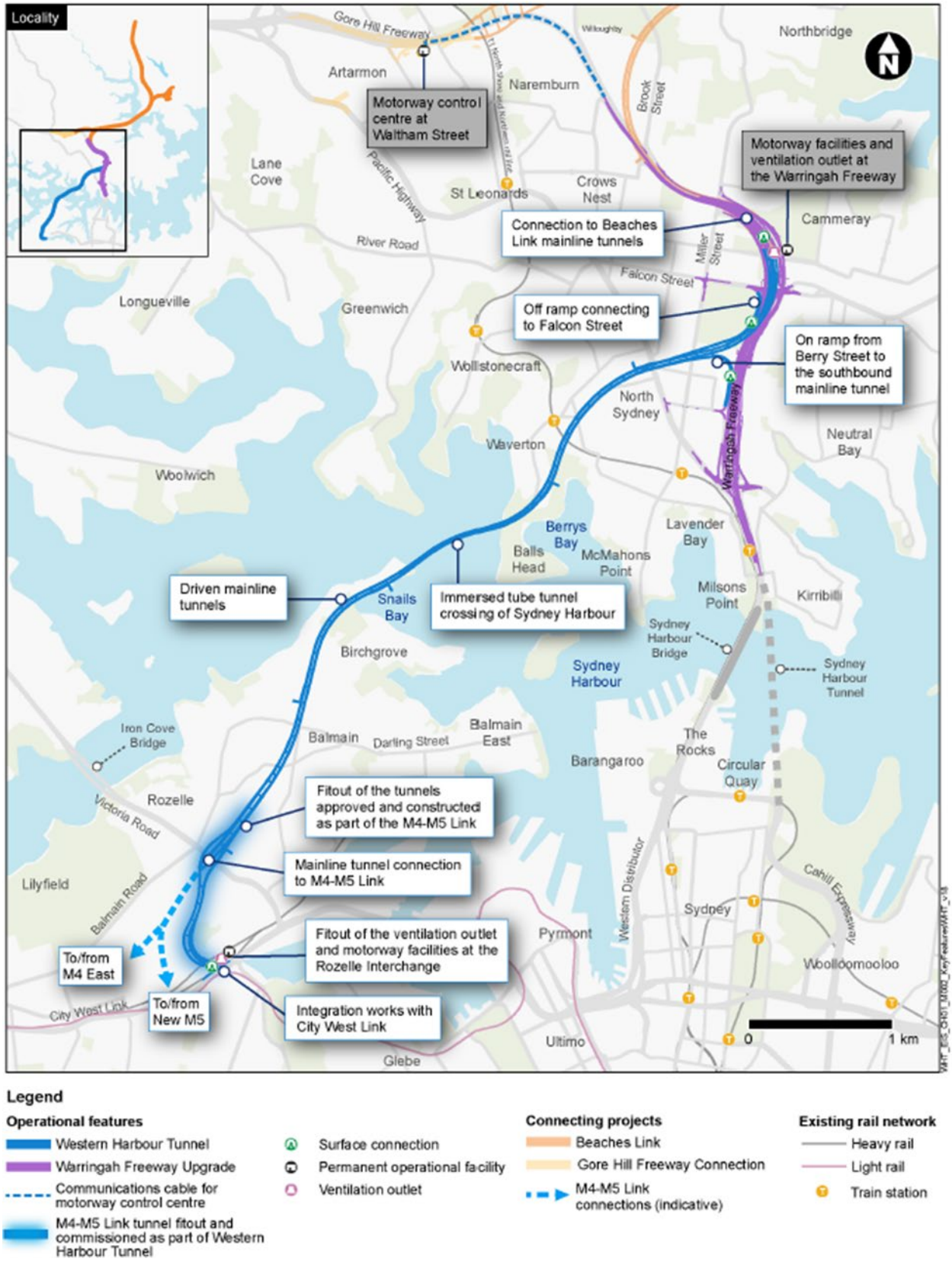


Figure 1-1 Key features of the Western Harbour Tunnel component of the Approved Project.

The Approved Project is being staged in accordance with the Minister's Conditions of Approval A10 and is split broadly into the following:

- Early and enabling work.
- Warringah Freeway Upgrade.
- Western Harbour Tunnel.

The Approved Project's Staging Report describes each of these broad stages and includes details on work and other activities, as well as applicable conditions to be complied with. In accordance with Condition of Approval A14, the Approved Project's Staging Report will be revised following determination of this modification request.

1.2.1 Contract packaging of WHT

After Project Approval, it was determined by Transport for NSW that the Approved Project will be delivered through two Stages. These are referred to in this Modification Report as WHT Stage 1 and WHT Stage 2.

WHT Stage 1 includes construction of approximately 1.7 kilometres of twin three-lane tunnels between Rozelle and Birchgrove. WHT Stage 2 includes construction of tunnels between Birchgrove and North Sydney (and under Sydney Harbour) including marine works and tunnel fit out. The extent of the WHT Stages is illustrated in Figure 1-2.

In January 2022 the NSW Government awarded the WHT Stage 1 contract to a John Holland and CPB Joint Venture. In December 2022 ACCIONA Construction Australia (ACCIONA) was awarded the WHT Stage 2 contract – the subject of this modification.

Figure 1-2 Indicative extent of the staging for the Approved Project.

1.3 Overview of the proposed modified project

Since approval was granted for the project, ACCIONA has been appointed to construct WHT Stage 2. This comprises a 4.2km section of tunnel between Birchgrove and Cammeray, including the crossing below Sydney Harbour.

Design development and construction planning has progressed since the assessment contained in the Project EIS, with major improvements in the construction solution identified to better balance environmental impacts with construction capabilities.

On that basis, Transport for NSW is proposing to modify the Approved Project to change the method of construction across Sydney Harbour from an IMT design to a TBM methodology (proposed modified project). The change in construction methodology will require a change in support activities, including the reconfiguration and removal of some construction support sites, and an additional construction support site.

The proposed changes to the Approved Project include:

- Changes to the tunnelling method to cross Sydney Harbour – from an IMT solution to tunnel excavated using a TBM between Birchgrove and Waverton.
- Changes to the construction of a section of driven tunnel – additional chamber excavation for the TBM underground launch site (adjacent to Birchgrove Park) and additional TBM receival chamber (adjacent to Carradah Park).
- Changes to the road alignment (horizontal and vertical) between the TBM launch chamber at Birchgrove and Cammeray to accommodate the changes in design and construction methodology.
- Changes to the Rozelle Rail Yards construction support site (WHT1) cut and cover section (now known as the City West Link Portal construction support site (WHT12).
- Changes to the White Bay construction support site (WHT3) – now known as the Glebe Island construction support site (WHT3).
- Changes to the Ridge Street North construction support site (WHT9) to allow for tunnel operations including spoil handling.
- Additional construction support site at Emu Plains (WHT13) primarily for the manufacture of precast segments for lining of the tunnel.

The changes in construction methodology would also result in the removal of several major construction sites and other activities including:

- Removal of dredging activities in Sydney Harbour and the large-scale IMT fabrication activities previously proposed at White Bay (WHT3)
- Removal of the approved construction support sites at:
    - Yurulbin Point (WHT4).
    - Sydney Harbour south cofferdam (WHT5).
    - Sydney Harbour north cofferdam (WHT6).
    - Berrys Bay (WHT7).
    - Victoria Road (WHT2).

Further details of the proposed modified project are provided in Chapter 5.

The proposed modified project also includes proposed changes to the Minister's Conditions of Approval and to the approved Environmental Management Measures (EMMs). The majority of these changes are a result of the changes to construction methodology and would mainly result in the removal of a number of the Minister's Conditions of Approval and EMMs. Some additional EMMs would be required for the Emu Plains construction support site (WHT13). Details on the proposed changes to the Minister's Conditions of Approval and to the approved EMMs are provided in Chapters 11 and 12 respectively, and Appendix B1 and B2.

1.4 Alternatives considered

The proposed modified project would itself represent an alternative to the Approved Project and was considered in the Project EIS. At that time the TBM option was considered less conventional and therefore was discarded. Since then, international experience with large TBMs and more detailed information on the geology below Sydney Harbour has provided confidence that the TBM would be a superior option to the IMT for this project. Other alternatives have also been considered for the proposed modified project including TBM launch sites and TBM support site options. Further details are provided in Chapter 4 (Selection of the preferred modification option).

1.5 Purpose and structure of this Modification Report

This Modification Report has been prepared for the purposes of section 180 of the *Environmental Planning and Assessment Regulation 2021* (EP&A Regulation). It has been prepared to comply with the Secretary's Environmental Assessment Requirements (SEARs) and having regard to DPE's State Significant Infrastructure and State Significant Project Guidelines.

The structure of the Modification Report is outlined in Table 1-1.

Table 1-1 Structure of this report.

Chapter / Appendix	Description
Chapter 1	**Introduction and background (this chapter)** Provides a broad overview of the Approved Project and an overview of the proposed modified project.
Chapter 2	**Approval framework** Provides an overview of the statutory context including for the proposed modified project and the next steps in the approval process.
Chapter 3	**Strategic context and need** Provides an updated strategic context and need for the proposed modified project.
Chapter 4	**Selection of the preferred modification option** Describes the options considered and identifies the preferred modification option.
Chapter 5	**Description of the proposed modified project** Provides a detailed description of the proposed modified project.
Chapter 6	**Stakeholder and community engagement** Provides an overview of the stakeholder engagement process that has been carried out for the proposed modified project and any changes to the approved engagement that would be carried out if the modification is approved.
Chapter 7	**Approach and scope of the environmental assessment** Provides an outline of the scope for the environmental assessment and justification for what issues are subject to further detailed assessment.
Chapter 8	**Assessment of impacts – Changes to tunnelling and Sydney Harbour crossing works** Outlines the assessment of potential impacts associated with the changes to tunnelling and Sydney Harbour crossing works.
Chapter 9	**Assessment of impacts – Emu Plains construction support site (WHT13)** Provides an assessment of the impacts associated with the Emu Plains construction support site (WHT13).
Chapter 10	**Assessment of impacts – Whole of project** Provides an assessment of the impacts which affect the whole of the project.
Chapter 11	**Proposed changes to the Minister's Conditions of Approval** Outlines the relevant Conditions of Approval that would require modification as a result of the proposed modified project.
Chapter 12	**Revised environmental management measures** Presents the proposed changes to the Revised Environmental Management Measures (REMMs) for the project.

Chapter / Appendix	Description
Chapter 13	**Justification and conclusion** Presents a justification and evaluation of the complete modified project, having regard to its environmental, social, and economic impacts and the principles of ecologically sustainable development.
Chapter 14	**References**
Appendix A	**Updated project description**
Appendix B1	**Revised Conditions of Approval**
Appendix B2	**Revised environmental management measures**
Appendix C1	**Updated statutory compliance table**
Appendix C2	**Options analysis**
Appendix D	**Technical Working Paper: Traffic and transport - construction**
Appendix E	**Technical Working Paper: Traffic and transport - operation**
Appendix F1	**Technical Working Paper: Construction noise and vibration - TBM**
Appendix F2	**Technical Working Paper: Construction noise and vibration - Emu Plains**
Appendix G	**Technical Working Paper: Air quality - operation**
Appendix H	**Human health review – air quality**
Appendix I	**Non-Aboriginal heritage – Emu Plains**
Appendix J	**Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) Stage 1 Assessment**
Appendix K1	**Technical Working Paper: Groundwater and settlement**
Appendix K2	**Technical Working Paper: Preliminary Site Investigation - Emu Plains**
Appendix L	**Technical Working Paper: Flooding - Emu Plains**
Appendix M	**Biodiversity Development Assessment Report - Emu Plains**
Appendix N	**Technical Working Paper: Social Impact Assessment**
Appendix O	**Pre-exhibition Consultation Report**

2. Approval framework

2.1 Modification of the Minister approval

Transport for NSW proposes to modify the Minister's approval for the Western Harbour Tunnel and Warringah Freeway Upgrade project (Approved Project) in accordance with section 5.25 of the EP&A Act. The Minister's approval is not required if the project as modified would be consistent with the Approved Project. The proposed modified project is not consistent with the Approved Project but would not constitute a project in its own right. Therefore, a modification of the approval is required.

On 16 May 2023 Transport for NSW submitted a pre-modification request to DPE to modify the project. DPE provided a scope of assessment letter for the preparation of the modification on 23 May 2023. No further Secretary's environmental assessment requirements (SEARs) were issued for the proposed modified project.

This Modification Report has been prepared in accordance with section 180 of the EP&A Regulation including having regard to DPE's State Significant Infrastructure and State Significant Project Guidelines.

A review of the statutory context is provided in the sections below. An updated statutory compliance table for the modified project is included in Appendix C1.

The assessment and approval process under Division 5.2 of the EP&A Act and where the project is in the planning approvals process is illustrated in Figure 2-1.

2.2 Modification to the Minister's order for CSSI

On 9 November 2020 the Minister for Planning and Public Spaces declared the project to be Critical State Significant Infrastructure (CSSI) under section 5.13 of the EP&A Act (the Order). A description of the development declared as CSSI is provided in Schedule 5 Section 22 of the *State Environmental Planning Policy (Planning Systems) 2021*). The proposed modified project would be consistent with this description with the exception that the proposed additional construction support site at Emu Plains (WHT13) would be located on land within a suburb not currently listed in Schedule 5 Section 22 (2).

The Minister for Planning and Public Spaces has been requested to amend the Order for the proposed modified project to proceed.

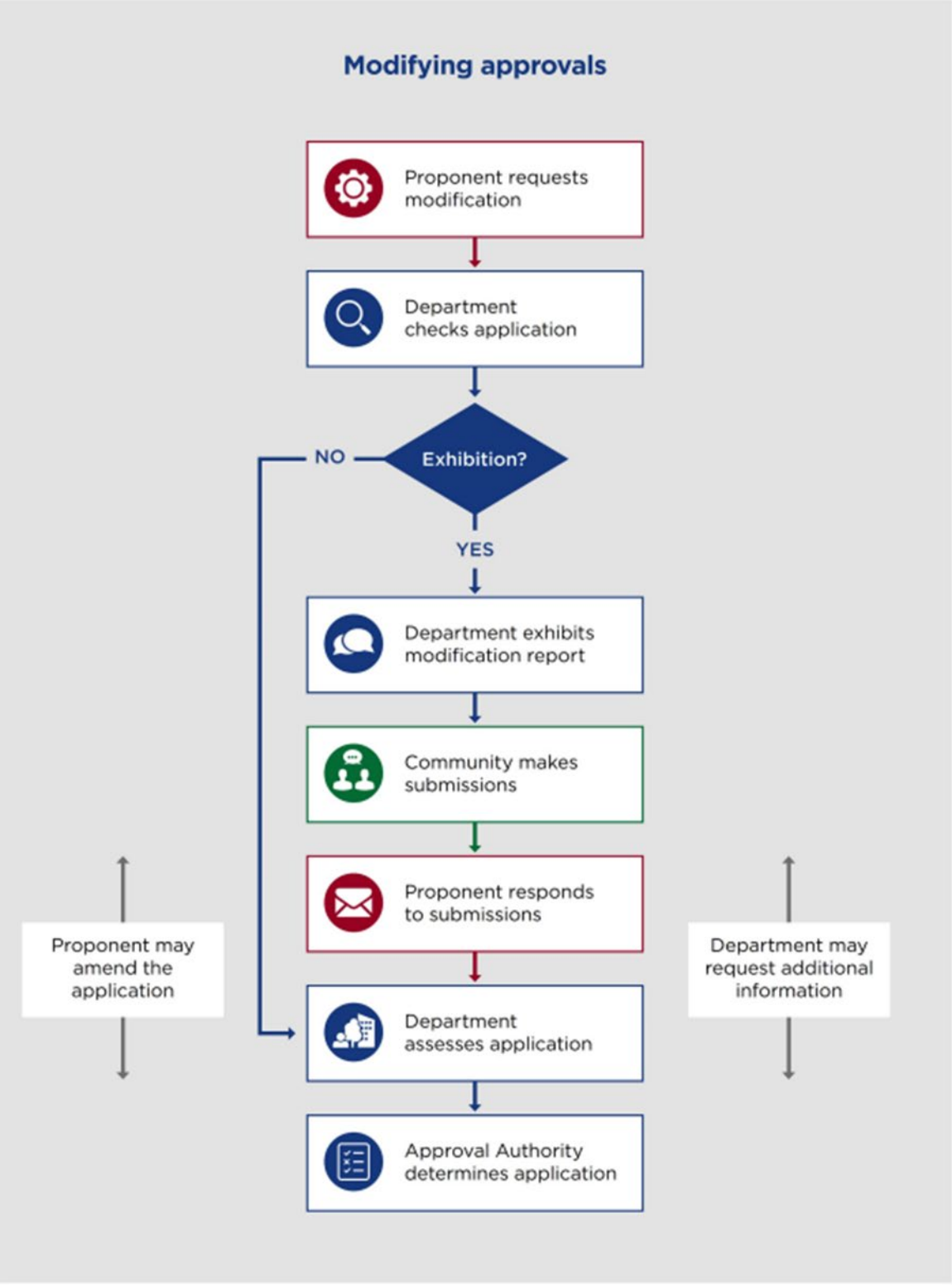


Figure 2-1 Approvals process flowchart under Part 5, Division 5.2 of the EP&A Act.

2.3 Environmental planning instruments

Section 5.22(2) of the EP&A Act excludes the application of environmental planning instruments to SSI projects except those instruments that apply to the declaration of SSI or CSSI. Section 2.1 of the Project EIS provides an overview of the assessment and approval framework relevant to the project. A review of environmental planning instruments (EPIs) has confirmed that there is no change to the statutory context identified in Chapter 2 (Assessment process) of the Project EIS.

The proposed modified project remains subject to the same assessment and approval process as the project under Division 5.2 of the EP&A Act.

2.4 Other NSW legislation

Section 2.2.1 of the Project EIS provides an overview of NSW legislation relevant to the proposed modified project.

Section 2.1.1 of the Project EIS discusses the EP&A Act and the relevance of various State Environmental Planning Policies (SEPPs). As discussed in Appendix C1 of this Modification Report, since exhibition of the Project EIS and the Project submissions report there have been some legislation updates including the introduction of the *Environmental Planning and Assessment Regulation 2021*, consolidation of some SEPPs and introduction of the *State Environmental Planning Policy (Transport and Infrastructure) 2021* (Transport and Infrastructure SEPP). However, the relevance of these changes to the proposed modified project are essentially updates to references to the relevant sections of the new legislation. These reference updates have been made in this Modification Report where appropriate.

A review of Section 2.2.1 of the Project EIS confirmed that the discussion of other NSW legislation relevant to the project remains valid for this proposed modified project and as such it is not repeated here. This includes the need for a project Environment Protection Licence (EPL) under Chapter 3 of the *Protection of the Environment Operations Act 1997* (NSW).

The proposed modified project would not trigger any additional approvals or licences.

2.5 Commonwealth legislation

Section 2.2.2 of the Project EIS provides an overview of Commonwealth legislation that is relevant to the project. In particular, it considered the requirements of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The EPBC Act applies to activities that have the potential to impact a matter of national environmental significance, one of which is national heritage places.

A review of Section 2.2.2 of the Project EIS confirmed that the discussion of Commonwealth legislation relevant to the project remains valid for this proposed modified project and as such it is not repeated here.

The proposed modified project would not trigger any Commonwealth legislation.

3. Strategic context and need

3.1 Strategic planning and policy framework

Chapter 3 (Strategic context and project need) of the Project EIS and Section A1.3 of the Project submissions report describes the strategic context and need for the Approved Project. A summary of this is provided below.

The Greater Sydney Region Plan – A Metropolis of Three Cities (Greater Sydney Commission, 2018) proposes a vision of three cities where most residents have convenient and easy access to jobs, education and health facilities and services. In addition to this plan, and to accommodate for Sydney's future growth, the NSW Government is implementing its Future Transport Strategy (NSW Government, 2022), a plan that sets the 40-year vision, direction, and outcomes for customer mobility in NSW. The Western Harbour Tunnel and Beaches Link program of works is proposed to provide additional road network capacity across Sydney Harbour and improve transport connectivity with Sydney's Northern Beaches.

The motorway crossings of Sydney Harbour, including the Sydney Harbour Bridge, Sydney Harbour Tunnel and ANZAC Bridge, are critical links in Sydney's motorway and arterial road network. In addition to the large number of customers who rely on these corridors, high demand and limited capacity on the Sydney Harbour crossings results in delays and unreliable journey times. The limited number of alternate routes for crossing Sydney Harbour makes these corridors critical to the performance of the broader motorway and arterial road network.

In addition to the large traffic volumes and limited alternative routes, a major contributor to congestion around the Harbour CBD is that many of the most critical road corridors including Sydney Harbour Bridge, the Sydney Harbour Tunnel, ANZAC Bridge, the Western Distributor, and the Warringah Freeway perform both bypass and access functions, reflected in the high proportion of vehicles using them to travel to destinations other than the Sydney CBD. These conflicting functions, combined with high traffic volumes, result in congestion and poor network performance experienced by freight, public transport, and private vehicle users.

The Sydney Harbour Bridge, Warringah Freeway and Eastern Distributor have been identified as three of Australia's 30 most congested road corridors, generating a congestion cost of $65,000 per day in 2016 (Infrastructure Australia, 2019). These corridors are integral to the economic growth of Sydney's Eastern Economic Corridor, and as Sydney's population and economy continues to grow, so will the pressure on access to these corridors. Improvements to existing transport networks and creation of new transport connections will be essential for Sydney to continue to be a competitive economy.

3.2 Project need

The project is identified as a priority initiative by Infrastructure Australia's A*ustralian Infrastructure Plan.* The *Infrastructure Priority List* outlines the projects importance in addressing urban congestion on Sydney's road network and to provide additional cross-harbour connectivity.

The project will improve capacity, reduce congestion, and improve road network performance and efficiency, enabling sustained growth and productivity across Sydney's Eastern Economic Corridor. The project will also enhance the resilience of the road network across the Eastern Harbour City, improving liveability and amenity for local communities by reducing through traffic and improving connectivity.

The Warringah Freeway Upgrade component of the project will connect the new tunnel with the existing Warringah Freeway corridor and streamline traffic movements to optimise the future use of the three harbour crossings.

This new western bypass of the Sydney CBD will serve through journeys between the south and west of Sydney, including the international gateways of Sydney Airport and Port Botany, and strategic centres north of the harbour including North Sydney, St Leonards, Chatswood, and Macquarie Park.

The increase in harbour crossing capacity and efficiency delivered by the project will also remove a major bottleneck that constrains the road transport capacity of areas north of the harbour, including the Northern Beaches. This enables future connections, such as the Beaches Link and Gore Hill Freeway Connection projects, which will deliver significant benefits for public transport, freight, and other transport customers over an increased catchment.

The major transport benefits of the project include:

- A third harbour crossing to reduce congestion on the Sydney Harbour Bridge, Sydney Harbour Tunnel and ANZAC Bridge, leading to faster and more reliable journeys to, from and around the Harbour CBD.

- Contribute to an integrated multi-modal transport network by enabling direct bus access to North Sydney and an efficient transfer to the new Sydney Metro.
- Return local streets to communities by moving traffic underground, freeing up local streets and supporting the sustainability of local town centres.
- Make journeys on the Warringah Freeway easier and safer by improving lane configuration and providing clear directions on the best way to cross the harbour to reach a specific destination.
- Enable local businesses to have better and more efficient access to Greater Sydney, making it easier to move goods and provide services, as well as bringing employees and businesses closer together.
- Opportunities to enhance the local community by improving shared user connections and providing new public open space.

3.3 Review of the strategic context and objectives for the proposed modified project

The proposed modified project would result in changes only to the construction methodology and does not represent a change in the strategic context or objectives of the Approved Project. The proposed modified project remains consistent with the objectives and justification of the Approved Project.

3.4 Need for the modification

The proposed changes have been identified as a construction solution that better balances environmental impacts with construction capabilities. The proposed modified project would greatly reduce environmental impacts associated with harbour-side construction sites including the removal of works in Sydney Harbour, and removal of four major construction support sites either in or surrounding Sydney Harbour. It would also remove a construction support site at Victoria Road (WHT2) and replace surface activities at the Rozelle Rail Yards (WHT1) with an underground construction site, enabling a more complete area of Rozelle Parklands to be returned to the public.

The proposed modified project would also avoid or reduce key issues associated with non-Aboriginal cultural heritage, Aboriginal cultural heritage, biodiversity, water quality, socio-economic and other key risks associated with the currently approved IMT method for crossing Sydney Harbour.

The additional construction support site at Emu Plains (WHT13) is required to support the TBM operations as the primary site for manufacture of the concrete segments for lining the tunnel. This site would have advantages over the Glebe Island construction support site (WHT3) with respect to available space and location within an industrial area, resulting in reduced potential disruption to supply and environmental risks.

4. Selection of the preferred modification option

4.1 Design refinement

During the tender process for WHT Stage 2, different designs and methodology were considered to enable the best design and outcome for the community and environment to be selected. ACCIONA submitted an alternative methodology option of tunnelling beneath Sydney Harbour using a TBM.

Design development during the tender included a significant focus on evaluation of potential tunnelling methods for crossing of Sydney Harbour. This analysis was carried out by a multidisciplinary team including design, construction, transport planning and environmental specialists to provide for a comprehensive analysis on alternatives.

4.2 Options considered

The main options considered during the tender for the Project are detailed in the following sections and are expanded upon in Appendix C2 (Options analysis). These are summarised in Figure 4-1 and Figure 4-2 and follow a process that aligns with how design development progressed over the tender phase.

4.2.1 Methodology for tunnelling below Sydney Harbour

During the preparation of the Project EIS, the process for selection of the preferred tunnel alignment and tunnel construction method included the development and evaluation of over 15 different combinations of tunnelling methods, including a TBM solution. When considering the performance of each of the potential methodologies against design, constructability, traffic performance, environmental and social criteria, the preferred method for crossing Sydney Harbour was determined in the Project EIS to be an IMT.

Since the Project EIS was prepared, TBM technology has advanced and has been used successfully at a similar scale internationally and in similar sub-sea environments. There has also been recent experience crossing under Sydney Harbour with the Sydney Metro City project, including more detailed information available regarding specific local geological conditions.

The experience with the use of and availability of larger TBMs coupled with the construction of the smaller Sydney Metro Tunnels under Sydney Harbour, provides confidence that using a TBM for the Sydney Harbour crossing would be a viable alternative construction methodology.

When considering the performance of both potential tunnelling methodologies against design, constructability, traffic performance, environmental and social criteria, the preferred method for crossing Sydney Harbour is TBM.

4.2.2 Tunnel boring machine launch site

The decision to proceed with and present a TBM design during the tender phase led to several other additional design options for launching and supporting the TBM.

These options included launching the TBM from Berrys Bay or launching the TBM underground at Birchgrove. The preferred option was determined to launch the TBM from an underground chamber at Birchgrove. This option would have significantly less environmental impacts, and importantly remove the need for both Berrys Bay and Yurulbin Point as substantial construction support sites. This would also allow the delivery of a proposed new foreshore park and public space much earlier than planned for the benefit of the local community.

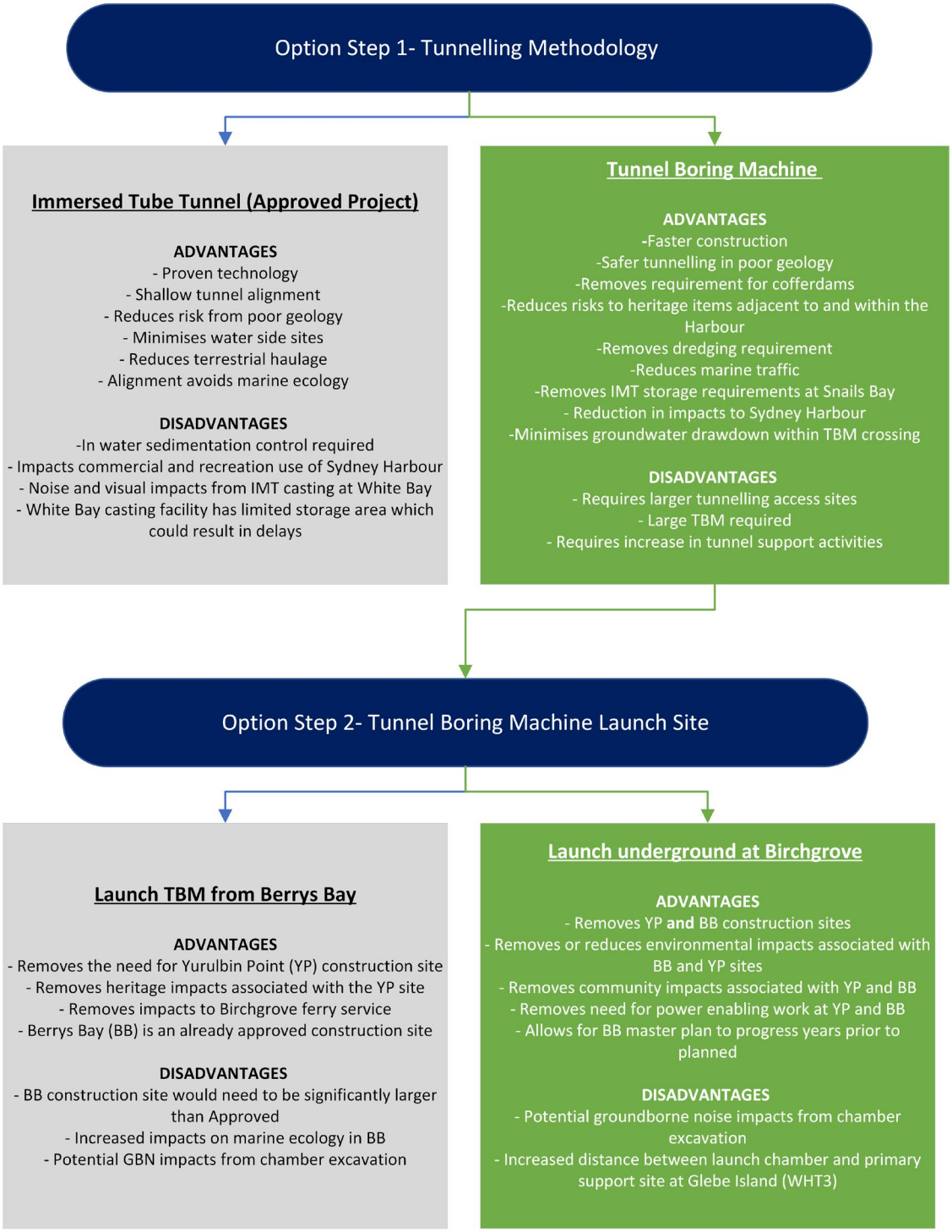


Figure 4-1 Process for option analysis – Steps 1 and 2.

4.2.3 TBM Support site options

The Mix-shield TBM operation has two main support site requirements to provide for construction:

- A casting facility to produce concrete elements that line the tunnel
- A slurry treatment facility to allow for removal of excavated material.

The Glebe Island section of the approved White Bay construction support site (WHT3) was proposed in the Project EIS as the location of concrete batching and casting for the IMT units. For the TBM option, it was proposed that the site be used in a similar way for the precast of tunnel lining segments and for slurry treatment. This option would also require a services corridor to deliver slurry from the TBM to the Glebe Island construction support site (WHT3).

To address storage requirements, an alternative would be to provide an additional construction support site as the primary pre-cast facility. This site would support concrete batching, segment, and culvert casting, as well as segment and culvert storage for the Project. In this option, the Slurry Treatment Plant would be located within an underground ventilation chamber constructed for WHT Stage 1 in Rozelle.

The preferred option for TBM tunnel support is to develop an additional construction support site for pre-casting and storage of tunnel lining segments/culverts and utilise the WHT Stage 1 ventilation tunnels and City West Link Portal construction support site (WHT12) to provide slurry treatment support to the TBMs. A summary of the options assessment for the TBM support site is provided in Figure 4-2.

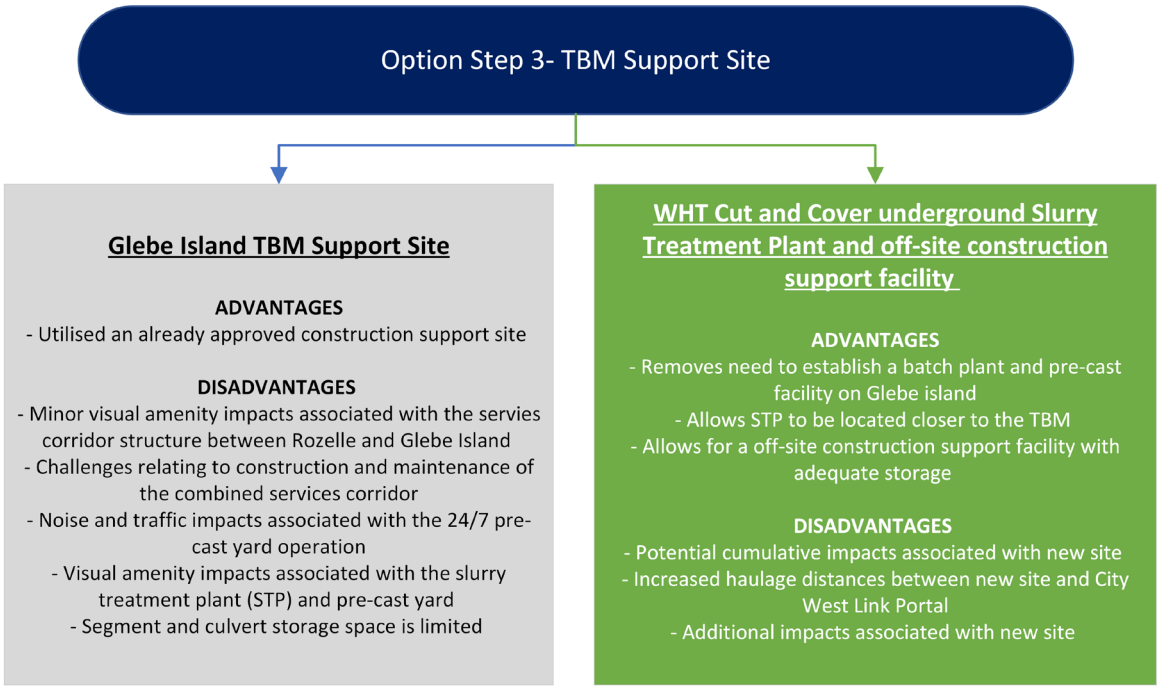


Figure 4-2 Process for option analysis - Step 3.

Off-site construction support facility options

A number of off-site construction support facility options were investigated after the award of the Project. These sites were equally pursued to determine which would provide the best outcome for the Project.

Table 4-1 Evaluation of the off-site construction support facility options

Option	Advantages	Disadvantages
Option 1- Port Kembla, NSW	• The site would be established on a former industrial site within an existing industrial locality. • Direct access to State roads for transporting segments. • Minimal additional impacts to sensitive receivers owing to the existing industrial nature of the site and the locality. • Potential for cooperative relationship with concrete producers in the area.	• Likely requirement for extensive contamination remediation works, which would substantially delay the establishment of the site. • Large (>96km) distance to and from the WHT12 delivery site would lead to an increase in diesel usage. • Extensive distance from WHT12 could cause construction delays in the event of traffic incidents. • Potential issues with approval pathway owing to existing approved projects.
Option 2 – Benalla, Victoria	• The site is an existing pre-cast facility that provides concrete elements to other projects. • Negligible additional impacts to sensitive receivers as the site is an existing pre-cast facility. • No additional NSW approvals for the construction site required.	• Extensive (>670km) distance to and from the WHT12 delivery site would lead to a significant increase in diesel usage. • Extensive distance from WHT12 could cause construction delays in the event of traffic incidents.
Option 3 - Emu Plains, NSW	• The site would be established within an existing quarry / spoil recycling facility. • Environmental impacts would be minimal owing to the long-term existing nature of the site as a quarry and spoil recycling facility. • Site located within the Sydney region (about 50km from WHT12). • Establishment of the site would require minimal earthworks to flatten the site. • There are few sensitive receivers within the vicinity of the proposed site.	• Two sensitive receivers expected to be impacted by construction traffic noise, which can be mitigated by at-property treatments if deemed to be required.
Option 4- Sydney Metro West Eastern Creek pre-cast facility, NSW	• The site is an existing pre-cast facility that provides concrete elements to other projects. • Negligible additional impacts to sensitive receivers as the site is an existing pre-cast facility. • Site located within the Sydney region (about 40km from WHT12).	• The facility would be required to be rebuilt due to the size and scale of the facility required for WHT. • The timing of when this site is expected to become available would not align with the timing of the WHT Project.

Option	Advantages	Disadvantages
Option 5 – Greenfield site in Badgerys Creek	• Site located within the Sydney region (about 50km from WHT12).	• The location of the site is within flood prone land. • Direct and indirect impacts to flora and fauna would be expected. • Direct impacts to potential Aboriginal heritage would be expected. • Significant earthworks would be required to flatten the site. • Local roads would be required to be used to access the site. • Major intersection upgrades would be required at the intersection of Elizabeth Drive to ensure road safety requirements. • Proximity to sensitive receivers. • Limited available land due to proximity to riparian land of South Creek.

The preferred off-site construction support facility is the Emu Plains location within the existing Boral Quarry. The additional construction support site at Emu Plains would provide a greater area for storage in an existing industrial environment and would significantly improve the reliability of supply of segments. This site was preferred over others primarily owing to its location within the Sydney region, its minimal environmental impact and minimal potential community impact.

4.3 Environmental and social outcomes achieved through the proposed modified project

The preferred option is a TBM tunnelling solution launched underground from Birchgrove, an additional construction support site located in Emu Plains (WHT13) and an underground STP utilising the existing tunnel.

This option would provide the best outcome when compared to the Approved Project across a number of key assessment aspects, most notably:

- Impacts to local residents.
- Environmental and Heritage.
- Marine safety on the Harbour.

The Project Submissions Report, which addressed concerns surrounding the Project from the community, government agencies and councils was analysed during the tender design process to identify how these concerns could be addressed through potential modifications.

The major community and stakeholder points of concern as identified in the Project Submissions Report are summarised in Table 4-2. This table notes how the proposed modified project would address these concerns and the subsequent benefit.

Table 4-2 Environmental and social outcomes achieved through selection of preferred modification option.

Location	Community feedback	How addressed in the TBM solution	Area of benefit
Sydney Harbour	Concern over sea-bed profiling through the contaminated floor of Sydney Harbour.	The TBM solution removes the need for dredging in the Harbour.	Environmental and Heritage. Marine safety on the Harbour. Removal of impacts to local residents.
	Concern over impacts to marine biodiversity and the environment including seals, penguins, seagrasses, and seahorses.	The TBM solution removes dredging activities and the need to build temporary cofferdams, significantly reducing the impact on marine biodiversity and the environment.	Environmental and Heritage.
	Concern over impacts to marine traffic including ships, oil tankers, ferries, cruise ships and recreational vessels.	It is no longer proposed to utilise the Harbour for construction.	Marine safety on the Harbour.
	Environmental, noise and visual impacts from the construction of the temporary cofferdams on the north and south sides of the Harbour.	The TBM solution does not require marine cofferdams or construction sites at Yurulbin Point and Berrys Bay, therefore environmental, visual and noise impacts from piling and construction will be removed for local residents.	Environmental and Heritage. Elimination of impacts to local residents.
Waverton	Concern over 55 heavy vehicles each day travelling down Balls Head Road to the Berrys Bay construction site.	The new design removes the construction site from Berrys Bay, so no construction vehicles associated with the construction of WHT will be utilising Balls Head Road. Note that during the Berrys Bay revitalisation work, heavy vehicles will still be required to access Balls Head Road.	Elimination of impacts to local residents.

Location	Community feedback	How addressed in the TBM solution	Area of benefit
	Concern for heritage impacts from construction activities e.g., impacts to Woodley's Shed at Berrys Bay and the Coal Loader.	There will be no surface construction activities in Berrys Bay or at the Coal Loader associated with the construction of WHT. As such, direct impacts to heritage items in this area have been removed.	Environmental and Heritage.
	Concern over impacts to the Microbats and Bent Wing bats residing in the Coal Loader Wharf.	The TBM tunnel is deeper than the Approved Project design. Vibration and ground borne noise impacts associated with construction of WHT are reduced when compared to what was characterised in the Project EIS. The removal of the need to construct the cofferdam adjacent to the Coal Loader would also remove all airborne noise impacts on the microbat colony.	Environmental and Heritage.
	Concern over impacts from construction activities including noise, dust, and lighting.	The new design removes the Berrys Bay construction support site and the northern harbour coffer dam identified in the Project EIS, eliminating impacts from noise, dust and lighting associated with these sites.	Environmental and Heritage. Removal of impacts to local residents.
	Concern over digging up local roads in Waverton for the installation of temporary power supply to the Berrys Bay construction site.	Under the TBM solution there is no construction site at Berrys Bay. As such, temporary power works have been halted in the area and are no longer required for the construction of WHT.	Removal of impacts to local residents.
	Concern over removal of contaminated material from the former Waverton Landfill site.	Owing to the deeper alignment required for the TBM harbour crossing, the Waverton Landfill site as described in the Project EIS will likely be avoided. Further geotechnical investigations will be carried out during detailed design to confirm whether the deeper tunnels will avoid the landfill completely.	Environmental and Heritage.
Birchgrove	Concern over construction vehicles using Louisa Road to access the construction site at Yurulbin Point.	No surface construction activities associated with construction of WHT will take place at Yurulbin Point.	Removal of impacts to local residents.
	Concern over impacts from construction activities including noise, dust, and lighting.	The new TBM design removes the Yurulbin Point construction site identified in the Project EIS, eliminating impacts from noise, dust, and lighting.	Environmental and Heritage. Elimination of impacts to local residents.
	Concern over the closure and temporary relocation of Birchgrove Ferry Wharf.	The Birchgrove Ferry Wharf is not impacted by the new design and the wharf will remain open.	Removal of impacts to local residents.

Location	Community feedback	How addressed in the TBM solution	Area of benefit
	Concern over visual impacts from IMT units held in Snails Bay.	The new design will use a TBM to excavate the spoil, eliminating the need to build concrete IMT units and store them at Snails Bay.	Removal of impacts to local residents.
White Bay	Concern over construction and cumulative impacts in close proximity to the Cruise Ship Terminal.	All construction activities on the south side of the harbour will take place at Glebe Island, the City West Link Portal (WHT12) and underground.	Reduced impacts to local residents.
	Concern the Glebe Island site would be used to store and treat contaminated seabed material, in close proximity to Balmain residents.	The TBM design will not require any dredging of contaminated material on the seabed of Sydney Harbour, therefore no contaminated material will be stored at the Glebe Island construction support site (WHT3).	Reduced impacts to local residents. Environmental and Heritage.

4.4 Conclusions

Based on an analysis of the alternatives presented during the tender phase and consideration of further information with respect to TBM technology and the better understanding of local geological conditions below Sydney Harbour, the preferred method for crossing Sydney Harbour would be by TBM, launched underground at Birchgrove with an underground slurry treatment plant. The change to a TBM would respond to many of the issues and concerns raised by the community, particularly with the removal of five major construction support sites.

An additional construction support site at Emu Plains would provide a greater area for storage and significantly improve the reliability of supply of segments. Whilst the use of this site would create new impacts, its location within an existing industrial facility would be a less environmentally sensitive location than at Glebe Island. It would also provide for diversification of the location of job opportunities to include Western Sydney.

5. Description of the proposed modified project

This chapter describes the proposed modified project in detail. An updated Project description is included in Appendix A (Updated Project Description).

5.1 Overview of the proposed modified project

Since the approval was granted for the project, ACCIONA has been appointed to construct the 4.2 km section of tunnel (between Birchgrove and Cammeray – including the crossing below Sydney Harbour). Design development and construction planning has progressed since the assessment contained in the Project EIS, with major improvements in the construction solution identified to better balance environmental impacts with construction capabilities.

The proposed changes to the Approved Project would be:

- Changes to the tunnelling method under Sydney Harbour – refer Section 5.2.
- Changes to the road alignment (vertical and horizontal) between the new TBM launch chamber at Birchgrove and Cammeray to accommodate the changes in design and construction methodology – refer Section 5.1.
- Changes to the construction of a section of driven tunnel – additional chamber excavation for the TBM underground launch site (adjacent to Birchgrove Park) and additional TBM receival chamber (adjacent to Carradah Park) – refer Section 5.3.
- Changes to the Rozelle Rail Yards construction support site (WHT1) cut and cover section (the City West Link Portal construction support site (WHT12)) – refer Section 5.4.
- Changes to the White Bay construction support site (WHT3), including no longer using the northern portion of the site (now referred to as the Glebe Island construction support site (WHT3))- refer Section 5.5.
- Changes to the Ridge Street North construction support site (WHT9) – refer Section 5.6.
- An additional construction support site at Emu Plains for the manufacture of precast segments for lining of the tunnel (WHT13) – refer Section 5.7.

Key features of the proposed modified project are shown in Figures 1.1 and 1.2.

The changes in construction methodology would also result in the removal of a number of major construction sites and other activities. These would include:

- Removal of dredging activities in Sydney Harbour and the large-scale IMT fabrication activities previously proposed at the White Bay construction support site (WHT3)
- Removal of the approved construction support sites at:
    - Yurulbin Point (WHT4).
    - Sydney Harbour south cofferdam (WHT5).
    - Sydney Harbour north cofferdam (WHT6).
    - Berrys Bay (WHT7).
    - Victoria Road (WHT2).

The location of the construction support sites that would now be removed by the proposed modified project are also shown on Figure 1.1.

No further assessment of the removal of these project elements is provided nor considered necessary as all related impacts would now be removed.

Figure 5-1 Overview of the proposed modified project alignment and removed construction sites.

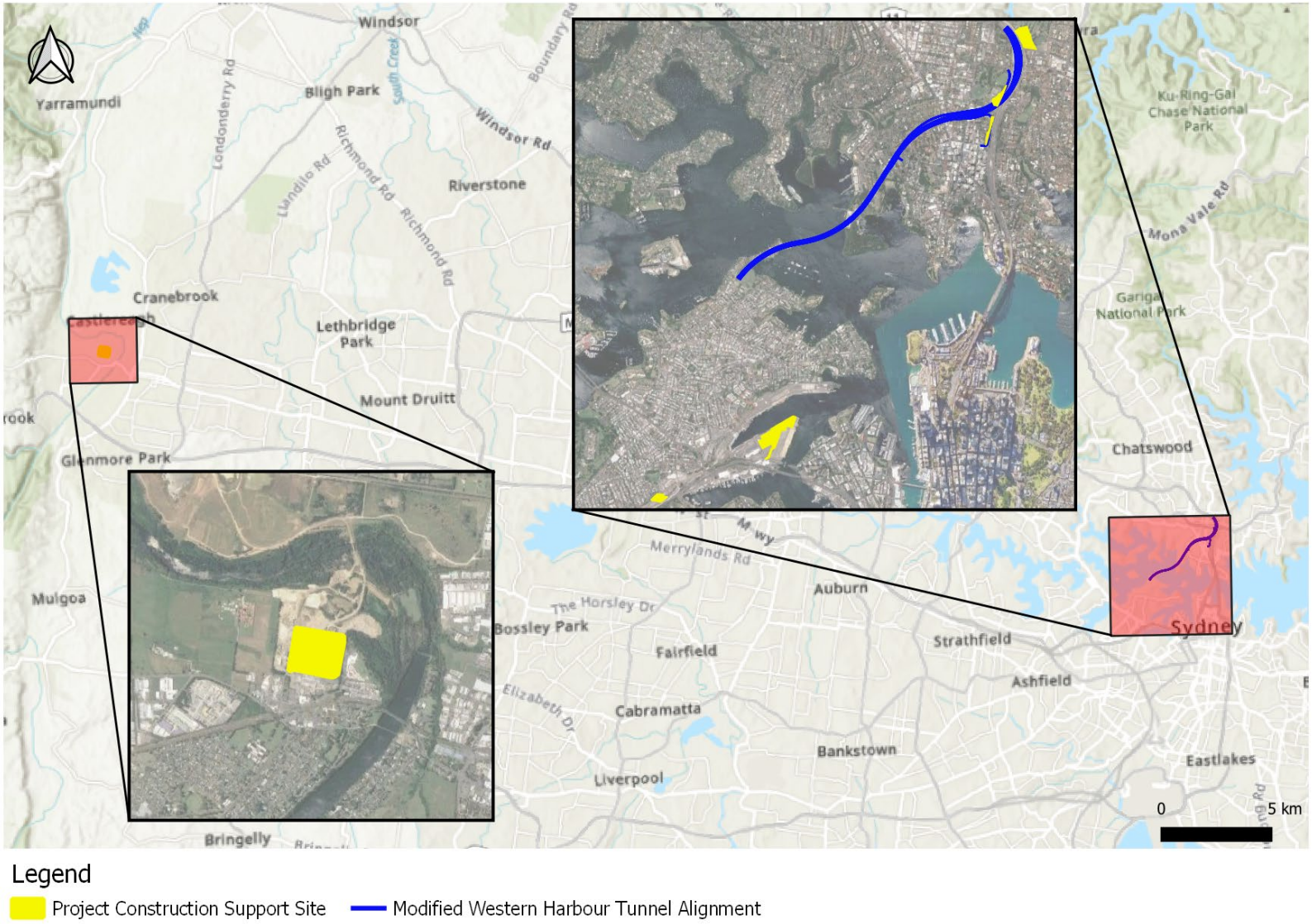


Figure 5-2 Locational context of the key elements of the proposed modified project.

5.2 Tunnelling method under Sydney Harbour

5.2.1 Comparison against the Approved Project description

Approved Project

Section 5.2.3 of the Project EIS detailed the key features of the WHT and identified that the project would comprise mostly driven tunnels, apart from the crossing of Sydney Harbour between Birchgrove and Waverton which would be constructed with an IMT. The IMT would connect to the driven mainline tunnels in Sydney Harbour from Yurulbin Point at Birchgrove and from Balls Head at Waverton.

The IMT tunnels were proposed to be installed as a series of pre-cast units in a trench excavated in the bed of Sydney Harbour, with fill and armour materials placed around the immersed tube tunnels for stability and protection. Each immersed tube tunnel would have accommodated three traffic lanes in each direction.

The IMT solution required four major construction support sites bordering the Harbour:

- Yurulbin Point (WHT4).
- Sydney Harbour south cofferdam (WHT5).
- Sydney Harbour north cofferdam (WHT6).
- Berrys Bay (WHT7).

The approved IMT solution also required the use of two construction sites at White Bay (northern and southern side) (WHT3) for manufacture, storage, and handling of the immersed tube sections as well as the transfer, stockpiling and processing of potentially contaminated dredge material from the dredging operation.

Proposed modified project

It is now proposed that the tunnels below Sydney Harbour (between Birchgrove and Balls Head) be constructed using two mix shield TBMs.

The two bored tunnels (approximately 1.8 km in length) would have a circular cross-section with an internal lined diameter of about 15.5 metres and an excavated diameter of about 16 metres to accommodate a three-lane tunnel in each direction and associated safety barriers, shoulders, and mechanical and electrical infrastructure.

Each TBM would typically consist of a shielded cutting head and trailing backup support services and mechanisms, which when combined are over 100 metres in length. Figure 5-3 shows the front section of the Mix shield TBM, and Figure 5-4 indicates a longitudinal section of the TBM.

Generally, the main aspects of TBM tunnelling include:

- Excavation.
- Lining installation.
- Culvert placement.
- Road infill.
- Tunnel fit out and finishing.
- Tunnel operation facilities.

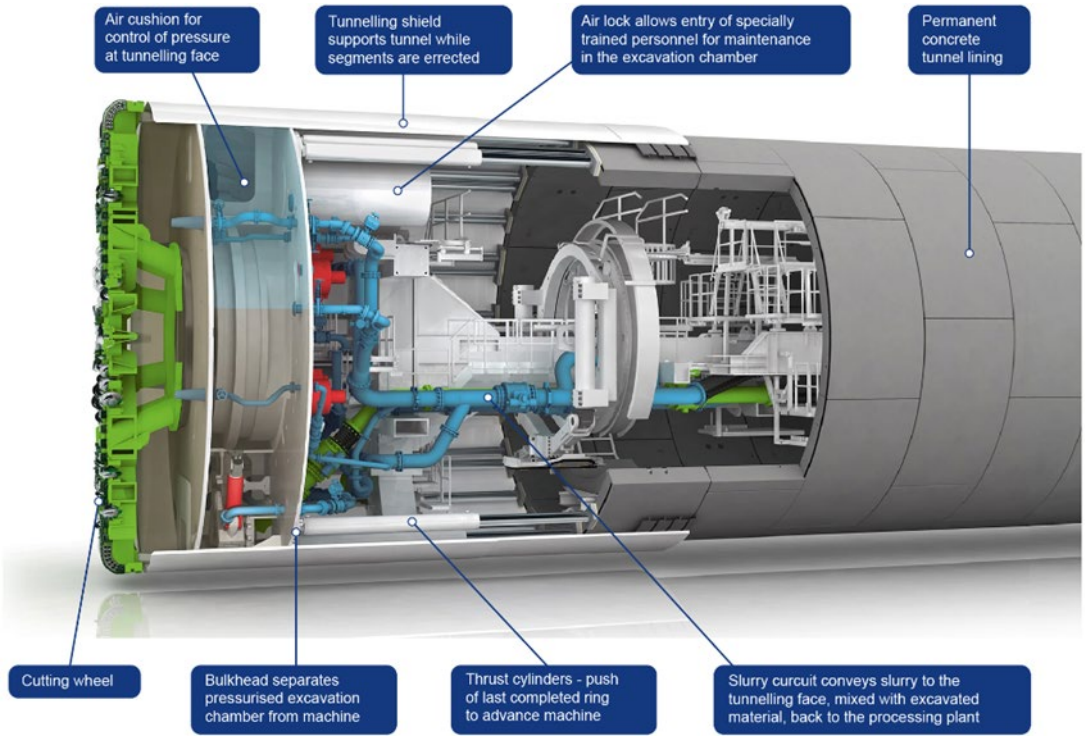


Figure 5-3 Example of a slurry shield TBM cross section - front section only (Source: Figure 4.14 of the Project EIS)

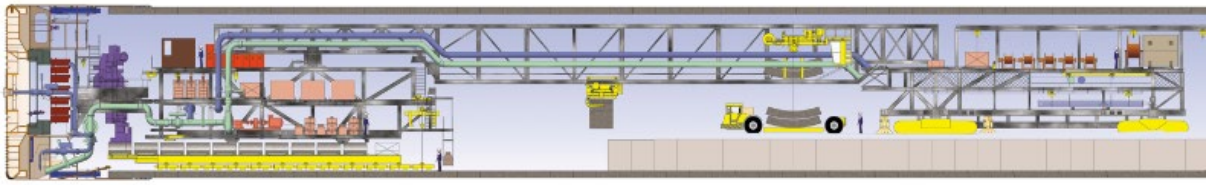


Figure 5-4 Example longitudinal section of the TBM

Excavation

The TBM cutting head is made up of cutting knives and discs that remove material from the tunnel face. The ground excavated by the cutter head is mixed into a chamber behind, filled with the pressurised circulating slurry. The pressure of this slurry is maintained by an air bubble chamber connected to a compressed air system, which will automatically pressurise the bubble and hence pressurise the slurry. This combination of pressurised bubble and slurry provides confinement pressure, or support, to the excavation face.

Excavated material would be removed from the excavation chamber at the extraction point. Larger rocks would be broken down by a crusher at this point to ensure all excavated material can be transported through the slurry pipes up to the slurry treatment plant.

Slurry treatment plant

The slurry treatment plant (STP) would be located within chambers excavated by the contractor for WHT Stage 1. An indicative layout is shown on Figure 5-5. These chambers would be fitted out with a STP during construction. After excavation at the TBM face, the spoil will be hydraulically transported to the STP through slurry lines, located within the excavated tunnels. Each TBM will have its own STP, which will be interconnected, but able to operate independently. This STP is a closed system which maximises the reuse of slurry and bentonite.

The STPs will be equipped with multiple tanks which will provide the ability to keep active quality slurry in sufficient quantity, with capacity to add or replace the active slurry with fresh batched bentonite. As part of the treatment process, the bentonite is separated out and reused. A residual 2.5% or less of bentonite is expected to remain in the spoil. As bentonite is a naturally occurring, chemically inert clay material, this isn't expected to affect the quality of the spoil for disposal or reuse. Once the spoil is treated through the STP the spoil will be tested in accordance with the NSW Waste Classification Guidelines (EPA, 2014) and transferred to a licenced facility where it would either be reused or disposed.

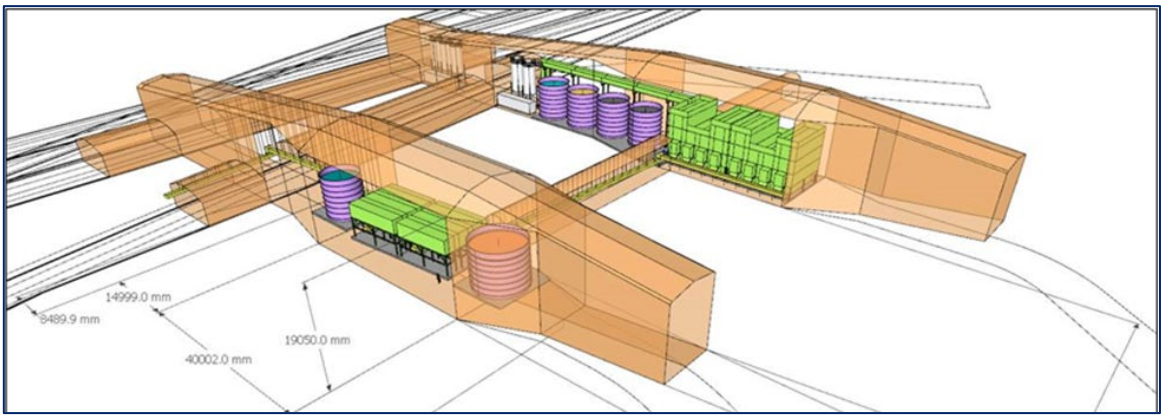


Figure 5-5 Indicative concept of the Slurry Treatment Plant set up within the excavated chambers.

Segment lining and culvert placement

During excavation hydraulic cylinders push the cutter head forward by bracing against the already installed concrete lining. Once an excavation cycle is complete, and enough space has been created at the front of the TBM, these hydraulic cylinders segmentally retract to allow for placement of the next pre-cast concrete segments.

Pre-cast segments are fed into the erector device via a conveyor belt system and then systematically placed to form the circular tunnel lining. A final keystone piece is inserted at the top of the tunnel to maintain the structure. Once all the lining sections have been placed, they are bolted to the previously laid segments.

As the TBM progresses and lining is placed, box culverts will be lowered into position in the tunnel invert. This allows for TBM support vehicles to follow closely behind the front section of the machine. The culvert installation is a repetitive step in the TBM advance cycle.

Once set correctly in place and bolted to the prior culvert, formwork will be used to allow grouting between the culvert floor and tunnel invert, entirely filling the nominal gap to provide a robust foundation beneath the culvert. Any gaps between the excavated tunnel wall and the tunnel lining would be filled with cement-based grout from grout batching plant(s) located at the tunnel boring machine launch site.

Supply of the precast tunnel lining segments and culverts would be via road transport from the Emu Plains construction support site (WHT13) and would enter the tunnel via the City West Link portal. For further details on the Emu Plains construction support site (WHT13) refer to Section 5.7.

Figure 5-6 shows a lined section of a Sydney Metro TBM tunnel.

Figure 5-6 A fully lined section of a Sydney Metro Tunnel.

Other tunnel activities

Other activities occurring inside the tunnel would include:

- Road backfill and drainage works
- Tunnel fitout and finishing works
- Tunnel operation including installation of ventilation fans.

These activities would not differ materially from what would be required for the Approved Project. Further details are provided in Chapter 6 of the Project EIS.

Surface features

Construction by TBM would eliminate all construction related works required in Sydney Harbour, including associated dredging activities. It would also remove the need for two marine construction support sites (Sydney Harbour south cofferdam (WHT5) and Sydney Harbour north cofferdam (WHT6)) and two temporary surface construction support sites (Yurulbin Point construction support site (WHT4) and Berrys Bay construction support site (WHT7)).

Construction of the tunnel by TBM would not result in any changes to any permanent surface works/features including the location and height of the ventilation outlets.

Tunnel alignment

The proposed change to a TBM solution would result in a minor change to the vertical and horizontal alignment of the tunnel. The proposed changes are generally needed to optimise the alignment for the TBM tunnelling across the Harbour.

A comparison of the vertical and horizontal alignment of the proposed modified project (using a TBM) with the approved IMT alignment is shown in Figure 5-7, Figure 5-8 and Figure 5-9.

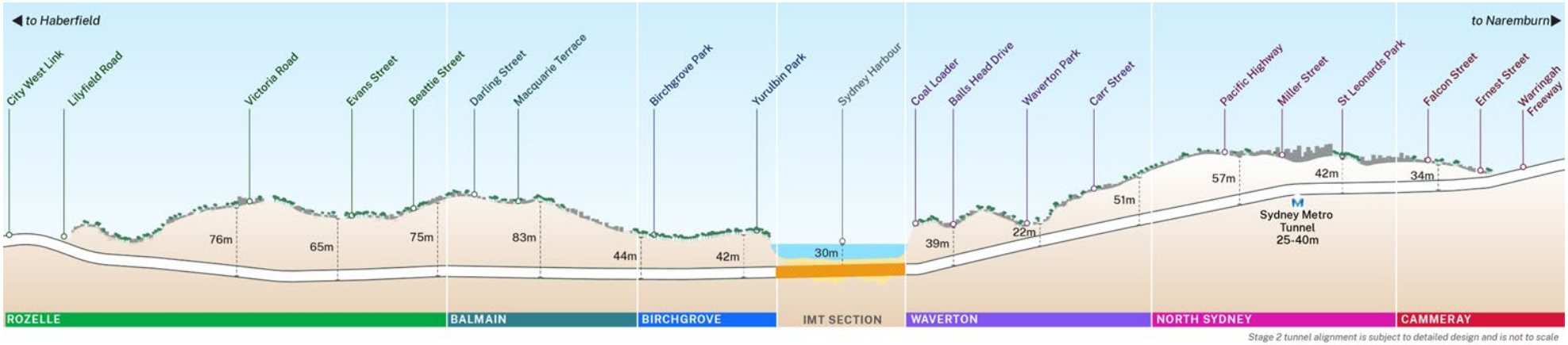


Figure 5-7 Approved Project – IMT vertical alignment.

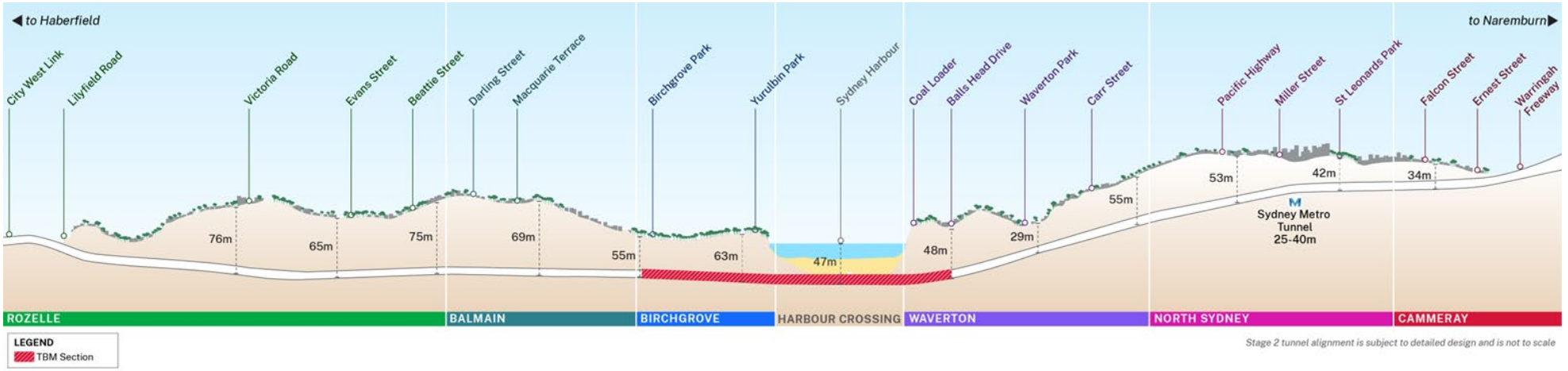


Figure 5-8 Proposed modified project – TBM vertical alignment.

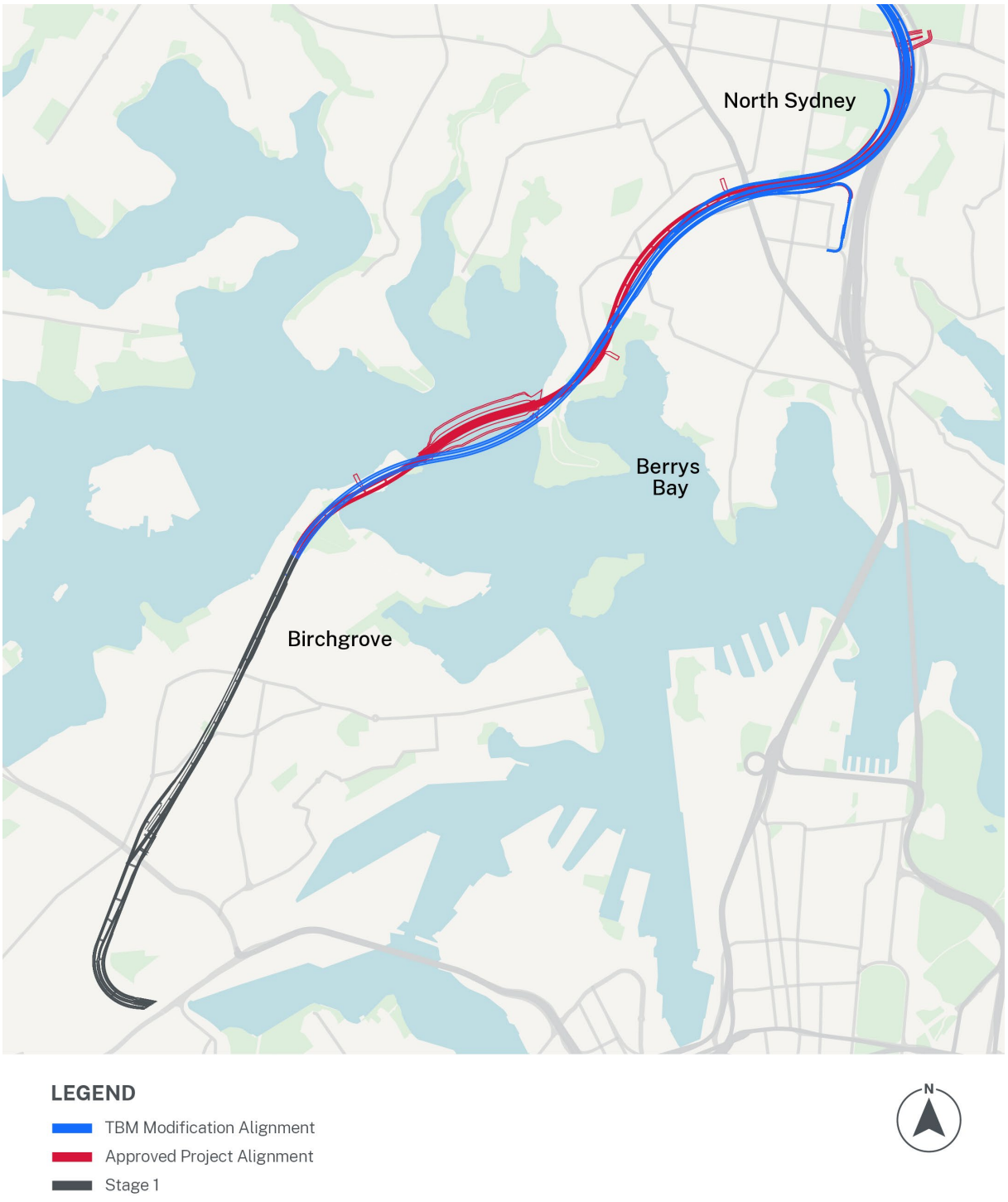


Figure 5-9 Proposed modified project – TBM horizontal alignment compared to the Approved Project alignment.

5.3 Chamber excavation for the TBM underground launch site and receival chamber

5.3.1 Approved Project

Section 5.2.3 of the Project EIS identified that the tunnels approaching Sydney Harbour would be driven tunnels constructed using roadheaders.

5.3.2 Proposed modified project

The change in construction methodology would require chambers to be excavated underground to allow for the launch and receival of the TBM. The excavation of these chambers would be entirely underground and would be supported by the existing construction support sites including City West Link Portal (WHT12), Glebe Island (WHT3), Ridge Street North (WHT9) and Cammeray Golf Course (WHT10).

A TBM launch chamber would be constructed below Birchgrove to facilitate the launch of the TBMs from the southern side of the Harbour. The launch chamber would consist of an underground excavation of around 180 metres long, 35 metres wide and about 25 metres tall. The launch chamber would be constructed approximately beneath Rose Street, Birchgrove, and would extend under the tennis courts and the edge of Birchgrove Oval as shown in Figure 5-10. Generally, the launch chamber would be constructed in the following sequence:

- Roadheaders would progressively cut the heading in a bullhorn formation
- Rock bolts and shotcrete would be installed progressively to stabilise the chamber to ensure a safe working environment.

Once the heading for the launch chamber is complete, the floor would be benched in layers using either roadheaders or surface mining machines. During the benching, rock bolts and shotcrete would be installed progressively to continue stabilising the chamber as the full depth of the chamber is excavated.

At the completion of TBM tunnelling, the launch chamber would be backfilled to the road level. The excavation of the launch chamber is expected to take between 6-9 months.

A receival chamber is proposed to be constructed under the Waverton Peninsula/Carradah Park. The receival chamber would be constructed on the outer sides of the mainline tunnel alignment, as shown in Figure 5-10. Generally, the receival chamber would be constructed in the following sequence:

- Roadheaders will cut the heading of the receival chamber
- Rock bolts and shotcrete will be installed progressively to stabilise the chambers to ensure a safe working environment.

Once the heading for the receival chamber is complete, the floor would be benched in layers using either roadheaders, surface mining machines or rock hammers. During the benching, rock bolts and shotcrete would be installed progressively to continue stabilising the chamber as the full depth of the chamber is excavated.

The receival chamber is proposed to be excavated by the roadheaders from the mainline excavation and will be constructed several months prior to the TBM breaking through. Once the TBMs breakthrough into the receival chamber, the TBM shields would be detached from the TBM train and moved laterally into the receival chamber on either side of the tunnels. The TBM shields would then be entombed in concrete and the remainder of the TBM train will be dismantled and reused or recycled. The excavation of the receival chamber is expected to take around three months.

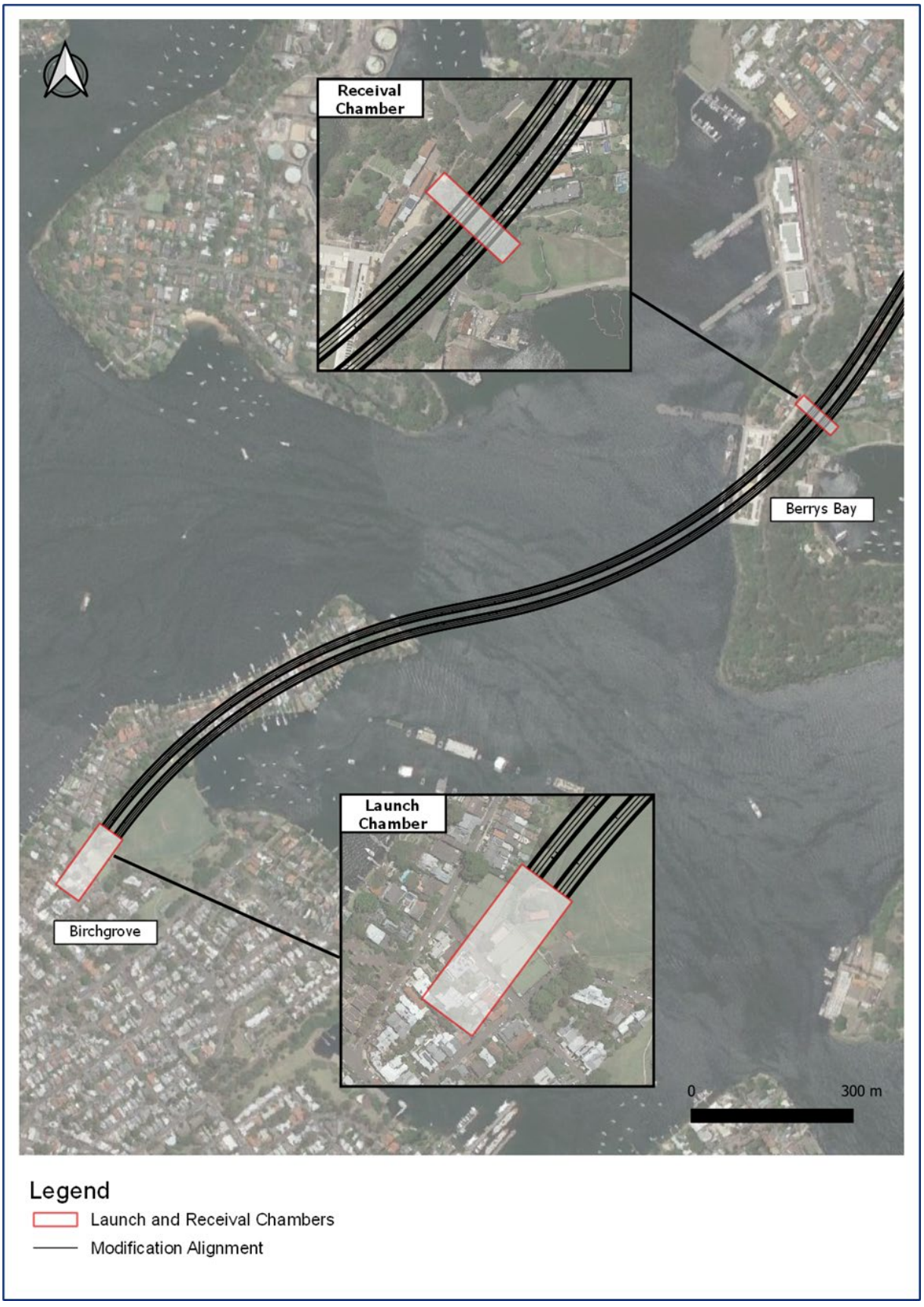


Figure 5-10 Indicative location of receival and launch chambers along the Modification alignment.

5.4 Rozelle Rail Yards construction support site (WHT1) – cut and cover section (WHT12)

5.4.1 Approved Project

The Rozelle Rail Yards construction support site (WHT1) was originally a construction support site for the Approved Project. The submissions report (Transport for NSW, 2020b) indicated that the layout and/or location of the Rozelle Rail Yards construction support site (WHT1) would be investigated during further design development and detailed construction planning to minimise any potential conflicts with the new open green space.

The delivery strategy for the WHT Project now includes two separate stages, one of which is the tunnelling from Rozelle to Balmain – WHT Stage 1 (refer Section 1.2.1). The existing M4-M5 Link contractor was awarded a variation in quarter 1 2022 to continue tunnelling and deliver WHT Stage 1. This decision allows tunnelling works (including spoil management) to be carried out from within the Stage City West Link Portal construction support site (WHT12). The contract packaging arrangement also removed the need for the Victoria Road construction support site (WHT2), also known as the Balmain League site.

Current approved activities carried out within the City West Link Portal construction support site (WHT12) by the WHT Stage 1 contractor are as follows:

- Spoil handing and removal
- Construction of water treatment plant
- Laydown and material stockpile
- Tunnelling support activities
- Underground works and deliveries 24 hours 7 days a week.

All works at the City West Link Portal construction support site (WHT12) are carried out underground to allow the Rozelle parklands to be delivered in full by the M4-M5 link contractor. Refer to Figure 5-11 which shows the location of the City West Link Portal construction support site (WHT12).

5.4.2 Proposed modified project

The City West Link Portal construction support site (WHT12) would continue to be used to support excavation and construction works for the mainline and ventilation tunnels associated with WHT Stage 2 including the crossing of Sydney Harbour. The key activities that would occur at this site would generally be consistent with the activities already approved and as detailed above.

The activities and equipment listed below would be set up at this site to support the TBM and cross passage excavation and permanent works:

- Treatment of slurry spoil from the TBM operation
- Spoil removal
- Water Treatment Plant(s)
- Feed and return slurry circuit booster pumps
- Ventilation Fans
- HV Substation for TBM and Glebe Island power supply
- Air Compressors
- Grout Batching Plant (optional) or grout line booster pumps
- Spoil Mucking Out Facility for TBM and cross passage spoil
- Medical/Emergency Airlock (optional).

To appropriately support the TBM tunnelling, this site would also require an increase in heavy vehicle movements along with spoil haulage 24 hours a day, seven days a week.

The tunnel segments, culverts, culvert backfill, TBM services, spoil removal, workers and materials supply would transit through the City West Link Portal from either an offsite location or from the Glebe Island south construction support site (WHT3). It is noted that all activities would be carried out from within the cut and cover area and tunnel as shown in Figure 5-11. There would be no surface activities or associated surface impacts within the Rozelle Parklands.

Figure 5-11 City West Link Portal construction support site (WHT12) tunnel portal.

5.5 Glebe Island construction support site – formerly the White Bay construction support site (WHT3)

5.5.1 Approved Project

The White Bay construction support site (WHT3) identified in the Project EIS included two sites – one on the northern and one on the southern side of White Bay.

The southern White Bay construction support site (now known as Glebe Island construction support site (WHT3)) has approval for:

- Early works and site establishment including demolition of structures within the boundary of the construction support site, piling to establish a wharf structure and moorings as part of the establishment of the casting and fitout facility; and establishment of a treatment area for dredged material that is not suitable for offshore disposal
- Casting and fitout of the IMT units
- Transport of IMT units to the mooring location at Snails Bay
- Spoil handling, treatment, and transport of dredged material not suitable for offshore disposal within the designated offshore disposal site
- Spoil handling and transport of excavated material from tunnelling at the Yurulbin Point (WHT4) and Berrys Bay (WHT7) construction support sites
- Storage and transport of major plant and equipment for the Yurulbin Point (WHT4) and Berrys Bay (WHT7) construction support sites, as well as the harbour crossing works
- The northern White Bay construction support site has approval to support dredging activities associated with the IMT construction.

General site activities (including casting and fitout of the IMT units) and spoil haulage are approved to be carried out during standard construction hours (7am to 6pm Monday to Friday, 8am to 1pm Saturday and no construction works on Sundays or public holidays).

Some deliveries to and from the site would have been required during the evening and night-time to support casting of IMT units and construction activities at the Yurulbin Point (WHT4) and Berrys Bay (WHT7) construction support sites. Access in and out of the southern and northern construction support sites was via James Craig Road.

5.5.2 Proposed modified project

Construction staging and support for the TBM is now proposed from the Glebe Island construction support site (WHT3) and from the City West Link Portal construction support site (WHT12). The approved northern White Bay construction support site, and related use of the Berrys Bay construction support site (WHT7) would no longer be required.

The proposed modifications are not intended to remove the requirements of the delivery of a proposed new foreshore park and public space at Berrys Bay, however, allow for the accelerated delivery for the benefit of the local community.

The Glebe Island construction support site (WHT3) would now be used for the following activities:

- Storage and transport of major plant and equipment to support TBM tunnelling
- Receival of TBM components
- Short term storage and transport of excavated material from TBM tunnelling. Note this will only be used where direct transport from the slurry treatment plant site at tunnel portals is not possible
- Laydown and storage of pre-cast segments for contingency.

The majority of the segments would be transported directly into the tunnel from the proposed Emu Plains construction support site (WHT13) (refer Section 5.7), however if this supply is interrupted, segments would be sourced from the contingency stockpile at the approved Glebe Island construction support site.

It is also proposed that the hours of operation at the Glebe Island construction support site be changed to 24 hours a day, seven days a week to allow for TBM support activities, along with parking and transferring workers into the tunnel as required.

The approved northern White Bay construction support site, and related use of the Berrys Bay construction support site (WHT7) would no longer be required.

Overall, there would be a net decrease in the total amount of land needed with the removal of the White Bay construction support site (northern side).

Figure 5-12 Proposed changes to the boundary of the White Bay Construction support site (now known as the Glebe Island construction support site) (WHT3). The site boundary would be subject to a lease agreement with Port Authority of NSW.

5.6 Changes to the Ridge Street North construction support site (WHT9)

5.6.1 Approved Project

The Approved Project includes spoil removal for the Falcon Street off-ramp to be carried out from the Cammeray Golf Course construction support site (WFU8/WFU10) and the Berrys Bay construction support site (WHT7).

The Project EIS states that the site would enable construction of:

- The cut and cover and trough portion of the WHT off ramp to Falcon Street
- Surface works required to integrate the Falcon Street off ramp
- The Ridge Street shared user bridge.

The Ridge Street North site construction support site (WHT9) was identified in the Project EIS as a major civil construction site that would support the construction of the Falcon Street off-ramp cut and cover and included spoil handling and removal.

The Project EIS noted that cut and cover construction at this site would generally be carried out during standard construction hours (7am to 6pm Monday to Friday, 8am to 1pm Saturday and no construction works on Sundays or public holidays).

Some construction activities supported by this site required out of hours work on occasion (e.g., connection of new works to the existing network). This meant that there would be discrete periods throughout the construction program where construction works at this site were to occur outside of standard construction hours. Access in and out of the site was proposed to be primarily via direct entry and exit from the Warringah Freeway with limited use of Ridge Street.

5.6.2 Proposed modified project

The proposed changes would remove the Berrys Bay construction support site (WHT7) which, in addition to supporting the Sydney Harbour north cofferdam, was proposed to be utilised for tunnelling in support of the Cammeray Golf Course construction support site (WHT10).

With the removal of this site, Cammeray Golf Course (WHT10) would be the only construction support site north of the Harbour Bridge approved for tunnel construction support activities. As such, to remove risk and pressure on Cammeray Golf Course (WHT10) it is proposed to use the Ridge Street North construction support site (WHT9) in the following additional capacity:

- To handle tunnel spoil, load trucks and remove tunnel spoil
- To treat wastewater associated with tunnelling activities.

The Ridge Street North construction support site (WHT9) would not increase in size compared to what was approved in the Project EIS. The layout of the Ridge Street North construction support site (WHT9) has been maximised to include the additional requirements within the approved footprint. A proposed indicative layout is shown in Figure 5-13 below.

To address potential additional noise impacts associated with this change, an acoustic shed would be constructed to fully enclose the tunnel spoil handling area of the site and to allow 24-hour spoil handling activities.

The utilisation of this site for tunnel spoil handling would reduce pressure on the Cammeray Golf Course construction support site (WHT10) and lessen risks associated with having only one point of spoil retrieval.

With the proposed changes to the use of this site, augmentation and/or provision of new utility services (such as electricity supply) may be required. This may entail additional temporary surface activities such as trenching down roads. The general extent of these works would be typical of most large infrastructure construction projects. Further detailed requirements would be investigated during detailed design. All utility works would be managed in accordance with the requirements for all other utility works identified for the Approved Project, including utility specific EMMs and a Utilities Management Plan.

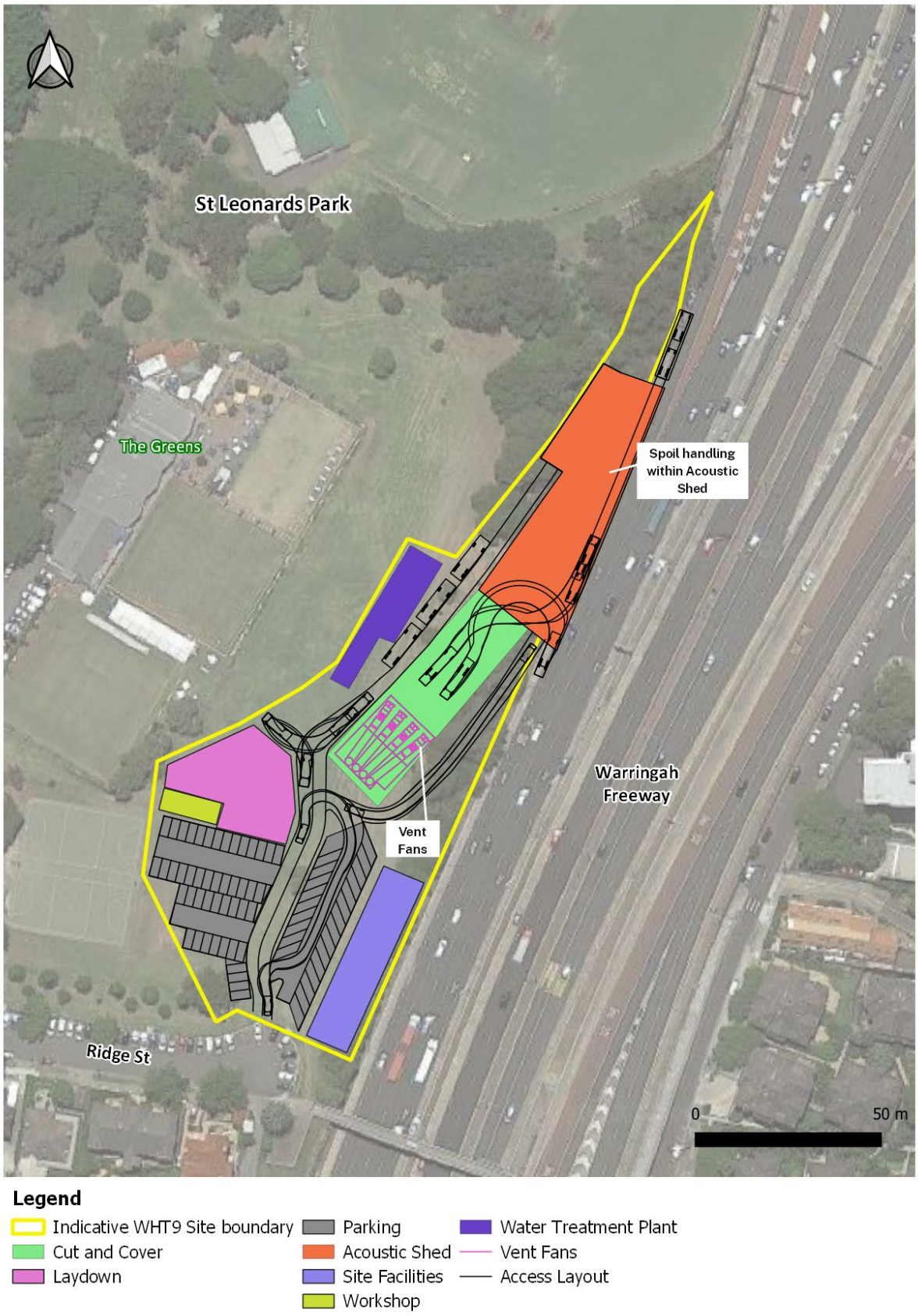


Figure 5-13 Ridge Street North construction support site (WHT9) - proposed indicative layout.

5.7 Emu Plains construction support site (WHT13)

5.7.1 Approved Project

The Project EIS identified the southern area of the White Bay construction support site (WHT3) for the casting and fit-out of the IMT units. The immersed tube tunnel was proposed to be about 630 metres long and was to consist of five individual units fabricated at the White Bay construction support site (WHT3).

The IMT units were to be fabricated on a submersible vessel moored at the White Bay construction support site (WHT3). Fabrication would include casting (i.e., concrete pouring into formwork for the units) and fit-out works. The IMT unit casting, fit-out and installation was expected to take between 4-5 years to complete in the Project EIS indicative construction program (Table 6-3 of the Project EIS).

5.7.2 Proposed modified project

As indicated in Section 4.2.3, the preferred option for TBM tunnel support would be to develop an additional construction support site at Emu Plains (WHT13) as the primary facility for pre-casting and storage of tunnel lining segments, culverts, and other concrete elements for the proposed modified project. This site would be located within the existing operating Boral Quarry located on Railway Street, Emu Plains.

Boral's Emu Plains Quarry has been supplying aggregates and sand to the Sydney metropolitan market since the early 1900's. Boral has owned and operated the site since the acquisition of BMI Limited in 1968. The site has operated under an Environment Protection Licence (EPL) since 2000. For the last 40 years, the site has primarily been a processing, stockpiling and water/tailings management facility, while extraction of the river gravel and sand has occurred on the Penrith Lakes Scheme site across the river to the north.

Whilst the Emu Plains construction support site (WHT13) would be located on a portion of the existing Boral site (refer Figure 5-14), it would be delineated as a separate site and operate independently from the existing Boral licence.

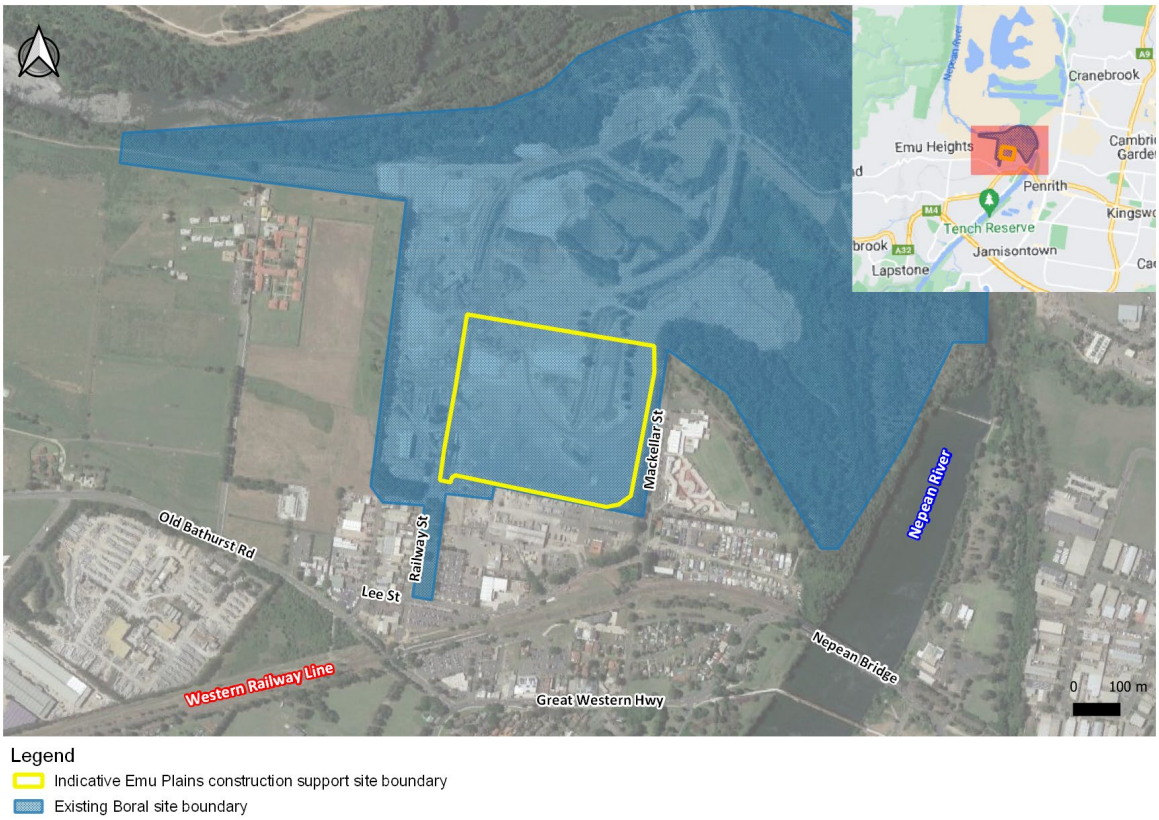


Figure 5-14 Location of Emu Plains construction support site (WHT13)

A summary of the key features of the Emu Plains construction support site (WHT13), consistent with the information presented in the Project EIS for other construction support sites, in provided in Table 5-1.

Table 5-1 Key features of the Emu Plains construction support site (WHT13)

Key Features	Summary
Site area	Approx. 145,000 m^2
Site description	This site is bounded to the north and west by the existing Boral Quarry operations, industrial properties to the south and Mackellar Steet to the east. Educational facilities are located to the east including Penola Catholic College and, Cath West Innovation College. Residential properties are located to the south-west of the site with the closest located on Railway Street. A Big 4 Holiday Park is located to the south-east A number of residential and commercial properties are also located further south between the Great Western Highway and the railway corridor. The Emu Plains construction support site (WHT13) is located on a portion of land that has been operated by Boral since 1968 and has been licenced under an EPL since 2000. The Boral site is currently licenced to carry out scheduled activities such as crushing, grinding, or separating, resource recovery and waste storage.
Key activities	Site preparation consisting of: • Connection of utilities (e.g., power, water, sewerage, gas, and communications). Power, water sewerage and communications would require localised connections from existing utilities that are connected to the Boral site. Gas connection may need to be extended from a local connection at the end of Railway Street • Earthworks to level the site (this may involve the use of retaining walls) • Installation of stormwater drainage and basin • Installation of lighting and signage. Construction and operation of the precast and construction support facility would encompass the following: • Casting sheds • A casting carousel and casting moulds • Segment and culvert storage • A concrete batching plant adjacent to the shed • Boiler, aggregate bins, and consumables • Electric gantry crane to manage pre-cast storage area and loading of trucks • Materials storage • A laydown/hardstand area • Offices and site amenities • Loading and unloading and circulation space for heavy vehicles • On-site parking for up to 60 light vehicles. The site would supply the manufactured segments directly to the Rozelle Railway Yards construction support site (WHT12) using large trucks (potentially purpose built) and possibly including B-doubles. The use of the Emu Plains construction support site (WHT13) would be temporary, with construction and operation of the facility occurring for about three to four years, subject to the delivery strategy and construction program for the Project. Whilst the majority of the segments would be transported directly into the tunnel from the proposed Emu Plains construction support site (WHT13), if this supply is interrupted, segments would be sourced from a possible contingency stockpile at Glebe Island (WHT3) - refer Section5.5. The future use of the site beyond the operation of the Project would be determined by Boral and would be subject to separate approvals, as required.

Key Features	Summary
Hours of construction	The site would operate 24 hours per day, 7 days per week (24/7 operation will likely only be required for the segment pre-fabrication and segment logistics and transport from the site to support the continuous operation of the TBM).

An indicative layout for the construction support site is shown in Figure 5-15. The detailed site layout will be further developed during detail temporary works design to maximise and optimise the use of space that is being made available by Boral. The final site area will be subject to a lease agreement with Boral.

Figure 5-15 Indicative layout – Emu Plains construction support site (WHT13)

6. Stakeholder and community engagement

6.1 Engagement process and activities carried out

6.1.1 Community consultation

Chapter 7 (Stakeholder and community engagement) of the Project EIS and Section A2 of the Project submissions report describes the engagement that has been carried out to date for the Approved Project. This chapter provides details of engagement which has occurred during preparation of this Modification Report and proposed ongoing stakeholder engagement.

Project EIS and Project submissions report community and stakeholder engagement

A summary of engagement activities carried out during preparation of the Project EIS and the submissions report is provided in Chapter 7 of the Western Harbour Tunnel and Warringah Freeway Upgrade Project EIS, and in Part A of the submissions report available at https://www.planningportal.nsw.gov.au/major-projects/projects/western-harbour-tunnel-warringah-freeway-upgrade

Consultation associated with this modification

The award of contract for WHT Stage 2 and the proposed change in methodology was publicly announced on 1 December 2022, at a press conference at Berrys Bay attended by the then NSW Premier, the Hon. Dominic Perrottet MP, The Hon. Natalie Ward, Minister for Metropolitan Roads, Ms Felicity Wilson MP, Member for North Shore, and Mr Bede Noonan, ACCIONA Chief Executive Officer.

The announcement was well publicised by metropolitan media channels and publications, including the Sydney Morning Herald and Channel 9 and Channel 7 News. In addition, the announcement was supported by a range of communications material and engagement activities, as summarised in Table 6-1 below. Further detail is provided in Appendix O.

Table 6-1 Communication material and engagement activities associated with this modification

Communications and/or engagement activity	Description
Media release	The announcement was accompanied by a media release issued by the Premier, Minister and Member for North Shore on 1 December 2022 https://www.nsw.gov.au/media-releases/major-milestone-for-sydneys-new-harbour-tunnel
Community update	WHT Stage 2, Community Update, delivered to residents across the Lower North Shore and Inner West. The community update was also published on the WHT Interactive Portal with a link distributed by email blast to stakeholders on the project distribution list. https://media.caapp.com.au/qqi12i.pdf
WHT animation	WHT Stage 2, Flyover video. https://media.caapp.com.au/embed/kx3z2s?autoplay=true
WHT Stage 2, Major Project Announcement Video	A video explaining the change in methodology from IMT to TBM with Deputy Secretary Infrastructure and Place, Camilla Drover and former Project Director, Dan Banovic. https://media.caapp.com.au/embed/nkeywc?autoplay=true
WHT Stage 2, Major Announcement FAQs – published December 2022	A Frequently Asked Questions document published on the WHT interactive portal to answer common questions asked by stakeholders and the public. https://media.caapp.com.au/tb1d73.pdf

Communications and/or engagement activity	Description
Fact sheets	• Modification Fact Sheet – published December 2022 https://media.caapp.com.au/03tg3g.pdf Tunnel Boring Machine Fact Sheet – published December 2022 https://media.caapp.com.au/2vnjcs.pdf • Waverton Fact Sheet – published December 2022 https://media.caapp.com.au/tzh1dn.pdf • Birchgrove Fact Sheet – published December 2022 https://media.caapp.com.au/95m9re.pdf
Market stalls	Transport for NSW have attended several community market stalls since the announcement of the change of methodology for the Project in December 2022. The project will continue to attend market stalls throughout the display period in the Lower North Shore and Inner West to discuss the proposed change in methodology and what this means for residents and the local community.
Community Information sessions	Transport for NSW and ACCIONA will undertake a combination of online and place based face-to-face community information sessions in North Sydney and Inner West Council areas. An online community information session will be held during the display period. The project will continue to engage directly with impacted residents along Ridge Street in North Sydney and Railway Street in Emu Plains. A dedicated place manager will be providing personalised responses to address specific impacts to these residents.

Stakeholder briefings	Prior to public exhibition of the EIS Modification Report, Transport for NSW and ACCIONA have carried out key stakeholder briefings to highlight and discuss the proposed changes between the original EIS and the Modification Report, in preparation for the exhibition period.
	These key stakeholder groups include:
	• Government Ministers and elected representatives.
	• State Government agencies including:
	  ○ Department of Planning and Environment (DPE).
	  ○ Heritage NSW.
	  ○ DPE Water.
	  ○ DPE – Environment and Heritage Group.
	  ○ Environment Protection Authority (EPA).
	  ○ Ports Authority of NSW.
	  ○ Local councils.
	• Office of the Chief Scientist and Engineer.
	• Local precinct committees and/or resident action groups.
	• Metropolitan Local Aboriginal Land Council (MLALC).

Modification Report Public Exhibition	This EIS Modification Report will be on public display for 28 days prior to the DPE completing its assessment. This is to give the community an opportunity to read the report and make a submission based on the merits of the proposed modified project. Once the public exhibition period is complete, Transport for NSW and ACCIONA will respond to the submissions in a Response to Submissions Report, with regard to the Department's State Significant Infrastructure Guidelines – Preparing a Submissions Report.

7. Approach and scope of the environmental assessment

7.1 Approach to the environmental assessment

The approach to the environmental assessment has been to compare the impacts assessed for the Approved and proposed modified project. This comparison focusses only on the impacts of the changes rather than assessing the entire project again.

For the purposes of assessing the change, the assessment has been divided into three sections:

- Tunnelling and Sydney Harbour crossing works.
- Emu Plains Construction Support Site (WHT13).
- Whole of Project changes.

The Tunnelling and Sydney Harbour crossing works section encompasses the following elements, as identified in Chapter 5:

- Changes to the tunnelling method to cross Sydney Harbour including road geometry changes.
- Changes to the construction of a section of driven tunnel, additional chamber excavation for the TBM underground launch site (adjacent to Birchgrove Park) and additional TBM receival chamber (adjacent to Carradah Park).
- Changes to the Rozelle Rail Yards construction support site (WHT1) cut and cover section (now City West Link Portal WHT12).
- Changes to Glebe Island construction support site (WHT3).
- Changes to Ridge Street North construction support site (WHT9) to allow for tunnel operations including spoil handling.

The assessment of impacts associated with tunnelling and Sydney Harbour crossing works is provided in Chapter 8.

The assessment of the Emu Plains Construction Support Site (WHT13) is provided in Chapter 9 as a separate assessment as it involves the addition of a site that is not adjacent to the existing project boundary.

The assessment of Whole of Project environmental changes is provided in Chapter 10.

Technical working papers to support the environmental assessment are provided as Appendices to this Modification Report. In the event of an inconsistency between a technical working paper and a Chapter of this Modification Report, the assessment provided in the Chapter will prevail to the extent of the inconsistency.

7.2 Scope of the environmental assessment

A scoping assessment has been completed to identify the likely potential environmental impacts associated with the proposed modified project which require further assessment, and those which are generally consistent with the Project EIS and therefore do not require further assessment. The scoping assessment for each of the sections assessed (as described above) is provided in Table 7-1.

In general terms, the Modification Report only relates to changes to the construction method. In this regard, all impacts requiring further assessment (with the exception of air quality and traffic) relate to potential construction stage impacts. Given the slight changes in tunnel alignment (refer Section 5.2), some potential changes to air quality and traffic during operation have been identified and have been included in the assessment.

The project would also result in a significant reduction, and in many cases removal, of impacts when compared to the Approved Project. A separate assessment has not been provided for impacts that have been removed by the proposed modified project. The removal of these impacts including the reduction of some risks and uncertainties has been considered as key benefits of the proposed modified project and are included as part of the justification of the modified project. Further details are provided in Chapter 13.

The proposed modified project would change or remove a number of environmental management measures (EMMs) and Minister's Conditions of Approval– notably all those associated with the removal of the activities associated with the IMT construction method. Where changes or removal of EMMs and the Minister's Conditions of Approval relate to the key issues assessed, specific details are provided in the corresponding sections. Where changes or removal of EMMs and/or the Minister's Conditions of Approval do not relate to the key issues assessed, details are provided in Chapters 11 and 12.

All changes to EMMs and to the Minister's Conditions of Approval as a result of the proposed modified project are provided in Chapter 11 (Revised Conditions of Approval) and Chapter 12 (Revised Environmental Management Measures) respectively.

Table 7-1 Scoping summary of the environmental assessment of the proposed modified project

Environmental issue (as per Project EIS)	Scoping assessment		
	Tunnelling and Sydney Harbour crossing works	Emu Plains construction support site (WHT13)	Whole of Project
Traffic and transport – construction	An increase in construction vehicle numbers would be required to access the City West Link Portal (WHT12) during the TBM tunnelling. This has been assessed in Appendix D (Technical Working Paper: Traffic and transport - construction). Section 8.1 of this report summarises the findings of this Technical Working Paper.	The addition of the Emu Plains construction support site (WHT13) required further assessment to determine impacts associated with the establishment and operation of this site. These impacts have been assessed in Appendix D (Technical Working Paper: Traffic and Transport - construction). Section 9.1 of this report summarises the findings of this technical paper.	Not required
Traffic and transport – operation	Minor changes to the road geometry have the potential of impacting the operation traffic performance. This has been assessed in Appendix E (Technical Working Paper: Traffic and Transport – operation). The findings of this technical paper are summarised in Section 8.2.	An operational traffic and transport assessment is not required as the Emu Plains construction support site (WHT13) would not continue beyond the construction stage of the proposed modified project.	Not required
Noise and vibration - construction	The change in construction methodology required the re-assessment of noise and vibration impacts associated with tunnelling and harbour crossing works. Changes have been assessed in Appendix F1 (Technical Working Paper: Construction noise and vibration – TBM). Section 8.3 of this report summarises the findings of this Technical Working Paper.	The addition of the Emu Plains construction support site (WHT13) requires the assessment of construction noise and vibration impacts associated with the construction support site. The establishment and operation of this site during construction has been assessed in Appendix F2 (Technical Working Paper: Construction noise and vibration – Emu Plains). Section 9.2 of this report summarises the findings of this Technical Working Paper.	Not required

Environmental issue (as per Project EIS)	Scoping assessment		
	Tunnelling and Sydney Harbour crossing works	Emu Plains construction support site (WHT13)	Whole of Project
Noise and vibration - operation	The proposed changes associated with the modified project are not expected to impact operational noise and vibration. The operational noise and vibration assessment undertaken for the Project EIS is expected to remain relevant to the proposed modified project. As such no additional operational noise and vibration assessment is required.	An operational noise and vibration assessment is not required as the Emu Plains construction support site (WHT13) would not continue beyond the construction stage of the proposed modified project.	Not required
Air quality - construction	The proposed modified project is expected to reduce construction air quality impacts by removing several terrestrial construction support sites. Of particular note, no additional construction air quality impacts are expected to result from the use of Ridge Street North (WHT9) for spoil handing. This is because all spoil handling work would be undertaken within an acoustic shed which would shield receivers from dust associated with construction. This is an improvement to the site proposed in the Project EIS which was to be an open earthworks site. No additional construction air quality mitigation measures are required in response to this modification.	The addition of the Emu Plains construction support site (WHT13) required assessment of construction air quality impacts at this site. This has been assessed in Section 9.3 of this report.	Not required
Air quality - operation	Minor changes to the road alignment would have the potential to change impacts on operational air quality. This has been assessed in Appendix G (Technical Working Paper: Air quality – operation). A summary of the findings of this technical paper are provided in Section 8.4 of this report.	An operational air quality assessment is not required as the Emu Plains construction support site (WHT13) does not extend to the operation of the proposed modified project.	Not required

Environmental issue (as per Project EIS)	Scoping assessment		
	Tunnelling and Sydney Harbour crossing works	Emu Plains construction support site (WHT13)	Whole of Project
Human health	Minor changes to operational air quality would have the potential to change human health impacts. A specialist review of the potential changes to human health impacts is included as Appendix H (Technical Working Paper: Human health review – air quality) and summarised as part of the operational air-quality assessment – refer Section 8.4.	No additional human health impacts are expected as a result of the Emu Plains construction support site (WHT13). No further assessment is required.	Not required
Non-Aboriginal Cultural Heritage	The proposed modified project is expected to reduce impacts to Non-Aboriginal Cultural Heritage associated with the tunnelling and harbour crossing works by removing several terrestrial and marine construction sites. No additional heritage impacts are expected to result from the proposed modification. Potential vibration impacts to heritage items are assessed in Appendix F1 (Technical Working Paper: Construction noise and vibration - TBM) and summarised in Section 8.3 of this report.	As the site is located in an area not already assessed within the Approved Project construction boundary, the potential for impacts to additional non-Aboriginal heritage items require assessment. This has been assessed in Appendix I (Technical Working Paper: Non-Aboriginal Heritage – Emu Plains). Section 9.4 of this report summarises the findings of this Technical Working Paper.	Not required
Aboriginal Cultural Heritage	The proposed modified project is expected to reduce impacts to Aboriginal Cultural Heritage associated with the tunnelling and harbour crossing works by removing several terrestrial and marine construction sites. No additional heritage impacts are expected to result from the proposed modified project. Potential vibration impacts to heritage items during construction are assessed in Appendix F1 (Technical Working Paper: Construction noise and vibration - TBM) and summarised in Section 8.3 of this report.	As the site is located in an area not already assessed within the Approved Project construction boundary, the potential for impacts to additional Aboriginal heritage items require assessment. An assessment in line with the Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) has been caried out for the Emu Plains construction support site (WHT13). This is attached as Appendix J (PACHCI Stage 1 Assessment). Section 9.4 of this report provides a summary of the findings.	Not required

Environmental issue (as per Project EIS)	Scoping assessment		
	Tunnelling and Sydney Harbour crossing works	Emu Plains construction support site (WHT13)	Whole of Project
Geology, soils, and groundwater	The proposed modified project has the potential to change groundwater impacts from what was expected in the Project EIS. This has been assessed in Appendix K1 (Technical Working Paper: Groundwater and settlement). Section 8.5 of this report summarises the findings of this Technical Working Paper.	As the site is located in an area not already assessed within the Approved Project construction boundary, the potential for additional soil and contamination impacts requires further assessment. This has been assessed in Appendix K2 (Technical Working Paper: Preliminary Site Investigation – Emu Plains) and summarised in Section 9.5.	Not required
Hydrodynamics and water quality	The proposed modified project is expected to significantly reduce impacts to hydrodynamics and water quality when compared to what was characterised in the Project EIS. No further assessment of hydrodynamics and water quality is required for the tunnelling and harbour crossing works Chapter of this report.	Due to the location of the Emu Plains construction support site (WHT13), impacts to water quality of the receiving environment require assessment. These impacts have been assessed in Section 9.7.	Not required
Flooding	The proposed modified project is not expected to result in changes to flooding beyond what has already been characterised in the Project EIS. No further assessment of flooding is required for the tunnelling and harbour crossing works.	A review of potential flood issues associated with the Emu Plains construction support site (WHT13) is provided in Appendix L (Technical Working Paper: Flooding - Emu Plains) and is summarised in Section 9.6.	Not required
Biodiversity	Chapter 19 of the EIS provided a qualitative assessment of potential impacts to the microbat colony that seasonally (autumn and winter) occupies one of the Coal Loader tunnels in Waverton. Impacts to this colony are expected to be significantly less than what was anticipated in the Approved Project	A Biodiversity Development Assessment Report (BDAR) has been prepared for the Emu Plains construction support site (WHT13) and is provided in Appendix M (Biodiversity Development Assessment Report – Emu Plains). Section 9.8 of this report summarises the findings of this Report.	Not required

Environmental issue (as per Project EIS)	Scoping assessment		
	Tunnelling and Sydney Harbour crossing works	Emu Plains construction support site (WHT13)	Whole of Project
-	owing to the removal of construction support sites (the Sydney Harbour northern coffer dam and Berrys Bay) and a deeper tunnel alignment. Notwithstanding there is a potential for indirect impact from noise and vibration. Further assessment of this potential impact is included in Appendix F1 (Technical Working Paper: Construction noise and vibration - TBM) and is summarised in the noise and vibration assessment – refer Section 8.3 of this report.	-	-
Land use and property	Substratum acquisition is a requirement of all tunnel projects. The Project EIS identified that Transport for NSW would contact owners of properties affected by substratum acquisition. If any additional substratum acquisition is required, it will be undertaken in line with the process outlined in the Project EIS. As no additional impacts are expected to result beyond minor changes to substratum acquisition, no further assessment of land use and property is required.	The Emu Plains construction support site (WHT13) would be located on land currently owned and operated by Boral. This site currently operates as a materials recycling facility and is licenced for waste storage, resource recovery, and crushing, grinding, or separating under their EPL. The use of the Emu Plains construction support site (WHT13) would be done so in accordance with a lease agreement with Boral. Additionally, consultation with Penrith City Council has been undertaken as described in Chapter 6. As such no further assessment is required.	Not required
Socio-economics	A Social Impact Assessment (SIA) has been prepared to compare the social impacts of the proposed modified project with the Approved Project and is provided in Appendix N (Technical Working Paper: Social Impact Assessment). Section 8.6 of this report summarises the findings of this Technical Working Paper.	As the Emu Plains construction support site (WHT13) was not previously assessed in the Project EIS, a Social Impact Assessment (SIA) has been prepared and is provided in Appendix N (Technical Working Paper: Social Impact Assessment). Section 9.9 of this report summarises the findings of this Technical Working Paper.	Not required

Environmental issue (as per Project EIS)	Scoping assessment		
	Tunnelling and Sydney Harbour crossing works	**Emu Plains construction support site (WHT13)**	**Whole of Project**
Urban design and visual amenity	The only measurable change would be the temporary installation of an acoustic shed at Ridge Street North (WHT9). A visual impact assessment has been carried to assess any additional visual impacts associated with the new temporary acoustic shed required at the Ridge Street North construction support site (WHT9) and is provided in Section 8.7	The Emu Plains construction support site (WHT13) is located within an industrial area and the site is currently used by Boral for receival of spoil material from large infrastructure projects. The eastern side of the site is currently screened from Mackellar Street by a large, vegetated earth mound. This provides adequate visual screening from potential sensitive viewpoints including Penola Catholic College, CathWest Innovation College, and the Ingenia Holiday Park. No further visual impact assessment is considered necessary as there would be minimal changes to the existing visual environment to adjacent sensitive viewpoints.	Not required
Hazards and risks	Chapter 23 of the Project EIS identified potential hazards and risks to public safety, the surrounding community and the environment that may be associated with construction. Minor further assessment is required to identify any changes to any Hazards and risks. This assessment is included in Section 8.8.	No additional hazards and risks are expected as a result of the Emu Plains construction support site (WHT13). The site is located in an existing industrial area that facilitates similar activities to those proposed. The site would require heavy vehicles including possibly B-doubles, however the access routes to the site are currently used by a similar number and size of vehicles. The environmental management and mitigation measures identified for the Approved Project would be adequate to address any residual risks. No further assessment is required.	Not required
Resource use and waste management	Assessed as a whole of project issue.	Assessed as a whole of project issue.	The proposed modified project would result in some changes to resource use and waste.

Environmental issue (as per Project EIS)	Scoping assessment		
	Tunnelling and Sydney Harbour crossing works	Emu Plains construction support site (WHT13)	Whole of Project
-	-	-	These changes and associated impacts are assessed in Section 10.1.
Climate Change, Green House Gas and Sustainability	Assessed as a whole of project issue.	Assessed as a whole of project issue.	The proposed modified project would result in some changes to sustainability. These changes and associated impacts are assessed in Section 10.2 and Section 10.3.
Cumulative impacts	The proposed modified project would provide an overall reduction in cumulative impacts with the removal of a number of major construction support sites. Further discussion on the overall benefits are provided in Chapter 13. Remaining cumulative impacts during construction would be generally the same as those assessed for the Project EIS. There would be no changes to cumulative impacts as a result of the operation of the proposed modified project.	Given the geographically separate location for the Emu Plains construction support site (WHT13), cumulative impacts during construction are addressed separately for this site and is provided in Section 9.10. There would be no cumulative impacts during operation of the proposed modified project as the Emu Plains construction support site (WHT13) would no longer be in use.	Not required.

8. Assessment of impacts - Changes to tunnelling and Sydney Harbour crossing works

This Chapter provides an assessment of the proposed modified project with respect to the changes to tunnelling and Sydney Harbour crossing works. The issues addressed are in accordance with the scoping review which is provided in Chapter 7. The assessment focusses on the impacts of the proposed modified project in comparison the Approved Project. Assessment of impacts of the Emu Plains construction support site (WHT13) and impacts relating to the whole of project are provided in Chapters 9 and 10 respectively.

8.1 Construction traffic and transport

This section assesses the potential construction traffic and transport impacts of the proposed modified project and identifies measures to address these impacts. A detailed traffic and transport assessment has been carried out for the project and is included in Appendix D (Technical working paper: Traffic and transport - construction).

8.1.1 Assessment methodology

Consistent with the Project EIS, the assessment methodology for construction traffic and transport impacts considered the following four core components:

- Road transport
- Local roads and parking
- Public transport
- Pedestrians and cyclists (active transport).

Maritime traffic was also assessed in the Project EIS, however with the removal of the IMT tunnelling construction method, maritime operations have been removed and as such there is no further assessment of maritime traffic impacts. The benefits of removal of maritime traffic impacts are addressed in Chapter 13 (Justification).

The method and outputs of assessment for each component is summarised in Table 8-1.

Table 8-1 Approach to the construction traffic and transport assessment – changes to tunnelling and Sydney Harbour crossing works

Project Impacts	Method of assessment	Assessment output
Road traffic	Analysis of construction road traffic requirements in comparison to the approved traffic impacts.	Quantitative assessment of road traffic requirements against the road performance and resulting impacts as described in the Project EIS.
Local roads and parking	Analysis of any changes to the use of local roads or construction parking as a result of the modified activities.	Qualitative assessment of the changes to the use of local roads or construction parking against the impacts described in the Project EIS.
Public transport	Analysis of any changes to public transport impacts as a result of the modified activities.	Qualitative assessment of any changes to public transport as a result of the modified project.
Pedestrians and cyclists (active transport)	Analysis of any changes to active transport impacts as a result of the modified activities.	Qualitative assessment of any changes to active transport as a result of the modified project.

8.1.2 Construction traffic modelling and assessment criteria

The traffic model used as the base for the proposed modified project was adopted from the 2027 operational traffic model used in the Project EIS. The model was used to determine the existing and forecasted performance of key intersections adjacent to the construction support sites (including the new, open

connection to the M4-M5 link tunnels, just west of The Crescent and City West Link intersection). Further details are provided in Appendix D (Technical Working Paper: Traffic and transport - construction).

The construction support sites affected by the proposed modified project were modelled in either VISSIM or SIDRA Intersection 9.1 software. The selection of the model was based on what is expected to be the most appropriate for the proposed change, and availability of appropriate network models.

The average delay of each of the key intersections assessed as part of the modelling analysis has been categorised based on the Level of Service (LoS) criteria outlined in Table 8-2 below, and in accordance with The Guide to Traffic Generating Developments Version 2.2 (RTA, 2002).

Table 8-2 Level of Service (LoS) criteria (Source: Guide to Traffic Generating Developments Version 2.2 (RTA, 2002))

LoS	Average delay per vehicle (seconds/vehicle)	Traffic signals and roundabouts
A	Less than 15	Good operation
B	15 to 28	Good with acceptable delays and spare capacity
C	29 to 42	Satisfactory
D	43 to 56	Operating near capacity
E	57 to 70	At capacity, at signals, incidents will cause delays Roundabouts require other control mode
F	Over 70	Extra capacity required

8.1.3 Existing environment

Consistent with the approach in the Project EIS, the assessment of construction traffic and transport for the proposed modified project has been divided into two geographic areas - Rozelle and surrounds, and Warringah Freeway and surrounds.

All changes associated with the tunnelling and Sydney Harbour crossing works (primarily relating to WHT12 and WHT3) are addressed in the assessment of Rozelle and surrounds. Changes to the Ridge Street North construction support site (WHT9) are addressed in the assessment of Warringah Freeway and surrounds, which has been refined to focus only on the impacts of relevance to the proposed changes.

Rozelle and surrounds

The existing transport network within Rozelle and the surrounding areas is shown in Figure 8-1 and includes the suburbs of Balmain, Birchgrove, and Rozelle.

Figure 8-1 Existing transport network – Rozelle and surrounds.

Traffic volumes and patterns

A summary of existing peak hour traffic volumes per hour for Rozelle and surrounds in the AM peak (between 7am and 9am on a working weekday) and PM peak (between 4pm and 6pm on a working weekday) has been reproduced from Section 8.3.2, Table 8-5 of the Project EIS and shown in Table 8-3 below.

Table 8-3 Existing peak hour traffic volumes – Rozelle and surrounds

Road	Direction	AM peak		PM peak	
		Volume (vehicles)	Heavy vehicle percentage	Volume (vehicles)	Heavy vehicle percentage
City West Link west of The Crescent	Eastbound	2630	4%	2350	3%
	Westbound	1660	7%	2140	6%
James Craig Road south of The Crescent	Eastbound	260	5%	120	3%
	Westbound	140	5%	140	3%
The Crescent west of Victoria Road	Eastbound	3590	5%	2950	3%
	Westbound	2390	6%	3090	5%
Victoria Road north of The Crescent	Northbound	2090	6%	3710	5%
	Southbound	4060	6%	2930	5%

Public transport network

A summary of the public transport network that services Rozelle and surrounding areas has been reproduced from Section 8.3.2, Table 8-6 of the Project EIS and is provided in Table 8-4 below. The details of the services have been updated where timetables and routes have been revised since the Project EIS.

Table 8-4 Existing public transport network - Rozelle and surrounds

Public transport mode	Description of services in Rozelle and surrounds
Light rail	The L1 Dulwich Hill Line provides direct connections to Pyrmont, Leichhardt, Central and Dulwich Hill stops. The Rozelle Bay light rail stop is located near the intersection of City West Link and The Crescent. The Lilyfield light rail stop is located adjacent to the intersection of the City West Link and Catherine Street.
Ferry	Ferry services are provided from wharves located in Balmain, Balmain East, and Birchgrove. These wharves are serviced by the F8 Circular Quay to Cockatoo Island service that provides direct connections to Circular Quay, Balmain, Birchgrove, Greenwich Point, Woolwich, and Cockatoo Island. A private ferry operator also provides a service between Circular Quay and Lane Cove that provides direct connections to Circular Quay, Kirribilli, Darling Harbour, Balmain East, Birchgrove, Greenwich, Northwood, Longueville, Hunters Hill, and Riverview College Wharf. Balmain East wharf is also served by the F4 Cross Harbour Line that provides direct connections to Circular Quay, Barangaroo, McMahons Point, Milsons Point and Pyrmont Bay.
Bus	Within Rozelle and surrounding suburbs, there are 26 unique routes and about 1700 individual timetabled bus services on weekdays, 1000 services on Saturdays and 800 services on Sundays and public holidays. Bus services are operated by Sydney Buses and Transit Systems Sydney. Victoria Road and ANZAC Bridge are major bus corridors for services to the Sydney CBD, the Inner West, Ryde, Macquarie Park, and Parramatta.

Active transport network

The pedestrian network in the Rozelle area is well developed with footpaths provided along most of the roads and controlled crossings at signalised intersections. High pedestrian activity is associated with the Rozelle area along Victoria Road, James Craig Drive, ANZAC Bridge, and the foreshore area around Rozelle Bay. Active transport bridges as described in the Project EIS have changed as part of the WestConnex M4-M5 Link – Rozelle Interchange Project.

Two additional active transport bridges are currently being constructed to link Annandale to the future Rozelle Parklands. These bridges are expected to be open to the public prior to the commencement of the proposed modified project.

The cycle network in the Rozelle area consists of a mixture of off-road shared pedestrian and cyclist paths and on-road cycle routes on local and collector roads. The regional strategic cycle network provides connections between the area surrounding Rozelle and the Sydney CBD, North Sydney, Redfern, Green Square, Sydney Airport, Pyrmont, Surry Hills, Haberfield, and Summer Hill.

Off-road shared user paths are provided at the following locations:

- Victoria Road between The Crescent and Drummoyne.
- ANZAC Bridge.
- Along the foreshores of Iron Cove, Rozelle Bay, and Blackwattle Bay.

Existing road performance

City West Link and Victoria Road through Rozelle are two of the busiest road corridors in Sydney, providing access to and from the Sydney CBD for people living and working in Sydney's West, Inner West, and Lower North Shore. Congestion and delays on Victoria Road and City West Link are highest during the AM peak period, with the key constraints to traffic flows headed to the Sydney CBD on Victoria Road and City West Link. Feeder roads such as Balmain Road, Catherine Street and The Crescent cause additional congestion. The M4-M5 Link – Rozelle Interchange construction staging is also a major temporary constraint, with traffic lanes narrowed and regularly changing due to the construction staging. It is expected that the M4-M5 Link – Rozelle Interchange Project will be completed prior to major construction commencing on the Western Harbour Tunnel Project (Stage 2) and therefore the traffic flow and movement will change, with capacity greatly increased once that project is completed.

In the PM peak, the main constraint for westbound traffic is the right turn movement from ANZAC Bridge to Victoria Road, where queues are frequently observed across the ANZAC Bridge and onto the Western Distributor. Westbound congestion and queuing are also observed on the approaches to Evans Street in Rozelle, where steep grades slow down buses travelling in the kerbside lane, and at Darling Street. Northbound traffic on The Crescent also experiences high delays due to the limited capacity of the intersection of Johnston Street and The Crescent.

East of Rozelle, ANZAC Bridge and the Western Distributor form the main motorway network on the western side of the Sydney CBD, facilitating high traffic demands for travel both into and through the Sydney CBD and further north across Sydney Harbour to North Sydney and the Northern Beaches. The ANZAC Bridge operates close to capacity in both directions during peak periods with a high degree of weaving, merging, and diverging activity occurring on the Western Distributor around the Bathurst Street and King Street exits and the weave movement from the Western Distributor to the Bradfield Highway which occurs over a short 200 metre distance, all of which generates delay and reduces capacity through this section of the motorway.

Intersection performance

The Project EIS modelled key intersections based on 2016 travel demands to characterise existing intersection performance and is shown in Table 8-5. The intersection performance LoS information from the M4-M5 Link Project EIS is also included in Table 8-5. This modelling information has been included as the Rozelle Interchange is expected to be completed in 2023 – prior to the construction of the proposed modified project.

Table 8-5 Existing intersection performance – Rozelle and surrounds as relevant to the proposed modified project

Intersection	AM peak (8am-9am) LoS (average delay seconds) – As described in the Project EIS*	PM peak (5pm-6pm) LoS (average delay seconds) – As described in the Project EIS*	AM peak (8am-9am) LoS – As described in the M4-M5 Link Project EIS (2023 with M4-M5 Link Project completed) #	PM peak (5pm-6pm) LoS – As described in the M4-M5 Link Project EIS (2023 with M4-M5 Link Project completed) #
Victoria Road/The Crescent	B (27)	F (88)	C	C
The Crescent/James Craig Road	A (10)	B (25)	A	A
The Crescent/City West Link	B (21)	D (55)	C	B
City West Link/Catherine Street	C (38)	B (15)	N/A	N/A
City West Link/Balmain Road	F (72)	D (52)	N/A	N/A

Source: Western Harbour Tunnel and Warringah Freeway Upgrade Environmental Impact Statement. # WestConnex M4-M5 Link Project Environmental Impact Assessment.

The assessment identified that the following intersections were performing at an unsatisfactory Level of Service (LoS E or F):

- Victoria Road and The Crescent – PM peak
- City West Link and Balmain Road – AM peak.

With the M4-M5 link completed, the intersection of Victoria Road/The Crescent would perform at LoS C.

Warringah Freeway and surrounds (as relevant to the Ridge Street North construction support site (WHT9))

The existing transport network within the Warringah Freeway and surrounds area relevant to the Ridge Street North construction support site (WHT9) is shown in Figure 8-2 below and includes the suburb of North Sydney.

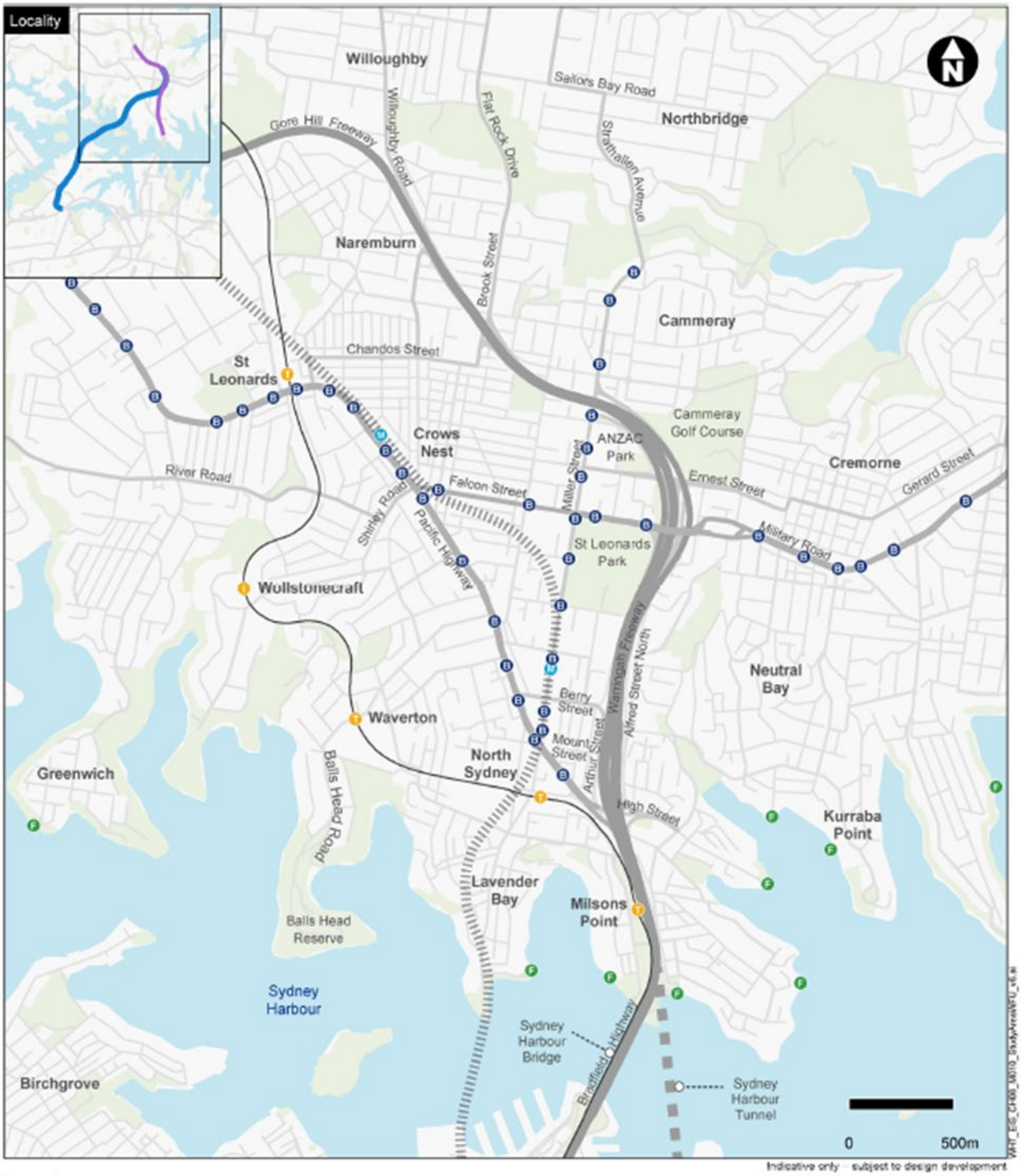


Figure 8-2 Existing transport network – Warringah Freeway and surrounds (as relevant to the Ridge Street North construction support site (WHT9)).

Traffic volumes and patterns

A summary of existing peak hour traffic volumes relevant to the Ridge Street construction support site (WHT9) in the AM peak (between 7am and 9am on a normal working weekday) and PM peak (between 4pm and 6pm on a normal working weekday) is provided in Table 8-6.

Table 8-6 Existing peak hour traffic volumes – Warringah Freeway and surrounds as relevant to Ridge Street North construction support site (WHT9)

Road	Direction	AM peak (7am to 9am)		PM peak (4pm to 6pm)	
		Volume (vehicles)	Heavy vehicle percentage	Volume (vehicles)	Heavy vehicle percentage
Ridge Street east of Miller Street	Eastbound	330	5%	130	2%
	Westbound	160	9%	260	4%

Public transport network

The Warringah Freeway and surrounding area is readily accessible via public transport. Rail services are provided at Milsons Point, North Sydney, Waverton and Wollstonecraft railway stations, which are located on the T1 North Shore, and T9 Northern Lines. A new station as part of Sydney Metro City & Southwest is under construction in North Sydney (Victoria Cross station) and is expected to be operational in 2024.

The Warringah Freeway and surrounding area is a major thoroughfare for buses including services operating along the Warringah Freeway, Military Road, Miller Street, and the Pacific Highway.

The area is also serviced by ferry, with ferry wharves located at McMahons Point, Milsons Point, Kirribilli, North Sydney, Neutral Bay, and Kurraba Point.

Active Transport network

The pedestrian network in the Warringah Freeway and surrounding area is well developed, with footpaths provided along most roads and controlled crossings at signalised intersections.

Pedestrians are prohibited from walking along the Warringah Freeway. High pedestrian activity associated with retail and commercial activities occurs within North Sydney CBD, with schools located west of the Pacific Highway and along Miller Street, and people carrying out leisure and exercise activities in and near Balls Head Reserve.

The cycle network in the Warringah Freeway and surrounding area consists mostly of on-road cycle routes on local, collector and sub-arterial roads.

The Warringah Freeway presents a significant barrier to east/west movements for pedestrians and cyclists, with crossings available at select locations. Based on pedestrian and cyclist surveys carried out for the project, Mount Street was identified as the most used crossing for pedestrians due to its proximity to North Sydney CBD, while West Street was the most used crossing for cyclists. The Falcon Street underpass was identified as being under-utilised by pedestrians and cyclists during the week and on weekends.

Existing road performance

The Warringah Freeway is the busiest section of motorway in NSW, with congestion and delays highest during the AM peak period, particularly for southbound traffic with queues extending as far north as the Miller Street interchange. During the PM peak, queuing and congestion is frequently observed on the northbound off ramp to Falcon Street eastbound.

Queuing and congestion is frequently observed on connecting roads within the North Sydney CBD area, to the west of the Warringah Freeway.

The Project EIS modelled key intersections based on 2016 travel demands to characterise existing intersection performance and are shown in Table 8-7. The key intersection of potential relevance to changes at the Ridge Street North construction support site (WHT9) would be the intersection of Ridge Street and Miller Street.

Table 8-7 Existing intersection performance – Warringah Freeway and surrounds as relevant to Ridge Street North construction support site (WHT 9)

Intersection	AM peak (8am–9am) LoS (average delay in seconds)	PM peak (5pm–6pm) LoS (average delay in seconds)
Miller Street/Ridge Street	C (39)	B (26)

The assessment indicated that this intersection currently operates at a satisfactory LoS in both the AM and PM peaks.

8.1.4 Assessment of potential impacts

Rozelle and surrounds

The Project EIS assumed that the M4-M5 link connection at Rozelle would still be under construction. Given the passage of time since the assessment in the Project EIS, the proposed modified project has now been assessed with the M4-M5 link connection open.

The assessment has adopted the Project EIS VISSIM model 'without construction traffic' to determine the forecast performance of the key intersections adjacent to the construction sites (including the now open connection to the M4-M5 link tunnels), just west of The Crescent and City West Link intersection. The 'without construction traffic' models were based on forecast traffic demand for 2027 from outputs from the Sydney Motorway Planning Model (SMPM). Further details are provided in Appendix D (Technical Working Paper: Traffic and transport - construction).

Construction traffic routes

Figure 8-3 below shows the primary access routes for heavy vehicles accessing the relevant construction support sites. These are generally consistent with what was described in the Project EIS.

Figure 8-3 Anticipated construction access routes. Note that the City West Link Portal site is an underground facility and will not impact the future Rozelle Parklands.

Construction vehicle movements

Daily and peak construction vehicle movements for the proposed modified project are shown in Table 8-8.

Table 8-8 Proposed access routes and revised peak traffic generation for WHT12 and WHT3 (and difference compared to EIS)

Construction support site	Primary access routes	Proposed modified project peak vehicle movements per day (changes compared to Approved Project)		Morning peak (6am to 10am) vehicle (4h) movements (changes compared to Approved Project		Evening peak (3pm to 7pm) vehicle movements (4h) (changes compared to Approved Project)	
		Light	Heavy	Light	Heavy	Light	Heavy
City West Link Portal WHT12	City West Link	200 (-105)	1527 (+1362)	44 (-90)	305 (+263)	44 (-93)	305 (+262)
Glebe Island WHT3	James Craig Road	530	304 (-396)	205	61 (-128)	255	61 (-128)

Note: numbers denoted within brackets indicate the change from the Approved Project

The key changes outlined in Table 8-8 from the Approved Project are:

- An increase in daily heavy vehicle movements on City West Link and James Craig Road associated with the City West Link Portal construction support site (WHT12).
- A decrease in daily heavy vehicle movements on James Craig Road associated with the Glebe Island construction support site (WHT3)

Impact assessment

The performance of the proposed modified project was assessed against the same metrics as was assessed for the Project EIS, these are:

- Travel times for traffic between key origin and destination points in the network which pass the City West Link Portal construction support site (WHT12).
- Key intersection performances based on average delay (expressed in seconds per vehicle) and levels of service (as defined in The Guide to Traffic Generating Developments Version 2.2 (RTA, 2002)).
- Cumulative traffic.
- Impacts on parking, public transport and active transport.

Travel times

Table 8-9 and Table 8-10 show the forecast corridor travel times for the general traffic in 2027 for the scenarios of without construction traffic and with construction traffic for the proposed modified project for the AM and PM peaks respectively.

Table 8-9 Modelled morning peak hour general traffic travel times with and without construction – Rozelle and surrounds.

Route	Direction	Base '2027 without construction vehicles' (hours)	Modified Project '2027 with construction vehicles' (hours)
City West Link to Pyrmont (Balmain Road to Pyrmont Street)	Eastbound	00:17	00:18
	Westbound	00:05	00:05

Table 8-10 Modelled evening peak hour general traffic travel items with and without construction – Rozelle and surrounds.

Route	Direction	Base '2027 without construction vehicles' (hours)	Modified Project '2027 with construction vehicles' (hours)
City West Link to Pyrmont (Balmain Road to Pyrmont Street)	Eastbound	00:05	00:05
	Westbound	00:06	00:06

Table 8-9 and Table 8-10 indicate the following:

- For the AM peak, the travel time between City West Link and Pyrmont would increase by around 1 minute in the eastbound direction. It is noted that this increase has been rounded up to the nearest whole minute.
- For the PM peak, there would be no increase in the travel time between City West Link and Pyrmont in either direction.

Intersection performance

Table 8-11 and Table 8-12 show the average delay and LoS for the key intersections potentially affected by the proposed modified project for Rozelle and surrounds for the AM and PM peak respectively.

Table 8-11 Modelled morning peak hour intersection performance with and without construction – Rozelle and surrounds

Intersection / peak period	Base '2027 without construction vehicles' – LOS (average delay in seconds)		Modified Project '2027 with construction vehicles' – LOS (average delay in seconds)	
	Average delay (sec)	Level of Service	Average delay (sec)	Level of Service
Victoria Road/The Crescent	59.91	E	60.66	E
The Crescent/James Craig Road	53.65	D	53.45	D
The Crescent/City West Link	76.99	F	82.68	F
City West Link/Catherine Street	51.95	D	50.38	D
City West Link/Balmain Road	95.73	F	108.62	F

Table 8-12 Modelled evening peak hour intersection performance with and without construction – Rozelle and surrounds

Intersection / peak period	Base '2027 without construction vehicles' – LOS (average delay in seconds)		Modified Project '2027 with construction vehicles' – LOS (average delay in seconds)	
	Average delay (sec)	Level of Service	Average delay (sec)	Level of Service
Victoria Road/The Crescent	33.41	C	24.61	B
The Crescent/James Craig Road	26.22	B	11.19	A
The Crescent/City West Link	47.34	D	61.52	E
City West Link/Catherine Street	23.03	B	23.22	B
City West Link/Balmain Road	58.02	E	46.31	D

Table 8-11 and Table 8-12 indicate the following:

- For the AM peak, there would be a minor increase in the average delay for traffic at the key intersections affected by the proposed modified project.
- For the PM peak, there would be some deterioration in performance at the intersection of The Crescent/City West Link (from D to E) because of greater conflicting movements. All other intersections would operate at an improved level of performance. Note that this conflicting movement is currently being used as part of the construction of Stage 1 of WHT. This will also be included in the operational state of this intersection.

Cumulative traffic

The cumulative construction impacts which were assessed in the Project EIS have been updated based on current construction progress and publicly available information or information previously included in the Project EIS and incorporated into the indicative construction program for the proposed modified project as provided in Table 8-13 below.

Table 8-13 Indicative construction programs (peak vehicle movements)

Construction project	Indicative construction program							
	2020	2021	2022	2023	2024	2025	2026	2027
M4-M5 Link Connection (WestConnex 3B)								
Sydney Metro West – Central Tunnelling Project								
Sydney Metro West – Eastern Tunnelling Project and Bays Station construction[2]								
WHT Stage 1 – Tunnelling[1]								
WHT Stage 2 – Launch chamber construction								
WHT Stage 2 – Harbour Crossing (TBM Tunnelling)								
WHT Stage 2 – Tunnel lining and fit-out construction								

1 WHT Stage 1 is a separate package with works being completed separately to this Modified Project

2 Peak tunnelling identified between Q1 2024 and Q2 2025. After tunnelling is completed the station development will continue between Q2 2025 and Q4 2027.

Note: construction durations are representative of the period where peak vehicles movements would occur. i.e., the period for Sydney Metro represents the expected tunnelling period.

The peak construction movements associated with WHT Stage 2 would relate to TBM tunnelling works, which is scheduled to commence after the peak vehicle movements associated with adjacent projects.

Peak truck movements to and from the site from City West Link have been estimated to occur in approximately 2026, however may extend into 2027. The total truck movements over the construction program are presented in Figure 8-4 below.

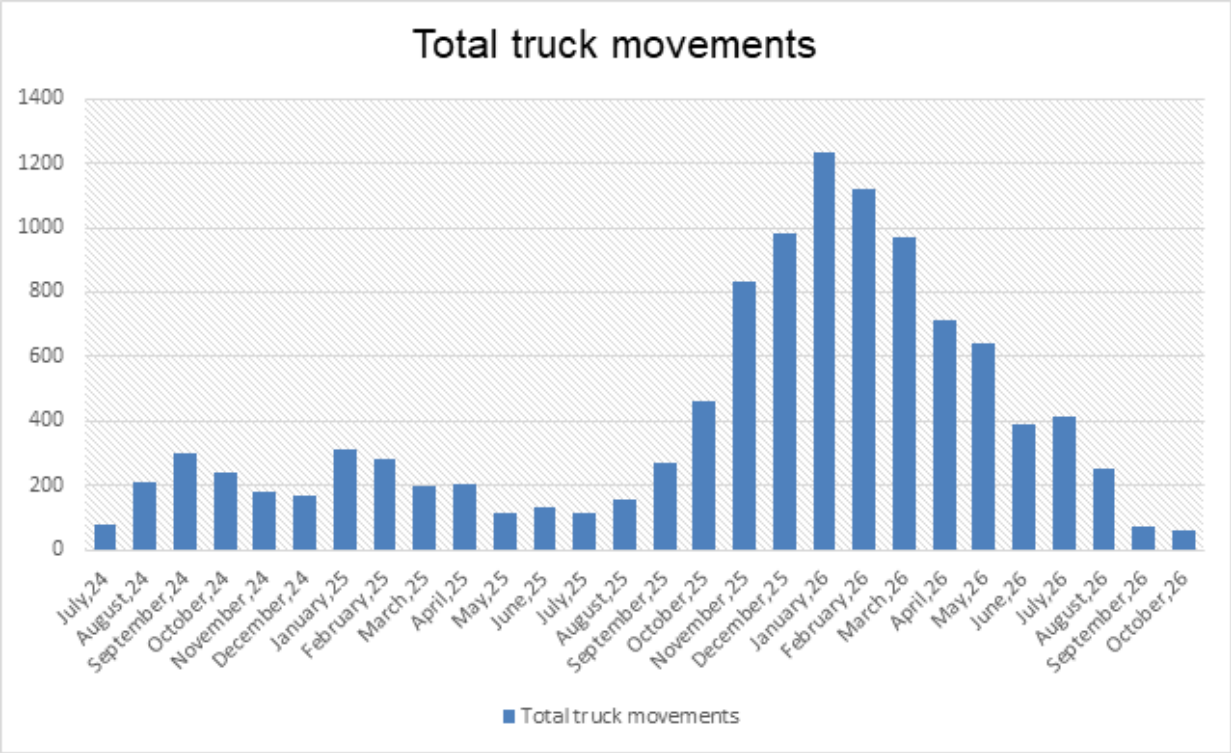


Figure 8-4 Total truck movements over the construction program for the proposed modified project

The figure shows that the peak heavy vehicle movements modelled in this assessment would be experienced for a relatively short time period. Based on Figure 8-4, peak heavy vehicle movement would exceed 500 per day for around 7 months during late 2025 and early 2026 and 1000 per day for around 2 months during early 2026. The latter would correspond to peak TBM operation.

Peak truck movements for the project are expected to occur after the completion of the major projects within Rozelle and surrounds. The construction of Sydney Metro West, The Bays station at White Bay has been identified to continue for several years after the completion of the Sydney Metro West tunnelling program and will require additional heavy vehicle movements in and out via James Craig and The Crescent, however due to the low number of heavy vehicle movements identified in the Sydney Metro West - Rail infrastructure, stations, precincts and operations EIS (peak of 34 HVs in peak periods), they are not anticipated to affect the performance at the intersections any further than already assessed as part of this impact assessment. As such, it is anticipated that cumulative traffic would not affect the performance at modelled intersections any further than already assessed in this modification.

Impacts on parking

Parking requirements assessed in the Project EIS for the City West Link Portal construction support site (WHT12) and Glebe Island construction support site (WHT3) will still be implemented during construction. Construction workforce would be encouraged to use public transport where reasonable and feasible to minimise the potential parking impacts on the road network, as described in Section 8.4.1 and 8.4.3 of the EIS. Workforce parking within the Glebe Island construction support site (WHT3) has been maximised and capacity has been increased when compared to the Approved Project.

Impacts on public transport

The potential impacts to public transport as a result of the Approved EIS construction traffic are limited to minor delays to buses owing to increased construction traffic. Based on the travel time and intersection performance results detailed in the above sections, the modification is unlikely to have an increased impact on public transport beyond what has already been characterised in the Approved Project.

Impacts on active transport

Impacts on active transport impacts identified in the Project EIS included construction traffic accessing the Victoria Road construction support site (WHT2) having to give way to pedestrian and cyclist traffic on the shared user path on Victoria Road. As this site is no longer required as part of the proposed modified Project this interface would no longer occur. The new connections as part of the M4-M5 Link Connection project will also be open to pedestrians as part of the commissioning of the Rozelle Parklands. The Project EIS had assumed that construction would still be underway.

A workforce pedestrian access would still be established as identified in the Project EIS. It may be necessary to facilitate pedestrian access from the new Rozelle Parklands into the cut and cover structure at the City West Link Portal construction support site (WHT12). The access is likely to utilise some of the new permanent structures and connections including the pedestrian bridge which crosses The Crescent (connecting the Light Rail stop at Rozelle to the Rozelle Parklands).

No additional impacts on pedestrian and cyclist connectivity have been identified as part of the proposed modified Project. The proposed modified Project will also have improved connectivity for active transport with the expected completion of the M4-M5 link connection works (including the new pedestrian bridge across The Crescent and City West Link Road as well as the Rozelle Parklands).

Warringah Freeway and surrounds (as relevant to Ridge Steet north construction support site (WHT9)

The additional light vehicle traffic proposed for Ridge Street North construction support site (WHT 9) has been modelled in SIDRA Intersection 9.1 software. The modelling was evaluated using SCATS data from November 2022. Further details are provided in Appendix D (Technical Working Paper: Traffic and transport - construction).

Construction traffic access routes and distribution

Figure 8-5 and Table 8-14 below shows the anticipated construction routes and traffic distribution used for the Ridge Street North construction support site (WHT9) modelling assessment.

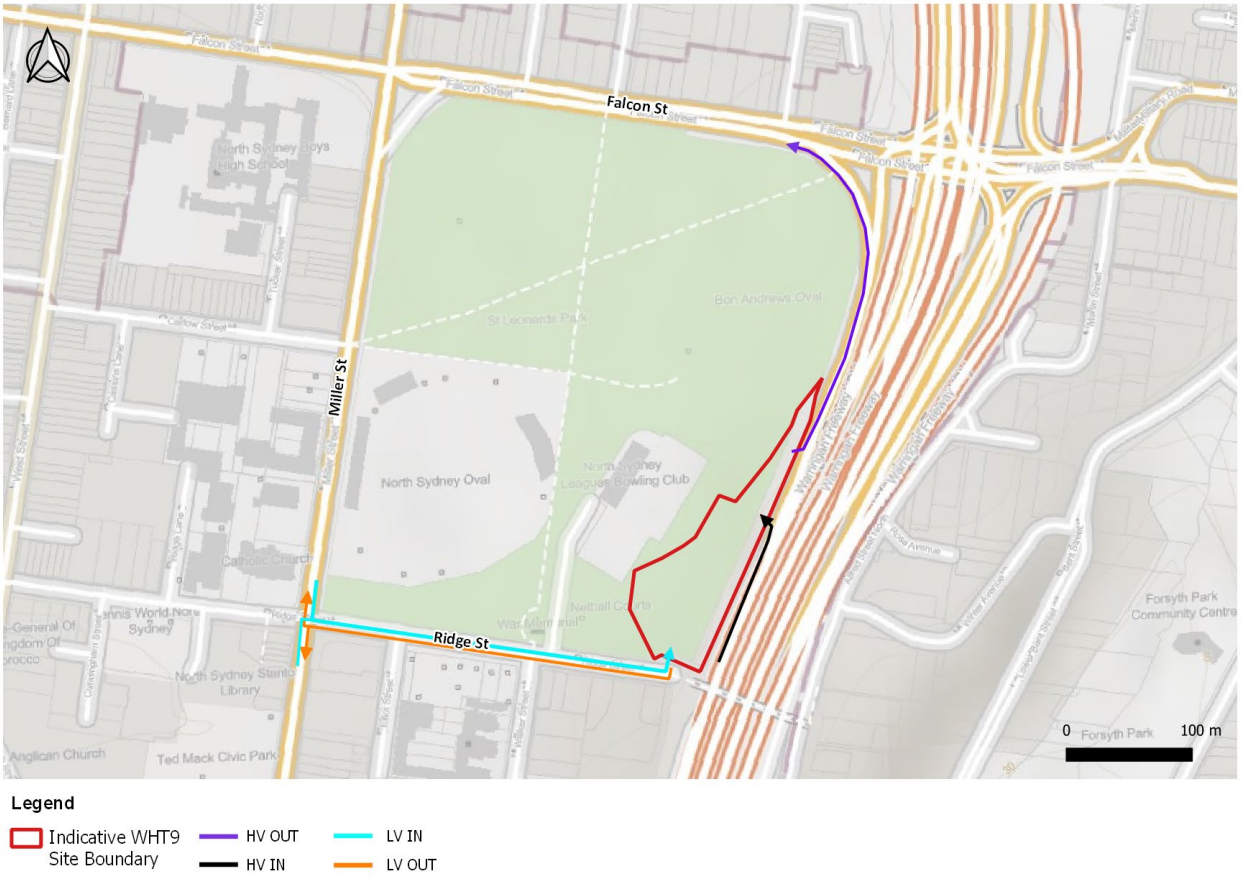


Figure 8-5 Anticipated construction access routes for Ridge Street North construction support site (WHT9).

Construction vehicle volumes

The site layout at the Ridge Street North construction support site (WHT9) has been optimised for the provision for on-site carparking. To facilitate the substantial increase in onsite parking beyond that assumed in the Project EIS, an increase in light vehicle movements from 70 (in plus out) to up to 300 (in plus out) per day along Ridge Street has been assessed.

Table 8-14 shows the anticipated peak construction vehicle movements for the proposed modified project in comparison with the Project EIS. A portion of light vehicle movements associated with the project have been assumed to arrive and depart in the AM and PM peak periods because of typical shift change operations.

Table 8-14 Proposed access routes and revised peak traffic generation for Ridge Street North construction support site (WHT9) (and difference compared to EIS)

Construction support site	Proposed access routes	Proposed modified project - Peak vehicle movements per day (changes compared to Project EIS)		Proposed modified project - morning peak vehicle movements 6am to 10am (changes compared to Project EIS)		Proposed modified project - evening peak vehicle movements 3pm to 7pm (changes compared to Project EIS)	
		Light	Heavy	Light	Heavy	Light	Heavy
Ridge Street North (WHT9)[1]	Ridge Street	300 (+230)	20 (0)	40 (0)	2 (0)	40 (0)	2 (0)
	Warringah Freeway	165 (0)	200 (0)	64 (0)	51 (0)	67 (0)	51 (0)

[1]No clear anticipated morning and afternoon peak movements and therefore the movements in peak hours have been estimated. Shift changes are expected to be outside of peak hours and outside of school zone hours

Impact assessment

Intersection performance

The performance of the intersection of Miller and Ridge Street with and without the proposed modified project is shown in Table 8-15 and Table 8-16 for the AM and PM peaks respectively.

Table 8-15 Modelled morning peak hour intersection performance without and with the proposed modified project - Miller and Ridge Street

Intersection / peak period	2023 'without construction traffic' – LOS (average delay in seconds)		'with construction traffic' – LOS (average delay in seconds)	
	Average delay (sec)	Level of Service	Average delay (sec)	Level of Service
Miller Street / Ridge Street	18.4	B	18.5	B

Table 8-16 Modelled evening peak hour intersection performance without and with the proposed modified project - Miller and Ridge Street

Intersection / peak period	2023 'without construction traffic' – LOS (average delay in seconds)		'with construction traffic' – LOS (average delay in seconds)	
	Average delay (sec)	Level of Service	Average delay (sec)	Level of Service
Miller Street / Ridge Street	20.7	B	21.5	B

Table 8-15 and Table 8-16 indicate that the existing intersection in both AM and PM peak periods performs well within an acceptable LoS and there would be minimal changes due to the proposed modified project.

Impacts on local roads and parking

As indicated above, onsite parking at the Ridge Street North construction support site (WHT9) has been substantially increased when compared to the Approved Project.

The peak light vehicle movements with the project are associated with shift changes. These times would likely see peak light vehicle movements occur outside commuter and school peak periods.

Impacts on public transport

No impacts on public transport are expected in relation to the Ridge Street North construction support site (WHT9) as a result of the proposed modified project.

Impacts on active transport

The proposed modified project is not anticipated to have any additional impacts on pedestrian and cyclists' connectivity around the Ridge Street North construction support site (WHT9).

Pedestrian connectivity at the intersection of Ridge Street and Miller Street would remain unchanged, and currently contains signalised crossings for pedestrians.

Special events

North Sydney Oval events have not been detailed for the entire construction period. The most significant events at the oval currently scheduled are;

- Rugby League
- Rugby Union
- Women's International Cricket
- Women's Australian Rules Football.

These events are typically held during the day or evening and on weekends with only a select few games being held on weekdays. When the events are held on weekdays they are generally held in the evenings. Whilst the proposed modified project includes additional light vehicle movements on Ridge Street, project vehicles would only represent a small percentage of the total light vehicle movements, and therefore would not result in a noticeable impact.

8.1.5 Assessment summary

The key findings of the assessment of construction traffic and transport impacts are:

Rozelle and surrounds:

- There would be an increase in heavy vehicle traffic utilising the City West Link Portal construction support site (WHT12) compared with the Approved Project
- There would be a substantial reduction in daily heavy and light vehicle movements on James Craig Road associated with the Glebe Island construction support site (WHT3) compared with the Approved Project
- A very minor increase (less than 1 minute) in travel times between City West Link and Pyrmont compared with the Approved Project during morning peak times
- A minor increase in the average delay at key intersections affected by the proposed modified project. The most notable would be some deterioration in performance at the intersection of The Crescent/City West Link (from D to E) during afternoon peak times because of greater conflicting movements. Many other intersections would operate at an improved level of performance
- No changes to impacts associated with parking or public transport
- The proposed modified project would result in improved connectivity for active transport with the expected completion of the M4-M5 link connection works.

Warringah Freeway and surrounds (as relevant to the Ridge Street North construction support site):

- The intersection of Miller Street and Ridge Street would continue to perform at a satisfactory LoS in both the AM and PM peak period
- The increase in on-site parking would increase light vehicle movements on Ridge Street by around 230 vehicles per day. The increase is not expected to generate any impact on the surrounding road network and would help minimise worker parking on local roads in the area
- Potential parking impacts would be less for the proposed modified project when compared with the Approved Project
- No changes to impacts on public transport or active transport
- Very minor impacts during special events.

It is also noted that the proposed modified project would remove all traffic and transport impacts associated with the construction support sites located in or around Sydney Harbour, as well as the removal of all maritime traffic impacts.

8.1.6 Environmental management measures

The impacts to construction traffic and transport for the changes to tunnelling and Sydney Harbour crossing works would be generally consistent with those identified in the Project EIS.

A number of EMMs associated with the IMT construction method would no longer be required. This would comprise:

- Marine works and marine traffic management plans
- CTT2, CTT3, CTT14, CTT15, CTT16, CTT17, CTT18 – as they relate to maritime construction impacts.

No further EMMs or changes to construction traffic EMMs would be required.

A number of Conditions of Approval would no longer be required. This would comprise:

- Condition of Approval E131 – which relates to vehicle access to Yurulbin Point
- Condition of Approval E134 - which relates to maximising removal of spoil by non-road methods
- Condition of Approval E151/E152 – relates to impacts on Birchgrove Ferry.

Further details are provided in Chapters 11 and 12.

No further amendments to the Minister's Conditions of Approval as they relate to construction traffic and transport would be required.

8.2 Operational traffic and transport

This section considers the potential operational traffic and transport impacts of the proposed modified project and identifies measures to address these impacts. A detailed traffic and transport assessment has been carried out for the project and is included in Appendix E (Technical working paper: Traffic and transport - operation).

8.2.1 Assessment methodology

The assessment methodology in the EIS for operational traffic and transport impacts considered four components:

- Road traffic
- Public transport
- Pedestrian and cyclists (active transport)
- Maritime traffic.

The proposed modified project would only impact on the road traffic component as a result of small changes in tunnel grade and tunnel alignment. The other core components considered in the Project EIS would not be materially changed by the modified activity and therefore no further assessment has been undertaken. Potential impacts on maritime traffic would be entirely removed by the proposed modification.

As changes associated with the proposed modified project are limited to minor grade and alignment changes, the operational traffic assessment only considers the relative traffic performance metrics that relate to the tunnel. There are no changes to the surface road network associated with the proposed modified project.

The method and outputs for the road traffic assessment is summarised in Table 8-17.

Table 8-17 Overview of approach to the operational traffic and transport assessment for the proposed modified project

Project Impacts	Method of assessment	Assessment output
Road Traffic	Analysis of operation road traffic requirements in comparison to the approved traffic impacts.	Quantitative assessment of road traffic requirements against the road performance and resulting impacts as described in the EIS.

Operational traffic modelling scenarios

The traffic model used for the proposed modified project followed the same approach as the Approved Project. This included use of the Approved Project model boundary, traffic profiles and demands, assessment periods

and assessment criteria. The proposed modified project models used the modelling parameters in accordance with criteria established by Transport for NSW.

Future year networks and traffic demands were developed for 2037 (year of opening plus 10 years) to assess future traffic network performance. Future performance was assessed for the AM peak (7am to 9am on a normal working weekday) and PM peak (4pm to 6pm on a normal working weekday) for the following scenarios:

- With the project ('Do something') (2037 interim state – without Beaches Link)
- With the proposed modified project and other planned or proposed projects ('Do something cumulative) (2037 ultimate state – with Beaches Link).

Assessment criteria

The criteria used to assess the operational traffic and transport impacts of the proposed modified project compared to the Approved Project was mid-block LoS in accordance with The Guide to Traffic Generating Developments Version 2.2 (RTA, 2002) refer Table 8-2 above.

8.2.2 Existing environment

The existing traffic and transport environment as relevant to the proposed modified project is described in Section 8.1

8.2.3 Assessment of potential impacts

The traffic model was updated using the proposed modified project design to determine whether changes in the horizontal and vertical alignments of the mainline tunnels would significantly change the outcomes of the traffic performance in terms of the LoS.

The road traffic performance comparison focussed on the future traffic performance (2037) rather than at the year of opening with the following scenarios modelled:

- Interim State 2 (2037, with WFU and WHT only, without BL) AM and PM
- Ultimate State (2037, with WFU, WHT and BL) AM and PM

From these scenarios the following one-hour peak periods were assessed:

- 08:00AM – 09:00AM
- 04:00PM – 05:00PM.

Assessment outcomes

The LoS at key mid-block locations as assessed in the Project EIS compared to the proposed modified project for the Interim and Ultimate State for 2027 and 2037 for the AM and PM peak are shown in Table 8-18 to Table 8-21. These tables summarise the midblock LoS and density (shown in brackets) of the motorway segments.

Table 8-18 2027 Mid-block LOS AM Peak - Project EIS compared with proposed modified project.

Location		2027 Interim State		2027 Ultimate State	
		Project EIS	Proposed modified project	Project EIS	Proposed modified project
Western Harbour Tunnel (Main Carriageway) NB		C (14.2)	D (18)	D (18.8)	D (19.2)
Western Harbour Tunnel (Main Carriageway) SB		C (14)	C (15.9)	D (19.3)	D (20)
Warringah Freeway to WHT On-Ramp		B (10.2)	C (13.2)	C*(12.1)	C (11.1)
WHT to Warringah Freeway Off-Ramp		B* (9.9)	C (13.7)	C (14.8)	C (11.9)
Rozelle On-Ramp	Two lanes	C (13.5)	A (6.5)	C (12.5)	B (7.1)
	One lane		C (12.8)		C (13.9)
Rozelle Off-Ramp		C (11.1)	B (9.8)	C (13.3)	C (11.9)
M4-M5 Link On-Ramp		B* (10)	C (13.9)	C (14.7)	C (14.8)
M4-M5 Link Off-Ramp		A* (6.5)	B (9.1)	B *(12.7)	C (11.6)

* updated Level of Service (LOS) reported based on the density value achieved in the Project EIS model

Table 8-19 2027 Mid-block LOS PM Peak - Project EIS compared with proposed modified project.

Location	2027 Interim State 2		2027 Ultimate State	
	Project EIS	Proposed modified project	Project EIS	Proposed modified project
Western Harbour Tunnel (Main Carriageway) NB	C (12)	C (14.7)	D (17.5)	D (17.3)
Western Harbour Tunnel (Main Carriageway) SB	B (10.1)	C (11.4)	C (13.5)	C (14)
Warringah Freeway to WHT On-Ramp	B (10.8)	A (6.9)	C* (13.1)	A (6.9)
WHT to Warringah Freeway Off-Ramp	B (8.7)	C (11.7)	B* (10)	B (10.8)
Rozelle On-Ramp - Two lanes	B (10)	A (4.9)	C (11.4)	A (5.8)
Rozelle On-Ramp - One lane	B (10)	B (9.3)	C (11.4)	C (11.4)
Rozelle Off-Ramp	A (5.3)	A (4.3)	A (6.1)	A (5.3)
M4-M5 Link On-Ramp	B (8.7)	C (11.6)	C (14)	C (13.7)
M4-M5 Link Off-Ramp	B (7.9)	B (8.5)	B (11)	B (10.4)

* updated Level of Service (LOS) reported based on the density value achieved in the Project EIS model

Table 8-20 2037 Mid block LOS AM Peak - Project EIS compared with proposed modified project

Location	2037 Interim State 2		2037 Ultimate State	
	Project EIS LoS (Vehicle density)	Proposed modified project LoS (Vehicle density)	Project EIS LoS (Vehicle density)	Proposed modified project LoS (Vehicle density)
Western Harbour Tunnel (Main Carriageway) NB	D (19.6)	E (22.9)	E (24.3)	E (24.6)
Western Harbour Tunnel (Main Carriageway) SB	D (19)	D (19.8)	E (24.5)	E (24.5)
Warringah Freeway to WHT On-Ramp	C (15.1)	D (17.7)	C (15.5)	C (13.8)
WHT to Warringah Freeway Off-Ramp	C (15.3)	D (18.9)	D (18.1)	D (16)
Rozelle On-Ramp – Two lanes	D (20.2)	B (8.5)	D (17)	B (9.4)
Rozelle On-Ramp – One lane	D (20.2)	D (17.2)	D (17)	D (18.9)
Rozelle Off-Ramp	D (17.3)	C (13.2)	D (19.1)	D (16.4)
M4-M5 Link On-Ramp	C (13.7)	D (17.4)	D (18.8)	D (18.7)
M4-M5 Link Off-Ramp	B (10.4)	B (10.6)	C (15.2)	C (13)

Table 8-21 2037 Mid block LOS PM Peak - Project EIS compared with proposed modified project

Location	2037 Interim State 2		2037 Ultimate State	
	Project EIS LoS (Vehicle density)	Proposed modified project LoS (Vehicle density)	Project EIS LoS (Vehicle density)	Proposed modified project LoS (Vehicle density)
Western Harbour Tunnel (Main Carriageway) NB	C (14.3)	D (17.2)	D (21.1)	D (20.8)
Western Harbour Tunnel (Main Carriageway) SB	C (14)	C (14.5)	D (18.5)	D (17.8)

Location	2037 Interim State 2		2037 Ultimate State	
	Project EIS LoS (Vehicle density)	Proposed modified project LoS (Vehicle density)	Project EIS LoS (Vehicle density)	Proposed modified project LoS (Vehicle density)
Warringah Freeway to WHT On-Ramp	C (13.5)	B (10.2)	C (16.4)	B (10.1)
WHT to Warringah Freeway Off-Ramp	C (11.3)	C (13.7)	C* (13.2)	C (12.4)
Rozelle On-Ramp - Two lanes	C (13.2)	A (6.5)	C (15.6)	B (8.1)
Rozelle On-Ramp - One lane	C (13.2)	D (12.7)	C (15.6)	D (16.2)
Rozelle Off-Ramp	B (7.6)	A (5.5)	B (8.8)	A (6.8)
M4-M5 Link On-Ramp	B (10.1)	C (13)	D (16.4)	C (15.8)
M4-M5 Link Off-Ramp	B (10.9)	B (10.8)	C (15)	C (13.1)

* updated Level of Service (LOS) reported based on the density value achieved in the Project EIS model

The results indicate that the proposed modified project would perform very similar to the Approved Project with some exceptions where there would be some minor reductions and improvements in performance. Some of these minor changes can also be attributable to the sensitivity of the traffic modelling process. Further details are provided in Appendix E: (Technical Working Paper: Traffic and transport - operation).

8.2.4 Assessment summary

The proposed modified project is expected to result in very minor changes (both positive and adverse) when compared to the Approved Project. Some of these minor changes can also be attributable to the sensitivity of the traffic modelling process.

8.2.5 Environmental management measures

The impacts to operational traffic and transport for the changes to tunnelling and Sydney Harbour crossing works would be generally consistent with those identified for the Approved Project. No further environmental management measures are considered necessary beyond those identified for the Approved Project. No amendments to the Minister's Conditions of Approval as they relate to operational traffic would be required.

8.3 Construction noise and vibration

This section provides an assessment of the potential construction noise and vibration impacts associated with the proposed modified project. It also outlines potential indirect impacts of noise and vibration on biodiversity, Aboriginal and non-Aboriginal heritage items.

A detailed noise and vibration assessment has been carried out for the project and is included in Appendix F1 (Technical Working Paper: Construction noise and vibration–TBM).

8.3.1 Assessment methodology

The noise and vibration impact assessment focused on the following activities of the proposed modified project:

- Construction noise assessment for the proposed changes to the Glebe Island construction support site (WHT3).
- Construction noise assessment associated with the proposed changes to the Ridge Street North construction support site (WHT9).
- Ground borne noise and vibration assessment for TBM and roadheader tunnelling works including the mainline tunnels, launch and receival chambers and cross-passages.
- Construction traffic noise from the City West Link Portal construction support site (WHT12).

Approach

The methodology for the assessment of noise and vibration impacts for the proposed modified project is as used for the Approved Project. This included the key following steps:

- Identification of noise sensitive receivers and noise catchment areas.
- Development of a study area for the assessment, including construction traffic noise.
- Background noise monitoring to determine existing noise levels.
- A construction noise assessment to predict noise levels that may be generated by the project, including airborne noise, ground-borne noise, and vibration.
- Identification of environmental management measures to avoid, minimise and manage noise and vibration impacts during construction of the project, including initial identification of potential noise barrier requirements and areas where at property treatments may need to be considered.

Standards and guidelines

The standards and guidelines relevant to the project as outlined in the Project EIS are described in Table 8-22. These requirements aim to protect the community and environment from excessive noise impacts during construction and operation of projects.

Table 8-22 Applicable noise and vibration standards and guidelines

Guideline/ Policy name	Where Guideline is used
Interim Construction Noise Guideline (ICNG) (DECC, 2009)	Assessment of construction noise impacts on sensitive receivers
Construction Noise and Vibration Guideline (CNVG) (Roads and Maritime Services[1], 2016)	Assessment and management protocols for noise and vibration impacts
Road Noise Policy (RNP) (DECCW, 2011)	Assessment of construction traffic impacts
Noise Policy for Industry (NPfI) (NSW EPA, 2017)	Assessment of operational noise impacts on sensitive receivers and measurement of existing noise environment
Assessing Vibration: A Technical Guideline (DEC, 2006)	Assessment of vibration for human exposure
BS 7385 Part 2-1993 – Evaluation and measurement for vibration in buildings Part 2	Assessment of vibration for building damage
DIN 4150-3 Structural Vibration – effects of vibration on structures	Assessment of vibration for damage of unsound heritage items

Assessment objectives and criteria

The construction noise and vibration assessment objectives and criteria applied to the proposed modified project are consistent with those used for the Approved Project and included criteria for:

- Air borne noise – residential (including sleep disturbance), non-residential sensitive receivers
- Ground-borne noise – residential and other sensitive receivers
- Vibration – structural
- Vibration – human comfort.

Further details are provided in Appendix F1 (Technical Working Paper: Construction noise and vibration–TBM).

Noise modelling

SoundPlan v 8.1 noise modelling software was used to calculate noise impacts in accordance with the ISO9613 prediction method at all identified noise-sensitive receivers. The model included:

- Topography – 1 metre DEM based on LPI Lidar data
- Noise contours modelled at 1.8 metres height and grid spacing 20 metres
- Single point predictions calculated at 1.5 metres above ground and 1.5 metres above each floor for multi-storey buildings
- Individual buildings and floor heights were incorporated in the model to account for shielding and reflections. Building heights were also taken from Lidar data
- Meteorology – worst-case conditions: gentle breeze (3-5 m/s) source to receiver and stable conditions (conducive of temperature inversion).

8.3.2 Existing environment

The proposed modified project is not expected to increase the number or change the distribution of sensitive receivers impacted by construction. Accordingly, the existing noise environment including background noise levels outlined in the Project EIS would still be relevant for the proposed modified project.

Noise catchment areas (NCAs)

The Project EIS established the location and type of noise sensitive receivers near to the tunnel alignment and construction support sites using a combination of aerial photography and visual inspections. These noise sensitive receivers were then grouped into noise catchment areas (NCAs) along the project alignment. The NCAs in the vicinity of the tunnel and surrounding the Glebe Island construction support site (WHT3) are shown in Figure 8-6 and Figure 8-7.

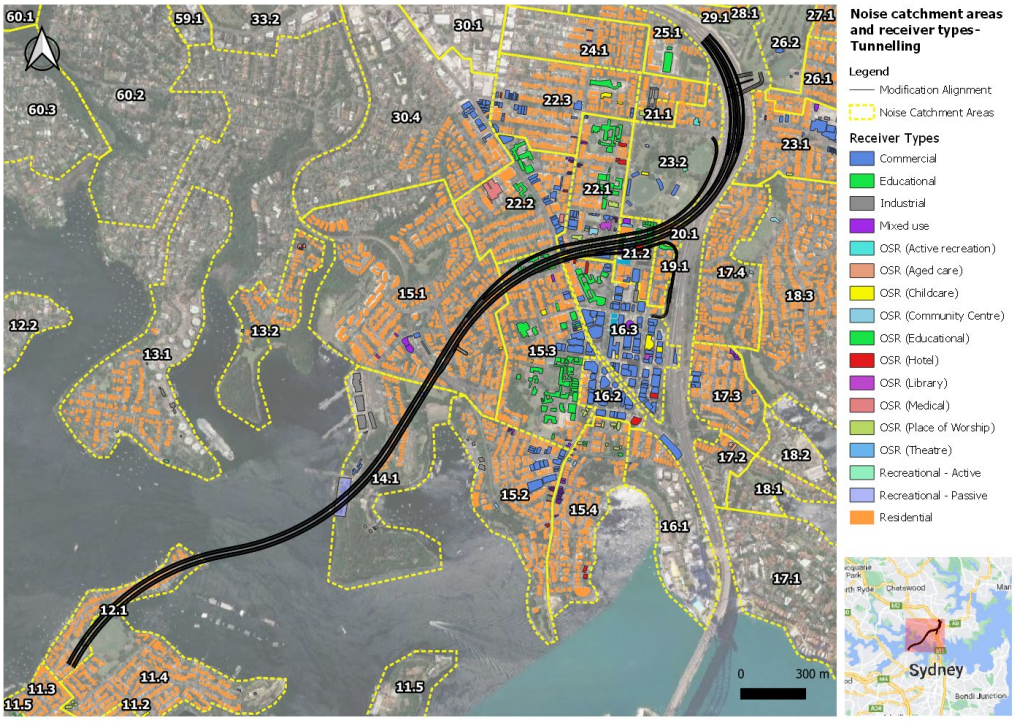


Figure 8-6 Noise Catchment Areas (NCAs) in the vicinity of the Approved Project tunnel alignment.

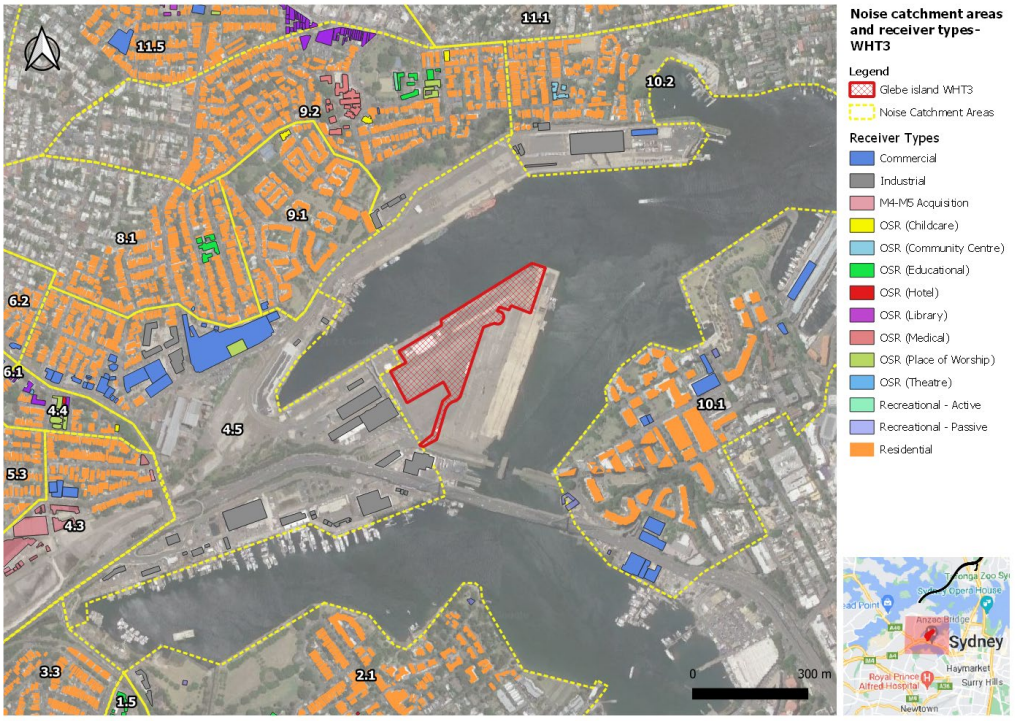


Figure 8-7 NCAs surrounding Glebe Island construction support site (WHT3)

Noise monitoring was carried out during the preparation of the Project EIS at 41 locations between June 2017 and November 2017 to establish the existing background noise levels within each of the noise catchment areas. Noise management levels (NMLs) were then determined for each NCA.

Table 8-23 presents the NMLs for the assessment of impacts for each NCA associated with construction activities as relevant to the proposed modified project.

Table 8-23 Noise management levels for assessed noise catchment areas – proposed modified project

NCA ID	Reference suburb (-sub area)	Noise management level (NML) LAeq(15min)				Screening level
		Standard Hours (RBL + 10 dB)	Outside standard hours: Out of Hours Work (OOHW) (RBL + 5 dB)			LAmax (RBL + 15 dB)
		Day	Day	Evening	Night	Night
2.1	Glebe	61	56	56	50	60
4.5	Rozelle	62	57	57	50	60
9.1	Balmain	59	54	54	51	61
9.2	Balmain	59	54	54	51	61
10.1	Pyrmont	58	53	50	49	59
10.2	Balmain east	58	53	50	49	59
11.3	Birchgrove	50	45	45	42	52
11.4	Birchgrove	50	45	45	42	52
11.5	Balmain	50	45	45	42	52
12.1	Birchgrove	56	51	50	45	55
14.1	Waverton	51	46	42	38	48
15.1	Waverton	52	47	46	43	53
15.3	North Sydney - south west	52	47	46	43	53
16.3	North Sydney - south west	70	65	65	55	65
17.4	Neutral Bay	65	60	59	50	60
19.1	North Sydney - north west	62	57	57	50	60
20.1	North Sydney - north west	62	57	57	50	60
21.2	North Sydney	63	58	54	46	56
22.1	North Sydney	62	57	52	41	51
22.2	Wollstonecraft	62	57	52	41	51
23.2	North Sydney	71	66	59	49	59

8.3.3 Assessment of potential impacts

Glebe Island construction support site

The Glebe Island construction support site (WHT3) would be used for construction staging, logistics, storage and transport of major plant and equipment to support TBM tunnelling. Several activities proposed to take place during the daytime period have already been assessed as part of the Approved Project.

The following activities have been assessed to take place 24 hours, 7 days per week at the site:

- Laydown and storage of pre-cast segments for contingency. Most of the segments will be transported directly into the tunnel from the pre-cast facility, however, if this supply is interrupted, segments will be sourced from the contingency stockpile at Glebe Island
- Shift change and worker transport to and from the site
- Parking and amenities for workers.

The purpose of this assessment is to determine whether the already approved activities can continue to operate below the NMLs for the extended construction hours.

The proposed plant and equipment that would be potentially operating during out of hours (OOHW) for the Glebe Island construction support site (WHT3) are summarised in Table 8-24 .

Table 8-24 Plant and equipment expected to operate out of hours at the Glebe Island construction support site (WHT3)

Equipment	Quantity	Sound Power Level, dBA LA_{eq}
Delivery trucks	4 per hour	103
Mobile crane in storage area	1	98
Light vehicles (parking)	Around 300 car spaces	64

Impact assessment

The predicted noise impacts, depicted by way of noise contours, are shown Figure 8-8 below. The predicted levels are compared to the NMLs to determine the potential impact from the Glebe Island construction support site (WHT3).

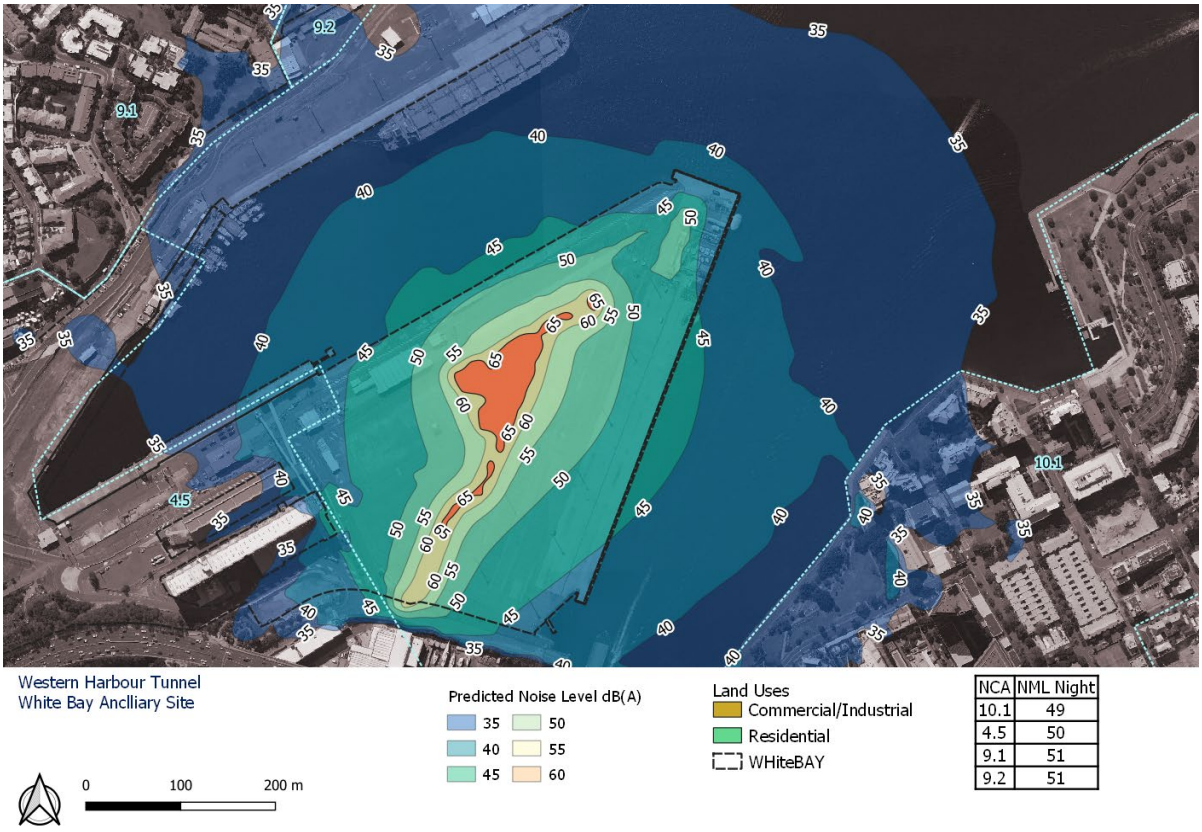


Figure 8-8 Glebe Island construction support site (WHT3) - predicted noise levels.

The assessment of potential noise impacts from the OOHW activities within surrounding NCAs (as listed above) against the criteria is shown in Table 8-25.

Table 8-25 Predicted noise levels at the Glebe Island construction support site (WHT3)

NCA ID	Noise Management Levels $L_{Aeq(15min)}$				Sleep Disturbance Screening Levels	Highest predicted noise level at a sensitive receiver		Compliant
	Standard Hours (RBL +10dB)	Outside standard hours: Out of Hours Work (OOHW) (RBL +5 dB)			L_{AMAX} (RBL +15 dB)			
	Day	Day	Evening	Night	Night	L_{Aeq}	L_{Amax}	
2.1	**61**	**56**	**56**	**50**	**60**	34	39	Y
8.1	**52**	**47**	**47**	**43**	**53**	34	39	Y
9.1	**59**	**54**	**54**	**51**	**61**	37	42	Y
9.2	**59**	**54**	**54**	**51**	**61**	37	42	Y
10.1	**58**	**53**	**50**	**49**	**59**	41	46	Y
10.2	**58**	**53**	**50**	**49**	**59**	36	41	Y

Predicted levels indicate noise during the OOHW periods would meet the NML for receivers in all nearby NCAs and specifically in NCA 10.1, having the most stringent night-time criteria, with an LAeq predicted noise level of 41 dB(A) for the closest receivers in Refinery Drive.

With no significant noisy activities being carried out in this location, the maximum (LAmax) predicted noise level for the compound in NCA 10.1 is 46 dB(A). This level of noise impact is below the sleep disturbance screening criteria of 59 dB(A).

The impact assessment above indicates that the Glebe Island construction support site (WHT3) would be able to operate within its NMLs and therefore meet the requirements outlined in the Minister's Conditions of Approval.

Further details are provided in Appendix F1 (Technical Working Paper: Construction noise and vibration - TBM).

Related construction traffic noise impacts

The City West Link Portal (WHT12) at the Rozelle interchange will be utilised as an access route for both light and heavy vehicles, the majority of which will comprise spoil movements from the tunnel works. Heavy vehicle movements from this site have already been approved for the Project. To appropriately support the TBM tunnelling, this site would require an increase in heavy vehicle movements beyond what is currently been approved along with spoil haulage 24 hours a day, seven days a week. This increase in traffic movements for 24/7 access is the only activity that requires assessment for this site.

As this location has the potential to increase noise levels close to residential locations in Railway Street opposite the portal, an initial traffic screening assessment has been completed to determine the magnitude of any increase in traffic noise. The screening assessment is applied to assess whether impacts are below the noise criteria guideline (NCG) level of 2 dB for noticeable noise level increase.

The initial screening test indicates that maximum daily construction traffic movements are unlikely to result in a noticeable increase (greater than 2 dB) in the day or night-time LAeq noise levels at receivers adjacent to the City West Link Portal (WHT12). In addition, many of the potentially impacted residential locations have already received noise treatments as the result of previous road upgrade and project works. It is expected that these residences would not be adversely affected by the marginal increase in noise levels resulting from construction vehicles accessing the City West Link Portal (WHT12).

Regarding potential night-time maximum noise events, construction traffic on the major roads is unlikely to significantly increase the number of maximum noise events due to the relatively high existing traffic volumes on these roads.

The traffic management plan and site inductions would cover instructions for operation of vehicles entering and leaving the sites to minimise noise. Truck marshalling areas, where required, would be located away from residences where possible to minimise noise impacts due to trucks idling near the sites.

Concurrent and consecutive construction projects

The nearest construction support site associated with this project is the City West Link Portal construction support site (WHT12), around 1 kilometre south-west of this site.

The nearest major infrastructure project is the Sydney Metro Project, with a construction support site located at White Bay adjacent to Port Access Road, approximately 400 metres west. Works within the former Rozelle

Rail Yards associated with the M4-M5 Link are expected to be complete by the end of 2023 and as such will not overlap with the use of the Glebe Island construction support site (WHT3).

Due to the large distance between the Glebe Island construction support site (WHT3) and the Sydney Metro works and high background traffic noise environment due to the proximity of the Anzac Bridge, it is unlikely that any cumulative impacts from the operation of both sites would occur.

Ridge Street North construction support site

The Ridge Street North construction support site (WHT9) is one of three approved construction support sites located north of the Sydney Harbour associated with the Approved Project. The following activities were assessed in the Project EIS for this site:

- Site establishment and tunnel structure works
- Road integration works
- Earthworks (including cut and cover excavation).

The proposed changes would relate to the installation of an acoustic shed to facilitate the loading of spoil and tunnelling supporting facilities, including spoil truck movements for 24/7 construction. Concrete deliveries and other tunnelling support activities would also be required outside standard hours. All heavy vehicle movements would exit to and enter from the Warringah Freeway.

Sources of noise associated with the proposed changes at the Ridge Street North construction support site (WHT9) would be:

- Ventilation fans
- Trucks hauling spoil from the tunnel
- Front end loader and excavator managing the spoil stockpile
- Spoil haulage vehicles removing spoil from the site.

Estimated sound power levels for the equipment and plant proposed to operate within the acoustic shed are summarised in Table 8-26.

Table 8-26 Summary of equipment sound power levels estimates – Ridge Steet north construction support site (WHT9)

Equipment	Sound Power Level (LAeq, 15 minute)	Additional mitigation
Ventilation fans	85 (silenced fan)	Operates within air intake plenum above cut and cover
Substation	85	Located inside substation building
Moxies (trucks) (4 per hour)	107	Within cut and cover section of tunnel attached to the acoustic shed
Front end loader and excavator	108	Operates within the acoustic shed
Water Treatment plant	82	Package plant with low noise footprint
Spoil trucks (4 per hour)	105	Accessed via Warringah Freeway and loaded inside acoustic shed

Impact assessment

The nearest sensitive receivers are residential apartment buildings located to the south on Ridge Street. The site also adjoins the Greens Bowling club to the north and the Warringah Freeway to the south.

Predicted noise levels from noise modelling are presented in noise contours in Figure 8-9 and Table 8-27. The predicted levels are compared to the NMLs to determine the potential impacts.

Noise modelling for the Ridge Street North construction support site (WHT9) was carried out for the operational scenario covering 24-hour spoil stockpiling and haulage via Warringah Freeway. Predicted noise levels at each floor of nearby receiver locations were modelled to determine compliance with the NML for each affected NCA.

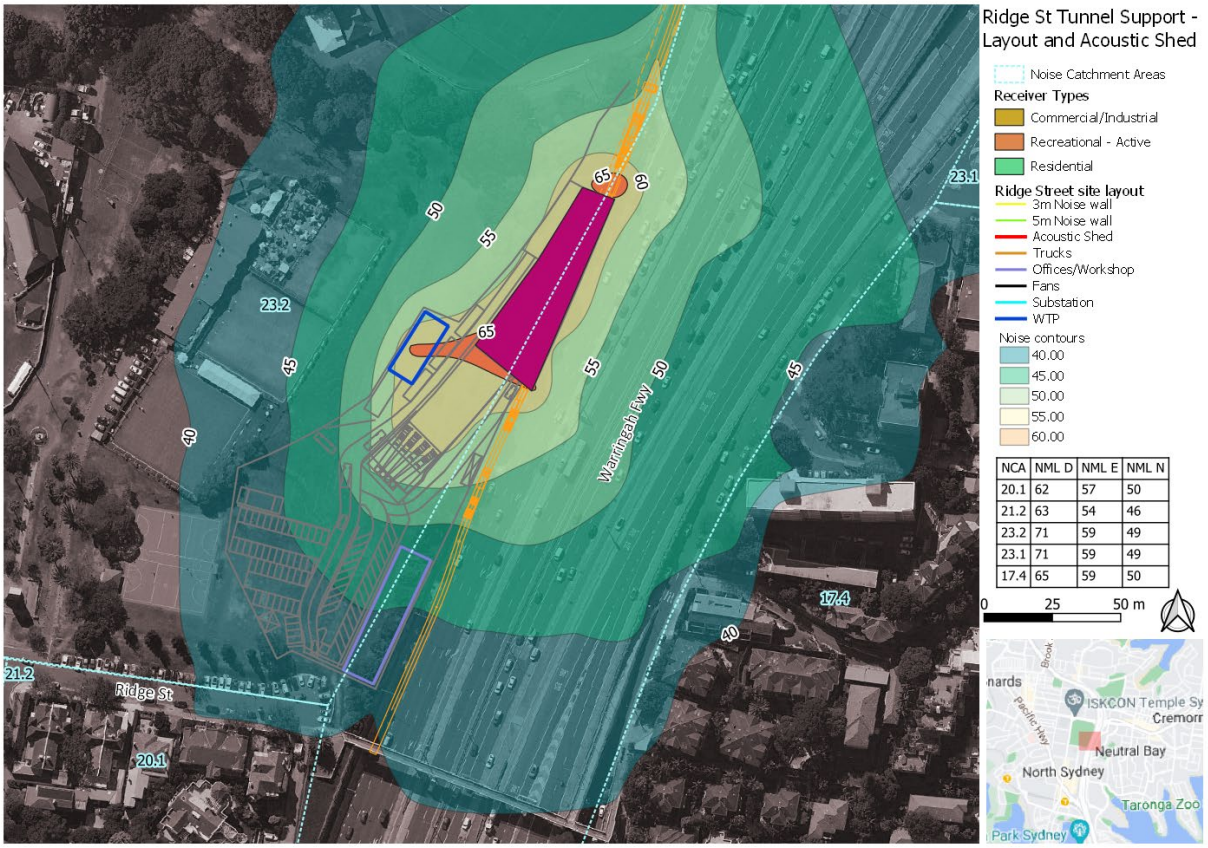


Figure 8-9 Predicted noise level contours - Ridge Street North construction support site (WHT9).

Table 8-27 Predicted noise levels - Ridge Street North construction support site (WHT9)

NCA ID	Noise Management Levels $L_{Aeq(15min)}$				Sleep Disturbance Screening Levels	Highest predicted noise level at a sensitive receiver		Compliant
	Standard Hours (RBL +10dB)	Outside standard hours: Out of Hours Work (OOHW) (RBL +5 dB)			L_{AMAX} (RBL +15 dB)			
	Day	Day	Evening	Night	Night	L_{Aeq}	L_{Amax}	
17.4	**65**	**60**	**59**	**50**	**60**	46	51	Y
20.1	**62**	**57**	**57**	**50**	**60**	41	46	Y
21.2	**63**	**58**	**54**	**46**	**56**	34	39	Y
23.1	**71**	**66**	**59**	**49**	**59**	40	45	Y
23.2	**71**	**66**	**59**	**49**	**59**	41	46	Y

With works inside the acoustic shed at night, no receivers would experience noise levels above their nominal night-time NML. In addition, there are no sleep disturbance impacts predicted for these activities.

The highest predicted noise level for the proposed construction compound is 46 dBA in NCAs 20.1 and 23.2. Noise contours providing a graphical indication of these noise impacts at 4.5 metres above ground (similar to the second storey of a residential building) are also shown in Figure 8-9.

Predicted noise from operation within the acoustic shed and associated infrastructure demonstrates that the works would be of low impact on the community and at lower levels than identified in the Project EIS for similar activities outside the shed.

Related construction traffic noise impacts

Heavy vehicle movements related to the Ridge Street North construction support site (WHT9) site would comprise of deliveries of materials and equipment as well as spoil haulage during excavation. Construction traffic servicing the Ridge Street North construction support site (WHT9) would exit the site via the Warringah Freeway and use the Falcon Street off ramp travelling west along Falcon Street to access the Pacific Highway. This would be a one-way movement as there would be no return path back to the site from Falcon Street.

Spoil haulage is expected to be up to 100 one-way vehicle movements per day with the spoil haulage generally restricted to the 15-hour day-time traffic noise assessment period (between 7:00am and 10:00 pm). Where delays to spoil haulage occur, there would also be the need to carry out some spoil removal during the night however, night-time truck movements would be restricted to around 5 trucks per hour with a total of 45 movements during any 9-hour night-time assessment period.

Construction traffic impacts are assessed against a screening assessment for potential traffic noise increases above the NCG 2 dB(A) criterion. Below this threshold, impacts are considered to be within an acceptable range, while an increase of greater than 2 dB(A) would trigger a more detailed study of changes to the existing traffic noise levels.

The assessment indicates that traffic noise levels would increase by around 0.5 dB(A) and would therefore meet the NCG requirements for acceptable construction traffic noise impacts. Further details are provided in Appendix F1 (Technical Working Paper: Construction noise and vibration - TBM).

Mainline tunnelling and cross passages

The proposed modified project would result in some changes to the mainline tunnelling and cross passages. An assessment has been carried out to compare predicted noise and vibration levels with the Approved Project.

The main sources of ground-borne noise and vibration would be construction of:

- Mainline tunnels – utilising a TBM for the harbour crossing and roadheaders.
- Cross passages and caverns – Rock hammer, roadheader and rock bolting rig.

This Modification Report presents changes to the mainline tunnelling and cross passages from the most recent design and compares the predicted noise and vibration levels to the Project EIS predictions to demonstrate that the scale of change. It is important to note that construction of cross passages and roadheader mainline tunnelling are approved activities under the existing Project Approval.

Assessment of ground borne noise impacts

Ground borne noise and vibration levels are predicted by calculating the closest distance between the tunnel or cross passage and receiver location, then converting the 3-dimensional slant distance to ground borne

noise or vibration level-based on industry standard relationships between distance and level of impact. Further details regarding ground borne noise and vibration modelling are provided Appendix F1 (Technical Working Paper: Construction noise and vibration - TBM).

Mainline tunnelling

Excavation of the twin mainline tunnels using TBMs and roadheaders may potentially result in audible ground-borne noise at a number of receiver locations along the alignment. Noting that the change in alignment is minor, the receivers potentially affected by ground borne noise would not change from those assessed in the Project EIS.

TBM mainline tunnelling

The majority of receivers potentially impacted by the TBMs are concentrated in the Birchgrove area where the TBM will traverse along Louisa Road, Birchgrove between an approximate depth of 40 metres to 50 metres (top of tunnels) with only limited receivers located between Balls Head and the receival chamber.

The numbers of potentially ground borne noise affected properties during TBM mainline tunnel excavation are summarised in Table 8-28 listed by NCA to indicate the higher risk portions of the tunnel alignment. Table 8-28 also presents the ground borne noise impacts predicted for the same NCAs during roadheader and rock hammer tunnelling in the Project EIS.

Table 8-28 Number of receivers expected to exceed NMLs for ground borne noise for TBM excavation tunnel excavation for the proposed modified project in comparison with the Approved Project

NCA	Proposed modified project (TBM excavation) – potential number of receivers impacted)			Project EIS Roadheader tunnelling – potential number of receivers impacted			Project EIS Rock-hammer tunnelling – potential number of receivers impacted		
	>35-40 dBA	>40-45 dBA	>45 dBA	>35-40 dBA	>40-45 dBA	>45 dBA	>35-40 dBA	>40-45 dBA	>45 dBA
11.3	-	-	-	-	-	-	**129**	**41**	-
11.4	-	-	-	-	-	-	**24**	**22**	**7**
12.1	**71**	-	-	-	-	-	**28**	**42**	**105**
14.1	-	-	-	**4**	-	-	**4**	**8**	**9**

Table 8-28 indicates:

- For the proposed modified project, there would be no exceedance of the ground borne noise NMLs at NCA 11.3, 11.4 and 14.1. This compares to a substantial number of exceedances in these NCAs for the Approved Project. The change and reduction of impact is due to the deeper tunnel alignment through this section.
- The number of exceedances at NCA 12.1 would be reduced from 175 receivers to 71 with the proposed modified project. Of the 71 predicted exceedances, the majority are predicted to be less than 1-2 dB above the night-time management level of 35 dBA.

As the TBM would progress at up to 50 metres per day, any exceedance of the night-time ground borne noise NML would only be expected for around 2 days depending on the depth. This is a significantly shorter impact duration compared to use of a roadheader or rock hammer as is proposed for the Approved Project. The other tunnelling methods generally progress at 20 metres per week leading to a longer impact duration. As the two TBMs will be launched within weeks of each other, cumulative impacts are not likely to occur. Some sensitive receivers may experience similar impacts to those characterized above a second time owing to the later launch of the second TBM.

Mainline roadheader excavation

Roadheader tunnelling from the Warringah Freeway would pass beneath residences located in North Sydney and Waverton at depths between 28 metres and 60 metres. The alignment is predominantly commercial premises and high rise residential, with some free-standing residential dwellings.

Roadheader construction consistent with the Approved Project would occur for all tunnel sections including the launch and receival chambers other than the TBM crossing. The tunnel alignment would be similar to the Approved Project and therefore a change in impact is not expected from what was previously assessed.

The number of residences potentially affected by ground borne noise when roadheader excavation of the proposed modified project is carried out during OOHW are summarised in

Table 8-29.

Table 8-29 Number of receivers expected to exceed the NMLs for ground borne noise for mainline roadheader excavation for the proposed modified project in comparison with the Approved Project

Corresponding NCAs	Proposed modified project Road-header tunnelling - receivers above NMLs			Project EIS Roadheader tunnelling – receivers above NMLs		
	>35-40 dBA	>40-45 dBA	>45 dBA	>35-40 dBA	>40-45 dBA	>45 dBA
14.1	-	-	-	**4**	-	-
15.1	-	**4**	-	**9**	-	-
15.3	-	-	-	-	-	-
16.3	-	-	-	-	-	-
17.4	-	-	-	-	-	-
19.1	-	**2**	-	**1**	**1**	-
20.1	-	**9**	-	**1**	-	-
21.2	-	**2**	-	**7**	-	-
22.1	-	-	-	-	-	-
22.2	-	-	-	-	-	-
23.1	-	-	-	-	-	-
23.2	-	-	-	-	-	-
Total	**0**	**17**	**0**	**22**	**1**	**0**

When tunnelling in the evening or night, the predicted number of receivers above the applicable ground-borne noise management level (GB NML) is low, at around 17 locations, with the night-time exceedances in the range of 10 – 20 dB above the NML. Impacts would be centred in the Waverton and North Sydney Areas where tunnelling works are closest to the surface. However, as tunnelling is progressive, not all impacts would occur at the same time. Given the expected progression of the roadheader is around 20 metres per week, the duration of the maximum impact would be reasonably short lived, however longer than what is expect of the TBM.

Additional mitigation measures as described in Appendix F1 (Technical working paper: Construction noise and vibration – TBM), such as respite offers / alternative accommodation, would be offered to receivers predicted to experience ground-borne noise levels greater than 10 dB above the GB NML.

Mainline tunnel rock drilling and bolting

As noted in the Project EIS, tunnelling works that use the roadheader method of construction would also require rock drilling and bolting to stabilise the roof of the tunnel.

A quantitative assessment has been carried out as part of the noise and vibration technical paper prepared for the proposed modified project and is presented in Appendix F1 (Technical Working Paper: Construction noise and vibration - TBM).

The assessment indicates that drilling during the evening or night periods would lead to potential exceedances of the ground borne NML at around 52 locations in the combined >35-45 dBA range at night, and seven exceedances above the >45 dBA NML. These impacts would also be centred on the Waverton and North Sydney areas similar to the roadheader impacts. Impacted residents may be eligible for alternative accommodation where these works occur outside standard construction hours.

Cross passages

The Project EIS identifies cross passages joining the north bound and south bound tunnels at a spacing of around 120 metres. The Project EIS assessed the noise and vibration impacts of constructing the cross passages by incorporation in the assessment of the mainline tunnelling. For the proposed modified project, a separate assessment of the noise and vibration impacts of the cross passages has been carried out.

The cross-passage excavation would be by either roadheaders or rock hammers and would take place in both standard and OOWH periods. Excavation with rock hammers during night-time periods would be avoided where possible. Where excavation with rock hammers during night-time periods is required, the specific location of any proposed hammering would be further assessed to ensure potential impacts are –limited to not exceed the Highly Intrusive criteria.

The assessment indicates that for OOHW using a 1000kg rock breaker, there would be around 7 receiver locations impacted between 1 and 10 dB above the NML. During the night, with lower NMLs, around 72

receivers would fall into the 0-10 dB exceedance category and there would be no receivers in the 10-20 dB exceedance category. Exceedances are generally predicted across the alignment between Birchgrove and the end of tunnelling works towards the Warringah Freeway. Further details are provided in Appendix F1 (Technical Working Paper: Construction noise and vibration - TBM).

Launch and receival chamber

The launch and receival chamber would be new elements of work required for the proposed modified project. The location of the launch and receival chambers are shown on Figure 8-10 and Figure 8-11 respectively.

Figure 8-10 Launch chamber location

Figure 8-11 Receival chamber location

The launch chamber would be predominately located under Birchgrove Tennis and Birchgrove Oval, with only a portion being located under residences. It would require an underground excavation around 180 metres long, 25 metres wide and 25 metres high.

The receival chamber would be located under Berrys Bay/ Carradah Park. It would require an underground excavation of around 20 metres long, 90 metres wide and 20 metres high.

The depth of the launch and receival chambers would be generally consistent with the proposed mainline tunnel crown in these locations as assessed as part of the Approved Project.

Table 8-30 presents a summary of the worst case predicted exceedances of ground borne noise NMLs for the launch and receival chamber excavation.

Table 8-30 Exceedances of residential receiver human comfort NML – proposed modified project (mainline tunnelling)

Location	Assessment period	Number of exceedances of NML by activity		
		Roadheader excavation	Rock breaking	Rock bolting
Launch chamber	Evening	-	**33**	**-**
	Night	-	**59**	**19**
Receival chamber	Evening	-	**3**	**2**
	Night	-	**5**	**2**

At the launch chamber site, rock breaking would result in the greatest level of impact with almost 60 exceedances at night with 8 of these at 10-11 dB above the night NML. Rock bolting would result in fewer exceedances, and these would only be 1-2 dB above the NML. Roadheader excavation is not expected to result in any exceedances of the night NML. The predominant tunnelling technique used to construct the chambers will be roadheaders, which are shown to unlikely exceed the NML's for ground borne noise.

At the receival chamber site, fewer receivers would be affected, with rock hammering resulting in only 5 exceedances at night. The highest predicted level at the Coal Loader Centre for Sustainability would exceed the commercial NML by 2 dB. The nearest residential receiver is predicted to exceed the night NML by around 15 dB and would require offers of alternative accommodation.

Active management of the use of rock breakers when excavating the chambers would consider restrictions on evening and night-time works in these instances.

Assessment of ground borne vibration impacts

Ground-borne vibration assessment is based on the shortest slant distance between source and receiver, meaning that the predicted level for residential receivers above the tunnel alignment would be the worst case. A summary of predicted exceedances of the human comfort Vibration Management Levels (VML) for each NCA is provided in Table 8-31.

Table 8-31 Predicted exceedances of residential receiver human comfort VML – proposed modified project (mainline tunnelling)

Vibration impact	Corresponding NCAs	Number of receivers expected to experience vibration levels above the human comfort VML	
		Day (7am to 10 pm): 0.40 m/s1.75	Night (10pm to 7am): 0.26 m/s1.75
Tunnel Boring Machine	**11.3**	-	-
Tunnel Boring Machine	**11.4**	-	-
Tunnel Boring Machine	**11.5**	-	-
Tunnel Boring Machine	**12.1**	-	**17**
Tunnel Boring Machine	**14.1**	-	-
Rock Drill	**15.1**	-	**1**
Rock Drill	**15.3**	-	-
Rock Drill	**16.3**	-	-
Rock Drill	**17.4**	-	-
Rock Drill	**19.1**	**1**	**2**
Rock Drill	**20.1**	-	**5**
/Rock Drill	**21.2**	-	**1**
/Rock Drill	**22.1**	-	-
Rock Drill	**22.2**	-	-
Rock Drill	**23.2**	-	-
Rock Breaker	**15.1**	**2**	**6**
Rock Breaker	**15.3**	0	0
Rock Breaker	**16.3**	0	0
Rock Breaker	**17.4**	0	0
Rock Breaker	**19.1**	**2**	**2**
Rock Breaker	**20.1**	**7**	**12**
Rock Breaker	**21.2**	**1**	4
Rock Breaker	**22.1**	0	0
Rock Breaker	**22.2**	0	0
Rock Breaker	**23.2**	0	0

Table 8-31 shows:

- No exceedances of the human comfort VML are predicted when only the roadheader is in operation and around 9 receivers around North Sydney are predicted to exceed night VML when rock drilling.
- Although it is not anticipated for all areas of the project, an assessment of the worst-case impacts from rock breaking (as presented in Table 8-31, indicates potential exceedances in NCAs 15.1, 19.1, 20.1 and 21.2 and therefore the use of rock breakers in these NCA's should be avoided during OOHW periods. If rock breaking within the mainline tunnels is to be undertaken during the evening or night in these NCAs, a site specific assessment would be required to provide additional information to assist in managing potential impacts.
- As with the ground borne noise for TBM tunnelling, the predicted exceedances of the VMLs are in most cases only minor.

Consistent with the Approved Project, active management of the drilling and bolting in the affected NCA's would consider restrictions on evening and night-time works in these instances.

Cosmetic Damage

Consideration of building damage from construction vibration requires the application of values in BS 7385 *Part 2-1993 Evaluation and measurement for vibration in buildings Part 2.* These values which are presented in Appendix F1 (Technical working paper: Construction noise and vibration – TBM), relate to transient vibration which does not give rise to resonant responses in structures.

The screening criteria used for cosmetic damage is dependent on the structure type, with Peak Particle Velocity (PPV) screening levels of 25.0 mm/s for reinforced or framed structures and PPV screening levels of 7.5 mm/s for light framed structures. For heritage structures, a screening value of 2.5mm/s PPV is used.

The maximum predicted PPV vibration level for each tunnelling activity is shown in Table 8-32.

Table 8-32 Predicted peak particle velocity (PPV) levels – proposed modified project (mainline tunnelling)

NCAs	Maximum predicted PPV (mm/s)				
	TBM	Roadheader	Rock breaker	Rock Drill	Cross Passage (RB)
11.3	0.0	-	-	-	0.0
11.4	0.2	-	-	-	0.0
11.5	0.0	-	-	-	0.0
12.1	0.5	-	-	-	0.2
14.1	0.6	0.0	0.9	0.5	0.4
15.1	-	0.0	0.8	0.4	0.2
15.3	-	0.0	0.2	0.1	0.2
16.3	-	0.0	0.2	0.2	0.2
17.4	-	0.0	0.2	0.1	0.1
19.1	-	0.0	0.9	0.5	0.5
20.1	-	0.0	1.3	0.6	0.4
21.2	-	0.0	1.0	0.5	0.6
22.1	-	0.0	0.4	0.3	0.3
22.2	-	0.0	0.1	0.1	0.1
23.2	-	0.0	0.1	0.1	0.1

Cross passages

The assessment indicates that human comfort criteria exceedances are expected to be minimal due to the short tunnel lengths and large distances between passages. Active management of cross passage construction would likely eliminate the predicted exceedances in the affected NCA's. Where construction occurs outside standard hours no VML impacts are expected.

Launch and receival chambers

Vibration is not likely to result in adverse impacts during chamber excavation with maximum PPV vibration at the nearest properties predicted of around 0.2 mm/s for hammering in the launch chambers and 0.4 mm/s for hammering in the receival chamber. This would not result in damage to any structures.

Biodiversity considerations

Chapter 19 of the Project EIS provides an assessment of the biodiversity impact assessment for the Approved Project. This assessment identified three listed threatened fauna species within the construction footprint.

One of the species identified was the Eastern Bentwing-Bat (*Miniopterus schreibersii oceanensis*) which had habitat recorded within two of the Coal Loader tunnels near Waverton.

For the purposes of comparing the potential noise and vibration impacts of the proposed modified project with the Approved Project, available data was used from the Project EIS. A specific assessment of potential construction noise and vibration impacts on the microbat colonies at the Coal Loader was included in the Project Submissions Report. This assessment identified the following construction activities that have the potential to generate noise or vibration in the vicinity of the Bentwing-Bat:

- Excavation of the mainline tunnels. Ground borne noise and vibration levels would be highest when the roadheader is directly below the Coal Loader tunnel, with levels decreasing as the roadheader moves away. Ground borne noise levels were predicted to be up to 44 dBA
- The installation and removal of cofferdams. In particular, the piling that is required for the installation of the Sydney Harbour north cofferdam (WHT6) located next to the Coal Loader tunnel which was predicted to be up to 64 dBA
- Rock hammering required for benching and/or tunnel fitout works within the mainline tunnels which was predicted to be up to 60 dBA.

An assessment of the proposed modified project indicates that the predicted ground borne noise levels when the TBM is at its closest point to the Coal Loader would be up to 39 dBA. As the TBM moves considerably faster than the conventional roadheader, these noise level would be expected to last for up to 2 days. For context, 39 dBA is below the recommended internal design levels for apartments as specified in “Australian Standard 2107 Acoustic-recommended design sound levels and reverberation times for buildings interiors” (AS2107) and would be comparable to the existing background noise levels.

Due to the change in construction methodology, the project will not require any surface activities that have the potential to create an airborne noise impact. Airborne noise from piling the cofferdams was predicted to be the most intrusive activity with predicted levels up to 64 dBA. Additionally, there will be no need for rock hammering near to the Coal Loader, as the TBM methodology does not require this activity.

As a result of the change in methodology which has removed the most intrusive works that had the potential to impact the Eastern Bentwing-Bat, along with the short duration and relatively low predicted ground borne noise levels associated with the TBM crossing, the modified project is unlikely to have an impact on the Bentwing-Bat roosting habitat.

Aboriginal heritage

All Aboriginal heritage locations are predicted to be below the guideline requirements (heritage screening criteria of PPV 2.5mm/s). While monitoring of Aboriginal heritage sites during the closest works would be necessary to confirm the predicted levels as identified for the Project EIS, no further mitigation measures are recommended for these sites. Where surface works are to be completed near Aboriginal heritage locations, an additional assessment of impacts would be required consistent with the Project EIS and the revised environmental mitigation measures, particularly AH2 to AH4. Further details including the specific sites assessed are provided in Section 4.2 of Appendix F1 (Technical Working Paper: Construction noise and vibration - TBM).

Non-aboriginal heritage

For identified non-Aboriginal heritage items along the alignment, a vibration screening criterion of 2.5 mm/s would be applicable until a full assessment of the structural integrity has been completed.

A preliminary assessment of vibration from the mainline tunnels and cross passages at the base of these structures has been carried out from the information currently available which indicates that with the highest predicted vibration level of around 1.3mm/s from rock hammering, no heritage structures identified adjacent to the alignment would experience vibration levels above the PPV 2.5mm/s threshold. Further details, including specific sites assessed are provided in Appendix F1 (Technical Working Paper: Construction noise and vibration - TBM).

8.3.4 Assessment summary

The key findings of the assessment of construction noise and vibration impacts are:

- During tunnelling, noise and vibration is likely to result in adverse impacts on noise sensitive receivers close to the tunnel alignment however this would be comparable with the Approved Project. The level of noise and vibration impacts from tunnelling with a TBM and/or roadheader would be low during the daytime and evening hours but would increase to moderate where impacts are experienced during the night-time period. Where NMLs and VMLs are predicted to be exceeded, appropriate mitigation measures such as offers of alternative accommodation would be implemented. It should be noted that the impact would be transient and would only last for a short period of time as the construction equipment passes by

- The noise levels around the Glebe Island construction support site (WHT3) and the Ridge Street North construction support (WHT9) site would be generally reduced
- There would be no exceedance of the ground borne NMLs associated with the main TBM tunnelling works. This compares to a substantial number of exceedances for the Approved Project
- Though the predictions indicate exceedances of the ground-borne noise management levels and vibration management levels at sensitive residential buildings during evening and night periods for other activities, these would be generally comparable with the Approved Project. The duration of any such exceedances would be only a few days for tunnelling when progressing along the alignment
- The construction of the new launch and receival chambers is not expected to result in exceedances of the NMLs where a roadheader is used. Should rock breaking be required outside standard construction hours, mitigation such as offers of alternative accommodation may be required
- No cosmetic damage as a result of ground borne vibration is predicted
- Maximum daily construction traffic movements are unlikely to result in a noticeable increase (greater than 2 dB(A)) in the day or night-time LAeq noise levels at receivers adjacent to the City West Link Portal
- The potential noise and vibration impacts on microbat colonies would be reduced when compared with the Approved Project.

The predicted impacts are based on preliminary tunnel designs, which would be reviewed following the completion of detailed design.

8.3.5 Environmental management measures

The impacts of construction stage noise and vibration for the changes to tunnelling and Sydney Harbour crossing works would be generally consistent with those identified for the Approved Project.

No further EMMs or changes to construction noise and vibration EMMs would be required.

A number of Conditions of Approval would require changes. This would comprise:

- Condition of Approval E68– with respect to activities at Berrys Bay and activities relating to trailer suction hoper dredging.
- Condition of Approval E77 and E78 – to include for cut and cover sections.

Further details are provided in Chapter 11.

No further amendments to the Minister's Conditions of Approval as they relate to construction noise and vibration would be required.

8.4 Operational air quality

This section provides a summary of the assessment of the potential operational air quality impacts associated with the proposed modified project. Further details are provided in Appendix G (Technical Working Paper: Air quality - operation). It also includes a review of the health impact assessment. This review is provided in Appendix H (Technical Working Paper: Human health review – air quality) and is summarised in this section.

8.4.1 Assessment methodology

The Project EIS Air Quality Impact Assessment (Project EIS AQIA) provides a comprehensive assessment of air quality impacts associated with the Approved Project. The additional assessment prepared for the proposed modified project has been performed by reviewing potential changes in air emissions that may occur as a result of the changes to the grade and alignment of the tunnel and are compared to those assessed for the Approved Project. The Project EIS AQIA has been applied as a reference.

Potential emissions from the proposed modified project have been assessed as to whether they are consistent with, or within the extent of, the potential emissions considered in the Project EIS AQIA. Where potential emissions have been identified as being greater or different to those considered in the Project EIS AQIA, an assessment of the materiality of these changes has been made.

For the health impact assessment, the implications of the proposed changes to air quality were reviewed consistent with the approach adopted for the assessment in the Project EIS.

8.4.2 Existing environment

Ambient air quality in Sydney is monitored across a network of monitoring stations operated by the Department of Planning and Environment and the NSW EPA. Section 12.4.3 of the Project EIS includes a summary of ambient air quality in Sydney based on data from these monitoring stations from a period between 2004 and 2018.

Expected traffic

The Project EIS AQIA included seven expected traffic scenarios. Further details are provided in Section 8.2. The scenarios were based on traffic volumes, distribution of traffic across the road network and average traffic speeds forecast by the strategic traffic model (Strategic Motorway Project Model, (SMPM)). The Project EIS AQIA also considered future changes over time in the composition and performance of the vehicle fleet.

The objective of these traffic scenarios was to assess whether the expected operation of the Approved Project would result in acceptable ambient air quality and formed the main focus of the Project EIS AQIA. The results from modelling these expected traffic scenarios were also used as one of the inputs for the Approved Project's human health risk assessment.

8.4.3 Assessment of potential impacts

Ambient air quality – Regulatory worst case (RWC)

The proposed modified project would not involve any alteration of the ventilation outlets or changes to ventilation outlet emission limits specified within Condition E21 of the Approved Project. As such, the proposed modified project would not result in changes to the regulatory worst case (RWC) emissions or the existing RWC assessment as provided in the Project EIS AQIA.

Operational air quality – Expected traffic case

The proposed modification of the tunnel construction method would not influence the underlying parameters that defined the formulation of expected traffic scenarios within the Project EIS AQIA, hence the proposed modified project would not influence emissions from surface roads or existing tunnel portals. Accordingly, the potential changes to operational air quality are limited to those associated with changes to road alignment, tunnel length and tunnel grade. Further details are provided below.

In tunnel air quality

In-tunnel air quality was addressed within the ventilation report that formed Annexure K to the Project EIS AQIA. It is anticipated that changes in the tunnel alignment and the distribution of grade changes will produce minor changes in vehicle emissions within the tunnel.

As part of the ventilation design for the TBM solution, an analysis of in-tunnel air quality demonstrates compliance with the emission limits as detailed in Conditions E5, E6 and E7 of the Project Approval under worst case traffic conditions. Further details are provided in Appendix G (Technical Working Paper: Air quality–operation).

In summary, the proposed modified project would comply with all the Conditions of Approval relevant to operational air quality.

Changes to assessed impacts

The minor change in project alignment (both horizontal and vertical–refer Section 5.2) would result in a minor change to emissions generated in the tunnel. A comparison of the Approved Project with the proposed modified project for key pollutants for the various traffic scenarios is provided in Table 8-33.

Table 8-33 Comparison of ventilation emission estimates (Proposed modified project compared to Project EIS AQIA).

Emission Estimate (kg/day)	Emissions - Cammeray (Outlet G)			Emissions - Rozelle (Outlet F)			Units
	Year 2027	Year 2037		Year 2027	Year 2037		
	Do something (DS) (WHT)	Do something (DS) (WHT)	Do something cumulative (DSC)	DS (WHT)	DS (WHT)	DSC	
NO_x							
Approved Project alignment	189	198	196	66	71	102	kg/day
Proposed modified project alignment	196	211	215	68	73	107	kg/day
Change	*+4%*	*+6%*	*+10%*	*+3%*	*+3%*	*+4%*	-
CO							
Approved Project alignment	211	209	227	167	170	175	kg/day
Proposed modified project alignment	222	217	238	167	171	177	kg/day
Change	*+5%*	*+4%*	*+5%*	*+0%*	*+0%*	*+1%*	-
$PM_{2.5}$							
Approved Project alignment	4.09	3.57	3.82	2.85	2.75	3.00	kg/day
Proposed modified project alignment	4.31	3.48	3.81	2.94	2.66	2.94	kg/day
Change	*+5%*	*-2%*	*0%*	*+3%*	*-3%*	*-2%*	-
PM_{10}							
Approved Project alignment	10.6	11.3	11.5	6.73	7.64	9.62	kg/day
Proposed modified project alignment	10.5	11.2	11.6	6.71	7.62	9.65	kg/day
Change	*-1%*	*-1%*	*0%*	*0%*	*0%*	*0%*	-

Table 8-33 indicates the following:

- Changes vary by pollutant, ventilation outlet and traffic year
- Changes in daily average emissions would range between a 3% reduction and a 10% increase
- Increases greater than or equal to 5% would be limited to Cammeray (Outlet G) only under the following scenarios:
  - 2027-Do something (DS) (WHT) - CO, PM2.5: +5%.

- 2037-Do something (DS) (WHT) - NOx: +6%
- 2037-Do something cumulative (DSC) - NOx: +10%, CO: +5%

Impacts on ambient air quality

To test the materiality of the predicted changes in ventilation outlet emissions, the influence of these changes on ambient air quality has been estimated for three pollutant / scenario combinations for Cammeray (Outlet G) for which the following increases were predicted:

- 2027-Do something (WHT) (DS WHT): PM2.5 increase of 5%
- 2037-Do something (WHT) (DS WHT): NOx increase of 6%
- 2037-Do something cumulative (DSC): NOx increase of 10%.

The assessment focused on nitrogen dioxide (NO2) and PM2.5, to represent key pollutants within the Project EIS AQIA and for road transport in general.

Table 8-34 to Table 8-36 present a summary of the approximated contribution of Cammeray Outlet G to annual average concentrations at the 10 most impacted RWR receptors as identified in the Project EIS AQIA for the three traffic scenarios where increases to daily emissions would be greater than or equal to 5%.

Table 8-34 Cammeray (Outlet G) – 2027-Do something (WHT), PM2.5

Receptor ID	Outlet Contribution: Annual Average $PM_{2.5}$ ($\mu g/m^3$)		
	EIS Modelling	5% Increase	Proposed Modified Project
RWR-13077	0.031	0.002	0.033
RWR-13143	0.031	0.002	0.033
RWR-13132	0.032	0.002	0.034
RWR-13022	0.031	0.002	0.033
RWR-13137	0.032	0.002	0.034
RWR-13106	0.031	0.002	0.032
RWR-13039	0.033	0.002	0.035
RWR-13024	0.029	0.002	0.030
RWR-14385	0.032	0.002	0.034
RWR-13167	0.033	0.002	0.034
Maximum	**0.033**	**0.002**	**0.035**

Note: Proposed modified project total may appear non-additive due to rounding.

Table 8-35 Cammeray (Outlet G) – 2037-Do something (WHT), NO2

Receptor ID	Outlet Contribution: Annual Average NO_2 ($\mu g/m^3$)		
	EIS Modelling	6% Increase	Proposed Modified Project
RWR-13077	0.27	0.02	0.29
RWR-13143	0.28	0.02	0.29
RWR-13132	0.29	0.02	0.30
RWR-13022	0.28	0.02	0.30
RWR-13137	0.28	0.02	0.30

Receptor ID	Outlet Contribution: Annual Average NO_2 (µg/m^3)		
	EIS Modelling	6% Increase	Proposed Modified Project
RWR-13106	0.29	0.02	0.31
RWR-13039	0.30	0.02	0.32
RWR-13024	0.27	0.02	0.29
RWR-14385	0.26	0.02	0.27
RWR-13167	0.29	0.02	0.31
Maximum	**0.30**	**0.02**	**0.32**

Table 8-36 Cammeray (Outlets G/H) – 2037-Do something cumulative, NO2

Receptor ID	Outlet Contribution: Annual Average NO_2 (µg/m^3)		
	EIS Modelling	10% Increase (Outlet G) *	Proposed Modified Project
RWR-13077	0.59	0.04	0.62
RWR-13143	0.60	0.04	0.63
RWR-13132	0.57	0.04	0.61
RWR-13022	0.58	0.04	0.62
RWR-13137	0.56	0.04	0.60
RWR-13106	0.61	0.04	0.65
RWR-13039	0.60	0.04	0.64
RWR-13024	0.57	0.04	0.61
RWR-14385	0.55	0.03	0.58
RWR-13167	0.57	0.04	0.60
Maximum	**0.61**	**0.04**	**0.65**

Notes: *A 10% increase at Outlet G equates to a 6% increase in combined emissions from Outlet G and Outlet H.

Proposed modified project total may appear non-additive due to rounding.

The tables indicate that the proposed modified project is expected to produce some small increases in pollutant contribution at the various receptors.

Assessment significance guidance

To assess the significance of these changes, the UK Institute of Air Quality Management (IAQM) *Land-Use Planning and Development Control: Planning for Air Quality*, Institute of Air Quality Management (IAQM, 2017) has been referenced. IAQM (2017) provides a framework for the evaluation of the magnitude and significance of predicted assessment impacts. This framework considers both the predicted total concentration (existing background + project) and the change in concentration associated with the project being assessed.

This guidance has also been referenced in assessments of road projects in New South Wales (EMM, 2022) in coordination with the NSW Advisory Committee on Tunnel Air Quality (ACTAQ). Table 8-37 presents a summary of air quality impact changes for individual receptors from the IAQM (2017) with minor adaptations for application in this assessment.

Table 8-37 Changes to air quality impacts for individual receptors (IAQM, 2017)

Total Concentration at Receptor as Proportion of Standard*	Change in Concentration as Proportion of Standard*				
	0%*	1%	2% - 5%	6% - 10%	>10%
<76%	Negligible			**Slight**	**Moderate**
76% – 94%	Negligible		**Slight**	**Moderate**	
95% – 102%	Negligible	**Slight**	**Moderate**		**Substantial**
103% – 109%	Negligible	**Moderate**		**Substantial**	
>109%	Negligible	**Moderate**	**Substantial**		

Notes: * Total concentration is taken as the maximum of either the project + background or the background (i.e., in cases where the project produces a reduction in concentration). **Change in concentration is to be applied as a whole percentage value. Unrounded values less than 0.5% apply as 0%.

Magnitude of impacts from changes in emissions

A summary of the maximum changes as a proportion of the respective standards for the 10 most impacted receptors near to the Cammeray ventilation outlet (Outlet G) is shown in Table 8-3 below.

Table 8-38 Impact of maximum change to 10 most impacted receptors as a proportion of standards

Parameter	Annual Average NO_2	Annual Average $PM_{2.5}$	Units / Basis
Air quality standard	31	8	$\mu g/m^3$
Maximum Change	0.04	0.002	$\mu g/m^3$
	0.12%	0.02%	% of standard
Magnitude of Maximum Change (IAQM, 2017)	Negligible	Negligible	-

As shown in the table, changes in emissions associated with the modification are predicted to have a negligible influence on ambient air quality.

Magnitude of impacts from Cammeray outlet

As an additional consideration, an assessment of magnitude of the influence of the Cammeray ventilation outlet has been made, inclusive of the both the Approved Project, and the marginal increase of emissions associated with the proposed modified project.

In the case of NO2, the impacts have been referenced from the 2037-DSC scenario, which represent the maximum of the two scenarios for which NO2 impacts were assessed quantitatively. Accordingly, the NO2 results presented here represent the combined influence of emissions from Outlet G and Outlet H. Table 8-39 presents a summary of this assessment.

Table 8-39 Impact of Cammeray Outlet as a proportion of standards

Parameter	Annual Average NO_2	Annual Average $PM_{2.5}$	Units / Basis
Air quality standard	31	8	$\mu g/m^3$
Approved Project			
Maximum Outlet Contribution	0.61	0.033	$\mu g/m^3$
	2.0%	0.41%	% of standard
Total Concentration at Receptors*	19.1 – 20.1	8.3 – 8.5	$\mu g/m^3$

Parameter	Annual Average NO_2	Annual Average $PM_{2.5}$	Units / Basis
	62% - 65%	103% - 106%	% of standard
Magnitude of Maximum Contribution (IAQM, 2017)	Negligible		-
Proposed Modified Project			
Maximum Outlet Contribution	0.65	0.035	$\mu g/m^3$
	2.1%	0.43%	% of standard
Total Concentration at Receptors*	19.2 – 20.1	8.3 – 8.5	$\mu g/m^3$
	62% - 65%	103% - 106%	% of standard
Magnitude of Maximum Contribution (IAQM, 2017)	Negligible		-

Notes: *Receptors are those listed in the Tables 8.34-8.36 above. Total concentrations are dominated by contributions from regional background and surface roads that are not influenced by the proposed modification.

As shown in Table 8-39, the maximum outlet contributions are predicted to be negligible in magnitude. Given the negligible scale of these increases, and the balance of increases and decreases in emissions across the pollutants and traffic scenarios, the influence of the proposed modified project on ambient air quality compared with the Approved Project is considered to be insignificant.

Health impact assessment

In-tunnel air quality

In-tunnel air quality is required to meet the in-tunnel air quality and visibility limits. The Project EIS Health Impact Assessment (HIA) demonstrated that meeting the in-tunnel air quality and visibility limits would be protective of the health of tunnel users, including those involved in the use of a number of connected tunnels where consecutive tunnel trips may result in a longer period of exposure to emissions within tunnels. Given that the in-tunnel air quality limits would be met, conclusions in relation to the impact on health for users of the tunnel would not change as a result of the proposed modified project from that presented in the Project EIS HIA report.

Community exposure

A review of the changes in emissions from the ventilation outlets that would potentially impact on concentrations in the community surrounding the outlets, indicates that for the key pollutants of oxides of nitrogen, carbon dioxide and PM2.5 the proposed modified project would not result in any changes to the assessment of health impacts from those presented in the Project EIS.

Further details are provided in Appendix H (Technical Working Paper; Human health review – air quality).

8.4.4 Assessment summary

The proposed modified project would:

- Comply with all existing Conditions of Approval as applicable to operational air quality
- Result in a negligible change to impacts on air quality when compared to the Approved Project
- Not result in any changes to the assessment of human health impacts from those presented in the Project EIS.

8.4.5 Environmental management measures

The impacts to operational air quality would be consistent with those assessed in the Project EIS. No further environmental management measures are considered necessary beyond those identified for the Approved Project. No amendments to the Minister's Conditions of Approval as they relate to operational air quality would be required.

8.5 Geology, soils, contamination, groundwater, and settlement

This chapter provides an assessment of the potential geology, soils, contamination, groundwater, and groundwater drawdown induced settlement associated with the proposed modified project.

Further details on groundwater and drawdown induced settlement are provided in Appendix K1 (Technical Working Paper: Groundwater and settlement).

8.5.1 Methodology

The Project EIS included detailed investigations of geology, soils, and contamination. This assessment includes a desktop review of these investigations. No additional field investigations were considered necessary noting that the proposed changes would not significantly differ from the geology, soils, and contamination context from the Approved Project.

The Project EIS included a groundwater modelling assessment of potential saline water intrusion that could occur due to the construction and operation of the Approved Project.

The potential for a change in groundwater inflows (including potential drawdown induced settlement) due to the proposed larger excavations associated with the TBM launch and retrieval chambers, was assessed by developing a 2D groundwater flow numerical model. This repeated the modelling approach used for the Project EIS.

8.5.2 Existing environment

Topography

The Project EIS detailed that the terrain along the project corridor is at an elevation of around 10 metres Australian Height Datum (AHD) at its southern extent at Rozelle and gently undulates towards Birchgrove. The maximum depth of Sydney Harbour in the vicinity of the crossing is about 40 metres below sea level on the eastern side adjacent to Balls Head.

Once the project crosses Sydney Harbour the topography has a moderate incline towards North Sydney, reaching an elevation of around 90 metres AHD at the Pacific Highway, North Sydney.

The Sydney Harbour estuary is a drowned river valley (palaeovalley), characterised by steep sided banks carved into Hawkesbury sandstone between 25 and 29 million years ago. Around 17,000 years ago the sea level rose, flooding the river valley and forming a flood tide delta (Sydney Institute of Marine Science, 2014). The Sydney Harbour crossing is underlain by estuarine, marine, and alluvial sediments overlying Hawkesbury Sandstone at depths of over 40 metres below sea level. Underlying rock within Sydney Harbour along the proposed alignment occurs as two depressions formed by an ancient river system and has sediment cover of up to 30 metres thick.

Geology

The Sydney 1:100,000 Geological Series Sheet 9130 (NSW Department of Mineral Resources, 1983) indicates that the majority of the project area is underlain by geological units associated with the Wianamatta Group. Hawkesbury Sandstone (Rh) underlies the majority of the project area, with isolated occurrences of Ashfield Shale (Rwa) in the north- eastern portion of the project area, around North Sydney and Neutral Bay.

In addition, areas of disturbed ground (man-made fill (mf)) are mapped within the Rozelle Rail Yards, Birchgrove Park and Waverton Park. An intermediate formation between the Hawkesbury Sandstone and the Ashfield Shale, the Mittagong Formation, is sometimes identified but is not mapped along the project alignment.

Soil groups

The Sydney 1:100,000 Soil Landscape Series Sheet 9130 (NSW Department of Mineral Resources, 1983) indicates that the residual soils within the project area include Blacktown (bt), Disturbed (xx), Hawkesbury (ha), and Gymea (gy) landscape groups. The majority of the project area is underlain by the Gymea landscape group with Hawkesbury landscape group surrounding the shorelines and isolated occurrences of the Blacktown landscape group around North Sydney.

Marine sediments

Sediments infilling the Sydney Harbour estuary (palaeovalley) comprise Pleistocene and Holocene age alluvial, colluvial, estuarine and marine deposits to about 30 metres thick, thickening towards the centre of Sydney Harbour. Palaeovalley sediments are comprised of silty and peaty sands, silts, and clays with shell layers.

Acid sulfate soils

Acid sulfate soils are the common name given to naturally occurring soils, commonly associated with low lying areas of fine-grained sediments and typically occur in lacustrine, estuarine, or swamp type environments, that contain iron sulfides (principally iron sulphide or iron disulphide or their precursors) which, on exposure to air, oxidise and create sulfuric acid.

Acid sulfate soil risk maps from the Australian Soil Resource Information System (ASRIS) database were reviewed to determine the probability of acid sulfate soil being present across the project area. The generalised acid sulfate soil probability across the project area has been assessed as follows:

- Sydney Harbour and Rozelle Bay – (A) high probability/confidence unknown
- Lilyfield to Snails Bay – (B3) low probability/low confidence
- Balls Head to Crows Nest – (C4) extremely low probability/very low confidence
- Artarmon – (B4) low probability/very low confidence.

Key areas of acid sulfate soil risk are associated with the sediments beneath Rozelle Rail Yards, Birchgrove Park, Sydney Harbour (tunnel crossing, Glebe Island and Berrys Bay) and Whites Creek.

Contamination

The Project EIS identified nine areas that would have a moderate to high-risk contamination rating. These are considered to be potential areas of environmental interest. Of those, five areas were associated with the Western Harbour Tunnel Stage 2 works. A summary of these sites, including their associated contaminants of concern, is provided below.

Rozelle Rail Yards, Rozelle

The historical rail yard land use (rail activities) and potential creek infilling at the Rozelle Rail Yards is known to have resulted in contaminated soil and groundwater in the area. This area contains soils contaminated with heavy metals, PAH, and asbestos. In addition, the historical infilling of the former creek and subsequent degradation of organics within the infill material may generate leachate which could migrate into and contaminate the underlying groundwater. If considerable organic content (e.g., timber, paper, green waste) is present within infill materials, this could generate landfill gas. This area poses a high potential contamination risk to construction activities associated with the project given the known presence of contaminated material from historical site activities at this location.

Birchgrove peninsula

Slag and ash materials may be present across areas of the Birchgrove Peninsula (including Yurulbin Park) associated with historic disposal practices of wastes from nearby industry (e.g., power stations). These slag and ash materials are generally present within surface fill materials and could contain elevated concentrations of heavy metals and hydrocarbons.

Historical industrial land use and demolition of structures at Yurulbin Park may have also contaminated the site with heavy metals, hydrocarbons, pesticides, polychlorinated biphenyls, phenols, organotins and asbestos. Therefore, this area posed a moderate contamination risk to construction given the potential for contamination to be present within the soil which, under the Approved Project, was likely to be excavated and exposed during construction of the Yurulbin Point construction support site (WHT4). Under the Approved Project, material was proposed to be transported to Glebe Island construction support site (WHT3).

Sydney Harbour

Existing contamination in Sydney Harbour is a result of historical inputs that remain in the sediments and some current sources such as stormwater. The very highest contamination concentrations are generally restricted to the bedded sediments and macroalga of the upper reaches and decrease seaward. The sediments pose a high contamination risk to construction of the Approved Project as it is likely to be excavated and exposed during construction of the Sydney Harbour coffer dams.

Balls Head peninsula

The historical use of the wharf at Balls Head Road, Waverton may have caused localised contamination associated with the loading and unloading of materials (particularly coal and other materials) and general maritime activities. Soil and rock located beneath the former bulk fuel storage site located at Waverton may contain residual heavy metal and hydrocarbon contamination associated with the former use of the site. This area posed a moderate contamination risk to construction considering the potential presence of contamination (in soil and/or rock) and that, under the Approved Project, such materials were likely to be excavated and exposed during construction of the Berrys Bay construction support site (WHT7). Under the Approved Project, material was proposed to be transported to Glebe Island construction support site (WHT3).

Waverton Park

Contaminated fill materials have been reported within Waverton Park; however, no groundwater samples have been taken to date. It is possible that the contamination reported in respect to fill material could represent a contamination source to groundwater beneath the site. If considerable organic content (e.g., timber, paper, green waste) is present within infill materials, this could generate landfill gas. This area poses a potential high contamination risk to construction given that contamination is known within fill material which could impact upon groundwater. Groundwater could be exposed during construction of the tunnel and/or construction could create preferential pathways for groundwater contamination and land.

Groundwater

Section 16.3.4 of the Project EIS noted that across the study area the groundwater levels are typically deeper beneath hills and shallowest beneath creeks and gullies. Groundwater within the project footprint is recharged by rainfall runoff and infiltration.

The regional water table across the study area typically mimics topography and flows from areas of high topographic relief to areas of low topographic relief. The depth of the water table is highly variable and can range from close to ground surface in low lying areas to 100 metres below ground level beneath elevated ridgelines. Localised water tables may also occur due to the highly stratified nature of the Hawkesbury Sandstone.

A composite water table contour map for the study area is presented in Figure 8-12. The water level contours shown confirm the general trend of the water table following topography, with groundwater flow from elevated areas (recharge) toward the harbours and major drainage lines (discharge).

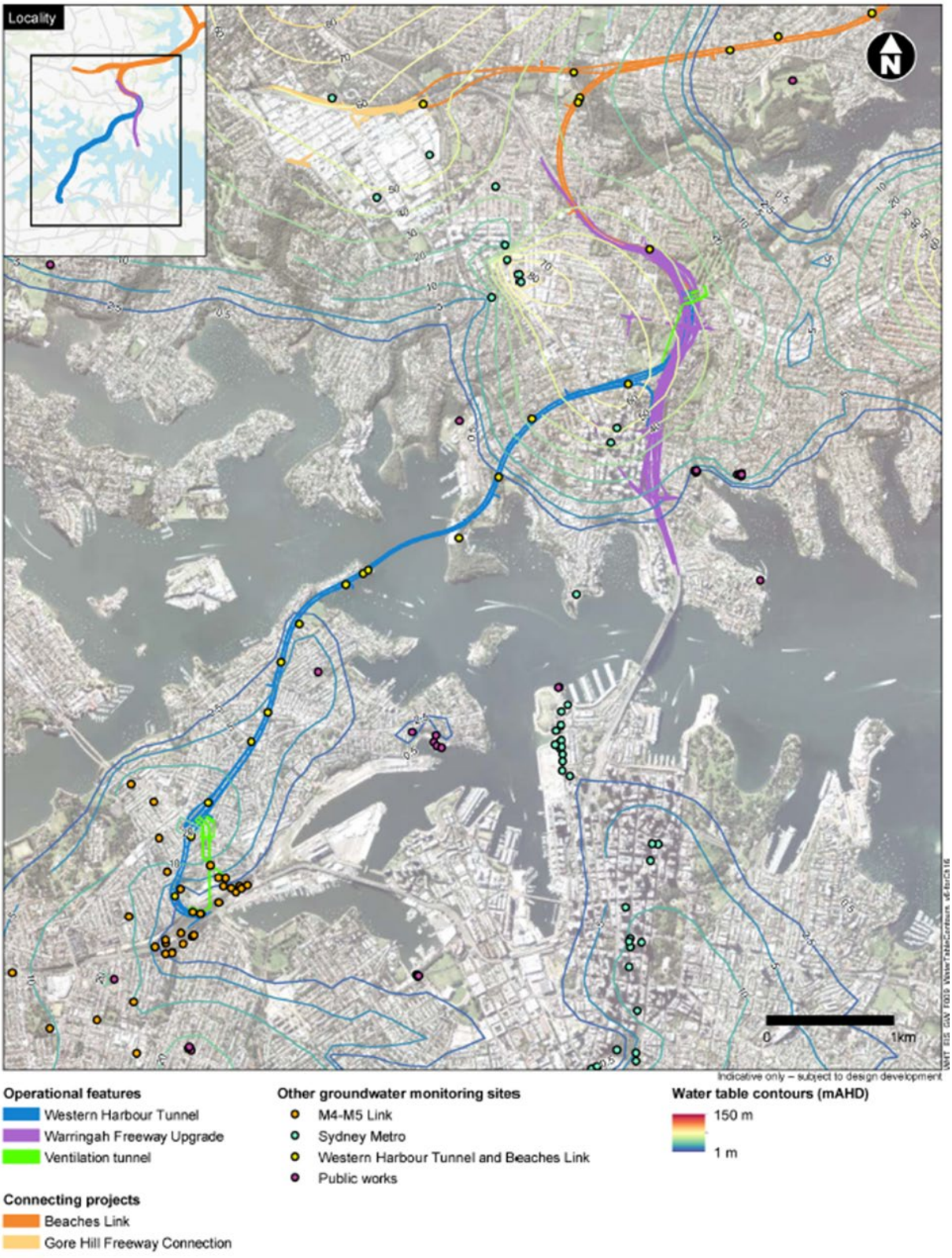


Figure 8-12 Water table contour map and groundwater monitoring network (from the Project EIS – Figure 16-5).

8.5.3 Assessment of potential impacts

Soils and contamination

Soils

The proposed modified project would intercept soils in a different way to what was characterised for the Approved Project. The TBM method of tunnelling would intersect Pleistocene soils beneath Sydney Harbour that are predominantly silty clay and sand. These soils would be removed by the TBM and pumped to the slurry treatment plant for treatment.

This method of spoil removal is expected to remove the need for any soil and sediment disturbance within Sydney Harbour compared to the dredging and excavation proposed in the Approved Project.

Acid Sulfate Soils

The risks associated with uncovering ASS would be further reduced from what was characterised for the Approved Project.

Acid sulfate soils are typically present in near surface soils of marine and estuary environments and are within soil and sediment within the Sydney Harbour alignment of the proposed tunnel. Due to the increase in the invert depth of the modified tunnel design, Acid Sulfate Soils (Class 1 – 4) are no longer expected to be encountered during the TBM excavation.

Further geotechnical investigations would be carried out upon commencement of the project to verify ground conditions for TBM construction. In the event that Acid Sulfate Soils are identified during tunnelling, it would be managed under an unexpected finds protocol in accordance with Acid Sulfate Soil Manual (ASSMAC, 1998) and NSW EPA Waste Classification Guidelines – Part 4: Acid Sulfate Soils (EPA, 2014).

Contamination

The proposed modified project would result in a substantial reduction in the disturbance of contamination. Details of the changes are provided Table 8-40 below.

Table 8-40 Potential areas of interest for contamination in relation to the proposed modified project compared with the Approved Project

Area of contamination	Construction works - Approved Project	Construction works – Proposed Modified Project	Impact of modification
Rozelle Rail Yards	• Rozelle Rail Yards construction support site establishment works • Tunnel fitout	The construction site would be located within existing structures (i.e., in the cut and cover or in already excavated tunnels or vent caverns)	• Work in this area would be contained to pre-existing structures i.e., the tunnel portal and existing mainline tunnels and vent caverns. • Impacts are expected to be less than what was characterised in the EIS owing to reduced ground disturbance and excavation requirement.
Birchgrove Peninsula	• Yurulbin Point construction support site establishment works • Tunnelling and associated excavation and stockpiling	• No construction support site establishment required at Yurulbin Point • Tunnelling via TBM only • No excavation or stockpiling required in this location	• Work in this area would be contained to the mainline tunnel alignment. No surface excavation would be required at Yurulbin Point. • Impacts are expected to be less than what was characterised in the EIS owing to reduced excavation requirement.

Area of contamination	Construction works - Approved Project	Construction works – Proposed Modified Project	Impact of modification
Sydney Harbour	• Construction support site establishment works for Sydney Harbour north and south cofferdams • Tunnelling and associated excavation and stockpiling • Dredging	• No construction support site establishment required • Tunnelling via TBM only • No construction of coffer dams and excavation from coffer dams • No dredging required • No excavation or stockpiling required in this location	• All tunnelling beneath Sydney Harbour would be carried out by the TBM. The tunnelling methodology would significantly reduce the potential of interacting with contaminated material during the construction of the harbour crossing. • All potentially contaminated spoil would be transported from the TBM face to the slurry treatment plant before treatment.
Balls Head peninsula	• Berrys Bay construction support site establishment works • Tunnelling and associated excavation and stockpiling	• No construction support site establishment required at Berrys Bay • Tunnelling via TBM only • No excavation or stockpiling required in this location	• Work in this area would be contained to the mainline tunnel alignment. No surface excavation would be required at Berrys Bay. • Impacts are expected to be less than what was characterised in the EIS owing to reduced excavation requirement.
Waverton Park	Tunnelling and associated excavation and stockpiling	• No excavation or stockpiling required in this location • Tunnelling via TBM only	• Work in this area would be contained to the mainline tunnel alignment. No surface excavation is proposed within or adjacent to Waverton Park. • The alignment has been designed to avoid the Waverton Park Landfill as far as practical.

Groundwater

A groundwater technical report has been prepared for the proposed modified project and is provided in Appendix K1 (Technical Working Paper: Groundwater and settlement). A comparison of the potential change in groundwater conditions at each receptor due to the proposed modified project is described below.

Changes to the tunnelling method to cross Sydney Harbour

As part of the proposed modified project, the twin tunnels between Birchgrove Park and Carradah Park, including under Sydney Harbour, are now proposed to be undrained (tanked) structures constructed using TBMs.

Due to the change in construction methodology associated with the proposed modified project, there would be reduced groundwater inflows. The proposed modified project would reduce groundwater drawdown in the Birchgrove Peninsula (including Yurulbin Park) which would also reduce any drawdown induced settlement beneath Birchgrove Peninsula (including Yurulbin Park).

Construction of chambers in Birchgrove and Balls Head

Changing to a TBM construction method for the tunnels between Birchgrove Park and Carradah Park would require the excavation of underground mined chambers. These would be adjacent to Birchgrove Park and Carradah Park where, respectively, the TBMs would be launched and the TBM cutterheads buried. These chambers would be larger (taller and wider) than the twin mined tunnels that would have been constructed in the equivalent locations for the Approved Project.

For the proposed modified project, groundwater inflows to the chambers would still be limited to less than the maximum rate specified for the twin drained tunnels that were to be constructed in the same locations, which

is a maximum inflow of 1 litre per second per kilometre of drained tunnel. The rate of inflow would be limited by implementing groundwater control measures (such as rock grouting) as required within the excavations.

Groundwater modelling of the proposed modified project indicates that the magnitude of drawdown directly above the proposed chambers may be higher than was predicted to occur for the Approved Project. However, beyond the immediate vicinity of the chambers (e.g., below Birchgrove Park), drawdown is predicted to be similar to that predicted in the Project EIS.

In accordance with the Minister's Conditions of Approval, groundwater monitoring data will be collected by the Project throughout construction to verify model predictions and, if required, contingency measures implemented to ensure the Conditions of Approval criteria are not exceeded. These could include additional monitoring, assessment of potential causes and, if required, design and/or construction methodology refinement.

Impact on potential receptors

Changes in potential impacts to receptors from groundwater and ground movement (settlement) resulting from the proposed modified project is summarised in Table 8-41 below.

Table 8-41 Potential impacts to receptors due to changes to groundwater.

Receptor	Change from Project EIS	Potential impact from the proposed modified project
Groundwater users (both Water Access Licences and stock and domestic use)	No change from Project EIS	• Not anticipated to result in a marked increase in the area of predicted drawdown. • No additional registered groundwater supply bores have been installed near the proposed changes since the EIS.
Groundwater-dependent ecosystems (GDEs) and sensitive environments	No change from Project EIS	• No GDEs or sensitive environments in the area of predicted drawdown.
Reduction in baseflow in potentially connected surface water systems	No change from Project EIS	• No significant surface water systems in the vicinity of the changes.
Areas of environmental interest	Improvement from Project EIS	• At Yurulbin Park, the proposed modification would reduce groundwater drawdown. • At Birchgrove Park there would be no change to the risk of contaminant migration from Birchgrove Park described in the EIS.
Activation of Acid Sulfate Soils that reduces the beneficial uses of the aquifer	No change from Project EIS	• No change to the potential to activate Acid Sulfate Soils at Birchgrove Park (if present) as a marked increase in groundwater drawdown due to the proposed modification is not predicted.
Structures (potential impact from settlement)	Variable, depending on location	• In areas where there would be a change from mined to TBM tunnels, the induced ground settlement is expected to be similar or lower. • In areas where new chambers would be constructed, the induced ground settlement is expected to be similar or higher, but still within the limits set in the Conditions of Approval.
Intrusion of saline water which reduces the beneficial uses of an aquifer	Not equivalent assessment to Project EIS	• Saline water intrusion is predicted to occur in areas where the tunnel alignment is close to the Harbour. This would have also occurred for the Approved Project.
Groundwater quality from tunnel materials	No change from Project EIS	• The proposed modified project would not change the materials used for tunnel construction from those described in the EIS. Hence the proposed modification would not change the potential impact to groundwater quality from tunnel materials.

Receptor	Change from Project EIS	Potential impact from the proposed modified project
Groundwater recharge	No change from Project EIS	• The proposed modified project would not change the size or location of areas which will be converted from pervious to impervious surfaces as part of the project. Hence the proposed modification would not change the potential impact to groundwater recharge rates.

Settlement

The change to TBM tunnel excavation of Hawkesbury Sandstone is expected to induce similar or lower ground settlement than the mined tunnelling approach planned for the Approved Project. This is primarily due to the circular shape of the TBM tunnel being more efficient for load distribution when compared with the relatively flat-arched roof of roadheaders as assessed for the Approved Project.

Due to the increased size of excavation, construction of the TBM launch and retrieval chambers may result in an increase in settlement compared to the Approved Project. However, the chambers would be still designed and constructed to ensure project-induced settlement would be limited to less than the rate specified in Condition E104 of the Minister's Conditions of Approval (see Appendix A).

The assessment of potential settlement will be updated during the detailed design development process. Risk mitigation measures will be developed and incorporated into the Project detailed design, construction approach and/or operation, as is required to ensure the Project remains compliant with the project Conditions of Approval. The proposed modified project would continue to comply with the Conditions of Approval in relation to settlement monitoring and response to any issues raised.

8.5.4 Assessment summary

The key findings of the assessment are as follows:

Geology, soil, and contamination

- Potential impacts on geology, soil and contamination would be similar to that assessed for the Approved Project
- The TBM tunnelling method would remove the need for any soil and sediment disturbance within Sydney Harbour when compared to the dredging and excavation proposed in the Approved Project
- Due to the increase in the invert depth of the tunnel, acid sulfate soils are no longer expected to be encountered during the TBM excavation
- The proposed modified project would result in a substantial reduction in the disturbance of contamination.

Groundwater

- The change from a drained to undrained ('tanked') tunnel would negate the requirement for ongoing dewatering. This change would reduce groundwater drawdown, and the potential for drawdown-induced settlement beneath Birchgrove Peninsula (including Yurulbin Park)
- The proposed increase in excavation required for the TBM launch chambers and receival chambers may increase groundwater inflow but would still comply with the Conditions of Approval for the Approved Project
- The proposed modified project would result in less groundwater impacts to receptors compared with the Approved Project.

Groundwater drawdown induced settlement

- The change to TBM tunnel excavation of Hawkesbury Sandstone is expected to induce similar or lower ground settlement than the mined tunnelling approach planned for the Approved Project
- Construction of the TBM launch and receival chambers may result in an increase in settlement compared to the Approved Project. However, the chambers would be still designed and constructed to meet the Conditions of Approval.

8.5.5 Environmental management measures

The impacts to geology, soils, contamination, groundwater, and settlement for the changes to tunnelling and Sydney Harbour crossing works would be generally consistent with those assessed in the Project EIS.

A number of EMMs relating to soils, contamination, groundwater, and settlement would require changes or to be removed. This would comprise:

- Changes to the Soil and Water Management Plan to remove requirements to assess contaminated sediments
- Removal of the Dredge Management Plan
- Changes to SG6 – with respect to removing Easton Park and Birchgrove peninsula (including Yurulbin Park)
- Changes to SG12 – to remove reference to sites no longer affected by the proposed modified project
- Removal of SG15 and SG16 – which relate to marine contamination impacts
- Removal of WQ6 – which relates to monitoring of dredge plumes.

A number of the Minister's Conditions of Approval would require changes or would no longer be required. This would comprise:

- Changes to Condition of Approval C4 (j) – reference to a Dredging and Disposal Management Plan is no longer required
- Removal of Condition of Approval C8 – Dredging and Disposal Management Plan is no longer required
- Changes to Condition of Approval C11 – reference to Marine Monitoring Program and Dredging Monitoring Program is no longer required
- Removal of Condition of Approval C15 and C16 – Marine Monitoring Program and Dredging Monitoring Program is no longer required.
- Changes to Condition of Approval E119 – removes reference to sediments
- Removal of Condition of Approval E204 – offshore disposal of tunnel spoil is no longer required
- Removal of Conditions of Approval E212-E215 – dredging is no longer required.

Further details are provided in Chapters 11 and 12.

No further amendments to the EMMs or the Minister's Conditions of Approval as they relate to soils, contamination, groundwater, and settlement would be required.

8.6 Socio-economics

This chapter provides a summary of the assessment of the potential socio-economic impacts associated with the proposed modified project in comparison to the Approved Project.

A full Social Impact Assessment is provided in Appendix N (Technical Working Paper: Social Impact Assessment).

8.6.1 Assessment Methodology

A Social Impact Assessment (SIA) has been carried out in consideration of the Social Impact Assessment Guidelines (DPE, February 2023), and appropriately scaled to reflect the likely social impacts resulting from the proposed changes to the Approved Project.

The following approach was adapted to prepare the SIA:

- Review of the Project's social locality and baseline identified as part of the Approved Project and consider any changes resulting from the modification
- Using suitable research and data collection methods to consider if the modification will result in any changes to the social impacts identified in the Approved Project
- Identification of any new social impacts resulting from the proposed changes to the Approved Project and proposing arrangements to monitor and manage residual social impacts
- Reporting of findings and outcomes of assessment in a basic SIA report.

The identification of likely social impacts considered the social impact categories outlined in the SIA Guidelines and whether the proposed changes might cause some form of impact (positive or negative, tangible, or intangible) or if the proposed changes reduce or remove a previously assessed social impact.

The categories assessed in the SIA prepared for the modification are identified in Table 8-42.

Table 8-42 Social impact categories assessed for the proposed modified project (from DPE, 2023)

Categories	Definition from the Social Impact Guidelines
Way of life	Including how people live, how they get around, how they work, how they play, and how they interact each day.
Community	Including composition, cohesion, character, how the community functions, and people's sense of place.
Accessibility	Including how people access and use infrastructure, services, and facilities, whether provided by a public, private, or not-for-profit organisation.
Culture	Both Aboriginal and non-Aboriginal, including shared beliefs, customs, values and stories, and connections to Country, land, waterways, places, and buildings.
Health and well-being	Including physical and mental health especially for people vulnerable to social exclusion or substantial change, psychological stress resulting from financial or other pressures, access to open space and effects on public health.
Surroundings	Including ecosystem services such as shade, pollution control, erosion control, public safety and security, access to and use of the natural and built environment, and aesthetic value and amenity.
Livelihoods	Including people's capacity to sustain themselves through employment or business.

8.6.2 Existing environment

The SIA generally adopts the same social environment including the demographic profile considered in the Project EIS, with specific reference to those areas relevant to the proposed modified project. This includes those localities within the social baseline that would be potentially directly or indirectly be impacted by the following five key elements of change to the Approved Project:

- Tunnelling methodology under Sydney Harbour and road geometry changes
- Cavern excavation for the TBM underground launch site (adjacent to Birchgrove Park) and TBM receival chamber (adjacent to Carradah Park)
- Changes to Rozelle Rail Yards construction support site (WHT1) - cut and cover section
- Changes to Glebe Island construction support site (WHT3)
- Changes to Ridge Street North construction support site (WHT9).

The SIA carried out for the Project EIS identified two precincts located to the north and south of Sydney Harbour, referred to as the South Harbour Precinct and North Harbour Precinct. Details of these precincts with respect to demographic profile, housing, social infrastructure, community values, employment centres, and access and connectivity can be found in Section 21 of the Project EIS.

8.6.3 Assessment of potential impacts

Tunnelling under Sydney Harbour

Table 8-43 identifies the changes to social impacts associated with the proposed modified project in relation to the tunnelling below Sydney Harbour. Further details are provided in Appendix N (Technical Working Paper: Social Impact Assessment).

Table 8-43 Summary of SIA assessment - tunnelling below Sydney Harbour

Impact / Opportunity	Existing / new social impact	Extent	Social Impact Categories	Assessed impact – Approved Project	Residual impact significance	Net change in social impact
Changes and delays to marine traffic resulting in negative changes to accessibility for marine users, both businesses, passengers, and recreational users	Existing	• Maritime businesses • Passengers • Recreational users	Accessibility	Moderate to moderate/low	Nil	Removed social impact
Disturbance of contaminated materials in Sydney Harbour changing how people experience the harbour and impacting on the marine environment, something they value	Existing	• Maritime business • Passengers • Recreational users	Surroundings	Raised as concern in the Submissions Report	Nil	Removed social impact
Changes to local amenity and character due to the construction of the temporary cofferdams and on the north and south side of the harbour	Existing	Residents in Rozelle, Birchgrove, Waverton, and North Sydney	Way of life Surroundings Culture	Moderate	Nil	Removed social impact
Operational air quality - With the change in horizontal and vertical geometry, potential changes to air quality have been assessed	Existing	Residents in Rozelle, North Sydney, and Cammeray	Way of life Surroundings Culture	Low	Low (unlikely and minor)	The change in air quality impacts have been determined to not be material
Potential property damage including damage to private properties, heritage buildings and structures of cultural significance due to vibration from tunnelling activities – causing damage to something that people value	Existing	• Owners of properties located near construction worksites, Aboriginal and Torres strait islander peoples, special interest groups • Wider community	Livelihoods Culture	Low	Low (unlikely and minor)	Reduction in negative social impact
Changes to community cohesion due to the temporary disruption of some social infrastructure and meeting places	Existing	• Community • Businesses	Community	Moderate-Low	Nil	Removed social impact

Change to how people access roads and other services, due to increased vehicle movements and traffic management	Existing	• Road users • Residents and Businesses in Birchgrove, Waverton, and North Sydney	Accessibility	Moderate	Low (unlikely and minor)	Reduction in negative social impact

Chamber excavation for TBM underground launch and receival sites

Table 8-44 identifies the changes to social impacts associated with the proposed modified project in relation to the chamber excavation for the TBM underground launch and receival sites. Further details are provided in Appendix N (Technical Working Paper: Social Impact Assessment)

Table 8-44 Summary of SIA assessment – chamber excavation

Impact / Opportunity	Existing / new social impact	Extent	Social Impact Categories	Assessed impact – Approved Project	Residual impact significance	Net change in social impact
Changes to how people access roads and other services, due to increased vehicle movements and traffic management	Existing	Residents in Birchgrove	Accessibility	Moderate	Medium (possible / moderate)	No changes to social impacts
Changes to how people experience noise and ground borne vibration during construction due to additional excavation work, including the potential for indirect impacts on Aboriginal and non-Aboriginal Cultural Heritage items	Existing	• Residents in Birchgrove • Aboriginal and Torres strait islander peoples, special interest groups	Surroundings Culture	Moderate	Low (unlikely and minor)	Reduction in negative social impact

Changes to Rozelle Rail Yards construction support site (WHT12) - cut and cover section

Table 8-45 identifies the new or changes to, social impacts associated with the proposed modified project in relation to the changes to the City West Link Portal construction support site (WHT12) - cut and cover section. Further details are provided in Appendix N (Technical Working Paper: Social Impact Assessment).

Table 8-45 Summary of SIA assessment - City West Link Portal construction support site (WHT12) (cut and cover section)

Impact / Opportunity	Existing / new social impact	Extent	Social Impact Categories	Assessed impact – Approved Project	Residual impact significance	Net change in social impact
Changes to how people access roads and other services, due to increased vehicle movements and traffic management	Existing	Road Users – City West Link	Accessibility	Moderate	Medium (possible / minor)	No changes to social impacts
Changes to amenity due to increased construction traffic hours to 24/7	New	Nearby residents in Lilyfield and Annandale	Way of Life	Not applicable	Low (unlikely and minor)	New social impact with low negative risk

Changes to Glebe Island construction support site (WHT3)

Table 8-46 identifies the new, or changes to, social impacts associated with the proposed modified project in relation to the changes to Glebe Island construction support site (WHT3). Further details are provided in Appendix N (Technical Working Paper: Social Impact Assessment).

Table 8-46 Summary of SIA assessment – Glebe Island construction support site (WHT3)

Impact /Opportunity	Existing / new social impact	Extent	Social Impact Categories	Assessed impact – Approved Project	Residual impact significance	Net change in social impact
Changes to the way people use and experience the Cruise Ship Terminal at White Bay resulting from changes to amenity and character due to the construction site at Glebe Island	Existing	• Maritime businesses • Passengers	Accessibility	Raised as concern in the Submissions Report	Nil	Improved social outcome relating to the removal of the construction site at White Bay (north)
Storage of contaminated materials at Glebe Island construction site changing how people experience their surroundings, something they value	Existing	Balmain residents	Surroundings	Raised as concern during submissions	Negligible	Improved social outcome relating to the removal of the construction site at White Bay (north)
Changes to amenity due to increased construction traffic hours to 24/7	New	Balmain and Pyrmont Residents	Way of Life	Not applicable	Low (unlikely and minor)	New social impact with low negative risk

Changes to the Ridge Street North Construction Support Site (WHT9)

Table 8-47 identifies the new, or changes to, social impacts associated with the proposed modified project in relation to the changes to the Ridge Street North Construction Support Site (WHT9). Further details are provided in Appendix N (Technical Working Paper: Social Impact Assessment).

Table 8-47 Summary of SIA assessment - Ridge Street North construction support site (WHT9)

Impact / Opportunity	Existing / new social impact	Extent	Social Impact Categories	Assessed impact – Approved Project	Residual impact significance	Net change in social impact
Changes to amenity due to site being used as a tunnelling support site and increased construction traffic hours to 24/7 Increase in noise due to the addition of activities that are occurring on the site	New	Residents along haulage route including Ridge Street	Way of Life	Not applicable	Low (unlikely and minor)	New social impact with low negative risk
Increase of parking provisions with the construction support site	Existing	Nearby businesses, including those on Ridge Street	Way of life Accessibility	Moderate	Medium (possible / minor)	Slight reduction in social impacts due to increase in available parking within the construction site for workers
Changes to the visual aesthetics due to the addition of an acoustic shed	New	Visitors to and workers of the Local Greens Bowling Club	Surroundings	Not applicable	Low (unlikely and minor)	New social impact with low negative risk

8.6.4 Assessment summary

The change in construction methodology would largely result in reduced or removed social impacts. By launching the TBM completely underground, it would remove the need for construction sites and cofferdams at Birchgrove and Waverton. It would also remove the need for dredging in Sydney Harbour – removing the impacts on existing harbour operations, including businesses and watercraft users.

There would be reduced or removed social impacts relating to amenity and access for those people who would likely have experienced a negative change due to the proposed temporary construction sites at Yurulbin Point and Berrys Bay, and cofferdams at Yurulbin Point and Balls Head. The removal of dredging would also mean there would be no impacts to Birchgrove Wharf.

The proposed modified project would introduce some new negative social impacts due to the proposed changes at the Ridge Street North site, however with the implementation of existing mitigation measures the magnitude of these impacts would be low.

8.6.5 Environmental management measures

The impacts associated with socioeconomics as a result of the proposed modified project for tunnelling and Sydney Harbour crossing works would be generally consistent with those identified for the Approved Project.

One EMM (LP4, associated with the IMT construction works and temporary relocation of moorings) would no longer be required. Further details are provided in Chapter 12.

No further EMMs or changes to social impact EMMs would be required.

No further amendments to the Minister's Conditions of Approval as they relate to social impacts would be required.

8.7 Urban design and visual amenity

This section provides an assessment of urban design and visual amenity of the proposed modified project. The only additional visual impacts associated with the proposed modified project would be the installation of an acoustic shed at the Ridge Street North construction support site (WHT9). Visual impacts would be significantly reduced in a number of other locations due to the removal of construction support sites at Victoria Road, Yurulbin Point, Berrys Bay, and Sydney Harbour north and south cofferdams. As such, this section only assesses potential visual amenity impacts associated with the proposed acoustic shed at the Ridge Street North construction support site (WHT9).

8.7.1 Assessment methodology

The Project EIS assessed the impacts on landscape character, by establishing landscape character zones (LCZ) for the study area. LCZs are defined as 'areas having a distinct character and consistent pattern of elements, including natural elements (e.g., soil, vegetation and landform) and/or human built form, making one landscape different from another'. Representative viewpoints with the potential to be visually impacted by elements of the project were identified for further analysis. Viewpoints were selected to show:

- A range of receptor types including public and private domain views (including residents, motorists, and users of public open space)
- A range of view types including elevated, panoramic, and filtered views
- A range of viewing distances from the Project
- Key or protected views identified in planning documents.

Potential impacts assessed for the Approved Project

The Ridge Street North construction support site (WHT9) was assessed in the Project EIS as a distinct and separate precinct with three key viewpoints:

- Viewpoint 1 – St Leonards Park open space
- Viewpoint 2 – North Sydney Bowling Club
- Viewpoint 3 – Residents on Ridge Street.

The Project EIS established the following visual amenity impacts that would be expected from the establishment and operations of the Ridge Street North construction support site (WHT9):

- A high temporary and localised visual impact was expected on the immediate park area surrounding the construction support site (viewpoint 1) due to this area of the park becoming inaccessible and views to and from the site being limited.

- A moderate to high visual impact was expected in the EIS from the North Sydney Bowling Club and dwellings on Ridge Street (viewpoints 2 and 3) due to the presence of temporary site hoardings, construction equipment and additional vehicle movements.
- High to moderate impacts were expected to reduce over time with the application of environmental management measures, particularly in respect to the maturing of replacement planting during the construction period.
- A moderate impact on night-time visual amenity could be expected for St Leonards Park and North Sydney Bowling Club users, and receivers at Ridge Street dwellings due to an increase in light sources as part of the construction works. Upon the completion of works, the area affected during construction would be returned to its pre-existing condition.
- There are likely to be temporary landscape impacts on the public open space surrounding the construction support site and adjacent residential dwellings. The increase in built form such as site offices and hoardings, would be incongruous within the existing undeveloped landscape character of the park. Once construction is complete and the site re-vegetated, no lasting impacts on landscape character are expected.

8.7.2 Assessment of potential impacts

The introduction of an acoustic shed at the Ridge Street North construction support site (WHT9) is expected to change the view from each of the three viewpoints assessed for the Approved Project. However, the change in visual impact would be no greater than what was assessed for the Approved Project.

The acoustic shed colour would be sympathetic to the environment it is located in and would be separated from residential premises by around 50 metres. It would also be located on part of the site which is generally lower and closer to the Warringah Freeway. Existing trees along Ridge Street would also filter the views of the acoustic shed from residents located on Ridge Street. This will mean that the acoustic shed will not significantly impose on any main views across the Warringah Freeway to Neutral Bay and the Sydney CBD.

Visualisations of the proposed site set up including the acoustic shed is provided in Figure 8-13 to Figure 8-15. The acoustic shed is not expected to be visible above the hoarding from the street level on Ridge Street, nor

from the North Sydney Bowling Club. The acoustic shed would be seen from a high point in St Leonards Park as shown in Figure 8-15. However, it would not block the view, nor would it be visually intrusive to park users.

Figure 8-13 Preliminary visualisation of the Ridge Street North construction support site (WHT9) layout during tunnelling from the viewpoint at 95 Ridge Street.

Figure 8-14 Preliminary visualisation of the Ridge Street North construction support site (WHT9) layout during tunnelling from the viewpoint from North Sydney Bowling Club.

Figure 8-15 Preliminary visualisation of the Ridge Street North construction support site (WHT9) layout during tunnelling from the viewpoint from St Leonards Park. The acoustic shed can be seen in the left-hand side of the image.

With respect to potential night-time lighting impacts, the night-time visual amenity impact would not change. All night-time construction activities would occur within the acoustic shed, and lighting would be no greater than what has already been assessed in the Project EIS. Consistent with the environmental management measures identified in the Project EIS, site lighting would be designed to minimise glare issues and light spillage into adjoining properties and be generally consistent with the requirements of Australian Standards and Guidelines 4282 – 1997 Control of the obtrusive effects of outdoor lighting.

Once construction is complete, the acoustic shed and construction support site would be removed, and the area returned to parkland as described in the Project EIS. Details of the return of open space will be subject to the Place Design and Landscape Planning process that is described in the Minister's Conditions of Approval E156-E181.

8.7.3 Assessment summary

The Approved Project was assessed to have a moderate to high visual impact during construction for residential, business, and recreational receivers that overlook the Ridge Street North construction support site (WHT9). The natural topography of the site means the acoustic shed would not significantly impose on any main views across the Warringah Freeway to Neutral Bay and the Sydney CBD. Overall, the addition of the acoustic shed at the site would lead to minor changes to viewpoints experienced, however these would not be inconsistent with what was assessed for the Approved Project.

Once construction is completed there is not expected be any change to what has already been characterised in the Project EIS.

8.7.4 Environmental management measures

The impacts to urban design and visual amenity for the changes to tunnelling and Sydney Harbour crossing works would be generally consistent with the impacts identified for the Approved Project.

No changes to EMMs in relation to urban design and visual amenity would be required

The following Minister's Conditions of Approval would be removed or changed as a result of the proposed modified project:

- Removal of Condition of Approval E158 – the requirement to retain certain building facades is no longer required as there would be no impact from the proposed modified project.
- Removal of Condition of Approval E188 – a design to reinstate Yurulbin Park no longer required as it would no longer be impacted by the proposed modified project

- Changes to Condition of Approval E191 – changes to the timeframe for public domain works.

Further details are provided in Chapter 11.

No further amendments to the Minister's Conditions of Approval as they relate to urban design and visual amenity would be required.

8.8 Hazards and risks

This chapter assesses potential hazards arising from incidents during project construction that could pose a risk to public safety, the surrounding community or the environment and summarises the approaches taken to manage these potential risks.

8.8.1 Assessment methodology

During construction, potential hazards and risks to public safety, the surrounding community or the environment may be associated with:

- Storage and handling of dangerous goods and hazardous substances
- Transport of dangerous goods and hazardous substances
- Ground movement (settlement) or geotechnical uncertainty
- Damage to or disruption of underground utilities and services
- Bushfires.

An assessment was carried out to identify any additional environmental hazards and risks that could arise for the proposed modified project when compared to the Approved Project.

The assessment focused on those hazards with the potential to adversely affect the surrounding environment and the general public, and took into account the following guidelines:

- Hazardous and Offensive Development Application Guidelines: Applying SEPP 33 (Department of Planning, 2011)
- Australian Code for the Transport of Dangerous Goods by Road and Rail (7th edition) (National Transport Commission, 2007)
- Storage and Handling of Dangerous Goods Code of Practice (WorkCover, 2005)
- Planning for Bushfire Protection (Rural Fire Service (RFS), 2006)
- Bush Fire Risk Management Planning Guidelines for Bush Fire Management Committees (RFS, 2008)
- Bushfire prone land mapping developed and published by the relevant local councils.

8.8.2 Assessment of potential impacts

Storage, handling and transport of dangerous goods and hazardous substances

The anticipated types and quantities of dangerous goods and hazardous substances that would be stored and used within the project construction support sites are listed in Table 23-2 of the Project EIS. Table 8-48 identifies additional quantities of dangerous goods and hazardous substances associated with the proposed modified project.

Table 8-48 Indicative dangerous goods and hazardous substances associated with the modification to be stored at construction support sites

Material	Australian Dangerous Goods Code Class	Storage method	Purpose on site	Construction support site
Bentonite	N/A	Within bulk silos (30-50t) in vicinity of underground Slurry Treatment Plant	Bentonite used for slurry in the STP	City West Link Portal (WHT12) – underground support facility

Material	Australian Dangerous Goods Code Class	Storage method	Purpose on site	Construction support site
Flocculant / Polymer	N/A	1000 litre intermediate bulk containers (IBC) or Bulker Bags at underground Slurry Treatment Plant and buffer storage at Glebe Island Site	Used for mud management (sludge thickening / dewatering) at STP	City West Link Portal (WHT12) – underground support facility and Glebe Island (WHT3) surface support site
Sodium Silicate (Water Glass)	N/A Not Dangerous Goods according to the criteria of the Australian Code for the Transport of Dangerous Goods by Road & Rail (ADG Code)	Delivery by single or B-double tankers to bulk tanks (20-30kL total capacity)	Component B (accelerator) for Tunnel Lining Backfill Grout	City West Link Portal (WHT12) – underground support facility
Retarder (for Grout)	N/A	1000 litre intermediate bulk containers (IBC)	Part of Component A (grout) for Tunnel Lining Backfill Grout	City West Link Portal (WHT12) – underground support facility
Polyurethane Foams and Resins	N/A	20 to 60 litre drums	Used for sealing of cracked concrete lining or leaking lining joints (relatively small quantities)	City West Link Portal (WHT12) – underground support facility and Glebe Island Surface Support Site
Dry Breathable Oxygen	N/A	Manifolded Cylinder Packs of 9-15 G sized high-pressure cylinders	For Hyperbaric Works on TBMs	City West Link Portal (WHT12) – underground support facility and Glebe Island (WHT3) surface support site

Proposed haulage routes associated with the proposed modified project are identified in Section 8.1 and would be generally consistent with the Approved Project. Consistent with the Approved Project, haulage routes have been identified to avoid local roads where possible. This would minimise any risks associated with the transport of dangerous goods and hazardous materials.

Ground movement and geological uncertainty

Ground movement (or settlement) refers to a localised lowering of the ground level due to construction activities involving excavation or disturbance below ground. If unmanaged, ground movement can present a risk to the stability of nearby buildings and other structures, including building basements and ground support structures.

An assessment of potential ground movement as it related to the proposed modified project is provided in Section 8.5 (Geology, soils, and groundwater) which indicates that impacts would be similar to the Approved Project.

Damage or disruption to underground utilities

The modification has been designed, where possible, to avoid utilities taking into account the results of utility investigations and consultation with utility providers carried out during the design process.

Consultation with utility infrastructure providers would continue during the design and construction phases of the project to mitigate the risk of unplanned and unexpected disturbance of utilities related to the modification.

Bushfires

The bushfire risk assessment undertaken for the Project EIS noted that in accordance with Planning for Bushfire Protection (RFS, 2006), the predominant vegetation class (bushfire prone land) has been assessed to a distance of 140 metres from the project in all directions.

With the removal of the Berrys Bay construction support site, no terrestrial sites would be located within 140 metres of bushfire prone land.

8.8.3 Assessment summary

Overall, the hazards and risks associated with the proposed modified project would be consistent with those already assessed for the Approved Project.

8.8.4 Environmental management measures

The impacts to hazards and risks for the changes to tunnelling and Sydney Harbour crossing works would be generally consistent with those identified for the Approved Project.

Changes to a number of EMMs associated with the removal of IMT construction works would be required. This would comprise:

- HR3
- HR4
- HR5

The above EMMs relate to the Berrys Bay construction support site (WHT7) which is no longer required. Further details are provided in Chapter 12.

No additional EMMs or other changes to hazards and risks EMMs would be required.

No further amendments to the Minister's Conditions of Approval as they relate to hazards and risks would be required.

9. Assessment of impacts - Emu Plains construction support site (WHT13)

This Chapter provides an assessment of the impacts of the proposed new construction support site at Emu Plains (WHT13). This site would only be used during the construction of the proposed modified project and as such, the impacts assessed only relate to the construction stage.

9.1 Construction traffic and transport

This section provides a summary of the traffic and transport assessment for works associated with the construction support site at Emu Plains (WHT13). A detailed traffic and transport assessment has been carried out and is provided in Appendix D (Technical Working Paper: Traffic and transport - construction).

9.1.1 Assessment methodology

The additional heavy and light vehicle traffic proposed for the Emu Plains construction support site (WHT13) has been modelled in SIDRA Intersection 9.1 software. The modelling has been conducted using the Sydney Coordinated Traffic System (SCATS) data from November 2022, as well as on-site traffic counts and observations at the un-signalised intersections. The on-site traffic counts were carried out on the 29 and 30 March 2023.

The addition of the new roundabout at the intersection of Smith Street and Old Bathurst Road, Emu Plains has also been included, along with assumptions made as part of the planning approval documents associated with the recently constructed commuter carpark opposite Smith Street on Old Bathurst Road.

The average delay of each of the key intersections assessed as part of the modelling analysis has been categorised based on the Level of Service (LoS) criteria as outlined in Section 8.1 above.

Construction traffic routes

The site was assessed under “worst-case” scenarios, with all heavy traffic using only Route A or Route B to allow for any possible variance during construction.

Route A for egress would be: Railway Street – Lee Street – Smith Street – Old Bathurst Road – Great Western Highway – Russell Street (south) - M4 Motorway and the reverse for entry.

Route B for egress would be: Railway Street – Lee Street – Smith Street – Old Bathurst Road – Russell Street (north) – Russell Street (south) – M4 Motorway and the reverse for entry.

The proposed Route A and Route B construction traffic routes are shown in Figure 9-1.

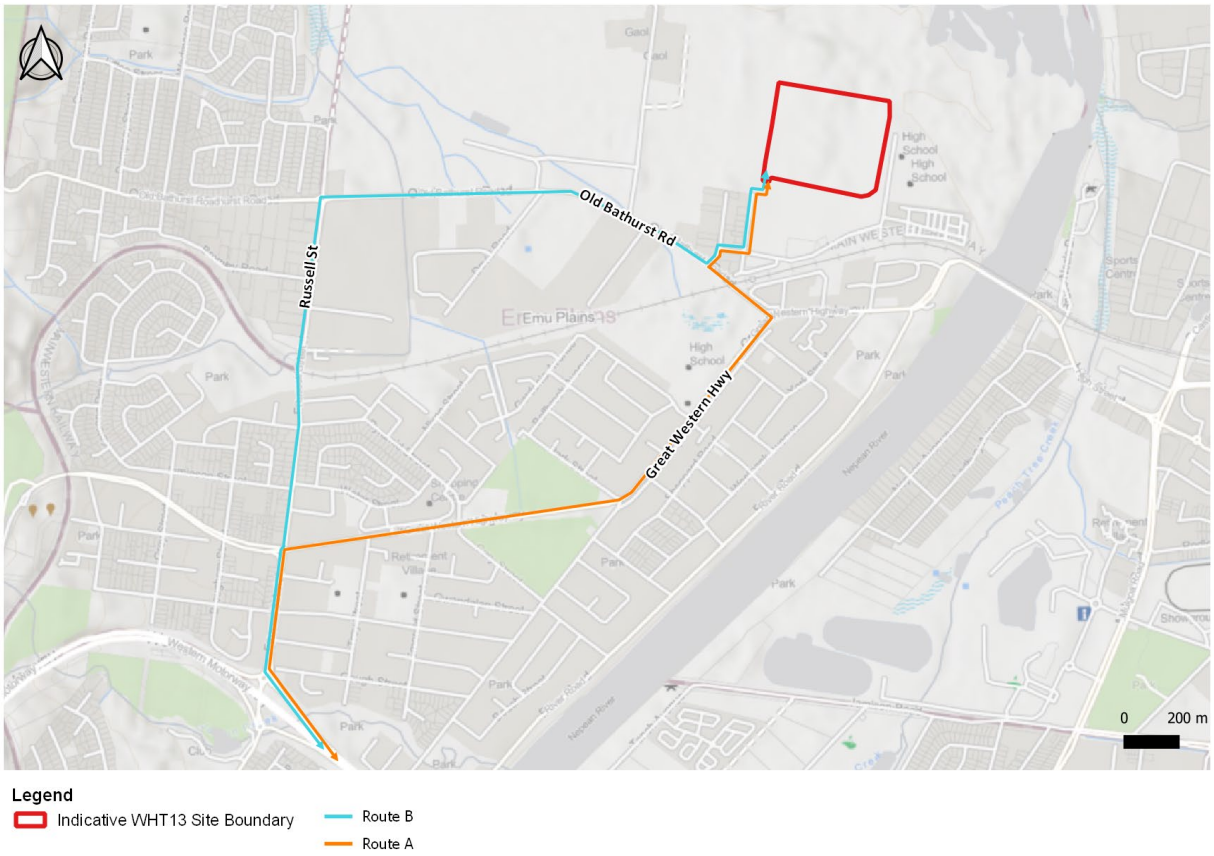


Figure 9-1 Proposed construction access routes (Route A and B) for the Emu Plains construction support site (WHT13).

Route A and Route B have both been assessed to allow some flexibility of construction routes during project delivery. The use of these routes would vary depending on the origin and destination and size of the vehicles wishing to access the site. Other triggers to alternate between the routes may be conflicting road occupancy works on the Great Western Highway or other construction activities on either of the routes to ensure minimal delay is experienced by construction vehicles.

Routes may also be amended to manage impacts throughout the 24-hour period, for example, Route A would be the preferred route between 10pm and 7am to minimise the potential impact from construction traffic noise generated by heavy vehicle movements.

Construction vehicle assumptions

Figure 9-1 shows the anticipated peak vehicle movements assumed for the Emu Plains construction support site (WHT13).

For the purposes of the modelling assessment, the peak construction volumes have been equally split over the daily (24-hour) totals. A portion of light vehicle movements have been assumed to arrive and depart in the AM and PM peak periods assuming typical shift change operations.

Table 9-1 Peak construction vehicle movements – Emu Plains construction support site (WHT13)

Construction support site	Proposed access point	Peak vehicle movements per day		Morning peak 4-hour vehicle movements (6am to 10am)		Evening peak 4-hour vehicle movements (3pm to 7pm)	
		Light	Heavy	Light	Heavy	Light	Heavy
Emu Plains (WHT13)[1]	Railway Street	100	180	50	30	10	30

Note 1 Majority of vehicle movements would be outside of peak hours. Segments would be transported between 7pm and 7am, and majority of other HV movements would occur during day-time hours

9.1.2 Existing environment

Roads immediately surrounding the site, Railway Street, Lee Street and Smith Street are classified as local roads. To the south, Old Bathurst Road and Russell Street are classified as regional roads. Local and regional roads are managed and maintained by local council. The Great Western Highway and the M4 Motorway are classified as State Roads and are managed and maintained by Transport for NSW.

Figure 9-2 shows the road classification of roads immediately surrounding the Emu Plains construction support site (WHT13) as well as those proposed to be utilised for construction traffic.

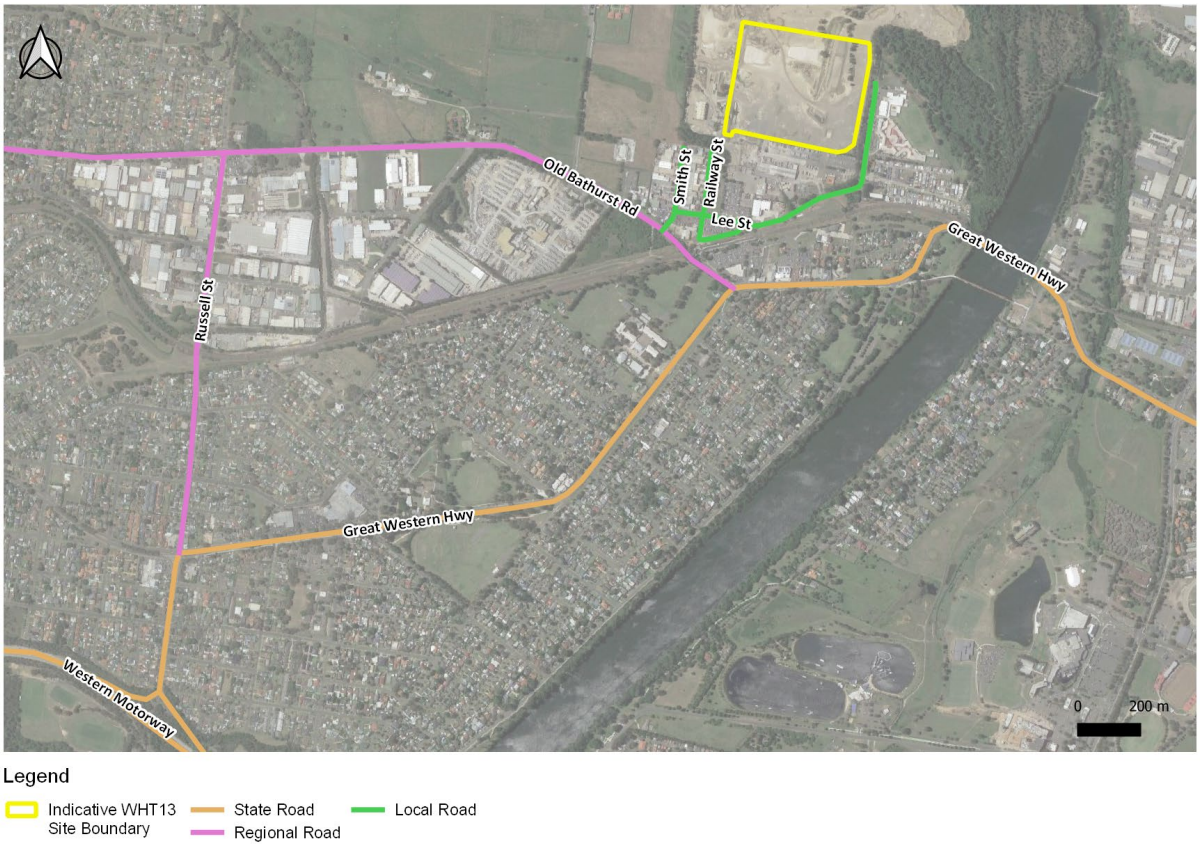


Figure 9-2 Road classification for key project roads in the vicinity of the Emu Plains construction support site (WHT13)

Traffic volumes

A summary of existing and with project peak hour traffic volumes and heavy vehicle percentages for roads potentially impacted by the Emu Plains construction support site (WHT13) are shown in Table 9-2.

Table 9-2 Existing peak hour traffic volumes in the vicinity of the Emu Plains construction support site (WHT13)

Road	Direction	Morning peak hour volume		Evening peak hour volume	
		Total vehicles	% heavy vehicles	Total vehicles	% heavy vehicles
Russell Street south of Old Bathurst Road	Northbound	497	16%	552	9%
	Southbound	450	11%	384	7%
Old Bathurst Road east of Russell Street	Eastbound	802	4%	612	4%
	Westbound	436	9%	936	5%
Smith Street north of Old Bathurst Road	Northbound	355	11%	83	7%
	Southbound	238	15%	170	3%
Old Bathurst Road east of Smith Street	Eastbound	527	2%	498	7%
	Westbound	757	1%	737	4%

Public transport network

There are no bus stops or public bus routes located along Old Bathurst Road between the roundabout with Russell Street and the intersection with Great Western Highway.

Emu Plains Railway station is located around 300 metres south of the Emu Plains construction support site (WHT13). This station is situated on the T1 and Blue Mountains Line with trains departing to the Blue Mountains and Sydney at approximately 6-to-8-minute intervals in the AM Peak (8-9 am) and PM Peak (5-6 pm).

Public transport is supported by two commuter carparks adjacent to the railway station. One additional commuter carpark is currently being constructed between Old Bathurst Road and the train line.

Active transport network

The proposed Emu Plains construction support site (WHT13) site is in an area not easily accessed by walking. Factors such as no active frontages on nearby roads, no points of interest, the limited number of houses and predominantly industrial premises situated in the vicinity restrict the uptake and attractiveness of walking.

Footpaths exist in the area generally connecting to Emu Plains Railway Station to the south. It is noted that new and safe pedestrian links will be provided from the new Emu Plains Commuter Car Park direct to Emu Plains Railway Station.

There are no cycle paths that connect directly to the Emu Plains construction support site (WHT13). Consequently, under the NSW Road Rules, people aged 16 and above would be required to cycle in mixed traffic conditions to reach the site. There is a shared path along a portion of the Great Western Highway. This path connects directly to Mulgoa Road in Penrith and the Western Motorway.

Existing intersection performance

The morning and evening peak hour LOS at relevant intersections in Emu Plains are shown in Table 9-3 below.

The existing intersection performance acts as the baseline for the construction traffic and transport assessment. This baseline takes into account the traffic that exists as a result of the commuter carpark construction as well as typical traffic from the existing Boral quarry site.

Table 9-3 Modelled existing intersection performance – Emu Plains construction support site (WHT13)

Intersection	Level of Service- Morning Peak	Level of Service- Evening Peak
Russell Street / Old Bathurst Road	A	F
Russell Street / Great Western Highway	D	D
Old Bathurst Road / Great Western Highway	C	B
Old Bathurst Road / Smith Street	A	B

The table indicates that all intersections generally operate at an acceptable LoS with the exception of the Russell Street / Old Bathurst Road intersection during the evening peak.

9.1.3 Assessment of potential impacts

Road network

The potential changes to the road network with respect to the total and percentage of heavy vehicles using either the A or B access routes during the AM and PM peaks are shown in Table 9.4 and Table 9-5 respectively. To assess a worst case, the numbers provided assume all traffic uses either Route A or Route B.

Table 9-4 Total vehicle and percentage heavy vehicles on Route A and Route B without and with the proposed modified project for the morning peak period – Emu Plains construction support site

Road	Direction	Morning peak hour			
		Existing (without project)		With project	
		Total vehicles	% heavy vehicles	Total vehicles	% heavy vehicles
Russell Street south of Old Bathurst Road[2]	Northbound	497	16%	507	16%
	South bound	450	11%	460	12%
Old Bathurst Road east of Russell Street[2]	Eastbound	802	4%	812	5%
	Westbound	436	9%	446	10%
Smith Street north of Old Bathurst Road	Northbound	355	11%	365	12%
	South bound	238	15%	248	16%
Old Bathurst Road east of Smith Street[1]	Eastbound	527	2%	527	2%
	Westbound	757	1%	767	2%

1 all construction traffic via Route A

2 all construction traffic via Route B

Table 9-5 Total vehicle and percentage heavy vehicles on Route A and Route B without and with the proposed modified project for the peak evening period – Emu Plains construction support site

Road	Direction	Evening peak hour			
		Existing (without project)		With project	
		Total vehicles	% heavy vehicles	Total vehicles	% heavy vehicles
Russell Street south of Old Bathurst Road[2]	Northbound	552	9%	557	9%
	South bound	384	7%	389	8%
Old Bathurst Road east of Russell Street[2]	Eastbound	612	4%	617	5%
	Westbound	936	5%	941	6%
Smith Street north of Old Bathurst Road	Northbound	83	7%	88	11%
	South bound	170	3%	175	5%
Old Bathurst Road east of Smith Street[1]	Eastbound	498	7%	503	8%
	Westbound	737	4%	742	5%

Table 9-4 and Table 9-5 indicates that the change in heavy vehicle numbers and percentages with the use of either Route A or Route B would be very minor, generally around one per cent or less (maximum of three per cent) on any road.

Intersection performance

Table 9-6 and Table 9-7 below show the existing and proposed performances of the intersections potentially impacted by the Emu Plains construction support site (WHT13) using either Route A or Route B for the AM and PM peak respectively.

Table 9-6 Modelled morning peak hour intersection performance with and without construction – Emu Plains construction support site (WHT13)

Intersection / peak period	2026 'without construction traffic' – LOS (average delay in seconds)		2026 'with construction traffic' – LOS (average delay in seconds)	
	Average delay (sec)	Level of Service	Average delay (sec)	Level of Service
Russell Street / Old Bathurst Road	8.1	A	8.7	A
Russell Street / Great Western Highway[1]	49.7	D	52.2	D
Russell Street / Great Western Highway[2]	49.7	D	51.3	D
Old Bathurst Road / Great Western Highway	41.0	C	41.6	C
Old Bathurst Road / Smith Street[1]	16.7	B	20.5	B
Old Bathurst Road / Smith Street[2]	16.7	B	19.5	B

1 all construction traffic via the Route A

2 all construction traffic via Route B

Table 9-7 Modelled evening peak hour intersection performance with and without construction – Emu Plains construction support site (WHT13)

Intersection / peak period	2026 'without construction traffic' – LOS (average delay in seconds)		2026 'with construction traffic' – LOS (average delay in seconds)	
	Average delay (sec)	Level of Service	Average delay (sec)	Level of Service
Russell Street / Old Bathurst Road	168.1 sec	F	173.0 sec	F
Russell Street / Great Western Highway[1]	54.7 sec	D	56.9 sec	D
Russell Street / Great Western Highway[2]	54.7 sec	D	59.4 sec	D
Old Bathurst Road / Great Western Highway	24.3 sec	B	24.5 sec	B
Old Bathurst Road / Smith Street[1]	8.4 sec	A	8.8 sec	A
Old Bathurst Road / Smith Street[2]	8.4 sec	A	8.7 sec	A

1 all construction traffic via Route A

2 all construction traffic via Route B

Table 9-6 and Table 9-7 indicate:

- During the AM and PM peak, the addition of project related vehicles would not change the existing LoS at key intersections with the use of either Route A or Route B.
- The roundabout at Russell Street and Old Bathurst Road has some existing delay and congestion issues during the evening peak period. Changes associated with the proposed modified project would be minor.

Local road and parking

To facilitate safe vehicle access and egress, minor temporary parking modifications (line marking and signage) would be required at the intersection of Lee Street and Smith Street to accommodate the swept paths of heavy vehicles. These are shown in Figure 9-3.

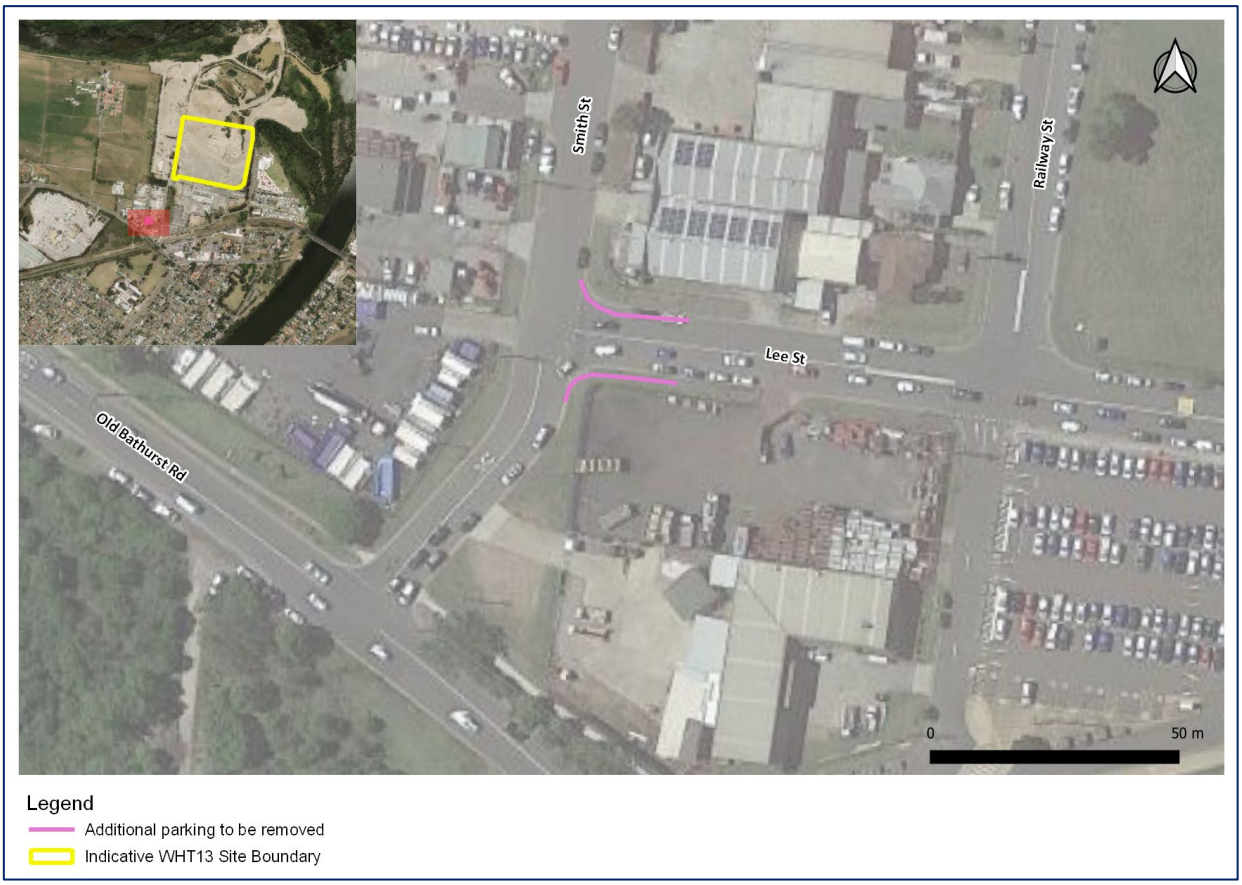


Figure 9-3 Local road and proposed parking adjustments – Emu Plains construction support site (WHT13).

This would require the removal of approximately 12 metres of the eastbound shoulder of Lee Street and the subsequent removal of 2-3 untimed parking spaces. Removal of a similar amount of parking spaces would also be needed on the westbound shoulder of Lee Street approaching the Smith Street intersection and would result in the loss of an additional 2-3 untimed parking spaces.

Impacts on public transport

A new commuter carpark is currently being constructed adjacent to the Emu Plains Railway station. The operation of both the carpark and train station would be unaffected by the project.

A number of bus routes operate within the area including routes 688, 689 and 691. The routes primarily use the Great Western Highway and Russell Street. Route 688 accesses streets in Emu Heights to the north and is accessed using the Old Bathurst Road intersection with Russell Street.

There would be negligible changes to the existing travel times for buses as a result of the additional vehicle movements associated with the project.

Impacts on active transport

The Transport for NSW *Cycleway Finder* outlines varied provisions for cycle access on the roads shown in the routes for the site. These routes include both off-road cycle shared paths and some on-road cycle access (as part of Route B via Old Bathurst Road).

There are no anticipated changes or modifications to the existing cycle routes in the area because of the inclusion of the Emu Plains construction support site (WHT13).

9.1.4 Assessment summary

The establishment and operation of the proposed Emu Plains construction support site would result in a negligible impact to the existing intersection performance.

Up to 6 parking spaces on Lee Street would need to be removed to facilitate safe truck turning movements. These changes would have very minor impact on the demand for parking given the existing availability of on-street parking.

9.1.5 Environmental Management measures

The overall impacts from the construction traffic and transport changes associated with the proposed modified Project are generally considered to be minor in nature. No additional mitigation measures relating to traffic and transport would be required as a result of the proposed modified Project.

No further environmental management measures are considered necessary beyond those required for the Approved Project. No amendments to the Minister's Conditions of Approval as they relate to construction traffic and transport would be required.

9.2 Construction noise and vibration

This section provides a summary of the noise and vibration impacts associated with the Emu Plains construction support site (WHT13). A detailed noise and vibration assessment has been carried out and is provided in Appendix F2 (Technical Working Paper Noise and Vibration – Emu Plains construction support site (WHT13)).

9.2.1 Assessment methodology

The methodology for the assessment of noise and vibration impacts includes the following steps:

- Identification of noise sensitive receivers and noise catchment areas
- Development of a study area for the assessment, including construction traffic noise
- Background noise monitoring to determine existing noise levels
- A construction noise assessment to predict noise levels that may be generated by the project including airborne noise, ground-borne noise, and vibration
- Identification of environmental management measures to avoid, minimise and manage noise and vibration impacts during construction of the project, including initial identification of potential noise barrier requirements along with areas where further mitigation may need to be considered.

Standards and guidelines

The noise and vibration assessment objectives and criteria applied to the proposed modified project are the same as those used in the Project EIS and included criteria for:

- Air borne noise – residential (including sleep disturbance), non-residential sensitive receivers
- Construction traffic noise
- Vibration – structural
- Vibration – human comfort

Although the proposed site will be operating to support the construction of the project, criteria for the operation of the facility has been determined using the EPA Noise Policy for Industry (NPfI), as the site would operate in a similar industrial manner with similar emissions to facilities assessed under the NPfI.

9.2.2 Existing environment

The existing land uses surrounding the Emu Plains construction support site (WHT13) are predominantly commercial and industrial with some local residential areas to the south of the site and educational establishments to the east.

The nearest residential receiver is the Ingenia Holidays Nepean River holiday park, which is located about 100 metres from the eastern boundary of the site. A single residential receiver is also located on the northwest corner of the intersection of Lee Street and Railway Street. Other residential areas are situated between the Main Western Railway Line and the Great Western Highway. Two educational facilities, CathWest Innovation College and Penola Catholic College are located to the east of the site on Mackellar Street. There is an earth mound on the western side of Mackellar Street which provides a screen from the two educational facilities to the existing Boral site.

The location of Emu Plains construction support site (WHT13) relative to the nearest receivers is shown in Figure 9-4. Receivers surrounding the site are included in the assessment and have been grouped into Noise Catchment Areas (NCAs) which are generally classified by land use to assist in assessing potential impacts.

Ambient noise levels were measured at the southwest and southeast corners of the site and are shown in Figure 9-4.

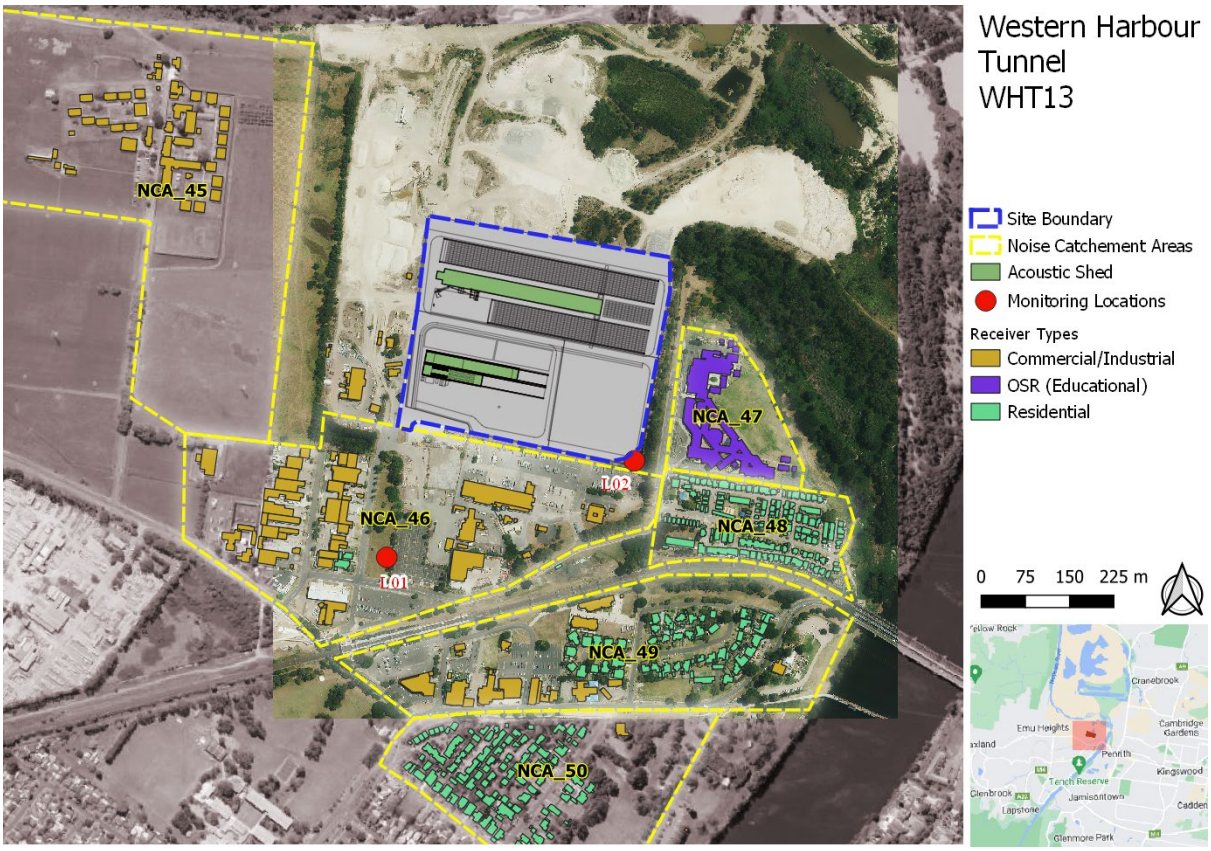


Figure 9-4 Noise Catchment Areas - Emu Plains construction support site (WHT13).

Ambient noise monitoring

Ambient noise levels were measured at the southwest and southeast corners of the site. Unattended background noise monitoring results are summarised for each monitoring location in Table 9.8.

Table 9-8 Summary of unattended noise monitoring results – Emu Plains construction support site (WHT13)

Monitoring location	Existing Noise level (dBA)[1]		
	Day RBL	Evening RBL	Night RBL
L01 – Railway Street	42	42	36
L02 – South east corner	39	39 (41[2])	36

1. Daytime is 7.00 am to 6.00 pm, evening is 6.00 pm to 10.00 pm and night-time is 10.00 pm to 7.00 am.

2. RBL for evening set at no greater than the daytime, and RBL for night-time set no greater than the day or evening following conservative principles outlined in the Noise Policy for Industry (EPA 2017).

9.2.3 Assessment criteria

Site establishment

In accordance with Table 2 of the Interim Construction Noise Guideline (ICNG), project-specific construction NMLs for each receiver type have been determined using the measured ambient noise levels (RBLs) and are presented in Table 9-9.

Table 9-9 Project Construction Noise Management Levels

Land use	Noise Management Level dB(A)				Sleep disturbance screening criteria
	Standard hours	OOHW			
	Day	Day	Evening	Night	
NCA46 – L01 - Railway Street	52	47	47	41	51
NCA48, 49 and 50 – L02- Southeast corner	49	44	44	41	51
Educational	55	55	55	55	-
Commercial / industrial	70/75				-

Note: site establishment works will generally be limited to standard daytime hours. Out of hour NMLs have been included in the event any works such as utility adjustments or work undertaken under a ROL are required.

As residential areas are generally located to the south-east of the site, the NMLs for these residential receivers are based on the RBL taken from L02. Residential dwellings located within NCA 46 have been assessed using the RBL for daytime and evening at L01.

Site operations

In accordance with the EPA's *Noise Policy for Industry* (NPfI), the project specific noise trigger levels for the nearest residential receivers, commercial and educational receivers are shown in Table 9-10. The lower of the intrusive and amenity criteria are highlighted and have been adopted for this assessment.

Table 9-10 Project Operational Noise Management Levels

NCA	Land use	Period	Recommended amenity noise level, LAeq (dBA)	Measured noise level (dBA)		Project noise trigger levels, LAeq, 15min (dBA)	
				Rating background level	Leq (period)	Intrusiveness	Amenity
NCA 48, 49, 50	Residential (suburban)	Day	55	39	58	**44**	58
		Evening	45	39	49	**44**	48
		Night	40	36	47	**41**	43
NCA 45,46	Commercial	When in use	65	-	-	-	**68**
NCA 47	Educational	When in use	35	-	-	-	**45***

Note Internal amenity criteria with 10 dB(A) correction for external noise values*

Construction Traffic

While operating within the construction site, construction vehicles are assessed as part of the construction activities. However, once these vehicles leave the construction site and enter public roads, they are assessed as road traffic.

The DECCW (2011) *Road Noise Policy* (RNP) is generally adopted to assess the impact of construction traffic on public roads. A screening test is first applied to establish whether existing road traffic noise levels will increase by more than 2 dB due to construction traffic. Where any noise increase is less than 2 dB, the objectives of the Road Noise Policy have been met.

Where the road traffic noise levels are predicted to increase by more than 2 dB as a result of construction traffic, consideration should be given to feasible and reasonable noise mitigation measures to reduce the potential noise impacts and preserve acoustic amenity.

In considering feasible and reasonable mitigation measures, the actual noise levels associated with construction traffic are assessed against the road traffic noise criteria in the RNP as follows:

- For existing freeway/ arterial/ sub-arterial roads - 60 dB LAeq(15hour) day and 55 dB LAeq(9hour) night.
- For existing local roads - 55 dB LAeq(1hour) day and 50 dB LAeq(1hour) night.

9.2.4 Assessment of potential impacts

Construction activities and source noise levels

The noise and vibration impact assessment for construction activities has been divided into site establishment activities and operation.

Site establishment

Sound power levels and predicted noise levels would depend on the number of plant items operating and their precise location relative to a sensitive receiver. Plant and equipment proposed for site establishment are listed in Table 9-11 together with estimated sound power levels for each phase of the works.

Table 9-11 Summary of site establishment activities and equipment – Emu Plains construction support site (WHT13)

Phase		Noise generating equipment		Estimated sound power level, dBA[1]
		No.	Type / size	
1.	**Site Preparation**			
1a	Perimeter fence install	1	5t excavator w/ auger and pneumatic post driver	95
1b	Site shed and amenities install	1	Tipper truck	98
		1	Franna	98
		1	Semi-trailer Hiab truck	103
1c	Hardstand install and bulk earthworks	1	Smooth drum roller	109
		1	15,000L water truck	107
		1	Grader	113
		1	D8 Dozer	113
		5	Truck and dog	110
2.	**Civil works**			
2a	Earthworks	1	Smooth drum roller	109
		1	815 Compactor	106
		1	15,000L water truck	107
		1	Grader	113
		5	Truck and dog	110
		1	20t excavator	105
		1	12t excavator	100
		2	30t Articulated Dump Truck (ADT)	110
2b	Drainage and utilities	1	Concrete pump	102
		3	Concrete agitator	109
		1	25t excavator	105
		1	30t ADT	110

Phase		Noise generating equipment		Estimated sound power level, dBA[1]
		No.	Type / size	
-	-	1	Tipper truck	108
		1	25t excavator	110
2c	Pavements	1	Asphalt paving machine	114
		1	Bobcat	107
		4	8-wheel bogies	110
3.	**Formwork, Reinforcement and Concrete Pouring (Works (FRP)**			
3a	Formwork and reinforcement installation	1	Telehandler	91
		1	25t franna pick and carry crane	98
		1	Tipper truck	108
3b	Concrete pour	1	Concrete pump	102
		3	Concrete agitator	109
3c	General structures and gantry installation	2	200t mobile crane	110
		4	Elevated Work Platform (EWP)	102

Site operations

Plant and equipment proposed for the operation of the Emu Plains construction support site are summarised in Table 9-12 together with the estimated noise levels.

Table 9-12 Operational scenarios and equipment – Emu Plains construction support site (WHT13)

Phase		Equipment		Estimated sound power level, dBA	Maximum sound power level, dBA
		No.	Type / size		
1	Precast Yard Operation Includes: • External activities such as concrete batching, crane operations and logistics (product handling and delivery). • Internal activities such as production of the concrete segments.	1	Batching Plant	105	111
		1	Front End loader	107	117
		1	Truck and dog deliveries	110	-
		2	Gantry Cranes (Electric)	90	95
		1	Semi-truck (segment)	100	105
		1	16 Ton forklift	103	110
		1	3-ton Forklift	98	-
		1	Concrete vibrators (inside acoustic enclosure)	113	-
		6-10	Rattle guns (inside acoustic shed)	103	-

Only some activities would continue to be operational during the night with most noisy equipment located within the acoustic shed. The equipment listed in Table 9-12 with LAmax values have been included in an assessment of sleep disturbance impacts for the night operational scenario.

Noise modelling

SoundPlan noise modelling software was used to calculate noise impacts in accordance with the ISO9613 prediction method at all identified noise-sensitive receivers. The model included:

- Topography – 1 metre DEM based on LPI Lidar data.
- Individual buildings for façade calculations and to account for shielding and reflections. Building heights are also taken from Lidar data.

- Individual sensitive receivers – One receiver location representing each residential dwelling and located at 1.5 metres height up to 1000 metres from the works.
- Construction noise sources – Activities and equipment included in the noise model as point sources in locations specified by Acciona. Sound power levels in Table 9-11 and 9-12. Each source is modelled at 1.5 metres above ground except for the batching plant at 8 metres.
- Meteorology –worst-case conditions: gentle breeze (3-5 m/s) source to receiver and stable conditions (conducive of temperature inversion).

Operating hours

During site establishment, activities would be carried out Monday to Friday 8am to 6pm, Saturday 8am to 1pm with no work on Sundays. Work outside of standard hours during site establishment would be carried out consistent with the Minister's Condition of Approval E68 (which allows for low impact works and other approved circumstances) and would generally entail low noise activities such as plant pre-start, re-fuelling, and maintenance.

During site operations activities would be carried out 24 hours per day, 7 days per week for the duration of the construction of the proposed modified project.

Predicted noise impacts

Site establishment

Predicted noise levels for the site establishment phase are summarised in Table 9-13. Noise contours illustrating the predicted level of impact are presented in Figure 9-5.

Table 9-13 Predicted noise levels and exceedances for construction – site establishment phase

Scenario	NCA ID	Noise Management Levels $L_{Aeq(15min)}$ Standard Hours (RBL +10dB)	Highest predicted noise level at a sensitive receiver	Compliant (Exceedance dB)
		Day	L_{Aeq}	
1a Perimeter fence install	45	**70**	46	**Y**
	46 (Residential)*	**49**	47	**Y**
	47 (School)	**55**	64	**N (0-10)**
	48	**49**	57	**N (0-10)**
	49	**49**	48	**Y**
	50	**49**	43	**Y**
1b Site shed and amenities install	45	**70**	37	**Y**
	46 (Residential)*	**49**	38	**Y**
	47 (School)	**55**	56	**N (0-10)**
	48	**49**	48	**Y**
	49	**49**	40	**Y**
	50	**49**	35	**Y**
1c Hardstand install and bulk earthworks	45	**70**	44	**Y**
	46 (Residential)*	**49**	45	**Y**
	47 (School)	**55**	62	**N (0-10)**
	48	**49**	59	**N (0-10)**
	49	**49**	46	**Y**
	50	**49**	41	**Y**
2a Earthworks	45	**70**	46	**Y**
	46 (Residential)*	**49**	47	**Y**
	47 (School)	**55**	64	**N (0-10)**

Scenario	NCA ID	Noise Management Levels $L_{Aeq(15min)}$ Standard Hours (RBL +10dB)	Highest predicted noise level at a sensitive receiver	Compliant (Exceedance dB)
		Day	L_{Aeq}	
-	48	**49**	57	**N (0-10)**
	49	**49**	48	**Y**
	50	**49**	43	**Y**
2b Drainage and utilities	45	**70**	45	**Y**
	46 (Residential)*	**49**	46	**Y**
	47 (School)	**55**	63	**N (0-10)**
	48	**49**	56	**N (0-10)**
	49	**49**	47	**Y**
	50	**49**	43	**Y**
2c Pavements	45	**70**	46	**Y**
	46 (Residential)*	**49**	47	**Y**
	47 (School)	**55**	64	**N (0-10)**
	48	**49**	57	**N (0-10)**
	49	**49**	48	**Y**
	50	**49**	43	**Y**
3a Formwork installation	45	**70**	37	**Y**
	46 (Residential)*	**49**	38	**Y**
	47 (School)	**55**	55	**Y**
	48	**49**	48	**Y**
	49	**49**	39	**Y**
	50	**49**	35	**Y**
3b Concrete pours	45	**70**	37	**Y**
	46 (Residential)*	**49**	38	**Y**
	47 (School)	**55**	55	**Y**
	48	**49**	48	**Y**
	49	**49**	39	**Y**
	50	**49**	35	**Y**
3c general structure installation	45	**70**	41	**Y**
	46 (Residential)*	**49**	43	**Y**
	47 (School)	**55**	60	**N (0-10)**
	48	**49**	53	**N (0-10)**
	49	**49**	44	**Y**
	50	**49**	39	**Y**

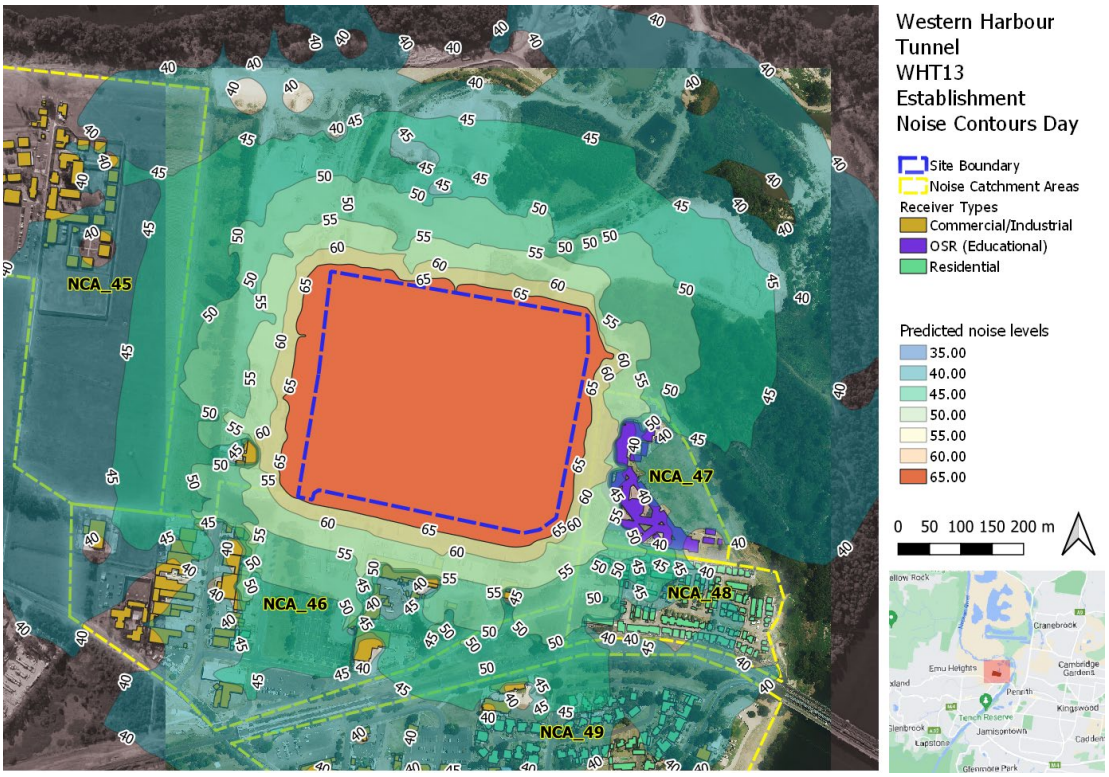


Figure 9-5 Predicted noise contours – site establishment phase.

The assessment indicates that most activities would not exceed the NMLs for standard hours at the nearest residential and no-residential receivers and there would be no receivers highly noise affected.

Possible exceedances of up to 10dBA are predicted for the closest receivers in NCA 48 (Ingenia Holiday Park) during civil earthworks. Exceedances are likely to be a result of working with compactors and rollers at the eastern boundary of the site and would be expected to transient and short in duration.

Penola Catholic College is also likely to experience exceedances during the site establishment phase for the closest noisy activities during civil works with the highest predicted LAeq noise level of 64 dB(A). Consultation and monitoring during this time will be a requirement to ensure amenity is not affected during school hours.

Periods of respite and relocating activities further back from the boundary and/or not using the noisiest equipment on the eastern boundary, would result in predicted noise meeting the NML. Implementing these measures would keep the potential risk of adverse impacts relatively low during the site establishment phase.

Monitoring of the site establishment phase of the project to confirm the predicted outcomes would be carried out during the noisiest work phases. This would be carried out in accordance with the approved Project Noise and Vibration Monitoring Program.

No construction works are proposed outside standard hours during the site establishment period. Pre-start of plant (warm-up), re-fuelling and maintenance at the beginning of the shifts may be possible after monitoring to ensure the NMLs would not be exceeded.

Where necessary, these activities could be completed with structures/barriers between noise source and receiver to provide additional attenuation.

Site operations

During the operation stage, the site would operate 24 hours per day, 7 days per week. Predicted noise levels for each phase of site operation activities during the day and night are summarised in Table 9-14 and Table 9-15 respectively. Noise contours illustrating the predicted level of impact are presented in Figure 9-6 and Figure 9-7.

Table 9-14 Summary of predicted noise levels and exceedances for site operations – Daytime

Scenario	NCA ID	Noise Management Levels $L_{Aeq(15min)}$ Non-Standard Hours (RBL +5dB) Day	Highest predicted noise level at a sensitive receiver	Compliant (Exceedance dB)
			L_{Aeq}	
Construction site operation	45 (Commercial/ Industrial)	**65**	38	**Y**
	46 (Residential)*	**41**	38	**Y**
	47 Penola Catholic Secondary College	**45**	45	**Y**
	47 CathWest Innovation trade and technical college	**45**	46	**N (1dB)**
	48 (Residential)	**42**	41	**Y**
	49 (Residential)	**42**	38	**Y**

*NCA is primarily commercial/industrial, however, as there is one residential property located in this NCA, the impacts were assessed as residential criteria.

Table 9-15 Summary of predicted noise levels and exceedances for operation phase – Night-time

Scenario	NCA ID	Noise Management Levels $L_{Aeq(15min)}$ Non-Standard Hours (RBL +5dB) Night	Highest predicted noise level at a sensitive receiver		Compliant (Exceedance dB)	
			L_{Aeq}	L_{Amax}	L_{Aeq}	L_{Amax} <52 dB(A)
site operation	45 (Commercial/ Industrial)	**65**	38	NA	**Y**	-
	46 (Residential)*	**41**	38	50	**Y**	**Y**
	47 Penola Catholic Secondary College	**NA**	NA	NA	-	-
	47 CathWest Innovation trade and technical college	**NA**	NA	NA	-	-
	48 (Residential)	**41**	38	49	**Y**	**Y**
	49 (Residential)	**41**	34	49	**Y**	**Y**

*NCA is primarily commercial/industrial, however, as there is one residential property located in this NCA, the impacts were assessed as residential criteria.

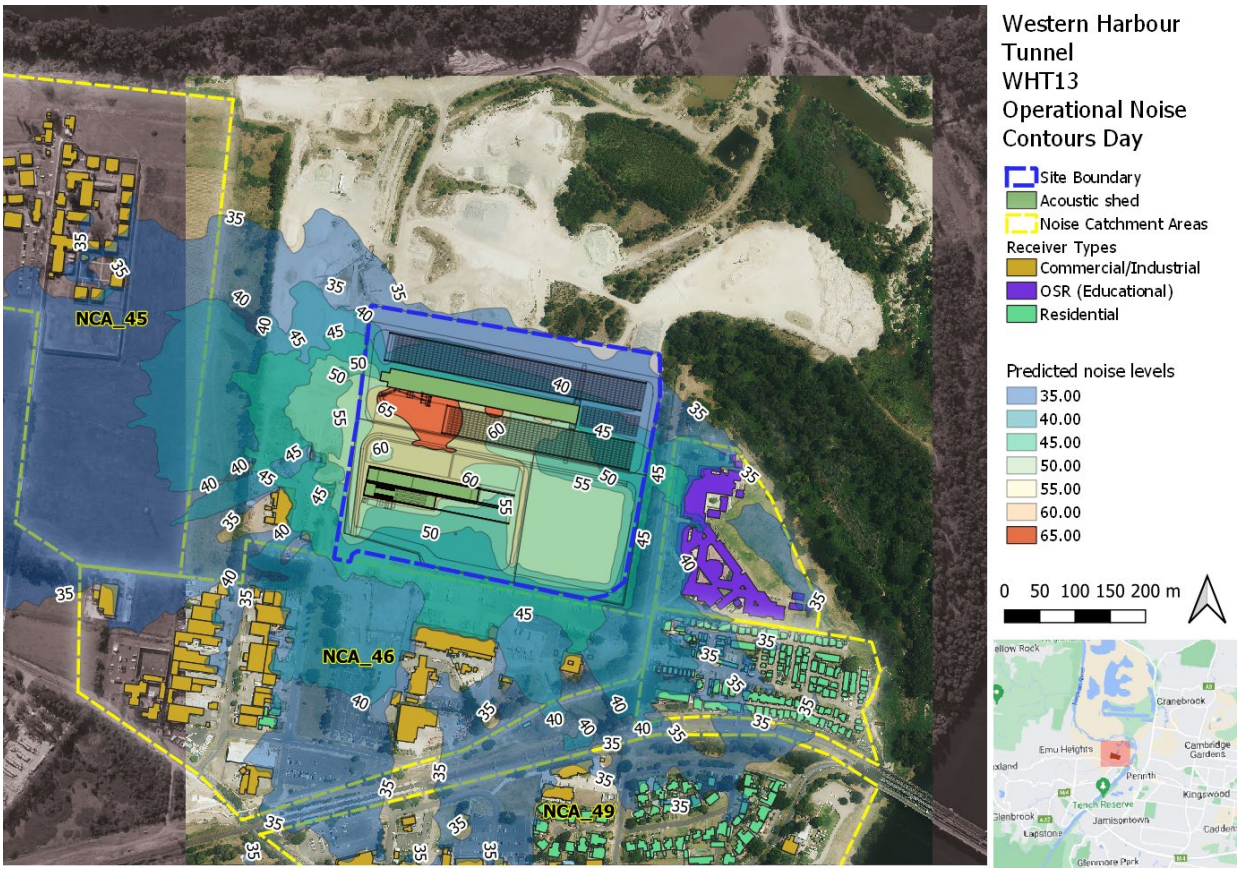


Figure 9-6 Predicted noise contours for site operations - Daytime

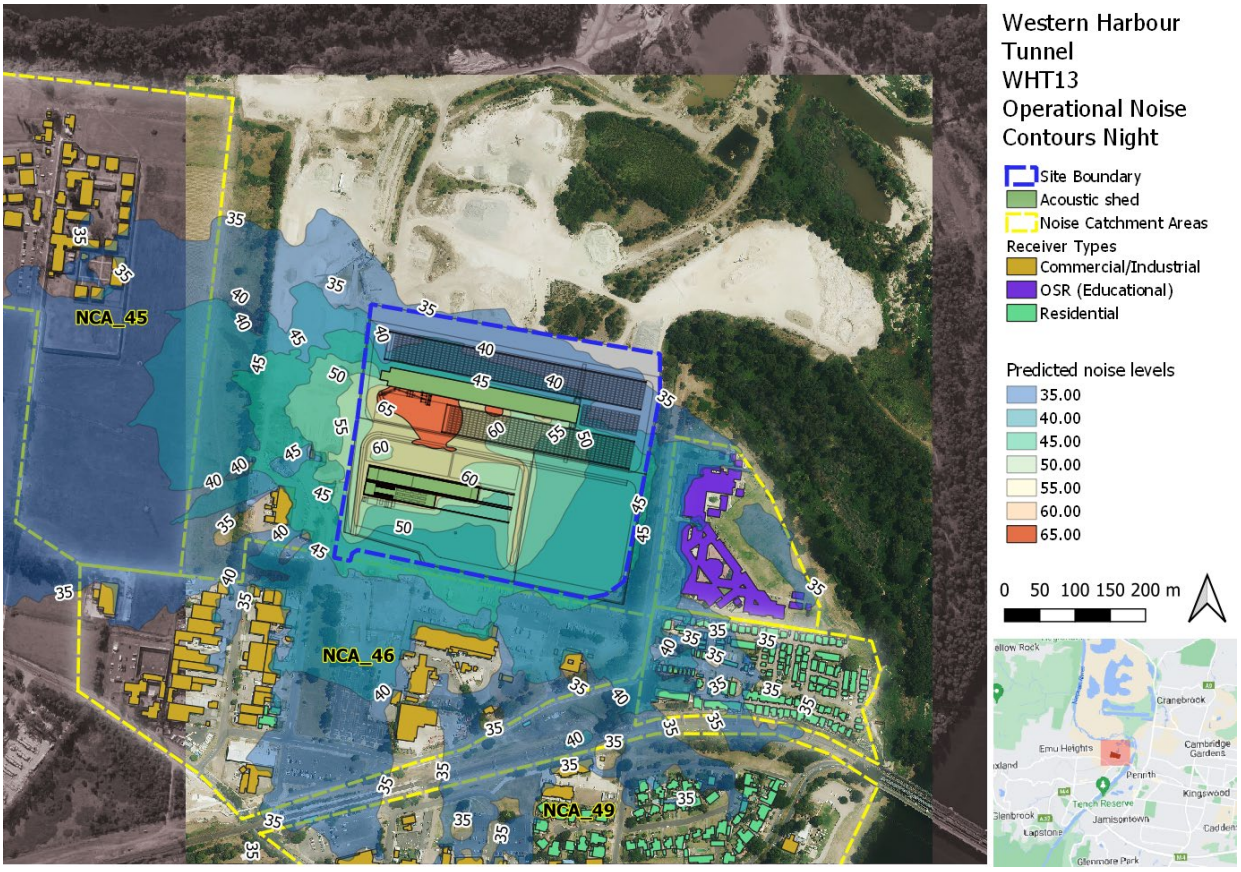


Figure 9-7 Predicted noise contours for site operations – Night time

The predicted noise levels indicate that no residential receivers would exceed the NML for day, evening, or night periods during site operations.

The Penola Catholic College would have the highest predicted external LAeq noise level of 45 dB(A) during site operations but would meet the amenity criteria for educational internal spaces. having the highest predicted external LAeq noise level of 45 dB(A) during site operations.

The CathWest Innovation trade and technical college is predicted to have an external LAeq noise level of 46 dB(A) at the most affected facade. As the trade college is an active learning space, the marginal exceedance of the external criteria (1dB(A) is expected to have a minimal impact on the internal amenity for students and teachers.

Where windows and doors are closed for these educational facilities, the internal noise levels would be lower than the noise goals in all instances.

Sleep disturbance

Site establishment would be during standard hours, therefore there would be no risk of disturbing sleep.

Maximum operational noise impacts are based on reduced site activities during the night. No material deliveries are scheduled during this time however, segment loading for night transportation would occur at the segment storage area in the north west of the site.

Predicted noise levels at the most affected receiver locations are less than the NPfI criteria for sleep disturbance criteria of 52 dB(A). Monitoring would be completed during the night period to confirm the range of LAmax noise levels from site activities at this time to confirm compliance with the operational sleep disturbance requirements for the site.

Potential vibration impacts

The only potential vibration intensive activity for the site would be the use of a vibratory roller during the site establishment stage.

Considering the nearest sensitive receiver is over 60 metres from the site boundary, the likelihood of cosmetic damage impacts from vibratory rolling during site establishment would be negligible.

For the largest sized rollers, human comfort impacts may be apparent at the closest locations however, these potential impacts would become less likely as the distance from the boundary for compaction work increases. As it is unlikely that vibratory rollers would be used on site beyond site establishment during standard hours, impacts to the surrounding community from vibration is expected to be minimal.

Construction traffic noise

Heavy vehicle routes

Route A and Route B for heavy vehicles accessing to/from the site are shown in Figure 9-8.

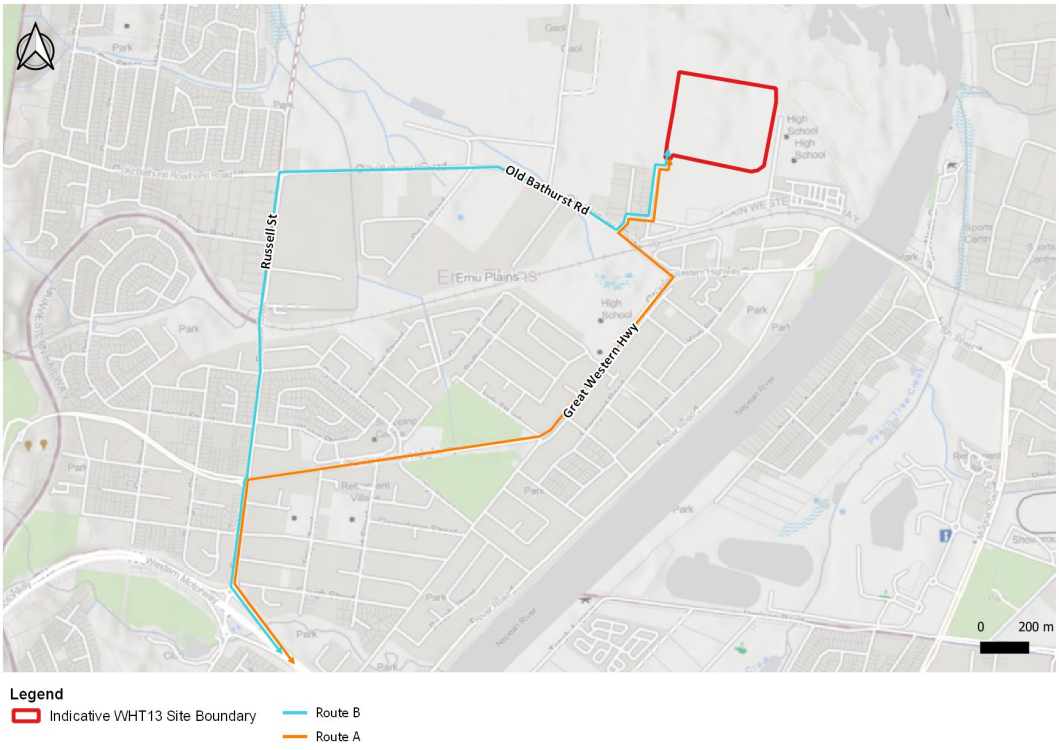


Figure 9-8 Emu Plains construction support site construction truck routes – Site operations phase

For egress Route A would exit left from Smith Street onto Old Bathurst Road, then right onto the Great Western Highway, left onto Russell Street (south) and then left onto the M4 Motorway. Entry would be the reverse.

For egress, Route B would exit right from Smith Street onto Old Bathurst Road, then left onto Russell Street (north) then left onto the M4 Motorway. All traffic would follow arterial roads (State or Regional Roads) up to Smith Street. From Smith Street to the entrance to the Emu Plains construction support site (WHT13), would be on local roads.

Along Route A between the site entrance and Old Bathurst Road there are two residential receivers located on the north west corner of the intersection of Lee Street and Railway Street. There are no residential receivers on Old Bathurst Road. There are residential receivers on the Great Western Highway and along Russell Street (south).

Along Route B, between the site entrance and Old Bathurst Road there are two residential receivers on Railway Street. There are no residential receivers along Old Bathurst Road (between Russell Street and the Great Western Highway) but there are residential receivers along Russell Street (north) and Russell Street (south).

Both the Great Western Highway and Russell Street carry about 15,000 and 11,000 vehicles per day respectively and pass through areas with residential receivers. Railway Street, Lee Street and Smith Street are local roads. At night, volumes on these roads are expected to be very low at around 1-2 vehicles per hour.

The Emu Plains construction support site would increase traffic by about 180 vehicles (one-way traffic movements) per day. Of these, around 75 would be heavy vehicles for delivery of raw materials/products and segment delivery trucks.

From Smith Street both Route A and Route B are characterised as arterial roads which use a 9-hour and 15-hour assessment period while Railway Street, Lee Street and Smith Street are local roads that use a one-hour assessment period in accordance with the TfNSW Road Noise Criteria Guideline (RNCG). An hourly breakdown of traffic has been used for both arterial and local roads in this assessment to provide traffic noise screening levels, which is conservative for arterial roads but consistent with the requirements for local roads.

Construction traffic noise assessment

Truck movements during the day are estimated at around 10-15 heavy vehicles per hour and around 3 heavy vehicles per hour at night.

Noise impacts on the arterial road sections of Route A and Route B are estimated to be 1.4 dB(A) above existing traffic noise levels during the worst 1 hour night period. This impact reduces to less than 1 dB(A) during the day which includes light vehicle movements during shift changeovers.

Impacts on Route A and Route B would therefore be below the screening level of 2 dB(A) for construction traffic noise impacts and therefore would meet the noise goals for residential receivers along these routes.

For the nearest residential receivers on local roads (two receivers located at the north west corner of Railway Street and Lee Street), night noise levels from heavy vehicle construction traffic is predicted to be around 51.4 dB(A). This would represent an increase of around 2.4 dB(A) above existing traffic noise levels and would exceed the screening criteria (i.e., maximum of 2dB(A)). The predicted noise level would also be 1.4 dB(A) above the RNCG level of 50 dB(A) night for local roads. Accordingly, mitigation measures for this residential receiver would be required. Mitigation options would be determined with the affected resident during the consultation phase of the proposal.

9.2.5 Assessment summary

Noise and vibration impacts associated with the Emu Plains construction support site (WHT13) are expected to be minor in nature. The closest sensitive receivers are not expected to experience noise levels that would result in significant disturbance. Some exceedances of the NMLs are expected during the site establishment phase which would only occur during day-time periods. No exceedances of the day, evening or night-time NMLs are expected to result from the site operation phase.

Construction traffic noise is expected to impact two receivers on the northwest corner of Railway Street and Lee Street. Further consultation would be carried out with this resident to establish appropriate mitigation measures.

9.2.6 Environmental management measures

The impacts associated with noise and vibration as a result of the Emu Plains construction support site (WHT13) are generally considered to be minor and short-term, limited to the site establishment phase. Although there are potential additional noise and vibration impacts, there would be no unique activities that would result in significant noise and vibration impacts. Noise and vibration impacts would be appropriately

managed through existing REMMs, Conditions of Approval and the Project Construction Environmental Management Plan, Noise and Vibration Management Plan and Monitoring Program.

An additional environmental management and mitigation measure (CNV11) has been identified as appropriate for the Emu Plains construction support site with respect to managing residual night-time noise from additional truck movements. No amendments to the Minister's Conditions of Approval as they relate to construction noise and vibration impacts would be required.

9.3 Construction air quality

The air quality impact assessment carried out for the Project EIS assessed potential construction air quality impacts using the methodology described in the UK Institute of Air Quality Management's (IAQM) Guidance on the assessment of dust from demolition and construction (IAQM, 2014). Particulate matter (PM) levels in the air are used to measure construction air quality impacts.

The most common particulate size measured for determining air quality impacts are:

- PM10 – particles less than 10 micrometers (μm) in diameter. Sources include sea salt, crushing or grinding operations and dust stirred up by winds over exposed soils or vehicles on roads.
- PM2.5 – fine particles less than 2.5 μm in diameter. Sources include all types of combustion, including motor vehicles, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes. May also include sea salt.

The IAQM Guidance on monitoring in the vicinity of demolition and construction sites (2018) recommends that priority be assigned to the measurement of PM10, as emissions of dust from construction sites are predominantly in the coarser fractions. Monitoring of PM2.5 concentrations should not normally be required (but should be reported where available) unless measurements for comparison with the air quality objectives are required.

Air quality impacts for the Emu Plains construction support site (WHT13) have been assessed consistent with the methodology used in the Project EIS.

For the purpose of the construction dust assessment, the IAQM methodology (IAQM, 2014) uses a four-step process to assess construction dust impacts:

- Step 1: Screening assessment based on distance to human and ecological receptors
- Step 2: Assess risk of dust impacts from activities based on the scale and nature of the works and
- sensitivity of the area
- Step 3: Determine site-specific mitigation
- Step 4: Reassess residual dust impacts after mitigation has been applied.

9.3.1 Existing environment

The closest Air Quality Monitoring Station (AQMS) is located in Penrith. Data from the Penrith AQMS from 2021 and 2022 indicates a background PM10 concentration of 15.3 μg/m3. Due to the close proximity of WHT13 to the Macquarie Park AQMS, the existing air quality environment surrounding WHT13 is considered to be consistent with the local and regional conditions of this monitoring station.

Annual averages of PM10 and PM2.5 for Penrith are outlined in Table 9-16 and illustrated in Figure 9-9

Table 9-16 Existing PM10 and PM2.5 annual averages from Penrith air quality monitoring station

Date	Penrith PM10 annual average (ug/m^3)	Penrith PM2.5 annual average (ug/m^3)
2021	16.7	7.9
2022	13.8	5.8
Average (Background)	15.3	6.85

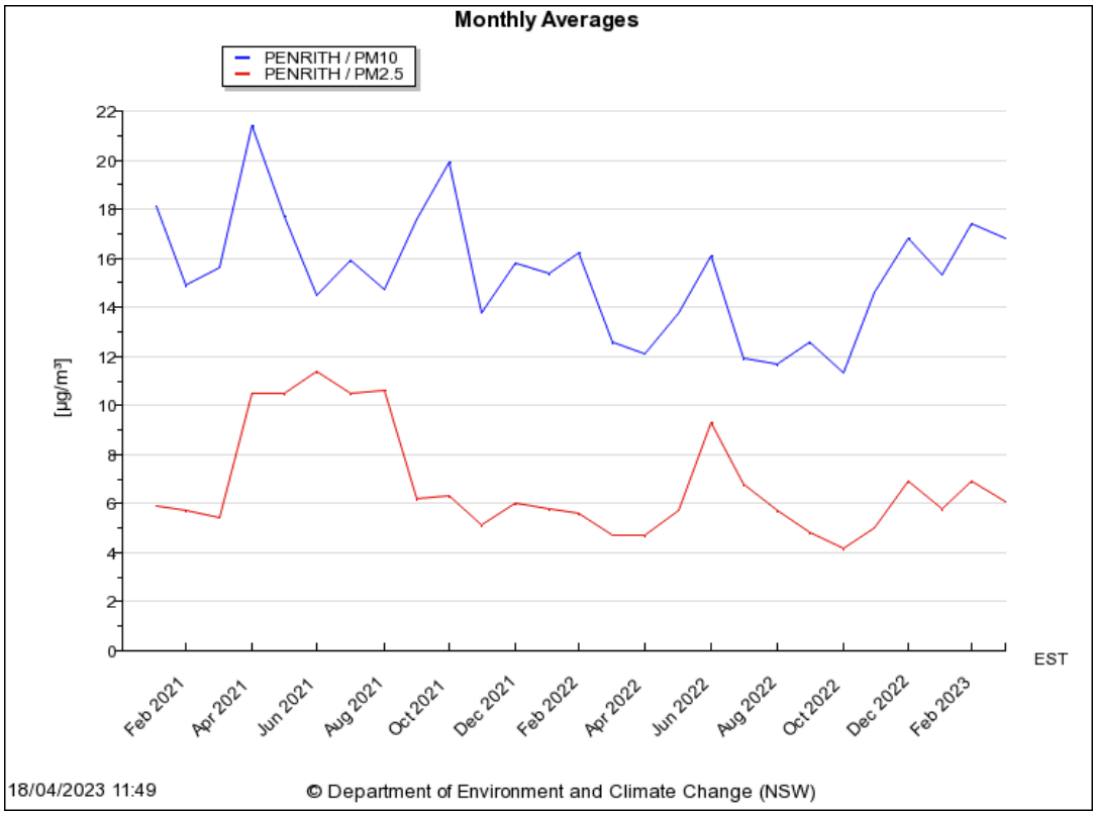


Figure 9-9 Monthly PM10 and PM2.5 averages for Penrith AQMS

9.3.2 Assessment of potential impacts

The IAQM recommends a construction dust assessment is generally required where:

- There are human receptors within 350 metres of the boundary of the site and/or within 50 metres of the route(s) used by construction vehicles on the public highway, up to 500 metres from the site entrances(s)
- There are ecological receptors within 50 metres of the boundary of the site and/or within 50 metres of the route(s) used by construction vehicles on the public highway, up to 500 metres from the site entrance.

For the screening assessment, the assessment area was assumed to be limited to the boundaries of the Emu Plains construction support site (WHT13). There would be human receptors within a 350-metre radius of the footprint of the Emu Plains construction support site (WHT13), although the total number of receptors would be low as shown in Figure 9-10. There would also be human receptors (zoned as low and medium density residential) along the proposed vehicle haulage routes (Great Western Highway, Old Bathurst Road, Mulgoa Road and Russell Street).

Sensitive ecological receptors are located within the Emu Plains construction support site (WHT13) buffer zone and have been assessed in Section 9.8

As there are human receptors within 350 metres of the Emu Plains construction support site (WHT13) and within 50 metres of the construction traffic routes, a construction dust assessment is required.

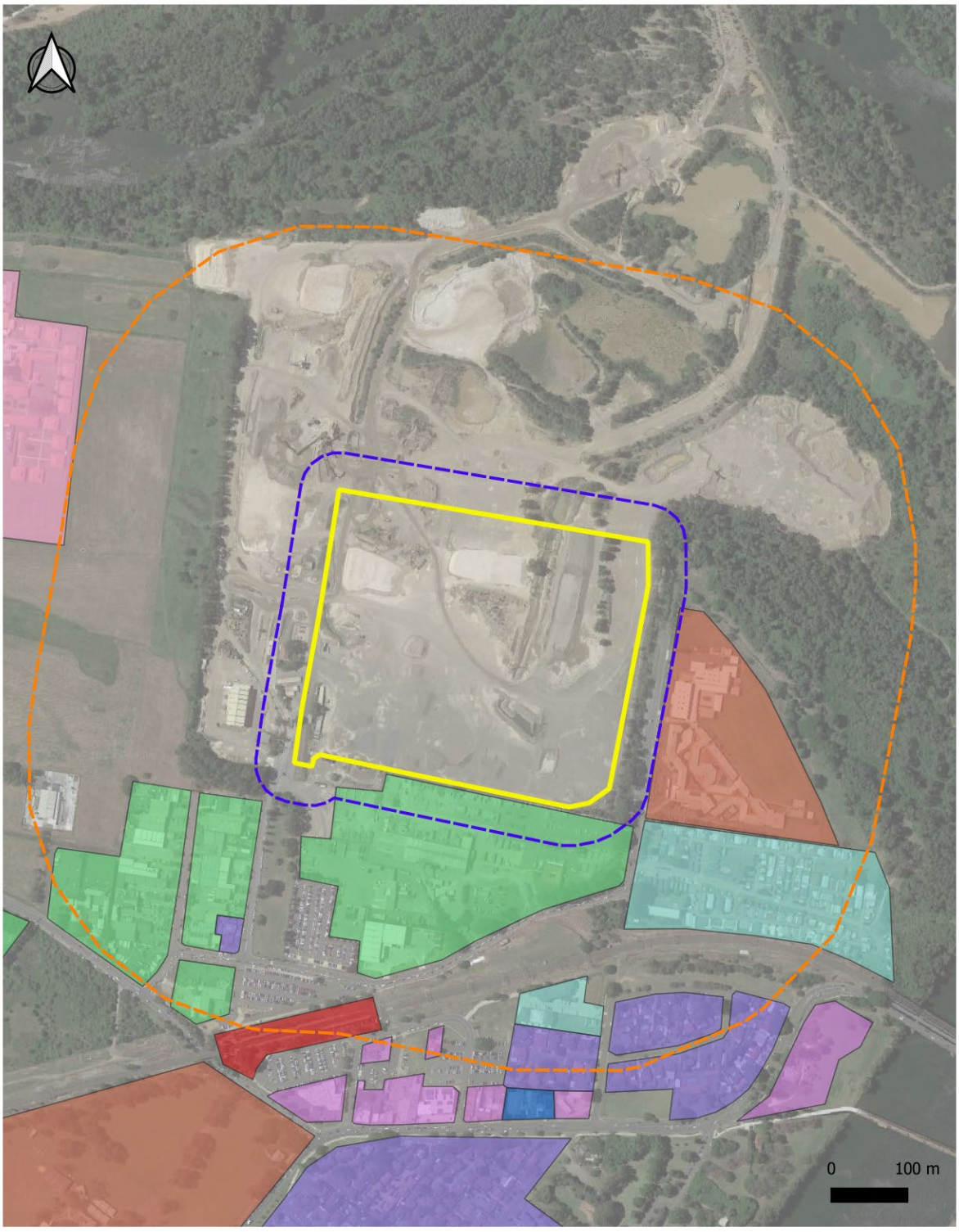


Figure 9-10 IAQM screening buffers – Emu Plains construction support site (WHT13).

Step 2: Dust Risk assessment

Step 2 requires an assessment of the risk of dust causing annoyance and/or health effects. This is determined by assessing:

- Step 2A: The scale and nature of the works, which determines the potential dust emission magnitude as small, medium, or large
- Step 2B: The sensitivity of the area to dust impacts which is defined as low, medium, or high sensitivity.

Step 2A Dust emission magnitude

The IAQM determines that construction activities likely to cause dust can be separated into the following four categories: demolition, earthworks, construction and track-out.

An assessment of the potential dust emission magnitude associated with the Emu Plains construction support site (WHT13) for each of these categories is provided in Table 9-17.

Table 9-17 Potential dust emission magnitude assessment associated with the Emu Plains construction support site (WHT13)

Activity	Description of activities at Emu Plains construction support site (WHT13)	Potential dust emission magnitude
Demolition	No demolition works would be required for the modification.	Small (Total demolition volume <20,000m3)
Earthworks	Earthworks would be required during site establishment to level the site to allow for hardstand to be laid.	Medium (Total site area >10,000m2, >10 heavy vehicles active onsite at any one time, >100,000 tonnes of material moved)
Construction and operation of the construction support site	During construction, the site would be used to construct concrete elements for the Project. The site would also operate as additional laydown for plant and equipment as required. The site would be either sealed or covered by sheds to allow for all weather access and worksite.	Small (Site operation would involve concrete batching and casting)
Haulage	About 180 heavy vehicle movements on a typical day to primarily transport concrete segments and pre-cast elements to the Project, along with raw materials import to support the concrete batching process and pre-mixed concrete from an offsite concrete batching plant.	Medium (>50 outward heavy vehicle movements in any one day)

Step 2B Sensitivity analysis

The IAQM methodology (IAQM, 2014) requires an analysis of the sensitivity of an area to dust soiling and health impacts caused by potential dust emissions by considering type and proximity of local receptors and local background PM10 concentration.

The overall sensitivity of the area surrounding the Emu Plains construction support site (WHT13) is determined to be medium. The site is currently an active materials recycling site which involves a significant amount of earth moving activities. The Emu Plains construction support site (WHT13) would reduce the amount of unconsolidated soil exposed by covering the site in hardstand.

Step 2C Risk of dust impact

Step 2C of the IAQM requires the dust emission potential determined in Step 2A to be combined with the sensitivity of the area determined in Step 2B to give the risk of impacts with no mitigation applied. The risk of dust impacts on sensitive receivers without mitigation is shown in Table 9-18.

Table 9-18 Dust risk assessment – Emu Plains construction support site (WHT13)

Potential impact	Risk of dust impacts on sensitive receptors - without mitigation			
	Demolition	Earthworks	Construction	Haulage
Dust soiling	Low	Medium	Low	Low
Human health (PM10)	Low	Medium	Low	Medium

Step 3: Determine site specific mitigation

The IAQM recommends site specific mitigation measures be applied to reduce potential dust emissions and a residual risk assessment (Step 4) be carried out to determine the risk of dust impacts, following the implementation of the recommended mitigation measures.

Step 4 of the IAQM has not been carried out, as the risk of dust impacts without mitigation has been assessed as low to medium. As such, no additional mitigation measures other than those described in Part D of the Submissions Report and the Conditions of Approval would be required.

9.3.3 Assessment summary

The assessment of air quality impacts indicates that potential dust emissions and associated residual risks would be low to medium without mitigation. With standard and well proven mitigation measures, these risks would be reduced to low.

9.3.4 Environmental management measures

The impacts associated with dust emissions as a result of the Emu Plains construction support site (WHT13) are generally consistent with those assessed in the Project EIS. Although there are potential air quality impacts associated with the Emu Plains construction support site (WHT13), there would be no activities in addition to those described in the Project EIS that would result in significant air quality impacts. No other changes to the environmental management measures or to the Minister's Conditions of Approval are considered necessary beyond those identified for the Approved Project.

9.4 Aboriginal and Non-Aboriginal cultural heritage

This section provides a summary of the assessment of the Aboriginal and non-Aboriginal cultural heritage impacts for works associated with new construction support site at Emu Plains (WHT13). Further details are provided in Appendix I (Technical Working Paper: Non-Aboriginal heritage – Emu Plains) and Appendix J (PACHI Stage 1 Assessment)

9.4.1 Assessment methodology

Aboriginal Cultural Heritage

The Aboriginal Cultural Heritage assessment was carried out in accordance with the Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (Roads and Maritime, 2011). The PACHCI applies the requirements of other relevant guidelines (refer to Section 15.1 of the Project EIS) to road projects.

The PACHCI includes up to four stages of assessment. These stages typically cascade following identification of potential impacts to Aboriginal Heritage items. Projects that can avoid impacts to Aboriginal Cultural Heritage may only be required to complete some stages of this procedure.

The four stages of this procedure are:

- Stage 1: Initial TfNSW assessment
- Stage 2: Further assessment and site survey
- Stage 3: Formal consultation and preparation of a cultural heritage assessment report
- Stage 4: Implement project mitigation measures.

Non-Aboriginal cultural heritage

The Project EIS identified non-Aboriginal heritage values, assessed the potential impacts on these values and recommended environmental management measures to minimise these potential impacts.

As the Emu Plains construction support site (WHT13) would be outside of the Approved Project boundary, a full assessment of the potential impact on non-Aboriginal heritage is required.

The methodology for the assessment is consistent with the methodology applied in the Project EIS which includes:

- A review of applicable legislation, guidelines, archaeological and historical reports, and publicly available databases to identify heritage items within and adjacent to WHT13 including:
  - Australia's National Heritage List (DAWE, 2022)
  - NSW State heritage inventory (NSW Government, 2022)
  - Section 170 NSW State heritage inventory (NSW Government, 2022)
  - Penrith Local Environment Plan 2010.
- Heritage advice to inform the assessment of potential heritage impacts from WHT13, and
- Recommendation of appropriate environmental management measures to avoid, mitigate and/or manage potential impacts on relevant non-Aboriginal heritage values.

9.4.2 Existing environment

Aboriginal Cultural Heritage

The PACHCI process requires desktop searches of the following heritage registers to be carried out to aid in the determination of risks to Aboriginal Cultural Heritage associated with the Project:

- Aboriginal Heritage Information Management System (AHIMS)
- Native Title Register
- State Heritage Inventory
- Australian Heritage Database.

Searches of the Native Title Register, State Heritage Inventory and the Australian Heritage Database noted the following of the site:

- The proposed construction site is not located within an area currently subject to a Native Title claim or listed on the Native Title Register
- There are no items listed on the State Heritage Register located adjacent to the proposed WHT13 site
- There are no items listed on the Australian Heritage Database located adjacent to the proposed WHT13 site.

Both 'basic' and 'extensive' searches of the AHIMS have been carried out for the Emu Plains construction support site (WHT13). These searches identified 10 known Aboriginal Heritage items within the searched extent. The Extensive AHIMS search of WHT13 indicated the sites listed in Table 9-19 are located in the area of the Emu Plains construction support site (WHT13). The location of these sites has been mapped in Figure 9-11 from the geographic data provided in the Extensive search.

Table 9-19 Results of AHIMS search around the Emu Plains construction support site (WHT13)

Site ID	Site name	Site types
45-5-5191	Museum Drive Penrith AFT 1	Artefact
45-5-3817	Emu Plains Rail Stabling Yards 1	Artefact
45-5-0522	Penrith P/1	Open Camp Site
45-5-3816	Emu Plains Rail Stabling Yards	Artefact
45-5-5484	Emu Plains Railway AFT	Artefact
45-5-0366	Emu Plains Emu Plains 4	Open Camp Site
45-5-0290	The Island	Open Camp Site
45-5-3904	EPRSY 3(PAD)	Potential Archaeological Deposit (PAD
45-5-5311	River Road AS1	Potential Archaeological Deposit (PAD
45-5-4361	Peachtree Creek PAD	Potential Archaeological Deposit (PAD

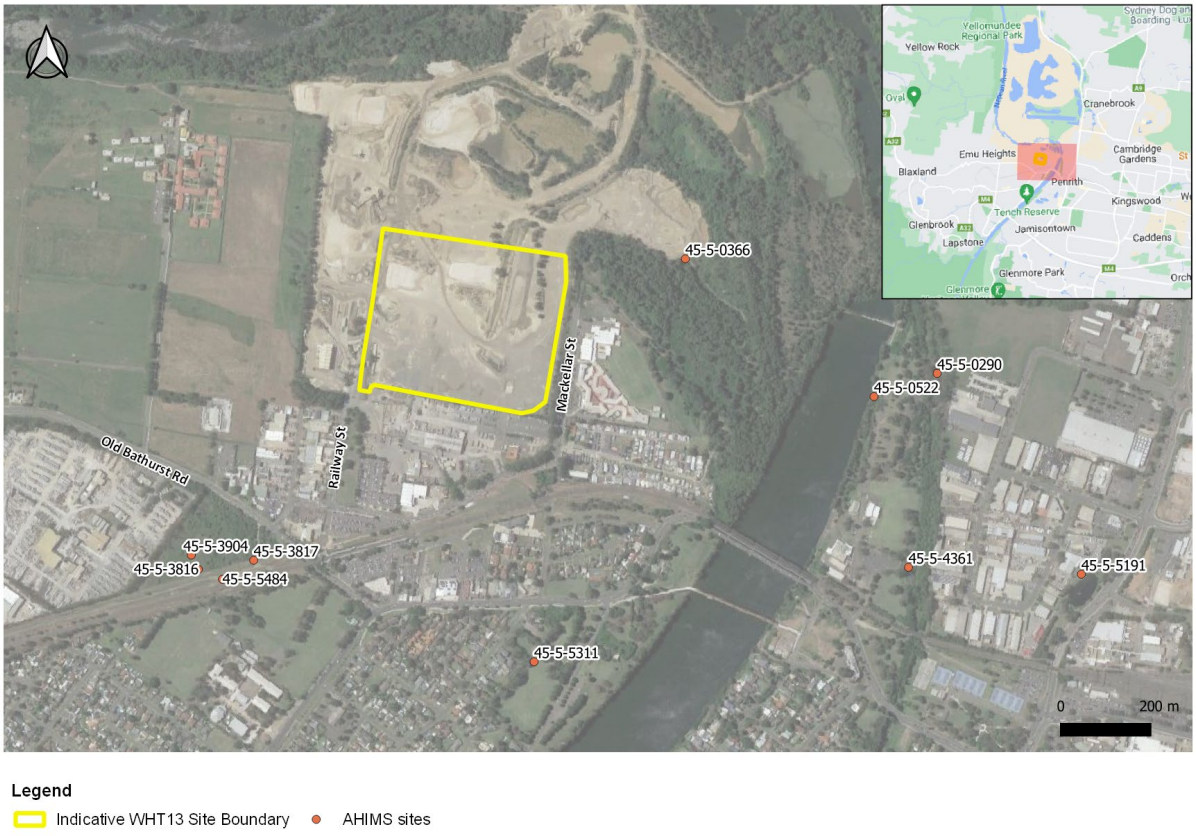


Figure 9-11 Location of Aboriginal Heritage sites in proximity of WHT13.

Non-Aboriginal Cultural Heritage

Heritage advice was obtained from Extent Heritage Pty Ltd. to determine the potential impacts on non-Aboriginal heritage. The advice provided by Extent Heritage is summarised below and the full report is provided in Appendix I (Technical Working Paper: Non-Aboriginal heritage – Emu Plains).

A search of the national, state, regional and local heritage registers identified one heritage site directly adjacent to the Emu Plains construction support site (WHT13). The local heritage item is listed on Schedule 5

of the Penrith Local Environmental Plan 2010 (Penrith LEP 2010) and is identified as 'Concrete House' (I58). The statutory curtilage for the item, as determined by the Penrith LEP 2010, applies to land legally defined as Lot 980 of DP810551.

The 'Concrete House' was assessed as having associative, technical and rarity significance at the local level. It is closely associated with the works of its designer Edward Giles Stone, who was an early pioneer of the use of pre-fabricated and reinforced concrete in Australia.

The house is an example of Stone's attempt to construct a domestic dwelling using his self-patented 'Considered System' and pre-cast concrete slabs.

Non-Aboriginal Cultural Heritage identified in the vicinity of WHT13, and the former location of the demolished "Concrete House" are shown in Figure 9-12.

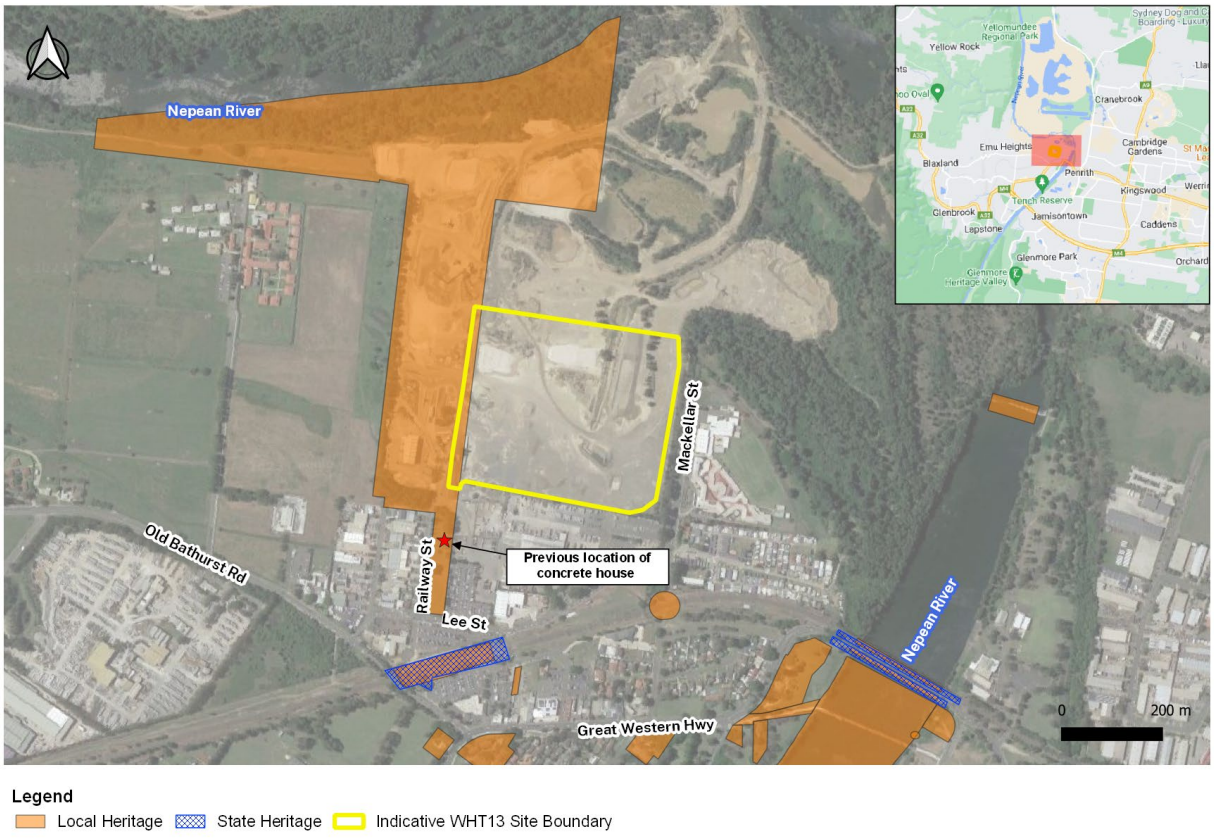


Figure 9-12 Heritage map showing the statutory curtilage for 'Concrete House', with indicative location of the items location marked in red

A development application for the demolition of 'Concrete House' at 39A-43 Mackellar Street, Emu Plains was approved by Penrith City Council on 10 November 2014 (DA14/0313.01) and has since been demolished.

A recent site inspection identified that the previous site of Concrete House has been fenced off from the active quarry operations. Within the fenced area, the site can be described as an overgrown grassy field, with mature trees along the north and west boundaries.

9.4.3 Assessment of potential impacts

Aboriginal Cultural Heritage

A Stage 1 PACHCI checklist was prepared for assessment by the Transport for NSW Aboriginal Cultural Heritage Officer.

The PACHCI process determined that based upon the desktop searches, it is unlikely that the establishment and operation of the Emu Plains construction support site (WHT13) would have an impact on Aboriginal Cultural Heritage. No further assessment was determined to be required. The PACHCI assessment letter is included in Appendix J (PACHCI Stage 1 Assessment).

Non-Aboriginal Cultural Heritage

A site inspection conducted in early 2023 by Extent Heritage confirmed that there are no extant built features remaining within the site and that all key elements of significance have been removed. As such, the site is no longer able to demonstrate the principal characteristics of significance for which it was listed for, and

subsequently there would be no impacts resulting from the establishment of the Emu Plains construction support (WHT13).

9.4.4 Assessment summary

There would be no impacts on Aboriginal or non-Aboriginal Cultural Heritage.

9.4.5 Environmental management measures

As there would be no impacts on Aboriginal or non-Aboriginal Cultural Heritage as a result of the Emu Plains construction support site (WHT13), no further environmental management measures are considered necessary beyond those identified for the Approved Project. No amendments to the Minister's Conditions of Approval as they relate to Aboriginal or Non-Aboriginal cultural heritage impacts would be required.

9.5 Geology, soils, contamination, and groundwater

This section provides an assessment of geology, soils, contamination, and groundwater impacts for works associated with the proposed new construction support site at Emu Plains (WHT13).

9.5.1 Assessment methodology

The assessment methodology for the Emu Plains construction support site (WHT13) is generally consistent with the methodology presented in the Project EIS.

To assess the impacts of the Emu Plains construction support site (WHT13) on soils and contamination, a desktop review of publicly available information and baseline investigation was carried out. This included:

- A review of the geological context, soil landscapes, salinity, and acid sulfate soils
- A Preliminary site investigation (PSI) was carried out by Rare Environmental to determine the potential for land contamination within the WHT13 site
- A review of the REMMs to determine whether any additional environmental management measures would be required.

9.5.2 Existing Environment

Topography

The Emu Plains construction support site (WHT13) would be located approximately 500 metres from the Nepean River. The site generally slopes downwards towards an artificial drainage channel. The site surface is highly modified, consistent with the continued use of the site over several decades.

The Emu Plains construction support site (WHT13) currently consists of fill, compacted, and graded at various levels. The site is raised in the east and slopes towards a drainage channel in the central east of the site. West of the drainage channel the site levels increase and become relatively flat. The central and eastern portions of the proposed Emu Plains construction support site (WHT13) footprint is currently utilised as a stockpiling area for gravel, aggregate and resource recovery stockpiling. The western portion is currently used for the storage of various plant and equipment.

Geology and soils

The site is considered to be 'disturbed terrain' as the original soil has been removed, greatly disturbed, or buried. The site consists of extensive excavation of natural quaternary deposits, including sand mining and anthropogenic deposits.

The natural, undisturbed geology of the area consists of alluvial terrace deposits (silty clay, fine to medium grained quartz-lithic sand and polymictic gravel (Clastic Sediment)) and quaternary alluvium consisting of sand, silt and gravels derived from sandstone and shale.

Figure 9-13 shows the mapped soil landscape types surrounding WHT13.

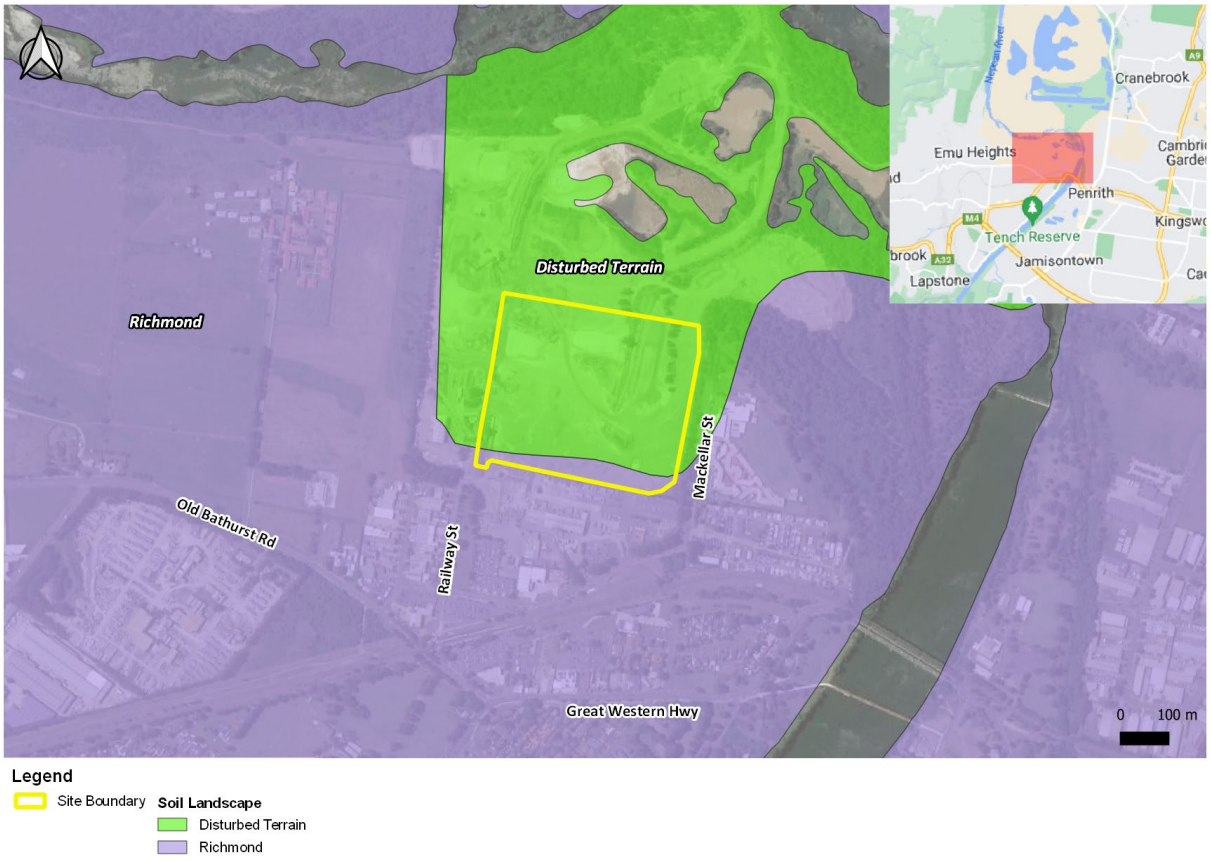


Figure 9-13 Soil types in the vicinity of the Emu Plains construction support site (WHT13).

Acid Sulfate Soils

Acid Sulfate Soils are the common name given to naturally occurring soils, commonly associated with low lying areas of fine-grained sediments and typically occur in lacustrine, estuarine, or swamp type environments, that contain iron sulfides (principally iron sulphide or iron disulphide or their precursors) which, on exposure to air, oxidise and create sulfuric acid.

The site is mapped as occurrence B, Low (6-70%) probability of Acid Sulfate Soils (Atlas of Australian Acid Sulfate Soils Data Source: CSIRO). Refer to Figure 9-14 for the probability of Acid Sulfate Soils map.

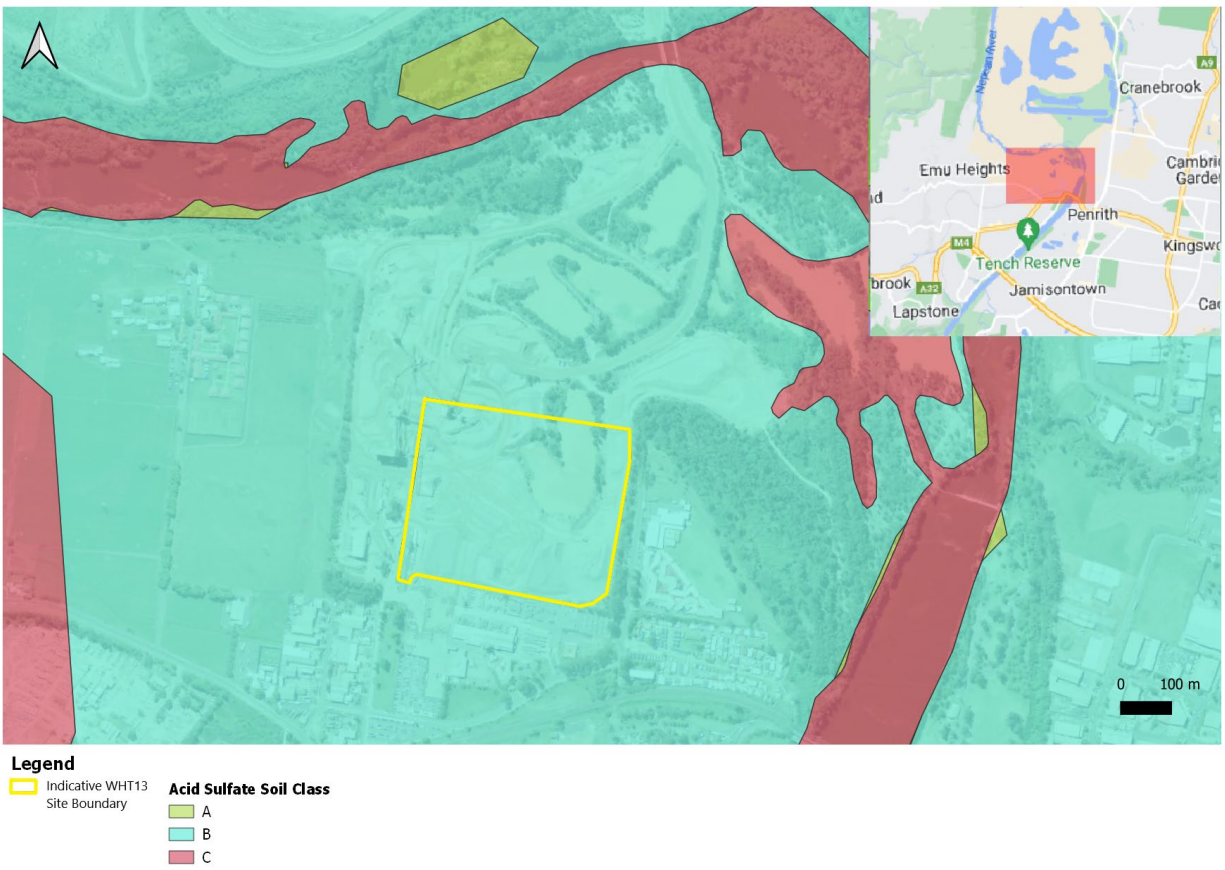


Figure 9-14 Probability of Acid Sulfate Soils – Emu Plains construction support site (WHT13).

Hydrogeology

The site consists of porous, extensive highly productive aquifers.

No groundwater wells were identified onsite, however, a review of groundwater wells listed within 1km of the site indicates that groundwater is expected to be present at approximately 15 metres to 20 metres below natural ground level.

Contamination

A Preliminary Site Investigation (PSI) was carried out by Rare Environmental Pty Ltd and is included in Appendix K2 (Technical Working Paper: Preliminary Site Investigation – Emu Plains). As part of the PSI, an online search of the NSW EPA databases was carried out in March 2023. The search included the site and surrounding areas, limited to premises within 1km of the site. The search indicated the following:

- The site has not been notified under section 60 of the Contaminated Land Management Act 1997 (CLM Act 1997)
- There are no records for the site or any properties within a 1km radius in relation to contaminated land under Section 58 of the CLM Act 1997
- A review of the EPA per and poly-fluoroalkyl substances (PFAS) investigation program indicated that no sites currently under investigation are within 1 km of the site.

Based on the desktop review and site inspection, it was established that key potential sources of onsite contamination are generally related to filling, the historical use of the site for agricultural purposes (i.e., spraying of crops) and potential impacts to upper soil horizons and shallow from spills or leaks of hydrocarbons and oils. Potential offsite sources of contamination relate to an Underground Petroleum Storage System (UPSS) located 100 metres west of the WHT13 site boundary, and industrial facilities located on the southern boundary.

Table 9-20 presents the key contamination issues and contaminants of potential concern (CoPC).

Table 9-20 Potential contaminant sources and contaminants of concern - Emu Plains construction support site (WHT13)

Potential Sources	Description	CoPC	Potential Contamination Risk
Onsite			
Historic filling	The site has been the subject of filling since the 1940's. There is potential for various fill types and contaminants to be present at the site.	TRH, BTEXN, PAH, metals, OCP, OPP, PCBs, phenols & asbestos	Moderate - High
Machinery use and storage	Potential impacts to upper soil horizons and shallow groundwater from spills, leaks, machinery use, machinery storage and remote refuelling activities.	TRH, BTEXN, PAH, metals &, VOCs	Low
Historical agricultural uses	Potential impacts to upper natural soil horizons from pesticide use. The natural soil horizon is likely to be covered with significant filling and not unlikely to be disturbed/intercepted during the construction works.	OCP/OPP	Low
Offsite			
UPSS	The UPSS is located approximately 100m from the western boundary of WHT13. The primary risk from the UPSS to WHT13 is the migration of hydrocarbon-impact groundwater to the site via groundwater flow. However, the UPSS is not hydraulically upgradient of the site as groundwater flow direction is assumed to be to the north towards the Nepean River.	TRH, BTEXN, PAH, metals &, VOCs	Low
Industrial land use on southern boundary	Industrial facilities are located immediately south of the site and hydraulically upgradient from WHT13. If groundwater contamination exists at this location, the potential migration of impacted groundwater to the site is considered possible.	TRH, BTEXN, PAH, metals &, VOCs	Moderate

Notes:
ACMs – Asbestos Containing Materials
TRH – Total recoverable hydrocarbons
BTEXN – Benzene, toluene, ethylbenzene, xylene, naphthalene
PAH – Polycyclic aromatic hydrocarbons
OCP – Organochlorine pesticides
OPP – Organophosphate pesticides
PCB – Polychlorinated biphenyls
Metals - As, Cd, Cr, Cu, Pb, Ni, Zn, Hg
VOCs – Volatile organic compound

9.5.3 Assessment of potential impacts

Soils

The proposed construction activities associated with the Emu Plains construction support site (WHT13) establishment works would involve surface excavation and earthmoving to level the site for hardstand establishment.

The temporary exposure of soil to water runoff and wind could increase soil erosion potential. There is the potential for exposed soils and other unconsolidated materials such as spoil, sand, and other aggregates, to be transported from the construction support site into surrounding waterways via stormwater runoff.

Given the existing use of the site and an open quarry/materials recycling facility, it is expected that the establishment of the Emu Plains construction support site (WHT13) would decrease the erosion potential of the site as a result of the sealing of the site.

Environmental management measures would include standard and well proven erosion and sediment controls and would be adequate in controlling any potential impacts.

Contamination

Based on the site inspection, the desktop review of site setting and historical land use information, a preliminary conceptual site model (CSM) was prepared and is provided in Table 9-21.

The CSM summarises the potential source-pathway-receptor (SPR) linkages for potential exposure to contamination.

Table 9-21 Preliminary conceptual site model -Emu Plains construction support site (WHT13)

Preliminary conceptual site model	
Potential Source	Historic agricultural activities. Controlled and uncontrolled filling. Leaks from machinery use, machinery storage and remote refuelling activities. Migration of impacted groundwater from offsite sources to WHT13 from industrial properties on the southern boundary.
CoPC	Metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn) TRH/BTEX PAH OCP/OPP/PCBs VOCs ACMs
Transport mechanisms	Placement of fill onsite. Aerial dispersion of dust and fines through the erosion/degradation and the disturbance of ACM during site use. Direct release to shallow soils. Leaching of contaminants through the soil profile to groundwater. Migration to the site via groundwater flow.
Exposure pathway	Direct contact with contaminated media. Ingestion/inhalation of soils or soil derived dust. Inhalation of fibres and vapours.
Potential receptors	Construction workers involved in site construction including above and below ground workers. Commercial workers using the site, following completion (operational phase). Trench workers accessing underground services (construction and operational phase).

The construction of the Emu Plains construction support site (WHT13) would encompass limited subsurface excavation works which have the potential to disturb underlying contamination (where present). Interaction with underlying groundwater is not envisaged, noting that groundwater in the vicinity of the Emu Plains construction support site (WHT13) is expected to be in the range of 15 metres to 20 metres below ground level. When established, the Emu Plains construction support site (WHT13) footprint would comprise primarily a hardstand (concrete) area and roads which would limit any potential interaction with underlying soils during the operational phase.

The assessment indicates that any potential contamination described as 'low risk' can be eliminated or managed via appropriate health and safety systems. These would typically involve preventing direct contact with excavated soils, appropriate communication with construction workers regarding the potential presence of shallow contamination, appropriate management of spoil and the development and implementation of an unexpected contamination finds protocol for contamination.

Additional investigation of the site would be required to further assess the moderate and high contamination risks identified at the Emu Plains construction support site (WHT13) resulting from:

- Historic fill brought onto site from unknown sources.
- Migration of impacted groundwater to the site from industrial facilities located immediately south of the site.

This would be consistent with the approach as assessed for other construction support sites for the project, and is in accordance with the project Condition of Approval E115:

'Prior to the commencement of any work that would result in the disturbance of moderate to high risk contaminated sites as identified in the documented listed in Condition A1, a Detailed Site Investigations must be undertaken by a Contaminated Land Consultant certified under either the Environment Institute of Australia or New Zealand's "Certified Environmental Practitioner" (Site Contamination) scheme (CEnvP(SC)) or the Soil Science Australia "Certified Professional Soil Scientist Contaminated Site Assessment and Management (CPSS CSAM) scheme'.

9.5.4 Assessment summary

Impacts on soils and erosion would be minimal.

Residual contamination is expected to be of low risk. Additional investigation of the site would be required to further assess the moderate and high contamination risk associated with historic fill and potential migration of groundwater from industrial facilities nearby.

9.5.5 Environmental management measures

Soil, geology, and groundwater impacts associated with the activities at the Emu Plains construction support site (WHT13) would be adequately managed by the environmental management measures identified for the Approved Project. Soil and water management measures will be implemented in accordance with the Blue Book and relevant Transport for NSW guidelines, procedures, and specifications.

No amendments to the Minister's Conditions of Approval as they relate to soils, groundwater and contamination impacts are required.

The site would be returned at the end of the lease to the condition as agreed within the lease agreement with the owner of the site.

9.6 Flooding

This section provides an assessment of the potential flooding impacts associated with the proposed Emu Plains construction support site (WHT13).

9.6.1 Assessment methodology

A qualitative flood assessment has been carried out by Aecom Aurecon Joint Venture to determine the potential impacts to flooding associated with the establishment of WHT13. This is included in Appendix L (Technical working paper: Flooding - Emu Plains). The assessment included a review of the latest topographic data as well as a review of the following publicly available flood studies:

- Nepean River Flood Study (Penrith City Council, 2018)
- Hawkesbury-Nepean Valley Regional Flood Study (NSW Government, 2019)

From these studies, the 5%, 2% and 1% AEPs flood modelling results (corresponding to 1 in 20 year, 1 in 50 year and 1 in 100-year flood event respectively) were used.

9.6.2 Existing Environment

Existing flood behaviour

The Boral site is located at the inner bend area of the Nepean River, and it is very likely to be flooded by backwater from the Nepean River during some flood events.

The water catchment areas related to the site total around 31.8 Ha, with the overland flow draining northwards towards the Nepean River. As shown in Table 9-22, there are two catchments located outside of the proposed Emu Plains construction support site (WHT13) (highlighted areas in green). The southern catchment is around 12.8 Ha between the Emu Plains construction support site (WHT13) and the Main Western Railway Line, which mainly consists of paved areas from industry land and road. The western catchment is around 4 Ha and mainly includes an area of gravel and unconsolidated soil.

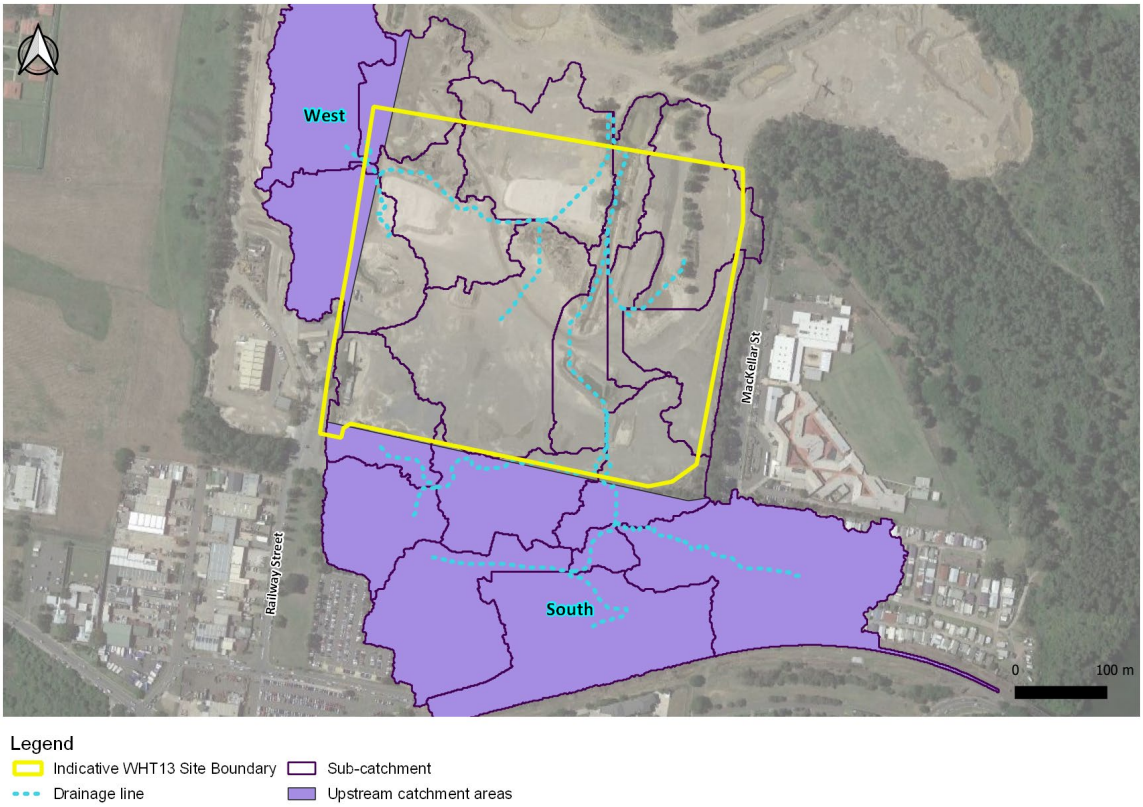


Figure 9-15 Water sub-catchments relevant to the Emu Plains construction support site (WHT13).

A summary of flood behaviour across the site during different flooding events of the Nepean River flooding is provided in Table 9-22.

Table 9-22 Flood behaviour across the Emu Plains construction support site (WHT13) for various flood events

Events	5% AEP	2% AEP	1% AEP
Nepean River Flood Study	Not flooded	Not flooded for the site area	The backwater from the Nepean River floods majority of the site area. The flood depth is generally less than 2 metres.
Hawkesbury-Nepean Valley Regional Flood Study	Not flooded	Flood water from the Nepean River fills two isolated low-lying areas within site. The water depth ranges from 0.3 – 1.2 metres	Flood water from the Nepean River fills a few isolated low-lying areas within site. The water depth ranges from 0.3 – 2 metres.

Flood evacuation routes

The North-West Sector Flood Evacuation Analysis (DoP, 2012) identifies flood evacuation routes that would be activated by the SES during a flood emergency. In general, the Emu Plains evacuation strategy is to evacuate via the Great Western Highway to the M4 before directing all evacuation traffic east towards Homebush, as shown in Figure 9-16 . With regard to evacuation routes, there is likely to be negligible impact on flood evacuation routes or the ability for emergency services to access flooded areas based on the routes identified in the North-West Sector Flood Evacuation Analysis (NSW Department of Planning, 2012).

As this area of Emu Plains has a risk of becoming a low flood island in a 1% AEP flood event, there is a low risk of workers becoming trapped on the site if the evacuation of the WHT13 construction support site is not managed appropriately. For this reason, it is recommended that an Evacuation Management Plan be prepared for the WHT13 site.

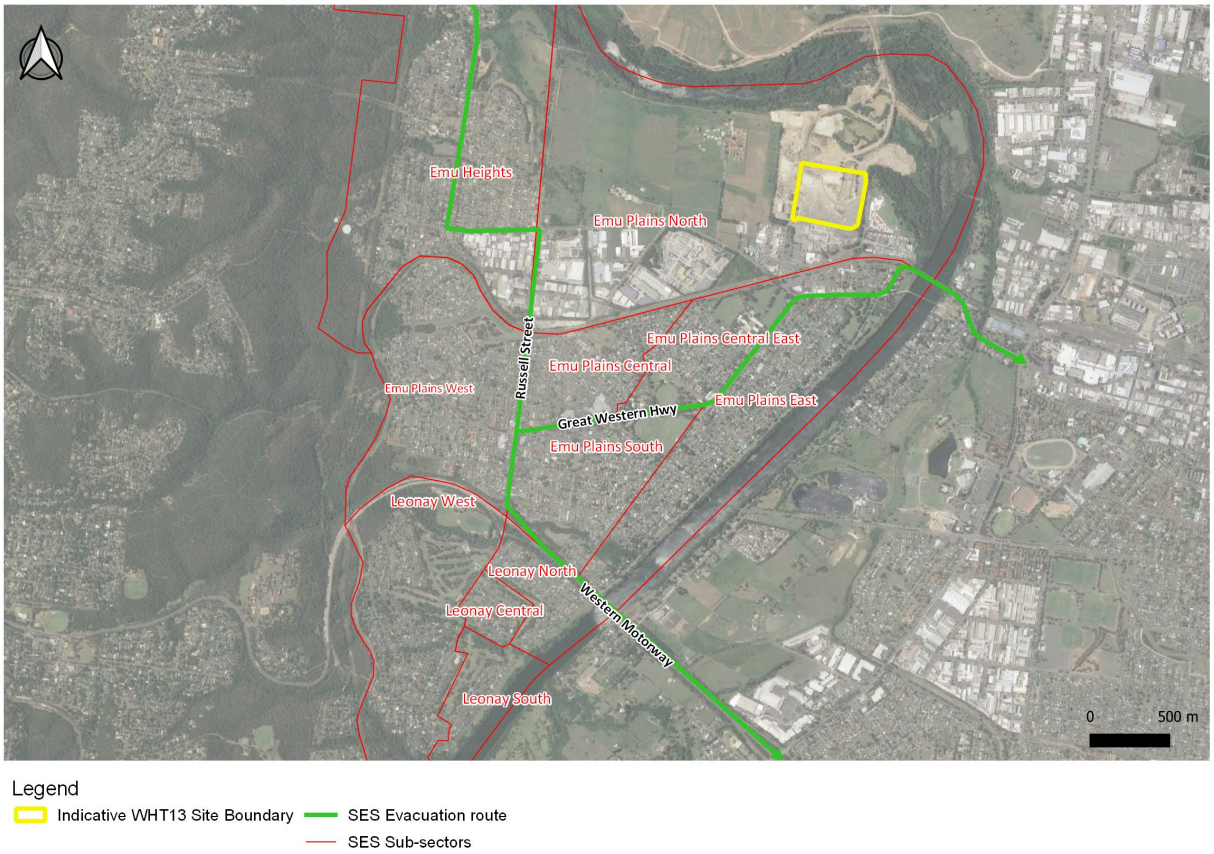


Figure 9-16 Emu Plains Evacuation Routes (Recreated from North West Sector Flood Evacuation Analysis, NSW Department of Planning, 2012, P20).

Assessment of potential impacts

At a regional level, the Emu Plains construction support site would have negligible flood impacts for the 5%, 2% and 1% AEPs. The flood storage currently provided within the Boral site is small and any loss of this storage area is not expected to have a noticeable impact on flooding.

At a local level, the installation of new drainage lines would allow for the existing stormwater path to be maintained. As such, impacts to this catchment are expected to be negligible.

The flow from the western upstream catchment is expected to be small due to its small catchment size and the pervious ground conditions. The flood water would enter the site but is unlikely to cause any flood level increase (afflux) upstream.

Removal of flood storage from the catchment would convey more overland flow. The excess overland flow is more likely to impact on the site than have a significant effect on local flooding patterns outside the site boundary.

Figure 9-17 shows an indicative site layout and preliminary drainage plan. This will be subject to change during detailed temporary works design.

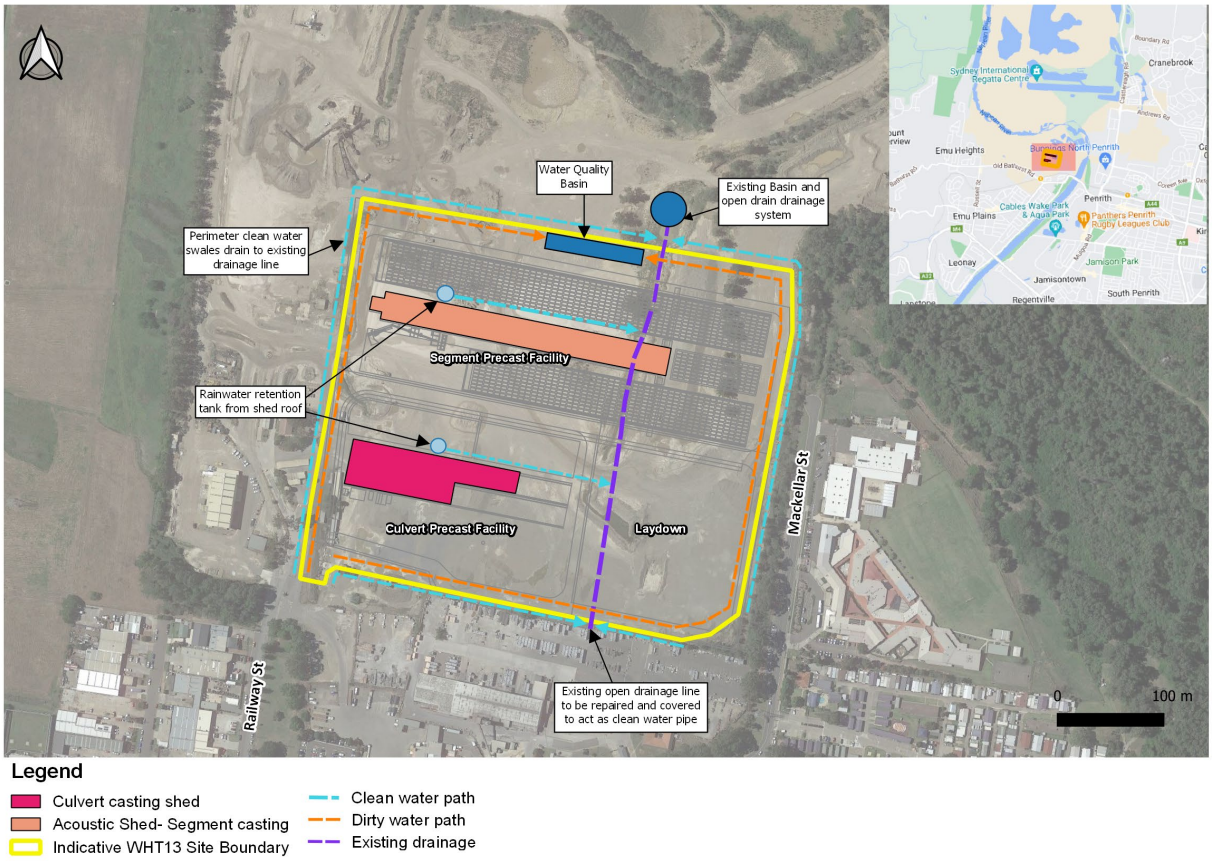


Figure 9-17 Indicative site drainage plan – Emu Plains construction support site (WHT13)

9.6.3 Assessment summary

At a regional level, the Emu Plains construction support site (WHT13) would have negligible flood impacts.

At a local level, the Emu Plains construction support site (WHT13) may result in additional impacts, but these would be largely contained to the site. Flood evacuation routes are not expected to be impacted by the establishment and operation of WHT13.

Additional mitigation measures have been identified below to address these residual flood issues.

9.6.4 Environmental management measures

The following mitigation measures would be implemented to reduce or avoid any negative flooding impacts on the site or surrounding catchments.

- Stormwater from the southern upstream catchment will be piped under the proposed construction support site and discharged into the existing open drainage line. A diversion drain(s) would be incorporated into the Emu Plains construction support site (WHT13) layout to divert overland flows around site buildings and other sensitive facilities. The drains would also convey sufficient flows to minimise or avoid flood level increase in the upstream catchments (Proposed new EMM F10).
- A basin(s) would be provided at the Emu Plains construction support site (WHT13) to compensate for the flood storage loss due to filling the existing basin(s) and the additional paved area. The basin(s) size would be determined by keeping the flow rate from the Emu Plains construction support site (WHT13) to Nepean River unchanged (Proposed new EMM F11).
- A Flood Evacuation Management Plan would be prepared to ensure all workers are evacuated prior to any flood emergency (Proposed new EMM F12).

These additional mitigation measures have been incorporated into the revised Project REMMs listed in Chapter 12 of this modification. No further amendments to the Approved Project environmental management measures or to the Minister's Conditions of Approval as they relate to flooding would be required.

9.7 Water quality

This section provides an assessment of the potential water quality impacts associated with the proposed Emu Plains construction support site (WHT13).

9.7.1 Assessment methodology

The Project EIS identified receiving water bodies within and adjacent to the Approved Project footprint, assessed the potential impact of the project on these water bodies, and recommended environmental management measures to minimise these potential impacts.

As the Emu Plains construction support site (WHT13) would be outside the Approved Project study area, a desktop review of publicly available resources was carried out to establish the existing environment of the Emu Plains construction support site (WHT13), and to determine the potential impacts to water quality associated with the site.

9.7.2 Existing Environment

The nearest surface watercourse is the Nepean River, located around 500 metres east of the site at the closest point. The Nepean River flows into the Hawkesbury River and then into Broken Bay and the Pacific Ocean at Barrenjoey Head. The Nepean River is a modified waterway which has been broken up by eleven weirs that help regulate the flow.

Penrith City Council monitors water quality in the Nepean River regularly to inform recreational users. The Council's water monitoring focuses primarily on weekly bacterial testing with monthly physical and chemical parameters being undertaken at key sites along the Nepean River between October and March each year. The closest monitoring sites to WHT13 are:

- Regatta Park, Emu Plains
- Rowing Club (Nepean River Weir), Penrith

A desktop search of the Penrith City Council Recreational Water Quality Monitoring web page identified that the annual river grade for both sites are "Poor". Council states the following for the sites:

'Location is susceptible to faecal pollution and microbial water quality is not always suitable for contact. During dry weather conditions, ensure that the location is free of signs of pollution, such as discoloured water, odour, or debris in the water, and avoid contact at all times during and for up to three days following rainfall.'

Sensitive receiving environments exist downstream of these monitoring sites. Most notably the Yellomundee Regional Park and the eastern most border of the Blue Mountains National Park.

Currently the existing Boral site contains several dams, including two tailings management dams, three sedimentation dams and one clean water management dam (See Figure 9-18). These dams exist in a semi-closed system where water is collected from surrounding stormwater and used on site. There are no discharges from this site directly into the Nepean River, the exception to this is when heavy rain occurs as dam spillways drain into the river.

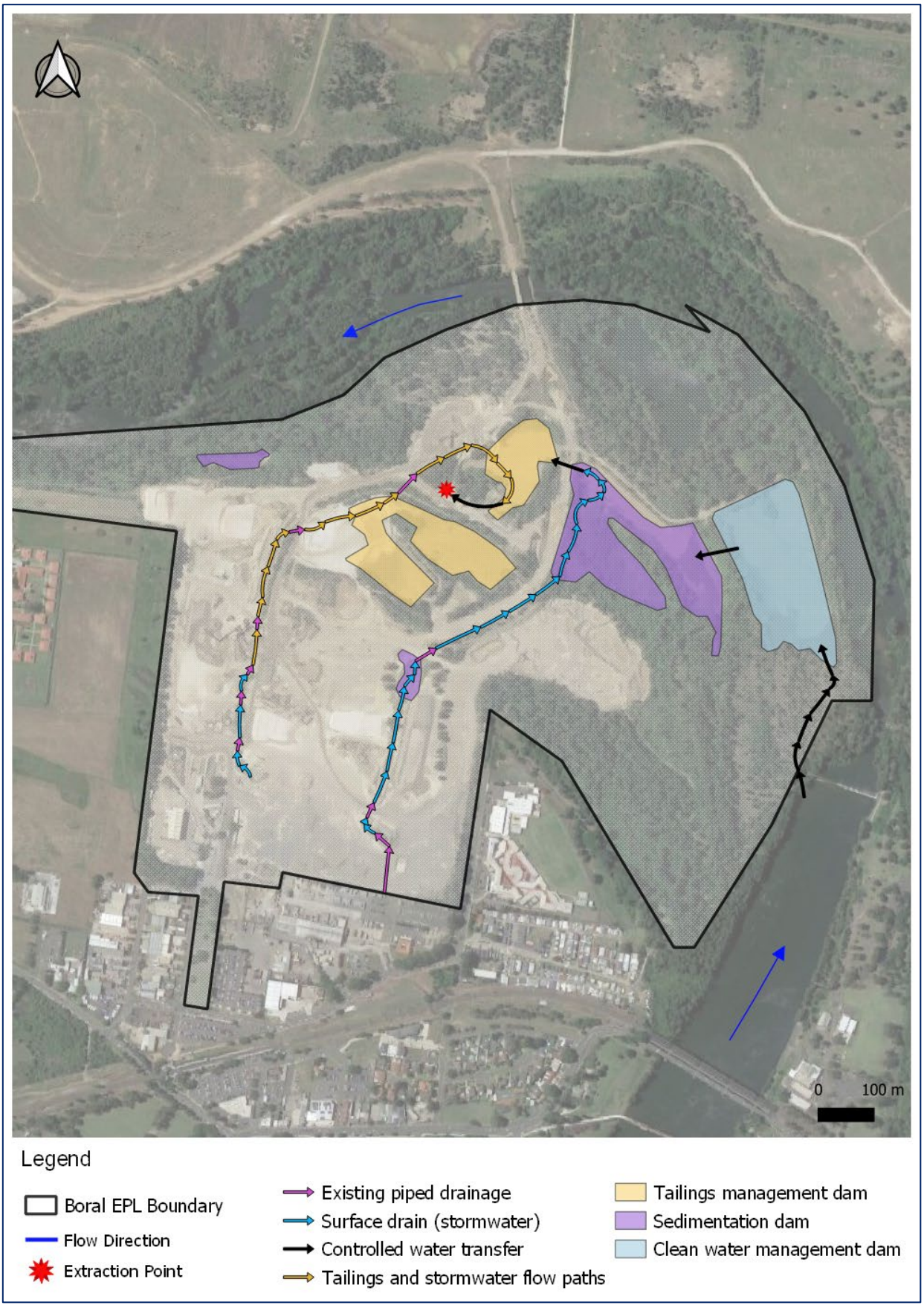


Figure 9-18 Existing site water quality management measures – Emu Plains construction support site (WHT13)

9.7.3 Assessment of potential impacts

Site activities

The potential impacts to surface water quality as a result of the establishment and operation of the Emu Plains construction support site (WHT13) are provided in Table 9-23.

Table 9-23 Potential water quality impacts – Emu Plains construction support site (WHT13)

Construction activities	Potential impacts
Site establishment	Establishment of construction support sites may result in erosion and mobilisation of exposed soils and open cuts by stormwater runoff and wind leading to sedimentation of waterways. Construction support sites may include activities that have the potential to impact downstream water quality if unmitigated through spills of pollutants flowing to downstream watercourses. Typical activities that pose a risk include: • Storage of chemicals • Vehicle wash down areas • Vehicle refuelling areas. Further, the movement of construction vehicles may transfer soil and pollutants to adjacent roads, which may then be conveyed via stormwater runoff into waterways.
Earthworks	Exposure of soils during earthworks, (including stripping of topsoil, excavation, removal of existing paved areas, stockpiling and transport of materials), can result in soil erosion and off-site movement of eroded sediments by wind and/or stormwater into receiving waterways. Once sediments enter waterways, they can directly and indirectly impact on the aquatic environment. If unmitigated, direct impacts could include reducing light penetration (limiting the growth of macrophytes), clogging fish gills, altering stream geomorphology, smothering benthic organisms, and reducing visibility for fish. Indirect impacts of increased sediments occur over the longer term and include accumulation and the release of attached pollutants such as nutrients and heavy metals.
Spills and leaks	If unmitigated, accidental spills or leaks could occur from spillage of diesel during refuelling, and leakage of hydraulic and lubricating oil from plant and equipment. Rinse water from plant washing and concrete slurries also have the potential to enter waterways if unmitigated.

The water quality impacts would be consistent with construction impacts to water quality as outlined in the Project EIS. The use of the Emu Plains construction support site (WHT13) would reduce the amount of unconsolidated soil on the Boral site via the laying of hardstand during site establishment. This would generally reduce the potential for dirty water runoff from the site into the Nepean River.

Water quality management and control features at the site would generally include:

- Complete bunding of the portion of the existing Boral site used for the Emu Plains construction support site (WHT13)
- Provision of collection/pump point(s) at the low corner/s of the area. Water that accumulates at the low point/s would be managed in accordance with the Managing Urban Stormwater: Soils & Construction Volume 1 (Landcom, 2004) (known as the “Blue Book”) prior to leaving the site
- Provision of an appropriately bunded area for the washout of concrete and vacuum truck waste disposal, thereby preventing rinse water from vehicle washout entering nearby waterways
- Provision for collection of clean rainwater from the shed roof to allow for direct reuse on site
- Provision of collection of water from the site in a basin or similar, to be held until the water is deemed ‘clean’ and can be allowed to flow into existing drainage channels within the Boral site or reused on site.

A detailed erosion and sedimentation control plan (ESCP) would be prepared and implemented for the site prior to the commencement of site establishment and would determine the specific details (including sizing) of controls to be implemented.

Non-potable water uses would include dust suppression and plant wash-down. Some demand activities are consumptive such as water used in the offices, which would be discharged to the existing sewerage network.

There would also be minor losses in the system due to evaporation. The remainder would be treated and either reused or discharged at the proposed discharge locations as shown in Figure 9-18

Non-potable sources (e.g., treated wastewater and harvested rainwater) may be used to meet construction water demand requirements. The deficit for the non-potable demand and any potable demand would be sought from the Sydney Water supply network.

The use of non-potable water over potable would be preferred, however this would be dependent on the location and nature of the water use as well as the quantity and quality of available water at the time. Water availability would vary as construction progresses as well as seasonally due to climate. It is expected that the potential for treated wastewater reuse would also show variability. Water extraction from surface water is not proposed during the establishment or operation of the Emu Plains construction support site (WHT13).

9.7.4 Assessment summary

With the use of standard and well proven management controls, water quality impacts would be minimal.

A detailed erosion and sedimentation control plan (ESCP) would be prepared for the site prior to the commencement of site establishment to determine the specific requirements.

9.7.5 Environmental management measures

The impacts associated with surface water quality as a result of WHT13 would be generally consistent with those assessed in the Project EIS. No further environmental management measures or changes to the Minister's Conditions of Approval are considered necessary beyond those identified for the Approved Project.

9.8 Biodiversity

A detailed assessment of terrestrial and aquatic biodiversity has been carried out for the Emu Plains construction support site (WHT13) and is included in Appendix M (Biodiversity Development Assessment Report - Emu Plains). This chapter summarises the findings of the BDAR.

9.8.1 Assessment methodology

The assessment of the impacts on biodiversity associated with the Emu Plains construction support site (WHT13) included:

- Describing the biodiversity values present within the Subject Land, including the extent of native vegetation, vegetation integrity and the presence of Threatened Ecological Communities (TECs)
- Determining the habitat suitability within the Subject Land for candidate threatened species
- Preparation of an impact assessment on biodiversity values, including potential prescribed impacts and Serious and Irreversible Impacts (SAIIs) within the Subject Land
- Discussion and recommended efforts to avoid and minimise impacts on biodiversity values
- Calculation of biodiversity credits (i.e., ecosystem credits and species credits) that measure potential impacts of the proposed modification to the Project on biodiversity values. This calculation will inform the decision maker as to the number and class of offset credits required to be purchased and retired as a result of the proposed modification, and
- Consideration and assessment of the impacts in accordance with other relevant legislation such as the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) and Fisheries Management Act 1994 (FM Act).

The assessment of biodiversity impacts included consideration of:

- Potential impacts on terrestrial biodiversity, consistent with the Biodiversity Assessment Method (BAM)
- Potential impacts on aquatic biodiversity.

9.8.2 Assessment guidelines

The following primary assessment guidelines were used to inform the biodiversity assessment:

- Biodiversity Assessment Method (Office of Environment and Heritage (OEH), 2017) – for the assessment of impacts on threatened species, threatened ecological communities, and their habitats, and the impact on biodiversity values, where required under the Biodiversity Conservation (BC) Act

- Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (Department of the Environment, 2013) – for the assessment of significance of impacts on matters of national environmental significance under the EPBC Act
- Policy and Guidelines for Fish Habitat Conservation and Management – Update 2013 (NSW DPI, 2013) – for the assessment of freshwater and marine biodiversity matters.

A list of all of the assessment guidelines that were used to inform the biodiversity assessment is provided in Appendix M (Biodiversity Development Assessment Report – Emu Plains).

Mapping and surveys

A desktop assessment was carried out for the project including review of information from relevant databases, vegetation maps, topographic maps as well as aerial imagery and Google Street View. This included:

- State and Commonwealth Datasets:
- EPBC Protected Matters Search Tool (DCCEEW, 2023)
- NSW BioNet. The website of the Atlas of NSW Wildlife (DPE, 2023a)
- NSW BioNet. Threatened Biodiversity Data Collection (DPE, 2023b)
- NSW BioNet. Vegetation Classification System (DPE, 2023c)
- NSW Government Spatial Services: Search and Discovery - Historical, Aerial and Satellite Imagery (Spatial Services, 2023a)
- NSW Government Spatial Services: Six Maps Clip & Ship (Spatial Services, 2023b)
- BAM Important Habitat Maps
- Fish Communities and Threatened Species Distributions of NSW (DPI, 2016)
- Freshwater Threatened Species Distributions Maps (DPI, 2013a)
- Key Fish Habitat Maps – Hawkesbury-Nepean (DPI, 2013b)
- Vegetation and Soil Mapping:
- The NSW State Vegetation Type Map (DPE, 2023d)
- The Native Vegetation of the Cumberland Plain, Western Sydney: Systematic Classification and Field Identification of Communities (DPE, 2015b)
- Soil Landscapes of the Penrith 1:100,000 Sheet (Bannerman S.M. and Hazelton P.A., 2011)
- eSPADE v2.2.0 (DPE, 2023e)

9.8.3 Field surveys

Supplementary field surveys were also carried out in March and April 2023. Details are provided in Chapter 2 of Appendix M (Biodiversity Development Assessment Report – Emu Plains).

Plant Community Types

The State Vegetation Type Map (DPE, 2023f) indicated the presence of two Plant Community Types (PCT) in proximity to the Emu Plains construction support site (WHT13):

- PCT 3320: Cumberland Shale Plains Woodland, and
- PCT 4025: Cumberland Red Gum Riverflat Forest

Field validated vegetation

Following field investigation, one PCT was identified as existing within the study area – approximately 1.31 hectares of Coastal Valleys Swamp Oak Riparian Forest (PCT 4023). PCT 3320 Cumberland Shale Plains Woodlands was mapped on a now disturbed terrain landscape and the closest adjoining soil landscape (Richmond) is underlain by quaternary alluvium, not shale and therefore would not meet the requirements for this PCT.

Field validated mapping including the location of the PCT 4023 Coastal Valleys Swamp Oak Riparian Forest is shown on Figure 9-19.

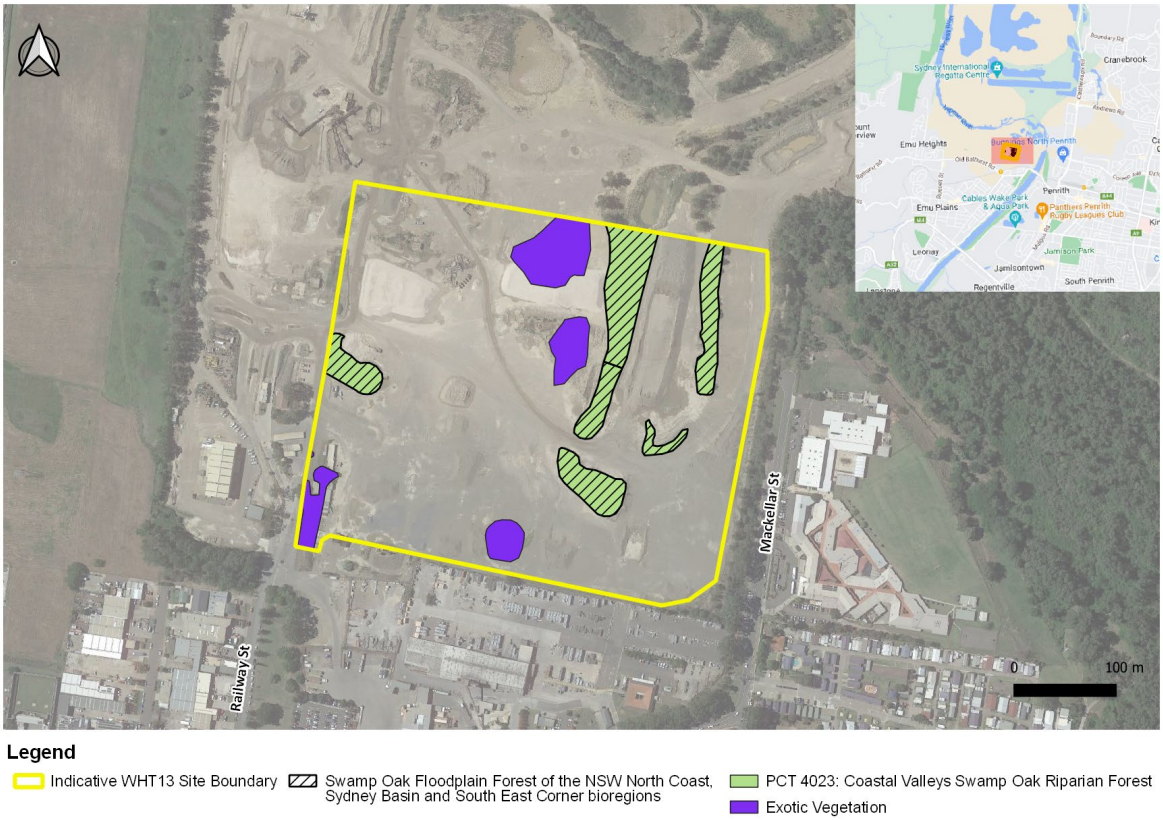


Figure 9-19 Field validated existing Plant Community Types - Emu Plains construction support site (WHT13).

Coastal Valleys Swamp Oak Riparian Forest (PCT 4023) was represented by two condition classes as follows:

- Vegetation Zone 1: Poor Condition (about 0.60 hectares)
- Vegetation Zone 2: Moderate Condition (about 0.71 hectares)

Despite the generally poor condition, the 1.31 hectares of the Coastal Valleys Swamp Oak Riparian Forest is likely to conform with the requirements under the Biodiversity Conservation Act 2016 (BC Act) as Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions and accordingly would be considered an endangered ecological community listing.

The vegetation within the study area would not conform to the Commonwealth Environmental Protection and Biodiversity Conservation Act (1999) (EPBC Act) listed Endangered Ecological Community, Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community as it fails to meet the condition thresholds, as the vegetation does not have a mostly native understorey (63% exotic cover).

Habitat suitability for threatened species

Threatened fauna and flora with potential to occur within the Emu Plains construction support site (WHT13) and immediate surrounds were identified following review of BioNet using a 10km x 10km search area centred on the site. Field surveys were also carried out to determine the presence of threatened flora and fauna, and habitat features on site. Further details about the site investigations are provided in Appendix M (Biodiversity Development Assessment Report – Emu Plains).

While a number of threatened fauna and flora species were identified as having the potential to occur within the study area, habitat features were not present on the site for these threatened species and the site was determined to be significantly degraded to the point that threatened flora and fauna species are unlikely to utilise the land. However, one threatened fauna species, the Southern Myotis, has been assumed present in the absence of a targeted survey.

Key Fish Habitat

Searches using the Freshwater Threatened Species Distributions Maps (DPI, 2023a) were carried out to produce a list of potential threatened freshwater fish species that may occur within the Subject Land. The sampling protocol used to assess the habitat features and stream condition indicators of aquatic habitat, particularly those relating to Key Fish Habitat (KFH), included assessment in accordance with the NSW Australian River Assessment System (AUSRIVAS) Sampling and Processing Manual (DEC, 2004a).

One unmapped, artificial waterbody is located within the site and is used as a detention basin for the existing Boral Quarry. The Nepean River, a 4th order watercourse is located approximately 500 metres east and 400 metres north of the site. Several 1st, 2nd, and 3rd order watercourses along with their associated riparian buffers, are located within a 500m buffer area.

As the detention ponds and swales can be classified as first-order 'streams' and contain minimal to no instream habitat, they are not considered to be Key Fish Habitat in accordance with the Policy and guidelines for fish habitat conservation and management – Updated 2013 (DPI, 2013c) and should be classified as Class 3 (minimal key fish habitat). No threatened species listed under the Fisheries Management Act 1994 would have potential habitat within the unnamed waterbody.

9.8.4 Assessment of potential impacts

Direct impacts

The proposed modified project would require the removal of approximately 1.31ha of degraded Coastal Valleys Swamp Oak Riparian Forest (PCT 4023). This vegetation is in poor condition, fragmented and located within a disturbed landscape that makes potential use by threatened species highly unlikely.

Indirect impacts

Indirect impacts occur when the proposal or activities relating to the construction or operation of the proposal affects native vegetation, threatened ecological communities and threatened species habitat beyond the site boundary. Impacts may also result from changes to land-use patterns, such as an increase in vehicular access and human activity on native vegetation, threatened ecological communities and threatened species habitat.

Important breeding habitats occur up to 500m north of the site that are known to support the Penrith Flying-fox camp. Given the existing industrial landscape, and the position of the Emu Plains Quarry and Penola Catholic College between the camp and the site, it is considered unlikely that the proposed modified project would result in an increase of indirect impacts to the camp.

Further assessment of the potential indirect impacts expected as a result of the Emu Plains construction support site (WHT13) are detailed in Table 9-24.

Table 9-24 Potential indirect impacts on biodiversity – Emu Plains construction support site (WHT13)

Indirect impact	Potential nature, extent, and duration
Inadvertent impacts on adjacent habitat or vegetation	Impacts to adjacent vegetation can be prevented or minimised through appropriate exclusion fencing, implementation of a site-specific Construction Environmental Management Plan detailing best practice environmental protection measures, strict water quality practices and stormwater controls, and by ensuring any lighting is directed towards the developed area, rather than towards the adjacent vegetation.
Reduced viability of adjacent habitat due to edge effects	Adjacent habitats are currently subject to a high degree of edge effects due to prior clearing and surrounding existing industrial land use. As such, an increase to edge effects is not expected to occur to the remnant surrounding vegetation as a result of the proposed modification. The vegetation adjoining the site on the elevated mound between the site and Mackellar Street illustrates the poor quality of groundcover with only 0.1% native grasses, and no native forbs, ferns or other. On the basis that this vegetation is elevated above the site (on a mound) and is already severely weed infested with no native groundcover, edge effects to adjacent habitats are unlikely to be exacerbated by the proposed modification.

Indirect impact	Potential nature, extent, and duration
Reduced viability of adjacent habitat due to noise, dust, or light spill	It is predicted that adjacent habitat outside the site would experience a negligible increase to indirect impacts created by noise, dust, and light spill, during construction and operation of the future development of the site. The approximate noise impact on the vegetated areas to the north and east is expected to be between 40-55dB during site establishment and <30dB in operation (See Section 9.2)). Disturbed vegetated areas outside the Subject Land, but within Emu Plains Quarry is expected to be between 40 and 45dB during establishment and operation. This is considered the 'worst case scenario' as the second pre-cast facility (north) is not expected to be operating at night. The rating background level is 41dB, which was measured near the caravan park to the east of the Subject Land. Site lighting will be designed to minimise glare and light spillage into adjoining properties and vegetation and be consistent with the requirements of Australian Standards and Guidelines 4282-2019 Control of the obtrusive effects of outdoor lighting. Additional control measures are to be installed to minimise glare and light spillage into adjoining vegetation to minimise potential impacts to fauna species and lighting is to be installed in a direction oriented away from the riparian vegetation adjoining the Nepean River. A light spill assessment has been carried out for the concept lighting design, which has determined that AS4282-2019 can be achieved with approximately 1.5ha of adjoining vegetation subject to light spill. These indirect impacts will be managed via best practices outlined in an approved Construction Environmental Management Plan. The Subject Land already occurs as an industrial area, and light and noise pollution is already moderate. These impacts are not likely to substantially increase due to the proposed future development. Any potential impacts are not considered significant as it is highly unlikely that species abundance would be diminished.
Transport of weeds and pathogens from the site to adjacent vegetation	Weeds occurring within the site are common with those occurring within adjacent vegetation to be retained. Increased transport of pathogens and weeds is unlikely to occur, however would be managed by biosecurity measures as outlined in the Construction Environmental Management Plan.
Increased risk of starvation, exposure and loss of shade or shelter	It is highly unlikely that any threatened fauna would be exposed to increased risks from starvation, exposure, and loss of shade and shelter beyond the Subject Land as a result of the proposed modification. No habitat is to be removed beyond the Subject Land, although disturbances from noise during construction and utilisation may deem such habitats unsuitable for certain species. However, due to the highly urbanised nature of the vegetation adjacent to the Subject Land, it is unlikely that this impact will be significant.
Loss of breeding habitats	No breeding habitat features (e.g., hollows, nests, caves) were identified immediately adjacent to the Subject Land. It is therefore considered unlikely that the proposed modification would result in a loss of breeding habitats. Aquatic habitats are unlikely to offer suitable breeding habitat for amphibians given their ongoing use for the Emu Plains Quarry, which has degraded the habitat to poor quality. Important breeding habitats occur up to 500 metres north of the Subject Land (e.g., Penrith Flying-fox camp) however these are located beyond the existing Emu Plains Quarry to the north and would not be impacted by light or noise impacts.
Trampling of threatened flora species	No impacts to threatened flora as a result of trampling are expected as a result of the proposed modified project. No threatened flora have been identified within the site, nor is suitable habitat considered to exist.
Increase in predatory species populations	It is likely that predatory species, such as foxes and cats, already inhabit areas surrounding the site. The vegetation clearance proposed by the proposed modified project, and proposed land use, is unlikely to increase predatory species populations.

Indirect impact	Potential nature, extent, and duration
Increase in pest animal populations	The site occurs in an urbanised area with impacts including introduced domestic pets such as cats Felis catus currently occurring within the locality. Pest animals such as Black Rats Rattus rattus are also widely spread within the region and are likely to occur across the locality. The proposed modified project would not result in an increase in available habitat for these species and is unlikely to lead to an increase in pest animal populations. Suitable waste disposal implemented during, and post construction would further reduce the resources available for pest species.
Disturbance to specialist breeding and foraging habitat, e.g., beach nesting for shorebirds.	No specialist breeding and foraging habitat was identified adjacent to the site, however located approximately 500 metres north of the site is the Penrith Grey-headed Flying-fox (GHFF) camp. The Penrith GHFF camp is located on the opposing side of the operational footprint of the Emu Plains Quarry. The Parramatta Park GHFF camp is reported to have been located 300 metres from the Parramatta Light Rail Project (PLR), and the results of monitoring for the PLR revealed high noise construction activities caused only low levels of disturbance and did not seem to impact the camp overall with no obvious changes in GHFF numbers. Dependent young and nursing females were observed during the survey however, these were not visibly impacted by the high-noise construction works (Ecosure, 2021). The proposed modification is located a further distance from the Penrith GHFF camp compared with the PLR project to the Parramatta GHFF camp (500 metres vs. 300 metres) and is similarly located in an urban/ industrial environment, i.e., the Penrith GHFF camp would be habituated to similar indirect impacts. Based on the findings of Ecosure (2021), the existing industrial landscape, and the position of the Emu Plains Quarry between the camp and the Subject Land, it is considered unlikely that the proposed modification would result in an increase of indirect impacts to the camp.

Key threatening processes

There are currently 39 Key Threatening Processes (KTPs) listed under the BC Act, 21 KTPs listed under the EPBC Act, and eight listed under the FM Act. Several KTPS are listed under more than one Act. KTPs relevant to the Emu Plains construction support site (WHT13) are shown in Table 9-25.

Table 9-25 Key threatening processes – Emu Plains construction support site

Key threatening process	Status	Proposed impacts from the proposed modified project
Native Vegetation and Terrestrial Habitat Impacts		
Land clearance/ Clearing of native vegetation	EPBC Act BC Act	Clearing of native vegetation would occur as a result of the proposed modification. A total of 1.31ha of native vegetation is proposed to be cleared across one PCT (PCT 4023).
Biosecurity Impacts		
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	EPBC Act BC Act	Construction work has the potential to introduce amphibian chytrid to the site which could lead to death of non-threatened frogs and tadpoles. Habitat for threatened frogs is considered to be absent within the Subject Land.
Invasion, establishment and spread of Lantana	BC Act	Lantana is already prevalent within and adjoining the site. This KTP is unlikely to be exacerbated on-site given it is already abundant.

Key threatening process	Status	Proposed impacts from the proposed modified project
Aquatic Impacts		
Degradation of native riparian vegetation along New South Wales water courses	FM Act	The native riparian vegetation within and adjacent to the Subject Land is already heavily degraded but the proposed modification may lead to an increase in this KTP.

The assessment indicates that impacts on KTPs from the Emu Plains construction support site would be minimal, as outlined in Table 9-25 above.

Groundwater dependent ecosystems

Assessment of the potential for the site to support groundwater dependant ecosystems was carried out using the Commonwealth's Bureau of Meteorology Groundwater Dependant Ecosystems Atlas (BOM, 2023). No vegetation within or directly adjoining the site has been mapped as a Groundwater Dependent Ecosystem.

Environment Protection and Biodiversity Conservation Act

The Protected Matters Search Tool identified the following as potentially occurring within the Subject Land (or within the area):

- 11 Threatened Ecological Communities
- 52 threatened species, and
- 16 Migratory species.

An assessment of the impacts of the proposed modification on Matters of National Environmental Significance (MNES) outlined in Department of Agriculture, Water and the Environment's Matters of National Environmental Significance, Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999 (Department of the Environment)A, 2013) was prepared to determine whether referral of the proposed modification to the Commonwealth Minister for the Environment and Water is required. MNES relevant to the proposed modification are summarised in Table 9-26.

Table 9-26 EPBC Act Assessment of Significant Impacts – Emu Plains construction support site (WHT13)

MNES	Proposed modification specifics	Impact
Threatened species	No EPBC Act listed threatened species have the potential to be impacted by the proposed modification.	No significant impact likely.
Threatened ecological communities	The PCT within the Subject Land does not meet the eligibility criteria for the EPBC Act listed TEC.	No significant impact likely.
Migratory species	Based on the results of the PMST, 16 listed migratory species may occur in the broader locality. Migratory species are unlikely to occur within the Subject Land given the location in the landscape and historical land use.	Some EPBC Act listed threatened and migratory wader birds including the Curlew Sandpiper, Great Knot, Red Knot, Eastern Curlew, Greater Sand Plover, Lesser Sand Plover, Bar-tailed Godwit and Black-tailed Godwit may occur in the adjacent riparian habitats associated with the Nepean River. The habitats in the Subject Land are not important habitats for migratory birds. The proposed modification would not substantially modify, destroy, or isolate an area of important habitat for the migratory species, and it would not seriously disrupt the lifecycle of an ecologically significant proportion of a population of migratory birds.

MNES	Proposed modification specifics	Impact
Wetlands of international importance (Ramsar sites)	The Subject Land does not contain any wetlands of international or national importance.	No significant impact likely.

The table indicates that no MNES were identified for the Emu Plains construction support site (WHT13).

9.8.5 Assessment summary

The key findings of the assessment of biodiversity impacts for the proposed Emu Plains construction support site are as follows:

- In terms of direct impacts, the Emu Plains construction support site (WHT13) would require the removal of approximately 1.31 hectares of Coastal Valleys Swamp Oak Riparia (PCT 4023). This removal would have minimal impact on biodiversity values noting the general poor condition of the vegetation. Assumed presence has also been identified for the Southern Myotis.
- Indirect impacts would be minor as the site is already used for industrial purposes, with light and noise pollution already moderate and the highly disturbed nature of the vegetation adjacent to the site. Any potential indirect impacts would be managed via best practices outlined in an approved Construction Environmental Management Plan.

9.8.6 Environmental management measures

No further environmental management measures are considered necessary beyond those identified for the Approved Project.

No amendments to the Minister's Conditions of Approval as they relate to biodiversity impacts would be required with the exception of changes to the biodiversity offset requirements as detailed below.

9.8.7 Biodiversity offset credits

The preferred approach to offset residual impacts of the proposal is to purchase and retire the appropriate species credits from registered Biodiversity Stewardship Sites that comply with the trading rules of the NSW BOS in accordance with the 'like for like' report generated by the BAM-C. If such credits are unavailable, credits would be sourced in accordance with the 'variation report' generated by the BAM-C.

Offset requirements for ecosystem credits

The offset requirement for impacts to native vegetation from the proposed modification was calculated using the BAM Calculator and is summarised below in Table 9-27.

Table 9-27 Ecosystem offset credits – Emu Plains construction support site (WHT13)

PCT	Vegetation zone	Vegetation Integrity Score Loss	Area (ha)	Credit Requirement
PCT 4023: Coastal Valleys Swamp Oak Riparian Forest	Zone 1: Poor_ Condition	5.1	0.60	0
	Zone 2: Moderate_ Condition	25.7	0.71	9

Offset requirements for species credits

One threatened species, Myotis macropus (Southern Myotis), has been assumed present within aforementioned PCT areas for the proposed modification. Credit requirement for this species directly relates to the area and condition of the recorded PCT4023. Offset requirements for Southern Myotis are presented in Table 9-28.

Table 9-28 Species credits – Emu Plains construction support site (WHT13)

Species	Vegetation zone	Vegetation Integrity Score Loss	Area (ha)	Credit Requirement
Myotis macropus / Southern Myotis	Zone 1: Poor_ Condition	5.1	0.60	2
	Zone 2: Moderate_ Condition	25.7	0.71	9

No other candidate species credit species would require offsetting through the retiring of biodiversity offset species credits under the BOS as a result of the proposed modified project. This is due to all other candidate species credit species being excluded from occurring on the Subject Land based on available habitat constraints or the habitat being substantially degraded such that the species is unlikely to utilise the Subject Land in accordance with the BAM.

9.9 Socio-economics

This chapter provides an assessment of the potential socio-economic impacts associated with the Emu Plains construction support site (WHT13).

9.9.1 Assessment methodology

A Social Impact Assessment (SIA) has been carried out in consideration of the SIA Guidelines (DPE, 2022), and has been appropriately scaled to reflect the likely social impacts resulting from the proposed changes to the Approved Project. The complete SIA is provided in Appendix N (Technical Working Paper: Social Impact Assessment). This section provides a summary of the findings of the SIA.

9.9.2 Existing environment

Location of proposed site

The Emu Plains construction support site (WHT13) is proposed to be located on a portion of the existing Boral site in the Emu Plains industrial area, located with Penrith City LGA. The site would primarily be used to pre-cast tunnel segments, culverts, and other concrete elements. which would then be transferred via truck to the City West Link Portal. Other heavy vehicle movements will also be required for materials delivery.

The current site has been operating by its current owner since the 1980's and has been licenced under an EPL since 2000. The site is currently licenced to carry out scheduled activities such as crushing, grinding, or separating, resource recovery and waste storage It is also licenced to receive tunnel spoil from the approved Sydney Metro City, M4-M5 Link and WestConnex Stage 2 projects.

The site currently operates generally between 5am to 10pm Monday to Saturday with maintenance operations allowed on Sundays between 5am and 5pm. The development consent for the operation of the site also carries current restrictions on the use of Russell Street, restricted to 7am to 6pm only.

Existing demographic profile

A snapshot of the population profile of Emu Plains in comparison to Greater Sydney and NSW is provided in Table 9-29.

Table 9-29 Community snapshot – Emu Plains construction support site (WHT13)

Indicator	Emu Plains	Greater Sydney	NSW
Population	8,126	5,231,147	8,072,163
Male	48.3%	49.4%	49.4%
Female	51.7%	50.6%	50.6%
Median age (years)	41	37	39
Aboriginal and/or Torres Strait Islander	4.0%	1.7%	3.4%
Families	2,263	1,380,176	2,135,964
Family households	73.7%	72.6%	71.2%

Average children per family with children	1.8	1.8	1.8
Total private dwellings	3,177	2,076,284	3,357,785
Average people per household	2.6	2.7	2.6
Median weekly household income	$1,877	$2,077	$1829
Median monthly mortgage repayments	$2,200	$2,427	$2,167
Median weekly rent	$420	$470	$420
Average motor vehicles per dwelling	1.9	1.7	1.8

In terms of the resident population, the suburb of Emu Plains is home to 8,126 people (ABS, 2021) with a median age of 41. This is slightly higher when compared to NSW, that has a median age of 39. The population includes 2,263 families with an average of 1.8 children. There is an average number of 2.6 people living in each private dwelling, of which there are 3,177. The dominate dwelling structure is a separate house (82.1%) followed by semi-detached, row or terrace house etc (12.4%). There is a splattering of flats and apartments (2.2%).

The majority of residents are Australian born (81.3) and 89% only speak English in their homes. There is a notable portion of the population (9.7%) where a non-English language is used which varies widely and is inclusive of (but not limited to) Greek, Arabic, Hindi, Mandarin and Croatian. This emphasises the need for any community engagement to be inclusive, and catering for the proportion of the community who do not speak English as their first language.

A total of 59.5% of the population are currently in the labour force, with the top five occupations of employment including professionals (21.4%), clerical and administrative workers (16.8%), managers (13.7%), technician and trades workers (13.2%) and community and personal service workers (10.4%). Of those participating in the labour force, almost half travelled to work by car as either a passenger or driver and only 2% used public transport. A third of the working population worked from home, which is reflective of the timing of the 2021 census data and the implications of Covid-19. The median household incomes were comparable to the NSW average ($1,877 median weekly income for those in Emu Plains, compared to $1,829 in NSW).

Existing social infrastructure

Existing social infrastructure in proximity to the Emu Plains construction support site (WHT13) is shown on Figure 9-20. The analysis for this study identified some essential social infrastructure that underpin the population's social well-being. The area surrounding the proposed support site is primarily industrial in nature, with some education and training, accommodation, and public transport provisions. There is also a commercial area on the southern side of the Emu Plains Railway Station as well as a residential area.

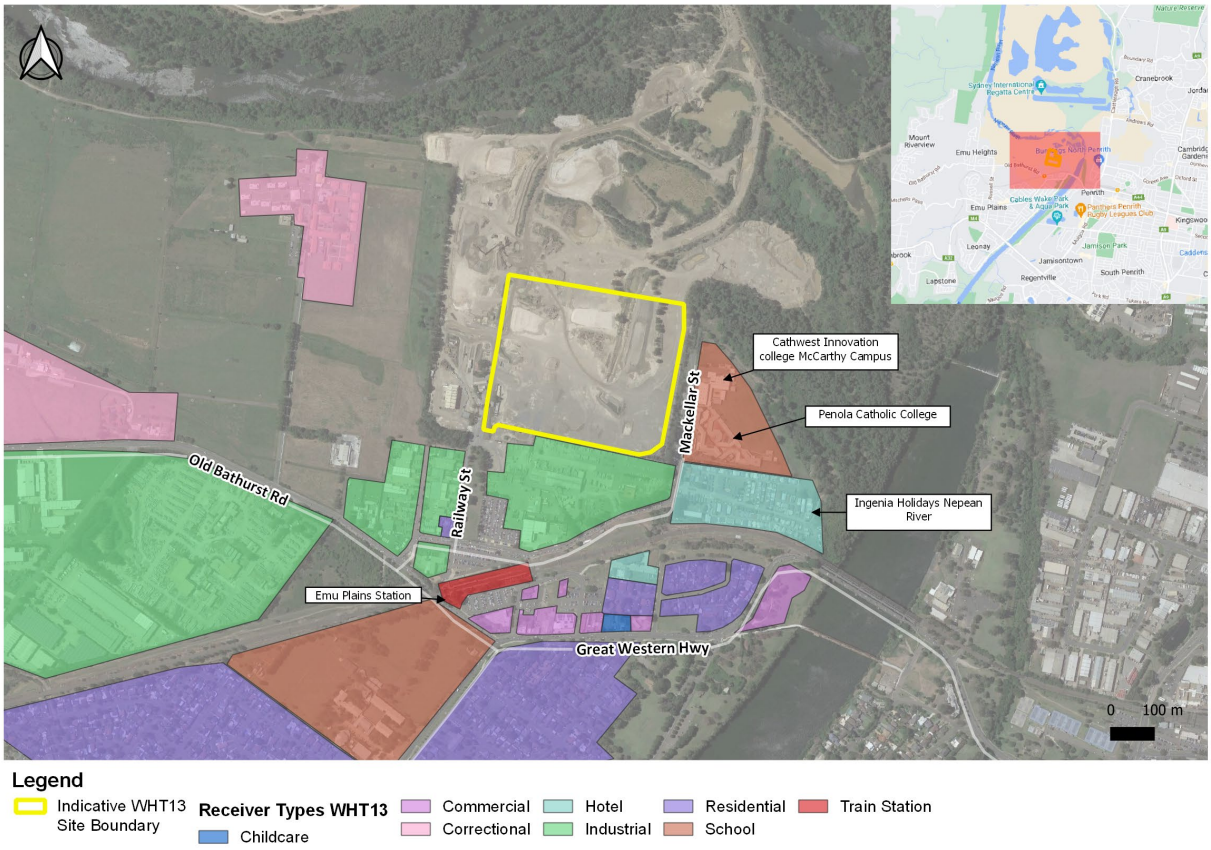


Figure 9-20 Existing social infrastructure surrounding the Emu Plains construction support site (WHT13).

9.9.3 Assessment of potential impacts

Table 9-30 provides a summary of the new social impacts associated with the proposed modified project in relation to the Emu Plains construction support site (WHT13). Further details are provided in Appendix N (Technical Working Paper: Social Impact Assessment).

Table 9-30 Summary of SIA assessment - Emu Plains Construction Support Site (WHT13)

Impact / Opportunity	Existing / new social impact	Extent	Social Impact Categories	Assessed impact – Approved Project	Residual impact significance	Net change in social impact
Changes to amenity (increase in noise and activities and light spill) due to site operating 24 hours per day, 7 days per week	New	• CathWest Innovation College - McCarthy Campus • Penola Catholic College • Ingenia Holidays Nepean River • Nearby residential receivers along Railway and Smith Street	Surroundings Way of life	Not applicable	Low (unlikely and minor)	New negative social impact
Change to how people access roads and other services, due to increased heavy vehicle movements	New	• Those living along proposed haulage route • Accessing Emu Plains Station • Road users	Accessibility	Not applicable	Low (unlikely and minor)	New negative social impact

9.9.4 Assessment summary

The proposed modified project would introduce some new negative social impacts due to the proposed Emu Plains Construction Support Site, however with the implementation of mitigation measures identified for the Approved Project the magnitude of these impacts would be reduced, resulting primarily in residual 'low' social impacts.

9.9.5 Environmental Management measures

The impacts associated with socio-economics as a result of the addition of the Emu Plains construction support site (WHT13) would be generally consistent with those assessed for the Approved Project. No further environmental management measures are considered necessary beyond those identified for the Approved Project. No amendments to the Minister's Conditions of Approval as they relate to socio-economics would be required.

9.10 Cumulative

9.10.1 Assessment methodology

Cumulative impacts can occur when impacts from the project interact or overlap with impacts from other projects and potentially result in a larger overall effect on the environment, businesses, or local communities. Cumulative impacts may also occur when projects are constructed consecutively, with construction activities occurring over extended periods of time with little to no break in between, resulting in construction fatigue for local receivers. Construction fatigue incorporates the potential for complaint fatigue, which may impact communication of community concerns during construction.

Consistent with the Project EIS, the approach adopted includes identification of potential projects that may overlap with respect to location, timeframe, and scale of potential impact. This considered current projects by state and local government agencies as well as major development applications.

Identification of potential projects

Projects and plans that satisfied the potential for cumulative impacts consistent with the criteria identified in the Project EIS are described in Table 9-31.

Table 9-31 Projects with potential cumulative impacts – Emu Plains construction support site (WHT13)

Project	Relevance	Key issues of potential relevance
Emu Plains Commuter Car Park	In close proximity The project is expected to be completed in early 2023. Major traffic generator	Traffic and transport
Existing Boral Quarry	Adjacent activity Currently operating Existing licence limitations on hours of operation	All
New industrial site development at 158-162 Old Bathurst Road	In close proximity Traffic generator	Traffic and transport

9.10.2 Assessment of potential impacts

An assessment of the potential cumulative impacts of the Emu Plains construction support site (WHT13) is presented in Table 9-32.

Table 9-32 Cumulative impacts – Emu Plains construction support site (WHT13)

Issue	Proposed impacts from the proposed modified project
Traffic and transport	Chapter 27 (Cumulative impacts) of the Project EIS provides an assessment of cumulative impacts associated with the Approved Project. Traffic associated with the Emu Plains construction support site would consist of a redirection of some traffic from the approved construction support sites, such as the Glebe Island construction support site (WHT3) to the proposed Emu Plains construction support site (WHT13). As assessed in section 8.1, this redistribution of construction traffic would have a negligible impact on the surrounding road network. The construction and operation of the Emu Plains construction support site (WHT13) would require heavy and light vehicle movements to and from the proposed construction support site. The site has an existing Boral facility operating under a separate, pre-existing approval. The existing approval permits frequent heavy vehicle movements to and from the site, and therefore the use of this site will not substantially alter the traffic profile into and out of the site. The Boral portion of the site would continue to operate under its existing planning approval and licence conditions. Heavy vehicle movements were observed on site, and it has therefore been assumed that the traffic data collected has incorporated these existing movements. Boral currently runs an average of about 240 heavy vehicle movements per day in and out of the site. The 'with construction' assessment of LoS in Table 9-6 and Table 9-7 used this average heavy vehicle movement number to determine the potential impact from a cumulative perspective. For completeness, a worst-case scenario has also been modelled and included in Appendix D. This worst-case assessment considered the existing and proposed performances should the Boral facility utilise all of their permitted quota of heavy vehicle movements daily (i.e., about 900 heavy vehicle movements per day). The assessment includes the same intersections assessed as part of the construction assessment in Table 9-4 and Table 9-5. The results of this worst-case assessment suggest that even with the additional movements there would likely be only a minor increase in delay and travel time for each of the sites, and all intersections would still perform similarly to how they would with the modified project. Other developments in the vicinity of the site as listed above have been included in the traffic assessment based on their relevant planning or development application documentation. It is expected that the Emu Plains construction support site (WHT13) will be operational in the period after these sites have been established. The additional traffic movements from the Boral site and other developments as listed have been included in the existing traffic conditions part of the assessment. The commuter carpark is positioned immediately opposite Smith Street and includes the provision of a new roundabout intersection to be constructed at the intersection of Smith Street and Old Bathurst Road. This new roundabout has also been incorporated into the assessment with the assumption it will be operational prior to any works associated with the Emu Plains construction support site (WHT13). Construction fatigue with respect to heavy vehicle traffic is not expected at the Emu Plains construction support site (WHT13) noting the long-term operation of the existing site and long-term industrial nature of the site.

Issue	Proposed impacts from the proposed modified project
Noise and vibration	The other key project in the vicinity of the Emu Plains construction support site (WHT13) which may impact on noise and vibration is Boral Quarry. Impacts from the Emu Plains construction site (WHT13) would be managed such that cumulative impacts with the adjacent site would be mitigated and managed to achieve outcomes consistent with the assessment of noise and vibration. Construction fatigue with respect to noise is not expected noting the noting the long-term operation of the existing site and long-term industrial nature of the site.
Air quality	The other key project in the vicinity of the site which may impact on air quality is the Boral Quarry. Impacts from the Emu Plains construction site (WHT13) would be managed such that cumulative impacts with the adjacent site would be mitigated and managed to achieve outcomes consistent with the assessment of air quality.
Heritage	As there are no assessed impacts on heritage there would be no potential for cumulative impacts
Geology, soils, contamination, and groundwater	The other key project in the vicinity of the site which may impact on soils, contamination and groundwater is the Boral Quarry. Impacts from the Emu Plains construction site (WHT13) would be managed such that cumulative impacts with the adjacent site would be mitigated and managed to achieve outcomes consistent with the assessment of soils, groundwater, and contamination.
Water quality	The other key project in the vicinity of the site which may impact on water quality is the Boral Quarry. Impacts from the Emu Plains construction site (WHT13) would be managed such that cumulative impacts with the adjacent site would be mitigated and managed to achieve outcomes consistent with the assessment of water quality.
Biodiversity	The impacts associated with the establishment and operation of the Emu Plains construction support site (WHT13) for the duration of construction of the project is not anticipated to increase the cumulative impacts of the project on biodiversity in the area. The only issue identified was potential indirect noise and/or lighting impacts. Noting the relatively short duration for the operation of this site, no longer term cumulative impacts are expected.
Social impact assessment	The extent of social impacts has been assessed as low. As such, there would be negligible potential for cumulative impacts. Construction fatigue is not expected noting the long-term operation of this site and the industrial nature of the site.
Urban design and visual	The extent of visual impacts has been assessed as low. Activities to be carried out at the Emu Plains construction support site (WHT13) would be largely consistent with activities already occurring onsite for the operation of Boral Quarry and therefore would not result in any material change to the existing landscape character or visual impacts already experienced by nearby receivers. As such, there would be negligible potential for cumulative impacts.
Hazards and risks	The key other project in the vicinity of the site which may impact on hazards and risks is the Boral Quarry. Impacts from the Emu Plains construction site (WHT13) would be managed such that cumulative impacts with the adjacent site would be mitigated and managed to achieve outcomes consistent with the assessment of hazards and risks.

Issue	Proposed impacts from the proposed modified project
Waste and resource management	The Emu Plains construction support site (WHT13) is not anticipated to increase the cumulative impacts of the project on waste and resource management.

9.10.3 Assessment summary

Activities at the proposed Emu Plains construction support site (WHT13) would be largely consistent with activities already occurring onsite for the operation of Boral Quarry and therefore would not result in any material change to the existing impacts already experienced by nearby receivers. As such, there would be negligible potential for cumulative impacts. The use of the site would also be for a relatively short duration so there would be no potential for longer term cumulative impacts.

9.10.4 Environmental management measures

No environmental management measures are considered necessary beyond those identified for the Approved Project. No amendments to the Minister's Conditions of Approval as they relate to cumulative impacts would be required.

10. Assessment of impacts - Whole of project

This Chapter provides an assessment of issues of relevance to the proposed modified project that would apply project wide during the construction stage. The assessment provides a comparison with the Approved Project. When operational, the proposed modified project would perform the same as the Approved Project.

10.1 Construction resource use and waste management

This section describes the resources and materials, including potential sources and the expected quantities, that would be used to construct the proposed modified project.

Construction of the proposed modified project would also generate waste streams which would require management and disposal in accordance with relevant state policies and guidelines. This section provides a description of likely waste streams, expected quantities, and waste management strategies.

10.1.1 Assessment methodology

The assessment of resource use and waste management comprised:

- Review of the likely resources required for the construction of the proposed modified project, including construction materials, water, and power.
- Review of the likely waste streams, volumes, and classifications
- Identification of opportunities for the avoidance, minimisation, and reuse of wastes, including targets for the beneficial reuse of solid wastes, wastewater, and other wastes consistent with the project's sustainability framework (refer to Chapter 25 (Sustainability) of the EIS)
- Identification of the environmental impacts associated with resource use and the generation (and subsequent disposal) of residual waste materials.
- Management strategies for waste during construction, including:
  - Managing construction waste through the resource management hierarchy established under the Waste Avoidance and Recovery Act 2001. Developing procedures for the assessment, handling, stockpiling and disposal of potentially contaminated materials and wastewater, in accordance with the Waste Classification Guidelines (NSW EPA, 2014a).

10.1.2 Assessment of potential impacts

Construction materials

The Project EIS noted that construction material requirements would be typical for a motorway project of this scale. The amount and type of construction materials required for the proposed modified project is not expected to significantly change.

While the resource requirements of the proposed modified project do have the potential to impact resource availability within the Sydney metropolitan region over the construction period, the concurrent construction of North Connex, M4-M5 Link and Sydney Metro Northwest demonstrates that the market is able to meet the concurrent construction of major infrastructure projects given sufficient opportunity to forward plan.

The addition of the Emu Plains construction support site (WHT13) is not expected to additionally strain resource availability.

Water

Water would be required during construction activities. Measures to avoid and minimise water consumption, particularly of potable water, have been included in the design and construction planning for the project.

Water for construction of the proposed modified project would be sourced according to the following hierarchy, where feasible and reasonable, and where water quality and volume requirements are met:

- Stormwater harvesting (non-potable water)
- On-site construction water treatment and reuse, including groundwater (non-potable water)
- Mains supply (potable water).

The water balance for the proposed changes associated with the tunnelling and Sydney Harbour works would be less than the Approved Project owing to the removal of several construction sites.

An indicative water balance has been calculated for the additional Emu Plains construction support site (WHT13) and is shown in Table 10-1.

Table 10-1 Water balance – Emu Plains construction support site (WHT13)

Site	Total water demand (kL/d)	Consumptive use (kL/d)	Groundwater inflows3 (kL/d)	Harvested rainwater (kL/d)	Treated water reused (kL/d)	Sydney water supply (kL/d)
WHT13	237	192	0	1	12	Up to 237*

Electricity

Table 10-2 summarises the indicative electricity demand comparing the Approved Project and the proposed modified project at the relevant construction support sites.

Infrastructure required to connect each construction support site with the electricity supply network outside the project corridor would be required. Electricity connections would be determined in consultation with Ausgrid to ensure design and installation meets Ausgrid's specifications and requirements. Where appropriate, existing conduits and electrical infrastructure would be used to minimise the impacts of the installation of new conduits in the network.

Table 10-2 Indicative electricity demand of the proposed modified project compared with the Approved Project

Construction support site	Indicative temporary power requirement (megavolt ampere (MVA)) - Approved Project	Indicative temporary power requirement (megavolt ampere (MVA))- Proposed modified project
Rozelle Rail Yards (WHT1)	5.5	0
City West Link Portal cut and cover (WHT12)	0	56
Victoria Road (WHT2)	8.5	0
Yurulbin Point (WHT4)	4	0
Berrys Bay (WHT7)	5	0
Cammeray Golf Course (WHT10)	5	6
Ridge Street North (WHT9)	0	5
Emu Plains (WHT13)	0	2
Total	**28**	**69**

The proposed modified project would require additional electricity demands of around 41 MVAs outlined in Table 10-2. The substantial increase in electricity demand is required to power the TBMs. From a total energy demand perspective, the increase in in electricity demand would be offset by a significant reduction in the use of diesel. Further details are provided below in section 10.2.

Solid and liquid wastes

Table 24-4 of the Project EIS summarises indicative solid and liquid waste streams that would be generated during construction, including examples of these waste streams, indicative waste stream quantities and anticipated waste classifications.

These waste streams are typical of construction and demolition activities and would be adequately managed with the implementation of common environmental management measures (refer to Section 24.6). Consistent with the resource management hierarchy under the Waste Avoidance and Resource Recovery Act 2001, solid wastes would be reused and recycled where feasible and reasonable. Construction waste would be disposed of at appropriate licenced facilities.

The proposed modification is not expected to generate a significantly different type or volume of solid or liquid waste compared to the Approved Project.

Wastewater

The Project EIS notes that wastewater volumes generated during construction would vary depending on the types of construction activities being carried out and the stage of construction. The majority of wastewater generated during construction would be through groundwater infiltration in the tunnels.

The proposed modification is not expected to generate a significantly different amount of infiltration compared to the Approved Project.

Spoil generation and management

As outlined in the Project EIS, the majority of land-based spoil generated by the project would be crushed sandstone from tunnelling. This material is generally considered as a desirable engineering fill and is typically reused in development sites and major earthworks projects across Greater Sydney.

The management of spoil material during construction of the project would depend on its composition, the location from which it was removed, and whether it is considered to be suitable or unsuitable for reuse. Table 10-3 shows the expected spoil volumes for the proposed modified project compared with the Approved Project.

Table 10-3 expected spoil volumes for the proposed modified project compared with the Approved Project

Construction site	Spoil volume (cubic metres) - Approved Project	Spoil volume (cubic metres)- TBM Proposed modified project
Rozelle Rail Yards (WHT1)	34,650	0
Victoria Road (WHT2)	565,740	0
Yurulbin Point (WHT4)	339,280	0
Berrys Bay (WHT7)	260,940	0
Cammeray Golf Course (WHT10)	410,510	504,447
Warringah Freeway	164,240	164,240*
Waltham Street (WHT11)	500	0
City West Link Portal Cut and Cover (WHT12)	0	881,330
Glebe Island (WHT3) TBM Spoil	0	0
Berry Street North (WHT8)	0	10,880
Ridge Street North (WHT9)	0	325,197
Sydney Harbour sediment (dredging)	1,012,300	0
Total – Western Harbour Tunnel and Warringah Freeway Upgrade	**2,788,160**	**1,886,094**

* Associated with the Warringah Freeway upgrade

The table indicates that the proposed modified project would reduce total spoil volumes by around 902,066,000 cubic metres or around 32 percent.

10.1.3 Assessment summary

The proposed modified project would not result in a material change to construction materials, solid and liquid waste, and wastewater. There would be an overall reduction in the use of water with the removal of 5 construction support sites, as well as a reduction in the volume of spoil generation. There would be an increase in the amount of electricity required for operation of the TBMs. From a total energy demand perspective, the increase in in electricity demand would be offset by a significant reduction in the use of diesel.

10.1.4 Environmental management measures

The impacts associated with resource use and waste management for the modification would be generally consistent with those assessed for the Approved Project.

No further environmental management measures are considered necessary beyond those identified for the Approved Project.

Condition of Approval E204 would be removed as there is no longer a requirement for offshore disposal of tunnel spoil.

No further amendments to the Minister's Conditions of Approval as they relate to resource use and waste management would be required.

10.2 Climate change and greenhouse gases

This section provides a comparative assessment of issues relating to climate change and greenhouse gas emissions between the proposed modified project and the IMT Methodology during construction. When operational, the proposed modified project would perform the same function as the Approved Project.

10.2.1 Assessment methodology

The assessment of climate change involved a review of the hazard categories and risks identified for the Approved Project.

For greenhouse gas emissions, direct Scope 1, 2 and 3 comparisons between the proposed modified project and the Project EIS were not possible as the Project EIS did not separate out just the IMT component. For the purposes of a comparison, a part quantitative assessment was carried out considering the major differences between the IMT and the TBM – with a particular focus of electricity, diesel consumption by truck movements (noting the greater distance to travel to the Emu Plains construction support site (WHT13)) and embodied CO2 in the main construction materials of concrete and cement.

10.2.2 Assessment of potential impacts

Climate Change

For the Project EIS, the assessment of climate change risks identified eight hazard categories with a Low-risk rating, and one hazard category with a Medium risk rating after additional treatment. The proposed modified project would not result in change to the identified risks or risk ratings. All climate change risks would be reviewed and updated as required throughout the design development and construction as part of the sustainability framework as described in Section 10.3.

Greenhouse gas

As identified in Section 10.1, the proposed modified project would require a greater amount of electricity due to the operation of the TBM. However, the associated increases in greenhouse gases would be offset by the overall reduction in fuel consumption due to less plant and equipment required for the TBM construction compared to the IMT construction. For example, no barging would be required, and removal of activities associated with five construction support sites would reduce fuel consumption. A preliminary assessment indicates a possible overall reduction of Scope 1&2 emissions for WHT Stage 2 with the proposed modified project of around 10 to 15%.

The proposed modified project would also use less concrete, cement and reinforcing steel compared to the IMT. This is due to the TBM cylindrical design that provides higher compression strength than other hollow shapes A preliminary assessment indicates that the TBM construction method would reduce the embodied carbon emissions for WHT Stage 2 by around 40-50% compared to the IMT option.

Overall, the proposed modified project is expected to result in less greenhouse gas emissions than the Approved Project. Further assessment of greenhouse gas emissions including measures to reduce all scope emissions would be carried out in accordance with the project's sustainability framework as outlined in Section 10.3.

10.3 Sustainability outcomes

The sustainability outcomes for the Approved Project as provided in Chapter 28 (Synthesis of the environmental impact statement) of the Project EIS are outlined in Table 10-1 below.

Table 10-1 Sustainability performance outcomes

Desired performance outcome	How performance outcomes would be achieved
Sustainability The project reduces the NSW Government's operating costs and ensures the effective and efficient use of resources. Conservation of natural resources is maximised.	In respect to sustainability, the project has been developed such that: • Sustainability considerations would be integrated throughout the design, construction, and operation • The project would seek to achieve an 'Excellent' Design and 'As Built' Infrastructure Sustainability rating • The project would be carried out in accordance with the sustainability framework developed for the project • Activities to implement the sustainability framework, including requirements from the Infrastructure Sustainability rating scheme, would be implemented through a Sustainability Management Plan.

Chapter 25 (Sustainability) of the Project EIS discusses the project's sustainability framework which ensures that sustainability is embedded in project planning, design, construction, and operation.

The sustainability framework provides the overarching vision, objectives, targets, and implementation approaches for the project. The key elements of the sustainability framework are shown in Figure 10-1 below.

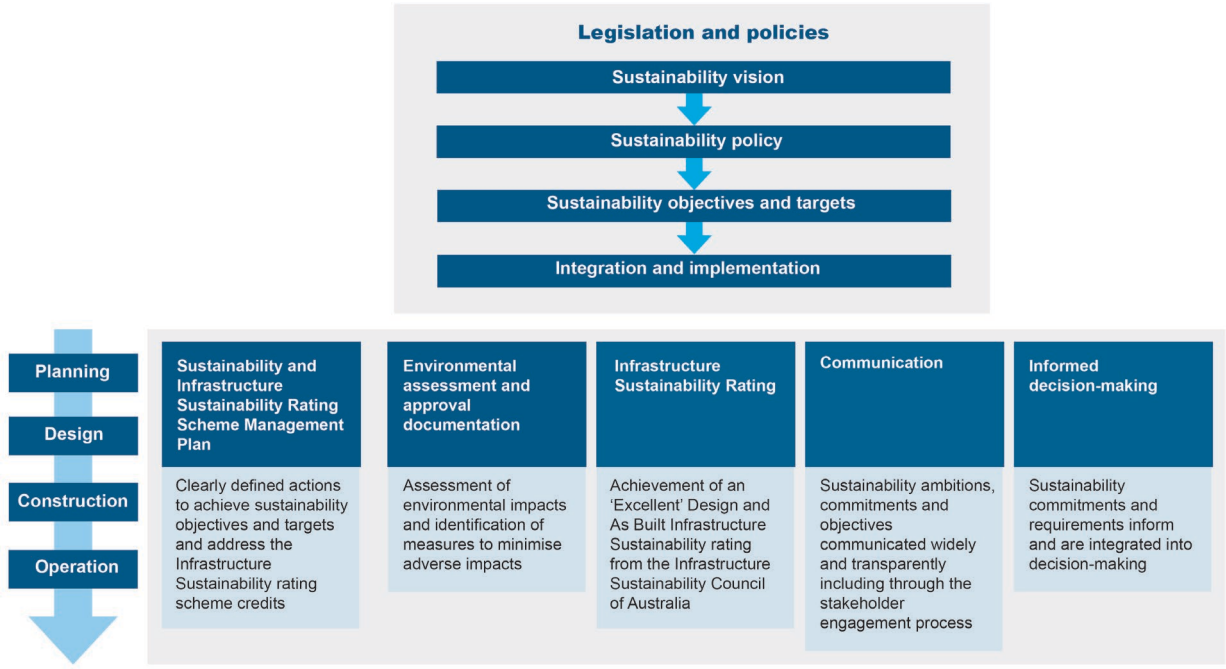


Figure 10-1 Western Harbour Tunnel and Warringah Freeway Upgrade sustainability framework.

Should the proposed modified project be approved, the sustainability outcomes would apply, and the proposed modified project would align with the sustainability framework by applying the sustainability objectives and targets of the project during its design, construction, and operation.

11. Proposed changes to the Minister's Conditions of Approval

The following tables outline the proposed changes to the Minister's Conditions of Approval and provides justification for the requested changes. Proposed deletions have been identified in red ~~strikethrough~~ text. Proposed additions have been identified in red text. It is noted that almost all changes relate to the removal of conditions that would otherwise apply to the IMT construction method. The main exceptions relate to including Emu Plains in a number of general requirements.

Table 11-1 Proposed changes to Schedule 1

Term	Requested change	Justification for change
Land	Include **Emu Plains** as a suburb	Addition of Emu Plains construction support site (WHT13)

Table 11-2 Proposed changes to Table: Definitions

Term	Requested change	Justification for change
Low Impact Work	~~h. the relocation of Cape Don and Baragoola historic vessels as permitted subject to **Condition E53**;~~	Cape Don is no longer required to be relocated due to the new tunnelling methodology, and Baragoola sank and has since been removed by Maritime.
TBM	**Tunnel Boring Machine**	New term added to the table due to the new tunnelling methodology, as this is used throughout Modification 2.

Table 11-3 Proposed changes to Table: Reports and Notifications that must be submitted to the Planning Secretary

Condition	Requested change	Justification for change
E131(e)	~~Access the Yurulbin Point ancillary facility (WHT4)~~	The Yurulbin Point construction support site is no longer required due to the TBM methodology.

Table 11-4 Proposed changes to Conditions of Approval

Condition	Requested change	Justification for change
A1	The Proponent must carry out the CSSI in accordance with the terms of this approval and generally in accordance with the: (c) Western Harbour Tunnel and Warringah Freeway Upgrade – Wicks Road construction support site Modification Report dated October 2022 (Modification 1) as amended by the Western Harbour Tunnel and Warringah Freeway Upgrade – Wicks Road construction support site Response to Submissions Report and Agency Advice (dated 25 November 2022) and (d) *Western Harbour Tunnel and Warringah Freeway Upgrade - Construction method change to TBM Modification Report* (dated July 2023) (Modification 2) as amended by the *Western Harbour Tunnel and Warringah Freeway Upgrade – Construction method change to TBM– Response to Submissions Report*.	Recognition of Modification 1 and Modification 2.
C4	Required CEMP Sub-plan: (d) Air quality ~~and odour~~ ~~(j)Dredging and Disposal Management Plan~~	Potential odour was related to the dredged material that was proposed to be bought to land under the IMT solution. Dredging is no longer required due to the TBM methodology; therefore, a Dredging and Disposal Management Plan is not required.

Condition	Requested change	Justification for change
C6	The **Flora and Fauna Management CEMP Sub-Plan** must include, but not be limited to: ~~a. details of the measures to minimise disturbance to marine vegetation and rocky reefs to the minimum extent necessary;~~ ~~b. details of the measures to minimise disturbance to habitat associated with White's seahorse (Hippocampus whitei);~~ ~~c. details of the measures to minimise disturbance to the Large Bent-winged Bat (Miniopterus orianae oceanensis) roosting site at Waverton, including the requirements of Condition E41;~~ ~~d. details and measures to identify Little Penguins (Eudyptula minor) near maritime construction sites including employing qualified spotters, and the stop work procedure upon sighting of the species;~~	Marine vegetation, White's seahorse habitat and Little Penguins are no longer impacted, as the TBM methodology does not require dredging. The TBM methodology minimises impacts to the Large Bent Wing Bat as much as possible. No further reasonable mitigation could be adopted that would not negatively affect the delivery of the Project. Monitoring of the Large Bent-wing Bat roosting site at Waverton is still proposed to occur in accordance with CoA E41-E43 as outlined below.
C7	The Maritime Heritage Management CEMP Sub-plan must: a. outline relevant work method requirements and maritime heritage inductions tailored for each type of work activity ~~such as dredging or piling;~~ d. identify exclusion zones, archival recording requirements, baseline and periodic monitoring protocols (including before and during construction), and final site inspections within three months of completion of works for the following maritime heritage sites: i. ~~Balls Head Coal Loader (including seawall/ stone wharf/ pier linked to the Balls Head Coal Loader~~ ~~(ii) Yurulbin Park maritime infrastructure;~~ ~~(iii) Unidentified Balls Head Bay 2 wreck;~~ (iv) ~~Collapsed wharf,~~ BP site, Berrys Bay; and ~~(v) Unidentified Balls Head Bay 1 wreck at Balls Head Coal Loader;~~	Dredging and piling is no longer required due to the TBM methodology, which removes impacts to maritime heritage. Items (d)(i), (ii), (iii), and (v) are no longer impacted. Construction support sites at Yurulbin Point and Berrys Bay are not required due to the TBM methodology. The BP site and Berrys Bay would be subject to requirements under this Condition owing to the construction of the Berrys Bay Master Plan.
C8	~~The Dredging and Disposal Management Plan must include, but not be limited to:~~ ~~(a) dredging design;~~ ~~(b) dredge soil information, including contaminated sediments and acid sulfate soils;~~ ~~(c) anticipated dredging quantities according to material type;~~ ~~(d) proposed dredging equipment;~~ ~~(e) work methods for dredging and disposal;~~ ~~(f) sequence of the works;~~ ~~(g) dredge positioning, control and calibration;~~ ~~(h) disposal areas;~~ ~~(i) environmental control and mitigation measures to be implemented to reduce potential noise, water quality and marine biodiversity impacts;~~ ~~(j) a tiered (trigger level) approach to progressively implementing additional management actions, based on the results of real-time and visual monitoring, to ensure that suspended sediment concentrations do not exceed the criteria specified in Condition E215. The approach must specify when dredging will cease based on the results of real-time and visual monitoring;~~ ~~(k) unexpected find protocols; and~~ ~~(l) records.~~ ~~Dredging is no longer required due to the TBM methodology.~~	Dredging is no longer required due to the TBM methodology; therefore, a Dredging and Disposal Management Plan is not required.

Condition	Requested change	Justification for change
C11	Required Construction Monitoring Programs: (b) Air Quality ~~(including Odour)~~ Monitoring ~~(e) Marine Monitoring Program~~ ~~(f) Dredging Monitoring Program~~	Dredging is no longer required due to the TBM methodology, this removes the potential impacts of odours. Impacts to water quality and marine fauna and habitats would also be removed.
C12	(l) any specific requirements as required by Conditions C13 to ~~C16~~C14	Amended reference to other conditions due to deletions below.
C15	~~The Marine Monitoring Program must include but not be limited to:~~ ~~(a) identification of seagrass, Whites seahorse and intertidal reef monitoring sites within the harbour upstream and downstream of any marine works the dredging location;~~ ~~(b) monitoring any potential damage to seagrass beds or rocky reefs as a result of the CSSI; and~~ ~~(c) trigger points for responding to any monitored changes which adversely impact on seagrass and intertidal reef areas, including the implementation of additional protection measures to address these changes and the associated timing.~~ ~~Nothing in this condition prevents the Proponent from including these requirements in the Surface Water Monitoring Program required under Condition C11 or the Dredging Monitoring Program required under Condition C16.~~	Dredging is no longer required due to the TBM methodology. Impacts to water quality and marine fauna and habitats would be removed.
C16	~~The Dredging Monitoring Program must include, but not be limited to:~~ ~~(a) the locations of sensitive marine habitats in the vicinity of dredging locations that are potentially sensitive to elevated suspended sediment concentrations (potential impact sites);~~ ~~(b) proposed monitoring locations for impact sites;~~ ~~(c) proposed monitoring locations upstream and downstream of dredging operations;~~ ~~(d) monitoring during each outgoing tide during daylight hours at a minimum of two locations 50 m downstream of the working area;~~ ~~(e) proposed background monitoring locations to allow identification of any differences between turbidity from dredging and local background turbidity levels;~~ ~~(f) a program for carrying out real-time time turbidity monitoring (continuous logging) at the proposed monitoring locations to confirm contributions to total suspended sediment concentrations from dredging;~~ ~~(g) a protocol for developing a scientifically rigorous correlation between turbidity (Nephelometric Turbidity Units – NTU) and total suspended solids (mg/L) to allow for rapid and accurate confirmation of suspended sediment levels in the field; and~~ ~~(h) a protocol for visual monitoring to ensure that visual surveillance for turbidity plumes occurs at all times during dredging by a person qualified to identify turbidity plumes.~~	Dredging is no longer required due to the TBM methodology, therefore a Dredging Monitoring Program is not required.

<table>
<tr><th>Condition</th><th>Requested change</th><th>Justification for change</th></tr>
<tr><td>E38A</td><td>Prior to clearing, the ecosystem and species credits in Table 8A that relate to the Emu Plains construction support site must be retired. The retirement of credits must be carried out in accordance with the offset rules of the Biodiversity Conservation Act 2016 (BC Act).

Table 8A: Ecosystem and species credits for the Emu Plains construction support site
<table>
<tr><th>Plant Community Type (PCT)</th><th>Number of Credits</th><th>In the below IBRA subregions</th></tr>
<tr><td>PCT4023: Coastal Valleys Swamp Oak Riparian Forest</td><td>9</td><td>Cumberland</td></tr>
<tr><th>Species (only for the below)</th><th>Number of Credits</th><th>In the below IBRA subregions</th></tr>
<tr><td>Myotis macropus (Southern Myotis)</td><td>11</td><td>Cumberland</td></tr>
</table></td><td>Additional ecosystem and species credits are required to be retired as a result of the establishment of the Emu Plains construction support site.</td></tr>
<tr><td>E39</td><td>The requirement to retire credits in Condition E38 and Condition E38A above may be satisfied by payment to the Biodiversity Conservation Fund of an amount equivalent to the class and number of species credits, as calculated by the Biodiversity Offsets Payment Calculator.</td><td>Added additional reference to CoA E38A.</td></tr>
<tr><td>E40A</td><td>Evidence of the retirement of credits or payment to the Biodiversity Conservation Fund in satisfaction of Condition E38A must be provided to the Planning Secretary prior to clearing.</td><td>Added additional reference to CoA E38A.</td></tr>
<tr><td>E41</td><td>A Microbat ~~Management Plan~~ Monitoring Program must be prepared to address impacts, detail mitigation measures and monitoring of the Large Bent-winged Bat (Miniopterus orianae oceanensis) identified at Balls Head Coal Loader.

The ~~Plan~~ Monitoring Program must include:

~~(a) measures to avoid and minimise impacts;~~
(b) details of potential impacts from construction;
~~(c) the monitoring program should include an adaptive management plan, which includes a decision-making framework that:~~
~~(i) defines performance criteria and thresholds, including 'impact trigger' and 'unacceptable impact' thresholds to be used as triggers for intervention, that are ecologically based and adhere to SMART principles;~~
(ii) details of monitoring techniques, timing, duration and frequency/intensity to be used;
(iii) in the event that an impact ~~trigger, unacceptable impact or other threshold is detected, the actions and mitigation measures to be implemented~~ is identified, an assessment of these impacts will be carried out and Condition E43 will be triggered;
(d) ongoing monitoring and reporting requirements during construction~~and operation~~; and
(e) contingency measures to address impacts attributable to the construction of the CSSI.

The plan must be developed in consultation with an independent and appropriately qualified expert in microbat biology and behaviour, EESG, North Sydney Council and be submitted to the Planning Secretary for approval prior to work that impacts microbats. The approved plan must be implemented during construction ~~and operation~~ of the CSSI.</td><td>The change in methodology reduces the potential for impacts to microbats at the Coal Loader due to the removal of the northern cofferdam and associated piling and construction.

Potential impacts would be related to the TBM tunnelling underneath the Coal Loader, however as the TBM is deeper than the IMT proposed in the EIS, and the duration of impacts would be significantly reduced, potential impacts are expected to be less than those presented in the EIS.

As discussed at the meeting with DPE and EHG on 26/04/2023, Transport considers a Monitoring Program to be more appropriate than a Management Plan due to the reduction in potential impacts. If monitoring determines there is an impact, the offset requirements in Condition E43 would still apply.</td></tr>
</table>

Condition	Requested change	Justification for change
E42	The Proponent must monitor ~~all~~ microbats ~~mitigation measures~~ for the period specified in the Microbat ~~Management Plan~~ Monitoring Program, or until it is ~~they are~~ demonstrated, to the satisfaction of the Coordinator General EESG, ~~to have been successful in mitigating~~ that all potential impacts on the Large Bent-winged Bat (*Miniopterus orianae oceanensi*) have ceased.	As above
E43	If by the end of the period of monitoring an unacceptable impact threshold has been reached ~~or the mitigation measures have not been demonstrated to the satisfaction of the Coordinator General EESG to have been successful (as required by Condition E42),~~ the Proponent must offset the impacts on the Large Bent-winged Bat by the retirement of biodiversity credits or payment to the Biodiversity Conservation Fund or the undertaking of other biodiversity conservation actions, as determined in consultation with and to the satisfaction of the Coordinator General EESG.	As above
E45	~~**Marine Ecology**~~ ~~An inspection must be undertaken by an experienced ecologist (and diver) in the 24 hour period prior to the commencement of work that may impact potential habitat (seagrass, kelp, sargassum, and existing structures such as piles, jetties, wharf pylons etc.) for the White's seahorse (*Hippocampus whitei*).~~	White's seahorse habitat is no longer impacted, as the TBM methodology does not require dredging.
E46	~~Any seahorses that are located in the work area, must be relocated to nearby like-for-like habitat in consultation with an experienced ecologist. Seahorse relocations must be performed by a suitably qualified professional and authorised by a section 37 permit under the Fisheries Management Act 1994.~~	White's seahorses are no longer impacted, as the TBM methodology does not require dredging.
E47	~~The loss of marine vegetation must be offset at a ratio of 2:1, in accordance with DPI Fisheries' requirements.~~ ~~Note: Offset works may include seagrass, saltmarsh, or mangrove planting within the same estuary.~~	Marine vegetation is no longer impacted, as the TBM methodology does not require dredging.
E53	~~**Maritime Heritage**~~ ~~Prior to the commencement of construction that would potentially impact upon the SS Baragoola and M.V. Cape Don, the Proponent must relocate the vessels to a suitable location accessible by the community groups undertaking vessel restoration. The relocation must be undertaken in consultation with vessel owners and relevant community groups and must not impact the heritage significance of the items.~~	Cape Don is no longer required to be relocated due to the new tunnelling methodology, and Baragoola sank and has since been removed by Maritime.
E54	~~The former Balls Head Coal Loader, including seawall, wharf, dolphins and associated maritime infrastructure, must not be physically damaged, disturbed, or destroyed by construction of the CSSI. Regular monitoring must be undertaken and incorporated into the **Heritage CEMP Sub-Plan** as required by **Condition C4**.~~ ~~Should the Proponent wish to disturb any heritage elements of the former Balls Head Coal Loader, consultation must occur with Heritage NSW prior to seeking Planning Secretary approval.~~	The construction support site at Berrys Bay is no longer required due to the TBM methodology.
E55	The potential to retain or minimise impacts to the NSW Torpedo Corps slipway within Woodleys Shipyard in the landscaping of Berrys Bay must be reviewed during detailed design. If reasonably practicable, the slipway must be retained or impacts minimised.	As above, this CoA would apply to the Masterplan works at Berrys Bay.

Condition	Requested change	Justification for change
E56	Prior to potential physical impact, archival recording must be undertaken for the following heritage items: (a) St Leonards Park (including W. Tunks Memorial Fountain, War Memorial, and North Sydney Oval), North Sydney; (b) North Sydney Sewer Vent; (c) ~~Yurulbin Park, Birchgrove; and~~ (d) ~~Balls Head Coal Loader Complex, Waverton.~~	Construction support sites at Yurrulbin Point and the coffer dam adjacent to the Coal Loader are no longer required.
E68	**Variation to Work Hours** **d. By Prescribed Activity,** including: ii. delivery of material that is required to occur outside of standard construction hours in **Condition** E66 to directly support tunnelling activities~~, except between the hours 10:00 pm and 7:00 am to/from WHT7 at Berrys Bay which could result in a sleep disturbance event for receivers in the proximity of Bay Road and Balls Head Road, Waverton~~; or iii. works within an acoustic shed or a cut and cover structure where there is no exceedance of the NMLs iv. ~~trailer suction hopper dredging~~; ~~spoil~~ haulage activities from City West Link; or	The construction support site at Berrys Bay is no longer required due to the TBM methodology. Works will be carried out in the cut and cover structure at the City West Link Portals (WHT12) (formerly known as the Rozelle Rail Yard construction support site), as approved in the EIS, including spoil handling and removal, construction of a water treatment plant, and tunnelling support activities. In addition, the site would support the TBM and cross package excavation and permanent works. Trailer suction hopper dredging is no longer required due to the TBM methodology.
E77	**Construction Noise Mitigation - Acoustic Sheds** All surface-based tunnelling support activities that generate noise levels above the noise management levels in **Condition E70** must occur within an acoustic shed (or cut and cover structures where there is no exceedance of the NMLs).	To accommodate works in the City West Link Portals (WHT12) as outlined above.
E78	All acoustic sheds and excavation covers (i.e. cut and cover roof) must be designed and used so that activities carried out within them do not result in the exceedance of the NMLs.	To accommodate works in the City West Link Portals (WHT12) as outlined above.
E117	The **Detailed Site Investigation Report** must provide details on: a. primary sources of contamination, for example potentially contaminating activities, infrastructure (such as underground storage tanks, fuel line, sumps or sewer lines) or site practices; b. contaminant dispersal in air, hazardous ground gases, surface water, groundwater, soil vapour, separate phase contaminants, ~~sediments,~~ infrastructure (e.g. concrete), biota, soil and dust;	Removal of the word "sediments" form the condition as it relates to Harbour dredged sediments.
E119	The Remediation Action Plan must include measures to remediate the contamination at the site to ensure the site will be suitable for the proposed use and detail how the environmental and human health risks will be managed during the disturbance, remediation and/or removal of contaminated soil~~/sediment~~ or groundwater.	Dredging is no longer required due to the TBM methodology. Removal of the word "sediments" form the condition as it relates to Harbour dredged sediments.

Condition	Requested change	Justification for change
E131	~~Vehicles associated with the CSSI (including light vehicles) are not permitted to access the Yurulbin Point ancillary facility (WHT4) at Birchgrove, except in the following circumstances:~~ ~~(a) where required in the event of an emergency; or~~ ~~(b) drop-off and pick-up of site personnel by shuttle bus services; or~~ ~~(c) geotechnical investigations and site surveys; or~~ ~~(d) installation of utilities including temporary construction power; or~~ ~~(e) extenuating circumstances which must be endorsed by the ER and approved by the Planning Secretary.~~ ~~The Traffic, Transport and Access Management CEMP Sub-plan must be updated to ensure the requirements of this condition are met.~~ ~~Note: For the purposes of this condition, extenuating circumstances does not include for economic reasons.~~	The construction support site at Yurulbin Point is no longer required due to the TBM methodology.
E132	Local roads proposed to be used by heavy vehicles to directly access the construction boundary and ancillary facilities that are not shown in Figure 5-7 to 5-22 inclusive of Appendix F of the EIS and in Figure 9.2 of Modification 2 must be approved by the Planning Secretary and included in the Traffic, Transport and Access Management CEMP Sub-plan.	The Emu Plains construction support site requires three local roads to be used to access the proposed site. Therefore, an additional reference to Figure 9.2 of the Modification 2 report has been added.
E134	~~Opportunities to maximise spoil / dredging material removal by non-road methods must be investigated and implemented where reasonably practicable to minimise movements by road.~~	There are no further opportunities to remove spoil by non-road methods.
E151	~~Prior to the decommissioning of the Birchgrove Ferry Stop, a replacement public transport service of comparable service must be provided during construction.~~	The modification would remove the need to close the Birchgrove Ferry Wharf, thus removing impacts on the operation of the ferry from Birchgrove.
E152	~~The Birchgrove Ferry Stop must be reinstated as soon as reasonably practicable following the completion of construction activities affecting the stop.~~	The modification would remove the need to close the Birchgrove Ferry Wharf, thus removing impacts on the operation of the ferry from Birchgrove.
E158	~~The Proponent must retain the building façades of 697 and 699 Darling Street, Rozelle.~~	The Victoria Road construction support site is no longer required to support the project.

Condition	Requested change	Justification for change
E188	~~**Yurulbin Park**~~ ~~The Proponent must engage a suitably qualified and experienced landscape architect to develop the design of the reinstated Yurulbin Park. The design must be provided as part of the PDLP and must include:~~ ~~(a) appropriate treatment of the original work of Bruce Mackenzie;~~ ~~(b) incorporation of Aboriginal art, pre-contact vegetation where possible to reconstruct or reawaken, and relevant interpretative landscape features that illustrate the former uses of the park;~~ ~~(c) adequate soil depths to allow trees to reach maturity;~~ ~~(d) enable safe and convenient access to the Birchgrove ferry wharf;~~ ~~(e) provision of a viewing platform; and~~ ~~(f) consideration of the Disability Discrimination Act 1992.~~ ~~The design of the reinstated Yurulbin Park must be delivered and returned to public open space as soon as practicable following the completion of the use of the Park for ancillary facility WHT4.~~	The construction support site at Yurulbin Point is no longer required due to the TBM methodology.
E189	**Berrys Bay** The Proponent must engage a suitably qualified and experienced landscape architect to develop the design of the open space at ~~WHT7~~ Berrys Bay. The design must be provided as part of the **PDLP**.	The construction support site at Berrys Bay is no longer required due to the TBM methodology and therefore the reference to "WHT7" has been removed. As TfNSW are still proposing to deliver the Berrys Bay Master Plan, the remainder of the CoA is retained.
E191	Public domain works as required by Condition E189 and E190 must be undertaken prior to operation of the tunnel. ~~following the completion of the use of the Park for ancillary facility WHT7.~~	The construction support site at Berrys Bay is no longer required due to the TBM methodology.
E204	~~Notwithstanding, Conditions E201, E202 and E203 does not apply to offshore disposal of tunnel spoil where a sea dumping permit has been obtained.~~	Offshore disposal is no longer required due to the TBM methodology.
E212	~~**Dredging**~~ ~~All activities associated with dredging, cofferdam construction and placement of the immersed tube tunnel components must be carried out in a manner that protects nearby intertidal rocky reefs, seagrass beds and other sensitive marine habitats within the harbour.~~	Dredging and the use of IMTs is no longer required due to the TBM methodology. Therefore, intertidal rocky reefs, seagrass beds and other sensitive marine habitats are no longer impacted.
E213	~~All dredging activities associated with the CSSI (where a Backhoe Dredger is used) must be undertaken in a manner that does not cause turbidity outside the silt curtain(s) to exceed background turbidity by more than an equivalent suspended sediment concentration of 50 mg/L. This limit applies within the waters of Sydney Harbour immediately outside the edge of the silt curtain. If turbidity levels exceed the above limit, the Proponent must:~~ ~~(a) immediately cease the dredging works contributing to the exceedance; and~~ ~~(b) investigate the cause of the increased levels of turbidity and develop and implement additional measures to prevent its recurrence.~~	Dredging is no longer required due to the TBM methodology.
E214	~~The floating boom and silt curtain system around backhoe dredging operations must be retained after completion of dredging until the turbidity within the system returns to background levels.~~	Dredging is no longer required due to the TBM methodology.

Condition	Requested change	Justification for change
E215	~~Management measures must be implemented during dredging activities where a Trailing Suction Hopper Dredger and/or a Cutter Suction Dredger is used to dredge uncontaminated material from the harbour to limit potential increases in suspended sediment concentration in adjacent areas to not exceed background turbidity by more than an equivalent suspended sediment concentration of 50 mg/L 50 metres downstream of the work area.~~	Dredging is no longer required due to the TBM methodology.

12. Revised environmental management measures

The Approved Project is subject to a range of environmental management measures that would be required to avoid or reduce the environmental impacts. These measures are presented in Appendix Y of the Project EIS and have since been updated for Modification 1 – Wicks Road Construction Support site (Modification 1). The updated environmental management measures are shown in Appendix C of Wicks Road Construction Support site – Modification Report (TfNSW 2023).

In general terms, the anticipated impacts associated with the proposed modified project would be largely consistent with those assessed in the Project EIS and as updated by Modification 1. However, the change to the method for crossing Sydney Harbour from an IMT to a TBM would remove the need for a number of environmental mitigation measures that relate to IMT specific activities. Accordingly, these environmental management measures are no longer considered necessary, and it is proposed that they be removed. The remaining environmental management measures would be otherwise adequate to address the residual environmental impacts associated with the tunnelling and Sydney Harbour works. No new or changes to other environmental management measures with respect to changes to the tunnelling method would be required.

An additional environmental management and mitigation measure would apply to the Emu Plains construction support site with respect to managing residual night-time noise from additional truck movements as well as additional EMMs to address potential site flooding.

Table 12.1 below identifies the proposed changes to the environmental management measures assuming the proposed changes to the environmental management measures for Modification 1 are approved. Where additional and/or modified environmental management plans/ and measures have been included as a result of the proposed modified project they are shown in red text. Where a measure has been deleted or text from a measure is proposed to be deleted, it appears as strikethrough text.

Should the proposed modified project be approved, these revised environmental management measures would apply and supersede all previous environmental management measures identified.

A full consolidated table of all environmental management measures assuming Modification 1 is approved is provided in Appendix B2.

Table 12-1 Proposed changes to environmental management measures

Ref	Phase	Impact	Environmental management measure	Location	Justification for change
~~CTT2~~	~~Pre-construction~~	~~Maritime construction~~	~~Moorings impacted during construction will be relocated elsewhere in Sydney Harbour in consultation with the lease holders.~~	~~WHT~~	Moorings will no longer be impacted due to the TBM methodology.
~~CTT3~~	~~Pre-construction~~	~~Maritime construction~~	~~A replacement service for commuters impacted by the temporary closure of Birchgrove Ferry Wharf will be determined during construction planning. The temporary closure of the Birchgrove Wharf will not occur until the replacement service is operational.~~	~~WHT~~	The Birchgrove Ferry Wharf will no longer be impacted due to the TBM methodology.
~~CTT14~~	~~Construction~~	~~Construction traffic~~	~~Haulage of spoil by barge will be considered as an alternative to road based haulage.~~	~~WHT~~	There are no opportunities for haulage of spoil by barge due to the TBM methodology.
~~CTT15~~	~~Pre c~~**~~C~~**~~onstruction~~	~~Maritime construction traffic~~	~~Construction vessels will be required to operate in a manner that minimises wash to areas of shoreline.~~	~~WHT~~	Marine construction vessels are no longer required due to the TBM methodology.
~~CTT16~~	~~Construction~~	~~Maritime construction traffic~~	~~Construction marine traffic activities will be scheduled to avoid times and locations of high recreational marine traffic where feasible and reasonable.~~	~~WHT~~	Marine construction vessels are no longer required due to the TBM methodology.
~~CTT17~~	~~Construction~~	~~Maritime construction~~	~~Harbour closures scheduling will be carried out in consultation with Port Authority of NSW, other divisions of Transport for NSW and other relevant stakeholders, including Sydney Harbour Federation Trust.~~	~~WHT~~	Harbour closures are no longer required due to the TBM methodology.
~~CTT18~~	~~Construction~~	~~Maritime construction~~	~~Construction vessel movements will be managed so that they will not interfere with port operations or the navigation of seagoing ships and ferries unless prior approval has been obtained from the Harbour Master.~~	~~WHT~~	Marine construction vessels are no longer required due to the TBM methodology.
CNV11	Construction	Construction traffic noise	Consultation with the owner/occupier of 17 and 19 Railway Street, Emu Plains will occur prior to the commencement of haulage during non-standard construction hours to determine appropriate mitigation measures to minimise impact on the receiver from haulage during non-standard construction hours.	Emu Plains	Additional mitigation measure proposed to minimise potential impacts on the receiver from haulage during non-standard construction hours.

Ref	Phase	Impact	Environmental management measure	Location	Justification for change
AQ1	Pre-construction	General	Standard construction air quality mitigation and management measures will be detailed in construction management documentation and implemented during construction, such as: b. ~~Management measures for managing unexpected odour generation likely to result in odour impacts at sensitive receivers in the vicinity during the disturbance, handling and storage of potentially odorous materials, including any contingency measures~~	WHT/WFU	Odour was expected to be generated during handling and management of harbour sediments. Works in the harbour are no longer required due to the TBM methodology.
~~HH1~~	~~Construction~~	~~Underwater noise impacts~~	~~Monitoring during piling activities will be carried out to validate the predicted underwater acoustic thresholds and management areas, and to further adapt management measures (as required). This will include a monitoring program with an initial trial of piling with corresponding communication measures to validate the predicted underwater acoustic thresholds and management areas.~~ ~~The monitoring results and management areas would be peer-reviewed prior to implementation to ensure they are appropriately protective of health.~~	~~WHT (Sydney Harbour)~~	Piling activities are no longer required due to the TBM methodology.

Ref	Phase	Impact	Environmental management measure	Location	Justification for change
~~HH2~~	~~Construction~~	~~Underwater noise impacts~~	~~Communication and management measures will be implemented during construction to manage potential underwater noise impacts to water-based recreational users during dredging and piling activities in Sydney Harbour. The communication tools and management measures that will be contemplated within the management zone include:~~ ~~a. Coordination of piling programs to minimise interaction with significant planned events on the harbour, where feasible and reasonable~~ ~~b. Communication of the piling program and management area so that recreational users know when the piling, dredging and other noise generating activities will be taking place, what they can expect, and the zones to minimise the possibility of being startled from a sudden increase in sound pressure underwater~~ ~~c. Direct communication with key local recreational stakeholders during the piling and dredging program to provide up-to-date scheduling~~ ~~d. Use of advertisements, signage, letter box drops and project updates to communicate the implementation of a management area during the works. This could include floating markers or signage on approach to the construction work~~ ~~Surveillance within the areas in which precautionary guideline level is exceeded to proactively monitor users in the prior to and during relevant activities that could pose a risk to recreational users.~~	~~WHT (Sydney Harbour)~~	There will be no underwater noise impacts due to the TBM methodology.
NAH5	Pre-construction	Impacts on specific non-Aboriginal heritage items	Archival recording will be carried out in accordance with the *Photographic Recording of Heritage Items Using Film or Digital Capture* guideline for areas/items subject to change within the following terrestrial items, in accordance with Appendix J (Technical working paper: Non-Aboriginal heritage): a. ~~Item 2: The Valley Heritage Conservation Area, Rozelle, and Balmain~~ b. ~~Item 4: Yurulbin Park, Birchgrove~~	WHT/WFU (Specific sites listed)	These areas will no longer be impacted due to the TBM methodology.

Ref	Phase	Impact	Environmental management measure	Location	Justification for change
~~NAH6~~	~~Pre-construction~~	~~Yurulbin Park~~	~~A condition survey will be completed prior to works commencing. Opportunities to temporarily remove, store and reinstate these elements on completion of construction work will be investigated and implemented if these elements need to be temporarily removed.~~	~~WHT (Yurulbin Park)~~	Yurulbin Park will no longer be impacted due to the TBM methodology.
NAH9	Pre-construction and construction	Impacts on archaeology	Archaeological investigations will be carried out at: ~~a)~~ ~~Item 4: Yurulbin Park, Birchgrove~~ ~~b)~~(a) Item 7: BP site, Waverton.		Yurulbin Park will no longer be impacted due to the TBM methodology.
NAH13	Construction - Berrys Bay	BP Site	The heritage item will be rehabilitated and returned to an equivalent state prior to operation of the tunnel. ~~Reinstatement of the site~~ This will include investigating the adaptive reuse of the site for the wider community.	WHT (BP Site)	Minor wording amendments to adjust the timing as Berrys Bay is no longer required as a construction support site.
~~NAH15~~	~~Design and construction~~	~~Maritime non-Aboriginal heritage impacts Berrys Bay~~	~~Investigate the potential to relocate or redesign the temporary wharves at the Berrys Bay construction support site (WHT7) to minimise impact on maritime heritage.~~ ~~Where this is not feasible then appropriate mitigation will be implemented before construction in accordance with the *Maritime Heritage Management Plan* (environmental management measure NAH16). Such mitigation will include carrying out archaeological excavation and documentation under the direction of a qualified archaeologist across all areas of impact at the site.~~	~~WHT (Berrys Bay)~~	Berrys Bay is no longer required as a construction support site due to the TBM methodology.

Ref	Phase	Impact	Environmental management measure	Location	Justification for change
NAH16	Pre-construction	Maritime non-Aboriginal heritage impacts	A Maritime Heritage Management Plan that details the objectives and methodologies to conserve maritime heritage and mitigate impacts will be prepared in consultation with a qualified and experienced maritime archaeologist. The Maritime Heritage Management Plan should specify: a. Unexpected finds protocols relevant to each type of activity ~~such as dredging or piling~~ b. Artefact management procedures, including identification of approved submerged reburial locations c. Relevant work method requirements and maritime heritage inductions tailored for each type of work activity ~~such as dredging or piling~~ d. Exclusion zone, archival, baseline and periodic monitoring protocols including before and during construction, and final site inspections within three months of completion of works for the following maritime heritage sites: ~~• Balls Head Coal Loader wharf~~ ~~• Yurulbin Park maritime infrastructure~~ ~~• Unidentified Balls Head Bay 2 wreck~~ • ~~Collapsed wharf,~~ BP site, Berrys Bay	WHT	Dredging and piling will no longer be required due to the TBM methodology. Yurulbin Park, unidentified Balls Head Bay 2 wreck and the collapsed wharf, BP site, Berrys Bay will no longer be impacted due to the TBM methodology. The completion of the Berrys Bay Master Plan work may still have a potential impact on the BP site and Berrys Bay, and therefore this dot point has been retained.
~~NAH17~~	~~Pre-construction~~	~~Maritime non-Aboriginal heritage impacts~~	~~Any pre-dredge clearance of the bed of the harbour in Sydney Harbour will be carried out in the presence of a qualified maritime archaeologist who will identify any additional inspection or documentation that should be carried out during the clearance dives. This may include inspecting the locations of known or suspected submerged cultural heritage, detailed recording, or recovery and relocation of heritage objects.~~	~~WHT~~	Dredging and piling will no longer be required due to the TBM methodology.

Ref	Phase	Impact	Environmental management measure	Location	Justification for change
NAH18	Pre-construction	Maritime non-Aboriginal heritage impacts	Archival recording of the following maritime heritage sites will be carried out prior to works commencing in order to mitigate against predicted or potential impacts, and to establish a baseline against which to measure any changes to these sites due to works at: ~~a. All maritime infrastructure associated with Balls Head Coal Loader~~ ~~b. Unidentified Balls Head Bay 2 wreck~~ ~~c. Yurulbin Park maritime infrastructure~~ ~~d. Collapsed timber wharf,~~ (a) BP site, Berrys Bay ~~e.~~ (b) Slipway No. 1, former Woodleys Shipyard, Berrys Bay. ~~The archival recording should include:~~ a. ~~Creation of a detailed site plan by a surveyor; for all maritime infrastructure associated with Balls Head Coal Loader, Yurulbin Park maritime infrastructure, collapsed timber wharf and Slipway No. 1, former Woodley's shipyard~~ b. ~~Detailed recording and inventory of all site elements~~ c. ~~Detailed diver survey and recording of submerged sites and site elements, primarily in the form of video and photography.~~ All archival recordings are to be prepared consistently with the current NSW Heritage Council endorsed standards and guidelines.	~~WHT~~	Dredging and piling will no longer be required due to the TBM methodology. Yurulbin Park, unidentified Balls Head Bay 2 wreck and the collapsed wharf, BP site, Berrys Bay will no longer be impacted due to the TBM methodology. The completion of the Berrys Bay Master Plan work may still have a potential impact on the BP site and Berrys Bay, and therefore this dot point has been retained.
~~NAH19~~	~~Pre-construction~~	~~Maritime non-Aboriginal heritage impacts~~	~~A side scan sonar survey will be prepared for sections of the Sydney Harbour crossing not already included in the side scan sonar coverage in Area A in the Appendix K (Technical working paper: Maritime heritage).~~ ~~A qualified maritime archaeologist will assess the results of the side scan survey to identify any additional potential heritage items requiring investigation and assessment.~~	~~WHT~~	Dredging and piling will no longer be required due to the TBM methodology.

Ref	Phase	Impact	Environmental management measure	Location	Justification for change
~~NAH20~~	~~Pre-construction~~	~~Maritime non-Aboriginal heritage impacts~~	~~Transport for NSW will relocate the historic vessels *M.V Cape Don* and *Baragoola* to a suitable alternate berthing nearby within Sydney Harbour before construction commences. Relocation of the vessels will be carried out in consultation with the vessel owners and associated community groups, and will be in the general vicinity of the existing berthing locations.~~ ~~Transport for NSW will take no action that results in the degradation of the heritage items until relocation occurs.~~	~~WHT~~	The M.V Cape Don is no longer required to be relocated due to the TBM methodology. The Baragoola recently sank and has been salvaged by Maritime.
~~NAH21~~	~~Construction~~	~~Maritime non-Aboriginal heritage impacts~~	~~An exclusion zone will be established around the former Balls Head Coal Loader wharf extending at least 15 metres from the edge of the wharf apron and thus also covering the Unidentified Balls Head Bay 1 and 2 wrecks.~~	~~WHT(Balls Head Coal Loader Wharf)~~	Marine work is no longer required due to the TBM methodology.
~~NAH22~~	~~Construction~~	~~Impacts to heritage listed structures~~	~~Environmental management measure CNV6 will be applied to manage vibration impacts to heritage structures.~~ ~~This includes, but is not limited to:~~ • ~~Balls Head Coal Loader wharf~~ • ~~Yurulbin Park maritime infrastructure.~~	~~WHT/WFU (Heritage listed structures)~~	Marine work is no longer required due to the TBM methodology.

Ref	Phase	Impact	Environmental management measure	Location	Justification for change
~~NAH23~~	~~Pre-construction and construction~~	~~Impacts to Balls Head Coal Loader and seawall~~	~~For the Balls Head Coal Loader and seawall, where vibration levels are predicted to exceed the standard minimum buffer distances to achieve screening levels, a detailed structural assessment will be carried out before construction commences to determine appropriate vibration criteria and site-specific minimum working distances to achieve this criteria.~~ ~~The detailed assessment will specifically consider the heritage values of the structure in consultation with a heritage specialist to ensure sensitive heritage fabric is protected. During detailed design, the construction methodology will be refined as needed to ensure the adopted criteria and site-specific minimum working distances for all vibration-intensive activities (eg Compaction, rock hammering, piling) can be met.~~ ~~During construction, site-specific buffer distances will be maintained to comply with relevant vibration limits for cosmetic damage, and vibration monitoring will be carried out to ensure vibration levels remain below the appropriate limits for the structure.~~	~~WHT (Balls Head Coal Loader and seawall)~~	Marine work is no longer required due to the TBM methodology.
~~NAH24~~	~~Construction and operation~~	~~Impacts to Yurulbin Park~~	~~A conservation management plan will be prepared for Yurulbin Park identifying those original designed features and remnant elements of Aboriginal and non-Aboriginal use of the site that can be conserved, retained or reconstructed to enhance the heritage significance of the heritage item.~~	~~WHT (Yurulbin Park)~~	Work in Yurulbin Park is no longer required due to the TBM methodology.
~~NAH25~~	~~Construction~~	~~Impacts to Yurulbin Park~~	~~The commemorative plaque related to the renaming of Yurulbin Point will be protected or temporarily removed for the duration of construction and then reinstated as part of the rehabilitation of the park after construction is completed in consultation with relevant Aboriginal representatives.~~	~~WHT (Yurulbin Park)~~	Work in Yurulbin Park is no longer required due to the TBM methodology.

Ref	Phase	Impact	Environmental management measure	Location	Justification for change
~~AH7~~	~~Pre-construction~~	~~Maritime - Aboriginal heritage impacts~~	~~The need for further high-resolution geophysical survey/s to identify the presence of submerged rock overhangs concealed by marine sediments will be investigated in consultation with a maritime archaeology advisor. If it is determined that a high-resolution geophysical survey could produce the desired results, the geophysical survey will be carried out.~~	~~Sydney Harbour - south and north cofferdams (WHT5 and WHT6)~~	Marine work is no longer required due to the TBM methodology.
~~AH8~~	~~Construction~~	~~Maritime - Aboriginal heritage impacts~~	~~The following mitigation measures will be carried out if the geophysical survey described in AH7 is inconclusive or if the geophysical survey identifies rock overhangs at least 1.2 metres in height:~~ a. ~~Excavations will be visually monitored after WHT5 and WHT6 cofferdams have been de-watered in order to identify voids within the bedrock and identify potential rock shelters~~ a. ~~In consultation with a suitably experienced geomorphologist, criteria will be established for the identification of pre-inundation soil deposits (peat, charcoal, roots, etc), and where necessary samples of marine sediments will be collected to identify if pre-inundation soil deposits are evident~~ ~~If pre-inundation soil deposits are evident then a controlled archaeological investigation will be carried out to recover any artefacts, subject to bed rock conditions and safety constraints within the cofferdams.~~	~~Sydney Harbour - south and north cofferdams (WHT5 and WHT6)~~	Marine work is no longer required due to the TBM methodology.
~~AH9~~	~~Pre-construction and construction~~	~~Maritime - Aboriginal heritage impacts~~	~~Prior to construction, determination of whether soil units have potential to contain cultural material will be carried out by a paleo-geomorphologist through review of existing borehole information.~~ ~~If the potential to encounter cultural material is identified, then an appropriate sampling protocol will be designed so that samples can be collected during construction if feasible.~~	~~In the immediate vicinity of borehole B215W in Area A, located between Yurulbin Point and Balls Head (Appendix L – Technical working paper: Cultural heritage assessment report)~~	Marine work is no longer required due to the TBM methodology.

Ref	Phase	Impact	Environmental management measure	Location	Justification for change
SG6	Construction	Impacts on site workers and/or local community through disturbance and mobilisation of contaminated material	Potentially contaminated areas directly affected by the project will be investigated and managed in accordance with the requirements of guidance endorsed under section 105 of the *Contaminated Land Management Act 2008*. This includes, but is not limited to, further investigations in potential areas of environment interest in the project footprint, including: • ~~Easton Park~~ • ~~Birchgrove peninsula (including Yurulbin Park)~~ • Balls Head peninsula • Waverton Park • Warringah Freeway (from North Sydney to Cammeray) • WFU10 (Wicks Road construction support site.	WHT/WFU	Work is no longer required in these two locations due to the TBM methodology.
SG10	Construction	Impacts on site workers and/or local community through disturbance and mobilisation of contaminated material	The Construction Waste and Resource Management Plan for the project will include procedures for handling and storing potentially contaminated substances.	WHT/WFU	To reflect the name of the Management Plan.
SG12	Construction	Impacts from disturbance of acid sulfate soils	Prior to ground disturbance in high risk acid sulfate areas at Birchgrove Park, ~~Rozelle Rail Yards, Sydney Harbour (tunnel crossing, White Bay~~ Glebe Island, ~~and~~ Berrys Bay~~)~~ and Whites Creek, testing will be carried out to determine the presence of acid sulfate soils.	WHT	Work is no longer required in these locations due to the TBM methodology.

Ref	Phase	Impact	Environmental management measure	Location	Justification for change
~~SG15~~	~~Construction~~	~~Marine contamination impacts~~	~~The appropriateness of offshore disposal will be assessed in accordance with the Commonwealth Department of Agriculture, Water and the Environment's, National Assessment Guidelines for Dredging (NAGD) (Department of Environment, Water, Heritage and the Arts, 2009). Offshore disposal will only be appropriate for material that meets the NAGD criteria.~~	~~WHT~~	Offshore disposal is no longer required due to the TBM methodology.
~~SG16~~	~~Construction~~	~~Marine contamination impacts~~	~~Marine sediments requiring disposal to landfill will be assessed in accordance with the NSW EPA (2014) Waste Classification Guidelines.~~	~~WHT~~	Dredging a disposal of sediments is no longer required due to the TBM methodology.
~~WQ6~~	~~Construction~~	~~Dredge plumes~~	~~Ongoing monitoring of dredge plumes will be carried out to validate the dredge plume dispersion predictions. Exceedances of the predicted dredge plume extents and intensities will trigger subsequent management responses that will include a range of strategies including, assessing whether secondary impacts are occurring (eg seagrass stress) and if so then further levels of management actions that may ultimately result in the cessation of dredging for a period sufficient to remove the stress.~~	~~WHT~~	Dredging and disposal of sediments is no longer required due to the TBM methodology.
F10	Construction	Impacts of construction sites on flood behaviour	Stormwater from the southern upstream catchment of WHT13 will be piped under the proposed construction support site and discharged into the existing open drainage line. A diversion drain(s) would be incorporated into the Emu Plains construction support site (WHT13) layout to divert overland flows around site buildings and other sensitive facilities. The drains would also convey sufficient flows to minimise or avoid flood level increase in the upstream catchments.	Emu Plains	In accordance with recommendations from the flooding assessment carried out for the additional construction support site proposed at Emu Plains (WHT13).
F11	Construction	Impacts of construction sites on flood behaviour	A basin(s) would be provided at the Emu Plains construction support site (WHT13) to compensate for the flood storage loss due to filling the existing basin(s) and the additional paved area. The basin(s) size would be determined by keeping the flow rate from the Emu Plains construction support site (WHT13) to the adjacent land unchanged.	Emu Plains	As above.

Ref	Phase	Impact	Environmental management measure	Location	Justification for change
F12	Construction	Flood evacuation	A Flood Evacuation Management Plan will be prepared for WHT13 to ensure all workers are evacuated prior to any flood emergency.	Emu Plains	Mitigation measure recommended by Penrith City Council as there is a risk that this area of Emu Plains is a low-flood island during large flood events.
B8	Construction	Noise and~~,~~ vibration ~~and light~~ impacts	Monitoring of Large Bentwing-bats in the Coal Loader tunnel prior to potential impact and during tunnelling beneath the Coal Loader ~~construction~~ (in the months of March to September) will be carried out. The frequency and methods of the monitoring will be provided in an adaptive monitoring program ~~management plan~~ developed prior to the ~~commencement of construction~~ impact and in consultation with the Department of Planning ~~Industry~~ and Environment (Environment, Energy and Science and the Regions, Industry, Agriculture and Resources divisions), North Sydney Council and an appropriately qualified expert in microbat biology and behaviour.	WHT	The change in methodology reduces the potential for impacts to microbats at the Coal Loader due to the removal of the northern cofferdam and associated piling and construction. Potential impacts would be related to the TBM tunnelling underneath the Coal Loader, however as the TBM is deeper than the IMT proposed in the EIS, and the duration of impacts would be significantly reduced, potential impacts are expected to be less than those presented in the EIS. As discussed at the meeting with DPE and EHG on 26/04/2023, Transport considers a Monitoring Program to be more appropriate than a Management Plan due to the reduction in potential impacts. If monitoring determines there is an impact, the offset requirements in Condition E43 would still apply.

Ref	Phase	Impact	Environmental management measure	Location	Justification for change
B9	Construction	Noise and~~,~~ vibration ~~and light~~ impacts	Prior to the ~~commencement of construction of the Sydney Harbour north cofferdam (WHT6),~~ excavation of the mainline tunnel ~~and any marine rock hammering~~ works within close proximity to the Coal loader roosting site, adaptive management measures to minimise impacts on the Large Bent-winged bat will be developed in consultation with Department of Planning~~, Industry~~ and Environment (Environment, Energy and Science and the Regions, Industry, Agriculture and Resources divisions), North Sydney Council and an appropriately qualified expert in microbat biology and behaviour ~~, if monthly monitoring during construction suggests Eastern Bentwing-bat behaviour is affected by construction noise.~~ These measures including the timing of their implementation will be detailed in an adaptive monitoring program ~~management plan.~~	WHT	As above
~~B13~~	~~Construction~~	~~Injury and mortality of fauna~~	~~An observer qualified to spot Little Penguins will be used during marine construction activities. A stop-work procedure will be implemented upon sighting of the species in the proximity of the works area.~~	~~WHT~~	Marine work is no longer required due to the TBM methodology.
~~B16~~	~~Construction~~	~~Impacts to marine vegetation and sensitive habitat~~	~~Transit routes for vessels entering and departing from construction support sites will be marked out with consideration for propeller wash and distances to sensitive marine habitats.~~	~~WHT~~	Marine work is no longer required due to the TBM methodology.
~~B17~~	~~Construction~~	~~Impacts to marine vegetation and sensitive habitat~~	~~Exclusion zones will be implemented to avoid disturbance to sensitive marine habitats not proposed to be directly impacted by the project's marine works. These include any intertidal sand and mudflats, intertidal rocky shore, subtidal rocky reef and seagrass habitats with potential to occur within or next to transit routes and vessel movements. Routine inspections and maintenance of exclusion measures fencing will be carried out.~~	~~WHT~~	Marine work is no longer required due to the TBM methodology.

Ref	Phase	Impact	Environmental management measure	Location	Justification for change
~~B19~~	~~Construction~~	~~Impacts to marine vegetation and sensitive habitat~~	~~To minimise the potential impact of turbidity (suspended sediment) on sensitive marine vegetation and habitats, silt curtains will be installed around seagrass patches and subtidal rocky reef contained within the Zone of Influence.~~	~~WHT~~	Marine work is no longer required due to the TBM methodology.
~~B20~~	~~Construction~~	~~Impacts to marine vegetation and sensitive habitat~~	~~Silt curtains will be monitored for effectiveness particularly following inclement weather and maintenance carried out when required. Records of monitoring and maintenance will be kept.~~	~~WHT~~	Marine work is no longer required due to the TBM methodology.
~~B21~~	~~Construction~~	~~Impacts to marine vegetation and sensitive habitat~~	~~Subtidal rocky reef and intertidal rocky shore habitat removed along the shoreline at the Sydney Harbour south cofferdam (WHT5) and Sydney Harbour north cofferdam (WHT6) will be rehabilitated and restored as close as possible to pre-construction conditions where feasible and reasonable.~~	~~WHT~~	Marine work is no longer required due to the TBM methodology.
~~B22~~	~~Construction~~	~~Invasion and spread of marine pests, pathogens and disease~~	~~Locally sourced vessels and equipment will be used where feasible and reasonable. Any vessels sourced internationally will be inspected for potential marine pests prior to departing from their previous port. Construction contractors will need to demonstrate that due diligence has been taken to avoid introducing marine pests, pathogens or disease from internationally sourced vessels and/or construction equipment prior to departure.~~	~~WHT~~	Marine work is no longer required due to the TBM methodology.
~~B23~~	~~Construction~~	~~Invasion and spread of marine pests, pathogens and disease~~	~~A targeted survey will be conducted of the dredge footprint to locate any areas of the marine algal pest *Caulerpa taxifolia*. If *Caulerpa taxifolia* is identified within the dredging footprint, surface sediments from these areas will be disposed of onshore rather than in the marine environment.~~	~~WHT~~	Marine work is no longer required due to the TBM methodology.
~~B24~~	~~Construction~~	~~Impacts to marine species~~	~~A stop work procedure will be developed to address marine mammal or reptile activity.~~	~~WHT~~	Marine work is no longer required due to the TBM methodology.
~~B25~~	~~Construction~~	~~Impacts to marine species~~	~~Salvage of live fish and other native marine organisms (eg large, mobile marine species macroinvertebrates) will occur during cofferdam dewatering and will be carried out by suitably qualified professionals. All salvaged organisms will be immediately relocated to similar habitat nearby.~~	~~WHT~~	Marine work is no longer required due to the TBM methodology.

Ref	Phase	Impact	Environmental management measure	Location	Justification for change
~~B26~~	~~Construction~~	~~Underwater noise impacts to marine species~~	~~Visual monitoring from the harbour surface will be carried out to identify any underwater noise related impacts on fish. If required, additional at source protection measures will be considered.~~	~~WHT~~	Marine work is no longer required due to the TBM methodology.
~~B27~~	~~Pre-construction and construction~~	~~Impacts to fisheries~~	~~Pre-construction surveys of seagrass and rocky reef habitat will be carried out by suitably qualified marine ecologists within the marine project area to search for, locate and translocate Syngnathid species that may be present to nearby unaffected habitat. The translocation procedure will be developed in consultation with Department of Planning, Industry and Environment (Regions, Industry, Agriculture and Resources).~~	~~WHT~~	Marine work is no longer required due to the TBM methodology.
~~B28~~	~~Construction~~	~~Impacts to vegetation at Berrys Bay construction support site~~	~~A narrow band of vegetation will be retained at the northern border of the Berrys Bay construction support site (WHT7) as a buffer, as far as is reasonably practical.~~	~~WHT~~	WHT7 is no longer required due to the TBM methodology.
~~B30~~	~~Pre-construction and construction~~	~~Impacts to micro-bat habitat~~	~~A site specific pre-construction assessment of construction lighting impacts on the Balls Head Coal Loader Large Bent-winged bat habitat will be carried out.~~ ~~Subject to outcomes of the assessment, construction lighting will be managed to minimise light spill impacts on this habitat with consideration of meeting requirements for worker safety, navigation and security.~~	~~WHT (Balls Head Coal Loader)~~	The northern Harbour construction site (coffer dam) is no longer required due to the TBM methodology.
~~LP4~~	~~Pre-construction and construction~~	~~Temporary relocation of moorings~~	~~Transport for NSW will consult with the owners and/or leaseholders and/or licence holders of moorings that require temporary relocation to determine alternative arrangements. All efforts will be made to relocate facilities as close to their original locations as possible.~~	~~WHT~~	Marine work is no longer required due to the TBM methodology, therefore moorings are no longer impacted.
LP9	~~Pre-construction and construction~~ Landscaping of Berrys Bay	Access to moorings and boat storage	Transport for NSW will improve access to the beach area next to the former quarantine station and work with North Sydney Council to provide boat and kayak storage options at that location as part of the landscaping design for Berrys Bay ~~before construction starts~~.	WHT (Berrys Bay)	Berrys Bay is no longer required as a construction support site, but this REMM will apply to the Masterplan works.

Ref	Phase	Impact	Environmental management measure	Location	Justification for change
HR3	Construction	Bushfire	Adequate access and egress for fire fighting vehicles and staff will be provided at the ~~Berrys Bay construction support site (WHT7) and~~ Wicks Road construction support site (WFU10). Access roads should have a minimum width of four metres to allow passage of fire fighting vehicles.	WFU10~~ WHT (Berrys Bay construction~~	The Berrys Bay construction support site is no longer required due to the TBM methodology.
HR4	Construction	Bushfire	Adequate setbacks from bush fire prone vegetation to allow fire fighting vehicle access will be provided for the ~~Berrys Bay construction support site (WHT7) and~~ Wicks Road construction support site (WFU10).	WFU10~~ WHT (Berrys Bay construction~~	The Berrys Bay construction support site is no longer required due to the TBM methodology.
HR5	Construction	Bushfire	First response capabilities, including fire extinguishers, water carts and hoses, will be assessed and provided at the ~~Berrys Bay construction support site (WHT7)~~ and Wicks Road construction support site (WFU10) where needed.	WFU10~~ WHT (Berrys Bay construction~~ support site (WHT7))	The Berrys Bay construction support site is no longer required due to the TBM methodology.

13. Justification and conclusion

This Chapter provides the justification and conclusions to the assessment of the proposed modified project. The justification considers:

- strategic context including project objectives and need
- compliance with relevant statutory requirements
- community views
- actions taken to avoid or minimise environmental impacts
- economic, social and environmental considerations
- principles of ecologically sustainable development
- objects of the EP&A Act
- cumulative impacts.

13.1 Strategic context including project objectives and need

The proposed modified project would result in changes only to the construction methodology and therefore would not represent a change in the strategic context, project objectives or need for the project. It would continue to support the current needs and future growth of the Eastern Harbour City and Eastern Economic Corridor through an efficient transport network, fundamental to the liveability, productivity, and sustainability of Greater Sydney. It would continue to be consistent with the Greater Sydney Region Plan, the Future Transport Strategy 2056 (NSW Government, 2022) and the State Infrastructure Strategy 2018 – 2038 (Infrastructure NSW, 2018) with respect to aligning land use, transport, and infrastructure outcomes for Greater Sydney.

13.2 Compliance with relevant statutory requirements

The Minister for Planning and Public Spaces approved the project under section 5.19 of the EP&A Act on 21 January 2021 (SSI 8863). Not all of the proposed changes can be accommodated within the existing project approval. As such, a Modification Report has been prepared in accordance with section 5.25 of the EP&A Act and the relevant provisions of the Environmental Planning and Assessment Regulation 2021 (EP&A Reg), including having regard to DPE's State Significant Infrastructure and State Significant Project Guidelines (DPIE, 2021a) including Preparing a Modification Report – Appendix F to the SSI Guidelines (DPIE, 2021b).

The proposed modified project would continue to comply with all relevant statutory requirements consistent with the Approved Project.

13.3 Community views

Community consultation has been, and will continue to be, an integral component of the development of the Project. The exhibition of the Project EIS identified a number of key issues of concern to the community. Key issues of potential relevance to the proposed modified project with respect to the tunnelling and Sydney Harbour crossing works included:

- Construction traffic and transport–particularly large volumes of construction traffic, loss of parking, closure of Birchgrove Wharf, the number of construction support site
- Construction noise and vibration impacts–particularly associated with the Warringah Freeway Upgrade and Berrys Bay
- General dust from construction sites
- Operational air quality impacts (this was the issue of greatest concern)
- Loss of public open space–particularly with respect to Berrys Bay and Yurulbin Park and other parks
- Tunnel depth and concerns this would change (become shallower and therefore greater impacts than predicted)
- Dredging and impacts on air quality and odours
- Groundwater and settlement
- Non-Aboriginal heritage impacts–particularly Yurulbin Point, the Coal Loader, and St Leonards Park
- Increase in CO2 emissions

Overall, the proposed modified project would have a beneficial or neutral impacts on the majority of these community concerns.

Community and stakeholder views in regard to the proposed Modification are generally positive in relation to the removal of impacts to the community or neutral where changes are minor with respect to the Project as a whole. Consideration of community views will continue with the public exhibition of this Modification Report. A response to community submissions raised from the public exhibition of this Modification Report will also be addressed before seeking planning approval.

13.4 Actions taken to avoid or minimise environmental impacts

The proposed modified project is in itself, an action taken to avoid or minimise environmental impacts. In particular, it would remove the need for five major construction support sites, including requirements for any dredging in Sydney Harbour. This would avoid or reduce impacts on key issues associated with non-Aboriginal heritage, Aboriginal Cultural Heritage, biodiversity, water quality, socio-economics and hazards.

The additional construction support site at Emu Plains (WHT13) is required to support the TBM operations as the primary site for manufacture of the concrete segments for lining the tunnel. This site would have advantages over the White Bay construction support site (proposed for the Approved Project to support the IMT) with respect to available space, and hence reduced potential disruption to supply as well as reduced potential environmental risks. It would also provide diversification in the location of jobs associated with construction of the Project to include Western Sydney.

Further details on impacts avoided are provided in Section 13.6.1.

13.5 Consideration of alternatives

The proposed modified project was an alternative considered at the time of preparing the Project EIS. However, owing to the large diameter and type of TBM required, it was not considered as a conventional solution at that time. Since the Project EIS was prepared, TBM technology and experience has advanced and the type and size of TBM has now been used successfully internationally in similar sub-sea environments.

In addition, there has been recent TBM experience in crossing Sydney Harbour with the Sydney Metro City project including more specific information gathering around geological conditions. The experience with the use of and the availability of larger TBMs, coupled with the experience with construction of the Sydney Metro Tunnels under Sydney Harbour, provides confidence that using a TBM for the Sydney Harbour crossing would be a viable alternative construction method.

Other options considered related to TBM refinement options were:

- TBM launch site options: The option of a launch site from Berrys Bay or underground from Birchgrove. The latter was found to have significant environmental benefits and was preferred.
- TBM support site options: The option of using Glebe Island construction support site or a new construction support site at Emu Plains. An additional construction support site at Emu Plains (WHT13) would provide a greater area for storage in a less sensitive environment and significantly improve the reliability of the supply of segments.

Overall, the proposed modified project would provide major benefits compared to the Approved Project. In particular, the removal of all dredging activities in Sydney Harbour and the removal of five construction support sites associated with the IMT construction method would result in substantial biodiversity, heritage, and social impact benefits. Whilst the use of a new construction support site at Emu Plains would raise new impacts, they would not be of a substantive nature and would result in better overall environmental and social outcomes than the use of the approved Glebe Island construction support site (WHT3) which is located in a more sensitive environment.

13.6 Economic, social, and environmental considerations

Consideration of economic, environmental, and social impacts has taken into account the following:

- major adverse and beneficial impacts
- project uncertainties
- residual risks.

13.6.1 Major adverse and beneficial impacts

The proposed modified project would result in changes (when compared to the Approved Project) primarily during the construction stage. Some unavoidable impacts (associated with, for example, construction impacts

from heavy vehicle traffic, noise, vibration and dust, access disruptions and visual impacts) would remain, however these impacts would be generally consistent with the nature, extent, duration, and intensity of the Approved Project. During operation, the only potential changes associated with the proposed modified project would relate to air quality and traffic due to the slight change to the vertical and horizontal alignment of the tunnel below Sydney Harbour.

A summary of the key beneficial and adverse impacts of the proposed modified project are presented in Table 13-1.

Table 13-1 Key beneficial and adverse impacts of the proposed modified project compared with the Approved Project

Environmental aspect	Key benefits compared to the Approved Project	Adverse impacts compared to the Approved Project	
		Changes to tunnelling and Sydney Harbour crossing works	Emu Plains construction support site (WHT13)
Traffic and transport - construction	Removes: • Construction traffic impacts on Bay Road and Balls Head Road • The need to close the Birchgrove Ferry Wharf • All marine traffic impacts in Sydney Harbour, including navigational restrictions and marine speed limits • Impacts on moorings in Berry's Bay and Snail's Bay	• Minor increase in heavy vehicle traffic on City West Link and James Craig Road • A very minor increase (less than 1 minute) in travel times between City West Link and Pyrmont • A minor deterioration in performance at the intersection of The Crescent/City West Link (from D to E). Many other intersections would operate at an improved level of performance. • Increase in on-site parking would increase light vehicle movements on Ridge Street by around 300 vehicles per day.	• Minor impacts with respect to traffic and transport • Some six parking spaces on Lee Street in Emu Plains may need to be removed to allow truck turning movements. These changes would have a minor impact on the demand for parking.
Traffic and transport - operation	No additional benefits compared to the Approved Project.	Very minor changes (positive and adverse) to the performance of some intersections.	Not applicable as this site would no longer be required after construction completion.
Noise and vibration - construction	Removes: • All construction noise associated with five major construction support sites • Noise impacts associated with dredging and disposal operation, including operating trailer suction hopper barges during non-standard construction hours • Noise exceedances of ground borne NMLs associated with the main TBM tunnelling works Reduces: • Noise levels around the Glebe Island construction support site and the Ridge Street North construction support site	• Exceedances of the ground-borne noise management levels and vibration management levels at sensitive residential buildings during evening and night periods for other activities. These would be generally comparable with the Approved Project. The duration of any such exceedances would be only a few days for tunnelling when progressing along the alignment • The construction of the new launch and receival chambers is expected to result in a number of further exceedances of the NMLs should rock breaking be required. If so, mitigation such as offers of alternative accommodation would be provided.	• Possible noise exceedances are predicted during civil earthworks (duration of around 3-4 months) including at CathWest Innovation College and Penola Catholic College. Consultation and monitoring during this time will be carried out to ensure the amenity (particularly for students) is not affected. Periods of respite and relocating activities further back from the boundary and/or not using the noisiest equipment on the eastern boundary, is expected to result in predicted noise meeting the noise management levels • For ongoing operational activities, there would be no exceedances for day, evening, or night periods. with the possible exception of one residential receiver. Mitigation options would be determined directly with this receiver.

Environmental aspect	Key benefits compared to the Approved Project	Adverse impacts compared to the Approved Project	
		Changes to tunnelling and Sydney Harbour crossing works	Emu Plains construction support site (WHT13)
Air quality - construction	Removes: • Impacts associated with odour from dredging and barging of dredged material Operation of the Emu Plains construction support site (WHT13) is expected to have a positive impact on local air quality when compared to the existing conditions, as a large proportion of the site will be either covered by the casting sheds or by hardstand.	No additional adverse impacts identified beyond those assessed for the Approved Project.	• Potential dust emissions during construction of the support site and associated residual risks would be low to medium without mitigation. With standard and well proven mitigation measures, these risks would be reduced to low.
Air quality – operation	No additional benefits compared to the Approved Project.	• Negligible change to impacts on air quality when compared to the Approved Project. • No change to the assessment of health impacts from those presented in the Project EIS	Not applicable as this site would no longer be required after construction completion.
Geology, soils, contamination, and groundwater	Removes: • risks associated with potentially contaminated marine sediments disturbed by dredging in Sydney Harbour • the requirement for ongoing dewatering beneath Birchgrove Peninsula (including Yurulbin Park) Reduces: • risks associated with potentially contaminated material within Birchgrove peninsula and at Berry's Bay. • Potential groundwater impacts to receptors	• The proposed increase in excavation geometry for the TBM launch chambers and receival chambers may increase groundwater inflow and potential for settlement but would still comply with the Conditions of Approval for the Approved Project.	• Residual contamination is expected to be of low risk. Additional investigation of the site will be required to further assess the moderate and high contamination risk associated with historic fill and potential migration of groundwater from industrial facilities nearby.

Environmental aspect	Key benefits compared to the Approved Project	Adverse impacts compared to the Approved Project	
		Changes to tunnelling and Sydney Harbour crossing works	Emu Plains construction support site (WHT13)
Socio-economics	Removes: • Impacts on accessibility for marine users, businesses, passengers, and recreational users • Impacts to local amenity and character due to the construction of the temporary cofferdams and on the north and south side of the harbour • Impacts to social infrastructure and meeting places of Yurulbin Park, Birchgrove Wharf, Waverton Park, and the Coal Loader Centre for Sustainability • Impacts to businesses within Berrys Bay such as Sydney Harbour Yacht Charter. The construction support site at Emu Plains (WHT13) would provide for the diversification of job opportunities and include Western Sydney	• There would be a new social impact associated with increase in construction hours, however this would have a low negative risk • At the Ridge Street North construction support site (WHT9) there would be a new social impact associated with a change in amenity and aesthetics with the new acoustic shed. This has been assessed as a low negative risk • There would be a slight reduction in social impacts due to an increase in available parking at the Ridge Street North construction support site (WHT9).	• There would be some new negative impacts associated with increased operating hours and increased heavy vehicle movements. However, the residual impacts significance would be low.
Urban design and visual amenity	Removes: • Visual amenity impacts to residents that adjoined or had views of the four removed harbour-side construction sites • Visual amenity impacts to community and waterway users along the Sydney Harbour foreshore from harbour-side construction sites • Visual amenity risks associated with dredging.	• The addition of the acoustic shed at the Ridge Street North construction support site (WHT9) would lead to minor changes to viewpoints experienced however, these would not be inconsistent with what was assessed for the Project EIS.	• The proposed site is located within an existing quarry and in an industrial area. Changes to the existing visual environment would be of a minor nature.

Environmental aspect	Key benefits compared to the Approved Project	Adverse impacts compared to the Approved Project	
		Changes to tunnelling and Sydney Harbour crossing works	Emu Plains construction support site (WHT13)
Hazards and risks	Removes: • Impacts to harbour traffic from the movement of IMT segments • Risks to IMT tunnels associated with falling and dragging anchors, sinking vessels, high currents, and propeller wash and vessel wake. • Risks associated with the connection of the roadheader and IMT tunnels.	No additional adverse impacts have been identified	No major adverse impacts have been identified.
Non-Aboriginal Cultural Heritage	Removes direct and indirect impacts to nine 'significant heritage items': 1. Glebe Island Bridge, Pyrmont 2. The Valley Heritage Conservation Area 3. Railway electricity tunnel under Sydney Harbour 4. Yurulbin Park 5. Long Nose Point Wharf 6. Balls Head Reserve 7. M.V Cape Don 8. Former BP site, Waverton 9. Former Woodleys Shipyard and NSW Torpedo Corps Slipway.	No additional adverse impacts identified beyond those assessed for the Approved Project.	No adverse impacts identified.
Aboriginal Cultural Heritage	Reduced potential indirect impacts to seven Aboriginal sites: 1. Quarantine Cave: Waverton 2. Coal Loader 1 3. Whale Rock 4. 5 Hands Shelter 5. Shed Cave 6. Yerroulbin Cave 7. Long Nose Point.	No additional adverse impacts identified beyond those assessed for the Approved Project.	No adverse impacts identified.

Environmental aspect	Key benefits compared to the Approved Project	Adverse impacts compared to the Approved Project	
		Changes to tunnelling and Sydney Harbour crossing works	Emu Plains construction support site (WHT13)
Hydrodynamics and water quality	Removes: • Impacts to water quality associated with the Harbour-side construction support sites • Water quality impacts associated with dredging in Sydney Harbour.	No additional adverse impacts identified beyond those assessed for the Approved Project.	• At a regional level, there would be negligible flood impacts • At a local level some additional impacts are expected but these would be largely contained to the site.
Biodiversity	Removes: • All impacts on biodiversity at Yurulbin Point and Berry's Bay • Potential impacts to Little Penguins and Whitebellied Sea Eagles associated with dredging • The need to remove 10.51 hectares of deepwater soft sediment habitat • The need to remove 0.01 hectares of habitat for the Black Rockcod and White's Seahorse • The need to remove around 0.03 hectares of seagrass. Reduces: • Potential indirect impacts (noise and vibration) to microbat colonies recorded in one of the Coal Loader tunnels in Waverton.	No additional adverse impacts.	• Requires the removal of approximately 1.31 hectares of Plant Community Type Coastal Valleys Swamp Oak Riparia. This removal would have minimal impact on biodiversity values • Assumed presence has also been identified for the Southern Myotis • Small offset requirements for impacts on biodiversity have been identified. • Indirect impacts (from noise and lighting) would be minor.
Land use and property	Removes the need to occupy public parkland for the establishment of construction sites at Yurulbin Point and Berrys Bay.	No additional adverse impacts.	No adverse impacts.

Environmental aspect	Key benefits compared to the Approved Project	Adverse impacts compared to the Approved Project	
		Changes to tunnelling and Sydney Harbour crossing works	Emu Plains construction support site (WHT13)
Resource use and waste management (whole of project)	Removes: • Contaminated dredged sediment from the waste stream Reduces: • Water demand with the removal of five construction support sites • The volume of spoil generation.	There would be an increase in the amount of electricity required, for operation of the TBMs. From a total energy demand perspective, the increase in electricity demand would be offset by a significant reduction in the use of diesel.	

Climate change risk and greenhouse gas (whole of project)	Reduces the amount of embodied greenhouse gas emissions compared to the IMT Methodology.	• No change to the climate change risks identified for the Approved Project
		• With respect to greenhouse gas emissions:
		  • Additional electricity consumption with the use of the TBM
		  • Reduced consumption of concrete and cement.
		
		Overall, there would be a reduction in greenhouse gas emissions.	

Sustainability	No additional benefits compared to the Approved Project.	The sustainability outcomes identified for the Approved Project would also apply to the proposed modified project.	
Cumulative impacts	Reduction in cumulative impacts in the Waverton and Birchgrove areas, as well as on Sydney Harbour.	No additional adverse impacts.	• There would be negligible potential for cumulative impacts. The use of the site would also be for a relatively short duration so there would be no potential for longer term cumulative impacts.

In comparison to the Approved Project, the proposed changes to the tunnelling and Sydney Harbour crossing works would result in an overall reduction in impacts, as outlined in Table 13 1. In particular, the removal of all dredging activities in Sydney Harbour and the removal of five construction support sites would result in substantial biodiversity, heritage and social impact benefits compared to the Approved Project.

The proposed modification would introduce a new construction support site at Emu Plains (WHT13) to replace the use of the Glebe Island construction support site (WHT3) as the primary precast facility. The Emu Plains construction support site (WHT13) is located within the existing Boral Quarry site and located in an industrial area. Whilst the use of this site would raise new impacts, they would not be of a substantive nature. Use of this site would result in better overall environmental and social outcomes than the use of the Glebe Island construction support site (WHT3) which is located in a more sensitive environment.

Overall, the proposed modified project is assessed as having a net reduction in overall environmental impacts during construction when compared to the Approved Project.

When operational, the proposed modified project would result in minimal changes to environmental impacts compared to the Approved Project. The proposed modified project would provide the same strategic project benefits and opportunities as the Approved Project including:

- Reducing congestion on distributor roads around the Harbour CBD, including the Sydney Harbour Bridge, Western Distributor and ANZAC Bridge
- Creating faster and more reliable cross-harbour journeys, particularly for traffic bypassing the Sydney CBD to the west
- Improving productivity along the Eastern Economic Corridor
- Increasing the resilience for the critical cross-harbour transport corridor
- Improving traffic performance on the Warringah Freeway to support long-term increased demand
- Improving urban amenity

13.6.2 Project uncertainties

Chapter 28 of the Project EIS identified a number of project uncertainties for the Approved Project. These same uncertainties would remain for the proposed modified project with the exceptions as described in Table 13-2 which would now be removed. No additional uncertainties have been identified for the proposed modified project.

Table 13-2 Changes to Approved Project uncertainties

Approved Project uncertainty	Approved Project proposed resolution requirements	Changes to Approved Project uncertainties as a result of the proposed modified project
The presence of, and potential impacts to areas of archaeological potential	Additional archaeological investigations would be carried out at: 1. Yurulbin Park, Birchgrove.	Removed

Approved Project uncertainty	Approved Project proposed resolution requirements	Changes to Approved Project uncertainties as a result of the proposed modified project
The presence of, and potential impacts on, maritime heritage	1. Investigate the potential to relocate or redesign the temporary wharves at Berrys Bay construction support site to minimise impact on maritime heritage 2. Any pre-dredge clearance of the bed of the harbour to include involvement by maritime archaeologist to minimise the risk of impact to potential maritime heritage remains such as maritime infrastructure, shipwrecks and discarded objects 3. Complete and review the sidescan sonar survey for areas to be affected by project works 4. Carry out high-resolution geophysical survey to further investigate potential submerged cultural heritage material where necessary. 5. Carry out controlled archaeological investigations to recover any artefacts if required and feasible.	Removed

13.6.3 Residual environmental risks

Appendix C of the Project EIS provided a residual risk analysis as derived after the application of the environmental management measures identified in the Project EIS. The risk analysis for the Approved Project identified several high and medium unmitigated risks which were assessed as having medium and low residual risk, after the application of environmental management measures.

The proposed modified project would remove the following high unmitigated risks identified for the Approved Project:

- Temporary maritime traffic impacts to ferries, recreational users, community groups and clubs, commercial and government operations
- Direct impacts to marine heritage items
- Disturbance of contaminated sediments during marine construction activities
- Marine water quality impacts from increased turbidity and sedimentation from dredging.

The proposed modified project would also remove the following medium unmitigated risks identified for the Approved Project:

- Underwater noise impacts (from piling and dredging activities) to human health
- Underwater noise impacts (from piling and dredging activities) to marine ecology
- Odour impacts from treatment and stockpiling of dredged material (eg at White Bay)
- Direct and indirect impacts to potential submerged Aboriginal sites
- Marine contamination during dredging activities
- Interactions between maritime traffic and tunnel infrastructure.

All other residual risks for the proposed modified project would remain the same as for the Approved Project.

13.7 Principles of ecologically sustainable development

Ecologically sustainable development is an objective of the Environmental Planning and Assessment Act 1979. This objective requires the integration of 'relevant economic, environmental and social considerations in decision making about environmental planning and assessment'.

Ecologically sustainable development is defined under the Protection of the Environment Administration Act 1991 (NSW) and Environmental Planning and Assessment Regulation 2021.

An assessment of the Approved Project against the principles of ecological sustainable development is provided in Chapter 28 of the Project EIS. The proposed modified project would continue to be consistent with respect to these principles.

13.8 Objects of the Environmental Planning and Assessment Act 1979

Consideration of the Approved Project against the objects of the Environmental Planning and Assessment Act (1979) is provided in Chapter 28 of the Project EIS.

The proposed modified project would be consistent with the attributes identified for the Approved Project, with some possible improvements with respect to principle (f) - to promote the sustainable management of built and cultural heritage (including Aboriginal Cultural Heritage. The proposed modified project would remove many of the impacts identified against this principle.

13.9 Cumulative impacts

During construction, there would be some reduction in cumulative impacts with the proposed modified project when compared to the Approved Project, largely associated with removal of five construction support sites. There would be some increased cumulative impacts when compared to the Approved Project associated with the proposed new construction support site at Emu Plains (WHT13). Overall cumulative impacts related to the proposed modified project would be less than the Approved Project.

The implementation of environmental management measures for the project would avoid, to the greatest extent possible, cumulative impacts with surrounding development. In particular, the design of the project has carefully considered minimising construction fatigue as far as practical. The intent is to reduce the overall cumulative or consecutive impacts on the community over a longer period.

Once operational, the proposed modified project would deliver the same beneficial cumulative impacts as the Approved Project including significant increases in travel speeds through sections of the surface road network, increased reliability, and a reduction in average travel times.

13.10 Conclusions

This Modification Report addresses the relevant provisions of the *Environmental Planning and Assessment Act 1979* and the *Environmental Planning and Assessment Regulation 2021*.

The changes associated with the proposed modified project relate to the construction stage. The proposed changes have been identified as a construction solution that better balances environmental impacts with construction capabilities.

The approval of the proposed modified project would greatly reduce environmental impacts associated with harbourside construction sites including the removal of four major construction support sites surrounding or in Sydney Harbour. It would also remove the Victoria Rd (WHT2) construction site and replace surface activities at the Rozelle Rail Yards (WHT1) with an underground construction site that enables a more complete area of Rozelle Parklands to be returned to the public.

The proposed modified project would also avoid or reduce key issues associated with non-Aboriginal Cultural Heritage, Aboriginal Cultural Heritage, biodiversity, water quality, socio-economic and hazards and other key risks associated with the currently approved IMT method for crossing Sydney Harbour.

The additional construction support site at Emu Plains (WHT13) is required to support the TBM operations as the primary site for manufacture of the concrete segments for lining the tunnel. This site would have advantages over the Glebe Island construction support site (WHT3) with respect to available space and the industrial nature of the site and reduced potential disruption to supply and potential environmental risks.

When operational, the proposed modified project would provide the same benefits of the Approved Project. It would relieve congestion, improve travel times, improve road safety, and enhance and expand capacity on key road corridors. In particular, the project would relieve congestion on the Sydney Harbour Bridge and Sydney Harbour Tunnel, enabling faster, more reliable journeys for bus customers, freight and private vehicle users on all road corridors crossing Sydney Harbour.

The proposed modified project is therefore considered to provide an overall benefit when compared to the Approved Project and would be in the public interest.

Prepared by
Hutchison Weller Pty Ltd
MCAL Environmental Consulting Pty Ltd

Transport for NSW
July 2023
23.096
ISBN: 978-1-922875-85-3
Western Harbour Tunnel and Warringah Freeway Upgrade Modification 2 – TBM construction methodology

NSW GOVERNMENT